STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ADDENDUM NO. 6
FOR

INTERSTATE ROUTE H-3, H-3 FINISH (UNIT VIII)
FEDERAL-AID INTERSTATE PROJECT NO. I-H3-1(75) Unit VIII
AND
INTERSTATE ROUTE H-1 SEISMIC RETROFIT
AUSTIN-BISHOP SEPARATION AND WAIAU INTERCHANGE
FEDERAL-AID INTERSTATE PROJECT NO. BR-H1-1(241)

DISTRICT OF EWA
ISLAND OF OAHU
2003

Amend the bid documents as follows:

1. Amend the **NOTICE TO BIDDERS** as follows:

   Prospective bidders are hereby notified that receiving of sealed bids scheduled for November 13, 2003 is now scheduled for 2:00 P.M., November 26, 2003. The attached NOTICE TO BIDDERS shall be incorporated and made a part of the NOTICE TO BIDDERS.

2. **SPECIAL PROVISIONS**

   a. Replace the Table of Contents, Pages 1 though 6, dated 6/20/03 with the attached Table of Contents, Pages 1 through 6, dated 10/27/03.

   b. Amend 101.03 Definitions by revising the definition of Critical Path to read as follows:

      "Sequence of activities that must be completed on schedule for the entire project to be completed on schedule. The critical path shall be the longest sequence of activities to complete."

   c. Amend 101.03 Definitions by revising the definition of Substantial Completion to read as follows:

      "The point at which the project is complete such that it can be safely and effectively used by the public without unreasonable delays, disruption, or impediments which shall include but not be limited to, all bridge deck, parapet, pavement structure, shoulder, permanent signing and markings,

traffic barrier, safety appurtenance, seismic retrofit work, and the planting period is complete. The plant establishment period and post construction survey of the viaduct deck concrete overlay will not be required for substantial completion."

d. Replace Pages 102-1a through 102-12a, dated 3/17/03 with the attached Pages 102-1a through 102-12a, dated 10/13/03.

e. Replace Pages 103-1a through 103-14a, dated 4/3/03 with the attached Pages 103-1a through 103-14a, dated 10/13/03.

f. Replace Pages 104-1a through 104-23a, dated 4/9/03 with the attached Pages 104-1a through 104-23a, dated 10/13/03.

g. Replace Pages 105-1a through 105-14a, dated 3/22/03 with the attached Pages 105-1a through 105-14a, dated 10/13/03.

h. Replace Pages 106-1a through 106-4a, dated 2/10/03 with the attached Pages 106-1a through 106-5a, dated 10/13/03.

i. Replace Pages 108-1a through 108-26a, dated 4/9/03 with the attached Pages 108-1a through 108-26a, dated 10/13/03.

j. Amend 109.04(F)(9)(c) to read as follows:

"The Engineer will pay, if the State is solely responsible for and when the requirements of this Section are met, for equipment that is idle and\or on stand-by, 50% of the hourly rental rate excluding the estimated operational cost per hour per working day. The Engineer will not pay for idle or stand-by time due to inclement weather or due to the contractor's actions which may include but are not limited to shutdowns due to holidays or any day the contractor chooses to suspend work or is required to be suspended by the Contract Documents. The Engineer will solely decide if the equipment is idle and\or on stand-by and if it merits compensation."

k. Replace Pages 202-1a through 202-5a, dated r03/12/03 with the attached Pages 202-1a through 202-15a, dated 10/11/03.

l. Replace Pages 206-1a through 206-14a, dated r03/28/03 with the attached pages 206-1a through 206-14a, dated r10/16/03.

m. Replace Pages 211-1a through 211-8a, dated 01/24/03 with the attached Pages 211-1a through 211-8a, dated r10/16/03.

n. Replace Pages 411-1a and 411-24a, dated 9/18/03 and 411-2a through 411-23a, dated 3/12/03 with the attached Pages 411-1a through 411-29a, dated 10/16/03.

o. Replace Pages 503-1a through 503-5a, dated r06/20/03 with the attached Pages 503-1a through 503-41a, dated r10/16/03.

p. Replace Page 504-1a, dated 9/18/03 with the attached Page 504-1a, dated r10/16/03.

q. Replace Page 507-1a, dated r03/12/03 with the attached Page 507-1a, dated 10/16/03.

r. Replace Pages 511-1a through 511-26a, dated 03/31/03 with the attached Pages 511-1a through 511-30a, dated 10/16/03.

s. Replace Pages 513-1a through 513-6a, dated 3/31/03 with the attached Pages 513-1a through 513-6a, dated r10/16/03.

t. Replace Pages 530-1a through 530-10a, dated r03/12/03 with the attached Pages 530-1a through 530-11a, dated r10/16/03.

u. Replace Pages 540-1a through 540-9a, dated r03/12/03 with the attached Pages 540-1a through 540-12a, dated r10/16/03.

v. Replace Pages 606-5a through 606-6a, dated 1/24/03 with the attached Pages 606-5a through 606-7a, dated 10/16/03.

w. Replace Pages 616-1a through 616-14a, dated r3/31/03 with the attached Pages 616-1a through 616-13a, dated r10/16/03.

x. Replace Pages 617-1a through 617-6a, dated r3/31/03 with the attached Pages 617-1a through 617-3a, dated r10/16/03.

y. Replace Pages 618-1a through 618-9a, dated r3/31/03 with the attached Pages 618-1a through 618-7a, dated r10/16/03.

z. Replace Pages 619-1a through 619-10a, dated r3/31/03 with the attached Pages 619-1a through 619-7a, dated r10/16/03.

aa. Replace Pages 636-1a through 636-8a, dated 3/12/03 with the attached Pages 636-1a through 636-9a, dated 10/16/03.

bb. Replace Pages 645-1a through 645-13a, dated 11/27/02 with the attached Pages 645-1a through 645-15a, dated 10/16/03.

cc. Replace Page 653-2a, dated 3/12/03 with the attached Page 653-2a, dated 10/16/03.

dd. Replace Pages 656-1a through 656-21a, dated 03/31/03 with the attached Pages 656-1a through 656-21a, dated r10/16/03.

ee. Replace Pages 657-1a through 657-20a, dated 03/31/03 with the attached Pages 657-1a through 657-21a, dated 10/16/03.

ff. Replace Pages 660-1a through 660-7a, dated r01/24/03 with the attached Pages 660-1a through 660-7a, dated r10/16/03.

gg. Replace Pages 663-1a through 663-3a, dated 9/18/03 with the attached Pages 663-1a through 663-3a, dated 10/16/03.

hh. The attached Pages 667-1a through 667-22a, dated r08/08/03 shall be incorporated and made a part of the Special Provisions.

ii. The attached Pages 668-1a through 668-17a, dated r08/08/03 shall be incorporated and made a part of the Special Provisions.

jj. Replace Pages 681-1a through 681-16a, dated r03/31/03 with the attached Pages 681-1a through 681-19a, dated 10/16/03.

kk. Replace Pages 690-1a and 690-5a dated 9/18/03 with the attached Pages 690-1a and 690-5a, dated 10/16/03.

ll. Replace Pages 694-4a through 694-5a, dated 3/12/03 with the attached Pages 694-4a through 694-5a, dated 10/16/03.

mm. Replace Pages 696-1a through 696-26a, dated 3/12/03 with the attached Pages 696-1a through 696-26a, dated 10/16/03.

nn. The attached Page 705-1a dated r10/16/03 shall be incorporated and made a part of the Special Provisions.

3. PROPOSAL SCHEDULE

Replace Pages P-8 through P-44, dated 9/18/03 with the attached Pages P-8 through P-44, dated 10/24/03.

4. PLANS

a. Replace Plan Sheet Nos.:

5, 9 through 11, 16, 17, 25 through 38, 75, 77, 85, 116, 141, 149 through 151, 153, 219, 221, 227, 269, 283, 286 through 288, 317, 324 through 329, 339 through 342, 350, 419, 564 through 579, 581 through 611, 613 through 669, 674 through 683, 685, 688, 693 through 699, 701 through 703, 706 through 709, 717 through 722, 724 through 727, 729 through 740, 747, 748, 751, 753 through 755, 757 through 765, 767, 769 through 771, 776 through 779, 782, 786 through 792, and 815

with the attached Plan Sheet Nos.:

ADD.5, ADD.9 through ADD.11, ADD.16, ADD.17, ADD.25 through ADD.38, ADD.75, ADD.77, ADD.85, ADD.116, ADD.141, ADD.149 through ADD.151, ADD.153, ADD.219, ADD.221, ADD.227, ADD.269, ADD.283, ADD.286 through ADD.288, ADD.317, ADD.324 through ADD.329, ADD.339 through ADD.342, ADD.350, ADD.419, ADD.564 through ADD.579, ADD.581 through ADD.611, ADD.613 through ADD.669, ADD.674 through ADD.683, ADD.685, ADD.688, ADD.693 through ADD.699, ADD.701 through ADD.703, ADD.706 through ADD.709, ADD.717 through ADD.722, ADD.724 through ADD.727, ADD.729 through ADD.740, ADD.747, ADD.748, ADD.751, ADD.753 through ADD.755, ADD.757 through ADD.765, ADD.767, ADD.769 through ADD.771, ADD.776 through ADD.779, ADD.782, ADD.786 through ADD.792, and ADD.815.

b. Replace Plan Sheet Nos., Dated 6/20/03, as indicated in the revision block:

ADD.6, ADD.14, ADD.15, ADD.60 through ADD.62, ADD.66 through ADD.68, ADD.78 through ADD.80, ADD.90, ADD.109, ADD.117, ADD.118, ADD.122 through ADD.124, ADD.131, ADD.133, ADD.134, ADD.136, ADD.140, ADD.142 through ADD.144, ADD.156, ADD.164, ADD.166, ADD.168, ADD.170, ADD.172, ADD.174, ADD.180, ADD.182, ADD.188 through ADD.190, ADD.192 through ADD.194, ADD.277, ADD.416, ADD.418, ADD.563, and ADD.784

with the attached Plan Sheet Nos., Dated 10/16/03, as indicated in the revision block:

ADD.6, ADD.14, ADD.15, ADD.60 through ADD.62, ADD.66 through ADD.68, ADD.78 through ADD.80, ADD.90, ADD.109, ADD.117, ADD.118, ADD.122 through ADD.124, ADD.131, ADD.133, ADD.134, ADD.136, ADD.140, ADD.142 through ADD.144, ADD.156, ADD.164,

ADD.166, ADD.168, ADD.170, ADD.172, ADD.174, ADD.180, ADD.182, ADD.188 through ADD.190, ADD.192 through ADD.194, ADD.277, ADD.416, ADD.418, ADD.563, and ADD.784.

c. The attached Plan Sheet Nos. ADD.221S-1, ADD.225S-1, ADD.225S-2, ADD.228S-1, ADD.238S-1, ADD.287S-1 through ADD.287S-16, ADD.601S-1 through ADD.601S-4, ADD.603S-1 through ADD.603S-3, ADD.605S-1, ADD.605S-2, ADD.626S-1, ADD.626S-2, ADD.641S-1, ADD.641S-2, ADD.654S-1, ADD.660S-1, ADD.676S-1, ADD.676S-2, ADD.770S-1 through ADD.770S-15 shall be incorporated and made a part of the Plans.

Please acknowledge receipt of this Addendum No. 6 by writing in "Addendum No. 6 _____" and recording the date of its receipt on page P-4 of the Proposal.

for RODNEY K. HARAGA
Director of Transportation

NOTICE TO BIDDERS

(Chapter 103D, HRS)

The receiving of sealed bids for **INTERSTATE ROUTE H-3, H-3 FINISH (UNIT VIII), FEDERAL-AID INTERSTATE PROJECT NO. I-H3-1(75) UNIT VIII and INTERSTATE ROUTE H-1 SEISMIC RETROFIT, AUSTIN-BISHOP SEPARATION AND WAIAU INTERCHANGE, FEDERAL-AID INTERSTATE PROJECT NO. BR-H1-1(241), DISTRICT OF EWA, ISLAND OF OAHU,** scheduled for November 13, 2003, at the Contracts Office, Department of Transportation, 869 Punchbowl Street, Honolulu, Hawaii 96813 is now SCHEDULED for 2:00 P.M., November 26, 2003, at which time and place they will be publicly opened and read.

for RODNEY K. HARAGA
Director of Transportation

Advertised: Honolulu Star-Bulletin
Honolulu Advertiser
October 31, 2003

Internet Posting: October 30, 2003

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SECTION 102 - BIDDING REQUIREMENTS AND CONDITIONS

Make the following amendments to said Section:

(I) Amend **102.01 Prequalification of Bidders** to read as follows:

"102.01 Prequalification of Bidders. Prospective bidders shall be capable of performing the work for which they are bidding.

According to Section 103D-310, HRS, each prospective bidder shall file written notice of its intention to bid no later than 4:30 P.M., 10 calendar days before the bid opening date (not including the bid opening date), at the Contracts Office, Department of Transportation, 869 Punchbowl Street, Honolulu, Hawaii 96813. If the tenth day is on a Saturday, Sunday, or State holiday, the Notice of Intention to Bid is due on the last working day before the due date. Mailed notice must be received in sufficient time to meet the deadline set above. Faxed notice is acceptable provided the Contracts Office receives the faxed notice within the time stated above. The fax number is (808) 587-2132. It is the bidder's responsibility to ensure that the Contracts Office receives the Notice of Intent on time and in a legible condition.

According to said Section 103D-310, HRS, the Department may require any prospective bidder to submit answers to questions contained in the 'Standard Qualification Questionnaire For Prospective Bidders On Public Works Contracts' on the form furnished by the Department, properly executed and notarized, setting forth a complete statement of the experience of such prospective bidder and its organization in performing similar work and a statement of the equipment proposed to be used, together with adequate proof of the availability of such equipment. Whenever it appears to the Department, from answers to the questionnaire or otherwise, that the prospective bidder is not fully qualified and able to perform the intended work, the Department will, after affording the prospective bidder an opportunity to be heard and if still of the opinion that the bidder is not fully qualified to perform the work, refuse to receive or consider any bid offered by the prospective bidder. All information contained in the answers to the questionnaire shall be kept confidential. Questionnaire so submitted shall be returned to the bidders after serving their purpose.

No person, firm or corporation may bid where (1) the person, firm, or corporation, or (2) a corporation owned substantially by the person, firm, or corporation, or (3) a substantial stockholder or an officer of the corporation, or (4) a partner or substantial investor in the firm is in arrears in payments owed to the State of Hawaii or its political subdivisions or is in default as a surety or failure to do faithfully and diligently previous contracts with the State."

(II) Amend **102.04 Estimated Quantities** by revising the last sentence of the last paragraph to read as follows:

"The Department may increase, decrease, or omit each scheduled quantities of work to be done and materials to be furnished. When the Department increases or decreases the estimated quantity of a contract item by more than 15% the Department will make payment for such items according to Subsection 104.11 – Variations in Estimated Quantities."

(III) Amend **102.05 Examination of Contract and Site of Work** by adding the following:

"The geotechnical engineering report, 'Geotechnical Engineering Exploration, Interstate Route H-1 Widening, Waimalu Viaduct (Westbound), Pearl City Off-Ramp to Kaonohi Street, Pearl City to Aiea, Oahu, Hawaii,' dated March 31, 2003 by Geolabs, Inc. may be examined and borrowed at the Contracts Office, Department of Transportation, 869 Punchbowl Street, Honolulu, Hawaii 96813.

The following hazardous material surveys may be examined and borrowed at the Contracts Office, Department of Transportation, 869 Punchbowl Street, Honolulu, Hawaii 96813:

1. 'Hazardous Materials Survey, Interstate Route H-1 Widening, Waimalu Viaduct to Pearl City Off-Ramp, Demolition of Residential Structure, 98-318 Pono Street, Aiea, Hawaii,' dated May 1, 2003

2. 'Hazardous Materials Survey, Interstate Route H-1 Widening, Waimalu Viaduct to Pearl City Off-Ramp, Demolition of Residential Structure, 98-359 Ponohana Loop, Aiea, Hawaii,' dated May 1, 2003

3. 'Asbestos, Lead-Painted Surfaces, PCB Fluorescent Light Ballast, Mercury-Containing Light Bulbs Survey and Waste Characterization, Waimalu Gardens, Building 1 (98-323 Ponohana Place, T.M.K. 9-8-26:69), Building 323 (98-323 Pono Street, T.M.K. 9-8-26:09), and Building 342 (98-342 Ponohala Place, T.M.K. 9-8-26:09), Aiea, Oahu, Hawaii, 96707' dated October 1, 2003

Borrowed reports shall be returned in good condition within 30 calendar days after the bid opening date.

(IV) Amend **102.07 Irregular Proposals** by adding the following after item **(5)**:

"**(6)** If in the opinion of the Director, the bidder and its listed subcontractors do not have the Contactor's licenses or combination of Contractor's licenses necessary to complete the work."

(V) Amend **102.08 Proposal Guaranty** to read as follows:

"**102.08 Proposal Guaranty.** The Department will not consider a proposal of $25,000 or more unless accompanied by:

(1) a deposit of legal tender; or

(2) a valid surety bid bond, underwritten by a company licensed to issue bonds in the State of Hawaii, in the form and composed, substantially, with the same language as provided herewith and signed by both parties; or

(3) a certificate of deposit, share certificate, cashier's check, treasurer's check, teller's check, or official check drawn by, or a certified check accepted by and payable on demand to the State by a bank, savings institution, or credit union insured by the Federal Deposit Insurance Corporation (FDIC) or the National Credit Union Administration (NCUA).

(a) The bidder may use these instruments only to a maximum of $100,000

(b) If the required security or bond amount totals over $100,000 more than one instrument not exceeding $100,000 each and issued by different financial institutions shall be acceptable.

(c) The instrument shall be made payable at sight to the Department of Transportation, State of Hawaii.

According to Section 103D-323, H.R.S., the above shall be in a sum not less than 5% of the amount bid."

(VI) Amend **102.12 Disqualification of Bidders** to read as follows:

"**102.12 Disqualification of Bidders.** The Department may disqualify a bidder and reject its proposal for the following reasons:

(1) Submittal of more than one proposal whether under the same or different name.

(2) Evidence of collusion among bidders. The Department will not recognize participants in collusion as bidders for any future work of the Department until such participants are reinstated as qualified bidders.

(3) Lack of proposal guaranty.

(4) Submittal of an unsigned or improperly signed proposal.

(5) Submittal of a proposal without a listing of subcontractors or containing only a partial or incomplete listing of subcontractors.

(6) Submittal of an irregular proposal according to Subsection 102.07 - Irregular Proposals.

(7) Failure to submit and comply with the Statement of Affirmation and Acknowledgment of Disadvantaged Business Enterprise (DBE).

(8) Evidence of assistance from a person who has been an employee of the agency within the preceding two years and who particpcated while in State office or employment in the matter with which the contract is directly concerned, pursuant to Section 84-15, HRS."

(9) Suspended or debarred in accordance with HRS 104-25.

(10) Failure to complete the prequalification questionnaire.

(11) Failure to attend the mandatory pre-bid meeting.

(VII) Amend **Section 102.14 - American Products Preference** to read as follows:

"**102.14 American Products Preference.** The 'Buy America' provision in the Surface Transportation Assistance Act of 1982 is applicable to Federal-Aid projects. The bidders shall give preference to American products, materials and supplies.

Bidders may submit a bid based upon furnishing domestic or foreign steel. The basis for determining the foreign or domestic character of the steel is on the place of manufacture. Any domestic steel furnished shall be manufactured from materials and supplies mined, produced or manufactured in the United States.

The 'Buy America' provision does not apply to minimal use of foreign steel such that the cost, delivered to the project site, is less than $2,500 or 0.1% of the total contract amount, whichever is greater.

The Department directs the bidder to the instructions in the Proposal regarding alternate bidding procedures for foreign steel. The Department will decide the total bid for bid comparison purposes as provided in the proposal.

The Department will award the contract to the bidder who submits the lowest total bid based on furnishing domestic steel, unless such total bid exceeds the lowest total bid based on furnishing foreign steel by more than 25%. If a tie occurs between a bid based upon furnishing foreign steel and a bid based upon furnishing domestic steel including the 25% price differential, the Department will consider the bid based on furnishing domestic steel as the lower bid.

The basis for the determination of foreign or domestic character of the steel are on place of manufacture. Manufacturing processes and its coating, if any, for domestic steel shall occur in the United States."

(VIII) Amend **102.15 Declaration of Non-Collusion** to read as follows:

"**102.15** (Unassigned)"

(IX) Amend **102.16 Substitution Of Materials and Equipment** to read as follows:

"**102.16 Substitution Of Materials and Equipment.**

(A) Substitution Before Bid Opening. When the specifications and/or plans specify brand materials or equipment by brand name to indicate a quality, style, appearance, or performance, the bidder will be assumed to have based his bid on one of the specified products, and where such proprietary product is specified, an alternate brand may be qualified if found equal or better by the Director. Bidders requesting qualification of alternate proprietary products must submit a request to the Director for review and approval at the earliest date possible, but in any event, such request must be received at the Contracts Office not later than 14 days before the bid opening date, not including the bid opening date.

It shall be the responsibility of the bidder to submit, in quintuplicate, sufficient evidence based upon which a determination can be made by the Director that the alternate brand is qualified. The evidence shall be transmitted with a covering letter which shall list the evidence submitted and the items for which the substitution is requested.

If the evidence accompanying a request for substitution is insufficient to qualify a particular model, the request shall be denied.

(B) Substitution After Bid Opening. Substitution of material or equipment will not be allowed after the bid opening date except under the following circumstances:

(1) A specified or pre-qualified item is delayed by a lengthy strike in the factory or other unforeseeable contingency beyond the control of the Contractor which would cause an abnormal delay in the project completion.

(2) A specified or pre-qualified item is found to be unusable due to change or other circumstances.

(3) If the Contractor is willing to provide a more recently developed or manufactured item of material or equipment of the same manufacturer which the Director determines to be equal or better than the one specified or pre-qualified.

A substitution request, regardless of reason, shall be fully explained in writing, by the Contractor and shall include his justification for said request, the quantities and unit prices involved, quotations and such other documents as are deemed necessary to support the request. Substitutions allowed pursuant to this provision, with the exception of the circumstance described under (B)3, do not qualify as value engineering. Any savings in cost will accrue to the State except where value engineering applies, and any additional cost for the substituted items will be paid for by the Contractor.

The above shall not be construed to mean that substitution for brand name specified materials and equipment will be allowed; the Director reserves the right to deny any request he deems irregular or not in the best interest of the State.

The burden of proof as to the comparative quality and suitability of alternate equipment, articles or materials shall be upon the Contractor and he shall furnish, at his own expense, all information necessary or related thereto as is required by the Director. The Director shall be the sole judge of the comparative quality and suitability of alternates and his decision is final.

The above provisions shall not be construed as permitting the use of alternates for equipment, articles or materials which are not designated under a trade name or the name of a manufacturer and his information catalogue and for which specifications are set forth."

(X) Add the following:

"102.18 Preferences. Hawaii Products, Recycled Products, and In-State Preferences shall not apply to this project."

102.19 Certification for Safety and Health Program for Bids in excess of $100,000. According to Section 396-18 of the Hawaii Revised Statutes, the bidder or offeror, by signing and submitting this proposal, certifies that a written safety and health plan for this project will be available and implemented by the notice to proceed date for this project. Details of the requirements of this plan may be obtained from the State Department of Labor and Industrial Relations, Occupational Safety and Health Division (HIOSH)."

102.20 Tax Clearance. All bidders should submit original tax clearance certificates or certified copies from the Department of Taxation (DOTAX) and the Internal Revenue Service (IRS) with their bid proposals when the bid is $25,000 or more. Bidders are required to provide a tax clearance prior to entering into a public contract of $25,000 or more, pursuant to ACT 352, SLH 1997.

Tax clearances may be obtained by completing the Tax Clearance Application (Form A-6) and submitting it to the DOTAX or the IRS. The application may be obtained from the DOTAX, or the IRS. The application may be mailed in or walked in to either the DOTAX or the IRS. Both tax agencies encourage the use of their mail-in process, which should be completed within 21 calendar days. Tax clearance certificates will be issued to the applicant upon determination that the applicant has filed all tax returns due, and has paid all amounts owing on such returns, including penalty and interest."

Only original tax clearances or certified copies will be accepted for this purpose. Failure to submit the required tax clearance certificates will be sufficient grounds for the State to refuse to receive or consider the prospective bidder's proposal.

Tax clearance certificates are valid for 6 months. The validity period will begin with the later approval date stamped on the tax clearance.

The tax clearance submitted with the bid proposals must be valid on the solicitation's first legal advertisement date or any date thereafter up to the bid opening date. Valid tax clearances submitted with the proposal will remain valid for the contract award and encumbrance.

If a business cannot obtain a tax clearance certificate because of tax delinquencies, it may submit a 'special letter' from DOTAX and/or the IRS. The 'special letter' may only be obtained if

(1) the business has an existing installment agreement with the tax agency, or

(2) the delinquency is the subject of an administrative or judicial appeal.

The bidder is cautioned that the 'special letter' from the IRS must be certified by DOTAX. All conditions applied to tax clearance certificates for this purpose are applicable to these 'special letters'. Instructions to obtain the 'special letter' are available from each respective tax agency.

Various combinations of tax clearance certificates and 'special letters' are acceptable for this purpose as follows:

(1) Tax clearance signed by both tax agencies;

(2) Individual tax clearance certificates from each tax agency, respectively;

(3) Tax clearance certificate from one tax agency and a 'special letter' from the other tax agency; or

(4) 'Special letter' from both tax agencies.

102.21 Escrow Proposal Documentation (EPD). The apparent three lowest bidders shall submit all supporting information and calculations (EPD) used to determine its proposal for this project. The EPD shall be received by the Contracts Officer by December 4, 2003. Failure to submit the EPD will be cause for rejection of the proposal.

The Department will hold the EPD of the successful bidder in escrow for the duration of the Contract. The Department will use the EPD solely for the purpose of determining the Contactor's proposal concept, if necessary, for price adjustments as provided in the Contract or to resolve claims or disputes. The Department will return to each unsuccessful bidder, its EPD upon execution of the Contract.

The Department acknowledges that the EPD as defined herein, constitutes trade secrets. This acknowledgement is based on the Department's express understanding that:

(1) The information contained in the EPD is not known outside of the bidder's business.

(2) The information contained in the EPD is safeguarded while in the bidder's possession.

(3) The information contained in the EPD is extremely valuable to bidder.

(4) The information contained in the EPD could be extremely valuable to the bidder's competitors by virtue of the EPD reflecting the bidder's construction strategies, assumptions and intended means, methods and techniques of construction.

(5) The bidder expended substantial sums of money in developing the information included in the EPD.

(6) The EPD would be difficult for a competitor to replicate the information contained therein.

(7) The EPD includes a compilation of information used in its business, intended to give bidders an opportunity to obtain an advantage over competitors who do not know of or use the contents of the documentation.

The Department agrees to safeguard the EPD against disclosure to the fullest extent permitted by law.

The successful bidder agrees as a condition of Award, that the EPD constitutes all the information used in the preparation of its bid. The Awardee shall not use other bid preparation information to establish the base amounts of original contract proposal items for resolution of price adjustments as provided in the Contract, disputes, or claims.

(A) EPD Format. Bidders are encouraged to submit EPD in their usual cost estimating format. No standard format is required. While the intent is not to cause bidders additional work during proposal preparation, the EPD must allow for complete understanding and proper interpretation by the Department. Electronic files will not be accepted. If the proposal was prepared utilizing electronic files, hard copies shall be submitted. The EPD shall be in a form such that it can be read without the aid of a computer or other device(s).

The EPD shall itemize the costs for pay items. The EPD shall be in English. Bidders shall break down the pay items into components small enough to allow a detailed cost estimate. Bidders shall break down the costs allocated to each component into the bidder's usual estimate categories such as direct labor, repair labor, equipment parts and supplies, expendable materials, permanent materials, and subcontractor's costs. Bidders shall make plant and equipment and indirect cost allocations to bid items as appropriate. Bidders shall break down cost in the bidder's usual format. Bidders shall identify all costs.

Bidders shall include quantity takeoffs, calculations of rates of production and progress, copies and quotes from subcontractors and suppliers, and memoranda, narrative, reference material and other information used by the bidder to arrive at the prices contained in the proposal.

The successful bidder shall make available a representative who can fully explain its EPD to the Department.

(B) EPD Submittal. Bidders shall submit the EPD spreadsheet and supporting documents in sealed containers. Bidders shall label the containers clearly with the bidder's name, date of submittal, project name, project number, and 'ESCROW PROPOSAL DOCUMENTATION'. Bidders shall accompany the EPD with an affidavit, in the form following this Section.

(C) Pre-Storage Examination. The Engineer will examine the EPD of the apparent low bidder in the presence of the apparent low bidder before award of the contract. At least one member of the apparent low bidder's staff who is knowledgeable in how the bid was prepared shall be present at the examination. The member of the apparent low bidder's staff is to ensure and demonstrate that the EPD is complete. This examination does not constitute approval of proposed construction methods, estimation assumptions, or interpretations of contract documents. The apparent low bidder shall promptly submit incomplete or missing data before the award of the contract. The examination does not alter conditions or terms of the contract. The Department will reseal and store the EPD in the presence of the apparent low bidder after examination. The Department will acknowledge receipt of the EPD by returning to the bidder the countersigned affidavit specified below.

(D) Storage. The EPD shall remain the property of the apparent low bidder subject to use as provided herein. The Department will store the EPD until the Contract is awarded. After Contract award, the Awardee shall obtain a safety deposit box from an escrow institution for storage of the EPD for the duration of the Contract. The escrow institution will be recommended by the Department and accepted by the apparent low bidder. The escrow institution will not allow one party to obtain access to the EPD without the other.

The cost of this storage will not be paid for separately and shall be considered incidental to the various contract items.

(E) Review. The Department or the Contractor may review the EPD at any time deemed necessary in conjunction with but not limited to,

settling price adjustments as provided in the Contract, disputes, claims or change orders. Review of the EPD is subject to the following conditions:

(1) As trade secrets are described herein, the EPD is proprietary and confidential.

(2) The Department and the Contractor shall each designate in writing, three representatives who are authorized to review the EPD on their behalf.

(3) The Department and the Contractor shall each designate in writing, a representative to receive notice to review of the EPD on their behalf.

(4) The Department or the Contractor will give 24 hours written notice to the other party before reviewing the EPD. The review shall take place within two working days of notice.

(5) A representative of both the Department and the Contractor shall always be present when the EPD is reviewed. All reviews shall be conducted in the presence of a Contractor's representative who can fully explain all portions of the EPD.

(6) The Department will return the EPD to the escrow institution following each review.

(7) Making copies of specific pages of the EPD for use by the Department or Contractor for settlement purposes shall be allowed. The copies shall be returned or destroyed after they are of no further use.

(F) Return. The Department will return all EPD to the Contractor after making final payment to the Contractor."

ESCROW PROPOSAL DOCUMENTATION AFFIDAVIT

THE UNDERSIGNED HEREBY CERTIFIES THAT THE ESCROW PROPOSAL DOCUMENTATION CONTAINED HEREIN CONTAINS ALL OF THE INFORMATION, WHICH WAS USED TO DEVELOP THE PROPOSAL DOCUMENTATION, IS ACCURATE, CORRECT AND COMPLETE.

BY: _____

TITLE: _____

FIRM: _____

DATE: _____

COUNTERSIGNED BY THE DEPARTMENT AFTER EXAMINATION OF ESCROW PROPOSAL DOCUMENTATION.

BY: _____

TITLE: _____

DATE: _____

SECTION 103 - AWARD AND EXECUTION OF CONTRACT

Make the following amendments to said Section:

(I) Amend **103.01 Consideration of Proposals** by revising the first paragraph to read as follows:

"The Department will compare the proposals in terms of 'Cost Plus Time Bidding' after the Contracts Officer opens and reads the proposals. This method will be used for award consideration only. It will not be used to determine the contract award amount or the final payment due to the Contractor at project completion. The Amount for Comparison of Bids is the sum of two components as shown by the following formula:

Amount for Comparison of Bids = (Sum of the Dollar Amount of the Bid Items and the Foreign Steel Disincentive) + (Product of the Contract Time and the Road User Cost)

(1) Contract Time shall not exceed the maximum identified on page P-1. Bids submitted with a Contract Time in excess of this maximum will be rejected as non-responsive. Bids, which do not provide a Contract Time, will be rejected as non-responsive.

(2) Road User Cost, as established by the Department for this project, is $ 19,500 per calendar day.

If a discrepancy occurs between unit bid price and extension, the unit bid price shall govern. If a discrepancy occurs between Contract Time and the product of Contract Time and Road User Cost, Contract Time shall govern."

(II) Amend **103.03 Award of Contract** to read as follows.

"The award of contract, if it be awarded, will be made within 60 calendar days after the opening of bids, to the lowest responsible bidder, as determined by the Amount for Comparison of Bids, whose proposal complies with all the requirements. The successful bidder will be notified by letter mailed to the address shown on his/her proposal, that his/her proposal has been accepted, and that he/she has been awarded the contract.

Pursuant to Sections 103-53 and 103(D)-308, H.R.S., and as provided in Section 102.20 Tax Clearance of the Special Provisions, the awardee is required to provide a valid state and federal tax clearance as a prerequisite to entering into a public contract.

Act 52, SLH 2003, amended Section 103D-310, HRS, by adding subsection (c) which, in part follows:

'(c) All offerors, upon award of contract, shall comply with all laws governing entities doing business in the State, including chapters 237, 383, 386, 392, and 393, and shall:

(1) Be incorporated or organized under the laws of the State; or

(2) Be registered to do business in the State as a separate branch or division that is capable of fully performing under the contract.'

At the release of this solicitation, implementation of the law is pending guidance from the Departments of Labor and Industrial Relations and Commerce and Consumer Affairs. Should guidance be received and implemented prior to award of this contract, the prospective awardee will be required to comply."

(III) Amend **103.06 Requirement of Contract Bond** to read as follows:

"At the time of execution of the contract, the successful bidder shall file a good and sufficient performance bond and a payment bond on the forms furnished by the Department (see attached) conditioned for the full and faithful performance of the contract according to the terms and intent thereof and for the prompt payment to all others for all labor and material furnished by them to the bidder and used in the prosecution of the work provided for in the contract. The bonds, each of which shall be of an amount equal to 100% of the amount of the contract price and including 5% of the contract amount estimated to be required for extra work. The bidder shall limit the acceptable performance and payment bonds to the following:

(a) Legal tender;

(b) Surety bond underwritten by a company licensed to issue bonds in the State of Hawaii; or

(c) A certificate of deposit; share certificate; cashier's check; treasurer's check, teller's check drawn by or a certified check accepted by and payable on demand to the State by a bank savings institution or credit union insured by the Federal Deposit Insurance Corporation (FDIC) or the National Credit Union Administration (NCUA).

1. The bidder may use these instruments only to a maximum of $100,000.

2. If the required security or bond amount totals over $100,000 more than one instrument not exceeding $100,000 each and issued by different financial institutions shall be acceptable.

Such bonds shall also by the terms inure to the benefit of any and all persons entitled to file claims for labor done or material furnished in the work so as to give them a right of action as contemplated by Section 103D-324, HRS."

(IV) Amend **103.07 Execution of the Contract** by revising the first paragraph to read as follows:

"**103.07 Execution of Contract.** The contract bond and 'Chapter 104, HRS Compliance Certificate ', similar to a copy of the same annexed hereto, shall be executed by the successful bidder and returned within ten days after the award of the contract or within such further time as the Director may allow after the bidder has received the contract for execution."

(V) Amend **103.07 Execution of the Contract** by adding the following:

"The Contractor shall execute the following Right of Entry Agreement with Hillside Terrace IV Apartment Owners Association prior to commencing work. A copy of the fully executed Right of Entry Agreement shall be provided to the Engineer. The Right of Entry Agreement is attached."

RIGHT OF ENTRY AGREEMENT

THIS AGREEMENT, effective as of _____, made and entered into by and between HILLSIDE TERRACE IV APARTMENT OWNERS ASSOCIATION ("HILLSIDE") whose mailing address is c/o PaR Management, Inc., P.O. Box 8229, Honolulu, Hawaii 96830, hereafter referred to as the "GRANTOR", and_____ _____, (hereafter the "CONTRACTOR"), a corporation under the laws of the State of Hawaii, whose business address is:_____ _____.

WITNESSETH THAT:

WHEREAS, the CONTRACTOR requires the temporary use of certain property designated as Construction Parcel C-1, being a portion of Tax Map Key No. (1) 9-8-60-01 (Portion), containing an area of approximately 24,000 square feet, situated at Waimalu, Ewa, Oahu, Hawaii as shown on the map attached hereto as Exhibit "A" and incorporated herein by reference (hereafter referred to as the "Property"), for a public purpose, to wit: the construction, preservation and protection of Interstate Route H-1 Widening (Westbound) Waimalu Viaduct to Pearl City Off-Ramp, Federal Aid Project No. IM-HP-H1-1(237), at Waimalu, Ewa, Oahu, Hawaii, (hereafter referred to as the "Project"), and

WHEREAS, the CONTRACTOR was awarded the Project Contract by the State of Hawaii, Department of Transportation

(hereafter the "STATE"); and

WHEREAS, the CONTRACTOR is desirous of obtaining immediate possession of the Property in order that construction of the Project may proceed without delay; and

WHEREAS, the GRANTOR is owner of, or may have an interest in, the Property which will be affected by the Project; and

WHEREAS, the GRANTOR is desirous of cooperating with the CONTRACTOR so that the construction of the Project may proceed without delay,

NOW, THEREFORE, in consideration of the premises and the covenants contained herein, the parties hereto mutually agree as follows:

1. Grant of entry. The GRANTOR hereby grants to the CONTRACTOR, its officers, employees and subcontractors, permission to enter upon and take possession of the Property as shown on the map for the Project filed in the Highways Division, Department of Transportation, State of Hawaii for the purposes of the Project enumerated above.

2. Indemnification. The CONTRACTOR shall indemnify the GRANTOR and the STATE against any liability, including all loss, damages, costs, expenses and attorney's fees for any damage to real or personal property, or injury to or death of persons when such damage, injury or death is caused by the negligence of the CONTRACTOR in the exercise of the rights

granted under this Agreement, provided, that the CONTRACTOR shall not be obligated to indemnify the GRANTOR if and to the extent that such damage, injury or death is caused by the negligence of the GRANTOR or any of the GRANTOR's officers, employees, agents or representatives.

3. No unreasonable interference. The GRANTOR agrees not to unreasonably interfere with the CONTRACTOR's facilities, operations and activities in, on or connected with the Property. CONTRACTOR agrees that GRANTOR and utility companies may continue to exercise any existing rights each may have related to the Property, including but not limited to, access over and through the Property, as long as said exercise of rights does not unreasonably interfere with the CONTRACTOR's work on the Property.

4. Insurance. The CONTRACTOR shall carry, at its own expense, commercial general liability and automobile liability insurance covering all activities conducted on the Property. The limit of liability for the commercial general liability insurance coverage shall not be less than TWO MILLION AND NO/100 DOLLARS ($2,000,000.00) for each of the following coverages: (a) bodily injury and property damage (per occurrence), (b) personal and advertising injury and (c) products - completed/operations aggregate. The limit of liability for the automobile liability insurance coverage shall not be less than ONE MILLION AND NO/100 DOLLARS ($1,000,000.00)

for each of the following liability coverages: (i) bodily injury (per accident) and (ii) property damage. The GRANTOR shall be included as an additional insured on the commercial general liability and automobile liability policies. The CONTRACTOR will, prior to the commencement of any work within the Property, furnish to the GRANTOR and the STATE, a certificate of insurance evidencing the above insurance coverage.

5. Term. The term of this Agreement shall be from the effective date of this Agreement until _____, unless sooner terminated by the CONTRACTOR in accordance with paragraph 7 herein.

6. Extension. This Agreement may be extended upon mutual written agreement of the parties hereto.

7. Termination. This Agreement may be terminated upon thirty (30) days written notice by the CONTRACTOR as to all or any portion of the Property.

8. Effect of termination. Upon termination of this Agreement, the CONTRACTOR's obligation pursuant to paragraph 2 herein shall terminate, excepting any causes of action that may have accrued prior to said termination

9. Removal. Upon termination of this Agreement, the CONTRACTOR shall remove from the Property in an orderly manner, any and all personal property, including machinery, equipment, tools and motor vehicles stored or otherwise placed on the Property by the CONTRACTOR.

10. Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed an original, and said counterparts shall together constitute one and the same agreement, binding all of the parties hereto, notwithstanding all of the parties are not signatory to the original or the same counterparts. For all purposes, including, without limitation, recordation, filing and delivery of this instrument, duplicate unexecuted pages of the counterparts may be discarded and the remaining pages assembled as one document.

11. Headings, captions. The headings and captions used herein are for convenience of reference only and are not to be used to construe, interpret, define or limit the paragraphs to which they may pertain.

12. Binding effect. The term "GRANTOR" wherever used herein shall include the Hillside Terrace IV Apartment Owners Association, its personal representatives, parent entities, subsidiaries, successors and assigns, jointly and severally, and the term "CONTRACTOR" wherever used herein shall include _____, its successors and permitted assigns. This instrument shall be binding upon and shall inure to the benefit of the GRANTOR and the CONTRACTOR.

13. Assignment. The GRANTOR may not assign or otherwise transfer any interest in this Agreement without the written consent of the CONTRACTOR.

14. Amendment. This Agreement shall not be amended except in writing signed by the parties.

IN WITNESS WHEREOF, the GRANTOR and the CONTRACTOR have each caused this instrument to be duly executed this _____ day of _____, 20___, all effective as of the day, month, and year first above written.

GRANTOR:

HILLSIDE TERRACE IV APARTMENT OWNERS ASSOCIATION

By_____
Print Name:_____
Its_____

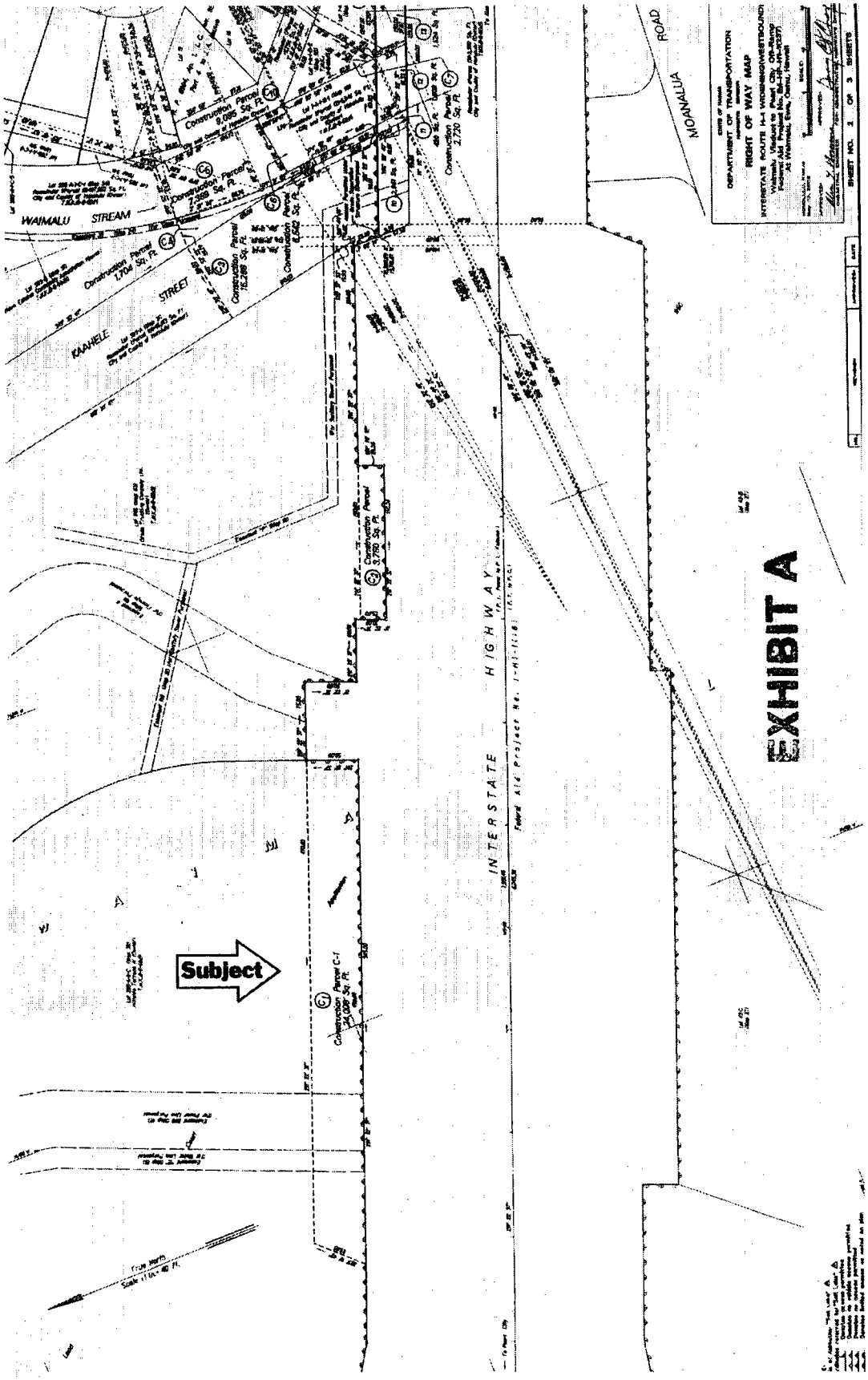
By_____
Print Name:_____
Its_____

CONTRACTOR:

_____

By_____
Print Name:_____
Its_____

By_____
Print Name:_____
Its_____



I-H3-1(75) Unit VIII
BR-H1-1(241)
103-10a

10/13/03

(VI) Amend **103.09 Submission of Insurance Certification** to read as follows:

"**103.09 Submission of Insurance Certification.** The Contractor shall submit to the Engineer within 15 days of the contract award date, three copies each of insurance certification stating that the Contractor has taken out and is keeping in effect:

(1) Commercial General Comprehensive Personal Injury and Property Damage Liability insurance with the following minimum limits of liability:

Products - Completed/Operations Aggregate	$2,000,000
Personal and Advertising Injury	$2,000,000
Bodily Injury and Property Damage	$2,000,000 each occurrence

naming the State of Hawaii; its officers and employees, Hillside Terrace IV Apartment Owners Association (Construction Parcel C-1, as identified on Exhibit B); Newtown Estates Community Association (Construction Parcel C-4, as identified on Exhibit B); Okada Trucking Co., Ltd. (Construction Parcel C-2, as identified on Exhibit B); and City and County of Honolulu, Board of Water Supply (Construction Parcel C-28, as identified on Exhibit C) as additional insured.

(2) Automobile Liability insurance with the following minimum limits of liability:

Bodily Injury Liability	$1,000,000 (Per accident)
Property Damage Liability	$1,000,000

naming the State of Hawaii; its officers and employees, Hillside Terrace IV Apartment Owners Association (Construction Parcel C-1, as identified on Exhibit B); Newtown Estates Community Association (Construction Parcel C-4, as identified on Exhibit B); Okada Trucking Co., Ltd. (Construction Parcel C-2, as identified on Exhibit B); and City and County of Honolulu, Board of Water Supply (Construction Parcel C-28, as identified on Exhibit C) as additional insured.

(3) Workers' Compensation.

The insurance mentioned above shall cover the insured for work done:

(1) under the contract including force account work,

(2) incidental to the contract including traffic detour work or other work done out of the work area,

(3) outside the project limits including hauling of equipment and materials, and

(4) contract change orders including force account work.

If the Contractor and/or its insurer wrongfully fails to defend and/or indemnify the State of Hawaii; its officers and employees, Hillside Terrace IV Apartment Owners Association; Newtown Estates Community Association; Okada Trucking Co., Ltd.; and City and County of Honolulu, Board of Water Supply in any liability claims, the Department may bar the Contractor and/or its insurance company from bidding, working on construction projects, and/or insuring construction projects for a period of up to two consecutive years from the date determined by the Department.

This remedy is non-exclusive. The Department may exercise this remedy in addition to other remedies for breach of the project contract on account of any failure to defend and/or indemnify.

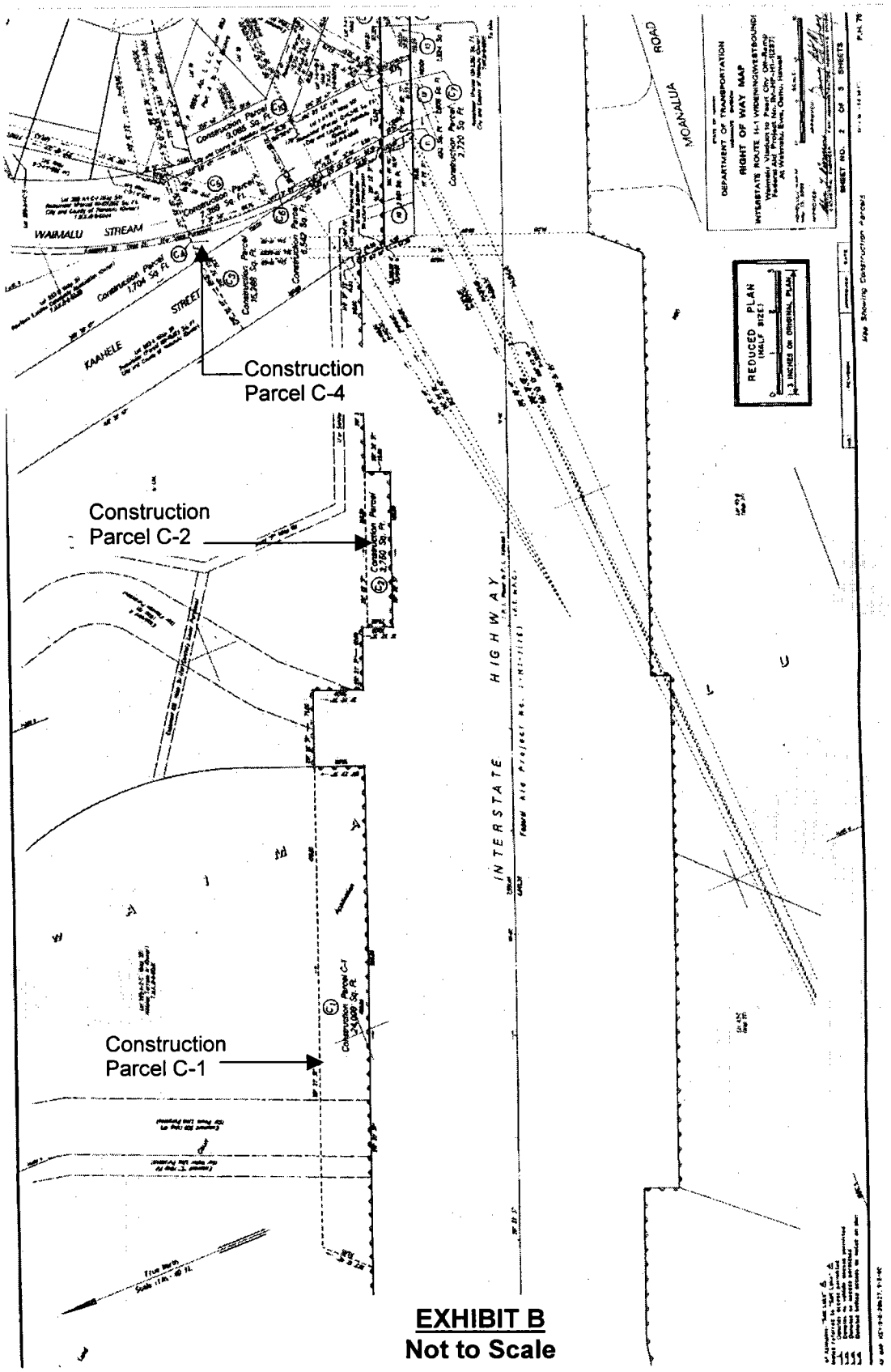


EXHIBIT B
Not to Scale

I-H3-1(75) Unit VIII
BR-H1-1(241)
103-13a

10/13/03

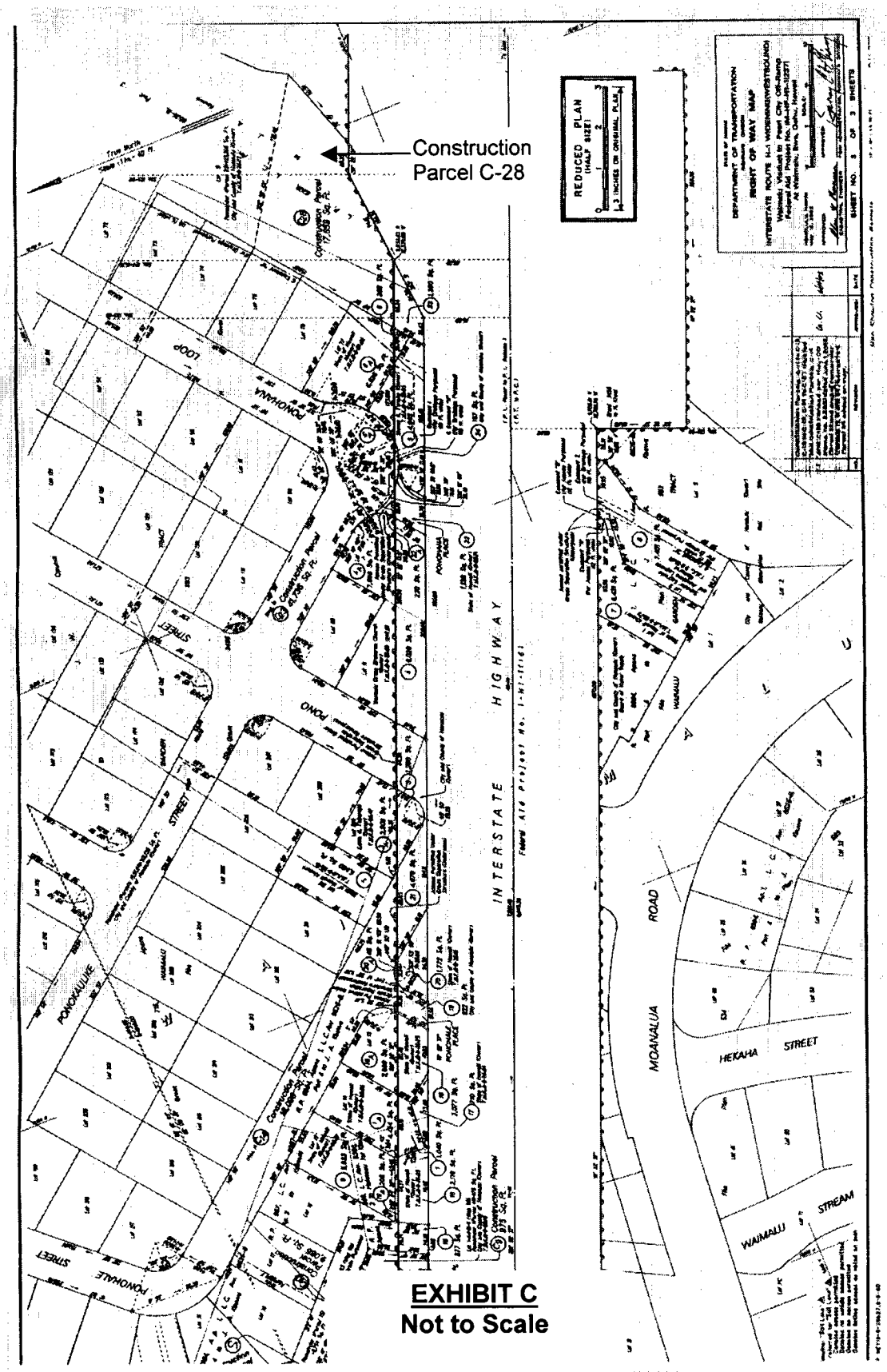


EXHIBIT C
Not to Scale

I-H3-1(75) Unit VIII
BR-H1-1(241)
103-14a

10/13/03

SECTION 104 - SCOPE OF WORK

Make the following amendments to said Section:

(I) Delete the paragraph before **104.01(B) Voluntary Partnering.**

(II) Delete **104.01(B) Voluntary Partnering** in its entirety.

(III) Amend **104.02 Alterations of Plans or Type of Work** to read as follows:

"104.02 Alterations of Plans or Type of Work. The Engineer may at any time, during the progress of the work, by written order and without notice to the sureties, make changes in the work as may be found to be necessary or desirable. Such changes shall not invalidate the Contract nor release the surety. The Contractor will perform the work as changed, as though it had been a part of the original contract.

(A) Minor Changes. The Engineer may direct minor changes in the work with no changes in contract price or time of performance. If a Contractor believes a minor change directive justifies a change in Contract price or time, it must follow the required oral and written notices identified in 104.02(B) Orders and Directives.

(B) Orders and Directives. Any order, direction, instruction, interpretation or determination from the Engineer that is not a field order or change order, may be considered as a compensable change only if the Contractor gives the Engineer an oral notice of its intent to treat such order, direction, instruction, interpretation or determination as a change directive before the Contractor acts in conformity with the order, direction, instruction, interpretation or determination, but not later than noon of the following working day. The oral notice shall be followed by a written notice of a potential claim that must be delivered to the Engineer within five days after communication of the order, direction, instruction, interpretation, or determination to the Contractor. The written notice of a potential claim shall state the date, circumstances, and source of the order, direction, instruction, interpretation, or determination that the Contractor regards as a compensable change, whether extra costs and a time extension will be requested, and Contractor's justification for claiming extra costs, or time. Such written notice may not be waived and shall be a condition precedent to the filing of any claim by the Contractor. Unless the Contractor acts in accordance with this procedure, any such order, direction, instruction, interpretation, or determination shall not be treated as a change for which the Contractor may make a claim for an increase in the contract time, compensation or contract price related to such work.

No more than ten working days after receipt of the written notice of a

potential claim from the Contractor, a written response shall be issued for the subject work if the State agrees that it constitutes a change. The Contractor shall deem it a rejection of its potential claim if a written response is not issued in the time established. If the Contractor objects to the Engineer's position, it shall file a written claim with the Engineer within 30 days after delivery to the Engineer of the Contractor's written notice of a potential claim. Failure by the Contractor to submit a written notice of a potential claim in the time specified waives all rights for an increase in contract time or compensation related to such work. The claim shall be determined as provided in Subsection 105.18 -- Claims for Adjustments and Disputes. In all cases, the Contractor shall proceed with the work as specified in the order, direction, instruction, interpretation, or determination immediately upon providing the Engineer with the oral notice described above, unless otherwise directed in writing by the Engineer.

(C) Penal Sum of the Surety Performance and Payment Bonds. The penal sum of the Surety Performance and Payment Bonds will be adjusted by the amount of each and every Contract Change Order

(IV) Amend **104.03 Extra Work** to read as follows:

"**104.03 Field Orders.** Upon receipt of the Field Order the Contractor shall proceed with the changes as ordered. If the Contractor does not agree with any of the terms or conditions or the adjustment or non-adjustment to the contract time and/or contract price set forth therein, the Contractor shall file a protest verbally to the Engineer before the Contractor acts in conformity with the Field Order, but no later than within 3 days after receipt of the Field Order and in writing within 5 days after receipt of the written Field Order. In the written protest the Contractor shall give all reasons in detail for its protest of the Field Order. The protest shall be determined as provided in Subsection 105.18 - Claims for Adjustment and Disputes.

Failure to file the written protest or to protest a portion(s) of the Field Order within the time specified shall constitute agreement on the part of the Contractor with all the terms, conditions, amounts and adjustment or non-adjustment to contract price and/or contract time set forth in the Field Order or the non–protested portion of the Field Order. The requirement for timely written notice shall be a condition precedent to the assertion of a claim and will not be waived. In all cases, the Contractor shall proceed with the work as changed by the Field Order."

(V) Delete **104.05 Construction and Maintenance of Detours** in its entirety.

(VI) Delete **104.06 Rights in and Use of Materials Found on the Work** its entirety.

(VII) Delete **104.07 Quarries and Pits on State Land for State and Federal Projects Only** in its entirety.

(VIII) Move **104.08 Falsework Lighting** to **104.11 Falsework Lighting**.

(IX) Move **104.04 Maintenance of Traffic** to **104.08 Maintenance of Traffic**.

(X) Add the following:

"**104.04 Contract Change Orders.** The Engineer will issue sequentially numbered Contract Change Orders at times it deems appropriate during the contract period. A Contract Change Order may contain the adjustment in contract price and/or time for a number of Field Orders. In all cases, the Contractor shall proceed with the work as changed by the Contract Change Order. No payment for any changes will be made until the Contract Change Order is issued.

104.05 Duty of Contractor to Provide Change Proposals. A Field Order may request the Contractor to supply the Engineer with a detailed proposal for an adjustment to the contract time or contract price for the work described therein. Any such request for a proposal shall not affect the duty of the Contractor to proceed as ordered with the work described in the Field Order.

The Engineer at times may issue a Request for Change Proposal to the Contractor requesting price and/or time adjustment proposals for contemplated changes in the work. The Request for Change Proposal is not a directive for the Contractor to perform the work described therein.

The Contractor shall submit a detailed written proposal in a time span allowed by the Engineer or if a time span is not stated by the Engineer it shall be within 15 days after receipt of a request for Request for Change Proposal or Field Order containing a request for proposal. The format shall set forth all charges the Contractor proposes for the change and a detailed justification for the proposed adjustment of the contract time, all properly itemized and supported by sufficient substantiating data to permit evaluation. The Engineer will determine whether the proposal is acceptable.

No payment shall be allowed to the Contractor for pricing, negotiating, research, or designs for proposed or actual changes. No time extensions will be granted for delay caused by late Contractor pricing of changes or proposed changes or time spent in negotiation.

The Engineer may accept the entire proposal, or any discrete cost item contained within the proposal, or the proposed adjustment to contract time by a notice in writing to the Contractor delivered to the contractor within thirty days after receipt of the proposal. The written acceptance by the Engineer of all or part of the Contractor's proposal shall create a binding agreement between the parties for that aspect of the change.

If the Engineer refuses to accept the Contractor's entire proposal, the

Engineer may issue a Field Order for the work; or if a Field Order has already been issued, the Engineer may issue a supplemental Field Order establishing new contract prices, the remaining adjustments to contract price and /or contract time for the ordered changes. If the Contractor disagrees with any term, condition or adjustment contained in such Field Order or supplemental Field Order, it shall follow the protest procedures set forth in and be subject to the other terms of Subsection 104.03, Field Order.

104.06 Payment for Deleted Materials.

(A) Canceled Orders. If acceptable material was ordered by the Contractor for any item deleted by an ordered change in the work prior to the date of notification of such deletion by the Engineer, the Contractor shall use its best efforts in a timely manner to cancel the order. The Department will pay reasonable cancellation charges required by the supplier. The Contractor will be paid an additional 7 percent markup on all reasonable cancellation charges for compensation of overhead and profit.

(B) Returned Materials. If acceptable deleted material is in the possession of the Contractor or is ultimately received by the Contractor, and if such material is returnable to the supplier and the Engineer so directs, the material shall be returned. After the Contractor returns acceptable material to the supplier, the Department will pay for the reasonable charges made by the supplier or other source for the return of the material. The Contractor shall be paid a markup for overhead and profit on charges made by the supplier. The Contractor shall be paid a 7 percent markup on the reasonable charges made by the supplier or other source for returning the material for compensation for overhead and profit. The cost to the Contractor for handling the returned material will be paid as provided in Subsection 104.09 Methods of Price Adjustment.

(C) Uncancelled Material. If orders for acceptable material that was deleted cannot be canceled at a reasonable cost or returned, it will be paid for at the actual cost to the Contractor including a markup for overhead and profit of 7 percent. In such cases, the material paid for shall become the property of the Department and the cost of further storage and handling will be paid as provided in Subsection 104.09 Methods of Price Adjustment.

All charges the Contractor proposes for the acceptable material that was deleted shall be properly itemized and supported by sufficient substantiating legible data to permit evaluation. The Engineer will determine whether the proposal is acceptable.

104.07 Differing Site Conditions.

(A) Notification of the Engineer. The Contractor shall promptly and

before such conditions are disturbed, notify the Engineer of:

(1) Subsurface or latent physical conditions at the site differing materially from those indicated in this Contract; or

(2) Unknown physical conditions at the site of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Contract.

(B) Adjustment of Price or Time for Performance. After receipt of the notice, the Engineer shall promptly investigate the site and if it is found that the conditions do materially so differ and cause an increase in the Contractor's cost of, or the time required for performance of any part of the work under this Contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made and the Contract modified by Contract Change Order. Any adjustment in contract price or time made pursuant to this clause shall be determined in accordance with the price and/or time adjustment subsection of the Contract.

(C) Timeliness of Claim. No claim of the Contractor under this subsection shall be allowed unless:

(1) The Contractor gives verbal notification to the Engineer within 12 hours of discovery of the differing site condition.

(2) The Contractor gives written notification to the Engineer no later than 5 days after the discovery of the differing site condition.

The Engineer may in writing, extend the times prescribed in this subsection. The notices to the Engineer are non-waivable conditions precedent to any claim under this Section.

(D) No Claim After Final Payment. No request by the Contractor for an equitable adjustment to the Contract shall be allowed if asserted after final payment under this Contract."

(XI) Amend **104.08 Maintenance of Traffic** to read as follows:

"**104.08 Maintenance of Traffic.**

(A) General. The Contractor shall keep the road open to traffic during the progress of the work according to Section 645 - Work Zone Traffic Control.

The Contractor shall furnish, erect, and maintain lights, barricades, signs and other traffic control devices. Also, the Contractor shall take precautions for the protection of the work and safety of the public according to Subsection 107.13 Public Convenience and Safety and Section 645.

Obstructions to a roadway attributable to construction, maintenance, or engineering survey on or near public streets and highways are a hazard to motorists, pedestrians and workers at the work site. The Contractor shall take such safety and precautionary measures as may be required according to Chapter 286, HRS; the Hawaii Administrative Rules, Title 19, Subtitle 5, Chapters 127, 128 and 129; and the most current editions or revisions of the MUTCD.

Where so provided on the plans, the Contractor may bypass traffic over an acceptable detour route. Keep the portion of the project used by public traffic in passable condition. Also, provide and maintain temporary crossings with trails, roads, streets, businesses, parking lots, garages, residences, and farms.

If elimination of abutting owners' access occurs, do not close the existing access until the replacement access facilities are usable. The Contractor may obtain written permission from the abutting owners setting the conditions for closing the existing access. Submit a copy of this agreement with the abutting owners to the Engineer for acceptance before such work begins.

Provide a smooth and even surface for public traffic use when working on an existing facility kept open to traffic. Conduct such work on only portion of the roadway. Alternate construction from one side to the other while routing traffic over the opposite side. Place sufficient fill at culvert and bridge locations to permit traffic to cross. Conduct culvert installation on only portions of the roadway to permit safe passage of traffic.

During subgrade and paving operations, consider use of shoulders for public traffic. If using part-width paving methods, consider use of side of the roadbed opposite the one under construction for public traffic. Keep a passageway wide enough to make at least two lanes of traffic open when sufficient width is available. The Engineer will consider shaping or maintaining the shoulders as included in the contract price of the various contract items and the Department will not make additional compensation.

Do not store material or equipment where the material or equipment will interfere with public traffic. Remove equipment and other obstructions to permit free and safe passage of public traffic when each day's work ends or if suspension of construction operations occurs.

Traffic incidental to other construction projects that abuts the principal routes of travel are part of the public traffic and shall be as required by contract.

The Contractor shall bear expenses of maintaining traffic over the section of road undergoing improvement or repair. Also, bear expenses of constructing, maintaining, removing, and furnishing approaches, crossings, intersections, and flaggers and their equipment, without direct compensation. Exceptions are as follows:

(1) Special Detours. The Department will cover payment for cost of constructing, maintaining, and removing such detour(s) when the proposal contains an item for "Construction and Maintenance of Detours". Also, the Department will include payment for the construction and removal of temporary bridges and accessory features. The Department will furnish right-of-way for temporary highways or bridges called for under this paragraph.

(2) Maintenance of Traffic During Suspension of Work. Provide safe passage for public traffic through the work site according to Subsection 108.08 - Temporary Suspension of Work.

(3) Special Maintenance Specified by the Engineer. The Engineer will pay the Contractor by one of the methods of Subsection 104.09 Methods of Price Adjustment if the Engineer specifies the special maintenance. The Engineer will be the sole judge of work to be classified as special maintenance.

(B) Traffic Maintenance Plans. Submit in writing traffic maintenance plans and schedules, including plans and schedules for traffic detours, road or lane closures, lane switches and the placement of temporary traffic control devices, warning signs, barricades and other protective devices, to the Engineer for acceptance at least ten working days before the date such work is scheduled to begin.

Such plans and schedules shall contain:

(1) a brief description of the work,

(2) dates of work,

(3) times of day affected,

(4) proposed public information sign, and

(5) proposed news release.

(6) detour layout plans.

Give the Fire Department at least 24 hours notice in writing before blocking or closing off access to streets. Keep fire hydrants accessible to the Fire Department. Do not place material or other obstruction closer to a fire hydrant than permitted by ordinances, rules or regulations. If there are no ordinances, rules or regulations, do not place material or other obstruction within 5 feet of a fire hydrant.

Make arrangements according to the contract for emergency work that may be required when work is not in progress.

The Engineer will permit lane closures only according to the "Construction Work Zone Notes" of the contract plans.

Exceptions to the lane closure hours identified in the "Construction Work Zone Notes" of the contract plans shall require the Engineer's acceptance in writing.

The Engineer will permit the Contractor to close only the number of lanes of traffic identified in the "Construction Work Zone Notes" of the contract plans during its working hours. During non-working hours, keep all lanes open to traffic and allow traffic to flow at the posted speed limit.

Failure to open lanes to traffic beyond the lane closure hours identified in the "Construction Work Zone Notes" of the contract plans shall result in assessment of liquidated damages as specified in Section 108.11 - Liquidated Damages and Failure to Complete on Time.

The Contractor shall not conduct operations on any roadway involving traffic lane closures or slowdown of traffic on the following dates:

(1) The day preceding a holiday from 3:00 PM to Midnight,

(2) All State Holidays,

(3) The Thanksgiving Holiday weekend (Thursday, Friday, Saturday and Sunday),

(4) The two week holiday period for Christmas and New Years, and

(5) The three consecutive week period for the "Beat the School Jam" during August and/or September.

No time extension shall be given for the restricted dates of operations

listed above. Should the Contractor conduct operations in violation of the above restrictions, every calendar day of violation shall be deducted from the Completion Time. This will be in addition to any lane rental charges and/or liquidated damages.

Notify the State and County transportation agencies including Bus Systems Division, Police Department, Fire Department, Ambulance Service, and the Department of Health in writing at least five days before the start of construction.

Construct, install, maintain, and remove five advisory signs as specified by the Engineer. Place the signs within the project limits. The signs shall have black letters on orange background. The minimum size of the signs shall be four feet high by eight feet wide.

The sign message shall include the starting date, hours, limits and duration of construction. The height of the letters shall be 8 inches, Series D. If accepted by the Engineer, the Contractor may use a minimum height of 6 inches, Series D. The Engineer will review and accept the advisory sign wording before installing. Install the advisory sign two weeks before the start of construction.

Take measures necessary to insure that safe and easily accessible passage is provided for pedestrians who must travel in or near the construction zone.

The Engineer will pay for furnishing, placing, maintaining and removing the advisory signs and insuring safe and accessible passage for pedestrians under 621.7020 – Construction Sign "Notice to Motorist".

Submit requests for review and acceptance of detours and lane closures that will impact traffic during peak hours before scheduling the work to begin as follows:

(1) detours - 8 weeks, and

(2) lane closures - 6 weeks.

Also, these requests shall include:

(1) An explanation of proposed changes to the existing traffic pattern;

(2) A schedule of when installing informational and traffic control signs;

(3) A schedule of when publishing advertisements;

(4) A plan showing the proposed informational and traffic control signs; and

(5) A plan showing the lane changes or detours. Plans for multi-lane highway lane changes and detours shall include details of the beginning of the lane changes or detours.

The Engineer will not make payment for reviewing request submittals.

(C) Advertisement. If requested by the Engineer, place an advertisement in the newspaper for the following traffic pattern changes in operation during peak hours or night work:

(1) Detours;

(2) Lane closure;

(3) Permanent road closure; and

(4) Permanent new route that changes a previous route.

The advertisement shall contain the following information:

(1) Map of traffic pattern change limits;

(2) Map showing lane(s) closure and detour pattern;

(3) Notice of starting and ending dates and duration; and

(4) Explanation of the lane(s) closure or detours "Notice To Motorist".

The quality of the map shall be as follows:

(1) The Department will not allow free hand printing or pencil;

(2) Highlight important feature in bold letters by darkening, cross-hatching, crossing-out or coloring;

(3) Minimum size shall be five columns wide and four columns deep. Lesser width columns may be considered to balance against the size of the drawing;

(4) Text Specifications.

(a) Work being featured - 3/16 inch text

(b) Major roads and features - 1/8 inch text

(c) Other roads and features- first letter upper case

(d) "Notice to Motorists" in upper case

(e) Message - first letter upper case

(5) Line Thickness.

(a) Important feature being advertised - thicker than rest of map

(b) Directional arrow - bolder than the rest of the lines shown on the map, when important, to show the route traffic should use.

(6) Show reference direction such as "TO HILO, WAILUKU, HONOLULU, or LIHUE" with arrow.

The Contractor shall submit:

(1) the "Notice to Motorists" for review and acceptance before placement in the newspaper 6 weeks before the start of work.

(2) the actual size of the notice to be published in the newspaper for review and acceptance. The Engineer will not allow reduction of the notices once accepted. The final "Notice to Motorists" submittal shall be a good copy of the camera ready advertisement.

Place the advertisement for three consecutive days and within one week before the traffic pattern changes in the:

__✓__ Honolulu Star-Bulletin and Honolulu Advertiser

Provide message boards as requested by the Engineer prior to lane or ramp closures.

The Contractor is directed to Section 645 - Work Zone Traffic Control for payment of advertisement.

(D) Lane Rental Provision. Monetary assessments will be made against the Contractor for each quarter hour there are restrictions,

encroachments, or a reduction in the number of available travel lanes on Interstate Route H-1, including its on-ramps, off-ramps, and shoulder lanes. This will include all calendar days, during the allowed closure hours identified in the "Construction Work Zone Notes" of the contract plans, for all lanes affected by the Contractor's operations, including lane closures shown on the contract plans.

This provision will be applicable without regard to the length of lane closed to traffic. For multiple work areas requiring the independent closure of the same or alternating lanes, the lane rental will be based on the reduction in the number of lanes open to traffic.

(1) Definition of Terms.

(a) Quarter Hour – Any 15-minute period or portion of a 15-minute period, beginning at the time when a lane is closed or obstructed by the Contractor's operation.

(b) Rental Charge – The amount, as shown in this Section, which represents the average quarter hourly cost of interference and inconvenience to the road user for each lane closure or obstruction.

(c) Lane Obstruction – When the Contractor's operations have resulted in:

i. A useable lane width less than 11-feet,

ii. A horizontal clear distance, which is measured from an object to an adjacent lane line, of less than 2-feet or as specified in the Contract, or

iii. A reduced width of the eastbound shoulder lane.

(2) Rental Charge. The rental charge to be assessed for each lane closure or obstruction per direction of traffic per hour will be the estimated public inconvenience for such lane closure or obstruction as follows:

Closure and/or Obstruction	Weekday Estimated Public Inconvenience Per Quarter Hour						
	Midnight to 4:00 A.M.	4:00 A.M. to 6:00 A.M.	6:00 A.M. to 10:30 A.M.	10:30 A.M. to 2:30 P.M.	2:30 P.M. to 6:30 P.M.	6:30 P.M. to 10:00 P.M.	10:00 P.M. to Midnight
One Lane of Westbound Interstate Route H-1	$0	N/A	N/A	$250	N/A	N/A	$0
Two Lanes of Westbound Interstate Route H-1	$250	N/A	N/A	$3,000	N/A	N/A	$250
Full Closure of All Westbound Interstate Route H-1 Lanes and Shoulders	$600	N/A	N/A	N/A	N/A	N/A	$2,000
Full Closure of All Eastbound Interstate Route H-1 Lanes and Shoulders	$500	N/A	N/A	N/A	N/A	N/A	$1,500
Closure of Eastbound Interstate Route H-1 Shoulder Lane	$0	N/A	N/A	$0	$0	$0	$0
One Lane of Westbound Pearl City Off-Ramp	$0	$250	$250	$250	$2,000	$500	$0

Closure and/or Obstruction	Saturday Estimated Public Inconvenience Per Quarter Hour						
	Midnight to 4:00 A.M.	4:00 A.M. to 6:00 A.M.	6:00 A.M. to 10:30 A.M.	10:30 A.M. to 2:30 P.M.	2:30 P.M. to 6:30 P.M.	6:30 P.M. to 10:00 P.M.	10:00 P.M. to Midnight
One Lane of Westbound Interstate Route H-1	$0	$0	$0	$250	$2,000	$250	$250
Two Lanes of Westbound Interstate Route H-1	$250	$250	$250	N/A	N/A	N/A	$500
Full Closure of All Westbound Interstate Route H-1 Lanes and Shoulders	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Full Closure of All Eastbound Interstate Route H-1 Lanes and Shoulders	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Closure of Eastbound Interstate Route H-1 Shoulder Lane	$0	$0	$0	$0	$0	$0	$0
One Lane of Westbound Pearl City Off-Ramp	$0	$0	$250	$250	$500	$250	$0

Closure and/or Obstruction	Sunday Estimated Public Inconvenience Per Quarter Hour						
	Midnight to 4:00 A.M.	4:00 A.M. to 6:00 A.M.	6:00 A.M. to 10:30 A.M.	10:30 A.M. to 2:30 P.M.	2:30 P.M. to 6:30 P.M.	6:30 P.M. to 10:00 P.M.	10:00 P.M. to Midnight
One Lane of Westbound Interstate Route H-1	$0	$0	$0	$250	$250	$250	$0
Two Lanes of Westbound Interstate Route H-1	$250	$250	$250	N/A	N/A	N/A	$250
Full Closure of All Westbound Interstate Route H-1 Lanes and Shoulders	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Full Closure of All Eastbound Interstate Route H-1 Lanes and Shoulders	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Closure of Eastbound Interstate Route H-1 Shoulder Lane	$0	$0	$0	$0	$0	$0	$0
One Lane of Westbound Pearl City Off-Ramp	$0	$0	$0	$0	$250	$0	$0

* NOTE: The State reserves the right to calculate public inconvenience costs for situations unaccounted for.

The applicable lane rental charges will be deducted from the allowance pay item, Item No. 104.1000 – Lane Rental Incentive. The deduction will be made based on the applicable rate for any and all closures whether work is being performed or not. Any money remaining in this item after project completion will be paid to the Contractor. However, if the entire pay item is expended before the work is completed, the Engineer will deduct the applicable lane rental charges from any monies due the Contractor for work performed.

(XII) Add the following:

"104.09 Methods of Price Adjustment. Any adjustment in the contract price pursuant to a change or claim shall be made in one or more of the following ways:

(1) By agreement on a fixed price adjustment before commencement of the pertinent performance or as soon thereafter as practicable;

(2) By unit prices or other price adjustments specified in the contract or subsequently agreed upon;

(3) The Engineer may base the adjustment for a lump sum item on a

calculated proportionate unit price. The Engineer will calculate the proportionate unit price by dividing the original contract lump sum price by the actual or original estimated quantity established by the Contract Documents.

(4) In such other manner as the parties may mutually agree;

(5) At the sole option of the Engineer, work may be paid for on a force account basis in accordance with Subsection 109.04(A) Force Account Method;

(6) By the Engineer's determination of the reasonable and necessary costs attributed to the event or situation caused by the change, plus appropriate profit or fee, all computed by the generally accepted accounting principals and applicable sections of Chapter 3-123 and 3-126 of the Procurement Code – Rules and Regulations and using Subsection 109.04(A)(1) Allowances for Overhead and Profit herein, as the method for calculating overhead and profit."

"**104.10 Weekend and Night Work.** The Department of Health has issued the following community noise variance permit. The Contractor shall comply with the conditions of this permit. If this community noise variance permit is revoked or work stopped due to public complaints regarding noise from the Contractor's work, the Contractor shall comply with the "maximum permissible sound levels" found in HAR 11-46-4(a). The Contractor will not be eligible for additional time or money.

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to:
File:

RECEIVED
SEP 3 - 2002
DEPARTMENT OF TRANSPORTATION
HIGHWAY-DD

August 9, 2002

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Glenn Kurashima
Project Manager
SDOT-Design Branch-Highways Design Section
601 Kamokila Boulevard, Room 609
Kapolei, HI 96707

Dear Mr. Kurashima:

Enclosed is the VARIANCE (Docket No. 02 NR-VN-15) for Community Noise Control which was granted on August 9, 2002. We are also enclosing for your information the Findings of Fact and Conclusions of Law.

Please note the variance conditions and if there are any questions relative to the variance, please do not hesitate to contact me at 586-4702.

Sincerely,

for Jay K Nakasone

Russell S. Takata
Environmental Health Program Manager
Noise, Radiation & IAQ Branch

I-H3-1(75) Unit VIII
BR-H1-1(241)
104-16a

10/13/03

STATE OF HAWAII
DEPARTMENT OF HEALTH

In the Matter of the Application For Variance for:	)	
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION HIGHWAY DESIGN SECTION Noise – Expansion and Improvements to the H-1 Freeway between the Kaonohi Street Overpass and Kamehameha Highway	)	Docket No. 02-NR-VN-15 V-268

FINDINGS OF FACT AND CONCLUSION OF LAW

The application of the State of Hawaii, Department of Transportation, Highways Division, Highway Design Section, 601 Kamokila Boulevard, Room 609, Kapolei, Hawaii for a variance from Section 11-46-6(a) of Chapter 11-46, Hawaii Administrative Rules, Community Noise Control, was reviewed by the Noise, Radiation and Indoor Air Quality Branch of the Department of Health.

Findings of Fact

1. Section 342F-5, Hawaii Revised Statutes (H.R.S.), and Section 11-46-8, Hawaii Administrative Rules (H.A.R.), authorize the director to grant variances.

2. Section 11-46-6(a), H.A.R., states, "Without a permit or variance issued pursuant to section 11-46-7 or 11-46-8, no person within the state shall operate from any premises or land owned, rented, leased, occupied or controlled by that person, any excessive noise source."

3. The applicant proposes to expand and improve the H-1 freeway between the Kaonohi Street overpass and Kamehameha Highway. All of these improvements will result in enhanced roadway capacity and facilitate traffic flow in the westbound direction.

4. A variance from the provision of Chapter 11-46, H.A.R., is being requested for those periods when a permit cannot be granted. The variance is requested for Mondays through Fridays from 6:00 p.m. to 5:00 a.m.; on Saturdays from 7:00 a.m. to 9:00 a.m.; and Saturdays from 6:00 p.m. until 5:00 a.m. on Monday.

5. The area is characterized by a mix of single and multifamily dwellings, two elementary schools, and mixed commercial and light industrial uses.

6. Residents impacted by the project will be given advance notice regarding the project plans via a mailout that will also provide a name and phone number of a contact person who will respond to citizen complaints during the construction period.

7. A public informational meeting was held on June 26, 2002 at the Waimalu Elementary School Cafeteria. Approximately 3000 announcements were distributed to area residents and businesses drawing about 50 people to attend the meeting.

8. The equipment used for this project may create noise in excess of the maximum permissible sound levels found in Section 11-46-4(a). A variance is needed to perform the work during the requested hours not covered under a Community Noise Permit.

9. This project requires blocking traffic for extended periods of time. Working at night will avoid traffic congestion during the daytime hours.

10. The project will increase the number of westbound lanes on this segment of the H-1 Freeway from five to six. The project is proposed as a logical continuation of already-completed improvements to the connection between westbound Interstate Route H-3 and westbound Interstate Route H-1. The project will meet current freeway design standards, increase traffic safety, relieve traffic congestion, and meet the overall projected operating conditions on this segment of Interstate Route H-1.

11. The contractor will be required to maintain all equipment in good working order. All equipment will be equipped with mufflers. Any equipment found to be in poor repair or not in compliance with applicable regulations of the State and City and County of Honolulu shall be corrected prior to use.

12. Department of Transportation field personnel and the general contractor will monitor all equipment and construction activities on the job site to ensure the use of noise abatement measures. The contractor will immediately correct any violations that occur.

13. Instructional meetings will be held for construction crews and truck drivers to discuss noise abatement procedures, including the use of engine brakes, loading and unloading cargo, no shouting, the use of signal callers, and other practices as required.

14. The variance is requested from May 1, 2003 to November 30, 2004.

Conclusion of Law

Section 342F-5(c), H.R.S., states that no variance shall be granted by the Department unless the application and supporting information clearly show that:

1. The granting of the variance is in the public interest as defined in the Section 342F-4(c)(4), H.R.S.

2. The granting of this variance will not substantially endanger human health or safety.

3. Compliance with the rules, regulations or standards from which the variance is sought would produce serious hardship without equal or greater benefits to the public.

Based upon the foregoing findings of fact, it is concluded that these requirements have been met.

Recommendation

It is recommended that the variance request be GRANTED with the following conditions:

1. The applicant shall make every effort to minimize noise emanating from the project.

2. The applicant shall have a job-site inspector to whom immediate noise complaints can be forwarded for a prompt response and who shall also have the general responsibility of monitoring quiet work procedures.

3. If the noise level is such that the Department receives numerous complaints, the contractor shall cease operations, if ordered, and complete the project during hours on weekdays and weekends as directed.

4. The applicant shall notify the Noise, Radiation and Indoor Air Quality Branch, State Department of Health, as to the date and time of any variance hour's activity as soon as the dates are confirmed and also when the project is completed.

5. Should the duration of the project continue beyond the termination date, the applicant shall submit a request for extension along with an updated work schedule prior to November 30, 2004.

6. Pursuant to Section 342F-5(d)(3), H.R.S., the applicant shall be required to perform noise sampling during the variance hours and report the results of such sampling to the Noise, Radiation and Indoor Air Quality Branch of the Department of Health.

DATED: Honolulu, Hawaii, AUG 9 2002.

for Jeyk Nakasone

RUSSELL S. TAKATA
Environmental Health Program Manager
Noise, Radiation and IAQ Branch

STATE OF HAWAII
DEPARTMENT OF HEALTH

In the Matter of the Application For Variance for:	)	
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION HIGHWAY DESIGN SECTION Noise – Expansion and Improvements to The H-1 Freeway between the Kaonohi Street Overpass and Kamehameha Highway	)	Docket No. 02-NR-VN-15 V-268

DECISION AND ORDER

Pursuant to Chapter 342F, Hawaii Revised Statutes (H.R.S.), and Chapter 11-46, Hawaii Administrative Rules (H.A.R.), Community Noise Control; and based upon the application and review by the Noise, Radiation & Indoor Air Quality Branch, the variance request from the provisions of Section 11-46-6(a), H.A.R., is hereby GRANTED with the following conditions:

1. The applicant proposes to expand and improve the H-1 freeway between the Kaonohi Street overpass and Kamehameha Highway.

2. The variance is granted from May 1, 2003 to November 30, 2004.

3. The applicant shall make every effort to minimize noise emanating from the project.

4. The applicant shall have a job-site inspector to whom immediate noise complaints can be forwarded for prompt response, and who shall have the general responsibility of monitoring quiet work procedures.

5. If the noise level is such that the Department receives numerous complaints, the contractor shall cease operations during the variance hours, if ordered, and complete the project during times as directed.

6. The applicant shall notify the Noise, Radiation and Indoor Air Quality Branch, State Department of Health, as to the date and time of any variance activity as soon as the dates are confirmed and also when the project is completed. Should the duration of the project continue beyond the termination date, the applicant shall submit a request for extension along with an updated work schedule prior to November 30, 2004.

7. Pursuant to Hawaii Revised Statutes, Chapter 342F, Section 342F(d)(3), the applicant shall be required to perform noise sampling during the variance hours and report the results of such sampling to the Noise, Radiation and Indoor Air Quality Branch of the Department of Health.

DATED: Honolulu, Hawaii, AUG 9 2002.

JERRY Y. HARUNO
Environmental Health Program Administrator
Environmental Health Services Division

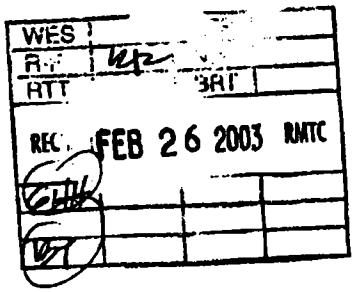
LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
File:

February 25, 2003



Brian Takeda
Project Planner
R. M. Towill Corporation
420 Waiakamilo Road, Suite 111
Honolulu, Hawaii 96817-4941

Dear Mr. Takeda:

This is in reference to your request for an amendment of the **Community Noise Variance (Docket No. 02-NR-VN-15); Expansion and Improvements to the H-1 Freeway between the Kaonohi Street Overpass and Kamehameha Highway.**

The hours for the Community Noise Variance have been amended to 6:00 p.m. Fridays to 7:00 a.m. Mondays.

Should you have any questions, please contact Mr. James Toma of our staff at 586-4700.

Sincerely,

Russell S. Takata
Environmental Health Program Manager
Noise, Radiation & Indoor Air Quality Branch

"**104.11 Variations in Estimated Quantities.** Where the quantity of a unit price item in this contract is estimated on the proposal schedule and where the actual quantity of such pay item varies more than 15 percent above or below the estimated quantity stated in this contract, an adjustment in the contract price shall be made upon demand of either party. The adjustment shall be based upon any increase or decrease in costs due solely to the variation above 115 percent or below 85 percent of the estimated quantity. The adjustment shall be subject to Subsection 104.09 – Methods of Price Adjustment and Subsection 109.04(A) – Allowances for Overhead and Profit."

END OF SECTION

SECTION 105 - CONTROL OF WORK

Make the following amendments to said Section:

(I) Amend **105.02(B) Working and Shop Drawings** by revising the fourth paragraph to read as follows:

"The Contractor shall submit a minimum of eight (8) complete sets of working and shop drawings for review. The Department will not make additional payment for furnishing the working and shop drawings. The Department will consider them incidental to the various contract items."

(II) Amend **105.02(B) Working and Shop Drawings** by revising the fifth paragraph to read as follows:

"The Engineer may take four or more weeks to review the working and shop drawings depending on the complexity. The Contractor shall submit working and shop drawings for review on time and at the earliest possible date after the Notice to Proceed date to meet the construction schedule. The Contractor shall not make changes in the accepted working and shop drawings without the written comments of the Engineer. The Engineer will not consider delays caused by the Contractor's failure to submit the working and shop drawings on time a justifiable reason for contract time extensions."

(III) Amend **105.02(B) Working and Shop Drawings** by revising the sixth paragraph to read as follows:

"Review by the Engineer does not relieve the Contractor of its responsibility for the accuracy of the dimensions and details of the working and shop drawings. The Contractor shall be responsible for ensuring that the working and shop drawings conform with the contract. The review of the working and shop drawings shall not justify a waiver of errors, discrepancies or omissions."

(IV) Amend **105.06 Cooperation Between Contractors** by adding the following:

"The Contractor shall coordinate his work with all adjacent projects, including but not limited to:

Moanalua Freeway Resurfacing, Halawa Interchange to Kahauiki Interchange, Federal-Aid Project No. DPI-0203(1)

Moanalua Freeway Lighting Improvements, Kamehameha Highway to H-1 Halawa Interchange, Project No. 78A-01-02M

Kamehameha Highway, Halawa Stream Bridge (Inbound) Replacement, Federal-Aid Project No. BR-099-1(19)

Interstate Route H-1 Kaamilo Street & Kaonohi Street Separations (Seismic Retrofit), Federal-Aid Project No. BR-H1-1(243)

Waimalu Stream Dredging (City and County of Honolulu, Department of Design and Construction)

The Contractor shall fully cooperate with the Contractors of the above mentioned projects and the Engineer in the manner described in this Section at no additional cost to the State. This includes, but is not limited to, attending and participating in construction and/or coordination meetings."

(V) Delete **105.08 Authority and Duties of Project Engineer** in its entirety.

(VI) Delete **105.09 Duties of the Inspector** in its entirety.

(VII) Add the following:

"**105.08 Authority of State Personnel.**

(A) Authority of the Resident Engineer. As the direct representative of the Engineer, the Resident Engineer is responsible for administration of the project including, but not limited to, coordination of daily work, monitor and inspection of the contract work, resolution of field conflicts, issuance of instructions and orders, negotiations, documentations and records, approval of force account work for the project, etc.

(B) Authority of the Inspectors. Inspectors, as a representative of the Resident Engineer or other agencies, will inspect the work done and materials furnished. The Inspectors observe and inspect the contract performance and materials solely to protect the interest of the Department. Such inspection may extend to the preparation, fabrication, or manufacture of the materials to be used. The inspector does not have the authority vested in the Resident Engineer unless specifically delegated in writing. The Inspector may not alter or waive the provisions of the contract, issue instructions contrary to the contract, or act as foreman for the Contractor.

Failure of the Inspector at any time to reject non-conforming work shall not be considered a waiver of the Department's right to require work in strict conformity with the Contract Documents as condition of final acceptance.

(C) Authority of the Consultant. The Department may engage Consultants for limited or full observation to supplement the inspections performed by the State and respective Counties. Unless otherwise specified

in writing to the Contractor, such retained Consultants shall have the authority of a project inspector."

(VIII) Amend **105.12 Removal of Unacceptable and Unauthorized Work** to read as follows:

"105.12 Removal of Unacceptable and Unauthorized Work.

(A) Unacceptable Work. The Engineer will consider work not conforming to the contract as unacceptable work. The Contractor is directed to Subsection 105.03 - Conformity with the Contract.

Remove unacceptable work found to exist immediately upon discovery. Replace the work according to the contract at no additional cost to the State. Unacceptable work includes poor workmanship and use of defective materials.

The Engineer may remedy such unacceptable work and deduct the costs from monies due or to become due the Contractor if the Contractor fails to comply as specified by the Engineer.

(B) Unauthorized Work. The Engineer will consider work done contrary to the specifications of the Engineer, work done beyond the lines as given, or extra work done without authority as unauthorized. The Engineer will not make payment for such work. The Engineer may order such work removed or replaced at no cost to the State."

(IX) Amend **105.13 Load Restrictions** to read as follows:

"105.13 Load Restrictions. Comply with legal load restrictions in the hauling of materials on public roads. A special permit will not relieve the Contractor of liability for damage that may result from the moving of material or equipment.

Limit hauling of materials over the base course or surface course under construction according to the contract. The Engineer will not permit loads on a concrete pavement, base or structure before the expiration of the curing period. All loads shall not exceed the legal load limits. The Contractor shall be responsible for damages done while hauling equipment.

When the Material Transfer Vehicle (MTV) exceeds legal axle or total weight limits for vehicles under the Hawaii Revised Statutes, Chapter 291, the following are required when crossing bridges within the project limits unless otherwise noted on the plans or specified herein:

(1) The MTV shall be fully emptied of mix prior to crossing a bridge.

(2) The MTV shall move across the bridge at a relatively constant speed

not exceeding 5 miles per hour. The MTV shall not stop on the bridge.

(3) No other vehicle or equipment shall be on the bridge while the MTV is crossing the bridge.

Transporting of MTV(s) by means of truck-tractor/trailer combination with size and weight exceeding legal limits shall be according to Chapter 104 of Title 19, Department of Transportation, entitled "Movement by Permit of Oversize and Overweight Vehicles on State Highways."

(X) Amend **105.18 Claims for Adjustments and Disputes** to read as follows:

"105.18 Claims for Adjustments and Disputes. The Contractor's notification requirements in 104.02 Alterations of Plans or Type of Work and 104.03 Field Orders will not be waived and shall be a condition precedent to the filing of any claim by the Contractor. Unless the Contractor acts in accordance with these procedures, any right to make a claim for an increase in the contract time, compensation or contract price related to such work and/or damages is waived by the Contractor. The Contractor shall not have the right to appeal to the Director, as stated in this section, for failure to meet the notification requirements.

No claim by the Contractor for an adjustment hereunder shall be allowed if notice is not given before final payment under this contract.

The Engineer will review the protest and render a written decision. The Engineer's decision shall be final and conclusive unless, within 30 calendar days from the date of the Engineer's decision, the Contractor furnishes a written appeal to the Director. The appeal shall fully state the Contractor's reasons, based upon its original submittal, with all supporting documentation, as to why the Engineer's decision should be overturned. Eight copies of the appeal package shall be sent through the Engineer. The 30-day deadline is counted from the date of the day after the Engineer's decision to the date of receipt of the Contractor's appeal by the Engineer. The decision of the Director shall be final. Any adjustment in the contract price made pursuant to this clause shall be determined according to Subsection 104.09 – Method of Price Adjustment.

Failure to file written protest or to protest a portion(s) of the Engineer's decision with the Director within the time specified shall constitute agreement on the part of the Contractor with all the terms, conditions, amounts and adjustment or non-adjustment to contract price and/or contract time set forth in the Engineer's decision.

The provisions of this Subsection shall not be construed as establishing any claims contrary to the terms of Subsection 104.02 - Alteration of Plans or Type of Work.

Nothing herein contained, however, shall excuse the Contractor from compliance with any rules of law precluding any state officers and any Contractors from acting in collusion or bad faith in issuing or performing contract change orders which are clearly not within the scope of the contract."

(XI) Amend **105.19 Value Engineering** by revising the first sentence of the first paragraph to read as follows:

"In accordance with Section 103D-411, HRS, on projects with contract amounts in excess of $250,000 the following Value Engineering Incentive Clauses shall apply, and the Contractor submitting cost reduction proposals, will be allowed to share in those cost savings that ensue from the cost reduction proposals, hereinafter referred to as Value Engineering Change Proposal (VECP)."

(XII) Amend **105.19 Value Engineering** by adding the following paragraph:

"In order to increase work zone safety, the moveable concrete barrier system will not be subject to this Value Engineering provision. This system includes Item Nos. 694.0010 – Moveable Concrete Barrier (MCB), 694.0020 – Moveable Concrete Barrier (MCB) End Treatment, and 695.0100 – Moveable Concrete Barrier Transfer Machine (MCBTF)."

(XIII) Amend **105.19 Value Engineering** by adding the following paragraphs, which shall apply to a VECP for the Waimalu Viaduct (Westbound):

(I) The terms viaduct, structure, and bridge are considered to be mutually interchangeable herein.

(II) Design conditions. Any Value Engineering Change Proposal for the Waimalu Viaduct shall also meet all of the previous and following conditions in this Section.

(A) Maintain roadway and shoulder widths.

(B) Maintain horizontal and vertical alignments.

(C) Maintain the minimum vertical and horizontal clearances required by the State as follows:

(1) Vertical clearance above a roadway, temporary or permanent, to any part of the bridge structure shall be at least 17-feet.

(2) Horizontal clearance from a roadway, temporary or permanent, to any part of the bridge structure shall be at least 3-feet. This clearance is applicable to structural elements from

the roadway finish grade elevation to 17-feet above the roadway finish grade.

(3) Light poles shall be located away from traffic, with a clear distance of 2-feet from the front face of the concrete barrier, measured from the top of the barrier. This distance shall be to any part of the light pole, including the transformer box.

(4) Vertical clearance, shall be a minimum of 2-feet from the soffit of the structure to finish grade or existing ground, whichever is lower.

(D) Maintain total bridge lengths for each structure.

(E) Maintain a constant bridge superstructure depth.

(F) Maintain pier locations.

(G) Maintain abutment locations and orientations.

(H) Maintain shape and finish of the bridge railings.

(I) Maintain the architectural features of the sound walls.

(J) Maintain finish of piers, abutments, retaining walls, and soffits of superstructures.

(K) Maintain locations of drainage elements.

(L) Maintain size and locations of utilities carried on bridges.

(M) Maintain elevations of top of footings based on State investigation and evaluation of subsurface conditions.

(N) Maintain concrete design for bridge structures. Structural steel bridge structures are not acceptable.

(O) Strengthening and other modifications of the substructure (i.e., piers, footings, and drilled shafts) may be required for the design of a particular VECP superstructure.

(P) Include the seismic retrofitting of the existing Waimalu Viaduct.

(Q) Traffic control plans in the Contract Documents shall not be changed.

(III) Submittals. If the Contractor submits a VECP, he shall meet the following requirements:

(A) Conceptual Design Submittal. If the Contractor elects to submit a VECP, he shall submit, within 21 calendar days after the award of the contract, twenty (20) copies of the conceptual scheme for the Engineer's review and approval or rejection of the VECP. This submittal shall include the following:

(1) A detailed description of the VECP, with conceptual drawings and preliminary calculations.

(2) Itemization of redesigns necessary for the VECP.

(3) Detailed design and construction schedules showing completion of the project within the contract time specified in the Proposal.

(4) Plans and working drawings shall comply with Subsection 105.02.

Review and approval or rejection of the Contractor's conceptual design will be performed by the Engineer within 29 calendar days after receipt of the complete conceptual design submittal. At a minimum, the complete conceptual design submittal shall include the type of structure, construction method and construction phasing. The Engineer will be the sole authority in making the final determination as to when the conceptual design submission is deemed complete.

If the conceptual design is not approved, the VECP will be rejected and the Contractor shall construct the project as shown in the bid contract plans and specifications.

(B) Final Design Submittal. If the conceptual VECP submittal is accepted, the Contractor shall prepare new drawings in accordance with the current State Standards. All submittals shall be signed and stamped, as applicable by a Structural, Civil, Geotechnical, or Electrical Engineer licensed in the State of Hawaii. All final design submittals shall be made in 20 copies.

The plans, design calculations including computer data for one frame (segment between two nearest expansion joints) plus a complete CPM schedule and any modification to the specifications including theoretical quantity changes in the proposal schedule for the

entire length of the project shall be submitted to the Engineer for review and approval within 60 calendar days after approval of the conceptual alternative design. The Contractor shall convert all computer data to programs acceptable to the Engineer. Review by the Engineer will be performed within 60 calendar days after submission of the complete final design of the first frame. At a minimum, the complete final design of the first frame shall include all specifications, calculations, and plans required for construction. The Engineer will be the sole authority in making the final determination as to when the final design submission of the first frame is deemed complete.

The plans and design calculations for the remaining frames shall be submitted in 45 day intervals. Each submittal of the remaining frames will require an additional 45 calendar days for review. No more than two frames shall be submitted for review during the same review period.

If the final VECP is rejected or if the Contractor is unable to modify the design in accordance with the Engineer's review requirements, the Contractor shall construct the project as shown in the bid contract plans and specifications.

If the VECP is accepted by the Engineer, the Contractor shall submit master tracings of the VECP drawings. Master tracings shall be provided for all sheets revised or affected by the VECP. The preparation and submission or master tracings shall be coordinated with the Engineer.

All of the final master plan tracings and the calculations for the accepted VECP shall be stamped and signed, as applicable, by the Structural, Civil, Geotechnical, or Electrical Engineer licensed in the State of Hawaii. The affected or revised VECP sheets shall not have the stamp of the original plans Engineer and the stamp of the Contractor's VECP engineer together on any sheet.

The Contractor shall provide 40 half-sized and 10 full-sized copies of the final master plans, 40 copies of the approved revised specifications, and six copies of the approved calculations.

All accepted design calculations, computer data, CPM schedules, specifications, and tracings shall become the sole property of the State.

The Contractor may begin constructing the VECP after approval of the first frame.

(IV) Qualifications.

(A) Contractor's Qualifications. The Contractor shall have at least five years experience in constructing the type of bridge in the VECP. In addition, the full-time field staff shall include a superintendent and senior engineer with responsible experience in the type of construction proposed in the VECP.

The Contractor shall submit in writing for the Engineer's approval, details of the qualifications and experience of both individuals together with the Conceptual Design Submittal. The written details of the qualifications shall list the projects which the Contractor and the field staff have completed successfully using similar type of construction, and include, for each one, the contract value, a brief description of the work, and the name, address and current telephone number of the owner.

(B) Designer's Qualifications. The Contractor's designer shall have at least five years experience with responsible charge in designing the type of bridge in the VECP. The Contractor shall submit in writing for the Engineer's approval details of the qualifications and experience of the designer together with the Conceptual Design Submittal. The written details of the qualifications shall list the projects with the designer has completed successfully and include, for each one, a brief description of the work and the name, address and current telephone number of the owner.

(V) Design Requirements.

(A) General. The design shall comply with AASHTO 1998 Load and Resistance Factor Design (LRFD) Specifications, Second Edition and its subsequent interim specifications with Interim Supplements and modifications by the State of Hawaii, Department of Transportation, except where provisions of these specifications and contract plans exceed such requirements.

(1) Provide a positive connection between the widened portion of the bridge and the existing bridge. The structural capacity of the slab at the joint location shall, at a minimum, match the structural capacity of the slab immediately adjacent to the joint. This includes but is not limited to shear and moment capacities.

(2) Maintain a closure pour between the existing bridge and the widening. The pour strip shall be a minimum of 2-feet wide and shall not be poured until a minimum of 28 days after the entire deck for that particular frame is poured, or 4 days after

the concrete pour of the transverse beams, whichever is the later for that particular frame.

(3) Remove and replace the existing deck (overlay deck section) adjacent to the existing railing as shown on the bid contract plans.

(4) The restraint condition at the support (fixed, hinged, or expansion) of the widened portion of the bridge shall match the restraint condition of the existing bridge.

(5) The removal and restoring of the existing light standards and the temporary electric lighting shall be equal or better than in the contract.

(6) In prestressed concrete members, allowable tensile stress in the precompressed tensile zone after all losses have occurred shall be zero.

(7) Comply with HDOT memorandum HWY-DB 2.7490, dated August 13, 2002 with subject title, "Bridge Design Criteria, August 2002."

(B) Seismic Design. The design shall comply with AASHTO 1998 Load and Resistance Factor Design (LRFD) Specifications, Second Edition and its subsequent interim specifications with Interim Supplements and modifications by the State of Hawaii, Department of Transportation, except where provisions of these specifications and contract plans exceed such requirements. The acceleration coefficient, A, to be used for this site is 0.18 and shall be considered Seismic Performance Zone 2. The Importance Category shall be considered critical.

Seismic retrofitting of the existing bridges shall follow Caltrans Earthquake Retrofit Guidelines for Bridges.

A seismic analysis and design of the proposed VECP structure shall be done if there is any change in the mass, distribution of the mass, or stiffness of the structure as compared to the structure that is described in the contract documents. This seismic analysis and design shall include the existing viaduct structure as well as the new structure.

(C) Design Loads. Comply with "Viaduct General Notes" in the contract plans and the following:

(1) Concrete (normal) weight = 160 pcf for design loads; 150 pcf for determining modulus of elasticity.

(2) Earth weight = 120 pcf minimum.

(3) Thermal forces – range of temperature shall be as follows:

Temperature rise = 30°F
Temperature fall = 30°F

(4) Shrinkage factor = 0.0003 minimum

(5) Basic wind speed = 105 mph

(6) Load capacity inventory and operating ratings shall be calculated in accordance with the Load Factor method of the AASHTO "Manual for Condition Evaluation of Bridges" and the following conditions:

(a) The live load used in establishing the above ratings shall be proportional to the Standard AASHTO HS 20-44 loading with impact.

(b) For the inventory rating, the working unit stresses shall not exceed the allowable design stresses for which the structure was originally designed. For prestressed concrete, the allowable tensile stress in the precompressed tensile zone after losses have occurred shall be zero (a deviation from AASHTO).

(c) For the operating rating for prestressed concrete members, the maximum tension allowed in the concrete shall be $6(fc)^{1/2}$.

(d) The computations shall include dead load shear and moment diagrams and influence diagrams for maximum shear and positive and negative moments of the girders for use by the State to determine permissible overload vehicles on structures with special permit.

(e) For girder type structures, furnish controlling girder positive and negative moment rating and location, the controlling shear rating and location and the top slab rating.

(f) For frame type structures, furnish the controlling positive and negative moment rating and location, the controlling shear rating and location, and the top slab rating.

(D) Materials. Comply with the "Viaduct General Notes" in the contract plans.

(E) Reinforcement. Comply with "Viaduct General Notes" in the contract plans and the following minimum shear reinforcement in footings:

(1) Column Footings. Vertical No. 5 bars at 12-inches spacing in each direction in a band between "d" of the footing from the face of the column and 6-inches maximum from the column reinforcement. Shear bars shall be hooked around the top and bottom reinforcement mat in the footing.

(F) Foundation.

(1) Drilled shafts shall be used. Minimum spacing of shafts shall be 2-1/2 times the diameter of the shaft.

(2) The minimum longitudinal reinforcing for the drilled shaft shall be 0.005 times the gross area of the shaft for the entire length of the shaft.

(G) Miscellaneous.

(1) Additional permits and right of way access to parcels required for the VECP shall be the responsibility of the Contractor and shall be at no cost to the State. No extension in time to complete this project will be given because of these issues.

(2) Expansion devices for all utilities shall be provided at deck expansion joints.

(3) Drain pipes carried on the viaduct shall be ductile iron pipes. Expansion devices for ductile iron pipes shall be provided at deck expansion joints.

(4) All plans for concrete box girders shall include a note indicating that the girder stem bottom fillets are optional, unless required to satisfy stresses by design. Fillets at the top corners are required.

(5) Widths of falsework traffic openings shall be designated in the plans and specifications.

(6) All original design calculations including moment and influence line diagrams used in calculations, computer user's manual and input and output data, and load capacity ratings, shall be bound and shall include a Table of Contents. All calculations shall be checked and signed or initialed by the checker in an appropriate space on the calculations.

(H) Construction Requirements. Comply with "Viaduct General Notes" in the contract plans.

(VI) Project Schedule. The project schedule shall not be lengthened to accommodate the VECP. The time required by the Contractor to prepare and the Engineer to review the conceptual, final or any other submittals shall be considered as part of the contract time and will not be added to the completion time. Shift work will be permitted provided that the Engineer gives approval and is satisfied that operation at night will proceed in a safe manner and with no lowering of construction standards.

(VII) Review and Approval by the Engineer. The Engineer shall be the sole authority to decide the acceptability of any proposed VECP. The Engineer may disapprove of the VECP for any of the following reasons:

(A) Nonconformance with the requirements of this section or other contractual stipulations.

(B) In the Engineer's opinion the alternative design may not produce a finished structure which is at least equivalent in all respects to the basic bridges depicted in the bid contract plans and specifications.

(C) Adverse impacts to the public or other parties.

(D) Deviation from the Permit Requirements.

(E) Nonconformance to Subsection 107.01 – Laws to be Observed.

Unless and until the Engineer gives final approval in writing for the VECP, the Contractor shall remain obligated to construct the project as shown in the bid contract plans and specifications.

(VIII) Contractor's Responsibility. The Contractor shall bear full responsibility for all proposed VECP and construction methods. All submittals must be reviewed and approved by the Engineer and such approval shall not relieve the Contractor of any responsibility as noted in Subsection 105.02.

(XIV) Delete **105.20 Disputes Review Board** in its entirety.

END OF SECTION

SECTION 106 - CONTROL OF MATERIAL

Make the following amendments to said Section:

(I) Amend **106.03 Sampling, Tests, Cited Specifications** by revising the third paragraph to read as follows:

"AASHTO, ASTM, HDOT, or other recognized national organizations in use by the Department at the time of the advertisement for project bid shall prevail for the project, except as otherwise specified."

(II) Amend **106.03 Sampling, Tests, Cited Specifications** by revising the last paragraph to read as follows:

"(1) AASHTO Standard Specifications for Highway Materials and Methods of Sampling and Testing, (Parts I and II), 21st Edition.

(2) ASTM Standards, Volumes 00.01 to 15.09, 1999 Edition."

(III) Amend **106.04 Plant Inspection** by revising the first paragraph to read as follows:

"**106.04 Manufacturing Plant Inspection.** When the location of manufacturing plants allows, the Engineer may inspect the plants periodically for compliance with specified manufacturing methods. The Engineer may get samples of materials for laboratory testing for compliance with material quality requirements. This may be the basis for acceptance of manufacturing lots as to quality."

(IV) Amend **106.05 Storage of Materials** to read as follows:

"**106.05 Storage of Materials.** The Contractor shall, as part of the contract price, provide all storage space. Materials shall be stored and handled to preserve their quality and fitness for the work. Stored materials shall be located so as to facilitate their prompt inspection by the Engineer. Unless otherwise provided by the contract documents or by separate written agreement with the State, no site within the project limits may be used for storage purposes or for the placing of the Contractor's plant and equipment. Prior to final inspection, the Contractor shall, at no additional cost to the State, restore all storage sites within the project limits to their pre-existing or similar condition.

(V) Amend **106.07 Unacceptable Materials** to read as follows:

"**106.07 Unacceptable Materials**. The Department will not accept materials that do not conform to the requirements of these contract documents, whether in place or not. Unacceptable materials will be rejected and shall be removed from

the site of work immediately unless otherwise permitted by the Engineer in writing. The Contractor shall not use corrected rejected material until the Engineer gives written acceptance. If the Contractor fails to comply forthwith with any order of the Engineer made under the provisions of this Subsection 106.07, the Engineer shall have the authority to remove and replace non-conforming materials and charge the cost of removal and replacement to the Contractor."

(VI) Amend **106.09 Special Test Methods** to read as follows:

"**106.09 Special Test Methods.** The Department uses the test methods specified below and are modifications of standard procedures or methods peculiar to the Department. References to Hawaii Test Method may be found in the new manual "Hawaii Test Methods", published by State of Hawaii, Department of Transportation, Highways Division, Materials Testing and Research Branch, dated December 2000.

(A) Relative Compaction Test. This test determines the ratio of the dry unit weight (density) of in-place soil to the maximum dry unit weight of the same soil.

(1) Maximum Dry Unit Weight. The test procedure for determining the maximum dry unit weight shall be in accordance with AASHTO T 180 (20TH Edition), Method D, with correction for fraction over 3/4-inch.

(2) Density of Soil In-Place. The test procedure for determining the density of soil in-place shall be according to Hawaii Test Methods HDOT TM 1, 2, and 3.

(B) Wet Preparation of Disturbed Soil Samples. When designated by the Engineer, the wet method of sample preparation (Hawaii Test Method HDOT TM 5) shall be used for sensitive soil mixtures.

(C) Test for Field Resistivity And pH Of Backfill Material. The test to determine the field resistivity and pH of backfill material shall be determined according to Hawaii Test Method HDOT TM 4 to estimate the service life of metal pipes.

(D) Operation of the California Type Profilograph and Evaluation of Profiles. The test to determine the profile index shall be made in accordance with Hawaii Test Method HDOT TM 6.

(E) Relative Density Of Asphalt Pavement By Cores. The relative density of asphalt pavement by cores shall be determined by Hawaii Test Method HDOT TM 7.

(F) Determining Total Moisture Content of Bituminous Mixtures or Mineral Aggregates Using Microwave Ovens. The total moisture content of bituminous mixtures or mineral aggregates using the microwave ovens shall be determined in accordance with Hawaii Test Method HDOT TM 8."

(VII) Amend **106.10 Certificate of Compliance** by revising the first sentence of the second paragraph to read as follows:

"A certificate of compliance shall accompany each lot of materials or assemblies delivered to the work site with substantiating test data of the lot clearly identified."

(VIII) Amend **106.10 Certificate of Compliance** by adding the following paragraph:

"The Engineer will not pay for materials purchased or for any work performed that involves any material that has not been accepted by the Engineer."

(IX) Add the following subsections:

"106.13 Ordering of Certain Materials. The intent of this contract is to complete work within the specified time. Therefore, the Contractor shall submit to the Department, within 7 days following award of contract, written evidence that the Contractor ordered:

1. The necessary materials/equipment with manufacturer's brochure/shop drawings specified for this project and

2. The necessary plant materials, in the sizes and quantities identified in the contract documents.

The Department will purchase said materials/equipment and plant materials at cost which includes the cost of the materials/equipment and plant materials based on invoices, the cost of transporting the materials/equipment and plant materials to the location designated by the Engineer, and applicable State excise taxes if the award is rescinded by the Department after the Contractor orders the materials specified above. The Contractor shall not include profit.

106.14 Assignment Of Antitrust Claims For Overcharges For Goods and Materials Purchased. Vendor and purchaser recognize that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by the purchaser. Therefore, vendor hereby assigns to purchaser any and all claims for such overcharges as to goods and materials purchased in connection with this order or contract, except as to overcharges which result from antitrust violations commencing after the price is established under this order or contract and which are not passed on to the purchaser under an escalation clause.

Contractor and owner recognize that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by the owner. Therefore, Contractor hereby assigns to owner any and all claims for such overcharges as to goods and materials purchased in connection with this order or contract, except as to overcharges which result from antitrust violations commencing after the price is established under this order or contract and any contract change order. In addition, Contractor warrants and represents that each of its first tier suppliers and subcontractors shall assign any and all such claims to owner, subject to the aforementioned exception."

106.15 Submittal Data. The contract contains the description of various items which the Contractor must submit to the Engineer for review and acceptance. The Contractor shall provide 8 copies of the required submissions unless otherwise specified. Copies shall be clear and legible. Items being submitted for review shall be marked as such. The Engineer will complete the review of the material within 30 days from the date of submission. The Engineer will advise the Contractor, in writing, as to the acceptability of the material submitted. The Engineer may determine that the item is acceptable, in which case no further action is required by the Contractor; or, the item may be partially or totally rejected, in which case the Contractor shall be required to modify the submittal as required by the Engineer and resubmit the item within 15 days. At this time, the review and acceptance cycle described above shall begin again.

Failure to furnish the required submissions by the time specified will result in no payments for work done that required those submissions until the Engineer receives the submission and finds them acceptable.

The purpose of the submittal data is to show specifically and in detail how the Contractor intends to satisfy the contract requirements. The Contractor shall cross off and initial the statements on preprinted literature which conflict with the contract requirements. The Contractor shall clearly indicate what item on the submittal is being submitted for review, what requirement it is meeting, and for what contract item it is for.

Each submittal shall contain sufficient information and details to permit the Engineer to evaluate the situation. The Engineer will not review submittals that are not sufficient to permit proper evaluation.

Following the review of the submittal data, the Engineer will mark the submittal items 'Accepted', 'Corrections Noted', or 'Rejected'. The Engineer will also mark each item that the Contract must resubmit. The Contractor may proceed with the items marked 'Accepted'. The Contractor shall not proceed with items marked 'Rejected' or 'Corrections Noted' or with items for which resubmission is required, but shall proceed immediately to correct said items and resubmit them for review.

In no case shall installation commence before acceptance of material data by the Engineer. The Contractor shall be liable for materials purchased or work done before such acceptance."

END OF SECTION

Amend Section 108 - Prosecution and Progress to read as follows:

"SECTION 108 - PROSECUTION AND PROGRESS

108.01 Subcontracting. The Contractor shall not subcontract, sell, transfer, assign, or otherwise dispose the contract or any portion thereof, or his/her right, title, or interest in the contract without the written consent of the Director. The Contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age, or disability in the selection or retention of subcontractors, and in the procurement of materials and leases.

Subject to the provisions of Section 103D-302, HRS, the Contractor may subcontract a portion of the work but the Contractor shall remain primarily responsible for the work so subcontracted, provided that the Contractor shall not be permitted to subcontract work to any subcontractor who has been suspended by the State. If requested by the Engineer, the Contractor shall provide a copy of any subcontract to the Engineer within seven calendar days.

The Contractor shall perform with his/her own organization, work amounting to not less than 30 percent of the total contract cost. Where an entire item is subcontracted, the value of work subcontracted, the value of work subcontracted will be based on the contract item bid price. When a portion of an item is subcontracted, the value of work subcontracted will be estimated by the Director and be based on the cost of such portion of the contract item.

Under Section 103D-302, H.R.S., The Contractor is required to list the names of persons or firms to be engaged by the Contractor as a joint contractor or subcontractor in the performance of the contract. Bids that do not comply with the above requirements may be accepted if acceptance is in the best interest of the State and the value of the work to be performed by the subcontractor or joint contractor is equal to or less than one percent of the total bid amount. When a change in a listed subcontractor is requested by the Contractor, submission of a formal release from the listed subcontractor is required by the State before a substitution will be considered for approval regardless of whether the substitute is another subcontractor or said Contractor.

When any portion of the work which has been subcontracted is not prosecuted in a manner satisfactory to the Director, the Contractor, upon receipt of a written notice thereof, shall immediately remove the subcontractor from the project, and the subcontractor shall not again be employed on the project.

No subcontract shall in any case release the Contractor of his/her liability under the contract and bonds.

Under Section 103D-302, HRS, the Contractor is required to list the names of persons or firms to be engaged by the Contractor as a subcontractor or joint contractor in the performance of the contract. When a change in a listed subcontractor is requested by the Contractor, submission of a formal release from the listed subcontractor is required by the State before a substitution will be considered for approval regardless of whether the substitute is another subcontractor or the Contractor himself/herself.

108.02 Notice to Proceed (NTP). When the Director accepts the contract, the Department will give a NTP to the Contractor. The Department will show the date that the Contractor may begin the work, which is the beginning of contract time. The date specified in the NTP will be no later than 120 days from the date of award unless there is no execution of contract.

The Contractor shall be allowed fourteen calendar days from the specified date to begin its work. In the event that the Contractor refuses or neglects to start the work, the Director may terminate the contract in accordance with Subsection 108.12 – Default and Termination of Contract.

Do not work before the specified date without a written acceptance. When the Contractor begins work before receiving the NTP, the Department will consider the Contractor doing work at its own volition and risk.

The Engineer will not allow additional compensation nor an extension of time for delay, hindrance or interference caused by doing the project work before the NTP date except when the same situation would have occurred if the Contractor had begun work after the NTP date.

108.03 Preconstruction Data Submittal. The awardee shall submit to the Department for information and review the pre-construction data within 15 days from the date of award of the contract. Such data shall include:

(1) List of Supervisory Personnel;

(2) Name and signature of person(s) authorized to sign for the Contractor;

(3) Work Schedule;

(4) Solid Waste Disposal Form;

(5) City & County of Honolulu Temporary Use Permit;

(6) Tax Rates;

(7) Insurance Rates and Insurance Certificate;

(8) Right of Entry Agreements, as identified in 103.07 – Execution of the Contract; and

(9) List of Suppliers.

108.04 Substitution of Materials and Equipment after Bid Opening. For substitution of materials and equipment, refer to Subsection 102.16 – Substitution of Materials and Equipment.

108.05 Progress Schedules. The software used for scheduling shall be the latest version of SureTrak Project Manager by Primavera Systems, Inc. No alternative software will be considered.

The Contractor shall submit an acceptable initial Time-Scaled Logic Diagram package (TSLD Package) to the Engineer for review before the date of NTP or within 30 calendar days after award of the contract whichever is earlier. The TSLD Package shall consist of the following:

1. Four sets of its Time-Scaled Logic Diagram (TSLD) schedule

2. All the files needed to re-create that time period's plot and reports on a 3-1/2 inch high-density floppy disk

3. An anticipated work completion or payment graph plotting contract time and gross payment anticipated submittal and when the Engineer requests an updated graph.

4. A listing of equipment that is anticipated to be used on the project. Include type, size, make, year of manufacture and all information necessary to identify the equipment in the Rental Rate Blue Book for Construction Equipment.

5. An anticipated manpower requirement graph plotting contract time and total manpower required. This may be superimposed over the payment graph

6. A Method Statement for each major activity group or description of work. A major activity is defined as an activity that has a duration longer than 5 days, or a milestone activity or a contract item that exceeds $10,000 for the total amount for that item on the Contract cost proposal or a critical path activity or an activity designated as such by the Engineer. Each Method Statement shall be a detailed narrative describing the work to be done and the method by which the work shall be accomplished. Included as part of each Method Statement shall be the planned quantity and type, make and model of equipment, the manpower to do the work,

which shall also include worker classification and the production rate per eight hour day needed to meet the time frame indicated on the schedule. If the production rate varies by more than plus or minus ten percent or if planned equipment or manpower should change for any reason then another Method Statement shall be provided and additional information supplied to substantiate and differentiate it from other like activities.

7. Provide two each, a color timescaled Project Evaluation and Review Technique (PERT) charts using the activity box template of Logic – Early Start or any template requested by the Engineer

The TSLD Package shall be submitted with all the elements listed above; no partial submittals will be accepted.

The Engineer will review and comment on the submitted TSLD Package. The Contractor shall adjust the schedule to address comments made by the Engineer. Submit the complete TSLD Package to the Engineer for review until the Engineer finds it acceptable. The Engineer will not authorize progress payments until the Engineer acknowledges, in writing, a receipt of a TSLD Package that meets all the requirements of this Subsection.

After the acceptance of the initial TSLD and when construction starts submit four plotted progress schedules, two PERT charts and reports on all construction activities every two weeks (bi-weekly). This scheduled bi-weekly submittal shall also include an updated version of the project schedule on a 3-1/2 inch high-density floppy disk. The disk shall have all the information needed to re-create that time period's TSLD plot and reports. The bi-weekly submittal shall include but not be limited to an update of activities based on actual durations, additional new activities and any changes in duration or start or finish dates of any activity. Setting for software shall be such that changes in the activity's start or finish dates shall result in a change in all activities that it precedes.

Also, submit with every update, in report form, any changes to the progress schedule since the previous schedule submittal. During the period when there is no acceptable progress schedule, the Contractor shall make no claim for additional compensation for delays and waives the right to claim for additional compensation and/or time for that period of time. Progress schedules when submitted after the fact, more than four working days after the required submittal date, will not be considered timely. Therefore, it shall not be acceptable as evidence for delays. The Engineer may change the frequency of the submittal requirements but may not require a submittal of the schedule to be more than once a week. The Engineer may decrease the frequency of the submittal of the bi-weekly schedule.

All progress schedules submittal shall be a color Time-Scaled Logic Diagram (TSLD). The critical path shall be marked in red. For both the TSLD and PERT chart, no blue or black line diagrams will be acceptable. The Engineer will designate the color to be used and the size of the plot and quality of paper for both the TSLD and PERT chart.

When requested by the Engineer, submit updates of the anticipated work completion graph, equipment listing, manpower requirement graph or method statement. Submit such updates within four calendar days from the date of request by the Engineer.

Non-compliance with the required submittal timeline herein will be grounds for delaying the processing of the progress payment until the submittal is received and accepted.

The Contractor shall meet on a bi-weekly basis with the Engineer to review the progress schedule. The Contractor shall have someone attending the meeting that can answer all questions on the TSLD submitted.

The critical path is defined as the chain(s) of activities that take the longest time to accomplish completion of the project.

Any float in the project schedule is owned by the project, and as such, neither the owner nor the Contractor owns it.

Full compensation for any additional costs occasioned by compliance with the provisions in this Subsection shall be considered incidental to various contract items of work and no additional compensation of any kind will be allowed therefore.

(A) For Contracts One Million Dollars ($1,000,000) or less or For Contract Time 100 Working Days or 140 Calendar Days or less. For contracts of one million dollars ($1,000,000) or less or for contract time of 100 working days or 140 calendar days or less, the progress schedule will be a Time Scaled Logic Diagram (TSLD). The Contractor shall submit a TSLD and it shall meet the following requirements and have these essential and distinctive elements:

(1) the major features of work, such as but not limited to grubbing, roadway excavation, structure excavation, structure construction, BMP installation, shown in the chronological order in which the Contractor proposes to work that feature or work and its location on the project. The schedule shall account for normal inclement weather, unusual soil or other conditions that may influence the progress of the work, schedules and coordination

required by any utility, off or on site fabrications, and all other pertinent factors that relate to progress,

(2) all features listed or not listed in the Contract Documents that the Contractor considers a controlling factor for the timely completion of the contract work;

(3) the time span and sequence of the activities or events for each feature, and its interrelationship and interdependencies in time and logic to other features in order to complete the project;

(4) the total anticipated time necessary to complete work required by the contract;

(5) a chronological listing of critical intermediate dates or time periods for features or milestone or phases that can affect timely completion of the project;

(6) major activities related to the location on the project;

(7) non-construction activities, such as submittal and acceptance periods for shop drawings and material, procurement, testing, fabrication, mobilization, and demobilization or order dates of long lead material;

(8) set schedule logic for out of sequence activities to retain logic. In addition, open ends shall be non-critical;

(9) show target bars for all activities:

(10) vertical and horizontal sight lines both major and minor shall be used as well as a separator line between groups. The Engineer shall determine frequency and style.

(11) the file name, print date, revision number, data and project title and number shall be included in the title block; and

(12) have columns with the appropriate data in them for activity ID, Description, Original Duration, Remaining Duration, Early Start, Early Finish, Total Float, Percent Complete, Resources. The Resource column shall list who is responsible for the work to be done in the activity. These columns shall be to the left of the bar chart.

(B) For Contracts Which Have A Contract Amount More Than One Million Dollars ($1,000,000) Or Having A Contract Time Of More Than

100 Working Days Or 140 Calendar Days. For contracts which have a contract amount more than one million dollars ($1,000,000) or contract time of more than 100 working days or 140 calendar days, the Contractor shall submit a Timed-Scaled Logic Diagram (TSLD) and it shall meet the following requirements and have these essential and distinctive elements:

(1) have the information and requirements listed in A above;

(2) provide additional reports and graphics available from the software as requested by the Engineer;

(3) sufficient detail to allow at least weekly monitoring of the Contractor and subcontractor's operations;

(4) the time scaled schematic shall be on a calendar or working days basis. What will be used shall be determined by how the Contract keeps track of time. It will be the same. Plot the critical calendar dates anticipated

(5) breakdown of activity, such as forming, placing reinforcing steel, concrete pouring and curing, and stripping in concrete construction. Indicate location of work to be done in such detail that it would be easily determined where work would be occurring within approximately 200 feet;

(6) latest start and/or finish dates for critical phasing;

(7) identify responsible subcontractor, supplier, and others for their respective activity;

(8) no individual activity shall have duration of more than 20 calendar days unless requested and approved by the Engineer;

(9) all activities shall have work breakdown structure codes and activity codes. The activity codes shall have coding that incorporates information for phase, location, who is responsible for doing work and type of operation and activity description and

(10) incorporate all physical access and availability restraints.

(C) Early Completion TSLD. In the event, the Contractor submits and the Department receives a schedule, e.g., shorter than the contract time, such will not constitute an agreement to modify the contract time or completion date, nor will the receipt and acceptance of such a schedule incur any obligation by the Department. The Contractor shall be solely responsible for and shall accept all risks and any delays, other than those

that can be directly and solely attributed to the Department, that may materialize during the construction work until the contract completion date is reached. The contract time or completion date is established for the benefit of the Department and cannot be changed without an appropriate change order issued by the Department. The Department will not be responsible if the Contractor does not meet its accelerated schedule. Unless the Contractor can prove that, the Department is solely responsible for its failure to meet its schedule. The Department will be responsible for or obligated to accept the work before the completion date established by the Contract providing it meets all the requirements of the Contract Documents except for Contract Time.

If the TSLD indicates an early completion of the project, the Contractor shall upon submittal of the schedule cooperate with the State in explaining how he will achieve it. In addition, the Contractor shall submit the above explanation in writing which shall include the State's part, if any, in achieving the early completion date. Early completion of the project shall not rely on changes to the Contract Documents unless approved by the Engineer.

(D) Contractor Responsibilities. The Contractor shall not construe receipt of TSLD package to assign responsibility of performance or contingencies to the State. Submittal of and the Engineer's receipt of the TSLD Package will not imply the Department's approval of the schedule breakdown, its individual elements, and any critical path that may be shown. Acceptance of the schedule will not be deemed an agreement by the Department that the constructions means, methods and resources shown on the schedule will result in work that conforms to the contract requirements. The Contractor has the risk of all elements (whether or not shown) of the schedule and its execution. The Contractor has the responsibility to adjust forces, equipment and work schedules in order to meet the contract completion date.

When making TSLD submittals the Contractor shall show how they intend to make those adjustments and remain on the anticipated schedule and within the contract time.

The Contractor shall begin work according to the submitted TSLD after receiving the NTP. Prosecute the work in the order of the schedule expeditiously. The Engineer may require the Contractor to provide additional work forces and equipment to bring the operation into accordance with the submitted TSLD if failure to proceed as provided in the schedule or prosecution of the work in the current manner does not insure completion within the specified Contract time. This action by the State shall be not considered as a directive for constructive acceleration and therefore will be at no additional cost to the State.

When the Contractor fails to insure completion within the specified time, the Engineer will consider employing an outside work force and equipment. The Engineer will charge the Contractor all cost to do the work including but not limited to, profit, employee benefits and fringes, bonds, taxes, insurance, overhead and depreciation for plant and equipment.

(E) Weekly Meeting. In addition to the bi-weekly schedule meetings the Contractor shall meet once a week with the State to have a general discussion on but not limited to, the progress of the project, potential problems, coordination of work, submittals etc. The personnel attending shall have the ability to make decisions and answer questions.

The Contractor shall bring to weekly meeting a detailed work schedule showing the next three weeks work. The three-week schedule shall show:

(1) All construction events, traffic control and BMP related activities and are of such detail that the Engineer will be able to determine at what location and type of work will be done for any day for the next three weeks. This is for the State to use to plan its manpower requirements for that time period;

(2) The duration of all events and delays;

(3) The critical path on the three-week schedule shall be clearly marked in red or marked in a manner that makes it clearly distinguishable from other paths and is acceptable to the Engineer;

(4) The detail of the three-week schedule shall be significantly greater than the one presented in the TSLD. The Engineer will be the sole judge if the amount of detail presented is sufficient;

(5) Critical submittals and RFI's that are expected to be needed in the next three weeks shall be listed also;

(6) The three-week schedule shall have on each page the project title, project number, date created, period the schedule covers, Contractor's name and creator of the schedule.

(7) The three-week schedule is in addition to the TSLD and shall in no way be considered as a substitute for the TSLD or vice versa.

The Contractor shall submit two days ahead of the weekly meeting a list of outstanding submittals and/or RFIs or issues that need resolution that will be needed in the near future with a rating of urgency. The status of which will be discussed at the weekly meeting.

In addition to the three-week schedule, the Contractor shall submit and be ready to discuss all of their required erosion control inspection reports for the past week.

108.06 Limitation of Operations. Conduct work with the least interference of traffic. Use care to the location of detours and the provisions for handling traffic. Do not create more work to the prejudice or detriment of work already started. The Engineer may require the Contractor to finish a section before starting work on additional sections if the opening of that section is essential to public convenience.

108.07 Character Of Workers, Methods, And Equipment. The Contractor shall at all times provide adequate supervision and sufficient labor and equipment to complete the work in the manner and within the time required by the contract.

(A) Character and Proficiency of Workers. All workers shall posses the proper license and/or certification, job classification, skill and experience necessary to properly perform the work assigned to them. All workers engaged in special work or skilled work such as bituminous courses or mixtures, installation of reinforcing steel, concrete pavement or structures, electrical installation, plumbing installation, or in any trade shall have sufficient experience in such work and in the operation of the equipment required to properly and satisfactorily perform all work. All workers shall make due and proper effort to execute the work in the manner prescribed herein, otherwise, the Engineer may take action as prescribed herein.

At the written request of the Engineer, the Contractor shall remove the workers who do not carry out the assigned work in a proper and skillful manner or who are excessive or disrespectful, intemperate, disorderly or neglects or refuses to comply with directions given, or is otherwise objectionable. The worker shall be removed forthwith by the Contractor or subcontractor employing such worker and shall not be employed again in any portion of the work for two years on Federal-Aid, State, or County projects from the date of departure without the written consent of the Department.

Should the Contractor or subcontractor continue to employ, or again employ such person or persons on the project, the Engineer may

withhold all payments, which are or may become due, or the Engineer may suspend the work in writing until the Engineer's orders are followed.

No payment or time extension will be made for the cost of such suspensions.

(B) Insufficient Workers. The Contractor shall begin work according to the submitted progress schedule after receiving NTP. The Contractor shall prosecute the work in the order of the schedule expeditiously. The Engineer may require the Contractor to provide additional work force and equipment to bring the operation up to the submitted progress schedule if failure to proceed as provided in the schedule or prosecution of the work does not insure completion within the specified time

The Engineer will consider employing a working force and equipment if the Contractor fails to comply with the above. The Engineer will charge the Contractor the cost to do the work including but not limited to depreciation for plant and equipment.

(C) Equipment Requirements. All equipment furnished by the Contractor and used on the work shall be of such size and of such mechanical condition that the work can be performed in an acceptable manner at a satisfactory rate of progress and the quality of work produced will be satisfactory.

(1) Equipment used on any portion of the project shall be not injure the work, persons at or near the site, roadway, adjacent property, or other objects will result from its use.

(2) If the Contractor fails to provide adequate equipment for the work, the contract may be terminated as provided under Subsection 108.09 – Termination of Contract for Cause.

(3) In the event that the Contractor furnishes and operates equipment on a force account basis, it shall be operated to obtain maximum production under the prevailing conditions.

The Contractor shall use methods or equipment that will complete the non- prescribed work according to the contract.

If the contract specifies certain methods and equipment for that work, the Contractor shall use such methods and equipment unless the Engineer accepts the Contractor's choice of methods and equipment.

If the Contractor plans not to use the methods and equipment specified in the Contract the Contractor shall submit a written request that includes an explanation of the reasons for changing such methods and equipment. The written request shall include a full description of the methods and equipment that the Contractor is proposing. If the Engineer grants the request, the request will be on the condition that the Contractor shall be fully responsible for completing the work according to the Contract. If the Engineer concludes that the work does not meet Contract requirements after trial use of the requested methods or equipment, the Contractor shall stop using the requested method or equipment. Complete the remaining work with the specified methods and equipment. Remove and replace the deficient work with work of specified quality or take such other corrective action. The authorized requested methods or equipment will not change the basis of payment for the contract items involved nor the project contract time.

108.08 Temporary Suspension of Work.

(A) Suspension of Work. The Engineer may, by written order, suspend the performance of the work, either in whole or in part, for such periods as the Engineer may deem necessary, for any cause, including but not limited to:

(1) Weather or soil conditions considered unsuitable for prosecution of the work;

(2) Whenever a redesign that may affect the work is deemed necessary by the Engineer;

(3) Unacceptable noise or dust arising from the construction even if it does violate any law or regulation;

(4) Failure on the part of the Contractor to:

(a) Correct conditions unsafe for the general public or for the workers;

(b) Carry out orders given by the Engineer;

(c) Perform the work in strict compliance with the provisions of the contract; or

(d) Provide adequate supervision on the jobsite.

(5) The convenience of the State.

(B) Partial and Total Suspension. Suspension of work on some but not all items of work shall be considered a "partial suspension". Suspension of work on all items shall be considered "total suspension". The period of suspension shall be computed from the date set out in the written order for work to cease until the date of the order for work to resume.

(C) Reimbursement to Contractor. In the event that the Contractor is ordered by the Engineer in writing as provided herein to suspend all work under the contract for the reasons specified in Subsections 108.08(A)(2), or 108.08(A)(5) of the "Suspension of Work" paragraph, the Contractor may be reimbursed, for actual direct costs incurred on work at the jobsite, providing the contractor did not contribute to the reason for the suspension and as authorized in writing by the Engineer, including costs expended for the protection of the work. An allowance of 5 percent for indirect categories of delay costs will be paid on any reimbursed direct costs, including overhead and delay impact costs. No allowance will be made for anticipated profits. Payment for equipment which is ordered to standby during such suspension of work shall be made as described in Subsection 109.04(F)(9) - Rental Rates for Idle and Standby Time. No reimbursement and/or extension of time will be given for the remaining reasons stated in the "Suspension of Work" paragraph or for any suspension due to the contractor's actions which include but are not limited to shutdowns due to holidays or any day the contractor chooses to suspend work or is required to be suspended by the Contract Documents. The Engineer will decide who is responsible for suspensions.

(D) Cost Adjustment. If the performance of all or part of the work is suspended for reasons beyond the control of the Contractor except an adjustment shall be made for any increase in cost of performance of this contract (excluding profit) necessarily caused by such suspension, and the contract modified in writing accordingly.

However, no adjustment to the contract price shall be made for any suspension, delay, or interruption:

(1) For weather related conditions,

(2) To the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor; or

(3) For which an adjustment is provided for or excluded under any other provision of this Contract.

(E) Claims for Adjustment. Any adjustment in contract price made shall be determined according to Subsections 104.02 – Alterations of Plans or Type of Work, 104.03 – Field Orders and 104.09 – Methods of Price Adjustment.

Any claims for such compensation shall be filed in writing with the Engineer within 30 days after the date of the order to resume work or the claim will not be considered. The claim shall conform to the requirements of Subsections 104.02 – Alterations of Plans or Type of Work, 104.03 – Field Orders and 105.18 – Claims for Adjustments and Disputes. The Engineer will take the claim under consideration, may make such investigations as are deemed necessary and will be the sole judge as to the equitability of the claim.

(F) No Adjustment. No provision of this clause shall entitle the Contractor to any adjustments for delays due to failure of its surety, the cancellation or expiration of any insurance coverage required by the contract documents, for suspensions made at the request of the Contractor, for any delay required under the contract, for suspensions, either partial or whole, made by the Engineer under Subsection 108.08(A)(4) of the "Suspension of work" paragraph.

108.09 Early Completion Incentive Provision. This Contract provides an incentive payment for early Substantial Completion. This incentive consists of $19,500 for each calendar day prior to the expiration of Contract Time, in which the Engineer accepts the Work as Substantially Complete. The maximum incentive payment is $2,925,000 (150 calendar days).

Contract Time adjustment shall be limited to the critical path in the project schedule.

The Engineer may require the Contractor to provide additional evidence (i.e., warranties, manufacturer diagrams, test certifications) before the Engineer will give incentive allowance for time saved.

The Department will pay the incentive, if warranted, under the 'Incentive Allowance' proposal item.

108.10 Determination of Contract Time

(A) Calculation of Contract Time. When the Contract Time is on a Working Day basis, the total contract time allowed for the performance of the work will be the number of working days shown in the Contract plus any additional working days authorized in writing as provided hereinafter. A working day shall be as defined in Section 101 – Terms, Abbreviations, and Definitions for the definition of Working Day. A working day will be

charged if the Contractor worked more than four hours during a working day on the critical path activity. The count of elapsed working days to be charged against contract time, will begin from the date of Notice to Proceed and will continue consecutively to the date of Substantial Completion determined by the Engineer.

When the contract is on a calendar day basis, the total contract time allowed for the performance of the work will be the number of calendar days shown in the contract plus any additional days authorized in writing as provided hereinafter. A calendar day shall be as defined in Section 101 – Terms, Abbreviations, and Definitions for the definition of Calendar Day. The count of elapsed calendar days to be charged against contract time, will begin from the date of Notice to Proceed and will continue consecutively to the date of project acceptance determined by the Engineer. This includes the NTP, holidays and non-working days. The Engineer will exclude calendar days elapsing between the orders of the Engineer to suspend work and resume work for suspensions not the fault of the Contractor.

When the contract completion time is a fixed calendar date, it will be the date on which all work on the project shall be completed. Maintenance periods will not be included as part of the contract time unless specifically noted in the contract documents.

When multiple shifts are used to construct the project, the Department will not consider the hours worked over the normal eight working hours per day or night as part of a normal working day. A day will be charged if the Contractor worked more than four hours during a calendar day, excluding Saturday, Sunday and holidays, on an activity that is on the critical path of the project's progress schedule. When time allowed by the phasing in the contract documents is less than 8 hours during the normal daylight working hours, the amount of time worked to be charged a day shall be 50 percent of the allowed work time instead of 4 hours.

(B) Modifications of Contract Time.

(1) Extensions. For increases in the scope for work caused by alterations and additional work made under Subsection 104.02 – Changes, the Contractor will be granted a time extension only if the changes increase the length of the critical path for the Contract. If the Contractor believes that an extension of time is justified and is not adequately provided for in the Change Order, it must request the additional time sought in writing when the detailed cost breakdown required by Subsection 104.02 – Changes, is submitted. The Contractor must show how the time of

performance for the critical path will be affected and must also support the time extension request with schedules and statements from its subcontractors, suppliers, and/or manufacturers. Compensation for any altered or additional work will be paid as provided in Subsection 104.02 – Changes.

Additional time to perform the extra work will be added to the time allowed in the contract without regard to the date the change directive was issued, even if the contract completion date has passed. A change requiring time will not constitute a waiver of pre-existing Contractor delay.

(2) Delay for Permits. For excessive delays beyond the control of the Contractor in obtaining necessary permits, one day extension for each day delay may be granted by the Engineer, provided the Contractor notifies the Engineer as soon as the delay occurs that the permits are not available. Time extensions will be the exclusive relief granted on account of such delays. No additional compensation will be paid for these extensions.

(3) Delays Beyond Contractor's Control. For delays affecting the critical path caused by acts of God, or the public enemy, fire, inclement weather days or adverse conditions resulting therefrom, earthquakes, floods, epidemics, quarantine restrictions, all labor disputes or strikes affecting the Contractor or State, freight embargoes, delivery of materials and/or equipment and other reasons beyond the Contractor's control, the Contractor may be granted an extension of time provided that:

(a) The Contractor notifies the Engineer in writing within five work days after the occurrence of the circumstances described above and states the possible effects on the completion date of the contract and

(b) The Contractor, if requested, submits to the Engineer within ten working days after the above notification a written statement describing the extent of the delay to the project. The extent of delay must be substantiated as follows:

1. State specifically the reason or reasons for the delay and fully explain in a detailed chronology the effect of this delay to the work and/or the completion date.

2. Submit copies of pertinent documentation to support the time extension request.

3. Cite the period of delay and the time extension requested.

4. A statement either that the above circumstances have been cleared and normal working conditions restored as of a certain day or that the above circumstances will continue to prevent completion of the project. If the delay has not ended at the time of the submittal of the written statement the Contractor shall submit a written statement of when in its opinion the delay ended and the justification for that date.

(c) and the Contractor is unable to work on critical path work for more than four hours on a day or 60 percent of the allowed work time during daylight hours, whichever is less.

Time extensions will be the exclusive relief granted and no additional compensation will be paid the Contractor for such delays.

(4) Contract Time Adjustment Due to Delays. Delays of contract work that merit a contract time adjustment will be computed as follows:

(a) The number of days delayed will not be counted as part of the contract time. The Contract completion date will be adjusted.

(b) During periods of delay of the work, the Contractor will be granted a time extension only if the delay prevents the Contractor from permitting the normal work force from proceeding with critical path work for at least four hours. If the Contractor believes that an extension of time is justified for a partial delay work, it must request the extension in writing at least five working days before the partial delay will affect the critical operation(s) in progress. The Contractor must show how the critical path was increased based on the status of the work and it must also support its claim. The Contractor shall support its claim with statements from its subcontractors if their work on the critical path was delayed. A delay of work will not constitute a waiver of pre-existing Contractor delay

(5) Contractor Caused Delays. No time extension will be considered for the following:

(a) Delays within the Contractor's control in performing the work caused by the Contractor, subcontractor and/or supplier.

(b) Delays within the Contractor's control in arrival of materials and equipment caused by the Contractor, subcontractor and/or supplier in ordering, and fabricating, delivery.

(c) Delays requested for changes which the Engineer determines unjustifiable due to the lack of supporting evidence or because the change is not on the critical path.

(d) Delays caused by the failure of the Contractor to submit for review and acceptance by the Engineer, on a timely basis, such as but not limited to shop drawings, descriptive sheets, material samples, and color samples except as covered in Subsection 108.08(B)(3).

(e) Failure to follow the procedure within the time allowed to qualify for a time extension.

(6) Reduction in Time. If the Department deletes any portion or changes of the work, an appropriate reduction of contract time may be made.

108.11 Liquidated Damages and Failure to Complete on Time. The Contractor shall comply with the contract terms regarding opening lanes to traffic during the hours specified in Subsection 104.08(B) - Traffic Maintenance Plans and the "Construction Work Zone Notes" of the contract plans. If the Contractor fails to comply with this requirement, the Engineer will assess liquidated damages of $500 for every one-to fifteen-minute increment for each surface street lane not open to the public. In addition, the Engineer will assess liquidated damages, which are estimated public inconvenience amounts and shown below, for every one-to fifteen-minute increment for the appropriate number of Interstate Route H-1 lanes which are not open to the public. The Engineer will decide the time and liquidated damages assessed.

Closure and/or Obstruction	Weekday Estimated Public Inconvenience Per Quarter Hour						
	Midnight to 4:00 A.M.	4:00 A.M. to 6:00 A.M.	6:00 A.M. to 10:30 A.M.	10:30 A.M. to 2:30 P.M.	2:30 P.M. to 6:30 P.M.	6:30 P.M. to 10:00 P.M.	10:00 P.M. to Midnight
One Lane of Westbound Interstate Route H-1	N/A	$2,000	$4,000	N/A	$9,000	$2,000	N/A
Two Lanes of Westbound Interstate Route H-1	N/A	$4,000	$18,000	N/A	$25,000	$13,000	N/A
Full Closure of All Westbound Interstate Route H-1 Lanes and Shoulders	N/A	$5,000	$30,000	$68,000	$90,000	$62,000	N/A
Full Closure of All Eastbound Interstate Route H-1 Lanes and Shoulders	N/A	$40,000	$120,000	$62,000	$65,000	$22,000	N/A
Closure of Eastbound Interstate Route H-1 Shoulder Lane	N/A	$400	$1,800	N/A	N/A	N/A	N/A
One Lane of Westbound Pearl City Off-Ramp	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Closure and/or Obstruction	Saturday Estimated Public Inconvenience Per Quarter Hour						
	Midnight to 4:00 A.M.	4:00 A.M. to 6:00 A.M.	6:00 A.M. to 10:30 A.M.	10:30 A.M. to 2:30 P.M.	2:30 P.M. to 6:30 P.M.	6:30 P.M. to 10:00 P.M.	10:00 P.M. to Midnight
One Lane of Westbound Interstate Route H-1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Two Lanes of Westbound Interstate Route H-1	N/A	N/A	N/A	$5,000	$17,000	$2,000	N/A
Full Closure of All Westbound Interstate Route H-1 Lanes and Shoulders	*	*	*	*	*	*	*
Full Closure of All Eastbound Interstate Route H-1 Lanes and Shoulders	*	*	*	*	*	*	*
Closure of Eastbound Interstate Route H-1 Shoulder Lane	N/A	N/A	N/A	N/A	N/A	N/A	N/A
One Lane of Westbound Pearl City Off-Ramp	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Closure and/or Obstruction	Sunday Estimated Public Inconvenience Per Quarter Hour						
	Midnight to 4:00 A.M.	4:00 A.M. to 6:00 A.M.	6:00 A.M. to 10:30 A.M.	10:30 A.M. to 2:30 P.M.	2:30 P.M. to 6:30 P.M.	6:30 P.M. to 10:00 P.M.	10:00 P.M. to Midnight
One Lane of Westbound Interstate Route H-1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Two Lanes of Westbound Interstate Route H-1	N/A	N/A	N/A	$2,000	$4,500	$500	N/A
Full Closure of All Westbound Interstate Route H-1 Lanes and Shoulders	*	*	*	*	*	*	*
Full Closure of All Eastbound Interstate Route H-1 Lanes and Shoulders	*	*	*	*	*	*	*
Closure of Eastbound Interstate Route H-1 Shoulder Lane	N/A	N/A	N/A	N/A	N/A	N/A	N/A
One Lane of Westbound Pearl City Off-Ramp	N/A	N/A	N/A	N/A	N/A	N/A	N/A

* NOTE: The State reserves the right to calculate public inconvenience costs for situations unaccounted for.

The Engineer may consider delays caused by a problem beyond the Contractor's control in opening lane(s) closure on time for not charging liquidated damages. Equipment breakdown is not a cause to waive liquidated damages.

Before closing lane(s), the Contractor shall submit a contingency plan for acceptance by the Engineer which will indicate what steps and efforts the Contractor shall take to open lane(s) to the public on time. The Engineer will not allow lane closures until the Engineer accepts the contingency plan. The Engineer will not make separate payment for work to implement a contingency plan.

The Contractor shall complete the work within the number of working days specified in the contract. The contract will begin officially from the date designated in the NTP. If the contract specifies a calendar date as the date of completion, the Contractor shall complete the work by that date.

Delay in the completion of the work within the required time will inconvenience the public, obstruct traffic and interfere with business.

The Contractor shall pay $19,500 to the Department for each calendar day after expiration of the Contract Time in which the Contract has not been Substantially Completed, as defined in Subsection 101.03 – Definitions. The Contractor shall not pay by way of a penalty. The Department may deduct the

amount from monies due or that may become due under the Contract if the Contractor does not pay the liquidated damages.

The Contractor shall complete the work on any Punchlist created after Substantial Completion, within the Contract Time or any extension thereof. When the Contractor fails to complete the work on such Punchlist within the Contract Time or any extension thereof, the Contractor shall pay liquidated damages to the State. These liquidated damages will be $3,600 per calendar day. Liquidated damages shall not be assessed for the period between Substantial Completion of the work and the time the Punchlist is delivered to the Contractor. The Engineer will not assess liquidated damages for failure to complete the plant establishment period or post construction survey of the viaduct deck concrete overlay within the Contract Time.

The findings of the Director shall be accepted by the parties hereto as final, but any allowance of time and remission of charges shall in no other manner affect the rights or obligations of the parties under this contract, nor be construed to prevent action under Subsection 108.12 - Default and Termination of Contract in case the Contractor fails in the judgement of the Director to make reasonable and satisfactory progress after such allowance of time has been granted.

(a) Liquidated Damages Upon Termination. If the Department so terminates the Contractor's right to proceed, the resulting damage will consist of such liquidated damages for such reasonable time as may be required for final completion of work.

(b) Liquidated Damages In The Absence Of Termination. If the Department does not terminate the Contractor's right to proceed, the resulting damage will consist of such liquidated damages until the work is completed or accepted.

108.12 Default and Termination of Contract.

(A) If the Contractor:

(1) Fails to begin the work under the contract within the time specified in the Notice to Proceed, or

(2) Fails to perform the work with sufficient workers and equipment or with sufficient materials to assure the prompt completion of said work, or

(3) Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or

(4) Discontinues the prosecution of the work, or

(5) Fails to resume work which has been discontinued within a reasonable time after notice to do so, or

(6) Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or

(7) Allows any final judgement to stand against the Contractor unsatisfied for a period of 10 days, or

(8) Makes an assignment for the benefit of creditors, or

(9) Fails to comply with 49 CFR Part 26, 'Participation by Disadvantaged Business Enterprises in Department of Transportation Programs', or

(10) For any other cause whatsoever, fails to carry on the work in an acceptable manner, or

(11) Fails to submit required project documentation, including project progress schedule, labor compliance reports and payroll records, on time, or

(12) Makes a false or misleading statement in the contract, including declaration, certification, affidavit, warranty, or verification submitted with the project or engage in conducts perpetuating a falsehood, fraud or erroneous impression relating to this project, or

(13) Is suspended due to HRS 104-25,

the Engineer will give notice in writing to the Contractor and its surety of such delay, neglect, or default.

The Department may take the prosecution of the work out of the hands of the Contractor or surety without violating the contract if the Contractor or surety receives written notification from the Engineer of such delay, neglect or default and the Contractor or surety fails to proceed according to the notice to remedy the delay, neglect or default, within a period of 10 days after receipt of said notice. The Department may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods required for the completion of the project according to the contract.

All costs and charges incurred by the Department, together with the cost of completing the work under contract, will be deducted from any monies due or which would or might have become due to the Contractor had the Contractor been allowed to complete the work under the contract. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Department the amount of such excess.

The Department may bar Contractors from bidding and working on construction projects of the Department for two consecutive years from the date of termination. This includes its owners, officers, and managerial and supervisory staff terminated under provisions of this section.

(B) Erroneous Termination For Default. If, after notice of termination of the Contractor's right to proceed under the provisions of this clause, it is determined for any reason that the Contractor was not in default under the provisions of this clause, or that the delay was excusable under the provisions of this clause, the rights and obligations of the parties shall, if the contract contains a clause providing termination for convenience of the State, be the same as if the notice of termination had been issued pursuant to such clause.

(C) Additional Rights and Remedies. The rights and remedies of the State provided in this clause are in addition to any other rights and remedies provided by law or under this contract.

(D) Termination For Convenience.

(1) Terminations. The Department may, when the interests of the State so require, terminate this contract in whole or in part, for the convenience of the State. The Department shall give written notice of the termination to the Contractor specifying the part of the contract terminated and when termination becomes effective.

(2) Contractor's Obligations. The Contractor shall incur no further obligations in connection with the terminated work and on the date set in the notice of termination the Contractor shall stop work to the extent specified. The Contractor shall also terminate outstanding orders and subcontracts as they relate to the terminated work. The Contractor shall settle the liabilities and claims arising out of the termination of subcontracts and orders connected with the terminated work. The Department may direct the Contractor to assign the Contractor's right, title, and interest under terminated orders or subcontracts to the State. The Contractor must still

complete the work not terminated by the notice of termination and may incur obligations as necessary to do so.

(3) Right to Construction and Goods. The Department may require the Contractor to transfer title and deliver to the State in the manner and to the extent ordered by the Department:

(a) Any completed constructions; and

(b) The partially completed construction, goods, materials, parts, tools, dies, jigs, fixtures, plans, drawings, information, and contract rights (hereinafter called "construction material") as the Contractor has specifically produced or specially acquired for the performance of the terminated part of this contract.

The Contractor shall protect and preserve property in the possession of the Contractor in which the State has an interest. If the Director does not exercise this right, the Contractor shall use best efforts to sell such construction, goods, and construction materials according to the standards of Section 490:2-706, HRS. This in no way implies that the State has breached the contract by exercise of the termination for convenience clause.

(4) Compensation.

(a) The Contractor shall submit a termination claim specifying the amounts due because of the termination for convenience together with cost or pricing data, submitted to the extent required by Subchapter 15, Chapter 3-122, HAR, bearing on such claim. If the Contractor fails to file a termination claim within one year from the effective date of termination, the Department may pay the Contractor, if at all, an amount set according to Subparagraph 108.12(D)(4)(c)2.

(b) The Department and the Contractor may agree to a settlement provided the Contractor has filed a termination claim supported by cost or pricing data submitted as required and that the settlement does not exceed the total contract price plus settlement costs reduced by payments previously made by the State, the proceeds of any sales of construction, supplies, and construction materials under paragraph 108.12(D)(3) of this clause, and the contract price of the work not terminated.

(c) Absent complete agreement under subparagraph 108.12(D)(4)(b) of this paragraph, the Department shall pay the Contractor the following amounts, provided payments under subparagraph 108.12(D)(4)(b) shall not duplicate payments under this paragraph the total (without duplication of any items) of:

1. The cost of all contract work performed before the effective date of the notice of termination work plus a fair and reasonable profit on such portion of the work (such profit shall not include anticipatory profit or consequential damages) less amounts paid or to be paid for completed portions of such work; provided, however, that if it appears that the Contractor would have sustained a loss if the entire contract would have been completed, no profit shall be allowed or included and the amount of compensation shall be reduced to reflect the anticipated rate of loss;

2. Costs of settling and paying claims arising from the termination of subcontracts or orders pursuant to paragraph 108.12(D)(2) of this clause. These costs must not include costs paid according to subparagraph 108.12(D)(4)(c)1 of this paragraph;

3. The reasonable settlement costs of the Contractor including accounting, legal, clerical, and other expenses reasonably necessary for the preparation of settlement claims and supporting data with respect to the terminated portion of the contract and for the termination and settlement of subcontracts thereunder, together with reasonable storage, transportation, and other costs incurred in connection with the protection or disposition of property allocable to the terminated portion of this contract; and

4. The total sum to be paid the Contractor under this paragraph shall not exceed the total contract price plus the reasonable settlement costs of the Contractor reduced by the amount of any sales of construction supplies, and construction materials under paragraph 108.12(D)(3) of this clause, and the contract price of work not terminated.

(d) Cost claimed, agreed to, or established under subparagraphs 108.12(D)(4)(b) and 108.12(D)(4)(c) of this paragraph shall be according to Chapter 3-123, HAR.

108.13 Emergency and Legally Justifiable Cause for Termination of Contract. The Engineer may end the contract when a national emergency or other reasons beyond the control of the Engineer makes the termination necessary. The Department will give the Contractor a written notice of termination. The Engineer will pay the Contractor for work done and accepted at the contract unit prices or lump sum prices upon termination. The Engineer will reimburse the Contractor for required expenditures in preparing for and moving to and from the project site. Also, the Engineer will reimburse the Contractor for required expenditures not compensated for. The Contractor shall not submit claims for interest or loss of anticipated profits.

The Engineer will purchase the materials from the Contractor at actual cost per receipted bills. The Contractor shall get these materials to the worksite at locations designated by the Engineer. The Engineer will inspect and test these materials for acceptance. The Contractor shall not have incorporated these materials in the work yet. Store and maintain these material properly."

END OF SECTION

Amend **SECTION 202 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS** to read as follows:

"SECTION 202 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS

202.01 Description. This section is for the removal and disposal of buildings, fences, structures, old pavements, abandoned pipelines, concrete barriers, guardrail and other obstructions designated or not permitted to remain; salvaging of designated materials and backfilling the resulting trenches, holes, and pits; abatement of lead, asbestos, arsenic, and PCB-containing materials; and rearranging of utility and non-highway facilities, existing highway improvements, and Portland Cement concrete to remain. Rearrangement includes installation, relocation, alteration, salvaging, removing and disposing of structures and obstructions.

When the proposal does not include pay items for this section, conduct that work under Section 203 - Excavation and Embankment.

Removal of lead-containing or asbestos-containing materials associated with existing drain pipes shall be performed in accordance with the requirements of Section 690 - Removal of Lead-Containing Materials.

202.02 Materials. None specified.

202.03 Construction Requirements. The Contractor shall exercise every precaution to preserve and protect structures, fences, and utilities to remain or removed by others according to Subsections:

(1) 107.16 - Protection and Restoration of Property and Landscape,

(2) 107.20 - Contractor's Responsibility for Work, and

(3) 107.21 - Contractor's Responsibility for Utility Property and Services.

(A) Obstructions. Remove obstructions that interfere with construction according to the contract including

(1) signs, posts, raised bars, guardrails, and structures placed for the information, safety, direction, or control of traffic;

(2) monuments, fences, and headers;

(3) curb and gutter, drainage and sewerage structures except those constructed of Portland Cement concrete;

(B) Removal Methods. Obliterate existing roads that are not to remain in place. Obliteration includes rooting, plowing, pulverizing or scarifying to a minimum depth of 6 inches or to the bottom of the underlying base, whichever is less. Place an earth cover of not less than 6 inches in thickness. Submit an earth cover for acceptance.

After the demolition of the residential structures, fill all holes with earth fill, and grade lot to have a smoother appearance. Submit an earth fill for approval.

Break up bituminous material into pieces not larger than 4 inches in greatest dimension. Mix the bituminous material with an equal quantity of underlying material. Shape the ground to provide a presentable and well-drained area.

Backfill trenches, holes, depressions and pits left by the removal of the obstruction with embankment material.

Remove abandoned utility lines, such as pipes and conduits, within the roadbed area to a depth of at least 24 inches below finished grade.

Seal the pipes that the contract calls to abandon with:

(1) a tight-fitting plug,

(2) a wall of Class A or Class B concrete not less than 6 inches thick, or

(3) a brick wall not less than 8 inches thick with cement mortar joints.

Demolish abandoned manholes to an elevation three feet below finished grade. Also, backfill the abandoned manholes as required by the contract. Salvage the manhole frame and cover according to Section 604 - Storm Drain Manholes, Drop Inlets and Catch Basins.

(C) Disposal. Dispose of the materials according to Subsection 201.03(B) - Removal and Disposal of Material.

(D) Removal of Concrete. Remove existing concrete slabs, walls, foundations, and old pavements within the roadbed areas to a depth of at least three feet below finished grade.

Cut portions of concrete curbs, gutters, sidewalks, aprons, driveways and pavements to remain to a depth of one and a half inches with a power-drive abrasive saw. At areas where residential structures are to be demolished, use a diamond blade saw to cut through the entire thickness of the portions of concrete curbs, gutters, sidewalks, aprons, driveways and pavements to remain. The saw cut shall be neat and true with no shattering or spilling of the portion of concrete remaining in place or joining with the new work.

Remove the concrete without damaging the concrete and reinforcing steel that are that is to remain in place. Repair damages at no cost to the State.

Clean the existing reinforcement thoroughly that is to be incorporated in the new work material before embedding reinforcement in new concrete at no cost to the State.

Burying of concrete for disposal will not be allowed. Submit in writing for acceptance by the Engineer the manner the removed concrete may be disposed of and at such locations. Dispose of concrete in accordance with the requirements of Subsection 201.03(B) - Removal and Disposal of Material.

Remove and dispose of reinforcing or other steel encountered in concrete according to Subsection 201.03(B) - Removal and Disposal of Material.

Remove and dispose of the concrete pavements and similar slabs upon which embankments are to be constructed.

(E) Removal of Bridges. Removal of bridges includes removing, salvaging, reconstructing and disposing of the entire or portions of the structures including deck drains, gratings and steel frames. Bridges may be constructed of timber, structural steel, or reinforced concrete.

Conduct removal operations in a manner that will cause the least interference to public traffic. Removal operations shall also meet the requirements of the construction phasing, traffic control and other applicable portions of the contract.

Carefully remove materials that the contract calls to salvage. Stockpile the salvaged material near the site as designated. Mark the steel members so they may be matched later. Carefully remove timber members and deliver them to a designated baseyard as specified by the Engineer.

Materials, that are to be salvaged or used in the reconstructed work, which have been damaged or destroyed by the Contractor's operations shall be repaired or replaced in an acceptable manner at no cost to the State. When damaging or destroying the salvaged or used materials in the reconstructed work, repair or replace that material at no cost to the State.

When the contract does not call to salvage the materials, remove and dispose the materials according to Section 201 - Clearing and Grubbing.

Remove pilings, piers, abutments and pedestals to at least 12 inches below ground line.

When the contract calls for removing portions of a bridge, conduct the work without damage to the portion that is to remain in place. The use of a hoe ram or concrete crusher, will be allowed to remove the upper 18" of the existing concrete barrier but will not be allowed to remove the viaduct deck and the bottom six inches of the existing concrete barrier.

The Contractor shall protect from damage and thoroughly clean adhering material from the existing reinforcement incorporated in the new work before embedding in fresh concrete. Two feet of the existing viaduct concrete railing and existing deck reinforcement shall extend into the deck closure pour or as directed by the Engineer. The viaduct concrete railing shall not be removed until the permanent railing is completed.

(F) Removal of Concrete Barriers and Guardrail. Within each work area, do not remove existing concrete barriers or guardrail until temporary or permanent barriers or guardrails are in-place. The concrete railing on the viaduct shall not be removed until the permanent concrete railing on the viaduct is completed.

Remove concrete barrier footings to a minimum depth of six inches below subbase or as shown on plans.

(G) Removal of Residential Structures. Remove residential structures according to the contract.

(1) Condition of Structures. The State assumes no responsibility for the actual condition of items or structures to be demolished. Conditions existing at the time of inspection for bidding purposes will be maintained insofar as practicable. However, minor variations within the structures may occur prior to the start of demolition work.

(2) Protections. Provide temporary barricades and other forms of protection to protect the State personnel and the general public from injury due to selective demolition work.

(a) Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.

(b) Promptly repair damages caused to adjacent facilities by demolition work at no cost to the State.

(c) Conduct demolition operations and debris removal to ensure minimum interference with roads, streets, sidewalks, and other adjacent facilities. Do not close, block, or otherwise obstruct streets, sidewalks, or other facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

(d) Do not use cutting torches for removal until work area is cleared of flammable materials. Within concealed spaces, such as exterior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.

(e) Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

(f) Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.

(g) Noise shall be kept within acceptable levels at all times in conformance with State Department of Health, Title 11, Administrative Rules, Chapter 46 –Community Noise Control. The Contractor shall obtain and pay for community noise permit from the State DOH when construction equipment or other devices emit noise at levels exceeding the allowable limits.

(H) Removal and Disposal of Asbestos-Containing Materials. Asbestos containing materials have been identified in the following inspection reports:

- "Hazardous Materials Survey, Interstate Route H-1 Widening, Waimalu Viaduct to Pearl City Off-Ramp, Demolition of Residential Structure, 98-359 Ponohana Loop, Aiea, Hawaii", White Environmental Consultants Inc., dated May 1, 2003,

- "Hazardous Materials Survey, Interstate Route H-1 Widening, Waimalu Viaduct to Pearl City Off-Ramp, Demolition of Residential Structure, 98-318 Pono St., Aiea, Hawaii", White Environmental Consultants Inc., dated May 1, 2003,

- "Asbestos, Lead Painted Surfaces, PCB Fluorescent Light Ballast, Mercury Containing Light Bulbs Survey and Waste Characterization", EnvironMETeo Services, Inc., dated October 1, 2003.

(1) General Requirements. All work shall be done in compliance with the publications listed in this section as well as all Occupational Safety and Health Standards, the Uniform Building Code, the Uniform Fire Code, and as specified herein.

(a) Title 29 CFR Part 1910

(b) Title 29 CFR Part 1926

(c) Title 40 CFR Part 61

(d) Title 49 CFR 100-199

(2) Air Monitoring.

(a) Airborne concentrations of asbestos fibers shall be monitored in accordance with 29 CFR 1926.1101, current Environmental Protection Agency (EPA) guidance, and as specified herein. In addition to the monitoring done by the Contractor, the Engineer may perform independent monitoring inside and outside of the work area. All monitoring shall be performed by trained air monitoring technician. All sampling pumps shall be calibrated in the field with a secondary calibration device before and after each sample. Built-in rotometers on pumps are not acceptable.

(i) The minimum number of daily samples per work

area the Contractor shall take in areas without a negative exposure assessment are as follows:

(a) Two (2) air samples within the work area.

(b) Three (3) air samples located outside the work area.

(ii) The Contractor shall also conduct personnel monitoring continuously during asbestos removal operations to determine the 8-hour time weighted exposure of workers to airborne fibers.

(iii) The Contractor shall direct its laboratory, in writing, to release all employees and work site air monitoring data, and all other pertinent data and records, to the Engineer.

(iv) A laboratory accredited by the American Industrial Hygiene Association (AIHA) shall perform all analysis.

(v) The Contractor shall have its laboratory archive all air samples until the successful completion of the project.

(b) Laboratory results from air monitoring will be submitted to the Engineer within 16 hours from the end of the work shift for which monitoring was performed.

(c) Clearance air monitoring tests need not be performed if buildings are demolished immediately upon completion of visual inspection. However, if according to the Contract, the building is to be re-occupied, the following shall apply:

(i) The maximum acceptable level of airborne asbestos fibers for work area clearance is 0.01 f/cc. This level must be met before the work area is re-occupied. The Contractor, at his own expense, and at no cost to the State, will re-clean the work area if clearance air monitoring shows excessive airborne fiber levels.

(ii) Final clearance air monitoring test will not be performed until all areas and materials within the work

area are fully clean and dry.

(iii) Final clearance sampling will consist of a minimum of five samples collected within the regulated area. A minimum of 1,200 liters of air will be collected for clearance samples.

(iv) If the final clearance air monitoring results show that the work area has failed to meet the clearance criteria, the Contractor shall re-clean the work area and conduct a follow-up inspection to be followed by another set of clearance air monitoring samples. All work specified in this paragraph shall be done at no additional expense to the State.

(d) The independent testing laboratory shall be accredited by AIHA for the analysis required and shall be accredited by the National Institute of Science and Technology (NIST) under their National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos analysis and airborne asbestos fibers as appropriate.

(3) Initial Submittal. The Contractor shall submit the following documentation to the Engineer for review, approval or rejection:

(a) A work plan, prepared and signed by an EPA Accredited Project Designer and a Certified Industrial Hygienist (CIH), which includes procedures for:

(i) work area set-up and preparation,

(ii) asbestos removal,

(iii) worker protection,

(iv) material decontamination,

(v) personnel decontamination, and

(vi) waste transport and disposal.

(b) Authorization to dispose of asbestos waste by the proposed disposal site operator.

(c) Name and address of the proposed waste transporter.

(d) Notifications and certificates:

(i) A copy of the Contractor's written "Notification of Demolition and Renovation" to the Environmental Protection Agency and the State of Hawaii Department of Health.

(ii) A copy of the Contractor's written notification listing proposed workers to the State of Hawaii Department of Health with the response showing worker approval.

(iii) Legible copies of workers' current EPA and State of Hawaii Asbestos Abatement Certificates.

(e) Submit the name of the proposed Competent Person and a list of his previous projects.

Work, which disturbs the existing residences to be demolished, shall not begin prior to the Engineer's receipt and approval of the specified documentation.

(4) Periodic Submittals. Submit the previous day's Project Daily Logs to the Engineer.

(5) Submittal for Final Payment. The Contractor shall submit copies of the following documents with the application for final payment.

(a) Employees daily sign-in sheets, field logs.

(b) Waste Shipment Records (40 CFR 61, Figure 4).

(c) Disposal Site Receipts.

(6) Work Areas.

(a) Establish regulated work area in compliance with 29 CFR 1926.1101.

(b) Install decontamination areas in compliance with 29 CFR 1926.1101.

(7) Personnel Protection Procedures.

(a) Post the decontamination, safety, and work procedures to be followed by workers.

(b) Provide continuous on-site supervision by the approved Competent Person.

(c) Follow all worker protection procedures as described in the approved work plan.

(d) Provide the highest level of respiratory protection unless approved and documented exposure assessments establish that a lower level of protection is adequate.

(e) Maintain a daily log of all workers and visitors entering the regulated work area. Log shall contain the name and social security number of each individual, his organization, accurate time of entering and leaving, and purpose of visit.

(f) Monitor worker exposure to airborne asbestos fibers as required by 29 CFR 1926.1101.

(g) Provide approved filters for other airborne contaminants (solvents, etc.) which may be present. These filters shall be used in combination with approved asbestos filters. At no time shall this permissible exposure limit (PEL) for any airborne contaminant exceed the PEL listed in 29 CFR 1910, Subpart Z.

(8) Asbestos Removal Procedures. Asbestos removal shall be in accordance with the Contractor's approved work plan, applicable regulations, and this specification.

(9) Cleaning of Work Area.

(a) Upon completion of asbestos removal within a work area, remove visible accumulation of asbestos material and debris. Wet or High Efficiency Particulate Air (HEPA) vacuum all work area surfaces.

(b) Ensure that all asbestos-containing materials have been removed from concave corners and textured surfaces (i.e., concrete floors).

(c) Notify the Engineer in writing that asbestos work has been completed and the work area is ready for visual

inspection. Include a statement that all asbestos in the work area has been removed, repaired, and/or encapsulated as required by the contract, and that all debris has been removed.

(10) Post Clearance Inspection. After the work area barriers, plastic sheeting, decontamination area, HEPA filtration units, etc. have been removed, the Engineer shall conduct an additional inspection to verify that no asbestos debris, contaminated water, or other residue, concealed by the work area protection installations remain. Any such remaining residue shall be cleaned using HEPA vacuum cleaners and wet wiping methods.

(11) Asbestos Waste Disposal.

(a) Dispose of asbestos wastes in an EPA and DEC permitted asbestos landfill.

(b) Comply with current waste handling, storage, transportation, and disposal requirements of the waste disposal facility, US Department of Transportation, and EPA regulations.

(c) Label waste containers and vehicles in accordance with 40 CFR Part 61 and 49 CFR 100-199. Affix warning labels having waterproof print and permanent adhesive to all waste containers.

(d) Affix a Class 9 label with ID number 2212 on all four sides of the waste transport vehicle.

(e) Waste transport vehicles shall be lined with 6-mil polyethylene and be fully enclosed.

(f) Waste shipping papers shall identify waste as "Asbestos 9, NA 2212 III, RQ" and list the total quantity being transported in addition to the requirements of 40 CFR 61.

(l) Lead/Arsenic Materials.

(1) General. The buildings scheduled for demolition contain some lead containing paints and arsenic containing building products. Toxicity Characteristic Leaching Procedure (TCLP) analysis for these materials has been performed. Buildings that have been characterized as non-hazardous and all resultant debris may be disposed of as general construction debris. Structures that are

considered hazardous is required to be disposed of at an EPA approved hazardous waste landfill. However, monitoring of the site is required for both hazardous and non-hazardous structures.

(a) The purpose of the hazardous materials section for this project is to ensure Contractor compliance with the Occupational Safety and Health Administration (OSHA) Lead in Construction Standard, 29 CFR 1926.62, and to ensure this work does not create a lead or arsenic hazard to workers or others.

(b) Airborne concentrations of lead shall be monitored by an independent testing laboratory in accordance with 29 CFR 1926.1101, current EPA guidance, and as specified herein. The Engineer, in addition to the Contractor's monitoring, may perform independent monitoring inside and outside of the work area. All monitoring shall be performed by trained air monitoring technicians.

(c) Each testing laboratory selected to perform sample analysis for lead in paint, soil, dust, air, and perform TCLP tests for lead shall be currently judged proficient in lead analysis, as determined by the Environmental Lead Proficiency Analytical Testing (ELPAT)

(2) Respiratory Protection. The Contractor's Industrial Hygienist shall establish and implement a respiratory protection program as necessary to comply with the OSHA Lead in Construction Standard.

(3) Initial Submittal. The Contractor shall submit the following documentation to the Engineer for review, approval or rejection:

(a) Testing laboratories selected to perform sample analysis and reporting.

(b) Evidence that each employee engaged in lead work or who may be potentially exposed to lead, has completed training on lead, satisfying the requirements of 29 CFR 1926.62.

Work, which disturbs the existing residences to be demolished, shall not begin prior to the Engineer's receipt and approval of the specified documentation.

(4) Periodic Submittals. The Contractor shall submit to the Engineer updated documentation for any Initial Submittal requirements, which may have reached expiration and/or cancellation during the course of the project. The Contractor shall also submit:

(a) Air monitoring data sheets and final laboratory reports.

(b) Exposure assessments conducted during demolition.

(5) Execution. All hot work (burning, cutting, welding, etc.) resulting in the release of lead fumes shall be prohibited. Personnel not engaged in lead activities shall not be exposed at any time to airborne concentrations of lead dust or fumes in excess of the action level.

(6) Air Monitoring. Unless the Contractor submits an approved Negative Initial Determination to the Engineer, the Contractor shall conduct personal air monitoring during work in accordance with all applicable regulations and as specified herein. In addition to the monitoring done by the Contractor, the Engineer may perform independent air and dust monitoring of the Contractor's employees and the work area.

(a) The Contractor shall conduct worker exposure air monitoring in accordance with 29 CFR 1926.62. Personal air samples shall be taken on employees who are anticipated to have the greatest risk of exposure as determined by the competent person.

(b) Submit air sampling results within 24 hours after the samples are taken. Any results in excess of the action level shall be immediately reported to the Engineer.

(c) For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the control area. Any areas contaminated by the Contractor shall be cleaned at no cost to the State.

(J) PCB Removal. Remove and dispose PCB-containing fluorescent light fixture ballast. In addition to removal, the Contractor shall decontaminate any contaminated fixtures due to leaking ballast, if any.

(1) Work Area Preparation. Demarcate to restrict access to the work areas during the removal of ballasts.

(2) Personnel Protection Procedures. Each worker will be issued and will don personnel protective equipment such as face splash shields or other type of eye protection, PCB resistant aprons, gloves and full body protective disposable clothing.

(3) Lockout Tagout. The Contractor shall de-energize the lights and lock out the electrical panel to prevent any electrical shocks during the removal of the ballast. The Contractor will perform the lock out and tag out of the panel.

(4) Removal Procedures

(a) Intact Ballast. The ballast cover plates will be removed exposing the ballast. Each ballast will be inspected for leakage; if intact, the ballasts will be removed from the fixture and placed into a disposal drum for shipment to an appropriate disposal facility for final disposition.

(b) Leaking Ballast. The Contractor shall follow the procedures listed below upon detection of leaking ballast

(i) All components of the light fixture will be wrapped in 6 mil plastic and placed in a disposal drum.

(ii) All oily residues will be cleaned up using an approved solvent or detergent.

(iii) Workers will decontaminate themselves and their immediate work area. Wipe samples will be collected to verify the work area has been adequately cleaned.

(iv) Any rags or other materials used in the decontamination of light fixtures, if any, will be placed into impermeable poly bags and then placed into the 55-gallon disposal drums along with the ballast for permanent disposal.

(5) Waste Identification and Labeling. If the ballast do not have sufficient markings to determine the PCB concentration, the Contractor shall assume that the concentration exceeds 50 ppm. (Under the Toxic Substance Control Act, PCB's equal to or greater than 50 ppm is regulated as toxic waste by the federal government.)

PCB and marine pollution stickers will be placed on drums containing PCB's at or above 50 ppm. Each drum will also have a

label, which shows the name, address, phone number and EPA ID number. These labels will also have the proper U.S. DOT shipping name for the waste.

(6) Transportation and Disposal. All PCB waste shall be transported and disposed of in compliance with all existing local, state and federal regulations.

202.04 Method of Measurement. The Engineer will not measure the removal of structures and obstructions for payment.

202.05 Basis of Payment. The Engineer will pay for the accepted removal of structures and obstructions on a contract lump sum basis.

The price includes full compensation for removing and disposing of that item; excavating; backfilling; preparation of substrate surface; salvaging of materials removed including their custody, preservation, and storing on the right-of-way; disconnecting, removing, and/or capping existing utilities at areas where residential structures are to be demolished; removal of lead, asbestos, arsenic, and PCB-containing materials; all monitoring and documentation required for the removal of lead, asbestos, arsenic, and PCB-containing materials; and furnishing equipment, tools, labor, materials, and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Removal of _____ (_____)	Lump Sum

END OF SECTION"

Amend **Section 206 – Excavation and Backfill for Conduits and Structures** to read as follows:

"SECTION 206 — EXCAVATION AND BACKFILL FOR CONDUITS AND STRUCTURES

206.01 Description. This section is for:

(1) excavation to the depth and lines established for the foundations of bridges, retaining structures and other structures;

(2) excavation and backfilling trenches for culverts, structural plate culverts, utility pipes (including water and sewer lines), concrete and cement rubble masonry headwalls, grouted rubble paving, hand-laid and dumped riprap;

(3) other excavation specifically designated in the contract as structure excavation;

(4) backfilling according to this section and Section 624 - Water System and Section 625 - Sewer System;

(5) disposal of surplus material from the structure excavation;

(6) bailing, draining, sheathing and the construction of cofferdams, if found necessary, and the subsequent removal of sheathing and cofferdams;

(7) work associated with dewatering activities and complying with the conditions of the National Pollutant Discharge Elimination System (NPDES) Permit for Dewatering Activities.

(8) backfilling with CLSM according to this Section and Section 313 - Controlled Low Strength Material (CLSM) for utilities and structures.

Excavation for structures does not include the excavation:

(1) of post holes for fences, gates, or similar items;

(2) necessary to properly set curbs, paved gutters, headers, pavement or base course forms.

206.02 Materials. Materials shall conform to the following:

Filter Material	703.18
Structure Backfill Material	703.20
Trench Backfill Material	703.21

The Contractor may use Section 313 - Controlled Low Strength Material (CLSM) in place of trench and structure backfill material subject to the Engineer's acceptance except that CLSM shall be used as structure backfill material below the top of all Bent footings of Waimalu Viaduct (Westbound). Do not use CLSM as trench backfill when installing aluminum and aluminum coated pipe culverts. When using CLSM, the Engineer will consider CLSM as the required backfill and no additional payment will be made except at Waimalu Viaduct Bent footings.

206.03 Construction Requirements.

(A) General. Notify the Engineer 10 working days before excavation for structures, so that the Engineer can take cross-sectional elevations and measurements of the undisturbed ground.

The Contractor shall be responsible for protecting the sides of the excavations greater than five feet deep from cave-ins. If the Contractor decides to brace or shore the cut slope, the Contractor shall submit working drawings and calculations. The working drawings and calculations shall be stamped by a registered Hawaii Structural Engineer and a registered Civil Engineer specializing in Geotechnical Engineering in the State of Hawaii. If the Contractor decides not to brace the cut slope, the Contractor shall submit calculations, showing the stability of the slope, stamped by a registered Civil Engineer specializing in Geotechnical Engineering in the State of Hawaii. The working drawings and calculations shall be reviewed and accepted by the Engineer before proceeding with the construction.

Wherever the soil nail wall transitions to another wall type or transitions to a temporary excavation slope, the Contractor shall also submit working drawings and calculations as required above.

The upper limit of excavation shall be at least three feet from any metal guardrail or temporary concrete barrier, which shall comply with Section 107, at segmental retaining walls, abutments, wingwalls, retaining walls, Bents No. 1 and 2 at Kaahele Street, Bent No. 8 at Pono Street, and the piers of the Waiau Interchange Grade Separation. The temporary concrete barriers shall be pinned near the excavated areas but not on

Interstate Route H-1 unless otherwise permitted by the Engineer. The excavations at Bents No. 8 and 9 shall not disturb, damage or otherwise be detrimental to any portion of the existing buildings foundations.

Excavate foundations to the elevations according to the particular type of structure to be placed. See Viaduct General Notes 8(F) and 8(T) on plan sheet no. AS0.4 regarding restrictions on work within the Waimalu Stream Channel.

Do not disturb the ground below the elevations shown in the contract in structure excavation operations. When disturbing such ground below the required elevations, excavate the disturbed ground until the undisturbed ground is reached. Backfill this area with Class D concrete until the required foundation footing elevation is reached. This work shall be at no cost to the State.

Keep the foundation dry by draining, bailing, pumping, driving sheathings or constructing cofferdams and cribs.

When the material from excavation does not meet the quality requirements specified for the backfill, furnish such suitable material as required.

Use or dispose surplus and suitable material from structure excavation remaining after completing backfilling according to Section 203 - Excavation and Embankment.

(B) Cofferdams. Carry cofferdams for foundation construction well below the bottom of the footings. Brace well and as watertight as practicable. Provide the interior dimensions of cofferdams sufficient clearance for driving piles, constructing forms and, when placing no seal, to permit pumping outside the forms.

When the clearance provided in the contract between the outside line of the footing and piles or interior wall or surface is not sufficient to permit the driving of piles or building of forms, the Contractor may provide such clearance. The Engineer will consider such enlargement over one foot outside the dimensions of the footing shown in the contract for the sole purpose of expediting the work of the Contractor and is of no value to the State. The Engineer will not include such excavation and backfill for payment.

Correct or enlarge cofferdams that are tilted or moved out of position during the process of sinking. Such work shall be at no cost to the State.

In tidal waters or in streams at a time of probable flood, vent cofferdam walls at low water elevation to insure full hydrostatic head both inside and outside the cofferdam when pouring and setting of seals.

The Engineer will not permit shoring in cofferdams that will induce stress, shock, or vibration in the permanent structure or that cannot meet the requirements of Section 107.16 - Protection and Restoration of Property and Landscape.

When permitted, cross struts or bracing may extend through foundation concrete. The Engineer may permit such struts or bracing below low water to remain in place. Remove struts or bracing above low water. Fill any holes, depressions and voids completely the volume with concrete or mortar of the same compressive strength as that specified for the surrounding concrete.

If requested by the Engineer, submit drawings and design calculations showing the proposed method of cofferdam construction and other details left open to its choice or not fully shown on the contract for substructure work. The type and clearance of cofferdams shall be subject to acceptance.

Remove the cofferdams with sheathing and bracing to the level one foot below the streambed at no cost to the State after the completion of the substructure. Remove the cofferdam so as not to disturb or mar the finished concrete or masonry.

(C) Foundation Treatment. Uncover the rock fully when footing concrete or masonry is to rest upon rock. Remove the surface to a depth sufficient to expose sound rock as determined by the Engineer. Level off the rock roughly or cut and roughen to approximate horizontal and vertical steps.

Grout seams in rock under pressure. The Engineer will pay the cost for grouting under Contract Item No. 206.9010 - Foundation Grouting according to Subsection 109.04 - Extra and Force Account (F.A.) Work.

Do not disturb the bottom of the excavation when not using piles and footing concrete or masonry is to rest on an excavated surface other than rock. Do not make the final removal of the foundation material to grade until just before placing the concrete or masonry.

Complete the excavation for retaining structures, piers and abutments to the bottom of the footings before drilling shafts therein.

Remove excess materials remaining in the excavation after drilling shafts to the elevation of the bottom of the footings.

The Engineer will permit excavating a sufficient distance below the bottom of the footing as shown on the contract at no cost to the State when using shafts. When the ground has risen above plan grade after drilling the shafts, remove the surplus material at no cost to the State. When the surface of the ground is below plan grade after drilling the shafts, backfill to the plan grade with Class D concrete at no cost to the State.

(D) Inspection. When the Engineer needs to determine the character of the foundation material, dig test pits and make test borings and foundation bearing tests. The Engineer will pay the cost according to Subsection 104.03 - Extra Work.

Notify the Engineer for inspecting and accepting the elevation and character of the foundation before placing concrete or masonry in the footing whenever completing the structure excavation to the foundation grade of a footing.

(E) Structure and Trench Backfill. Do not deposit material in fills until the test samples imply that the concrete has developed a strength required in Subsection 503.03(E) - Loading against the back of:

(1) concrete abutments,

(2) piers,

(3) concrete retaining walls, or

(4) the outside walls of concrete box culverts

Cure the test samples under conditions similar to those affecting the structure. Continue backfilling so that excessive unbalanced loads are not introduced against the structure.

Place backfill material in uniform horizontal layers not exceeding 8 inches in loose thickness before compaction. Moisten and compact each layer of backfill until obtaining a relative compaction of not less than 95%. The Engineer may reduce compaction requirement of 95% in situations where such compaction is not feasible such as in footings located in running streams or in swampy areas. The Engineer will be the sole judge of the degree of reduction. Backfill the footings with rockfill instead of the 95% compaction requirement in stream beds subject to appreciable scour.

When the Engineer cannot use the field density test, compact each layer of backfill with vibratory or suitable equipment on granular backfill material. Test methods to decide maximum densities and relative compaction according to Subsection 106.09 - Special Test Methods.

Do not use water containing an excessive quantity of salt or other deleterious substances for compaction of structure and trench backfill for metal pipes.

The Engineer will not permit compaction of backfill material by ponding or jetting.

Class "D" concrete backfill shall be used below the top of Bent No. 11 footing.

When required, make sufficient fill at culverts and bridges ahead of other grading operations to permit public traffic to cross. Compact structure backfill at the following areas to a relative compaction of not less than 90%:

(1) Oversized drains not beneath surfacing;

(2) Footing for slope protection, slope paving, and aprons;

(3) Headwalls, endwalls, and culvert wingwalls;

(4) Retaining walls except portions under surfacing and crib wall;

(5) Inlets in median areas or in traffic interchange loops;

(6) Footings not beneath surfacing;

(7) Other locations where the plans show 90% relative compaction for structure backfill.

(F) Filter Material. Place filter material for backfill at bridge abutments, and retaining walls according to the contract.

Make the subgrade as impervious as possible by pneumatic tamping where the material is placed. Compact the filter material thoroughly in layers with the backfill.

(G) Dewatering Activities. If excavation or backfilling operations requires dewatering, and the Contractor elects to discharge dewatering effluent into Waters of the United States or existing drainage systems, the Contractor shall obtain a National Pollutant Discharge Elimination System (NPDES) Activity Dewatering Permit from the Department of Health, Clean Water Branch (DOH-CWB). Do not begin dewatering activities until the DOH-CWB has issued a Notice of General Permit Coverage (NGPC). Dewatering operations shall be according to the conditions in the NGPC. Submit a copy of the NPDES Activity Dewatering Application and Permit to the Engineer.

(H) Controlled Low Strength Material. CLSM shall be constructed (furnishing and placing) in accordance with Section 313 - Controlled Low Strength Material (CLSM) for utilities and structures. CLSM shall be used as backfill below the top of the viaduct drilled shaft footings except at both abutments and the Honolulu side of the Type 2 footing at Bent No. 2.

206.04 Method of Measurement.

(A) Structure Excavation. The Engineer will measure structure excavation per cubic yard. The limits for payment shall be according to the contract or as specified by the Engineer.

In the case of excavation for bridge, retaining wall, culvert headwalls, and other structures, no deduction in pay quantities will be made where the Contractor does not choose, subject to the Engineer's acceptance, to excavate material that is outside the limits of the actual structure but within the limits of excavation shown in the contract.

The Engineer will not measure beyond the limits of concrete neat pour lines.

The lower limit for payment of structure excavation for foundations for bridges, retaining walls, culvert headwalls, and other structures shall be the bottom of the completed foundations.

When specified by the Engineer to increase the depth of structure excavation below the depth shown in the contract, the Engineer will measure the material removed to a depth of not more than three feet below said depth at the contract price per cubic yard for structure excavation.

The Engineer will not make compensation for the:

(1) removal and disposal of material that may come into an excavation from outside the designated limits;

(2) the removal and disposal of swell material resulting from the driving of piles in an excavation;

(3) furnishing and placing backfill material in an excavation that is below the designated grade.

(4) preparation and submittal of working drawings and/or calculations.

The Engineer will not include such quantities in the quantities of structure excavation to be paid for.

The upper limit for payment of structure excavation shall be the original ground surface before the start of construction operations with the following exceptions:

(1) When structure excavation is done within the roadway excavation area or ditch and channel excavation area, the upper limit shall be the planes of the bottom and side slopes of said areas excavated shown on the contract or as specified by the Engineer.

(2) When structure excavation is made in new embankments, the upper limit shall be the planes of the new embankment at the elevation shown in the contract or specified by the Engineer for construction ahead of doing the required structure excavation. The upper limit shall be the surface of the embankment at the time the excavation is made.

Except for culverts, the lateral limits for payment of structure excavation including cement rubble masonry and concrete headwalls shall be the vertical surfaces one foot outside the neat lines of the footings and as shown on the plans or ordered by the Engineer.

For culverts, except for structural plate culverts, the lateral limits for payment of structure excavation shall be 18 inches outside the external limits of the pipe. For structural plate culverts, the lateral limits for payment shall be three feet outside the external limits of the pipe.

The lateral limits for payment of structure excavation for a battery of two or more culverts (culverts placed next to each other and intended to serve as a unit), except for structural plate culverts, shall be 18 inches outside the external limits of the two outer pipes. The lateral limits for

payment of structure excavation shall be three feet outside the external limits of the two outer pipes for structural plate culverts.

For culverts and structural plate culverts, the lower limits for payment shall be the bottom elevation of the bed course material, and the upper limits shall be the existing ground.

For culverts and structural plate culverts in embankment fill, the lateral, lower, and upper excavation limits shall be measured after the embankment is completed according to Section 603.03(A).

The Engineer will not apply these requirements where the spaces between the pipes permit the use of compacting equipment such as power rollers. Treat each pipe as a single culvert where using such equipment.

The Contractor shall remove soft, spongy, or unsuitable material from the width equal to the span or diameter of the culvert plus one diameter outside the lateral limits of the culvert when encountering such material.

When using CLSM for backfill, the trench width may be reduced to the outside diameter or span of the culvert plus six inches on each side for culverts less than or equal to 42 inches in diameter or span, and 12 inches on each side for culverts greater than 42 inches in diameter or span. Culvert shall be anchored so that the culvert does not float when CLSM is used as backfill.

The limits of payment for structure excavation at Bent No. 11 footing are shown on plan sheet AS 8.1. The limits of payment for structure excavation at Abutment No. 2 of Waimalu Viaduct shall be the vertical surfaces along the neat lines of the footing where GRP abuts the footing.

(B) Structure B ackfill. The Engineer will consider structure and trench backfills not specified in the proposal or ordered incidental to structure excavation. The Engineer will measure structure backfill for bridge abutments, wingwalls, retaining walls, Bent 11 column footing (Class D concrete) and structural plate culverts per cubic yard. Compute the quantities based on the following limits unless otherwise shown on the plans or specified:

(1) Bridge Abutments, Wingwalls and Retaining Walls.

(a) The lower limit shall be the top of the completed footings.

(b) The upper limit for payment shall be the finished grade or the bottom of the pavement structure when under the roadway area.

(c) The lateral limits shall be one foot outside the neat line of the footings. The limits whichever is at a greater distance from the backface in a direction normal to the wall stems shall be the vertical plane:

1. one foot outside the heel of the footing, or

2. five feet from the backface measured at the top.

The Engineer will deduct the volume of filter material measured within the limits of payment for structure backfill for bridge abutments, wingwalls, and retaining walls from the pay quantities of structure backfill.

(2) Structural Plate Culverts.

(a) The lower limit shall be the grade line or elevation designated in the contract or ordered specifically by the Engineer for the lower outside surface of the culverts.

(b) The upper limit shall be one foot above the top of the culverts.

(c) The lateral limits shall be the vertical surface 36 inches outside the lateral limits of the culverts.

The Engineer will deduct the volume occupied by the structural plate culvert within the limits of payment for structure backfill for structural plate culvert from the pay quantities of structure backfill.

The lateral limits for payment for structure backfill for a battery of two or more culverts placed adjacent to each other and intended to serve as a unit, shall be 36 inches outside of the external limits of the two outer pipes. The Engineer will not apply these requirements where the spaces between the pipes permit the use of compacting equipment such as power rollers. The Engineer will treat each pipe as a single culvert where the Contractor uses such equipment.

The lateral limits shall be the vertical surface one diameter outside the lateral limits of the culverts for areas of soft, spongy or unsuitable material.

(C) Structure and Trench Backfill for Culverts. The Engineer will not measure structure and trench backfills for culverts other than structural plate culverts.

(D) Trench Excavation for Utility Pipes. The Engineer will measure trench excavation for utility pipes, including water and sewer lines, per cubic yard.

(E) Trench Backfill for Utility Pipes. The Engineer will not measure trench backfills for utility pipes, including water and sewer lines.

(F) Filter Material. The Engineer will measure filter material per cubic yard. The Engineer will compute the quantities from the dimensions shown in the contract or as specified by the Engineer.

(G) Foundation Grouting. Foundation grouting on basalt rock formation, when directed by the Engineer, will be measured on a force account basis according to Subsection 109.04 - Extra and Force Account Work.

(H) Additional Foundation Over-Excavation. Additional foundation over-excavation of materials from depths greater than three feet below the bottom of footing elevation, when directed by the Engineer, will be measured on a force account basis according to Subsection 109.04 - Extra and Force Account Work.

(I) Controlled Low Strength Material. The Engineer will measure controlled low strength material per cubic yard for Waimalu Viaduct Bent footings only since CLSM at any other location shall be considered measured as the trench and structure backfill material required in this Section. The lower limit of the CLSM quantities will be based on the bottom of the mud slab as the lower limit, the top of the footing as the upper limit, and one foot outside the neat line of the footings as the lateral limits.

(J) Class D Concrete. The limits of payment for Class D concrete backfill at Bent No. 11 footing are shown on plan sheet AS 8.1.

206.05 Basis of Payment.

(A) Structure Excavation. The Engineer will pay for the accepted structure excavation at the contract unit price per cubic yard complete in place.

The price includes full compensation for excavating for structures and culvert trenches; keeping the foundation dry, placing and compacting surplus structure excavation in roadway embankments or disposing of the material along the roadway, protecting the sides of excavations, providing working drawings and/or calculations, providing cofferdams, notifying the Engineer for inspecting and accepting the elevation and character of the foundation; backfilling culvert trenches except for structural plate culverts; backfilling culvert trenches with CLSM except for structural plate culverts; furnishing and applying water for the compaction of structure backfill; testing the samples; placing backfill material in uniform horizontal layers; moistening and compacting each layer of backfill; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

If required, the price includes preparing an NPDES Dewatering Activities Permit application; obtaining a NPDES Permit Application (CWB-NOI Form G) from the Department of Health, Clean Water Branch; installing, operating, monitoring, and maintaining the dewatering activities; removing all equipment and facilities from the site; restoring the site to its original condition; and furnishing materials, equipment, tools, labor and other incidentals necessary to complete the work.

The Engineer will deduct the cost from the progress payment for citations received by the Department of Health for non-compliance with the NGPC. If the cost of the citations exceeds the amount of the progress payments, the Contractor shall pay the remaining balance to the State.

(B) Structure Backfill for Bridge Abutments, Wingwalls, Retaining Walls, Bent 11 Column Footing and Structural Plate Culverts. The Engineer will pay for the accepted structure backfill for bridge abutments, wingwalls, retaining walls, Bent 11 column footing (Class D concrete) and structural plate culverts at the contract unit price per cubic yard complete in place.

The price includes full compensation for using suitable material for backfilling structures and trenches; furnishing and applying water for the compaction of structure backfill; testing the samples; placing backfill material in uniform horizontal layers; moistening and compacting each

layer of backfill; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

(C) Structure and Trench Backfill for Culverts. The Engineer will not pay for structure and trench backfill for culverts other than structural plate culverts. The cost shall be incidental to Structure Excavation.

(D) Trench Excavation for Utility Pipes. The Engineer will pay for the accepted trench excavation for utility pipes, including water and sewer lines, at the contract unit price per cubic yard complete in place.

The price includes full compensation for excavating for utility pipes; placing and compacting surplus trench excavation in roadway embankments or disposing of the material along the roadway; dewatering, sheeting or sheathing; notifying the Engineer for inspecting and accepting the elevation and character of the trench; backfilling trenches, including installation of pipe cushion, cradle, select fill and backfill; backfilling trenches with CLSM; furnishing and applying water for the compaction of structure backfill; testing the samples; placing backfill material in uniform horizontal layers; moistening and compacting each layer of backfill; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

If required, the price includes preparing an NPDES Dewatering Activities Permit application; obtaining a NPDES Permit Application (CWB-NOI Form G) from the Department of Health, Clean Water Branch; installing, operating, monitoring, and maintaining the dewatering activities; removing all equipment and facilities from the site; restoring the site to its original condition; and furnishing materials, equipment, tools, labor and other incidentals necessary to complete the work.

The Engineer will deduct the cost from the progress payment for citations received by the Department of Health for non-compliance with the NGPC. If the cost of the citations exceeds the amount of the progress payments, the Contractor shall pay the remaining balance to the State.

(E) Trench Backfill for Utility Pipes. The Engineer will not pay for trench backfill for utility pipes, including water and sewer lines. The cost shall be incidental to Trench Excavation.

(F) Filter Material. The Engineer will pay for the accepted filter material at the contract unit price per cubic yard, complete in place. The price includes full compensation for tamping the subgrade; furnishing, and placing the backfill material in uniform horizontal layers; filter fabric,

moistening and compacting each layer; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

(G) Foundation Grouting. The Engineer will pay for the accepted foundation grouting on basalt rock formation on a force account basis according to Subsection 109.04 - Extra and Force Account Work.

(H) Additional Foundation Over-Excavation. The Engineer will pay for the accepted additional foundation over-excavation of materials from depths greater than three feet below the bottom of footing elevation according to Subsection 109.04 - Extra and Force Account Work.

(I) Controlled Low Strength Material. The Engineer will pay for the accepted controlled low strength material at the contract price per cubic yard, complete in place only at Waimalu Viaduct Bent footings. The price includes full compensation for furnishing, placing, and protecting from traffic, the controlled low strength material including all equipment, tools, labor, materials and incidentals necessary to complete the work as specified in this Section and in Section 313 - Controlled Low Strength Materials (CLSM) for utilities and structures.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Structure Excavation for _____	Cubic Yard
Structure Backfill for _____	Cubic Yard
Trench Excavation for _____	Cubic Yard
Filter Material for _____	Cubic Yard
Foundation Grouting	Force Account
Additional Foundation Over-Excavation	Force Account
Controlled Low Strength Material for _____	Cubic Yard"

END OF SECTION

The following Section shall be made part of the Standard Specifications:

"SECTION 211 – REINFORCED SOIL SLOPE

211.01 Description. This work includes furnishing and installing a reinforced soil slope system according to the contract.

Furnish all materials, storage, handling tools, equipment, labor, and any other appurtenances necessary to complete the work. Do not begin placement of the geosynthetic reinforcement until a qualified representative of the manufacturer is present at the beginning of the geosynthetic reinforcement placement.

211.02 Definitions.

(A) Reinforced Soil Slope. A fill embankment constructed with geosynthetic reinforcement at a steepened fill slope inclination of up to one and one-half horizontal to one vertical (1.5H:1V). As the steepened fill slope is constructed, horizontal layers of geosynthetic reinforcement, consisting of reinforced slope geogrids or geotextiles, are placed in the compacted fill at pre-determined levels. The lengths of the reinforced slope geogrid or geotextile layers are to anchor potential failure zones into stable interior sections of the embankment or hillside. As forces develop within a soil mass, the high-modulus reinforced slope geogrids or geotextiles are immediately pulled into tension.

(B) Geosynthetic Reinforcement. A reinforced slope geogrid or a reinforced slope geotextile that can develop sufficient mechanical interlock with the surrounding soil or rock.

(C) Reinforced Slope Geogrid. A polymer plastic formed into a very open, grid-like structure with large apertures fabricated for use as soil reinforcement.

(D) Reinforced Slope Geotextile. A stable woven network of long chain polymeric filaments or yarns fabricated for use as soil reinforcement.

(E) Primary Reinforcement. A geogrid which has been manufactured with high tensile strength and modulus in one direction only or a geotextile with high tensile strength and modulus in at least one direction.

(F) Secondary Reinforcement. A geogrid or geotextile which has been manufactured with high tensile strength and modulus in two directions, along the roll length and across the roll width.

(G) Erosion Control Matting. A geosynthetic material manufactured to control erosion of slopes and enhance grassing.

211.03 Submittals.

(A) Qualification of the Manufacturer. The manufacturer of the geosynthetic reinforcement products shall have at least five years experience in successfully installing their geosynthetic product. Reinforcement material shall have been used on at least five projects of a similar scope and a list of those projects with references to Owner, Engineer, and Contractor shall be submitted for approval at least 30 calendar days prior to initiating the reinforced soil slope construction.

(B) Materials. Prior to ordering geosynthetic reinforcement, submit the following for acceptance:

1. Test reports of the geosynthetic reinforcement properties;

2. Documentation substantiating the life of the geosynthetic reinforcement, and

3. Documentation for the ultimate tensile strength and reduction factors used in determining the long-term design strength for the geosynthetic reinforcement.

Prior to installation of the geosynthetic reinforcement, submit a manufacturer's certification that the geosynthetic supplied meet the respective index criteria set when the geosynthetic was approved by the State and measured in full accordance with all test methods and standards specified and as set forth in these specifications.

The manufacturer's certificate shall state that the furnished geosynthetics meet the requirements of the specifications as evaluated by the manufacturer's quality control program. The certificates shall be attested to by a person having legal authority to bond the manufacturer. In case of dispute over validity of values, the Engineer may require the Contractor to supply test data from an approved laboratory to support the certified values submitted.

211.04 Materials.

(A) Geosynthetic Reinforcement. The geosynthetic reinforcement shall consist of a reinforced slope geogrid or a reinforced slope geotextile that can develop sufficient mechanical interlock with the surrounding soil or rock. The geosynthetic reinforcement structure shall be dimensionally stable and shall

be able to retain its geometry under construction stresses. The geosynthetic reinforcement shall have high resistance to damage during construction, ultraviolet degradation, and all forms of chemical and biological degradation encountered in the soil being reinforced. The geosynthetic reinforcement shall be designated for a minimum life of 100 years.

(1) Reinforced Soil Geogrid. The geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock.

The geogrid shall have the following properties:

Property	Minimum Values
Long-Term Design Strength (LTDS) for Primary Reinforcements See Notes: (1), (2), and (3)	4,200 lbs/foot
Long-Term Design Strength (LTDS) for Secondary Reinforcements See Notes: (1), (2), and (3)	480 lbs/foot
Pullout Resistance Factor for Primary and Secondary Reinforcements - See Note (2)	0.40

Notes:

(1) Based on minimum average roll values (MARV) (lbs/foot)

(2) The long-term strength and pullout resistance factor shall be determined in accordance with the FHWA reports FHWA-SA-96-071 and FHWA-SA-96-072.

(3) Long-term Design Strength (LTDS) based on the following:

$$LTDS = T_{ult} / (RF_d \times RF_{id} \times RF_{cr})$$

Where

T_{ult} = ultimate tensile strength as determined in accordance with ASTM D 4595

RF_d = reduction factor for degradation for 100 year design life

RF_{id} = reduction factor for installation damage obtained from site installation damage testing RF_{cr} = reduction factor for creep developed in accordance with ASTM D 5262

(2) Reinforced Slope Geotextile. Geotextiles shall be woven and consist only of long chain polymeric filaments or yarns formed into a stable network such that the filaments or yarns retain their position relative to each other during the handling, placement, and design service life. At least 95 percent by weight of the long chain polymer shall be polyolefin or polyester. The material shall be free of defects and tears. The geotextile shall be free from any treatment or coating that might adversely alter its physical properties after installation.

The geotextile shall have the following properties:

Property	Minimum Values
Long-Term Design Strength (LTDS) for Primary Reinforcements See Notes: (1), (2), and (3)	4,200 lbs/foot
Long-Term Design Strength (LTDS) for Secondary Reinforcements See Notes: (1), (2), and (3)	480 lbs/foot
Pullout Resistance Factor for Primary and Secondary Reinforcements - See Note (2)	0.40

Notes:

(1) Based on minimum average roll values (MARV) (lbs/foot)

(2) The long-term strength and pullout resistance factor shall be determined in accordance with the FHWA reports FHWA-SA-96-071 and FHWA-SA-96-072.

(3) Long-term Design Strength (LTDS) based on the following:

$$LTDS = T_{ult} / (RF_d \times RF_{id} \times RF_{cr})$$

Where

T_{ult} = ultimate tensile strength as determined in accordance with ASTM D 4595

RF_d = reduction factor for degradation for 100 year design life

RF_{id} = reduction factor for installation damage obtained from site installation damage testing

RF_{cr} = reduction factor for creep developed in accordance with ASTM D 5262

(B) Select Granular Fill Material. The select granular fill material shall be coarse grain material free from organic or other deleterious materials. The backfill material shall conform to the following grading requirements and the top 3 feet shall contain sufficient fines (minus No. 10) to fill the voids in a compacted state.

U.S. Standard Sieve Size	Percent Passing By Weight
3 inch	100
¾-inch	75-100
No. 4	20 – 100
No. 40	0 – 60
No. 200	0 – 15

Select granular fill material shall also conform to the following requirements:

(1) The material shall be non-plastic. Plasticity Index (PI) as determined by AASHTO T-90 shall be 0.

(2) The fraction finer than 15 microns (0.015 mm) as determined by AASHTO T-88 shall not exceed 5 percent.

(3) The material shall exhibit an angle of internal friction of not less than 34 degrees, as determined by the standard Direct Shear test - AASHTO T-236 (ASTM D-3080), utilizing a sample of the material compacted to 95 percent of AASHTO T-180, Methods C or D at Optimum Moisture Content.

(C) General Backfill. All backfill material used above, behind, and below the zone being reinforced may consist of on-site fill material with a maximum

particle size of 6 inches with Unified Soil Classifications of MH, CL, ML, SM, SC, GM, and GC.

(D) Erosion Control Matting. Erosion control matting shall be a roll-on mat product as specified in Section 663 - Erosion Control Matting. Hydraulically applied products will not be accepted. Erosion control matting anchor materials and details shall be in accordance with Subsection 663.03(B) Installation.

211.05 Construction Requirements.

(A) Delivery, Storage, and Handling. Protect the geosynthetic reinforcement from temperatures greater than 60 degrees Centigrade or less, if recommended by the manufacturer, mud, dirt, and debris. Follow the manufacturer's recommendations in regards to protection from direct sunlight. The Engineer will reject the geosynthetic reinforcement, if it has defects, tears, punctures, flaws, deterioration, or damage. Replace any geosynthetic reinforcement damaged at no additional cost to the State.

(B) Site Excavation. Prepare all areas immediately beneath the installation area for the geosynthetic reinforcement according to the contract. Subgrade surface shall be level, free from deleterious materials, roots, loose, or otherwise unsuitable soils. Prior to placement of geosynthetic reinforcement, proof-roll subgrade with a 10-ton drum roller to provide a uniform and firm surface. Excavate and replace any soft areas with suitable compacted fill. The Engineer shall inspect that foundation surface prior to fill placement. Bench the backcut into competent soil in a manner that ensures stability.

(C) Geosynthetic Placement. Install the geosynthetic reinforcement according to the manufacturer's recommendations. Place the geosynthetic reinforcement within the layers of compacted soil.

Place the geosynthetic reinforcement in continuous longitudinal strips in the direction of main reinforcement. However, if the Contractor is unable to complete a required length with a single continuous length of geogrid, a joint may be made with the Engineer's approval. The Engineer will allow only one joint per length of geogrid. Install this joint for the full width of the strip by using a similar material of similar strength. Pull and hold the joints in geogrid reinforcement taut during fill placement. Do not use joints with geotextiles. Verify the correct orientation of reinforcement (roll direction) of the geogrids.

Place only that amount of geosynthetic reinforcement required for immediately pending work to prevent undue damage. After placing a layer of geosynthetic reinforcement, place and compact the next succeeding layer of soil as required. After placing the specified soil layer, install the next geosynthetic reinforcement layer. Repeat the process for each subsequent layer of geosynthetic reinforcement and soil.

Place and pull the geosynthetic reinforcement to lay flat and tight prior to backfilling. After replacing a layer of geosynthetic reinforcement, use suitable means, such as pins or small piles of soil, to hold the geosynthetic reinforcement in position until a subsequent soil layer can be placed. The Engineer will not allow a track-type vehicle on the geosynthetic reinforcement before at least 6 inches of soil has been placed.

During construction, keep the surface of the fill approximately horizontal. Place geosynthetic reinforcement directly on the compacted horizontal fill surface. Place geosynthetic reinforcements within 3 inches of the design elevations and extend the length according to the contract. Verify correct orientation of the geosynthetic reinforcement.

Form new foundations of structures that are designed to be embedded in the reinforced soil slope prior to filling. Then place the geosynthetic reinforcement around the forms for the foundations according to the recommendations of manufacturer. Care shall be exercised when compacting fill around the forms for the structure foundations to avoid deforming the forms.

(D) Fill Placement. Place, spread, and compact backfill to minimize the development of wrinkles and/or displacement of the geosynthetic reinforcement. Place fill in 8-inch maximum uncompacted lift thickness where heavy compaction equipment is to be used and 6-inch maximum uncompacted lift thickness where hand operated equipment is used. Compact select granular fill and general fill to not less than 95 percent relative compaction.

Compact fill according to the contract. Make density testing every 2,000 square feet of each lift of fill compacted by other than hand-operated machines and every 1,500 square feet of each lift of fill compacted by hand-operated machines.

Grade and roll backfill away from the slope crest and at the end of each day to prevent ponding of water on the surface of the reinforced soil mass.

Do not operate tracked construction equipment directly upon the geosynthetic reinforcement. A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over the geosynthetic reinforcement. Keep turning of tracked vehicles to a minimum to prevent tracks from displacing the fill and the geosynthetic reinforcement.

(E) Erosion Control Matting. Provide erosion control matting as specified in Section 663 – Erosion Control Matting at the face of all fill slopes designated as reinforced soil slope.

211.06 Method of Measurement. The Engineer will not measure reinforced soil slope for payment.

The Engineer will measure erosion control matting for reinforced soil slope under Section 663 – Erosion Control Matting.

211.07 Basis of Payment. The Engineer will pay for the accepted reinforced soil slope on a lump sum basis complete in place.

The price includes full compensation for furnishing all labor, materials, tools and equipment for performing all reinforced soil slope work completed in place including excavation, geosynthetic reinforcement, select granular fill, and general backfill.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Reinforced Soil Slope	___ Lump Sum

The Engineer will pay for erosion control matting for reinforced slope under Section 663 – Erosion Control Matting."

END OF SECTION

Amend **Section 411 - Portland Cement Concrete Pavement** to read as follows:

"SECTION 411 - PORTLAND CEMENT CONCRETE PAVEMENT

411.01 Description. This section is for constructing pavement excluding approach slabs adjacent to Waimalu Viaduct, composed of portland cement concrete (PCC) with or without reinforcement, on a prepared subgrade or base course according to the contract or as specified by the Engineer.

At the option of the Contractor, the Contractor may construct the pavement with equipment using stationary side forms or slip form paving.

411.02 Materials. Concrete shall have a minimum flexural strength, f'_r of 650 psi unless otherwise indicated on the plans, and shall conform to Section 601 - Structural Concrete.

Reinforcing steel shall conform to Subsection 709.01, except as otherwise noted on the plans.

Other materials shall conform to:

Joint Filler	705.01
Joint Sealer	705.04
Curing Materials	711.01

411.03 Construction Requirements.

(A) Proportioning. Base the proportioning on the predetermined cement content or designed for minimum flexural strength as specified in the contract. Submit the proportions of the materials for acceptance by the Engineer.

Determine the slump according to AASHTO T 119 (ASTM C 143) and air content according to AASHTO T 152 (ASTM C 231). Make, cure, and test the test specimens according to AASHTO T 23 (ASTM C 31), AASHTO T 22 (ASTM C 39) and AASHTO T 97 (ASTM C 78), and the cement content according to AASHTO T 121 (ASTM C 138).

State the proportions in terms of aggregates in a saturated surface-dry condition. Adjust the batch weights periodically to take into account the actual moisture of the aggregates at the time of use. The designated proportions govern during the progress of the work except in the following:

(1) Do not make changes in the sources or character of the materials without due notice to the Engineer. Do not use the new materials until the Engineer designates and accepts the new proportions based upon laboratory tests and trial mixes.

(2) When concrete having the required consistency cannot be produced without exceeding the maximum allowable water-cement ratio specified, increase the cement content as specified by the Engineer.

(3) When concrete of the desired plasticity and workability cannot be obtained with the proportions originally accepted, the Engineer will make such changes in aggregate weights as required provided the original designated cement content does not change except as specified in items (1) and (2) above.

(B) Equipment. The Engineer will examine the equipment and tools necessary for handling materials and doing the work for acceptance as to the design, capacity, and mechanical condition. The equipment shall be at the work site sufficiently ahead of the start of this activity for examination. The Contractor shall comply with the following:

(1) Batching Plant and Mixers. The batching plant and mixers shall conform to Section 601 - Structural Concrete.

(2) Hauling Equipment. Equipment for hauling concrete shall conform to Section 601 - Structural Concrete.

(3) Finishing Equipment.

(a) Finishing Machine. The finishing machine shall be self-propelled. When in operation, equip the finishing machine with at least two oscillating type transverse screeds supported by the forms. The finishing machine shall handle and finish the mixes required for this type of construction. The finishing machine shall not displace the reinforcement, side forms, or joints. No supports for the finishing machine shall be in the area where concrete is to be poured that day. Blockouts for the supports will not be allowed.

(b) Vibrators. Vibrators, for full width vibration of the concrete, may be either the surface pan type or the internal type with immersed tube or multiple spuds. The vibrators may be attached to the spreader or the finishing machine or mounted on a separate carriage. The vibrators shall not come in contact with the reinforcement, load transfer devices, subgrade, or side forms. Operate the vibrating equipment according to the manufacturer's recommended frequency. However, the frequency of the surface vibrators shall not be less than 3,500 impulses per minute and the

frequency of the internal type shall not be less than 5,000 impulses per minute. Hand vibrators shall have a frequency of not less than 5,000 impulses per minute. Furnish a tachometer for measuring and indicating the frequency of vibration.

(c) Machine Floats. Mechanical floats shall be self-propelled. Use mechanical floats designed to finish pavement smoothly and true to grade. Mechanical floats shall run either on side forms or on adjacent lanes of concrete.

Use floats constructed of hardwood, steel, or steel-shod and equipped with devices to permit adjusting the underside of a true flat surface.

(d) Slip-Form Pavers. Slip-form pavers shall be self-propelled. Use slip-form pavers equipped with traveling side forms of sufficient dimensions, shape, and strength to produce pavement of the required cross section. Slip-form paving equipment shall spread, consolidate and screed freshly placed concrete so a minimum of handwork is required to produce a dense homogeneous pavement true to the cross section and profile within the specified tolerances.

Use slip-form pavers equipped with high frequency internal vibrators for the full width. The vibrators may be mounted with their axis parallel or normal to pavement alignment. When mounting the vibrators with their axis parallel with the pavement alignment, space the vibrators at an interval not to exceed 2.5 feet measured center to center.

When mounting vibrators with their axis normal to the pavement alignment, space the vibrators so that the lateral clearance between individual vibrating units does not exceed 0.5 feet.

Use slip-form pavers designed so that the longitudinal axis at the center of each vibrating unit is not more than 0.5 feet above the pavement grade while spreading, compacting, and shaping the pavement.

The vibration rate of each vibrating unit shall be not less than 5000 cycles per minute. Furnish a tachometer to measure the frequency of vibration.

The Contractor may use the equipment designed to complete the paving operations with one machine or may consist of a mechanical spreader followed by a separator power unit.

(4) Concrete Saw. When sawing joints are elected or specified, provide sawing equipment adequate in number of units and power to complete the sawing with a water-cooled diamond edge saw blade or an abrasive wheel to the required dimensions and at the required rate. Provide at least one standby saw in good working order. Maintain an ample supply of saw blades at the work site during sawing operations. Provide adequate artificial lighting facilities for night sawing. This equipment shall be on the work site both before and continuously during concrete placement.

(5) Forms. Use straight side forms made of a metal having a thickness of not less than 7/32 inch, furnished in sections not less than 10 feet in length. Forms shall have a depth equal to the prescribed edge thickness of the concrete and a base width equal to at least 80% of the specified pavement thickness. The Engineer will not allow horizontal joint unless accepted by the Engineer as a built-up form. Each form section shall be straight and free from bends and warps. No section shall show a variation greater than 1/8 inch in 10 feet from the true plane on the top and 1/4 inch in 10 feet along the face of the form. The method of connecting form sections shall insure tight, neat joint. Side forms shall be of sufficient rigidity in the form and in the interlocking connection with adjoining forms such that springing will not occur under the weight of the subgrading and paving equipment or from pressure of concrete. The Contractor may use built-up metal forms by rigidly attaching a wood or metal section of suitable width and thickness to the bottom of the form providing an increase in depth of not more than 20%.

Use the flexible or curved forms of proper radius for curves of 100-foot radius or less. The Contractor may use the straight steel forms in sections of 10 feet or less in length for form lines having a radius greater than 200 feet. The Engineer will permit special forms of wood or steel for curved form lines having a radius of 200 feet or less. Where the use of standard pavement forms are impracticable, submit working drawings for acceptance. Five feet

long straight steel form section will be acceptable for curved form lines having a radius of not less than 100 feet.

Forms shall be of sufficient rigidity to prevent distortion in edge alignment due to pressure of concrete. Do not use the wood forms as a track for operating paving and finishing equipment.

(C) Preparation of Grade. After grading and compacting the roadbed, trim the grade to the approximate correct elevation, extending the work at least two feet beyond each edge of the proposed concrete pavement.

Grade and maintain the track path in a smooth compacted condition until after constructing the pavement.

(D) Setting Forms.

(1) Base Support. The foundation under the forms shall be hard and true to grade so that the form, when set, shall be firmly in contact for its whole length and at the specified grade. Fill the grades found below established grade with granular material in lifts of 0.5 inch or less for a distance of 18 inches on each side of the base of the form, and thoroughly compacted. Correct the above grade imperfections or variations by tamping or trimming as necessary.

(2) Form Setting. Set the forms sufficiently ahead of concrete placement to provide time to check the line and grade and provide a continuous concrete placement operation. After setting the forms to the correct grade, tamp the grade thoroughly, mechanically or by hand, at both the inside and outside edges of the base of the forms. Stake the forms into place with not less than three pins for each 10-foot section. Place a pin at each side of every joint. Lock the form sections tightly from play or movements. The forms shall not deviate from true line by more than 1/4 inch. Set the forms so that the forms will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Clean and coat the forms with a form release agent or oiled before placing the concrete.

(3) Grade and Alignment. Check and correct the alignment and grade elevations of the forms immediately before placing the concrete. When the forms are disturbed or grades become unstable, reset and recheck the forms.

(E) Conditioning of Subgrade or Base Course. Bring the subgrade or base course to proper cross section. Trim the high areas to proper elevation. The low areas may be filled and compacted to a condition similar to that of surrounding grade, or fill the low areas with concrete integral with the pavement. Maintain the finished grade in a smooth and compacted condition until placing the pavement.

If waterproof subgrade or base course cover material is not specified, moisten the subgrade or base course uniformly and remove excess water standing in pools or flowing on the surface before placing the concrete.

(F) Handling, Measuring, and Batching Materials. Handling, measuring, and batching materials shall be according to Section 601 - Structural Concrete.

(G) Mixing Concrete. Mixing concrete shall be according to Section 601 - Structural Concrete.

(H) Limitations of Mixing. Do not mix, place, or finish the concrete when the natural light is insufficient, unless an adequate and acceptable artificial lighting system is operated.

Before placing concrete pavement, have a good and sufficient supply of water available throughout the work. An inadequate water supply will be cause for delaying or shutting down the concrete mixer. In case of a deficiency of water, use the water available for curing the concrete already placed.

Make advance arrangements to prevent delay in delivery and placing of the concrete. An interval of more than 30 minutes between placing of two consecutive batches or loads of concrete shall constitute cause for stopping paving operations. When suspending concrete operations for such cause, make a joint at the location and of the type specified by the Engineer in the concrete already placed and according to Subsection 411.03(L) - Joints at no cost to the State.

(I) Placing Concrete. Make adequate advance arrangements for preventing delay in delivery and placing of the concrete. An interval of more than 45 minutes between placing of any two consecutive batches or loads shall constitute cause for stopping paving operations. When stopping paving operations, make a construction joint at the location and of the type specified by the Engineer at no cost to the State.

Slip-form paving and finishing machines shall be in satisfactory adjustment and operational condition. Before placing concrete, demonstrate proper adjustment of the screeds and floats on slip-form

pavers by measurements from grade stakes driven to known elevations. Demonstrate satisfactory operation and adjustments of the propulsion and control equipment, including pre-erected grade and alignment lines by moving the slip-form pavers and finishing machines over a 500-foot length of prepared subgrade with the propulsion and control equipment fully operational.

Either construct the pavement in 12-foot widths separated by longitudinal weakened joints or monolithically in multiples of 12-foot widths with a longitudinal weakened plane joint at each traffic lane line.

Place the concrete while fresh. Moisten subgrade before pouring. Do not use water for re-tempering concrete. Deposit the concrete on grade so as to require as little rehandling as possible. Unless truck mixers, truck agitators, or non-agitating hauling equipment are equipped with means for discharge of concrete without segregation of the materials, unload the concrete into an accepted spreading device and mechanically spread on the grade so as to prevent segregation of the materials. Placing shall be continuous between transverse joints without use of intermediate bulkheads. Use shovels for hand spreading, not rakes. Do not allow the workers to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Do not use concrete showing improper proportions of materials, including water, in the pavement. Remove and dispose such unsatisfactory concrete at no cost to the State.

Spread, shape, and consolidate the concrete so that the completed pavement will conform to the thickness and cross section requirements of the contract. The sides of pavement may be constructed on a batter not to exceed one horizontal to six vertical (1H:6V), provided the top of the pavement is maintained at the specified width.

When constructing portland cement concrete pavement adjacent to an existing parallel concrete pavement not constructed as part of the contract, spread, compact, and shape the concrete so that:

(1) the completed pavement will conform to the thickness and cross section requirements of the contract;

(2) the water does not pond on either side of the longitudinal joint with the existing pavement;

(3) the new pavement surface at the longitudinal joint conforms as close as possible to the elevation of the existing concrete

pavement. Eliminate any differences in elevation between the new pavement and the existing pavement by finishing the new pavement within one foot of the existing pavement by hand methods, adding or removing concrete as necessary;

(4) the transverse straightedge, longitudinal straightedge, and Profile Index requirements specified in Subsection 411.03(M) - Final Strike-Off, Consolidation and Subsection 411.03(N) - Surface Test will not apply to the pavement surface within one foot of the existing concrete pavement;

(5) the profiles of the completed pavement surface specified in Subsection 411.03(N) - Surface Test are not required within four feet of the longitudinal construction joint with the existing concrete pavement;

(6) the thickness measurements specified in Subsection 411.03(T) - Tolerance in Pavement Thickness are not made in pavement within one foot of the existing concrete pavement; and

(7) the transverse weakened plane joints are constructed in pavement widening to match the spacing and skew of the weakened plane joints in the existing pavement.

When placing concrete adjacent to a previously constructed lane of pavement, do not operate the mechanical equipment on the existing lane of pavement until the existing concrete pavement has obtained a strength of not less than 550 pounds per square inch when tested according to AASHTO T 97 - Flexural Strength of Concrete (using Simple Beam with Three Point Loading).

Construct the pavement using only that paving equipment that produces a finished surface meeting straightedge and profile index according to Subsection 411.03(M) - Final Strike-Off, Consolidation, and Finishing and Subsection 411.03(N) - Surface Test. Failure of equipment to produce pavement that conforms to said requirements will constitute cause for stopping placement of concrete until the deficiency or malfunction is corrected.

When placing concrete adjacent to an existing pavement, equip that part of the equipment supported on existing pavement with protective pads on crawler tracks or rubber tired wheels with the bearing surface offset to run a sufficient distance from the pavement edge to avoid breaking or cracking that edge.

Spreading, compacting, and shaping shall also conform to:

(1) Stationary Side Form Construction. Spread, shape, and consolidate the concrete by one or more machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement conforms to required cross section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to finish the work required at a rate equal to that of concrete delivery.

Effectively consolidate the concrete for the full paving width by means of surface or internal vibrators.

When using vibrators to consolidate concrete, the rate of vibration shall not be less 3,500 cycles per minute for surface vibrators and shall not be less than 5,000 cycles per minute for internal vibrators.

Amplitude of vibration shall be sufficient to be perceptive on the surface of concrete more than one foot from the vibrating element. Furnish a tachometer for measuring and indicating frequency of vibration.

Vibrators shall not rest on new pavement or side forms. Connect the power to vibrators so that vibration ceases when forward or backward motion of the machine is stopped.

Spread and shape the concrete for exit ramp termini, truck weigh stations, ramps and connectors with steep grades and high rates of superelevation, short sections of City and County streets and roads, and concrete required to be placed in short lengths or in widths other than multiples of 12-foot traffic lanes by acceptable powered finishing machines supplemented by hand work as necessary. Consolidation of such concrete shall be by high-frequency internal vibrators within 15 minutes after depositing the concrete on the subgrade. Vibrate with care so to assure adequate consolidation adjacent to forms and uniformly across the full paving width. The Engineer will not permit use of vibrators for extensive shifting of the mass of concrete. Discontinue the methods of spreading, shaping, and compacting that result in segregation, voids, or rock pockets. Adopt methods that will produce dense homogeneous pavement conforming to required cross section.

(2) Slip Form Construction. Slip form paving equipment shall spread, consolidate, and screed freshly placed concrete so that a minimum of handwork is required to produce a dense

homogeneous pavement true to cross section and profile. The Engineer will not permit abrupt changes in longitudinal deviation of the pavement. The horizontal deviation shall not exceed 1/10 of a foot from the alignment established by the contract.

Effectively consolidate the concrete for the full paving width by high frequency vibrators. Operate the slip-form paver with as nearly a continuous forward movement as possible. Coordinate the operations of mixing, delivering, and spreading the concrete to provide a uniform progress with stopping and starting of the paver held to a minimum. When stopping the forward movement of the paver, the vibratory and tamping elements shall also cease immediately. Do not apply tractive force to the machine except those tractive force controlled by the machine.

(J) Test Specimens. Furnish the concrete necessary for casting test beams and cylinders at no cost to the State. Cure the beams as specified for pavement according to AASHTO T 23 (ASTM C 31).

(K) Strike-Off of Concrete and Placement of Reinforcement. After placing the concrete, strike off the concrete to conform to the cross section shown in the contract and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation shown in the contract.

When placing reinforced pavement in two layers, strike off the entire width of the bottom layer to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in final position without further manipulation.

Place the reinforcement directly upon the concrete, place, strike off, and screed the top layer of the concrete. Remove and replace the portions of the bottom layer of concrete at no cost to the State when more than 30 minutes have elapsed after placement without covering the bottom layer with freshly mixed concrete.

When placing reinforced concrete in one layer, the reinforcement may be positioned ahead of concrete placement or may be placed in plastic concrete, after spreading by mechanical or vibratory means.

For the reinforcing steel, Subsection 602.04 - Storage, Surface Condition and Protection of Reinforcement, shall apply.

(L) Joints. Construct the joints normal to the pavement surface of the type, dimensions, and at locations required by the contract.

(1) Longitudinal Joints. The width of the longitudinal contraction joint shall be 1/8 inch with a depth of d = D/4 where:

d = minimum depth rounded up to the nearest 0.01-foot

D = thickness of pavement in lane

Place the deformed steel tie bars of the specified length, size, spacing and material perpendicular to the longitudinal joint at a target depth of d = D/2. Place the deformed steel tie bars by mechanical equipment or secure the deformed steel tie bars rigidly by chairs or other supports to prevent displacement. Use 30 inches long No. 5 rebars and space 30 inches center to center. Tie bars which are to be bent and later straightened shall be grade 40. The Engineer may require other sizes, grades, lengths, and spacing base on slab width, thickness and the type of underlying base. Do not paint or coat the tie bars with asphalt or other material not enclosed in tubes or sleeves.

(a) Longitudinal Construction Joints. When constructing adjacent paving lanes separately, the tie bars may be bent with keyways at right angles against the forms of the first lane constructed and straightened into final position before placing concrete in the adjacent lane or an acceptable two-piece tie bar connectors may be used. When inserting a two-piece tie bar connector mechanically during slip form paving, maintain the proper alignment and adequate bond with the plastic concrete.

(b) Sawed Joint. Complete the sawing of longitudinal joints within 12 hours of paving and before concrete is placed in subsequent adjacent lanes and before equipments or vehicles are allowed on the pavement.

(2) Transverse Expansion Joints. The expansion joint filler shall be continuous from form to form. Shape the expansion joint to the subgrade and to the keyway, if any, along the form. Furnish the preformed joint filler in lengths equal to the pavement width or equal to the width of one lane. Do not use damaged or repaired joint filler.

Hold the expansion joint filler in a vertical position to secure the preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joints shall not deviate more than 0.25 inch in the horizontal alignment from a straight line. When assembling joint fillers in

sections, do not use the offsets between units. The Engineer will not permit plugs of concrete anywhere within the expansion space.

(3) Transverse Contraction Joints. Transverse contraction joints include planes of weakness created by forming or cutting grooves in the surface of the pavement and, when shown on the plans, shall include load transfer assemblies.

(a) Formed Joints. The Contractor may use the formed joints made by depressing a tool or device into the plastic concrete, regardless whether the joints are to remain in or removed from the finished pavement, only with the written acceptance of the Engineer.

(b) Sawed Joints. Saw contraction joints by cutting grooves in the pavement with an acceptable power saw. The width shall be the minimum width possible with the type of saw being used not exceeding 1/4 inch.

After sawing each joint, clean the sawed cut and adjacent concrete surface thoroughly.

The Engineer will designate the first joint immediately after separation or transverse contact joint and every second planned transverse contraction joint as control joints. Saw them within 12 hours after placing the concrete. The Engineer will determine the exact time of sawing. If necessary and regardless of weather conditions, continue the sawing operations day and night. Complete the sawing of transverse contraction joints before placing the concrete in adjacent lanes and before permitting traffic on the pavement.

In succeeding lanes of concrete pavement, saw the transverse joints within 24 hours after pouring the concrete. The Engineer will determine the exact time. Omit not more than three consecutive planned transverse contraction joints.

Saw the remaining transverse contraction joints after 24 hours. Complete the transverse contraction joints before pouring the concrete in adjacent lanes and before permitting traffic on the pavement.

When a crack occurs within 5 feet of a planned transverse contraction joint, omit sawing of that joint. Discontinue sawing when a crack develops in front of the saw. The Engineer will not pay for the joints sawed in violation of these provisions.

When curing the pavement by curing seal, restore the portions of the seal that are disturbed by sawing operations by spraying the area with additional curing seal.

(c) Transverse Construction Joints. Construct a transverse construction joint when an interruption of more than 30 minutes in the concrete operations occurs. Do not construct the transverse joint within 10 feet of any expansion joint, contraction joint, or plane of weakness. When the Contractor has not mixed sufficient concrete at the time of interruption to form a slab at least 10 feet long, remove and dispose of any excess concrete back to the last preceding joint as specified by the Engineer at no cost to the State.

(4) Load Transfer Devices. Install the load transfer units, when required, at transverse joints. The load transfer units include dowel bars of a grade and size required by the contract spaced on one foot centers and held in position with a wire basket or mechanically implanted. Place the dowels at a depth of d = t/2 where:

d = minimum depth rounded up to the nearest 0.01 foot

t = thickness of pavement of each lane

Place the dowels at this depth in the pavement parallel to the surface and pavement edge with a tolerance for such alignment of ± 1/4 inch per dowel. Vibrate the concrete around dowel bars without disrupting the alignment of the load transfer devices. Demonstrate that the method of dowel placement will have the bars in the proper location after the paving train has made its final pass over the joint.

Mark the center of the dowel assembly properly on both sides of the pavement slab for reference in forming or sawing the contraction joint.

Use wire baskets that remain in the pavement to hold the dowels and preformed material for load transfer units. Furnish a metal dowel cap or sleeve on each dowel bar to accommodate the expansion. Equip the cap with a stop to prevent closing during pavement operation. Maintain a clearance of one inch between the closed end of the cap and the end of the dowel to accommodate future movement of the concrete slab.

(M) Final Strike-Off, Consolidation and Finishing.

(1) Sequence. The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging, and final surface finish.

In general, the Engineer will not permit the application of additional water to the surface of the concrete to assist in finishing operations. When the Engineer permits the application of water to the surface, only apply the water as a fog spray by an acceptable spray equipment.

If the finished surface shows signs of chalking or other indications of a weakened surface, immediately determine the depth of the weakened concrete. Propose a remedial method of repair that will provide a finished surface which matches the concrete poured in accordance with the Contract without the application of water, and that is acceptable to the Engineer.

(2) Finishing at Joints. Compact or firmly place the concrete adjacent to joints without voids or segregation against the joint material, under and around load transfer devices, joint assembly units, and other features designed to extend into the pavement. Vibrate the concrete adjacent to joints mechanically as required in Subsection 411.03(I) - Placing Concrete.

After placing and vibrating the concrete adjacent to the joint as required in Subsection 411.03(I) - Placing Concrete, bring the finishing machine forward, operating to avoid damage or misalignment of the joints. When operation of the finishing machine, to, over, and beyond the joints causes segregation of concrete and damage to or misalignment of the joints, stop the finishing machine when the front screed is approximately 8 inches from the joint. Remove the segregated concrete from in front of and off the joint; lift the front screed and set directly on top of the joint; and resume the forward motion of the finishing machine. When the second screed is close enough to permit the excess mortar in front of the screed to flow over the joint, lift the screed and carry it over the joint. Thereafter, the Contractor may run the finishing machine over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

(3) Machine Finishing.

(a) Nonvibratory Method. Distribute or spread the concrete as soon as placed. Soon after placing the

concrete, strike off and screed the concrete by a finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and to leave a surface of uniform texture. Avoid excessive operation over a given area. Keep the tops of the forms clean by an effective device attached to the machine and maintain the travel of the machine on the forms true without lift, wobbling, or other variation tending to affect the precision finish.

During the first pass of the finishing machine, maintain the a uniform ridge of concrete ahead of the front screed for its entire length.

(b) Vibratory Method. Vibrators for full width vibration of concrete paving slabs shall conform to Subsection 411.03(B)(3)(b) - Vibrators. When uniform and satisfactory density of the concrete is not obtained by the vibratory method, furnish equipment and methods that produce pavement conforming to the contract. The provisions in Subsection 411.03(M)(3)(a) - Nonvibratory Method, not in conflict with the provisions for the vibratory method shall govern.

(4) Nonvibratory Method, Hand Finishing. The Engineer will not permit hand finishing methods except the following:

(a) When the mechanical equipment breaks down, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs, or

(b) Where operations of the mechanical equipment is impractical such as narrow widths or areas of irregular dimensions, hand methods may be used to finish the concrete.

Strike off and screed the concrete, as soon as placed. Provide a second screed to strike-off the bottom layer of concrete if reinforcement is used.

The screed for the surface shall be at least two feet longer than the maximum width of the slab to be struck off. The screed shall be an acceptable design and sufficiently rigid to retain its shape. Use a screed constructed either of metal or of other suitable material shod with metal.

Attain consolidation by using a vibrator.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and so manipulated that neither end is raised from the side forms during the strike-off process. When necessary, repeat this operation until the surface is of uniform texture, true to grade and cross section and free from porous areas.

(5) Floating. After striking off and consolidating the concrete, smooth, true, and consolidate the concrete further by a longitudinal float, using one of the following methods:

(a) Hand Method. The hand-operated longitudinal float shall not be less than 12 feet in length and 6 inches in width, stiffened properly to prevent the float from flexing and warping. Work the longitudinal float with a sawing motion while the float is held in a floating position parallel to the road centerline and passing gradually from one side of the pavement to the other. Operate the float from the foot bridges, rest on the side forms, and span without touching the concrete.

Movement ahead along the centerline of the pavement shall be in successive advances of not more than 1/2 the length of the float. Waste excess water or soupy material over the side forms on each pass.

(b) Mechanical Method. Adjust the tracks and float accurately to the required crown. Coordinate the float with the adjustments of the transverse finishing machine so that a small quantity of mortar is carried ahead of the float. Adjust the forward speed so that the float laps the distance specified on each transverse trip. The float shall pass over each area of pavement at least two times. The Engineer will not permit excessive operation over a given area. Waste the excess water or soupy material over the side forms on each pass.

(c) Alternate Mechanical Method. As an alternative to Subsection 411.03(M)(5)(b) - Mechanical Method, a machine composed of a cutting and smoothing float or floats, suspended from and guided by a rigid frame may be used. Use a frame that is carried by four or more visible wheels riding on and constantly in contact with the side forms.

When necessary, the long-handled floats may be used to smooth and fill in open-textured areas in the pavement. The floats shall have blades not less than five feet in length and 6 inches in width. Do not use the long-handled floats to float the entire surface of the pavement in lieu of, one of the preceding methods of floating.

When striking-off and consolidating by the hand method and the crown of the pavement does not permit the use of the longitudinal float, float the surface transversely by the long-handled float. Do not work the crown out of the pavement during the operation. After floating, remove the excess water and laitance from the surface of the pavement by a straightedge 10 feet or more in length. Lap the successive drags 1/2 the length of the blade.

(d) Slip-Form Finishing. Construct the pavement with a preliminary float finish with devices incorporated in the slip-form paver. The Contractor may supplement these with suitable machine floats.

Correct the edge slump of pavement, exclusive of edge rounding, over 0.02 foot before concrete has hardened.

(6) Straightedge Testing and Surface Correction. After completing the floating and removing the excess water removed, but while the concrete is still plastic, test the surface of the concrete for trueness with a 10-foot straightedge. For this purpose, furnish and use an accurate 10-foot straightedge swung from a handle three feet longer than 1/2 the width of the slab. Hold the straightedge in contact with the surface in successive positions parallel to the road centerline and the whole area gone over from one side of the slab to the other as necessary. Advance along the road shall be in successive stages of not more than 1/2 the length of the straightedge. Immediately fill with freshly mixed concrete, strike off, consolidate, and refinish all depressions. Cut down and refinish high areas. Construct the surface across joints to meet the requirements for smoothness. Continue straightedge testing and surface corrections until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and cross section.

(7) Final Finish.

(a) After completing straight-edging and surface corrections and as soon as the water sheen has practically

disappeared, texture the pavement surface uniformly. Apply the final finish or texture by the use of an artificial turf drag followed immediately by a metal comb transverse grooving device.

(b) Use an artificial turf made of molded polyethylene with synthetic turn blades approximately 0.85 inches long and contain approximately 7,200 individual blades per square foot. Submit the artificial turf for acceptance by the Engineer.

(c) Attach the artificial turf suitably to a device that will permit control of the time and rate of texturing. Do not attach this device to other pieces of equipment in the paving train. The device shall be a separate piece of equipment to be used exclusively for the texturing operation. The artificial turf shall be full pavement width and of sufficient size that during the finishing operation, approximately two feet of turf parallel to the pavement centerline is contacting the pavement surface so as to produce a uniform appearing surface according to the contract. When necessary for maintaining intimate contact with the pavement surface, the Contractor may down the turf.

(d) The metal comb includes a single line of randomly placed tempered spring steel spaced at 3/4 inch on centers. Mount the metal comb securely in a suitable head. The tines shall be of the size and stiffness sufficient to produce a groove of the specified dimension in the plastic concrete without slumping of the edge or severe tearing of the surface.

(e) Transverse Grooving. Attach the metal comb to a mechanical device capable of transversing the entire pavement width in a single pass at a uniform speed. Operate the grooving device so as to produce a random pattern of grooves perpendicular to the pavement centerline. The randomly spaced grooves shall have a minimum spacing of 0.4 inch and a maximum spacing of 1.5 inches between centers, with no more than 50 percent of the spaces exceeding 1 inch, 1/8 inch to 3/16 inch deep, and 1/10 inch to 1/8 inch wide, all dimensions as measured on the hardened surface. Grooves produced over inductive loop detectors for the weigh-in-motion (WIM) system shall be not less than 3/32 inch deep nor more than 1/8 inch deep, as measured on the hardened surface.

(f) Longitudinal Grooving. Attach the metal comb to a mechanical device capable of grooving the entire pavement width in a single pass at a uniform speed. Operate the grooving device so as to produce a relatively uniform pattern of grooves parallel to the pavement centerline, spaced approximately 3/4 inch on centers, 1/8 inch to 3/16 inch deep, and 0.095 inch to 0.125 inch wide, all dimensions as measured on the hardened surface.

(g) Hand combs with steel tines shall be available for the purpose of providing a surface texture in event of breakdown of the mechanical comb, but shall not be the primary method of producing grooves.

(8) Edging at Forms and Joints. After the final finish, but before the concrete has taken its initial set, round the edges of the pavement along each side of each slab, on each side of the transverse expansion joints, and construction (contact) joints to a radius of 1/4 inch. Produce a well-defined and continuous radius and a smooth, dense mortar finish. Do not unduly disturb the surface of the slab by tilting the tool during use.

At joints, eliminate the tool marks appearing on the slab adjacent to the joints by brooming the surface. In doing this, do not disturb the rounding of the corner of the slab. Remove the concrete on top of the joint filler completely.

When one side of the joint is higher than the other or when the joint are higher or lower than the adjacent slabs, test the joints with a straightedge before the concrete has set and correction made.

(N) Surface Test. The finished pavement shall conform to the following requirements when tested by the Engineer not more than 14 days following the placement of concrete:

(1) Straightedge the pavement surface at locations determined by the Engineer with a straightedge 12 feet long. When laying the straightedge on a finished pavement in a direction parallel with centerline or perpendicular to centerline, the surface shall not vary more than 0.25 inch from the lower edge.

(2) The Engineer will determine the profile of the pavement surface using a profilograph according to Hawaii Test Method HDOT TM 6 and these provisions. The Engineer will take the profiles parallel to each edge of pavement and the approximate location of each longitudinal joint.

The Engineer will inform the contractor of the profilograph test's traces and profile index for the area tested. If the pavement surface test does not meet the requirements of the Contract Documents, the contractor shall utilize its own profilograph surface tests to determine where the pavement surface must be corrected. When the contractor has determined that the surface meets the requirements of the Contract Documents, the contractor shall request HDOT to perform another profile of the pavement surface using a profilograph according to Hawaii Test Method HDOT TM 6 and these provisions. The results of this test will determine if the surface is acceptable to the Engineer.

Make the request to the Engineer for all profile testing at least 7 calendar days before testing the pavement surface. Clean and clear the area to be tested of obstructions, provide MUTCD compliant traffic control at no additional cost to the State. Lane rental charges will be accessed. The Engineer will do up to two profilograph tests of the same area at no cost to the Contractor. Submit the total area to be tested at any time the request for testing is made, for acceptance by the Engineer. The minimum length of a test area shall be no less that 0.10 mile unless the work area remaining to be tested is less than 0.10 mile. After the second profilograph test is made of the same area, the Engineer will do additional profilograph testing at a cost to the Contractor at a rate of $750 per test. If the test takes more than one day, another $750 will be charged for each additional day. The cost of the extra profilograph testing shall be deducted from the monthly estimate, or if insufficient payment is to be made to cover the cost, the cost will be billed to the Contractor.

Repair the membrane curing film damaged during the testing operations as specified by the Engineer. The Contractor and the Engineer will use the initial profile testing to aid and evaluate the paving methods and equipment. When an average profile index exceeds 15 inches per mile, suspend the paving operations. The Engineer will not allow the Contractor to resume until corrective action is taken. Test the subsequent paving operation according to the initial testing procedures.

Furnish paving equipment and employ methods that produce a riding surface having a profile index of 10 or less, except as provided herein. The Engineer may accept the initial profiles up to 15 with applicable price adjustments.

Reduce individual high points over 0.3 inch, as determined by measurements of the profilogram according to Hawaii Test

Method HDOT TM6, by grinding until such high points as shown by reruns of the profilograph do not exceed 0.3 inch.

Do additional grinding as necessary to reduce the Profile Index to values specified, in any 0.1 mile section, along any line parallel with the pavement edge.

Do additional grinding as necessary to extend the area ground in each lateral direction so the lateral limits of grinding are at a constant offset from and parallel to, the nearest lane line or pavement edge. Also, do additional grinding as necessary to extend the area ground in each longitudinal direction so the grinding begins and ends at lines normal to the pavement centerline, within any one ground area. Ground areas shall be neat rectangular areas of uniform surface appearance.

When grinding pavement, do not finish the pavement to a smooth or polish texture. Grind the pavement to maintain a texture with randomly spaced grooves in the pattern and direction as specified in the contract plans, unless otherwise specified by the Engineer. If the pavement, in the opinion of the Engineer is judged to have a smooth or polished texture, the Contractor shall mechanically groove the surface at no cost to the State.

The Engineer will exclude the areas described in the sub-paragraphs below from the profile testing requirements described above.

(1) on horizontal curves having a centerline radius of curve less than 1,000 feet and pavement within the superelevation transition of such curves,

(2) within15 feet of a transverse joint that separates the Portland Cement Concrete pavement from an existing Portland Cement Concrete pavement not constructed under the contract or an asphalt concrete surfaced pavement; or a structural deck or approach slab,

(3) ramps and connectors with grades of 6 percent or more,

(4) The skewed construction joint that separates the Portland Cement Concrete pavement constructed under this contract and the Portland Cement Concrete pavement not constructed under this contract from the vicinity of Station 124+00 to the vicinity of Station 135+00.

The Engineer will apply the surface requirement described below to those areas exempted from the profile testing describe previously.

(a) Measure using a 12 foot straight edge, the perpendicular distance from the Portland Cement Concrete pavement surface to the lower edge of that straight edge. Between any two points of contact between the Portland Cement Concrete pavement surface and the lower edge of the straight edge, the measured distance shall be 0.25 inch or less for straight edge alignments parallel and perpendicular to the centerline of the lane that is being tested and

(b) The Portland Cement Concrete pavement that is being tested shall have its entire profilograph trace inside of 0.2 inch blanking band.

(c) The Engineer will inform the contractor of the profilograph test's traces and profile index for the area tested. If the pavement surface test does not meet the requirements of the Contract Documents, the contractor shall utilize its own profilograph surface tests to determine where the pavement surface must be corrected. When the contractor has determined that the surface meets the requirements of the Contract Documents, the contractor shall request HDOT to perform another profile of the pavement surface using a profilograph according to Hawaii Test Method HDOT TM 6 and these provisions. The results of this test will determine if the surface is acceptable to the Engineer.

The Engineer will not count the profile index obtained in the exempted areas for the calculation of any price adjustment due to profile index as stated in the Profile Index Price Adjustment table in 411.05(A) - Price Adjustments.

The Contractor shall correct all profiles by using grinding methods that does not impact, hammer, batter or cause micro-cracking in the pavement. Use of bush hammers or other impact devices are not permitted.

Before determining pavement thickness, the area shall be accepted by the Engineer as meeting the required profile index as well as having satisfactorily completed all other repairs.

The Engineer will not permit bush hammers or other impact devices.

Complete the corrective work before determining pavement thickness.

(O) Curing. When completing the finishing operations and when marring of the concrete does not occur, cover and cure the entire surface of the newly placed concrete according to one of the following methods shown below. When curing requires the use of water, the curing shall have priority to water supplies. Failure to provide sufficient cover material or lack of water to take care of both curing and other requirements shall be cause for immediate suspension of the concrete operations. Do not leave the concrete exposed for more than 1/2 hour between stages of curing or during the curing period. Maintain the covering in place for 72 hours after pouring the concrete.

(1) Cotton or Burlap Mats. Cover the entire surface of the pavement with mats. The mats used shall be of such length or width that as laid they extend at least twice the thickness of the pavement beyond the edges of the slab. Place the mats so that the entire surface and both edges of the slab are completely covered. Before placement, saturate the mats thoroughly with water. Place and weigh down the mats as to cause them to remain in intimate contact with the surface covered. Maintain the covering fully wetted and in position for the required period.

(2) Waterproof Paper. Cover the entire top surface and sides of the pavement with waterproofed paper. Lap the units at least 18 inches. Place and weigh down the paper as to cause the paper to remain in intimate contact with the surface covered. The paper shall have such dimensions that each unit laid shall extend beyond the edges of the slab at least twice the thickness of the pavement or of pavement width and two foot strips of paper for the edges. When laid longitudinally, securely seal the paper not manufactured in sizes which shall provide this width so that they do not open up or separate during the curing period. Thoroughly wet the surface of the pavement before placing the paper.

(3) Impervious Membrane Method. Spray the entire surface of the pavement uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. When initially curing the pavement with jute or cotton mats, the white pigment curing compound may

be applied upon removal of the mats. Do not apply the curing compound during rainfall.

Apply the curing compound under pressure at the rate of one gallon to not more than 150 square feet by mechanical spraying machines. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, stir the compound continuously by effective mechanical means. The Engineer will permit hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms. Hand spraying shall not be the primary method of applying the compound. Do not apply the curing compound to the inside faces of joints to be sealed.

When the curing film becomes damaged from causes within the required curing period, repair the damaged portions immediately with additional compound. Upon removal of side forms, protect the sides of the slabs exposed immediately to provide a curing treatment equal to that provided for the surface.

(4) White Polyethylene Sheeting. Cover the top surface and sides of the pavement entirely with polyethylene sheeting. Overlap the units at least 18 inches. Place and weigh down the sheeting as to cause the sheeting to remain in intimate contact with the surface covered. The sheeting as prepared for use shall have a dimension that each unit as laid shall extend beyond the edges of the slab at least twice the thickness of the pavement.

(P) Removing Forms. Remove the forms from freshly placed concrete after the concrete has set for at least 12 hours, except auxiliary forms used temporarily in widened areas. Remove the forms carefully so as to avoid damage to the pavement. After removing the forms, cure the sides of the slab as outlined in one of the methods indicated above. The Engineer will consider major honeycombed areas as defective work. Remove and replace the major honeycomb areas. Areas or sections removed shall not be less than 10 feet in length nor less than full width of the lane involved. When the removal and replacement of a section of pavement is necessary, also remove and replace remaining portion of the slab adjacent to the joints that is less than 10 feet in length.

(Q) Sealing Joints. When required by the contract, fill the joints with joint sealing material before the pavement is opened to traffic, and as soon after completion of the curing period is feasible. Clean each joint thoroughly of foreign matters including membrane curing compound and

clean the joint faces and dry the surface before sealing. Stir the material during heating so that localized overheating does not occur.

Apply the sealer as required by the contract or as specified by the Engineer. Pour the sealer without spilling the material on the exposed surfaces of the concrete. Immediately remove and clean the material on the surface of the concrete pavement. The Engineer will not permit the use of sand or similar material as a cover for the seal.

(R) Protection of Pavement. Protect the pavement and its appurtenances against both public traffic and traffic caused by its own employees and agents. This shall include flaggers to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, or crossover.

When by the Engineer, construct pavement crossings for the convenience of public traffic according to Subsection 104.04 - Maintenance of Traffic. The Engineer will not make additional compensation for the work involved.

Repair or replace damages to the pavement before final acceptance.

The Engineer will require the Contractor to have available materials for the protection of the edges and surface of the unhardened concrete. The protective materials include standard metal form or wood plank having a nominal thickness of not less than two inches and a nominal width of not less than the thickness of the pavement at its edges. The surface protective material includes burlap or cotton mats, curing paper, or plastic sheeting. When rain appears imminent, paving operations shall stop. Place the forms against the sides of the pavement and cover the surface of the unhardened concrete with the protective covering.

(S) Opening to Traffic. Do not open the pavement to traffic until the specimen beams conforming to Subsection 411.03(J) Test Specimens attain a flexural strength of 550 pounds per square inch when tested according to AASHTO T 97.

After concrete placement, do not open the pavement slabs accepted for early opening (less than 7 days) to traffic until beam test results of the concrete pavement slab has attained a minimum flexural strength of 550 psi at 24 hours. For 13 ?-inch thick pavement, the flexural strength to open the pavement slabs to traffic need to attain minimum of 450 psi at 12 hours.

Clean, sign, and mark the pavement properly and clear the pavement of obstructions before opening the roadway to public traffic.

The Engineer will not allow construction traffic, equipment, or materials on the pavement while the pavement is attaining the strength.

(T) Tolerance in Pavement Thickness. The Engineer will check the thickness of the pavement by cores taken by the Contractor according to AASHTO T 24. The Engineer will inform the Contractor to take core samples and observe the Contractor taking core samples. The Engineer will test the cores according to AASHTO T 148. Cores are to be taken to determine thickness acceptability after completion of all corrective work and only in areas that have been found to have met all the contract documents' smoothness requirements by the Engineer.

When cores are taken to determine the thickness of PCC pavement, a layer of material may adhere to the bottom of the core. Before determining the thickness of the PCC pavement, the Engineer will remove non-PCC pavement materials from the bottom of the core.

The Engineer will evaluate the pavement on the basis of primary and secondary unit. The primary unit of pavement will be the area of mainline pavement placed during one day's paving operations. Additionally, the Engineer will consider each ramp including tapers, each intersection, each crossover as a separate primary unit.

A secondary unit of pavement includes 1,000 linear feet or fraction thereof, of each mainline traffic lane and each shoulder in each primary unit. Also, each 1,300 square yards of pavement in ramps, tapers, intersections, and crossroads will be a secondary unit regardless of when the concrete was placed.

Drill one core in each secondary unit. When the length of that core is not deficient by more than 0.2 inch from the planned thickness, the Engineer will pay for that secondary unit at 100% of the contract unit price.

When the length of that core is deficient by more than 0.2 inch but less than 0.6 inch, drill two additional cores within the secondary unit and the Engineer will average the length of the three cores.

When the core in a secondary unit is deficient by more than 0.6 inch, the Engineer will not use the core to determine the average thickness of the secondary unit.

Drill additional cores at intervals not exceeding 10 feet in each direction from the deficient core, measured parallel to the centerline, until three cores are obtained in each direction which are not deficient by more than 0.6 inch.

The Engineer will evaluate the pavement between the two cores closest to each other of the group of three that passed separately from the balance of the pavement in that secondary unit. The limits for the evaluation will be between the longitudinal weakened plane or construction joint on each side of the core and between the next transverse weakened plane, construction, or expansion joint beyond each of the last two cores. Unless the Engineer allows the pavement to remain, remove and replace the pavement with pavement of the specified thickness. The Engineer will not pay for the removal of the deficient pavement. When the deficient pavement is allowed to remain, the Engineer will not make payment for the deficient pavement. Drill one additional core in the remaining portion of the secondary unit. The Engineer will evaluate this portion separately for payment as hereinbefore specified.

When removing deficient pavement, remove and replace the deficient pavement within the evaluation limits. After replacing the deficient pavement, drill one core at random in the secondary unit outside of the limits of the replaced pavement and drill one core in the new pavement. The Engineer will evaluate the pavement represented by the drilled core taken outside of the limits of the replaced pavement for payment as hereinbefore specified. When the core drilled in the replaced pavement is less than the specified thickness, the Engineer will not make payment for the replaced pavement.

Fill the core holes completely with concrete of the same quality as used to construct the pavement in the presence of the Engineer.

411.04 Method of Measurement. The Engineer will measure the concrete pavement per cubic yard complete in place. The width for measurement will be the width of the pavement shown on the typical cross section of the plans, additional widening where called for, or as specified in writing by the Engineer. The Engineer will measure the length horizontally along the centerline of each roadway or ramp. The thickness for cubic yard measurement will be the thickness of the pavement shown on the typical cross section of the plans or as specified in writing by the Engineer.

The Engineer will measure transverse contraction joints, other than transverse construction joint, per linear foot.

411.05 Basis of Payment. The Engineer will pay for the accepted PCC pavement at the contract unit price per cubic yard. The price includes full compensation for furnishing reinforcements, dowels, tie bars, other joint materials; furnishing, placing, and removing of forms, protection devices; furnishing and placing curing materials, furnishing and installing longitudinal joints, transverse expansion joints, and transverse construction joints; grinding and grooving; obtaining cores; backfilling holes with concrete; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

When the average length of cores indicates pavement thickness is deficient by more than 0.2 inch but not more than 0.6 inch, only the reduced price stipulated below will be paid. The Engineer will not make additional payment over the unit contract bid price for pavements having an average thickness over that shown in the contract.

The Engineer will pay for the accepted transverse contraction joints, other than transverse construction joints, at the contract unit price per linear foot of joint. The price shall be full compensation for the furnishing and placing the joints; and furnishing materials, equipment, tools, labor, and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
_____-inch, Concrete Pavement	Cubic Yard
Transverse Contraction Joint	Linear Foot

(A) Price Adjustments. When the average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than 0.6 inch, the Engineer will make payment at an adjusted price as specified in Table 411-I - Concrete Pavement Deficiency. Contract unit price in Table 411-I shall be in addition to adjustments made to the unit price after adjustments for other deficiencies, if applicable.

TABLE 411-I - CONCRETE PAVEMENT DEFICIENCY

Core Thickness, Less Than Specified Thickness, inch (rounded to the nearest 0.01 inch)	**Percent Of Contract Unit Price Allowed**
0.00 to 0.20	100
0.21 to 0.40	75
0.41 to 0.60	40

When the thickness of pavement is deficient by more than one inch and the Engineer determines that the area of such deficiency should not be removed and replaced, the Engineer will not make payment for the area retained.

When the Engineer determines that the deficient areas warrant removal, the deficient pavement and its removal shall be at no cost to the State. Replace the deficient areas with concrete pavement of the thickness shown in the contract. The Engineer will pay for an acceptable replacement pavement as specified in Table 411-I - Concrete Pavement Deficiency.

When the profile index does not exceed ten, the Engineer will make payment at the contract unit price for the completed pavement. When the profile index exceeds ten, the Engineer may accept, at the Engineer's sole option, the work at a contract unit price with adjustment in lieu of reducing the profile index. The Engineer will make the contract unit price adjustment according to the following schedule:

PROFILE INDEX	PRICE ADJUSTMENT (Percent of pavement unit bid price)
10 or less	100
Over 10 but less than 11	98
Over 11 but less than 12	96
Over 12 but less than 13	94
Over 13 but less than 14	92
Over 14 but less than 15	90
Over 15	Corrective work required

The Engineer will compute the unit bid adjusted price using the planned thickness of PCC pavement. This unit bid adjusted price will apply to the total area of the 0.1 mile section for the lane width represented by the profilogram."

END OF SECTION

Amend Section 503 – Concrete Structures to read as follows:

"SECTION 503 - CONCRETE STRUCTURES

503.01 Description. This work includes constructing concrete bridges, grade separations, culverts, head walls, retaining walls and other types of concrete structures according to the contract.

503.02 Materials.

(A) Portland Cement Concrete. Concrete shall be Class A and shall conform to Section 601 - Structural Concrete.

(B) Other Materials. Other materials shall conform to the following:

Joint Filler	705.01
Joint Sealer	705.04
Flashing Compound	705.05
Waterproofing	705.06
Waterstops	705.07
Dowels	709.01(E)
Curing Materials	711.01
Bearing Devices and Related Materials	712.09
Abrasive Coating	712.11

503.03 Construction Requirements.

(A) Foundation. The Contractor shall excavate and backfill the foundations according to Section 206 – Excavation and Backfill for Conduits and Structures and as specified herein.

The elevation of the bottom of footings shown in the contract are approximate only. The Engineer may order in writing such changes in dimensions or elevations of footings as may be necessary to secure a foundation according to the contract.

The Engineer will inspect and accept the foundations before the Contractor places the concrete. The Contractor shall backfill unauthorized excavation made below the required footing elevation or beyond the lines shown in the contract with concrete at no cost to the State. If according to the contract, the Contractor requires a redesign of the foundation because of the unauthorized excavation, the Contractor shall construct the redesign foundation at no cost to the State. The Contractor may, at its option, prepare and submit for acceptance the detailed plans incorporating the necessary redesign of the foundation. This work shall be at no cost to the State. The Contractor shall place piling according to Section 505 - Piling.

(B) Falsework and Centering. Falsework, formwork or centering is temporary construction work on which other work is wholly or partially supported until the permanent construction is strong enough to support itself. The falsework, formwork or centering includes the form lining and sheathing plus the necessary supporting members, hardware, and bracing. The Engineer shall consider the use of the words falsework, formwork, and centering as mutually interchangeable herein.

The Contractor shall submit working drawings and design calculations for falsework and centering to the Engineer. The Contractor shall also submit manufacturer's certificates or test the falsework and centering as necessary when requested by the Engineer. Tests done shall be at no cost to the State.

The Contractor shall provide the Engineer with sufficient time to review and accept the drawings and calculations. Such time shall be proportionate to the complexity of the falsework and centering and shall not be less than two (2) weeks. No falsework or centering construction shall start until the Engineer has reviewed and accepted the drawings and calculations. The Engineer will not relieve the Contractor of the responsibility for results obtained by using such drawings and calculations.

For Non-Federal Aid County projects, the Engineer will not require acceptance of the Contractor's drawings and calculations for falsework and centering construction. The Contractor shall be solely responsible for the results obtained by using such drawings and calculations.

The allowable stresses in the design of the falsework, formwork or centering shall be the same as those specified in the latest edition of "Standard Specifications for Highway Bridges". For allowable stresses not specified in AASHTO, nationally recognized industry specifications or codes may be used upon acceptance by the Engineer. The Contractor shall use the service load design method in the calculations. The Contractor shall avoid the cantilevered false members. The maximum

deflection due to the weight of dead and live loads shall be 0.4 percent of the span. The Contractor shall compensate for the deflections or other movements greater than quarter (1/4) inch by camber strips.

The Contractor shall calculate the spans as the smaller of center to center distance between supports or the clear span plus the member depth. The Contractor shall design the formwork for the bottom slab of box girders to carry the dead and live loads of both the top and bottom slabs unless the Contractor computes the bottom slab to carry the loads temporarily imposed upon.

The Contractor shall arrange the falsework system so that the loads imposed produce symmetrical and approximately equal reactions. The Contractor shall submit the falsework soil pressure, pile capacity and ground preparation for acceptance by the Engineer. The Contractor shall show them on the shop drawings. Where structures cross over waterways and other flood prone areas, the Contractor shall provide special consideration in the design of the supporting falsework to prevent reduction of supporting capacity due to effects of water.

If the Contractor is to prestress the concrete, the Contractor shall design the falsework to support the increased or readjusted loads caused by the prestressing forces.

The design load for the falsework or centering includes dead and live vertical loads and lateral load. The minimum vertical live load used in the design shall be fifty (50) pounds per square foot of surface area plus one hundred and fifty (150) pounds per linear foot applied at the outside edge of cantilevered members. The Contractor shall add the minimum vertical live load to the actual weight of the equipment. The design horizontal load for the falsework bracing system shall be the sum of the actual horizontal loads due to equipment, construction sequence or other causes plus an allowance for wind pressure; however, the minimum lateral load used in the design shall be three percent of the total dead load or 150 pounds per linear foot whichever is greater. The Contractor shall apply the minimum lateral load at the top surface of the falsework support.

The design calculations shall show the stresses and deflections in the load supporting members. Anticipated total settlements of falsework and forms shall be shown on the falsework drawings. These should include falsework footing pressure and settlement and joint take-up. Anticipated settlements shall not exceed one inch. Falsework supporting deck slabs and overhangs on girder bridges shall be designed so that there will be no differential settlement between the girders and the deck forms during placement of deck concrete. For structures where the height

of any portion of the falsework exceeds 14 feet, or where any individual falsework clear span length exceeds 16 feet, or where provision for vehicular, pedestrian or railroad traffic through the falsework is made, such drawings shall be signed by an engineer who is registered as a Structural Engineer in the State of Hawaii. Falsework over or adjacent to roadways which are open to traffic shall be designed and constructed so that the falsework will be stable if subjected to impact by vehicles.

In designing falsework and centering, the Contractor shall assume a weight of one hundred and sixty (160) pounds per cubic foot for concrete. The Contractor shall design and construct the falsework to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. The Contractor shall employ screw jacks or hardwood wedges to take up settlement in the formwork either before or during placing of concrete. The Contractor shall design the falsework for the support of the superstructure to support the loads that would be superimposed as if the entire superstructure were poured at once. For falsework design, the Contractor shall design the vertical falsework members supporting spans with a single hinge or double hinges within the span for twice the tributary falsework requirements for a distance of ten (10) feet, measured parallel to the centerline of the girder, each side of the hinges. This requirement shall apply to conventionally reinforced and prestressed structures. The Contractor shall design the falsework for prestressed structures for additional loads caused by prestressing.

The Contractor shall place the falsework or centering upon a substantial footing safe against undermining and protected the footing from softening.

The Contractor shall space, drive, and remove the falsework piling, when used, and acceptable to the Engineer. The Contractor shall set the falsework to give the finished structure the camber specified or shown in the contract.

The Contractor shall construct the arch centering according to centering plans acceptable by the Engineer. The Contractor shall make provisions by acceptable devices for the gradual lowering of centers and rendering the arch self-supporting. When ordered, the Contractor shall place the centering upon acceptable jacks to correct slight settlement that may occur during the placement of concrete.

In the design of bottom slab plywood forms and timber joists for concrete box girders, the Contractor may omit the top slab loads when the Contractor pours the top slab separately from the webs and bottom slab.

In the lost post method of deck forming of concrete box girders, the Engineer may not require two (2) inches by six (6) inches continuous mudsills beneath the posts, if the Contractor uses two (2) inches by (4) inches timber posts or smaller with soft wood wedges for supports.

Manufactured items shall conform to AASHTO standards. If the item is not covered by AASHTO, the Contractor may use the standards of nationally known organizations such as the AISC for steel, ACI for concrete, and NFPA for lumber. The Contractor shall furnish data listing the manufacturer's design criteria and recommendations or shall do such tests as are necessary to show the adequacy of the proposed device.

During placement of deck concrete, except that in the deck closure, reinforcing steel protruding from the new deck into the closure space shall be completely free of contact with the existing structure. Contact with existing reinforcing steel or concrete or attachments thereto, including forms, shall not be permitted.

Formwork for the new portion of the Viaduct shall not be supported by any portion of the existing Viaduct except that the portion of the Bent cap which dowels into the existing Bent cap as shown in Section 1 on plan sheet No. AS 11.16 may be supported by the existing column and except that formwork for the deck closure pour and in-span beams (diaphragms) shall be supported from the superstructure on both sides of the closure space and in-span beams.

Falsework for any component of the soil nail retaining walls shall not increase the design load for the soil nail retaining walls.

The formwork for the permanent facing for the soil nail wall shall not induce or increase any load on the soil nail wall or the shotcrete construction facing previously installed.

(C) Forms.

(1) Construction. Forms shall be of wood, metal or other acceptable material. The forms shall be mortar tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations including vibration. The Contractor shall construct and maintain the forms to prevent the opening of joints due to shrinkage of the lumber.

The Contractor shall fillet the forms at sharp corners. The Contractor shall give the fillet a bevel or draft such as girders and copings, to insure easy removal.

The Contractor shall set and maintain the forms true to the lines designated. When forms appear to be unsatisfactory, either before or during the placing of the concrete, the Engineer may order the work stopped until the Contractor have corrected the defects.

If the Contractor submerges the forms in water and the concrete poured in the dry, the Contractor shall make the forms watertight below the high water level by caulking, battens or other acceptable means.

The Contractor shall cover the knot holes and damaged areas with metal patches.

The Contractor shall control the rate of depositing concrete in forms to prevent deflections of the forms or form panels over the deflections permitted by the contract.

Forms not completely enclosed or hidden below the permanent ground surface shall conform to the contract for forms for exposed surfaces. The Engineer will consider interior surfaces of underground drainage structures completely enclosed surfaces.

Before the Contractor uses each forming system for exposed surfaces, the Contractor shall furnish form design and materials data to the Engineer for acceptance.

The Contractor shall design and construct the forms for exposed concrete surfaces so that the formed surface of the concrete does not undulate excessively between studs, joists, form stiffeners, form fasteners, or wales. The Engineer will consider undulations exceeding either three thirty-secondths (3/32) inch or 1/270 of the center to center distance between studs, joists, form stiffeners, form fasteners or wales excessive. If forms or forming system produce a concrete surface with excessive undulations, its use shall cease until the Contractor have made modifications according to the contract. The Engineer may reject portions of concrete structure with surface undulations over the limits herein.

The Contractor shall form exposed surfaces of each element of a concrete structure with the same forming material or with materials that produce similar concrete surface textures, color and appearance.

The Contractor shall face the forms for exposed surfaces with form panels. A form panel is a continuous section of form facing material, unbroken by joint marks, against which the Contractor places concrete.

(2) Form Lumber. Form lumber, except curved and special surfaces, shall be five (5) ply panel boards or dressed shiplap, used with or without form liners. The Contractor may use rough lumber for unexposed surfaces in the finished structure. The Contractor may use three (3) ply panel boards for forming the soffit of the unexposed portions of the top slabs of box girders.

Plywood for forms shall conform to the latest edition of "United States Product Standard PS-1 for Construction and Industrial Plywood". The Contractor shall place form panels in uniform widths of not less than thirty-six (36) inches and in uniform lengths of not less than six (6) feet, except where the dimensions of the members formed are less than the specified panel dimensions. The Contractor shall place the plywood panels with the grain of the outer plys in the direction of the span.

The Contractor shall place the form panels in a neat, symmetrical pattern subject to the acceptance of the Engineer. The Contractor shall place the panels with the long dimensions horizontal. Horizontal joints shall be level and continuous. The Contractor shall stagger and be perpendicular to the vertical joints when shown in the contract.

(3) Form Ties. Form ties shall be of sufficient strength and number to hold the form securely and prevent spreading of the forms during concrete placement. The Engineer will not permit the use of ties consisting of twisted wire loops to hold forms in position. The Engineer will not permit non-metallic forming ties, anchorages, forming supports or other accessories that the Contractor embed permanently in the concrete.

The Engineer will not permit the use of driven type of anchorages for fastening forms or form supports to the concrete.

The Contractor shall construct the form ties or anchorages within the forms to permit their removal to a depth of at least one (1) inch from the face without injury to the concrete. The Contractor shall design the fittings for form ties or anchorages so that upon their removal, the cavities left are of the smallest possible size. The

Contractor shall fill the cavities with cement mortar and leave the surface sound, smooth, even and uniform in color.

(4) Walls. For narrow walls and columns and where the bottom of the form is inaccessible, the Contractor shall leave the lower form boards loose.

(5) Surface Treatment. The Contractor shall clean and treat the forms with a non-staining form oil immediately before each use. The Contractor shall not use Materials that cling to or discolor the concrete.

(6) Metal Forms. The specifications for forms, regarding design, mortar tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse and oiling, apply to metal forms. The metal thickness used for forms shall be such that the forms will remain true to shape. The Contractor shall countersink the bolts and rivet heads. The Contractor shall design clamps, pins or other connecting devices to hold the forms rigidly together and to allow removal without injury to the concrete. The Contractor shall not use metal forms that do not present a smooth surface or do not line up properly.

(7) Reuse of Forms. The Contractor shall maintain the shape, strength, rigidity, watertightness and surface smoothness of reused forms. The Contractor shall resize the warped or bulged lumber before using. The Contractor shall not use unsatisfactory forms.

(D) Removal of Falsework and Forms. The Contractor shall not remove falsework or forms without the consent of the Engineer.

The Contractor shall not use methods of removal likely to cause overstressing of the concrete. The Contractor shall remove the supports to permit the concrete to uniformly and gradually take the stresses due to its own weight. In long span girder bridges and in arch bridges, the Contractor shall remove the falsework or centering according to the contract. In continuous or rigid frame structures, the Contractor shall not release the falsework before the last concrete (excluding concrete above the bridge deck) in that span and the first adjoining spans on each side has been in place for fourteen (14) days. For falsework removal, the Contractor shall consider the spans with single hinge within the span continuous. The Contractor shall consider the hinges of suspended spans within a bridge as ends of bridge for determining shoring requirements. In structures of these types, the Contractor shall remove the falsework

gradually and uniformly over their whole length, as ordered by the Engineer.

The Contractor shall not remove or release the falsework and forms earlier than the time specified in Table 503-I after placing the concrete. The Engineer will determine the exact time.

TABLE 503-I – REMOVAL OF FALSEWORK AND FORMS						
Centering under beams, arches and other members – 14 days						
Slabs with a maximum thickness of (Inches)	9		12		more than 12	
Removal Time (Days)	7		10		14	
Walls, columns and vertical sides of beams with a maximum height of (Feet)	2	5	10	20	30	40 or more
Removal Time (Days)	0.5	1	2	3	5	7
Note: Where forms also support the vertical or horizontal loads imposed on slab or beam soffits, the Contractor shall use the longer requirements for the removal time of the latter.						

The Contractor shall not remove the falsework and forms supporting the bottom slab of box girders until fourteen (14) days after the final top slab pour. The Contractor shall remove the forms for the webs of box girders before the Contractor pours the deck slab. The Contractor may leave the forms supporting the concrete top slab of box girders in place. The Contractor shall remove the interior forms in box girders except those permitted to remain in place, completely. The Contractor shall clear and sweep clean inside the box girder of loose material.

The Engineer may reduce the requirement of fourteen (14) days for the removal of falsework to ten (10) days if the concrete test specimens develops a compressive strength equal or greater than the twenty-eight (28) day compressive strength. The Engineer will cure the concrete test specimen under the provisions of paragraph 9.4 of AASHTO T 23.

The Contractor may strip the falsework for concrete box culverts and other concrete structures with spans of fourteen (14) feet or less when concrete strength reaches one thousand five hundred (1,500) pounds per square inch. The Contractor shall reshore the top slab. The Contractor shall not impose loads (including backfill) on the structure.

The Contractor shall always remove the forms from the columns to show the condition of the concrete in the columns before the Contractor removes the shoring beneath beams and girders.

(E) Loading. No parts of the structure, except abutment walls and wing walls, shall receive loading outside its own weight until:

(1) at least fifteen (15) days have elapsed after placing the concrete and

(2) until the test specimens show that the concrete has developed a compressive strength the larger of three thousand (3,000) pounds per square inch or the required twenty-eight (28) day compressive strength.

The Engineer will not permit the storing of materials on the structure until at least fifteen (15) days have elapsed since placement of concrete. The weight of the material shall not exceed fifty (50) percent of the live load.

The Contractor shall not place load on the structure until the Contractor has released the falsework completely.

The Engineer will not permit live load on completed portions of the structure when such live load will induce stresses above the allowable.

When twin structures are to be constructed side by side, the Engineer will consider on an individual conditional permit basis the use of a mobile crane on the completed inbound or outbound bridges. The Engineer will account for the inaccessibility of construction safety, and frequency of loading.

Backfilling of abutment walls and wingwalls shall be according to Section 206 - Excavation and Backfill for Conduits and Structures.

(F) Placing Concrete.

(1) General. The Contractor shall use the concrete while fresh and before the concrete has taken an initial set. The Contractor shall not retemper or remix the concrete that has partially hardened. The interval between placement of two (2) consecutive batches or loads of concrete shall not exceed thirty (30) minutes.

The Engineer will not permit deviation from the schedule for pouring concrete without the permission of the Engineer.

The Contractor shall moisten the surfaces thoroughly with water immediately before placement of concrete. The Contractor shall use neat cement mortar at construction joints.

The Contractor shall not place concrete in the structure before the Engineer have checked and accepted the forms and the reinforcing steel. The forms shall be clean of debris before placement of the concrete. The Contractor shall submit the method and sequence of placing concrete for acceptance.

The Contractor shall place the concrete for foundations, bottom slabs of box culverts and aprons on ground free from water. The Contractor shall dewater, sheath, place filter material and do other work as required by field conditions to provide a dry foundation bed according to the contract. The Engineer will consider costs for obtaining a dry foundation bed as included in the price for structure excavation.

The Contractor shall excavate and pour the sides of concrete or masonry footings not supported on piles or rock, to neat lines.

The Contractor shall place the concrete beginning at the low point and proceeding upgrade. The Contractor shall remove struts, stays, braces or blockings when the concrete placed has reached an elevation rendering their services unnecessary.

The Contractor shall deposit the concrete in approximately horizontal layers to avoid flowing along the forms. If the Contractor places less than a complete layer in one operation, the Contractor shall end the layer in a vertical bulkhead. The depth of layers shall be such that the Contractor shall place the succeeding layer before

The Contractor shall allow the concrete to set at least twelve (12) hours before the Contractor places the columns, caps or beams.

The Contractor shall not pour the horizontal members or sections until the Contractor has consolidated the concrete in the supporting vertical members or sections and shrinkage has occurred. When the contract shows construction joints, at least twelve (12) hours shall elapse between pours.

The Contractor shall not place the concrete in the superstructure until the Contractor has stripped the column forms sufficiently to show the character of the concrete in the columns. The Contractor shall not allow the load of the superstructure to come upon the bents until the bents have been in place at least fourteen (14) days.

The Contractor shall not pour the concrete in suspended span until the adjacent continuous spans are complete in place.

In structures with one (1) or two (2) hinges in a span, the Contractor shall pour the supporting ends of the hinges including the top slabs before the supported end.

The Contractor shall not pour the concrete sidewalks and curbs not monolithic with the bridge deck until after the Contractor has released the falsework for the spans.

(2) Chutes and Troughs. The Contractor shall place the concrete to avoid segregation of the materials and the displacement of reinforcement.

Where the contract requires steep slopes, the Contractor shall equip the chutes with baffle boards or be in short lengths that reverse the direction of movement.

The Engineer will permit the use of long troughs, chutes and pipes only with written authorization by the Engineer. The Contractor shall incline the chutes or pipes, if permitted, to permit the flow of concrete of the required consistency. The diameter of pipes shall not be less than six (6) inches. The Engineer will not allow the addition of water in the concrete mix to promote free flow in chutes of low inclination.

The Contractor shall not drop the concrete in the forms a distance of more than five (5) feet unless confined by closed chutes or pipes. Care shall be taken to fill each part of the form by depositing the concrete as near final position as possible. The Contractor shall work the coarse aggregate back from the forms and worked around the reinforcement without displacing the bars. After initial set of the concrete, the Contractor shall not jar the forms and shall not place strain on the ends of projecting reinforcing.

The Contractor shall keep the chutes, troughs and pipes clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. The Contractor shall discharge the water used for flushing clear of the concrete already in place. The Engineer will not permit the use of aluminum chutes, tremies, troughs and pipes.

(3) Vibrating. The Contractor shall consolidate the concrete, except concrete placed under water, by high frequency internal vibrators of a type, size and number acceptable by the Engineer. The frequency of the transmitted vibration shall be not less than four thousand five hundred (4,500) impulses per minute. The frequency of the transmitted vibration shall be such as to visibly affect a mass of concrete of one (1) inch slump over a radius of at least eighteen (18) inches. The number of vibrators employed shall be sufficient to consolidate the incoming concrete to a proper degree within fifteen (15) minutes after the Contractor deposits the vibrator in the forms. At least two (2) vibrators shall be available at the structure site when the Contractor places more than twenty—five (25) cubic yards of concrete. The Contractor shall apply the vibrators at uniformly spaced points and not farther apart than is visibly effective. The Contractor shall not attach the vibrators to or held against the forms or the reinforcing steel.

The Contractor may use acceptable external vibrators for consolidating concrete when the concrete is inaccessible for adequate consolidation provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

When required, the Contractor shall supplement the vibration by hand spading with suitable tools to assure proper and adequate compaction. The Contractor shall manipulate the Vibrators to work the concrete thoroughly around the reinforcement and imbedded fixtures and into corners and angles of the forms. The Contractor shall not use the vibrators to cause concrete to flow or run into

position instead of placing. The vibration shall be of sufficient duration to compact but shall not be prolonged to the point where segregation occurs.

(4) Depositing Concrete Underwater. The Contractor shall not deposit concrete except cofferdam seals underwater. Concrete deposited underwater shall be seal concrete according to Section 601 - Structural Concrete.

The Contractor shall place the concrete deposited underwater carefully in a compact mass in its final position by a tremie, a closed-bottom dump bucket or other acceptable methods. The Contractor shall not disturb them after being deposited. The Contractor shall maintain the still water at the point of deposit.

A tremie includes a tube having a diameter of not less than ten (10) inches, constructed in sections having flanged couplings fitted with gaskets. The Contractor shall equip the tube with the following to prevent water from entering the tube while charging the tube with concrete:

(a) a receiving hopper at the top and

(b) a device that closes the discharge end.

The Contractor shall support the tremie to permit:

(a) free movement of the discharge end over the entire top surface of the work and

(b) rapid lowering when necessary to retard or stop the flow of concrete.

The Contractor shall close and seal the discharge end entirely at the start of work to prevent water entering the tube. The Contractor shall keep the tremie tube full to the bottom of the hopper. When the Contractor dumps a batch into the hopper, the Contractor shall induce the flow of concrete by slightly raising the discharge end. The Contractor shall always keep the discharge end in the deposited concrete. The flow shall be continuous until the Contractor completes the work.

The underwater bucket shall have an open top. The bottom doors shall open freely outward when tripped. The Contractor shall fill the bucket completely and slowly lower the bucket to avoid

backwash. The Contractor shall not dump the bucket until the bucket rests on the surface upon which the Contractor is to deposit the concrete. After discharge, the Contractor shall raise the bucket slowly until well above the concrete. The Engineer will not permit the use of bottom dump buckets for bottom seal around foundation piling.

The Contractor is solely responsible for the design and construction of concrete seal. The exact thickness of concrete seal shall depend upon the hydrostatic head, bond and spacing of piles and size of the cofferdam. The Contractor shall allow the seal to remain in place for not less than seven (7) days before dewatering to set sufficiently to withstand the hydrostatic pressure. After sufficient time has elapsed, the Contractor shall dewater the cofferdam and clean the top of the concrete of scum, laitance and sediment. Before the Contractor deposits the fresh concrete, the Contractor shall remove the local high spots as necessary to provide proper clearance for reinforcing steel.

(5) Hot Weather Concreting. The Contractor shall not place the concrete where the temperature of the concrete is above ninety (90) degrees Fahrenheit.

When the ambient temperature is above ninety (90) degrees Fahrenheit, the Contractor shall cool the reinforcing steel, forms and other surfaces to below ninety (90) degrees Fahrenheit by a water spray or other acceptable methods.

(G) Joints.

(1) Construction Joints. The Contractor shall make the construction joints only at locations shown on the plans. Construction joints shall be perpendicular to the principal lines of stress and shall be at points of minimum shear. The Contractor shall roughen the surface of the construction joint to a full amplitude of approximately quarter (1/4) inch.

After the Contractor has placed concrete to the construction joint and after the concrete has set, the Contractor shall clean the entire surface of the joint including the projecting reinforcement thoroughly. The Contractor shall clean the joint of surface laitance, curing compound and other material foreign to the concrete. The Contractor shall expose the cleaned coarse aggregate by abrasive blast cleaning after the curing period or immediately before placing concrete at the joint.

Before placing new concrete, the Contractor shall draw the forms tightly against the concrete already in place. The Contractor shall clean thoroughly, saturate with water, and cover the old surface with a coat of mortar or neat cement grout before the mortar or grout has attained its initial set. The Contractor shall place the concrete in substructures so that horizontal construction joints shall be truly horizontal. Where possible, the Contractor shall not expose the joints to view in the finished structure. Where vertical construction joints are necessary, reinforcing bars shall extend across the joint to make the structure monolithic. The Contractor shall take special care to avoid construction joints through paneled wing walls or other large surfaces that the Contractor are to treated architecturally.

When a joint is necessary because of an emergency, the Contractor shall furnish and place reinforcing steel across the joint as ordered by the Engineer at no cost to the State.

(2) Expansion Joints. The Contractor shall provide expansion and contraction of concrete structures for by expansion joints. Expansion joints shall be of the type and in the location shown in the contract. Expansion joints may be the friction, open, filled compression, mortise or special type.

Metal friction joints include cast iron or bronze plates shown in the contract. The Contractor shall anchor the plates in correct position. The Contractor shall plane the sliding surfaces true and smooth. The direction of movement of the planing tool shall conform to the direction of movement of the structure. The Contractor shall not impede the movement by contacts of surfaces other than the bearing surfaces.

The Contractor shall construct open joints by removable bulkheading forms so that the Contractor may remove the forms without damage to the concrete.

The Contractor shall make the filled compression joints with preformed expansion joint filler. The Contractor shall cut the preformed joint filler to the same shape as the area to be covered. Preformed joint filler shall be quarter (1/4) inch smaller along the exposed surfaces in the finished work. The Contractor shall fix the preformed joint filler firmly against the surface of the concrete already in place so that the Contractor does not displace the preformed joint filler when the Contractor deposits the concrete

against the filler. When necessary to use more than one piece to cover a surface, the Contractor shall cover the joint between the separate pieces with a layer of two (2) ply roofing felt. The Contractor shall cover one (1) side with hot asphalt to insure proper retention. The Contractor shall fill the quarter (1/4) inch space along the edges at exposed faces with wooden strips of the same thickness as the joint material. The Contractor shall saturate these wooden strips with oil and have sufficient draft to make the wooden strips readily removable after the Contractor places the concrete. Immediately after the Contractor removes the forms, the Contractor shall inspect the expansion joint carefully. The Contractor shall clean and remove the concrete or mortar that has sealed across the joint.

The Contractor shall construct the mortised joints according to the contract. The mortised joints include a concrete or metal part sliding in a concrete or metal socket. The construction shall permit freedom of movement in two (2) directions and be watertight and rustproof as far as possible.

Steel joints include plates, angles or other structural shapes that the Contractor shall shape accurately at the shop to conform to the section of the concrete floor. The fabrication and painting shall conform to the contract. When specified in the contract, the Contractor shall zinc-coat the material instead of painting the material. The Contractor shall insure that the surface of the finished plane is true and free of warping. The Contractor shall use the positive methods in placing the joints to keep the joints in correct posftion during placing of the concrete. The opening at expansion joints shall be that designated on the plans. The Contractor shall avoid impairment of the clearance.

The Contractor shall so place the metal joints so that they are free from kinks. The joints shall be watertight and so arranged to lead drainage water to a point of discharge to prevent staining of the exposed concrete surfaces. The Contractor shall rivet and solder the joints. At bends, the strips shall be preferably one (1) piece.

The Contractor shall remove stones, forms or other foreign matter that would interfere with the efficiency of the joints.

When required, the Contractor shall furnish and install the waterstops according to the contract. The Contractor shall position the waterstops correctly in the form work so that the Contractor

aligns and centers the bulb with the joint opening. The Contractor shall vibrate the concrete surrounding the imbedded waterstops well to attain impervious concrete near joints. The Contractor shall cut and splice the waterstops at changes in direction as may be necessary to avoid buckling or distortion of the web or flange. Field splices shall be according to Subsection 705.07 - Waterstops.

(H) Waterproofing. Concrete surfaces shall be smooth and free from holes and projections that might puncture the waterproofing membrane. The Contractor shall dry and clean the surfaces thoroughly of dust and loose materials before waterproofing. The Contractor shall not waterproof in wet weather or when the temperature is below sixty—five (65) degrees Fahrenheit without written authorization from the Engineer.

Waterproofing includes a firmly bonded membrane composed of two (2) layers of saturated fabric and three (3) moppings of waterproofing asphalt. The Contractor shall apply a coat of primer to the surface of concrete according to the contract or ordered by the Engineer.

The Contractor shall apply a coating of primer to the surface extending twelve (12) inches on each side of the joint. The Contractor shall allow the primer to dry before the first application of asphalt. The Contractor shall heat the asphalt to a temperature of not less than three hundred (300) degrees Fahrenheit or not more than three hundred and fifty (350) degrees Fahrenheit. The Contractor shall mop the asphalt thoroughly onto the surface.

The Contractor shall place a strip of fabric eighteen (18) inch wide immediately on the hot asphalt. The Contractor shall carefully press the fabric into place to eliminate trapped air bubbles and to obtain close contact with the surface.

The Contractor shall then mop the second application of asphalt on the fabric and three (3) inches beyond the edges. Immediately following this operation, the Contractor shall press the second layer of fabric into place on top of the first layer.

The Contractor shall then mop the third and final application of asphalt on the fabric and three (3) inches beyond the edges. Laps at the ends of the fabric shall be twelve (12) inches.

The Contractor shall apply the primer to the concrete surface at the rate of one (1) gallon per one hundred (100) square feet. The Contractor shall apply the asphalt at the rate of fifteen (15) gallons per one hundred (100) square feet of finished work.

(l) Joint Sealing.

(1) Joint Seal (Poured) for Bridge Deck. The Contractor shall apply the sealant according to the contract and as ordered by the Engineer.

Immediately before applying the joint sealer, the Contractor shall clean the joints thoroughly by abrasive blasting or other acceptable means. The Contractor shall remove mortars, laitances, scales, dirt, dust, oil and other foreign matters. The Contractor shall then blow out the joint with high pressure, oil-free compressed air, removing the residue.

The Contractor shall not apply the joint sealer unless the joint is acceptable to the Engineer. The concrete and ambient temperatures shall not be less than fifty (50) degrees Fahrenheit.

The method of mixing and applying the two (2) component pourable joint sealer shall result in a homogeneous product. The Contractor shall power mix the materials for about eight (8) minutes. When the Contractor supplies component "A" that is less than twenty—five (25) percent by weight of Component "B", the Contractor shall not allow portions of Component "A" spatter on the side of the mixing container.

The Contractor shall apply the joint sealer so that the Contractor fills the joints without forming air holes and discontinuities. The top of the joint sealer shall be quarter (1/4) inch below the finished surface.

The Contractor shall remove the joint sealer that does not:

(a) cure to a homogeneous and rubber-like compound,

(b) bond to the joint faces, or

(c) comply with other requirements of this section.

The Contractor shall reclean the joint. The Contractor shall place the new joint sealer at no cost to the State.

After the Contractor seals the joints, the Engineer will not permit vehicles to travel over the joints until the Engineer grants permission.

(2) Joint Seal (Preformed) for Bridge Deck. The Contractor shall install the sealer as specified below and ordered by the Engineer.

Immediately before applying the joint sealer, the Contractor shall clean the joint thoroughly removing mortars, laitances, scales, dirt, dust, oil and other foreign matter.

The Contractor shall install the seal so that the Contractor will not abrade the seal by traffic, but effectively keep foreign material from entering the joint. The Contractor shall correct the spalls and protrusions in the joint before installation.

The Contractor shall install the preformed seal in one (1) continuous piece without field splices.

The Contractor shall not place the seal so that its top edge is below the riding surface according to the contract. The Contractor shall not go deeper than quarter (1/4) inch below the surface.

The top edge of the gasket should be in contact with the vertical walls of the joint. If spalling is evident, the Contractor shall repair the major spalls. The Contractor shall depress the seal below the minor spalls to have its top edge in contact with the vertical wall of the joint.

The Engineer will not permit twisting, curling, and nicking of the seal.

The Contractor shall protect the joint from the intrusion of earth, gravel, mortar or other foreign matter so that the structure can expand and contract as designed.

The groove width (w) shown on the plans shall be the width of the expansion joint at the time of the concrete pour. If this width is less than the manufacturer's minimum width for proper installation of the joint seal, the Contractor shall defer installation until after the Contractor pours the concrete. The Contractor shall install the seal after the joint width has increased to a width equal or greater than the minimum width recommended by the manufacturer.

The steel angle protective nosing assembly shall extend beyond the curb line and shall end one (1) inch from the edge of deck.

(3) Flashing Compound for Joints. The Contractor shall apply the flashing compound for retaining wall joints and other joints shown on the plans as recommended by the manufacturer.

(J) Concrete Exposed to Sea Water. In concrete structures exposed to sea water, the Contractor shall not form the construction joints between levels of extreme low water and high water as determined by the Engineer. Between these levels, the Contractor shall not remove the forms for thirty (30) days or longer if required by the Engineer.

(K) Protection and Curing. The Contractor shall protect the concrete from injurious action of the sun, rain, flowing water and mechanical damage. The Contractor shall not allow the concrete to dry out from the time the Contractor places the concrete until expiration of the minimum curing period. The minimum curing period shall be as follows:

(1) The Contractor shall cure the structures for at least seven (7) days. The Contractor shall maintain the temperature of structural concrete at no less than forty-five (45) degrees Fahrenheit for seventy-two (72) hours after placing. The Contractor shall maintain the temperature at no less than forty (40) degrees Fahrenheit for an additional four (4) days. When required by the Engineer, the Contractor shall submit a written outline of its proposed method for protecting the concrete.

(2) If the Contractor will submerge the cast-in-place parts of a structure permanently in fresh water, the Contractor may cure them for a period sufficient to prevent washing out of cement and then submerge immediately.

(3) If the Contractor will submerge the cast-in-place parts of a structure permanently in brackish or sea water, the Contractor shall them with fresh water for at least five (5) days. The Contractor shall then submerge the cast-in-place parts except to Subsection 503.03(J) - Concrete Exposed to Sea Water.

(L) Curing Methods. The Contractor shall cure the concrete by either water curing, impervious membrane curing or a combination of both. The exception is that the Contractor shall cure the full width of concrete bridge decks by a combination of impervious membrane curing and water curing. The Contractor may cure the surfaces of the horizontal

construction joints by the application of non-membrane curing compound that seals the concrete and does not reduce the bonding capacity of the interface. Before the Contractor applies that curing compound, the Contractor shall submit a written request including copies of test results and the manufacturer's catalogue for acceptance by the Engineer. The Contractor may steam cure precast concrete members according to Section 504 when permitted by the Engineer. Other exceptions are that the Contractor shall cure the first phase of the approach slab at both abutments of the Viaduct in the same manner as for the bridge decks and that the Contractor may follow the manufacturer=s recommendations for the cure the second phase of the approach slab at both abutments.

(1) Water Curing. The Contractor shall water cure by keeping the concrete continuously wet with fresh water by water sprays, a cceptable w ater saturated coverings, or by ponding. The Contractor shall keep wood forms that the Contractor leaves in place sufficiently damp to prevent opening at the joints and drying of the concrete.

The Contractor shall apply the moisture to the surface of the concrete with a fog spray nozzle when the surface water has evaporated. The Contractor shall continue the moisture to the surface until the regular curing begins. The amount of moisture applied shall not damage the surface or texture of the concrete. The water supply shall be adequate to fog and water cure the concrete.

Water curing for bridge decks shall begin after the Contractor applies the curing compound and immediately after the concrete surface is hard enough to receive the water without damaging the surface or texture of the concrete. The Contractor shall continue until the end of the specified curing period.

The Contractor shall provide adequate means to prevent curing water from falling on the traveled roadways under the structure. The Contractor shall also channel the water away from falsework and structure foundations.

(2) Impervious Membrane Curing. The Contractor shall seal the concrete surface thoroughly with a liquid membrane-forming compound. The Contractor shall apply the compound uniformly in two (2) or more applications. The ratio shall be a total of at least one (1) gallon for each one hundred fifty (150) square feet of concrete surface.

The Contractor shall not use curing compounds that will permanently darken the concrete on exposed surfaces in the completed structure. If the Contractor is to bond the concrete or apply waterproofing or epoxy, the Contractor shall not apply membrane curing compound. Exception is for the full width of bridge decks.

The Contractor shall not allow the concrete surfaces to dry before the Contractor applies the impervious membrane. If the Contractor breaks or damages the membrane film during the specified curing period, the Contractor shall give the area a new treatment duplicating the first application.

(M) Finishing Concrete Surfaces. The following requirements shall apply to the several classes of surface finish that the Contractor ordinarily apply to the various parts of concrete structures.

(1) Class 1 Ordinary Surface Finish. The Contractor shall apply the ordinary surface finish to concrete surfaces either as a final finish or preparatory to a higher class finish. On buried surfaces or enclosed surfaces such as the cells of box girders, the Contractor will not require removal of fins and form marks and the rubbing of mortared surfaces to a uniform color.

During the placing of concrete, the Contractor shall ensure that the methods of compaction used will result in a surface:

(a) of even texture,

(b) free from voids, water or air pockets, and

(c) where the Contractor forces the coarse aggregate away from the forms.

After the Contractor removes the forms, the Contractor shall remove the form bolts and ties to a depth of at least one (1) inch below the surface of the concrete. The Contractor shall clean, wet, and fill the resulting holes or depressions with mortar. Mortar includes one (1) part by volume of cement to two (2) parts of sand. The Contractor shall add white cement to the mortar in sufficient quantity to tint the mortar a shade lighter than the repaired concrete. Mortar shall not be more than one hour old. The Contractor shall get a perfect bond with the concrete. After the mortar has thoroughly hardened, the Contractor shall rub the surface with a carborundum stone to obtain the same color in the

mortar as in the surrounding concrete. The Contractor shall remove the fins caused by form joints and other projections. The Contractor shall remove stains and discolorations visible from the traveled way.

The Contractor shall clean and fill the pockets with mortar. Exceptions are those scattered pockets or pinholes less than half (1/2) inch in length or width and three-eighths (3/8) inch in depth. They shall also not affect the strength of the structure or endanger the life of the steel reinforcement. The Contractor shall fill the pockets on surfaces visible from pedestrian traffic and surfaces exposed to stream flow, salt air and salt water. The Contractor shall treat mortar for filling pockets as specified for bolt and tie holes. If rock pockets will affect the strength of the structure materially or to endanger life of the steel reinforcement, the Engineer may declare the concrete defective and require the removal and replacement of the structure affected.

The Contractor shall clean, wet, and fill the holes or depressions in surfaces that are to receive Class 2 Rubbed Finish with mortar. They shall clean, wet, and fill at least seven (7) days before starting Class 2 Rubbed Finish.

(2) Class 2 Rubbed Finish. The Contractor shall apply the Class 2 Rubbed Finish to the following surfaces:

(a) Surfaces of bridge superstructures, including pedestrian overpasses. The inside vertical surfaces of "T" girders, slab soffits of interior bays of "T" girders, enclosed surfaces of box girders, top surfaces of bridge decks, walkway surfaces and median strips need not apply Class 2 Rubbed Finish.

(b) Surfaces of bridge and pedestrian overpass piers, piles, columns, pier caps, abutments, wing walls, and retaining walls above finished ground and to at least one (1) foot below finished ground.

(c) Surfaces of open spandrel arch rings, spandrel columns and abutment towers.

(d) Surfaces above finished ground of culvert headwalls, and endwalls where visible from a traveled way.

(e) Surfaces inside the culvert barrels having a height of four (4) feet or more for a distance inside the barrel at least equal to the height of the culvert. They shall also be visible from the traveled way.

(c) Surfaces of concrete railings, end posts and curbs.

After completion of the Class I Ordinary Surface Finish, the Contractor shall sand the areas that do not exhibit a smooth, even surface of uniform texture and appearance. The Contractor shall sand the areas with a power sander or other acceptable abrasive means to obtain a uniform appearance and texture.

The Contractor shall use the power carborundum stones or disks to remove unsightly bulges or irregularities.

The intent is to secure a smooth, even surface of uniform appearance and to remove unsightly bulges or depressions due to form marks and other imperfections. The Engineer will not consider the scattered pockets or pinholes permitted under ordinary finish to affect the uniformity or texture. The extent of sanding and grinding will be according to the contract.

The final operation for this finish shall be the removal of the powder on the surface resulting from sanding and grinding. If the Contractor makes additional repair after sanding and grinding, the Contractor shall repeat the sanding and grinding after the Contractor cures the repair. The Contractor shall leave the finished surface free from powder and other foreign matter by washing or wiping with clean cloth.

(3) Class 6 Float Finish. The Contractor shall attain the Class 6 Float Finish as follows:

(a) Finishing Bridge Decks. The Contractor shall obtain a smooth riding surface of uniform texture true to the required grade and cross section, on bridge roadway decks.

The Engineer will not permit the Contractor to place concrete in bridge decks until the Contractor ensures the minimum rate of finished deck shall be at least twenty (20) linear feet per hour. The Contractor shall employ experienced operators and concrete finishers to finish the deck. The necessary finishing tools and equipment shall be on hand at the work site and in satisfactory condition for use.

The Contractor shall measure the rate along the centerline of the roadway.

Unless the Contractor provides acceptable lighting facilities, the Contractor shall complete the finishing operations during daylight hours.

Immediately before placing bridge deck concrete, the Contractor shall check the falsework and wedges. The Contractor shall insure that settlement and deflection due to the added weight of the bridge deck concrete shall be at a minimum. The Contractor shall provide suitable instruments, such as settlement gages, to permit ready measurement by the Engineer of settlement and deflection.

If settlement or other unanticipated events occur, the Contractor shall stop the placing of deck concrete until the Contractor provides corrective measures according to the contract. If the Contractor does not provide satisfactory measures before initial set of the concrete, the Contractor shall stop the placing of concrete. The Contractor shall install a bulkhead at a location determined by the Engineer. The Contractor shall remove the concrete in place beyond the bulkhead.

The Contractor shall place the bridge deck concrete in a uniform heading approximately perpendicular to the roadway centerline. The Contractor shall limit the rate of placing concrete that the Contractor may finish before the beginning of initial set. The Contractor shall not place the concrete for the deck surface more than ten (10) feet ahead of strike off. The Contractor shall spread the concrete to a uniform height and so as not to require striking off more than three (3) inches of concrete.

The Contractor shall finish the bridge decks with concrete wearing surfaces according to machine finishing unless the contract specifies manual finishing.

During the finishing operation while the concrete is still plastic, the Contractor shall test the surface with a ten (10) foot straight edge. The Contractor shall test the surface from the side or from transverse finishing bridges in the presence of the Engineer. The Contractor shall make the necessary corrections so that the Contractor will attain the

required tolerance with a minimum amount of remedial work after the concrete has hardened.

After the concrete has hardened sufficiently, the Contractor shall test the finished surface in the presence of the Engineer by a straight edge ten (10) feet long. The surface for concrete deck finish shall not vary more than one-eighth (1/8) inch from the lower edge of the straight edge.

If the concrete of the bridge deck is to be covered one (1) inch or more in thickness by bituminous surfacing, earth, or other cover, the surface of the concrete shall not vary more than quarter (1/4) inch from the lower edge of the ten (10) foot straight edge.

The Contractor shall remove high areas in the hardened surface by grinding. The Contractor shall not smooth or polish the finished texture of the structure as produced by grinding. They shall have a uniform texture of transverse grooves as ordered by the Engineer.

The Contractor shall submit the method of correcting low areas in writing. The Contractor shall not work on the low spots unless accepted by the Engineer.

The Contractor shall strike off the bridge deck surfaces under the curbs, railings, and sidewalks to the same plane as the roadway. The Contractor shall leave the bridge deck surfaces under the curbs, railings, and sidewalks undisturbed when future widening is shown on the plans.

When the width of the deck pour is six feet or less, the Contractor may use finishing methods other than those specified providing the completed deck surface conforms to the contract.

The Contractor shall remedy the completed bridge decks not according to the contract at no cost to the State until the Contractor gets the required finish.

1. **Machine Finishing.** The strike off and finishing machines shall be of an acceptable self-propelled type, operating on rails. The Contractor

shall use a strike off machine and a finishing machine or hand tools conforming to the contract.

The screed rails shall be adjustable for elevations. The screed shall be set to elevations, with allowances for anticipated settlement, camber and deflection, as required to form the surface of the bridge deck to the line and grade shown in the contract. The Contractor shall install screed rail type such that the rails shall not deflect appreciably under the applied loads. The supports for the screed rails shall not be placed within the deck concrete.

Before the Contractor begins concrete operations, the Contractor shall operate the strike off and finishing machines over the full length and full width of the bridge segment to be paved. The Contractor shall this test run with the screed and float adjusted to their finishing positions. While testing the machines, the Contractor shall check:

a. the screed rails for deflection,

b. the proper adjustment made,

c. the cover on slab reinforcement measured,

d. the controlling dimensions of slab reinforcement and

e. the forms.

The Contractor shall make the necessary corrections at this time.

After the Contractor has placed and consolidated the concrete, the Contractor shall strike off the surface of the concrete carefully by a strike off machine. The Contractor shall get a uniform deck surface true to the required grade and cross section.

When the acceptable machine used for strike off has a wheel base greater than six (6) feet, the Contractor shall float the concrete by a:

a. hand-operated longitudinal float board or

b. finishing machine equipped with a longitudinal float or

c. rotating element followed by a drag float pan.

The longitudinal float on the finishing machine shall have a length of not less than eight (8) feet nor more than twelve (12) feet. When both strike off and floating are by machines, the Contractor shall use two (2) machines with operators. The Contractor shall float the final pass as far back of the strike off as the workability of the concrete will permit.

The accepted strike off machine shall have a wheel base six (6) feet or less. The Contractor shall follow the strike off machine by two (2) separate hand-operated float boards for longitudinal floating or an acceptable finishing machine. The Contractor shall place the first hand-operated float in operation when the condition of the concrete will permit. The Contractor shall operate the second hand-operated float as far back of the first float as the workability will permit. Hand-operated float boards shall apply to the two (2) separate float boards for longitudinal floating.

The Contractor shall use longitudinal floats with the long axis of the float parallel to the center line of the bridge roadway. Longitudinal floats may be either hand-operated or machine-operated. The Contractor shall operate longitudinal floats with a combined longitudinal and transverse motion. The Contractor shall operate the rotating float with a rotational and transverse movement. The floats shall plane off the high areas and float the material removed into the low areas. Each pass of the float shall lap the previous pass by half (1/2) the length of the float. The Contractor shall continue floating until the Contractor gets a smooth riding surface. The Contractor shall meet the surface tolerances.

The Contractor may use an acceptable single machine equipped with a rotating auger for strike off and a rotating element. A drag float pan for consolidation and finishing shall follow. The Contractor shall have used this single machine successfully for finishing highway bridges. The finishing machine shall produce a deck surface according to the contract. When requested by the Engineer, the Contractor shall submit three (3) copies of manufacturer's operators and parts manual for the dual purpose alternate machine. Its operations shall be according to the manufacturer's manual.

Hand operated float boards and transverse finishing bridges shall conform to the manual finishing.

The Contractor shall provide not less than two (2) transverse finishing bridges.

The viaduct deck and the approach slabs shall be textured longitudinally by mechanical grooving. Grooves shall be cut into the hardened concrete using a mechanical water-cooled diamond edge blade saw device which shall leave grooves nominally 0.095-inch wide and 1/8-inch deep. The grooves shall be spaced apart in random spacing. The distance between the center grooves will have the following sequence: 3/4-inch, 1-1/8-inch, 5/8-inch, 1-inch, 5/8-inch, 1-1/8-inch, and 3/4-inch, in six-inch repetitions across the width to be grooved, in one pass of the mechanical saw device. If the machine is not able to groove the width in one pass, it shall match the pattern exactly and no joint shall be visible. One six-inch sequence may be adjusted by 1/4 sequence increments, to accommodate various cutting head widths, provided the general pattern is carried out. The tolerance for the width of the grooves is 0 to +0.05-inch. (i.e., the maximum groove width shall be 0.145-inch wide and the minimum groove width shall be 0.095-inch wide) and the tolerance for the depth of the grooves is 0 to ±1/16-inch. The tolerance for the spacing of the grooves is +1/4-inch at the exterior curves, between passes; this will be allowed to accommodate the bridge's curvature.

If grooves cannot be cut in a continuous longitudinal operation, the continuation of grooves shall be aligned such that joints are not visible. At the existing expansion joint structural steel nosings, groove cutting shall be adjusted so that the grooves end within two inches (measured normal to the center line of joint) leaving no ungrooved surface adjacent to each side of the joint greater than two inches in width. If, after the initial grooving, it is discovered that there are portions of the surface that remain ungrooved, the Contractor shall groove these areas based on a remedial plan accepted by the Engineer.

Before grooves are cut into the accepted hardened concrete, a final straight edging and corrective work, if required, shall be done by the Contractor. Grooves shall be cut continuously and parallel to the existing grooves. Grooving shall be done after the concrete has attained sufficient strength to prevent spalling and ravelling, and before the structure is opened to traffic.

A working drawing to control, collect and dispose of run-off water at an accepted off-site facility shall be submitted to the Engineer.

When constructing concrete bridge deck adjacent to an existing parallel concrete bridge deck not constructed as part of the contract, spread and shape the concrete so that:

1. the completed bridge deck will conform to the thickness and cross section requirements of the contract;

2. the water does not pond on either side of the longitudinal joint with the existing bridge deck;

3. the new bridge deck surface at the longitudinal joint conforms as close as possible to the elevation of the existing concrete bridge deck. Eliminate any differences in elevation between the new bridge deck and the existing

bridge deck by finishing the new bridge deck within one foot of the existing bridge deck by hand methods, adding or removing concrete as necessary;

4. the transverse straightedge, longitudinal straightedge, and Profile Index requirements specified in Subsection 411.03(M) - Final Strike-Off and Consolidation will not apply to the bridge deck surface within one foot of the existing concrete bridge deck;

The Contractor shall not apply any additional water to the deck surface in an effort to aid his finishing operation. The unauthorized application of water will result in the rejection of that day's concrete placement.

2. Manual Finishing. After the Contractor places the concrete and consolidates the surface, the concrete shall receive a preliminary finish. The preliminary finish includes striking off the surface of the concrete carefully with a template or strike board operated on and between supports or headers.

The Contractor shall set the supports or headers to elevations as required to form the surface of the bridge deck to the line and grade shown in the contract. The Contractor allow for anticipated settlement, camber, and deflection when computing the elevation.

The Contractor shall use the template or strike board to alternately tamp and strike off the concrete and move forward with a combined longitudinal and transverse motion. The Contractor shall leave a uniform film of mortar or grout of suitable consistency on the surface of the concrete after the last pass of the template or strike board.

The template or strike board shall be of rigid construction. The Contractor shall design the template or strike board such that the template or strike board shall resist deflection and distortion when in use.

The Contractor shall install such supports or headers that the supports or headers shall not deflect appreciably under the applied loads.

Supports or headers for deck pours shall be completely in place for the full length of the pour. The Contractor shall secure the supports and headers before placing deck concrete.

Following completion of the preliminary finish, the Contractor shall float the deck for concrete wearing surface in a direction parallel with the centerline of roadway from transverse bridges.

The Contractor shall span the transverse finishing bridges completely. The finishing bridges shall be of rigid construction. The finishing bridges shall be free of wobble and springing when used by the operators of the floats. The Contractor shall be able to move the finishing bridges easily. The number of finishing bridges provided shall be sufficient to permit the floating operation to follow the preliminary finishing operations without undue delay. The Contractor shall provide not less than two (2) transverse finishing bridges.

The Contractor shall float with two (2) separate wooden floats, each between twelve (12) to sixteen (16) feet long. The float boards shall be one (1) inch thick and four (4) to eight (8) inches wide. The Contractor shall rib the float boards rigidly. The Contractor shall provide adjusting screws at not more shall than twenty-four (24) inch centers between rib and float Contractor board. The Contractor shall maintain the float board flat and true.

The Contractor shall provide each float with adjustable handles at each end. The Contractor shall rib and truss each float as necessary to insure the float board has a true, rigid surface.

The Contractor shall operate the floats with a combined longitudinal and transverse motion, planing off the high areas and floating the material removed into the low areas. Each pass shall lap the previous

pass by half (1/2) the length of the float. The Contractor shall continue the floating until the Contractor gets a smooth surface.

The Contractor shall put the first float into operation when the condition of the concrete surface permits smoothing. The Contractor shall keep the first float in continuous operation until subsidence has taken place.

The Contractor shall operate the second float as far back of the first float as the workability of the concrete shall permit.

After the Contractor completes the floating operation the Contractor shall texture the deck surface according to the procedures outlined under machine finishing.

3. Surface Test.

The finished bridge deck shall conform to the following requirements when tested by the Engineer not more than 14 days following the placement of concrete:

a. Straightedge the bridge deck surface at locations determined by the Engineer with a straightedge 12 feet long. When laying the straightedge on a finished bridge deck in a direction parallel with centerline or perpendicular to centerline, the surface shall not vary more than 0.25 inch from the lower edge.

b. The Engineer will determine the profile of the bridge deck surface using a profilograph according to Hawaii Test Method HDOT TM 6 and these provisions. The Engineer will take the profiles parallel to each edge of bridge deck and the approximate location of each longitudinal joint. The State will determine the profile of the bridge deck of the travelway, shoulder, and closure pour as illustrated and

defined in the contract plan's "Normal Deck Section.

The Engineer will inform the Contractor of the profilograph test's traces and profile index for the area tested. If the bridge deck surface test does not meet the requirements of the Contract Documents, the Contractor shall utilize its own profilograph surface tests to determine where the bridge deck surface must be corrected. When the Contractor has determined that the surface meets the requirements of the Contract Documents, the Contractor shall request HDOT to perform another profile of the bridge deck surface using a profilograph according to Hawaii Test Method HDOT TM 6 and these provisions. The results of this test will determine if the surface is acceptable to the Engineer.

Make the request to the Engineer for profile testing at least 7 calendar days before testing the bridge deck surface. Clean and clear the area to be tested of obstructions, provide MUTCD compliant traffic control at no additional cost to the State if needed. Lane rental charges will be accessed if applicable. The Contractor shall provide all needed aid to the State so that the test can be performed. The Engineer will do up to two profilograph tests of the same area at no cost to the Contractor. Submit the total area to be tested at any time the request for testing is made, for acceptance by the Engineer. The minimum length of a test area shall be no less than 0.10 mile unless the work area remaining to be tested is less than 0.10 mile. After the second profilograph test is made of the same area, the Engineer will do additional profilograph testing at a cost to the Contractor at a rate of $750 per test. If the test takes more than one day, another $750 will be charged for each additional day. The cost of the extra profilograph testing shall be deducted from the monthly estimate, or if insufficient payment is

to be made to cover the cost, the cost will be billed to the Contractor.

Repair the membrane curing film damaged during the testing operations as specified by the Engineer. The Contractor and the Engineer will use the initial profile testing to aid and evaluate the deck concrete placement methods and equipment. When an average profile index exceeds 15 inches per mile, suspend the paving operations. The Engineer will not allow the Contractor to resume until corrective action is taken. Test the subsequent paving operation according to the initial testing procedures.

Furnish equipment and employ methods that produce a riding surface having a profile index of 10 or less, except as provided herein. The Engineer may accept the initial profiles up to 15 with applicable price adjustments.

Reduce individual high points over 0.3 inch, as determined by measurements of the profilogram according to Hawaii Test Method HDOT TM 6, by grinding until such high points as shown by reruns of the profilograph do not exceed 0.3 inch. At all areas, that need corrective work the Contractor shall determine the depth of the reinforcing steel. When the clearance between the bridge deck surface and the top of the reinforcing steel is less than one-inch, the Contractor shall submit a remedial repair method to protect the reinforcing steel from corrosion and to prevent the bridge deck from cracking or spalling that is acceptable to the Engineer. The remedial repair method and any design work shall be at no additional cost to the State.

Do additional grinding as necessary to reduce the Profile Index to values specified in any 0.1 mile section along any line parallel with the bridge deck edge.

Do additional grinding as necessary to extend the area ground in each lateral direction so the lateral limits of grinding are at a constant offset from and parallel to, the nearest lane line or bridge deck edge. Also, do additional grinding as necessary to extend the area ground in each longitudinal direction so the grinding begins and ends at lines normal to the bridge deck centerline, within any one ground area. Ground areas shall be neat rectangular areas of uniform surface appearance.

When grinding bridge deck, do not finish the bridge deck to a smooth or polished texture. Grind the bridge deck to maintain a texture with randomly spaced grooves in the pattern and direction as specified in the contract plans, unless otherwise specified by the Engineer.

The Engineer will exclude the areas described in the subparagraphs below from the profile testing requirements described above.

a. On horizontal curves having a centerline radius of curve less than 1,000 feet and bridge deck within the superelevation transition of such curves,

b. Within 15 feet of a transverse joint that separates the bridge deck from an existing Portland Cement Concrete pavement not constructed under the contract or an asphalt concrete surfaced pavement; or a structural deck or approach slab,

c. Ramps and connectors with grades of 6 percent or more.

The Engineer will apply the surface requirement described below to those areas exempted from the profile testing describe previously.

a. Measure using a 12 foot straight edge, the perpendicular distance from the bridge

deck surface to the lower edge of that straight edge. Between any two points of contact between the bridge deck surface and the lower edge of the straight edge, the measured distance shall be 0.25 inch or less for straight edge alignments parallel and perpendicular to the centerline of the lane that is being tested and

b. The bridge deck that is being tested shall have its entire profilograph trace inside of a 0.2 inch blanking band.

c. The Engineer will inform the Contractor of the profilograph test's traces and profile index for the area tested. If the bridge deck surface test does not meet the requirements of the Contract Documents, the Contractor shall utilize its own profilograph surface tests to determine where the bridge deck surface must be corrected. When the Contractor has determined that the surface meets the requirements of the Contract Documents, the Contractor shall request HDOT to perform another profile of the bridge deck surface using a profilograph according to Hawaii Test Method HDOT TM 6 and these provisions. The results of this test will determine if the surface is acceptable to the Engineer.

The Engineer will not count the profile index obtained in the exempted areas for the calculation of any price adjustment due to profile index. The price adjustment is shown in Profile Index Price Adjustment table in 411.05(A) – Price Adjustments.

The Contractor shall correct all profiles by using grinding methods that does not impact, hammer, batter or cause micro-cracking in the bridge deck. Use of bush hammers or other impact devices are not permitted.

(b) Sidewalks and Median Strips. The Contractor shall do the final finish for concrete sidewalks and median strips with a wooden float. The wooden be slightly rough.

The degree of roughness will be according to the contract. The top surfaces of decks, ramps and approach ramps for pedestrian structures and the top surfaces of sidewalks shall have an abrasive coating.

If abrasive coating is specified, the Contractor shall sprinkle quarter (1/4) pound of grain per square foot uniformly on the fresh concrete. The Contractor shall finish the surface with a wooden float. The Engineer will consider the application of abrasive coating incidental to concrete. The abrasive coating will not be paid for separately.

(N) Cleaning Up. Upon completion and before final acceptance of the structure, the Contractor shall remove falsework, excavated or useless material, rubbish and temporary buildings. The Contractor shall replace or restore public or private fences or property damaged during the prosecution of the work. The Contractor shall leave the bridge site and adjacent highway in a neat and presentable condition according to the contract. The Contractor shall remove the excavated material or falsework placed in the stream channel during construction before final acceptance.

503.04 Method of Measurement. The Engineer will not measure concrete for payment.

The Engineer will not measure the mechanical grooving of the viaduct deck and approach slabs.

The Engineer will not make deductions for the volume occupied by the reinforcing steel, piles, floor drains, weepholes, timber bumpers, pipes less than 8 inches, conduits, or expansion joint materials.

The Engineer will consider the wingwalls to be a part of the structure.

The Engineer will measure reinforcing steel according to Section 602 - Reinforcing Steel.

The Engineer will measure deck replacement concrete according to Section 540 - Viaduct Deck Concrete Overlay.

The Engineer will measure bearing and expansion plates according to Section 506 - Bearing and Expansion Plates.

503.05 Basis of Payment. The Engineer will pay for the accepted concrete at the contract lump sum price complete in place.

The Engineer will pay for the accepted mechanical grooving of the viaduct deck and approach slabs at the contract lump sum price complete in place.

The price includes full compensation for the concrete; for placing, curing and finishing including grooving; for furnishing materials including admixtures and cement (including extra cement added to concrete deposited under water); for furnishing and installing drains, scuppers, premolded joint fillers, joint seals, mud slabs beneath the footings, reinforcing steel for reinforced concrete jacket on 16" waterline, waterproofing at construction joints, waterstops, pipes, and conduits; for furnishing and installing metal rockers, anchor bolts, structural shapes for expansion joints and other similar items; for timber bumpers, forms, form lining and falsework or centering, bearing pads, structural steel bearing plates; and for equipments, tools, labor, materials, and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Mechanical Grooving	Lump Sum
Concrete _____ (Class _____ **if applicable**)	Lump Sum

The Engineer will pay for reinforcing steel according to Section 602 - Reinforcing Steel.

The Engineer will pay for bearing and expansion plates according to Section 506 - Bearing and Expansion Plates."

END OF SECTION

SECTION 504 - PRESTRESSED CONCRETE

Make the following amendments to said Section:

Amend **504.03(A) General** by revising the last paragraph to read as follows:

"The Contractor shall furnish and place the prestressed concrete members according to the dimensions in the plans and within the tolerances specified in the PCI "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products" (MNL-116-99). Two copies of this manual shall be furnished to the Engineer and such copies shall be incidental to the prestressed concrete members. However, the Contractor shall modify and schedule the fabrication of the prestressed concrete members such that any increase in camber due to time, creep or other factors shall not cause the total camber to exceed the maximum camber immediately prior to erection of girders as shown on the plans. Any prestressed concrete member that exceeds the PCI tolerance limit or the maximum camber specified in the contract will not be accepted."

Amend **504.03 (I) Handling, Storage and Transportation** by adding the following paragraph:

"The Contractor shall submit working drawings for the proper member support at each stage of handling, storage, transportation and placing prior to the concrete pour of the diaphragms. The member support shall minimize warping, bowing and the possibility of loss of support or bearing.

Girders shall not be stored on the viaduct or on any portion of the freeway."

Amend **504.03 (J) Placing** to read as follows:

"The Contractor shall place the precast, prestressed concrete members in the structure according to the contract. The placing of the girder shall not be done when the wind velocity could cause the girder to swing beyond the control of the crane operator or other placing personnel. During the placing operation, the girder shall not be allowed to swing, cross over or be above the lanes carrying public traffic. The girder, crane or any lifting machine shall not be allowed to be on or above the airspace of private property near the construction site.

Girder erection/placing times shall be between 10 A.M. to 2 P.M. if Interstate Route H-1 is used but the allowable work times for construction, including girder erection/placing below the Viaduct girder soffit level are shown on plan sheet AC13.1."

END OF SECTION

SECTION 507 - RAILINGS

Make the following amendments to said Section:

(I) Amend **507.04 Method of Measurement** to read as follows:

"**507.04 Method of Measurement.** The Engineer will measure railings per linear foot. The Engineer will make the measurement along the centerline and from end to end of the railing."

(II) Amend **507.05 Basis of Payment** to read as follows:

"**507.05 Basis of Payment.** The Engineer will pay for the accepted railings at the contract unit price per linear foot complete in place.

The price includes full compensation for furnishing, placing, and constructing the median barriers and railings; storing the material; furnishing and placing entrance posts, pylons, and other items integral with the railing and portion of the railing steel that extends into the slab or beams; and furnishing materials, labors, equipment, tools, and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Concrete Railings on _____	Linear Foot
Concrete Median Barriers _____	Linear Foot

The Engineer will pay for the portions of slab or beam bars that project into the railing according to Section 602 - Reinforcing Steel."

END OF SECTION

Amend Section 511 - Drilled Shafts to read as follows:

"SECTION 511 - DRILLED SHAFTS

511.01 Description. This section is for installing drilled shafts according to the contract documents. Drilled shafts include reinforced or unreinforced concrete with or without concrete bell footings.

511.02 Materials. Materials shall conform to the following:

(A) Portland Cement Concrete. Concrete shall conform to Section 601 - Structural Concrete except the concrete shall have minimum 28-day compressive strength f'_c = 4500 psi.

Proportion the concrete mix designs to get properties of high workability, compaction under self weight, and resistance to segregation. The maximum nominal aggregate size shall be 0.75 inch. The slump range shall be 7.0 inches ± 1.0 inch for concrete poured into a water free borehole and 8.0 inches ± 1.0 inch for concrete placed under water or under drilling slurry. Slump for the concrete shall be a minimum of four inches after four hours from initial mixing.

The Engineer will not permit superplasticizers.

(B) Reinforcing Steel. Reinforcing steel shall conform to Section 602 - Reinforcing Steel.

(C) Crosshole Sonic Logging (CSL) Test Access Tubes. CSL access tubes shall conform to the following requirements:

Access tubes shall be a minimum of 2.0-inches inside diameter, Standard steel pipe conforming to ASTM A53, Grade B, Type E or S.

Access tubes shall have a round regular inside diameter free of defects and obstructions, including all pipe joints, to permit free passage of the 1.375-inch maximum diameter source and receiver probes used for the testing. Access tubes shall be watertight with watertight couplings, free from corrosion with clean internal and external faces to ensure good bonding between the drilled shaft concrete and the access tubes. Tube ends shall not be damaged and shall be suitably prepared for watertight end caps and coupling. The access tubes shall be close-ended with a watertight cap at the bottom and fitted with removable end caps at the top. Watertight access tube coupling shall be used for extending the tubes .

Access tube acceptance will be based on manufacturer's certification that the furnished material meets the requirements of this specification.

511.03 Qualifications of Drilled Shaft Contractor. The Drilled Shaft Contractor shall be capable of performing the work specified and shall have the following minimum experience requirements below.

(A) Drilled Shaft Experience. Because of the expertise required to successfully complete the drilled shafts according to the contract, a qualified Drilled Shaft Contractor shall install the drilled shaft. The Drilled Shaft Contractor shall have installed at least five projects completed in the last 10 years on which the Contractor has installed a minimum of five drilled shafts of a diameter and length similar to those shown in the contract. The Drilled Shaft Contractor shall have supervisory personnel who participated in the construction of drilled shafts similar to the type proposed for a duration of at least three years within the last 10 years.

511.04 Pre-Construction Requirements.

(A) Experience Information. The Drilled Shaft Contractor shall submit the following information to the Engineer within 30 days after award of contract:

(1) List of drilled shaft projects completed in the past 10 years. The list of projects shall contain the names and phone numbers of owner's representatives who can verify the Contractor's participation on that project.

(2) Name and experience record of the drilled shaft superintendent in charge of drilled shaft operations for this project.

(3) A signed statement that the Drilled Shaft Contractor has inspected both the project site and the subsurface information for the project including soil or rock samples made available in the contract documents. Demonstrate an understanding of the subsurface conditions and all factors affecting the drilling operation.

(B) Protection of Existing Structures. Prevent damage to existing structures and utilities. Preventive measures shall include:

(1) Selecting construction methods and procedures that will prevent caving of the shaft excavation and

(2) Monitoring and controlling the vibrations from construction activities such as the driving of the casing or sheeting or drilling of the shaft.

(C) Installation Plan. At least 30 days prior to constructing the drilled shafts, submit an installation plan for acceptance by the Engineer. This plan, as a minimum, shall provide information on the following:

(1) List of all proposed equipment, and the capacities of the equipment, to be used on site including cranes, drills, augers, bailing buckets, final cleaning equipment, tremies or concrete pumps, and casing,

(2) Details of construction operation sequence and the sequence of shaft construction in bents or groups,

(3) Details of shaft excavation methods including how the excavated material from the drilled shaft will be controlled on site and removed,

(4) When the contract requires slurry, details of the methods to mix, circulate, and desand slurry,

(5) Details of methods to clean the shaft excavation,

(6) Details of reinforcement placement including support and centralization methods,

(7) Details of concrete placement including proposed operational procedures for free fall, tremie, or pumping methods, and

(8) Details of required load tests including load cell and test assembly, equipment and procedures, and recent calibrations for jacks or load cells supplied by the Contractor.

The Engineer will evaluate the drilled shaft installation plan for conformance with the contract within 20 days after receipt of the plan. The Engineer will notify the Contractor of additional information required and/or changes necessary to meet the contract requirements. The Engineer will reject parts of the plan that are unacceptable. The Contractor shall resubmit changes for re-evaluation. Procedural acceptance given by the Engineer shall be subject to trial in the field. The acceptance shall not relieve the Contractor of the responsibility to complete the work according to the contract.

(D) Trial Shaft Installation. Show the adequacy of its methods and equipment by successfully constructing one trial shaft. Position this trial shaft away from production shafts at the location shown in the plans or as modified by the Engineer. Construct the trial drilled shaft to the same diameter as production shafts or as directed by the Engineer. If bells are specified on the plans include a bell in the trial shaft. Install a temporary steel casing and drill the trial shaft to the maximum depth shown on the Plans.

Failure to show the Engineer the adequacy of methods and equipment shall be reason for the Engineer to require alterations in equipment and/or methods by the Contractor. Additional trial shafts required to demonstrate the adequacy of altered methods of construction or equipment shall be at no additional cost to the State. Once the Engineer has given acceptance to construct production shafts, the Engineer will not permit changes in the methods or equipment used to construct the satisfactory trial shaft without consent of the Engineer.

All trial shafts shall be backfilled with unreinforced concrete in the same manner that the production shafts are to be constructed. The Contractor may remove the temporary steel casing following placement of concrete in the trial shaft. All trial shafts shall be cut off 24 inches below finished grade and left in place. Restore the disturbed areas at the site of the trial shaft hole to their original condition. Backfilling of trial shaft not accepted by the Engineer will not be paid for.

(E) Drilled Shaft Load Tests. Load tests shall be performed at the locations shown on the plans and be completed before construction of any production drilled shafts. This work includes all labor, materials, equipment and services necessary for conducting the bi-directional axial load tests and reporting the results, including the following: (a) the number of bi-directional expandable load cells as indicated on the plans, (b) materials to construct a stable reference beam system(s) for monitoring vertical and horizontal deflection of the drilled shaft during testing, supported a minimum distance away from the reference system, (c) materials sufficient to construct and protect the work area, load test equipment, and personnel from inclement weather and sunlight, (d) electric power as required for lights, welding, instruments, etc., and (e) suitable optical survey equipment to measure the horizontal and vertical displacement of shafts during tests independent of the reference beam(s) and electronic equipment.

(1) Experience Requirements. The Contractor shall obtain the services of an experienced specialty Subcontractor with a minimum of three years of bi-directional load testing experience accepted by the Engineer to direct the assembly and instrumentation of the load

cells, and to record all data and furnish results of the test to the Engineer.

(2) Materials. Materials for the drilled shaft load test shall conform to the requirements of Section 511.02 with the following exceptions.

(a) Cement Grout. Grout for setting the expandable load cells shall be pumpable and shall have a minimum ultimate 7-day compressive strength of 4,000 psi.

(b) Concrete. Concrete for test shafts shall be batched and handled in accordance with the specifications, except that the Contractor shall supply a mix that will achieve a minimum ultimate 7-day compressive strength of 4,000 psi .

(3) Load Test Instrumentation. Provide instrumentation consisting of vibrating wire embedment strain gauges connected to a central data collection terminal; expandable load cell with readout device, and/or other equipment specified or indicated to measure movement of the top and bottom plates of the load cell, top of shafts, and strain at indicated locations within the shafts.

The embedment strain gauges shall be positioned along the test shaft at intervals shown on the Plans. The Engineer may require relocation of the embedment strain gauges and load cell based on the submittals provided by the Contractor. Each embedment strain gauge shall be capable of measuring strain to the nearest 0.0001 inch/inch and shall be capable of measuring or compensating for temperature. All embedment strain gauges shall have been calibrated or certified as accurate prior to installation.

Load cell shall be a flat, hydraulically expandable load cell of a minimum of 34 inches in diameter and capable of applying a load test of at least 2,500 tons in each direction. The load cell shall be accurate to within 1%, shall expand uniformly, and shall be capable of being installed as described herein. The load cell shall have provisions for monitoring displacements of the upper and lower plates to an accuracy of 0.0001 inch. The load cell shall have been calibrated or certified as accurate to within 1% of the true loads not more that six months prior to installation.

(4) Construction Requirement. The drilled shaft load test shall be a bi-directional load test utilizing hydraulically expanded load cell. The bi-directional load test separately tests the shear resistance and end-bearing of the drilled shaft by loading the shaft

in two directions (upward-shear resistance, downward-end bearing and shear resistance), using hydraulically expanded load cell, or by loading the shaft using other accepted methods capable of full separation of the shear bearing components. The drilled shaft used for the load test program shall be instrumented, as specified in this Section, by an experienced specialty Subcontractor accepted by the Engineer.

A permanent steel casing shall be installed during the load test shaft installation. The permanent casing for the load test shaft is used to reduce the potential for caving-in of the drilled hole. The permanent casing is also used for the load tests conducted to evaluate the load transfer in a similar manner to the production shafts. The tip elevation of the permanent casing for the load test shafts is shown on the Plans.

The Contractor shall supply equipment required to install the load cell, conduct the load test, and remove the load test apparatus as required. For the drilled shaft load test, the following set up procedure shall be used.

(a) The load cell, piping and other attachments will be assembled and made ready for installation under the direction of the specialty Subcontractor, in a suitable area, adjacent to the load test shaft, to be provided by the Contractor. The load cell assembly shall be placed at the location shown on the plans in conjunction with the construction of the reinforcing cage. The Engineer reserves the right to adjust the locations of the load cell prior to installation.

(b) Advance the load test excavation to the maximum depth shown on the plans. A successfully completed trial shaft shall not be used as the load test shaft.

(c) Clean the bottom of the shaft excavation after drilling is complete.

(d) Caliper testing shall be performed on the uncased portions of the load test shaft to obtain profile shape data to be used to verify the shaft verticality and diameter. A minimum of eight data points around the circumference of the load test shaft shall be obtained at every one foot increment throughout the uncased depth of the load test shaft. Caliper testing may be performed using a sonar-type caliper.

(e) Install the rebar cage assembly and load cell under the direction of the specialty Subcontractor and in the presence of the Engineer. The Contractor shall use the utmost care in handling the rebar cage/test equipment assembly so as not to damage the instrumentation during installation.

(f) After the installation of the rebar cage/test equipment assembly, the drilled shaft may be concreted in a similar manner specified for production shafts.

(5) Load Test Schedule. The Contractor shall notify the Engineer of the load testing schedule a minimum of five calendar days prior to the commencement of load testing.

(6) Load Test Procedures. The load test shall be completed and the load test data evaluated by the Engineer for revision to the production shaft length before construction of any production shafts. The Engineer shall have at least 20 calendar days after submission of the load test report to review the load test results prior to providing the production shaft lengths. Load testing of any shaft shall not begin until the concrete has attained a compressive strength of 4,000 psi.

Load the load test shaft using the quick load test method of ASTM D1143 except as modified herein. Apply the test load in increments of 50 to 100 kips, as directed by the Engineer. A load-deflection curve shall be plotted as the test progresses to avoid missing information near the failure load or to correct for precise load increments.

The load test shall be conducted to the maximum test load of 2,500 tons or plastic failure, whichever occurs first. Plastic failure is defined as the load corresponding to mobilization of side shear or end bearing and no further increase in load can be obtained.

The load test shall be held for a minimum of 12 hours (near plastic failure) to evaluate the creep effects, or at a load as directed by the Engineer.

(7) Cleanup. After completion of the load test, and at the direction of the Engineer, the Contractor shall remove all equipment, waste and other material that is not a part of the finished structure. The load cell remaining in the shafts shall then be grouted through the piping provided as a part of the load cell assembly.

After completing the test, cut off the load test shafts at an elevation 24 inches below the finished ground surface. The portion of the shafts cut off and removed shall remain the property of the Contractor.

(8) Replacement. Load test shaft found inadequate because of improper instrumentation, testing or construction procedures shall be replaced and retested, at no additional cost to the State.

(9) Reporting. Report the test results as specified in ASTM D1143-81 including, but not limited to, the following:

(a) Introduction.

(b) Drilled shaft installation procedure.

(c) Load test procedure and instrumentation.

(d) Appendix which shall include report of calibration of instruments, plan view location of the load test and test boring related to the Project, records of subsurface exploration, records of load test shaft installation, tabular and graphical presentation of the load-deflection data of end-bearing and side shear from the load test.

511.05 Construction Requirement.

(A) Construction Sequence. Complete the excavation to the footing elevations before shaft construction begins. Repair the disturbances caused by shaft installation to the footing area before pouring the footing. The drilled shaft construction sequence shall be conducted in a manner that does not allow additional shaft excavations, excessive vibrations and excessive loads within 15 feet or 3.0 shaft diameters, whichever is greater, within 24 hours of pouring the shaft concrete of the previous drilled shaft.

When installing drilled shafts with embankment placement, construct drilled shafts after the placement of fills.

Do not cap the drilled shafts before placing the fills as near to final grade as possible. Only leave room for construction of the caps.

(B) Construction Methods. Excavate shafts and bell footings to the dimensions and elevations shown in the contract. The methods and equipment shall be suitable for the intended purpose and materials met. Use the permanent casing method only when required by the contract or authorized by the Engineer. Blasting shall not be permitted.

(1) Dry Construction Method. The dry method includes drilling the shaft excavation, removing accumulated water and loose material from the excavation, and placing the shaft concrete in a dry excavation. Use this method only at sites where the groundwater table and soil conditions are suitable to permit construction of the shaft in a dry excavation. The Engineer will inspect the sides and bottom of the shaft visually before placing the concrete.

(2) Wet Construction Method. This method includes using water or mineral slurry to maintain stability of the hole perimeter while advancing the excavation to final depth, placing the reinforcing cage, and concreting the shaft. Use this method at sites where a dry excavation for placement of the shaft concrete cannot be maintained.

When locating drilled shafts in open water areas, extend the exterior casings from above the water elevation into the ground. Install the exterior casing to produce a positive seal at the bottom of the casing so that no intrusion or extrusion of water or other materials occurs into or from the shaft excavation.

(3) Casing Construction Method. The casing method may be used when shown in the contract or at sites where the dry or wet construction methods are inadequate. The casing may be placed either in a predrilled hole or advanced through the ground by twisting, driving, or vibration before cleaning the casing.

(C) Excavation.

(1) General. Make the shaft excavations at the locations, and to the shaft geometry and dimensions shown in the contract. Lower drilled shaft tip elevations when the material met during excavation is unsuitable and/or differs from that anticipated in the design of the drilled shaft. The Engineer will maintain a construction method log during shaft excavation. In general, the log will contain information such as the following:

(a) excavation diameters;

(b) type of material excavated with the elevations in the change of the material;

(c) rate of excavation;

(d) the description of and approximate top and bottom elevation of each soil or rock material;

(e) seepage or groundwater; and

(f) remarks.

Drilling of shafts within a horizontal distance of 3.0 times the shaft diameter (center-to-center) to the hole being drilled shall not commence until a minimum of 24 hours after the drilled shaft has been completed by placement of concrete to the top of shaft elevation in order to avoid interaction effects between adjacent shafts. Position the drilled shafts within 3 inches of the required position in a horizontal plane of the top of the shaft elevation.

On projects with cofferdams, provide a qualified diver to inspect the cofferdam conditions when the contract requires a seal for construction. Before placing the concrete seal, the diver shall inspect the cofferdam interior periphery. The cofferdam interior periphery inspection includes each sheeting indentation and around each drilled shaft.

Dispose the excavated material according to Section 203 - Excavation and Embankment.

When shown in the contract, excavate the bells to form the height and a bearing area of the size and shape specified in the contract. Excavate the bell mechanically.

Furnish drilled shaft concrete required to fill excavations for the bells and shafts dimensioned in the contract at no additional cost to the State.

Do not permit workers to enter the shaft excavation unless:

(a) a suitable casing is installed and the water level is lowered and stabilized, and

(b) adequate safety equipment and procedures are provided.

(2) Excavation and Drilling Equipment. The excavation and drilling equipment shall have adequate capacity including power, torque, and down thrust to excavate a hole to the maximum diameter and to a depth of 10 feet or 20% beyond the depths shown in the contract whichever is greater.

The use of special drilling equipment and/or procedures will be necessary to drill through the boulders and basalt rock formation present at the site. The Contractor shall anticipate an abundance of boulders of various sizes in deposits classified as "old alluvium" and "conglomerates" on the logs of borings and shall make allowance for difficult drilling in his/her bid. The Contractor shall also anticipate difficult drilling conditions in deposits classified as basalt formation on the boring logs.

The excavation and overreaming tools shall be of adequate design, size, and strength to do the work shown in the contract.

(a) Special Drilling Equipment. When conventional earth augers and/or underreaming tools cannot be used for drilling, provide special drilling equipment including rock core barrels, rock tools, air tools, and other equipment as necessary to construct the shaft excavation to the size and depth required. The use of special drilling equipment and procedures will be necessary to drill through the boulders and basalt rock formation and the cost shall be incidental to the respective classes of shaft excavation.

(b) Sidewall Overreaming. When the sidewall of the hole has softened, swelled, or degraded, sidewall overreaming will be required by the Engineer. Overreaming thickness shall be a minimum of 0.5 inches and a maximum of 3.0 inches. The Contractor may overream with a grooving tool or overreaming bucket. The thickness and elevation of sidewall overreaming shall be according to the contract or as directed by the Engineer. Overream sidewall and place additional shaft concrete at no additional cost to the State.

(3) Standard Excavation. Standard excavation is excavation done with conventional tools. Conventional tools include augers fitted with soil or rock teeth, drilling buckets, and overreaming attached to drilling equipment. This drilling equipment shall be of the size, power, torque, and down thrust (crowd) accepted for use by the Engineer after successful construction of a trial drilled shaft.

The standard excavation consists of drilling within fill materials and recent alluvium deposits. Fills and recent alluvium deposits are shown on the Logs of Borings.

Boulders of varying sizes and man-made materials, such as old concrete foundations not shown on the Plans, which may not be removed using standard excavation equipment, will be considered

as an obstruction under this subsection only. Remove obstructions embedded in the fills and recent alluvium deposits at the drilled shaft locations when authorized by the Engineer. The Contractor shall provide the necessary equipment to remove and dispose of materials met in forming the drilled shaft excavation, including installation of temporary casing and/or use of slurry, as necessary. The Engineer will pay for obstruction removal separately. The Engineer will be the sole judge in determining the various types of excavations for payment on the contract.

(4) Special Excavation. Special excavation is excavation that requires special tools and/or procedures to advance the drilled hole. The Engineer will pay for special excavation below the depth where conventional tools and drilling equipment accepted for standard excavation, operating at maximum power, torque and down thrust, cannot advance the hole. The Contractor shall get the refusal rate using the standard excavation tools and equipment when hole advancement is less than one (1) foot after (60) minutes of continuous drilling at full power.

Special excavation consists of drilling within the conglomerate and old alluvium deposits. Conglomerate and old alluvium deposits are shown on the Logs of Borings. The Contractor shall anticipate the presence of abundant cobbles, boulders and large rock fragments for the layers designated for special excavation. Cobbles, boulders, and large rock fragments are indicated on the Logs of Borings. Cobbles, boulders and large rock fragments shall not be considered an obstruction regardless of the size and hardness of the materials. Natural features will not be considered an obstruction under this subsection.

Special excavation does not include excavation within the basalt rock formation identified on the logs of borings.

The Engineer will consider special excavation when conglomerate and old alluvium (or other materials with an abundance of cobbles and boulders) are encountered in the drilled hole despite the density or character of materials encountered. The Engineer will be the sole judge in determining the various types of excavations for payment on the contract.

(5) Rock Excavation. Rock excavation is excavation conducted within basalt rock formations by using core barrel and other tools necessary for the removal of the cored material. Basalt rock formations are identified on the Logs of Borings. The Engineer will consider rock excavation when basalt rock formation is

encountered in the drilled hole despite the density or character (hardness) of basalt rock formation encountered. The Engineer will be the sole judge in determining the various types of excavations for payment on the contract.

(6) Obstructions Removal. Remove obstructions at the drilled shaft locations when authorized by the Engineer. Obstructions shall be man-made materials, such as old concrete foundations not shown on the Plans. Obstructions also may consist of boulders embedded in the fills and recent alluvium, when confirmed by the Engineer. Boulders encountered in the other material layers indicated on the logs of borings (conglomerate, old alluvium, and/or basalt rock formation) will not be considered obstructions in this subsection.

Drilling tools, lost in excavation, are not considered as obstructions. Remove the drilling tools promptly. The cost due to tools lost in the excavation shall be at no additional cost to the State including costs associated with hole degradation (requiring overreaming) due to removal operations or the time the hole remains open.

(D) Casings.

(1) General. Casings shall be steel (or corrugated aluminum pipe, where shown in the contract documents), smooth, watertight, and of ample strength to withstand both handling and driving stresses and the pressure of concrete and the surrounding earth materials. The inside diameter of the casing shall not be less than the specified size of the shaft. The Engineer will not allow extra compensation for concrete required to fill the oversized casing or oversized excavation. Remove casings from shaft excavations except when the casing is permanent. The length of permanent casings installed below the bottom of the footing elevation, shall remain in place.

When the shaft extends above ground or through a body of water, the shaft may be formed with removable casing except when the casing is permanent. For permanent casings, remove the portion of metal casings (or corrugated aluminum pipe) between an elevation of 2 feet below the lowest water elevation and the top of shaft elevation after curing the concrete. Remove the casing carefully so that the casing will not damage the concrete. When the casing needs to be removed after the concrete hardens in open water, design and submit the special casing system for acceptance by the Engineer. The Contractor may remove the casings when the

concrete attains sufficient strength provided that the following conditions are met:

(a) the curing of the concrete continues for the full 72 hour period;

(b) the shaft concrete is not exposed to salt water or moving water for 7 days; and

(c) the concrete reaches a compressive strength of at least 2,500 psi.

(2) Temporary Casing. The Engineer will consider subsurface casing temporary unless shown in the contract as permanent casing. Remove the temporary casing before completing the placing of concrete in the drilled shaft. The Contractor may require telescoping, predrilling with slurry, and/or overreaming to beyond the outside diameter of the casing to install the casing.

When choosing to remove a casing and substituting a longer or larger diameter casing through caving soils, stabilize the excavation with slurry or backfill before installing the new casing.

Before withdrawing the casing, the level of fresh concrete in the casing shall be the higher of the following:

(a) a minimum of 5 feet above the hydrostatic water level, or

(b) the level of drilling fluid.

While withdrawing the casing, maintain an adequate level of concrete within the casing to:

(a) displace the fluid trapped behind the casing upward and

(b) discharge the fluid at the ground surface without contaminating or displacing the shaft concrete.

When temporary casings become bound or fouled during shaft construction and cannot be removed, the Engineer will consider the drill shaft defective. Improve such defective shafts according to the contract. Such improvement may consist of removing the shaft concrete and extending the shaft deeper providing the shaft is straddled or replaced. Do corrective measures including redesign of footings caused by defective shafts

according to the contract at no additional cost to the State or extension of the contract time. The Engineer will not pay for the casing remaining in place.

(3) **Permanent Casing.** Use permanent casing when specified in the contract. The casing shall be continuous between top and bottom elevations according to the contract. After completing the installation, cut off the permanent casing at the prescribed elevation. Complete the shaft by installing necessary reinforcing steel and concrete in the casing.

When special temporary casings are in the contract or specified in writing by the Engineer, maintain the alignment of the temporary outer casing with the permanent inner casing and a positive, watertight seal between the two casings during excavation and concreting operations.

(E) Slurry. Use only polymer or mineral slurries in the drilling process. The mineral slurry shall have a mineral grain size that will remain in suspension and sufficient viscosity and gel characteristics to transport excavated material to suitable screening system. Polymer slurries shall have sufficient viscosity and gel characteristics to transport excavated material to suitable screening system. The percentage and specific gravity shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement.

During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole. When a sudden significant loss of slurry occurs, delay the construction of that foundation until an alternate construction procedure is submitted for acceptance by the Engineer.

Premix the polymer or mineral slurry thoroughly with clean fresh water and adequate time (as prescribed by the manufacturer) allotted for dehydration before introducing the slurry into the shaft excavation. The slurry tanks shall have the capacity for adequate slurry circulation, storage, and treatment. Excavated slurry pits in lieu of slurry tanks will not be allowed without the written permission of the Engineer.

Use desanding equipment to control slurry sand content to less than 4% by volume in the drilled hole. The Engineer will not require desanding equipment for setting temporary casing, sign post, or lighting mast foundations.

Prevent the slurry from "setting up" in the shaft, such as the following: agitation, circulation and/or adjusting the properties of the slurry. Dispose of slurry in suitable areas off from the project site.

Carry out the control tests using suitable apparatus on the mineral slurry to resolve the density, viscosity and pH. An acceptable range of values for those physical properties is in Table 511-1. Test the density, viscosity, and pH value during the shaft excavation to establish a consistent working pattern. Make a minimum of four sets of tests during the first 8 hours of slurry use. When the results show consistent behavior, decrease the testing frequency to one set every 4 hours of slurry use.

Before placing concrete in the shaft excavation, take slurry samples from the base of the shaft using a sampling tool. Extract slurry samples from the base of the shaft and at intervals not exceeding 10 feet up the shaft. Extract samples until two consecutive samples produce acceptable values for density, viscosity, pH, and sand content (within the values shown on Table 511-1).

Ensure that the bottom of the shaft does not accumulate heavily contaminated slurry suspension. The heavily contaminated slurry suspension could impair the free flow of concrete. When finding unacceptable slurry samples, take actions necessary to bring the slurry as specified in the contract. Do not pour the concrete until re-sampling and testing results produce acceptable values. Furnish the reports of tests required above to the Engineer on completion of each drilled shaft. An authorized person of the Contractor shall sign the reports.

During construction, maintain at the level of slurry not less than four feet above the highest piezometric water pressure along the depth of a shaft. When the slurry construction method fails, stop this method and propose an alternate method for acceptance by the Engineer.

TABLE 511-1
POLYMER, SODIUM BENTONITE OR ATTAPULGITE
IN FRESH WATER

Property	*Range of Values		Test Method
	Time of Slurry Introduction	In Hole At Time Of Concreting	
Density (pcf)	64.3** - 69.1**	64.3** -75.0**	Density Balance
Viscosity (sec/qt)	28 - 45	28 - 45	Marsh Cone
pH	8 – 11	8 - 11	pH paper pH meter

* At 20°C

** Increase by two pounds per cubic foot in salt water

Notes: a. When the Contractor does not need to control the bottom hole conditions or when tests show that other criteria are appropriate, the Engineer may modify the values.

b. When the contract requires desanding, the sand content shall not exceed 4% percent (by volume) in the borehole as resolved by the American Petroleum Institute sand content test.

c. Submit changes for acceptance in writing by the Engineer.

The Contractor shall use and dispose of slurry in accordance with applicable Federal, State, and County requirements.

(F) Excavation Inspection. Provide equipment for checking the dimensions and alignment of each permanent shaft excavation. Determine the dimensions and alignment according to the contract. Measure the final shaft depths with a suitable weighted tape after final cleaning.

A minimum of 50% of the base of each shaft shall have less than 0.5 inches of sediment at the time the concrete is placed. The maximum depth of sediment or debris on the base of the shaft shall not exceed 1.5 inches. The Contractor will measure the shaft cleanliness in the presence of the Engineer by methods deemed appropriate to the Engineer.

Also, for dry excavations, the maximum depth of water shall not exceed 3 inches before pouring the concrete.

(G) Reinforcing Steel Cage Construction and Placement. Assemble and place the reinforcing steel cage immediately after the Engineer inspects and accepts the shaft excavation before pouring the concrete. The reinforcing steel cage includes longitudinal bars, ties, cage stiffener bars, spacers, centralizers, and other necessary appurtenances to complete the cage.

Tie and support the reinforcing steel in the shaft so that the reinforcing steel will remain within allowable tolerances given in Subsection 511.04(I) - Construction Tolerances. Use the concrete spacers at sufficient intervals (near the bottom and at intervals not exceeding 10 feet up the shaft) to insure concentric spacing for the entire cage length. Construct the spacers of accepted material equal in quality and durability to the concrete specified for the shaft. The spacers shall be of adequate dimension to insure a minimum of four inches annular space between the outer portion of the reinforcing cage and the side of the excavated hole. Provide accepted cylindrical concrete bottom supports to maintain the proper distance between bottom of the cage and base of the shaft excavation.

Check the elevation of the top of the steel cage before and after pouring the concrete. When not maintaining the rebar within the specified tolerances, make the corrections needed to bring to within tolerances of the contract. Do not construct additional shafts until after modifying the rebar cage support according to the contract.

When the bottom of the constructed shaft elevation is lower than shown in the contract, extend at least half of the longitudinal bars required in the upper portion of the shaft the additional length. Continue the tie bars for the extra depth, spaced 2-foot on center. Extend the stiffener bars to the final depth. These bars may be lap splice or unspliced bars of the proper length. The Engineer will not permit welding to the reinforcing steel. Unless the extra depth of the drilled shaft is required due to modifications by the Engineer, the additional reinforcing bars shall be at no additional cost to the State.

(H) Crosshole Sonic Logging (CSL) Test Access Tubes. Installation of access tubes shall be in accordance with ASTM Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing Designation D 6760, except as modified herein.

Install access tubes in all drilled shafts to allow performance of CSL tests as shown on the plans. The access tubes shall be round, regular internal diameter, and free of defects so as to permit the free and unobstructed passage of the probes. The access tubes shall be installed

such that all internal joints are flush. The access tube shall be watertight with clean internal and external faces (free of corrosion), the latter to ensure good bond between the concrete and the tubes. The Contractor shall submit a proposal for installation of the access tubes to the Engineer prior to construction. Fit the access tubes with a water-tight germinant cap on the bottom.

Attach CSL access tubes securely to the interior of the reinforcement cage as near to parallel as possible to the vertical center axis of the drilled shaft in each drilled shaft and in the pattern shown on the plans. Extend the access tubes from about 6 inches from the bottom of the reinforcement cage to at least 3.5 feet above the top of the shaft. The top of the access tubes shall be capped all the time to prevent objects from falling in. Joints required to achieve full length of access tubes shall be watertight.

Contractor shall take extra care to prevent damaging the access tubes during reinforcement cage installation. Do not bend or damage tubes during reinforcement installation operations. If a tremie pipe is used, the tremie pipe shall not be allowed to rest on top of the access tubes during the concrete pour. Fill the tubes with potable water as soon as possible after concrete placement (within 2 hours after concrete placement) and reinstall the top watertight caps. Installation of CSL access tubes shall be incidental to the construction of the drilled shaft and shall be at no additional cost to the State.

The completed drilled shaft foundations will be tested by the Engineer using crosshole sonic logging (CSL) after at least one day of curing time, but no later than 14 days after concreting. . The Contractor shall assist in the testing by making all the shafts in the project accessible to the Engineer for testing whenever requested by the Engineer. Assistance by the Contractor shall be incidental to the construction of the drilled shaft and shall be at no additional cost to the State. The Contractor shall provide accurate data on the dates and time of concrete pouring in each drilled shaft and the surveyed location of each tube. The State will require a minimum of 7-working days after testing of any drilled shaft to accept or reject that shaft.

The results of the CSL tests will be based on the percentage decrease in velocity as correlated to the following Concrete Condition Rating Criteria (CCRC), as shown in Table 511-2. Deviations from the following values shall be used for determining the Concrete Condition Rating.

Table 511-2 Concrete Condition Rating Criteria			
Concrete Condition Rating	Rating Symbol	Velocity Reduction	Indicative Results
Good	G	0 – 10%	Acceptable concrete
Questionable	Q	10% - 25%	Minor concrete contamination or intrusion. Questionable quality concrete.
Poor	P/D	> 25%	Defects exist, possible water slurry contamination, soil intrusion, and or poor quality concrete.
Water	W	V = 4,760 – 5,005 feet/sec	Water intrusion or water filled gravel intrusion with few or no fines present.
No Signal	NS	No signal received	Soil intrusion or other severe defect absorbed the signal, tube debonding if near top.

Suspected defective drilled shafts, determined by the Engineer based on the CSL tests, shall be cored by a minimum of 2 cores per shaft by the Contractor. The number of cores and core location within the drilled shaft shall be approved by the Engineer. Cost of coring performed on acceptable drilled shaft will be borne by the State. Cost of coring performed on defective drilled shaft and shaft remediation shall be borne by the Contractor. If the drilled shaft in question is on the critical path, a time extension will be given if the drilled shaft is found to be not defective. Contractor shall submit a corrective methods plan within 14 days of the defective shafts to the Engineer for review and approval prior to their use.

After completion of the crosshole sonic logging tests and final acceptance of the drilled shaft, all the access tubes shall be completely filled with non-shrink, non-metallic, non-gaseous cementitious grout of the same strength as the drilled shaft concrete at no additional cost to the State.

(l) Concrete Placement.

(1) General. Place the concrete through a tremie pipe, concrete pump or by drop chute using accepted methods as described below.

If possible, place the concrete immediately after placing the reinforcing steel.

Concrete placement shall be continuous from the bottom to the top elevation of the shaft. Concrete placement shall continue after the shaft is full until good quality concrete is evident at the top of shaft.

The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed two hours. A longer placement time may be requested, and requests shall be submitted to the Engineer for review and approval 30 calendar days prior to the concrete pour (with a longer placement time) is needed.

Before placing the concrete, the Contractor shall submit results of 3-day, 7-day, 14-day and 28-day compressive strength tests of a trial mix and a slump loss test at least 30 days prior to placement of concrete. Also the Contractor shall submit minimum six (6) standard concrete cylinders of the same concrete mix as the drilled shaft to the Engineer for Ultrasonic Pulse Velocity measurements. The Engineer will perform the Ultrasonic Pulse Velocity test in accordance with ASTM Standard Test Method for Pulse Velocity through Concrete Designation C 597. Supply a concrete mix that will maintain a slump of four inches or greater after four hours from initial mixing. Conduct the trial mix and slump loss tests using concrete and under ambient temperatures appropriate for the site conditions.

The top surface of the drilled shafts shall be cleaned and roughen prior to concrete placement for the footing.

(2) Monitoring Concrete Volume. For each drilled shaft, prepare and submit a monitoring record the next working day after concrete placement has been completed. All monitoring shall be performed in the presence of the Engineer or his representative. As a minimum, the monitoring record shall consist of the following:

(a) A chart that is made up after drilled shaft excavation has been completed and accepted by the Engineer and before concrete placement has commenced. Indicated on the chart, depth of hole plotted with theoretical volume of concrete to fill drilled shaft hole. Plot concrete elevation (surface) along the vertical axis and concrete volume along the horizontal axis.

(b) As concrete is being placed, measure concrete surface at an interval of approximately each cubic yard of concrete discharged. Plot concrete volume actually placed at each elevation point. Use this chart to determine if any necking down or enlargement of shaft has occurred during concrete placement.

(c) Keep records of steel and concrete movement to document the following conditions:

(1) When removing temporary or permanent casing, elevation of the top of reinforcing cage shall not rise more than 2 inches from its original elevation;

(2) As temporary casing is extracted, static level of fluid concrete shall not rise.

(2) Concreting by Tremie. Tremie methods may be used for concrete placement in wet or dry excavations. Tremie methods shall include a tube of sufficient length, weight, and diameter to discharge concrete at the shaft base elevation. The tremie shall not contain any aluminum parts that will have contact with the concrete. The tremie inside diameter shall be at least 6 times the maximum size of aggregate used in the concrete mix but shall not be less than 6 inches. The inside and outside surfaces of the tremie shall be clean and smooth to permit flow of concrete and unimpeded withdrawal during concreting. The wall thickness of the tremie shall be adequate to prevent crimping or sharp bends that restrict concrete placement.

The tremie used for wet excavation concrete placement shall be watertight. Underwater placement shall not begin until after placing the tremie to the shaft base elevation. Valves, bottom plates or plugs may be used only if concrete discharge begins within one tremie diameter of the base. Remove the plugs from the excavation. When not removing the plugs, an acceptable material will remain that will not cause a defect in the shaft.

Construct the discharge end of the tremie to permit the free radial flow of concrete during placement operations. Immerse the tremie discharge end at least 5 feet in concrete after starting the flow of concrete. The flow of concrete shall be continuous. Maintain the concrete in the tremie at a positive pressure differential to prevent water or slurry intrusion into the shaft concrete.

When removing the tremie line orifice from the fluid concrete column and discharging concrete above the rising concrete level during the concrete pour, the Engineer will consider the shaft defective. In such case, remove the reinforcing cage and concrete, the necessary sidewall removal specified by the Engineer, and repour the shaft. Costs of replacement of defective shafts shall be at no additional cost to the State.

(3) Concreting by Pump. Concrete pumps and lines for concrete placement in wet or dry excavations may be used. Pumps and pump lines used to place concrete shall be of sufficient length, weight, and diameter to discharge concrete at the shaft base elevation. The pump and pump lines that are in contact with concrete shall not contain aluminum parts. Pump lines shall have a minimum diameter of 6 inches and watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation.

For wet excavations, use a plug to separate the concrete from the fluid in the hole until pumping begins. Remove the plug from the excavation. When the plug is not removed, leave a material accepted by the Engineer that will not cause a defect.

The discharge orifice shall remain at least five feet below the surface of the fluid concrete. When lifting the pump line during concreting, reduce the line pressure temporarily until the orifice at a higher level in the excavation has been repositioned.

When removing the pumpline orifice from the fluid concrete column and discharging concrete above the rising concrete level during the concrete pour, the Engineer will consider the shaft defective. In such case, remove the reinforcing cage and concrete, the necessary sidewall removal specified by the Engineer, and repour the shaft. Costs of replacement of defective shafts shall be at no additional cost to the State.

(4) Concreting by Drop Chutes. The Engineer will permit free fall placement of concrete only in dry excavations. Dry excavations are excavations where the maximum depth of water does not exceed 3 inches. The Engineer will not permit the free fall method in wet excavations.

Use the drop chutes to direct placement of free fall concrete. Drop chutes shall include a smooth tube of one piece construction or sections that the Contractor may add or remove. The concrete may be placed through a hopper at the top of the tube or side

openings during concrete placement. Support the drop chute so that the free fall of the concrete measured from the bottom of the chute is less than 25 feet.

Concrete placed by free fall shall fall directly to the base without contacting the rebar cage or drilled hole sidewall. When concrete placement causes the shaft excavation to cave or slough, or when the concrete strikes the rebar cage or sidewall, reduce the height of free fall or reduce the rate of concrete flow into the excavation. When the concrete cannot be placed satisfactorily by free fall, use tremie or concrete pump to pour.

(J) Construction Tolerances. The following construction tolerances apply to drilled shafts:

(1) The drilled shaft shall be within 1/12 of the shaft diameter or 3 inches, whichever is less, in the horizontal plane at the plan elevation for the top of the shaft.

(2) The vertical alignment of the shaft excavation shall not vary from the plan alignment by more than 0.25 inch per foot of depth. The alignment of a battered shaft excavation shall not vary by more than 0.5 inch per foot of depth from the prescribed batter.

(3) After placing the concrete, the top of the reinforcing steel cage shall be no more than 6 inches above and no more than 3 inches below the plan position.

(4) Permanent casing diameters shown in the contract refer to the inside diameter (ID) dimensions. When accepted by the Engineer, a casing larger in diameter than shown in the contract may be provided to ease meeting this requirement. When not using casing, the minimum diameter of the drilled shaft shall be not more than 1 inch less than the specified shaft diameter. When using a series of telescoping casings, size the casing such that the minimum shaft diameters listed above can be maintained.

(5) Excavate the bearing area of bells to the plan bearing area as a minimum. The diameter of the bells shall not exceed three times the specified shaft diameter. Other plan dimensions shown for the bells may vary when accepted by the Engineer.

(6) The top elevation of the shaft shall have a tolerance of ± 1.0 inch from the plan top of shaft elevation.

(7) The dimensions of casing are subject to American Pipe Institute tolerances applicable to regular steel pipe.

(8) Design the excavation equipment and methods so that the completed shaft excavation will have a flat bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of ± 3/8 inch per foot of diameter.

Drilled shaft excavations that cannot be completed within the required tolerances are unacceptable. When accepted by the Engineer, corrections may be made to an unacceptable drilled shaft excavation by a combination of the following methods:

(1) Overdrill the shaft excavation to a larger diameter to permit accurate placement of the reinforcing steel cage with the required minimum concrete cover.

(2) Increase the number or size of the reinforcing steel.

(3) Enlarge the bearing area of the bell excavation within the tolerances allowed.

The acceptance of correction procedures is dependent on analysis of the effect of the degree of misalignment and improper positioning. The Engineer may accept the correction methods proposed based on design analysis submitted by the Contractor. A Hawaii Licensed Professional Engineer in the Structural Branch and Civil Branch (specializing in the Geotechnical field) shall stamp and sign the redesign drawings and computations. Correct out of tolerance drilled shaft excavations, including engineering analysis and redesign, at no additional cost to the State.

(K) Integrity Testing. Drilled shafts shall be tested for soundness and integrity, as directed by the Engineer. Integrity testing shall consist of concrete coring at production shafts determined by the Engineer. Coring shall be performed by the Contractor at the locations designated by the Engineer in the presence of the Engineer. The Contractor shall core a minimum 3-inch diameter vertical hole throughout the full depth of the drilled shaft, and the core hole shall be centrally located and approved by the Engineer. The Engineer will determine the production drilled shaft to be cored based on the Engineer's records and/or CSL test results. The cored holes shall be filled with non-shrink, non-metallic, non-gaseous cementitious grout of the same minimum strength as the drilled shaft.

511.06 Method of Measurement.

(A) Furnishing Drilled Shaft Drilling Equipment. The Engineer will not measure furnishing drilled shaft drilling equipment for payment.

(B) Obstructions. The Engineer will measure obstructions per hour. The Engineer will maintain the start and stop times, measured to the nearest 0.25 hours, to remove obstructions when considered an obstruction and authorized by the Engineer.

The Engineer will not include length of time required to remove obstructions from the other excavation items.

(C) Load Test. The Engineer will pay for load test per each.

(D) Trial Shaft. The Engineer will measure trial shafts per linear foot. The Engineer will measure the length along the centerline of the shaft including bells. The length shall be the elevation difference between the existing ground surface before drilling and authorized bottom elevation of the hole.

(E) Permanent Casing. The Engineer will measure permanent casing per linear foot.

The Engineer will measure the length of the permanent casing along the centerline of the casing. The length shall be the elevation difference between the plan bottom of footing and the final bottom of permanent casing. The Engineer will maintain a drilled shaft log for payment.

(F) Standard Shaft Excavation. The Engineer will measure standard shaft excavation per linear foot.

The Engineer will measure the length along the centerline of the shaft. The length shall be the elevation difference between the plan top of shaft and the bottom of standard shaft excavation to the nearest foot discounting the depths from which any material that is removed as an obstruction. The Engineer will maintain a drilled shaft log for payment.

The Engineer will not measure any length of drilled shafts required due to unauthorized over-excavation.

(G) Special Shaft Excavation. The Engineer will measure special shaft excavation per linear foot.

The Engineer will measure the length along the centerline of the shaft. The length shall be the elevation difference between the bottom of

standard shaft excavation and the bottom of special shaft excavation to the nearest foot. The Engineer shall maintain a drilled shaft log for payment.

The Engineer will not measure any length of drilled shafts required due to unauthorized over-excavation.

(H) Rock Excavation. The Engineer will measure rock excavation per linear foot.

The Engineer will measure the length along the centerline of the shaft. The length shall be the elevation difference between the bottom of special shaft excavation and the plan final bottom of shaft to the nearest foot. The Engineer shall maintain a drilled shaft log for payment.

The Engineer will not measure any length of drilled shafts required due to unauthorized over-excavation.

(I) Drilled Shafts. The Engineer will measure drilled shafts per linear foot. The Engineer will measure the length along the centerline of the shaft including bells. The length shall be the elevation difference between the plan top of the shaft and the final bottom of shaft. The Engineer will maintain a drilled shaft log for payment.

(J) Coring for Integrity Testing. The Engineer will measure coring for integrity testing per linear foot. The length shall be the elevation difference between the plan top of drilled shaft to the final bottom of shaft. The Engineer will maintain a coring log for payment.

511.07 Basis of Payment.

(A) Furnishing Drilled Shaft Drilling Equipment. The Engineer will pay for the accepted furnishing drilled shaft drilling equipment on a lump sum basis complete in place.

The price includes full compensation for furnishing and moving the drilling equipment and necessary tools and equipment to the project, setting the equipment up at the locations and removing the equipment from the project.

The Engineer will make payment of 60% of the contract amount for this item when all drilling equipment is ready to drill the Trial Shaft.

The Engineer will make payment for the remaining 40% of the contract amount when all shaft concrete has been placed up to the top of the shafts.

(B) Obstructions. The Engineer will pay for the accepted removal of obstructions at the contract unit price per hour complete in place. The maximum payment per designated obstruction shall not exceed 20 times the unit cost for unclassified shaft excavation of the diameter excavated. The price includes full compensation for removing the obstruction and furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work.

(C) Load Tests. The Engineer will pay for the accepted drilled shaft load tests at the contract unit price per each complete in place.

The price includes full compensation for drilling, placing permanent steel casing and concrete, furnishing and installing reinforcing steel, performing caliper measurements, furnishing and installing load cells, instrumentation, collecting data, keeping records and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

(D) Trial Shaft. The Engineer will pay for the accepted trial shaft holes at the contract unit price per linear foot complete in place. The price includes full compensation for excavating including the use of temporary casing, providing inspection facilities, backfilling the hole with concrete, restoring the site, and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

The Engineer will not pay for trial shaft holes of which the Contractor has failed to demonstrate to the Engineer the adequacy of Contractor's proposed methods and equipment.

(E) Permanent Casing. The Engineer will pay for the accepted permanent casing at the contract unit price per linear foot complete in place.

The price includes full compensation for furnishing and installing the permanent casing to the specified depths, as dictated by the subsurface conditions, and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

The price for the Corrugated Aluminum Pipe (CAP) permanent casing includes full compensation for furnishing and installing the permanent casing to the specified tip elevations, as shown on the Plans, including excavation below the ground surface, placement of the casing, and backfilling the excavation back to the surrounding ground surface with compacted fill, and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

(F) Standard Shaft Excavation. The Engineer will pay for the accepted standard shaft excavation at the contract unit price per linear foot complete in place.

The price includes full compensation for excavating, removing and disposing of excavated materials, using slurry as necessary, and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

The Engineer will not pay for any length of drilled shafts required due to unauthorized over-excavation.

(G) Special Shaft Excavation. The Engineer will pay for the accepted special shaft excavation at the contract unit price per linear foot complete in place.

The price includes full compensation for excavating, removing and disposing of excavated materials, using slurry as necessary, and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

The Engineer will not pay for any length of drilled shafts required due to unauthorized over-excavation.

(H) Rock Excavation. The Engineer will pay for the accepted rock excavation at the contract unit price per linear foot complete in place.

The price includes full compensation for excavating, removing and disposing of excavated materials, using slurry as necessary, and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

The Engineer will not pay for any length of drilled shafts required due to unauthorized over-excavation.

(I) Drilled Shafts. The Engineer will pay for the accepted drilled shafts at the contract unit price per linear foot complete in place.

The price includes full compensation for reinforcing and concreting the production shafts, inspecting the shafts, such as the use of video cameras and lights, monitors and cables, and safety cages, and furnishing labor, materials, equipment, tools and incidentals (including access tubes for CSL testing and backfilling and concrete cylinders for the Ultrasonic Pulse Velocity testing of concrete) necessary to complete the work.

(J) Coring for Integrity Testing. The Engineer will pay for the accepted coring for integrity testing at the contract unit price per linear foot

complete in place. The Engineer will not pay for coring performed on defective drilled shafts.

The price includes full compensation for testing the drilled shafts for soundness and integrity by coring, filling the cored holes with non-shrink, non-metallic, non-gaseous cementitious grout, and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

The Engineer will make payment under the following:

Pay Item	**Pay Unit**
Furnishing Drilled Shaft Drilling Equipment	Lump Sum
Obstructions	Hour
Load Test	Each
Trial Shaft	Linear Foot
Permanent Casing (___-inch diameter)	Linear Foot
Standard Shaft Excavations (___-inch diameter)	Linear Foot
Special Shaft Excavations (___-inch diameter)	Linear Foot
Rock Excavation (___-inch diameter)	Linear Foot
Drilled Shafts (Type ___)	Linear Foot
Coring for Integrity Testing	Linear Foot

END OF SECTION"

Make the following a part of the Standard Specifications:

"SECTION 513 - CONCRETE MASONRY UNIT

513.01 Description. This section is for constructing concrete masonry unit walls according to the contract.

513.02 Materials.

(A) Hollow Concrete Masonry Units. Hollow concrete masonry units shall be load - bearing units and shall meet the requirements of ASTM C 90. Units shall be two - core type, 8 inch nominal height, 16 - inch nominal length and width as indicated on the plans and as listed below. Provide standard manufactured smooth finish texture at concealed locations. Provide manufactured split block texture at visible vertical surfaces as indicated on the plans.

(1) Standard regular 8" x 8" x 16" basalt limestone smooth face.

(2) Standard regular 8" x 8" x 16" basalt limestone smooth face, knock out lintel bond beam.

(3) Split face block, 8" x 8" x 16" basalt limestone split face texture at one face.

(4) Split face block, 8" x 8" x 16" basalt limestone split face texture at one face, knock out lintel bond beam.

Units for jamb, corner sill, lintel and other special shapes shall be provided as required.

All units shall be sound, free of cracks, straight and true. They shall be either steam-cured or cured under atmospheric conditions for a minimum of 30 days. Color shall be standard with manufacturer.

(B) Other materials. Materials shall conform to the following:

Portland Cement	701.01
Reinforcing Steel	709.01
Curing Materials	711.01
Water	712.01

Aggregates for use in mortar shall conform to ASTM C 144.

Aggregates for use in grout shall be 3/8 inch pea gravel conforming to ASTM C404 and grades according to ASTM D 448, No. 10.

Admixture, if used, shall conform to ASTM C 494, Type A or D and shall be mixed in proper amounts according to the directions of the manufacturer.

Horizontal joint reinforcement shall be of ladder design with No. 9 gage, deformed side rods and welded No. 12 gage or larger cross rods, or as indicted on the plans.

Hydrated lime shall conform to ASTM C 207, Type S, unless approved otherwise by the Engineer.

Water based, water repellent penetrating sealer for masonry shall contain between 10 percent and 20 percent solids and shall be emulsions especially formulated for use on porous masonry.

513.03 Construction Requirements.

(A) General. The construction shall conform to the applicable subsections of Section 503 - Concrete Structures, Building Code Requirements for Masonry Structures (ACI 530), Specifications for Masonry Structures (ACI 530.1), and Chapters 17 and 21 of the Uniform Building Code as amended by the City and County of Honolulu.

Special inspection of structural masonry is required and will be preformed by the Engineer. The Contractor shall notify the Engineer at least 24 hours in advance of any required special inspections. Such special inspections shall be in accordance with Chapter 17 of the Uniform Building Code as amended by the City and County of Honolulu.

All walls shall be continuously braced over the height of the walls during construction to prevent damage or displacements which may result from construction live loads, impact or wind loads or other loads imposed prior to the completion of grout placement plus 28 days. The Contractor shall submit working drawings and design calculations for wall bracing for the Engineers approval prior to the start of construction. The bracing and required submittals shall conform to Section 503.03 (B) Falsework and Centering. The wall bracing shall be designed for a wind velocity of 105 miles per hour. The resulting design wind pressure shall be no less than 30 pounds per square foot applied in a direction perpendicular to the plane formed by the braced wall surface.

(B) Fabrication. Concrete masonry units shall be manufactured with natural aggregates of basalt and limestone. Proportions shall be determined by the manufacturer. No integral color additives are required.

Carefully stack masonry units prior to use and protect from physical damage. Handle units with reasonable care to prevent marring or damage of faces, edges and corners. Do not dump units from hand truck or wheelbarrows.

Beds on which masonry is to be laid shall be clean and truly level. Construct masonry units plumb, level and true. Masonry units in walls shall be constructed so that the exposed face is laid true and flat. All cutting and fitting as may be required for maintaining wall profiles and necessary to accommodate other trades shall be done neatly using power driven carborundum saw. The Contractor is responsible for controlling any dust pollution caused by the cutting operation. Do not wet masonry unit before use.

Lay mortar units in the first course with mortar beds not exceeding 3/4 inch in thickness. Webs adjoining cells containing reinforcements shall also be bedded in mortar to prevent escape of grout. Butter vertical head joints well for a thickness equal to face shell of block. These joints shall be shoved tightly so that mortar bonds well to both blocks. Fill joints solidly from face of block to depth of face shell.

The allowable tolerance from plumb for walls shall be 1/4 inch for every 10 foot height or a proportion thereof. The allowable tolerance from level shall be 1/4 inch for any 20 foot length or a proportion thereof.

Mortar joints shall be straight, clean and in thickness of 3/8 inch plus or minus 1/8 inch. Provide concave joints by tooling all exposed horizontal and vertical joints with ½ inch to 5/8 inch round bars at least 14 inches long to produce a dense, slightly concave surface well bonded to the block at the edges. Tooling shall compact mortar, pressing excess mortar out of the joint rather than gouging it out.

The bond pattern shall be running bond.

Build all hollow masonry units to preserve unobstructed vertical continuity of cells to be filled. Walls and cross webs forming such cells shall be full-bedded in mortar to prevent leakage of grout.

When there is an interruption in laying hollow masonry units, the racking method shall be used to provide a stepping back of successive courses of masonry.

Place joint reinforcement in horizontal joints so that longitudinal wires are fully embedded in face shell mortar for their entire length. Reinforce horizontal masonry unit bond beam and fill solid with grout.

Fill all cells with grout in lifts not exceeding 8 feet unless otherwise shown on the plans. When grouting is stopped for one hour or longer, form construction joints by stopping pour of grout 1-1/2 inches below the top of the uppermost unit. Do not place grout until mortar joints have set a minimum of 24 hours.

Care shall be taken to prevent mortar splotches. Wash off mortar spilled on wall immediately before it can set up. Protect finished walls against stains and mortar spills as work progresses. After the wall is constructed, do not saturate it with water for curing, cleaning, etc.

Point all holes or defective mortar joints in exposed masonry and where necessary, cut out defective joints and repoint. Smoothing of walls which produces 'bright spots' will not be accepted. Protect adjoining work from damage.

After completion of the walls and prior to waterproofing and backfilling, apply a water based, water repellent penetrating sealer for masonry to all exposed surfaces. The product and product application shall be approved by the concrete masonry unit fabricator and by the Engineer. The product application shall be in strict accordance with the manufacturers recommendations.

(C) Mortar and Grout. Store Portland cement, hydrated lime and admixtures in such a manner as to prevent deterioration or contamination with foreign matter. Cement which has become caked, partially set or otherwise deteriorated or any material which becomes damaged or contaminated shall be rejected.

Proportion materials for mortar and grout by volume and in such manner that specified proportions can be controlled and accurately maintained. Fine aggregates shall be measured in damp loose condition. Mixing shall be by mechanical batch mixer for at least 3 minutes for mortar and 5 minutes for grout. Hand mixing shall be permitted only for small batches of 3 cubic feet or less.

(1) Mortar shall be Type M and shall be freshly prepared and uniformly mixed in the following proportion:

1 part Portland cement

0 to ½ parts of hydrated lime
2-1/4 to 3 parts mortar sand

Admixtures may be added in accordance with the manufacturer's specifications. Add sufficient water to provide workable consistency.

Place mortar in final position within 1-1/2 hours after mixing. In any event, mortar shall attain not less than 2,500 psi, 28 day compressive strength.

(2) Grout shall be freshly prepared and uniformly mixed in the following proportion subject to 28 day compressive strength requirements listed below:

1 part Portland Cement
3 parts fine aggregate
2 parts coarse aggregate
0 to 1/10 part hydrated lime to one part Portland Cement

Grout designed by concrete suppliers may be used upon approval of the Engineer.

Add sufficient water to produce consistency just fluid enough for pouring without segregation. Slump shall be between 9 and 11 inches. Place grout in final position within 90 minutes after mixing. Do not use grout after initial set has occurred. In any event, grout shall attain not less than 3,000 psi, 28 day compressive strength.

(D) Reinforcements. Reinforcements shall be free from scale, loose flaky rust or other coatings that will destroy the bond. Reinforcements shall be straight except for bends around corners or where bends or hooks are detailed. Size and spacing shall be accurate and shall be as indicated on the plans.

Place and tie vertical reinforcements at top and bottom and at intervals not to exceed 192 diameters of reinforcement. Lap dowels and splices as indicated but not less than 40 diameters or 24 inches, whichever is longer.

(E) Additional Requirements. See plans for additional requirements.

513.04 Method of Measurement. The Engineer will measure concrete masonry units per square yard.

513.05 Basis of Payment. The Engineer will pay for the accepted concrete masonry units at the contract unit price per square yard. The price includes full compensation for shop drawings and calculations, formwork including bracing, installing horizontal and vertical reinforcements, sealer, waterproofing, dowels, water, mortar and grout, dust and silt control and furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
CMU Noise Barrier Walls 8 inch CMU	Square Yard

The Engineer will not pay for all work including the demolition and replacement of the CMU wall and other existing facilities near Waimalu Viaduct Bent No. 9 on plan sheet AS9.4A and will consider the cost of such work as incidental to the construction of the bent footing."

END OF SECTION

Make the following Section a part of the Standard Specifications:

"SECTION 530 - SEGMENTAL RETAINING WALL

530.01 General.

(A) Description. This work includes constructing segmental retaining walls, as shown on the contract drawings, according to the requirements of the contract, including:

(1) Underdrain.

(2) Geocomposite drain.

(3) Furnishing and placing segmental concrete facing units.

(4) Furnishing and placing geogrid reinforcement.

(5) Furnishing and placing select granular backfill with geogrid reinforcement and unit backfill within the facing units.

(6) Furnishing and placing low-density concrete backfill.

(B) Submittals.

(1) Working Drawings and Data. The Contractor shall submit the following within 45 calendar days from the date of contract award:

(a) Manufacturer's literature and product data for underdrain pipe and geocomposite drain.

(b) Manufacturer's installation instruction for geocomposite drain.

(c) Details of segmental concrete facing units and sample of unit showing shape and proposed color which shall be similar to the concrete masonry unit constructed under Section 513.

(d) Data including physical properties of the geogrid reinforcement and all reduction factors.

(e) Data including gradation of select granular backfill.

(f) Manufacturer's installation instructions for geogrid reinforced segmental retaining wall.

(g) Working Drawings.

The Engineer shall be the sole authority for determining if the proposed segmental retaining wall system is acceptable for the use on the project.

The Contractor shall prepare a submittal for review and acceptance by the Engineer. The submittal shall contain shop drawings and notes to fully describe the construction of the segmental retaining wall system. No work shall be started or materials ordered until the Engineer has accepted the submittal.

Partial submission of documents required for the submittal will not be permitted.

Other submittals such as product data, samples, test reports, certificates of compliance, warranties where specified and others shall be made as required by the contract documents.

(C) Quality Assurance.

(1) Components of the wall shall be manufactured by a firm regularly engaged in the manufacture of these components.

(2) Installation of the wall components shall be performed by personnel with experience in the products to be installed. The Contractor installing the segmental retaining wall components shall have installed a minimum of three (3) retaining walls of similar length and height as the retaining walls for this project.

(3) The Contractor shall have a technical representative of the manufacturer to provide aid and field supervision to assure that the work is properly installed and performed as recommended by the manufacturer. Recommendations made by the technical representative on or off the jobsite, and accepted by the Engineer, shall be adhered to by the Contractor and shall be at no additional cost to the State.

(D) Product Delivery, Storage, and Handling.

(1) Geocomposite drain shall be suitably wrapped and protected from exposure to direct sunlight.

(2) Geogrid shall be protected from damage, from temperatures greater than 140°F, and from deleterious materials.

(3) Storage and handling shall be according to the manufacturer's instructions.

530.02 Alternate Segmental Retaining Wall (SRW) System. The Contractor may submit an alternate segmental retaining wall system other than the system shown on the Contract Documents. The design of the alternate SRW system shall consider the internal stability and external stability of the wall mass including the bearing pressure, overturning, sliding and slope stability.

The Engineer reserves the right to reject any alternate segmental retaining wall system should the alternate SRW, in the Engineer's judgment, present unreasonable slope stability risks or does not meet all of the required criteria.

(A) Alternate SRW systems shall conform to the following criteria and shall be designed and stamped by a licensed Structural Engineer in the State of Hawaii:

(1) A uniform surcharge load of 250 psf for personnel traffic shall be used over the retaining wall system.

(2) The stability of the wall mass shall be analyzed in order to insure that the wall shall function as intended. The failure plane must be analyzed such that the soil stabilizing component extends sufficiently beyond the failure plane to stabilize the material. The failure plane may be established by acceptable theories of soil mechanics or by experimental data. Any experimental data indicating failure planes varying from the normally accepted theories of soil mechanics shall be presented to the Engineer for review and acceptance before any adjustments in the failure plane is acceptable. External loads that affect the internal stability such as those applied through footings, traffic, slope surcharge, and hydrostatic loads shall be accounted for in design.

(3) The following minimum Factors of Safety (FS) shall be used.

(a) Sliding of the wall mass - $FS \geq 1.5$

(b) Overturning of the wall mass - $FS \geq 2.0$

(c) Pullout Resistance - $FS \geq 1.5$

(d) Ultimate Bearing Capacity of the wall mass - $FS \geq 2.0$

(4) The minimum length of geogrid shall be 0.8 times the wall height or as indicated on the plans for the individual walls. The wall height is to be measured from top of footing or leveling pad to the finished grade.

(5) Adequate subsurface drainage system shall be provided for the SRW systems.

(6) The Contractor shall submit working drawings and calculations to the Engineer for review.

(B) Alternate SRW systems shall also conform to the original requirements, except as modified above, when accepted by the Engineer.

(C) Delays or additional costs due to the use or submittal of an alternate SRW system shall be the sole responsibility of the Contractor.

530.03 Materials.

(A) Underdrain. Underdrain shall conform to Section 605 - Underdrain of the Standard Specifications.

(B) Geocomposite Drain. Geocomposite drain shall conform to Section 646 - Geocomposite Drain of the Standard Specifications, except for method of measurement and basis of payment.

(C) Geogrid.

(1) General. The standards referenced herein for the wall geogrid reinforcement include the following:

(a) Geosynthetic Research Institute (GRI)

GG1 Standard Test Method for Geogrid Rib Tensile Strength

GG2 Standard Test Method for Geogrid Junction Strength

GG4 Standard Practice for Determination of the Long-Term Design Strength of Geogrids

(2) Geogrids shall conform to Subsection 716.06.

(3) Geogrid structure shall consist of select high density polyethylene only. Geogrids manufactured from polyester or polypropylene resin will not be accepted. Geogrid shall be a geosynthetic reinforcement material having regular and defined open

areas, and shall have a long-term design strength (LTDS), shown on the plans for the individual walls, as determined by GRI GG4.

(4) Geogrid shall have minimum allowable junction strength equal to or greater than 90% of the ultimate strength of the geogrid. At the allowable tensile strength, the maximum geogrid extension shall not exceed 10 percent when tested according to GRI. Incorporate factors of safety for installation, damage, and biological chemical degradation according to GRI GG4. Determine ultimate tensile strength by GRI GG1 test method for quality control purposes.

The Long-term Design Strength (LTDS) is defined as follows:

$LTDS = T_{ult} / (RF_d \times RF_{id} \times RF_{cr})$

Where

T_{ult} = ultimate tensile strength as determined in accordance with ASTM D 4595

RF_d = reduction factor for degradation for 100 year design life

RF_{id} = reduction factor for installation damage obtained from site installation damage testing

RF_{cr} = reduction factor for creep developed in accordance with ASTM D 5262

(D) Segmental Concrete Facing Units.

(1) Concrete shall conform to Section 601 - Structural Concrete and as specified herein. Provide cap units at the top of the segmental concrete units.

(2) Concrete used in the manufacture of the units shall have a 28-day compressive strength of not less than 4,000 psi.

(3) Segmental concrete unit dimensions shall differ not more than $\pm$ 1/8 inch from the manufacturer's published dimensions.

(4) Units shall be sound and free of cracks and other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the construction. Minor cracks incidental to the usual method of manufacture, or minor chipping

resulting from shipment and delivery (up to 5 percent of total units), will not be grounds for rejection.

(5) Exposed surfaces of units shall be free of chips, cracks, or other imperfections when viewed from a distance of 10 feet under diffused lighting.

(E) Connecting Pins. Connecting pins shall be high strength reinforced fiberglass specifically designed for the purpose of connecting the facing units. Minimum allowable shear strength shall be 2,000 lbs.

(F) Select Granular Backfill Material.

(1) The select granular backfill material shall be coarse grain material free from organic or other deleterious materials. The backfill material shall conform to the following grading requirements and the top 3 feet shall contain sufficient fines (minus No. 10) to fill the voids in a compacted state.

U.S. Standard Sieve Size	Percent Passing By Weight
2 inch	100
No. 4	75-100
No. 4	50-75
No. 200	0 – 15

Select granular backfill material shall also conform to the following requirements:

(a) The material shall be non-plastic. Plasticity Index (PI) as determined by AASHTO T-90 shall be 0.

(b) The fraction finer than 15 microns (0.015 mm) as determined by AASHTO T-88 shall not exceed 5 percent.

(c) The material shall exhibit an angle of internal friction of not less than 34 degrees, as determined by the standard Direct Shear test - AASHTO T-236 (ASTM D-3070), utilizing a sample of the material compacted to 95 percent of AASHTO T-180, Methods C or D at Optimum Moisture Content.

(G) Unit Backfill. Unit backfill shall be crushed stone or aggregate conforming to the following gradation.

U.S. Standard Sieve Size	Percent Passing By Weight
1 inch	75 – 100
¾ inch	50 – 75
No. 4	0 – 60
No. 40	0 – 50
No. 200	0 – 5

(H) Low-Density Concrete Backfill. The low-density concrete backfill shall consist of a lightweight cellular concrete with a maximum wet plastic density of 35 pounds per cubic foot and a minimum compressive strength of 80 psi at 28 days. The concrete shall be composed of Portland cement, water, aggregates, fiber reinforcement, and a foaming agent. The mixing proportion shall be as determined by the manufacturer to meet the specified requirements.

Use only experienced applicators, licensed or approved by the low-density concrete manufacturer. Only mixing and pumping equipment approved by the low-density concrete manufacturer shall be used.

Submit the following information to the Engineer for acceptance:

(1) manufacturer's product data, including test results for density and compressive strength;

(2) written proof of manufacturer's approved applicator; and

(3) the proposed low-density concrete mix design.

530.04 Construction Requirements.

(A) Underdrain. Underdrain installation shall conform to Section 605 - Underdrain of the Standard Specifications.

(B) Geocomposite Drains.

(1) Geocomposite drains shall be installed to conform to the excavation surface. Geocomposite drains shall be attached to the excavation surface by methods accepted by the Engineer.

(2) Geocomposite drains shall be spliced and connected in accordance with manufacturer's instructions to maintain continuity of flow channel through the drain.

(3) Should the geotextile cover fabric become damaged during installation by tearing or puncturing, the damaged section shall be completely cut out and replaced. If, in the judgment of the Engineer, the damage is not serious enough to warrant removal, the damaged area shall be repaired by overlaying with a piece of fabric, large enough to cover the damaged area and provide a 4 inch overlap on all sides, and taping it in place with 3 inch wide strips of waterproof, plastic tape.

(4) Geocomposite drains shall be protected from damage and deleterious contamination where drains must remain exposed until they are covered with embankment or select granular backfill material.

(C) Wall Construction.

(1) Except for concrete backfill, compact the subgrade of original ground or embankment to 90% relative compaction. Remove soft, yielding, or otherwise unsuitable foundation material to a depth of 2 feet, and replace with select granular backfill material. Place select granular backfill material in 6 inch layers and compact to 95% relative compaction. In areas were groundwater is encountered, replace with AASHTO M 43, No. 67 gradation wrapped in a non-woven geotextile fabric.

(2) Segmental Concrete Facing Units.

(a) Place the first course of segmental concrete wall units on top of and in full contact with the leveling pad. Check units frequently for proper elevation and alignment.

(b) The units shall be placed side by side for full length of the wall, and in proper alignment with the aid of a string line or offset from baseline.

(c) Connecting pins shall be installed and the voids in and around the units shall be filled with compacted or tamped unit backfill.

(d) Remove excess material from the top of the units before installing next course. Completely fill each course before proceeding to next course.

(e) Lay units in a manner such that adjoining unit pin holes are 12 inches on center or as otherwise shown on the plans. Lay units such that only the front face of the units is visible.

(3) Geogrid.

(a) Orient geogrid with the highest strength axis perpendicular to the wall alignment.

(b) Place geogrid at the elevations and to the extent shown on the working drawings or as ordered by the Engineer.

(c) Lay geogrid horizontally on compacted backfill. Place the next course of segmental concrete wall units over the geogrid. Pull the geogrid taut and anchor before placing backfill on the geogrid.

(d) Geogrid shall be continuous throughout their embedment lengths. The Engineer will not accept spliced connections between shorter pieces of geogrid.

(4) Select Granular Fill.

(a) Spread select granular fill and compact in such a manner that minimizes the development of slack in the geogrid.

(b) Place select granular fill and hand compact in lifts not to exceed 6 inches.

(c) Compact select granular fill to 95% relative compaction. Maintain moisture within 2 percent of optimum moisture content throughout each layer of the backfill material before and during compaction.

(d) Use lightweight hand-operated compaction equipment within 3 feet from the tail of the concrete units.

(e) At the end of each day's operation, slope the last lift of reinforced backfill away from the wall units to direct runoff away from the wall face. In addition, surface runoff from adjacent areas shall not enter the wall construction site.

(D) Relative Compaction. Relative compaction shall conform to Subsection 106.09(A) - Relative Compaction Test of the Standard Specifications.

(E) Low-Density Concrete Backfill. Remove all construction debris and extraneous material. Seal all gaps in the forms and walls. Remove all free standing water before placement of the low-density concrete backfill. Conduct the following tests on the low-density concrete backfill to be placed:

(1) Slump Test. The slump of the concrete shall be 9.5 inches ± 2 inches (ASTM C 142).

(2) Field Samples for Lab Testing. Make cylinder samples according to ASTM C 495 and deliver to testing laboratory as follows:

(a) Compressive Strength. Test four cylinders in accordance with ASTM C 495 at 28 days to determine the average unconfined compressive strength with the following exception: For low-density concrete backfill with air dried densities of less than 100 pcf, use 6-inch x 12-inch cylinders only.

(b) Air Dried Density. Test three 6-inch x 12-inch cylinders in accordance with ASTM C 495 at 28 days with the following exceptions: Do not moist cure or oven dry the density specimens. The samples shall be air cured only.

All costs for samples and testing shall be at no cost to the State.

The low-density concrete backfill shall be conveyed from the mixer to place of final deposit using chutes or by pumping to insure a practically continuous flow of concrete. If the concrete is pumped, the pump shall be equipped with either a gate or rock valve. The low-density concrete backfill shall not be allowed to fall freely more than 6 feet. Open troughs and chutes shall be kept clean and free from coatings of hardened concrete, oil and grease.

Deposit the low-density concrete backfill in its final location no longer than 60 minutes after its arrival on the jobsite. Do not place the concrete during rain. Protect fresh concrete from the rain until it reaches its initial set. Do not shovel the low-density concrete backfill into position. In addition, the use of vibrators to transport or consolidate the concrete shall not be allowed.

530.05 Method of Measurement. The Engineer will not measure segmental retaining walls when contracted on a lump sum basis.

530.06 Basis of Payment. The Engineer will pay for the accepted segmental retaining walls on a lump sum basis complete in place. The price includes full compensation for furnishing and installing segmental concrete facing units, connecting pins, excavation, select granular fill, unit backfill, low-density concrete backfill, steel pipe railings, working drawings, calculations, excavation, ledge cuts, leveling pads, wall caps, underdrain, geocomposite drain, geogrid reinforcement, all materials, equipment, tools, labor and incidentals necessary for the construction of the walls.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Segmental Retaining Wall No. _____	Lump Sum"

END OF SECTION

Make the following Section a part of the Standard Specifications:

"SECTION 540 - VIADUCT DECK CONCRETE OVERLAY

540.01 Description. This Section describes removing and replacing portions of concrete deck on the Waimalu Viaduct (Westbound).

The terminology of replacement concrete, concrete overlay, and overlay used in this work shall be considered as interchangeable.

Related works for the replacement concrete are applicable and specified in Section 202 - Removal of Structures and Obstructions, Section 503 - Concrete Structures, Section 601 - Structural Concrete, Section 602 - Reinforcing Steel and Section 712.01 – Water.

In case of discrepancy with other Sections of the Specifications, the requirements of this Section shall govern.

540.02 Materials.

(A) General. Materials for the replacement concrete shall meet the applicable sections of the Contract Documents. Replacement concrete shall have minimum compressive strengths of at least 3000 psi at 3 hours, 4000 psi at 6 hours and 6000 psi at 7 days and at 28 days as determined by AASHTO T22, ASTM C 109, or ASTM C 779. These tests shall be performed by the Contractor in the presence of the Engineer. If ASTM C 779 is used, the Contractor shall first prepare base-line samples, which will be used by the Engineer for comparison and acceptance of field work. Replacement concrete shall be compatible with the existing Portland cement deck to provide the bond strengths required in 540.03(H) Tensile Bond Tests. The records of these tests shall be submitted to the Engineer during the same day the tests are performed.

The water used in this work shall also meet requirements specified in Section 712.01 – Water.

(B) Proprietary Products. The Contractor shall provide a certification with supporting test data from each manufacturer of proprietary products that their material will meet the requirements of this Section. The Contractor shall perform all work in conformance with manufacturer's recommendations. A pre-placement meeting shall be held with the Engineer, Contractor and each manufacturer's representative to verify methods and procedures for replacement concrete work. Each manufacturer's technical representative shall be present during its portion of the work. The technical representative shall be capable and

knowledgeable about the product it represents, e.g., know under what conditions the product should be placed for optimal results, know what causes defects or problems, and know how to troubleshoot their product. The technical representative shall provide aid and field supervision to assure that the work is properly installed and performed as recommended by the manufacturer. Recommendations made by the technical representative on or off the jobsite, and accepted by the Engineer shall be adhered to by the Contractor and shall be at no additional cost to the State.

The materials for the viaduct overlay section shall be as shown in Figure 1:

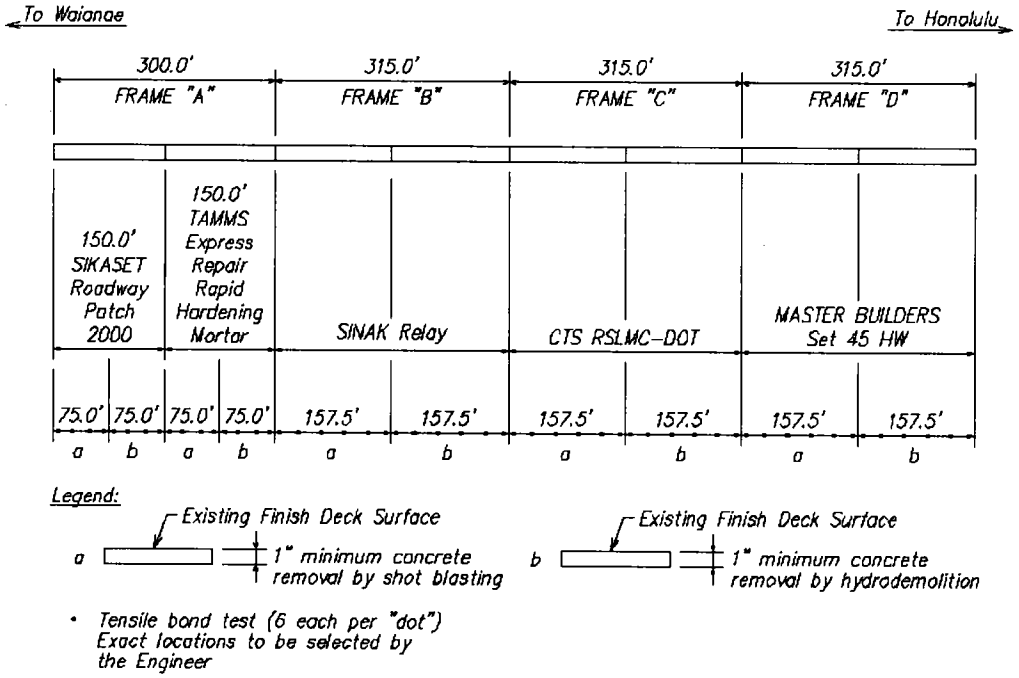


FIGURE 1

VIADUCT DECK CONCRETE OVERLAY MATERIALS, REMOVAL METHODS AND TENSILE TEST LOCATIONS

The specified proprietary products shall be replaced with another type of replacement concrete that is selected by the Engineer, when the Engineer determines that the specified proprietary product is unacceptable.

540.03 Construction Requirements. The limits of the viaduct deck replacement concrete are shown on the plans.

(A) Submittals. At least four weeks prior to start of this work, ten copies of the following for each manufacturer shall be submitted. Until the replacement concrete material is accepted, based on the submittals, no work shall be performed. The submittals shall include but not be limited to the following:

(1) Certification, test data and assurances noted in Subsection 540.02 (B) Proprietary Products.

(2) Replacement concrete product information sheets, including shelf life, placement rates and details.

(3) Details of equipment and procedures used for concrete removal, delivery of concrete overlay, placement, consolidation, finishing and mechanical grooving.

(4) Details for the curing of the replacement concrete.

(5) Step-by-step work sequence of the overlay work including concrete removal, substrate preparation, overlay placement, curing, compressive strength testing, tensile bond testing, and mechanical grooving.

(6) Details to control runoff water from the hydrodemolition and mechanical grooving operations.

(7) Requirements or limitations of the following items. Include recommended procedures to maintain adherence to the requirements and limitations.

- **(a)** Ambient air temperature.
- **(b)** Wind velocity.
- **(c)** Plastic concrete overlay temperature.
- **(d)** Relative humidity
- **(e)** Surface moisture evaporation rate.
- **(f)** Temperature of fresh concrete overlay relative to the air or deck surface temperature.
- **(g)** Theoretical evaporation rate.
- **(h)** Rain.
- **(i)** Placement of the concrete overlay.
- **(j)** Substrate surface preparation requirements.

All submittals required under this sub-section for all replacement concrete shall be submitted as one submittal. A submittal that lacks the required information will be returned to the Contractor with no comments.

(B) Concrete Removal and Substrate Surface Preparation. The upper one inch (minimum depth removal) of the existing viaduct concrete deck in the area designated in Figure 1 and in the Contract plans shall be removed. For each area that is to have a proprietary concrete overlay installed, one half of the existing concrete deck shall be removed entirely by shot blasting. The remaining half shall be removed by hydrodemolition as shown in Figure 1. Milling or grinding equipment shall not be used in the removal of the existing viaduct deck concrete. No concrete overlay removal work shall be performed in the span currently being overlaid and in the adjacent spans.

The Contractor shall be responsible for surveying concrete cover over the reinforcing steel or other metal objects before sawing or concrete removal.

Prior to any concrete removal, the planned longitudinal and transverse edges of the overlay shall be sawn vertically to a depth of one-fourth inch. If concrete cover is less than three-eighths inch over the top of the reinforcing steel or other metal objects, the existing deck shall not be sawn within two inches from outer limits of the rebar or metal object. Saw cuts shall also terminate at two inches from expansion joint structural steel nosings. Miscellaneous metal objects with less than one-inch cover shall be removed when designated by the Engineer prior to pouring overlay.

Hydrodemolition or shot blasting shall not damage the reinforcing steel or any other object to remain in the structure nor shall it produce any cracks in the final prepared substrate surface of the existing concrete. The concrete deck demolition operation shall produce a substrate surface with a roughness of approximately one-fourth inch amplitude and a minimum macrotexture depth of 0.08 inch as determined according to ASTM E 965 Measuring Surface Macrotexture Depth using a Volumetric Technique. The profile of the substrate surface shall also meet International Concrete Repair Institute (ICRI) concrete surface profile CSP 7. Tests shall be performed by the Contractor, in the presence of a State inspector. Perform a minimum one macrotexture depth test every fifty feet or faction thereof of longitudinal distance for each combination of concrete demolition and concrete replacement material but not less than two tests per test combination. Locations of the test shall be determined solely by the Engineer. If the test results prove the minimum macrotexture depth is less than 0.08 inch or the ICRI concrete surface profile is less than CSP 7, additional surface preparation for the entire area being tested shall commence immediately. The area shall be re-tested until the remedial surface preparation provides satisfactory test results. The Contractor shall

select a shot blaster and shot size that will not leave a polished substrate surface. The faces of concrete overlay construction joints, patches and concrete placed at existing deck drains shall also be roughened to the same above requirements. No overlay placement shall be done until the minimum macrotexture depth is achieved. Debris including water from hydroblasting, shot blasting and cleaning operations shall be thoroughly removed using vacuum machines and disposed properly outside the project limits. Brooms shall not be used in the debris removal operation.

If the presence of reinforcing steel or other metal objects in the concrete to be removed prevents the shot blasting from achieving the specified results, the concrete in that area shall be removed by hydrodemolition at no additional cost to the State.

Dust, dirt, oil, grease and other contaminants that will affect bonding of the overlay shall be removed from the concrete substrate and reinforcing steel. The Contractor shall protect prepared surfaces from dust and other contaminants with plastic sheets until the placement of concrete overlay. Should more than 48 hours elapse between the completion of the blasting and cleaning operations, and placement of the overlay, another water blast cleaning with a pressure of not less than 5,000 psi shall be performed regardless of the apparent condition of the concrete surface.

At locations with existing deck drains, the gratings and portions of the steel frame including the anchors within the concrete overlay shall be removed. The top one-inch of the concrete used to backfill the deck drains shall be removed and replaced at the same time and manner as the adjoining overlay. Details for construction of the overlay at these deck drains are shown in the plans. The sequence of the overlay work is also shown in the plans.

(C) Placing Overlay. The placement of the replacement concrete (1" minimum depth) shall be according to Section 503 Concrete Structures and as amended herein. Replacement concrete shall be placed in a continuous operation.

The Contractor shall humidify the air behind the screed using fog sprays. Fog sprays that drip on the concrete shall be taken out of service and replaced immediately.

Longitudinal joints will be allowed only at the interface of the new overlay and the remaining existing concrete. Transverse construction joints may be allowed when accepted by the Engineer. However, the last 12 inches of the concrete overlay measured longitudinally from the

transverse construction joint shall be removed and replaced using the same requirements as the adjoining concrete overlay. The last 12 inches that ties into the existing concrete or an expansion joint structural steel nosing may remain.

(1) Construction Vehicles. Construction vehicles shall not exceed a 5-mph speed limit within 100 feet longitudinally and 12 feet transversely of the placement area. This speed limit shall be imposed in both directions; that is, for arrival and departure. The concrete overlay delivery trucks shall not contaminate the prepared deck surface and shall have oil-catching diapers attached to the entire undercarriage of the trucks.

(2) Rate of Placement. The concrete overlay shall be placed continuously at a minimum placement rate as recommended by each concrete overlay manufacturer and as stated in the pre-placement meeting. The Contractor shall minimize the use of transverse construction joints.

(D) Finishing. The finishing operations shall proceed at a steady pace with final finishing completed before concrete overlay starts to its initial set. The Contractor shall finish the concrete overlay surface with a Class 6 float finish by either machine or manual methods. The Contractor shall not apply any additional water to the overlay surface in an effort to aid his finishing operation. The unauthorized application of water will result in the rejection of that day's replacement concrete placement. The rejected concrete overlay shall be removed and replaced with the same type of concrete overlay using the same demolition method. The requirements for texturing the concrete overlay shall be replaced with the requirements of Section 503 - Concrete Structures for longitudinal mechanical grooving. The finished surface shall match the grade and slope of the existing concrete.

(E) Curing. Curing of the concrete overlay shall be according to Section 503 – Concrete Structures unless otherwise recommended by the manufacturer and permitted by the Engineer. Special curing procedures, as necessary, shall be used to control plastic shrinkage cracking.

(F) Surface Tests. The finished bridge deck shall conform to the following requirements when tested by the Engineer not more than 14 days following the placement of concrete:

(1) Straightedge the bridge deck surface at locations determined by the Engineer with a straightedge 12 feet long. When laying the straightedge on a finished bridge deck in a

direction parallel with centerline or perpendicular to centerline, the surface shall not vary more than 0.25 inch from the lower edge.

(2) The Engineer will determine the profile of the bridge deck surface using a profilograph according to Hawaii Test Method HDOT TM 6 and these provisions. The Engineer will take the profiles parallel to each edge of bridge deck and the approximate location of each longitudinal joint. The State will determine the profile of the bridge deck of the travelway, shoulder, and closure pour as illustrated and defined in the contract plan's "Normal Deck Section".

The Engineer will inform the Contractor of the profilograph test's traces and profile index for the area tested. If the bridge deck surface test does not meet the requirements of the Contract Documents, the Contractor shall utilize its own profilograph surface tests to determine where the bridge deck surface must be corrected. When the Contractor has determined that the surface meets the requirements of the Contract Documents, the Contractor shall request HDOT to perform another profile of the bridge deck surface using a profilograph according to Hawaii Test Method HDOT TM 6 and these provisions. The results of this test will determine if the surface is acceptable to the Engineer.

Make the request to the Engineer for profile testing at least 7 calendar days before testing the bridge deck surface. Clean and clear the area to be tested of obstructions, provide MUTCD compliant traffic control at no additional cost to the State if needed. Lane rental charges will be accessed if applicable. The Contractor shall provide all needed aid to the State so that the test can be performed. The Engineer will do up to two profilograph tests of the same area at no cost to the Contractor. Submit the total area to be tested at any time the request for testing is made, for acceptance by the Engineer. The minimum length of a test area shall be no less than 0.10 mile unless the work area remaining to be tested is less than 0.10 mile. After the second profilograph test is made of the same area, the Engineer will do additional profilograph testing at a cost to the Contractor at a rate of $750 per test. If the test takes more than one day, another $750 will be charged for each additional day. The cost of the extra profilograph testing shall be deducted from the monthly estimate, or if insufficient payment is to be made to cover the cost, the cost will be billed to the Contractor.

Repair the membrane curing film damaged during the testing operations as specified by the Engineer. The Contractor

and the Engineer will use the initial profile testing to aid and evaluate the deck concrete placement methods and equipment. When an average profile index exceeds 15 inches per mile, suspend the paving operations. The Engineer will not allow the Contractor to resume until corrective action is taken. Test the subsequent paving operation according to the initial testing procedures.

Furnish equipment and employ methods that produce a riding surface having a profile index of 10 or less, except as provided herein. The Engineer may accept the initial profiles up to 15 with applicable price adjustments.

Reduce individual high points over 0.3 inch, as determined by measurements of the profilogram according to Hawaii Test Method HDOT TM 6, by grinding until such high points as shown by reruns of the profilograph do not exceed 0.3 inch. At all areas, that need corrective work the Contractor shall determine the depth of the reinforcing steel. When the clearance between the bridge deck surface and the top of the reinforcing steel is less than one-inch, the Contractor shall submit a remedial repair method to protect the reinforcing steel from corrosion and to prevent the bridge deck from cracking or spalling that is acceptable to the Engineer. The remedial repair method and any design work shall be at no additional cost to the State.

Do additional grinding as necessary to reduce the Profile Index to values specified in any 0.1 mile section along any line parallel with the bridge deck edge.

Do additional grinding as necessary to extend the area ground in each lateral direction so the lateral limits of grinding are at a constant offset from and parallel to, the nearest lane line or bridge deck edge. Also, do additional grinding as necessary to extend the area ground in each longitudinal direction so the grinding begins and ends at lines normal to the bridge deck centerline, within any one ground area. Ground areas shall be neat rectangular areas of uniform surface appearance.

When grinding bridge deck, do not finish the bridge deck to a smooth or polished texture. Grind the bridge deck to maintain a texture with randomly spaced grooves in the pattern and direction as specified in the contract plans, unless otherwise specified by the Engineer.

The Engineer will exclude the areas described in the subparagraphs below from the profile testing requirements described above.

(1) On horizontal curves having a centerline radius of curve less than 1,000 feet and bridge deck within the superelevation transition of such curves,

(2) Within 15 feet of a transverse joint that separates the bridge deck from an existing Portland Cement Concrete pavement not constructed under the contract or an asphalt concrete surfaced pavement; or a structural deck or approach slab,

(3) Ramps and connectors with grades of 6 percent or more.

The Engineer will apply the surface requirement described below to those areas exempted from the profile testing describe previously.

(1) Measure using a 12 foot straight edge, the perpendicular distance from the bridge deck surface to the lower edge of that straight edge. Between any two points of contact between the bridge deck surface and the lower edge of the straight edge, the measured distance shall be 0.25 inch or less for straight edge alignments parallel and perpendicular to the centerline of the lane that is being tested and

(2) The bridge deck that is being tested shall have its entire profilograph trace inside of a 0.2 inch blanking band.

(3) The Engineer will inform the Contractor of the profilograph test's traces and profile index for the area tested. If the bridge deck surface test does not meet the requirements of the Contract Documents, the Contractor shall utilize its own profilograph surface tests to determine where the bridge deck surface must be corrected. When the Contractor has determined that the surface meets the requirements of the Contract Documents, the Contractor shall request HDOT to perform another profile of the bridge deck surface using a profilograph according to Hawaii Test Method HDOT TM 6 and these provisions. The results of

this test will determine if the surface is acceptable to the Engineer.

The Engineer will not count the profile index obtained in the exempted areas for the calculation of any price adjustment due to profile index. The price adjustment is shown in Profile Index Price Adjustment table in 411.05(A) – Price Adjustments.

The Contractor shall correct all profiles by using grinding methods that does not impact, hammer, batter or cause micro-cracking in the bridge deck. Use of bush hammers or other impact devices are not permitted.

(G) Initial Delamination Tests Seven days after the requirements for curing have been met, the entire concrete overlay surface shall be sounded by the Contractor, in a manner approved by and in the presence of the Engineer, to insure proper bond of the replacement concrete to the viaduct deck. Replacement concrete in unacceptable areas shall be removed and replaced by the Contractor at no addition expense to the State.

(H) Tensile Bond Tests. The Contractor shall drill a minimum of six cores perpendicular to the concrete overlay surface for every 50-feet or fraction thereof, of longitudinal length for each different combination of concrete demolition method and concrete replacement material. However, not less than six cores shall be done for each day's installation of replacement concrete or for each continuous pour. Locations of the cores will be selected solely by the Engineer. The minimum numbers and general locations of the tension tests are shown in Figure 1. Drilling operation shall be done such that it will produce a cored disc 2 inches in diameter. The core shall have the appearance of a small island of overlay material. The core depth shall be the full thickness of the overlay plus ½ inch of existing concrete deck concrete. Prior to drilling, each core location shall be sand blasted a minimum area of 6 inch by 6 inch to remove curing compound, laitance, high spots or other deleterious substance in performing a tensile bond test as described in "Appendix A – Test Methods" of ACI Standard 503R Use of Epoxy Compounds With Concrete. Drilling operation shall be done in advance to provide adequate adhesion of the pullout disc to the concrete overlay prior to determining the bond strength. Each failure of the epoxy to bond to the concrete overlay is cause for an additional test core to be drilled to replace each failed core. Cores which contain deck reinforcing steel shall also be unacceptable. All remedial test cores shall be at no additional cost to the State.

The Contractor may use pull-off or button-type tension test methods in accordance with ASTM C 900 or ASTM D 4541 in lieu of the ACI Standard 503R if approved by the Engineer.

The Contractor, in the presence of the Engineer, shall perform the two tensile bond tests at each location noted above for each different combination of substrate surface and concrete overlay proprietary product at 3 hours, at 7 days and at 28 days after the overlay is placed. The three hours will be measured from the time the concrete overlay used for the test is placed and not the time of the completion of the overlay pour. The records of these tests shall be submitted to the Engineer during the next working day after the tests are performed. Any concrete overlay with tensile bond test strength of less than 250 psi will not be acceptable unless failure occurs in the existing concrete.

After testing, the holes shall be patched with overlay accepted by the Engineer and finished to the overlay surface elevation and texture.

(I) Texturing. The overlay shall be textured longitudinally by mechanical grooving in accordance with Section 503.03 (M)(3)(a)1 – Machine Finishing.

(J) Post-Construction Survey and Final Inspection. A post-construction survey of the entire concrete overlay shall be performed in accordance with ASTM D 4580 by the Contractor in the presence of the Engineer to check for cracks, delaminations, and other defects three months after completion of the last overlay placement. The survey shall include visual checks for cracks or other defects and checks for delaminations using a chain drag, metal rods or other equivalent equipment. Cracks greater than 0.01" width but less than 1/2" deep shall be sealed with material compatible with the overlay and acceptable to the Engineer. The Contractor shall replace sections of the overlay where delaminations are found or where cracks larger than 0.01" width or penetrates the thickness of the overlay one-half inch or more. Delaminated areas will not be accepted by the Engineer. The unacceptable areas shall be saw cut into rectangular areas and repaired with a replacement concrete selected by the Engineer. The records of the post-construction survey shall be submitted to the Engineer along with the pulled cores. All of the cores shall be marked with the location, date of test and sample number. Also, submit a drawing showing where the test locations were. If the Contractor's operations do not allow the use of the movable concrete barriers as required or shown in the Contract Documents, the Contractor shall submit to the Engineer a traffic control plan and shall not proceed with the tests until the Engineer finds the Contractor's traffic control plan acceptable.

540.04 Method of Measurement. The Engineer will not measure viaduct deck replacement concrete work for payment.

The Engineer will measure tensile bond tests, which includes coring, patching, finishing and other necessary work, per each.

540.05 Basis of Payment. The Engineer will pay for the accepted viaduct deck replacement concrete at the contract lump sum price based on the type of overlay regardless of the method used in the preparation of the substrate surface. The price includes full compensation for but is not limited to labor; material; equipment, tools and other incidentals necessary to complete the work including concrete overlay; structural steel; removal of drain lines and strap hangers; survey of the concrete overlay to locate areas of bond failures, cracks, delaminations or other defects; sealing cracks or the replacement of unacceptable overlay; any design of traffic control and the implementation of it, and reinforcing steel work at the existing drains necessary to complete the work according to the Contract Documents.

The Engineer will pay for the accepted tensile bond tests at the contract unit price per each. The costs of sand blasting the core areas and filling the holes with replacement concrete after the pull-off tests shall be considered incidental to this pay item.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Replacement Concrete for Frame _____	Lump Sum
Tensile Bond Tests	Each

The Engineer will pay for the removal of portion of existing concrete deck for replacement in accordance with the provisions of Section 202 – Removal of Structures and Obstructions.

The Engineer will pay for the texturing by mechanical grooving in accordance with the provisions of Section 503 - Concrete Structures."

END OF SECTION

any panel is not out of alignment by more than ½-inch from a straight line.

(3) The units shall be set in a vertical position, closely following the roadway grade. All installations shall be done in a first class workman-like manner.

(4) All units shall be removed, cleaned, repaired, stored, transported and finally placed as ordered by the Engineer upon completion of the work.

(5) The Contractor shall furnish, install and maintain one (1) RM-2 reflector marker (not RM-3 as shown on the Standard Plans) and one (1) lamp (steady burn or flashing) on each section and a longitudinal 4-inch wide, 20-foot long permanent preformed pavement marking tape, Type 1 (color to match appropriate pavement stripe) on the side of the guardrail facing traffic on each section on the slanted face. The Contractor shall furnish and install steel pins for connecting the barrier sections.

(6) The Contractor shall furnish, install and maintain one (1) portable concrete barrier end treatment that is fully compatible with PCB. The end treatment shall be designed and crash tested to meet the requirements of NCHRP Report 350, Test Level 3.

(7) Crash Cushion Object Marker. Retroreflective sheeting shall be installed on a crash cushion whenever an object marker is not provided by the manufacturer. Make crash cushion object markers according to the dimensions and notes shown in the contract. Retroreflective sheeting material shall conform to Subsection 712.20(c)(4) - Type III or IV Retroreflective Sheeting.

606.04 Method of Measurement. The Engineer will measure guardrail per linear foot.

The Engineer will measure from center to center of end posts. When making end connections to masonry or steel structures, the Engineer will measure to the face of such structures.

The Engineer will measure rigid barrier type guardrail per linear foot from end to end of the type specified.

The Engineer will measure end anchorage, terminal section and transition section as units of each kind.

The Engineer will measure State furnished portable concrete barrier per each.

606.05 Basis of Payment. The Engineer will pay for the accepted guardrail at the contract unit price per linear foot complete in place. The price includes full compensation for removing existing guardrails and posts; filling of post holes; grading and compacting the shoulder area; installing physical barrier; furnishing and installing the guardrails; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

The Engineer will pay for the accepted end anchorage, terminal section and transition section at the contract unit price per each complete in place. The price includes full compensation for removing existing guardrails and posts; filling of post holes; grading and compacting the shoulder area; installing physical barrier; furnishing and installing the end anchorage, crash cushion object marker, terminal section and transition section; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

The Engineer will pay for the accepted State furnished portable concrete barrier at the contract unit price per each. The price includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals necessary to haul the barriers from stored areas to the jobsite; prepare beds; set barriers; provide, install and maintain pins, reflector markers, and lamps; complete a full and useable unit; relocate barriers during construction, if required; and clean, repair and haul the barriers after complection of the project to the Waipio Interchange or a location of equal distance as directed by the Engineer.

The use of "State Furnished Portable Concrete Barriers" will depend on the availability of State owned portable concrete barriers at the time of need. The Contractor shall include sufficient costs in his/her proposal to account for large overruns or underruns. Adjustment to the proposed unit prices shall not be allowed under Section 104.09 - Methods of Price Adjustment.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Guardrail Type _____	Linear Foot
_____ Guardrail	Linear Foot
End Anchorage Type _____	Each
Terminal Section Type _____	Each

Transition Section Type _____	Each
Concrete End Post (_____)	Each
State Furnished Portable Concrete Barrier	Each"

END OF SECTION

Amend **Section 616 - Sprinkler System** to read as follows:

"SECTION 616 - SPRINKLER SYSTEM

616.01 Description. This work includes installing a sprinkler systems such as piping, sprinkler heads, valves, automatic controllers, remote control valves, booster pumps, valve assembly units, power and control wiring, pullboxes, and related equipment and materials at locations shown in the contract or as specified by the Engineer.

616.02 Materials. Materials shall conform to the following:

Trench Backfill Material	703.21
Polyvinyl Chloride (PVC) Pipe	706.13
Dark Green Enamel Paint	708.03
Pullboxes	712.06(B)
Frames and Covers	712.07(A)
Sprinkler Heads	712.12
Valves	712.13
Pressure Regulators	712.14
Backflow Preventers	712.15
Precast Concrete Meter and Valve Boxes and Covers	712.23
Cables, Conductors and Wires for Irrigation System	712.34(C)
Automatic Controller	712.42(A)
Pump, Motor and Motor Controller	712.43
Springs for Sprinkler Risers	712.47
Electrical Appurtenances	712.48
Valve Boxes and Covers (Plastic and Concrete)	712.49
Switching Tensiometer	712.50

Rain Sensor Switch	712.52
Cullet Materials for Drainage System	717.04

Materials and equipment incorporated in the irrigation system shall be new and shall be of recognized standard quality. The Engineer will inspect and test the materials according to the contract.

Electrical equipment shall conform to the NEMA Standards. Electrical work shall conform to the National Electrical Code (the Code), General Order No. 6 of the Hawaii Public Utilities Agreement, local power company rules, and local ordinances that may apply.

Sprinkler water lines under the roadway shall be PVC pipe, Schedule 80 with threaded connections.

Concrete for reaction blocks, pump foundations and jackets shall be Class B conforming to Section 601 - Structural Concrete.

Within ten (10) days following the award of contract, submit a list of the irrigation equipment that the Contractor will use on the project. The list shall be by name of manufacturer and catalog number. The list of irrigation equipment shall include sprinkler heads, valves, irrigation control equipment, booster pump units, and pump controls as required for the irrigation system.

Materials will be subject to inspection by the Engineer. Failure of the Engineer to note faulty material or workmanship during construction will not relieve responsibility by the Contractor for removing or replacing such materials and redoing the work at no cost to the State.

616.03 Construction Requirements.

(A) Installation.

(1) General. The irrigation system shown in the contract is diagrammatic only. Provide the pipe fittings or substitute other pipe fittings necessary to complete the connections shown in the contract. Alterations and changes in the layout may occur to conform to the ground conditions and to obtain full and adequate coverage of water. Do not change or alter the system as planned without prior acceptance by the Engineer.

Ream the pipes after being cut and clean and free the pipes from dirt or other foreign matter. Make the metal to metal screwed joints with an accepted non-soluble and nontoxic lubricant on the male thread only.

Excavate the necessary trenches and other openings a minimum of eighteen (18) inches of depth or to the required depth shown in the contract. Excavate the additional depth and width where required, to ease valves, reaction blocks, concrete jackets, rock removal, connections to other mains or to clear subsurface obstructions. Trenches shall be of sufficient width to permit snaking of plastic pipe not connected by rubber ring-type fittings. The Contractor need not snake the pipe connected with rubber ring-type fittings.

Trenches for plastic pipe shall be smooth and free of jagged rubble or sharp objects that will cause abrupt bending stresses and uneven weight distribution during backfilling operations. Before backfilling the pipe line trenches in an area that the Contractor will water,:

(a) pressure test that unit of the irrigation system and

(b) modify the sprinkler locations if necessary to get complete and uniform coverage or flow.

Supply line trenches located next to curbs, dikes, and paved shoulders shall be at least four feet from said curbs, dikes, and paved shoulders.

Install reaction blocks according to the manufacturer's instructions and as specified by the Engineer. Furnish a copy of the manufacturer's instructions to the Engineer before installing the pipes.

When installing supply lines through existing paved areas, replace the sub-base, base, and paving removed with material of equal quality.

Set the risers for sprinklers on slopes approximately perpendicular to the plane of the slope or half-way between perpendicular to slope and vertical for best coverage. Install each series of sprinklers and adjust and test operate the nozzles to establish the location on the slope and proper angle of the risers.

If the location of a supply line interferes with the drilling of plant holes, locate the plant holes to clear the supply lines. Do not install supply lines through plant holes except in the installation of emitters or bubbler type sprinkler heads.

Install the vertical spring action check valves on the sprinkler risers or swing joints if not integrated into the sprinkler body, or as specified by the Engineer.

Before the Contractor removes or disturbs markers showing the location of existing cross-over conduits, mark the conduit location on the pavement.

Connect the underground metallic pipes, valves or fittings made of dissimilar metals through a dielectric coupling or bushing. Separate these pipes physically from other metal objects a minimum of one-eight inch. The Contractor may require non-conducting spacers that will insure physical separation of pipe from foreign objects as decided by the Engineer.

Before any portion of the pipeline on the supply side of a control valve is backfilled, expel the air from the line. Then turn the water on and maintain at full pressure for not less than eight (8) consecutive hours. Also, before any portion of the pipeline on the discharge side of a control valve is backfilled, do a similar test except the test shall be for duration of one hour. Repair leaks that develop in the portion of the system installed by the Contractor and replace defective materials at no cost to the State. Plug or cap the pipe where the Contractor will install sprinklers while making this test. Then check the entire system for uniform and complete coverage after installing sprinklers.

After installing the pipe and testing the pipe properly according to the contract, backfill and compact the trench in six (6) inch layers according to Section 206 - Excavation and Backfill for Conduits and Structures. Dispose of the remaining material.

In planting areas, the Contractor may compact the backfill material by ponding or jetting with water until the backfill material, after settlement, is level with the surrounding soil. Fill the pipeline with water before compacting the backfill material.

Backfill the pipe trenches so that sharp objects will not damage the pipe. Do not place rocks directly on the pipe.

When backfilled area has settled, refill and compact said area including furnishing, applying, and compacting the fill material.

When meeting solid rock, excavate the rock:

(a) to a depth six (6) inches below the invert grade and

(b) to a width four (4) inches on each side of the pipe.

Backfill the space up to the invert with trench backfill material. Compact the trench backfill material firmly.

Install the pressure regulators and backflow preventers according to the Plumbing Code of the respective County.

(2) PVC Pipe. Join the plastic pipe and fittings by solvent cementing, slip seat joints, or threaded joints. Cuts shall be square-end and clean. When clamping the pipe, protect the pipe from nicks and scouring by wrapping in canvas, emery paper or other accepted materials.

Install the plastic pipes and fittings according to the manufacturer's instructions and procedures. Furnish a copy of the printed instructions to the Engineer before installing the pipe. The Contractor shall be responsible for making arrangements with the pipe manufacturer for field assistance.

In making solvent cement joints, do not apply pressure until the joints cure for an adequate time. Solvent welded joints shall be used for three (3)-inch and smaller piping only. All four (4)-inch and larger piping shall utilize ductile iron ring tight fittings conforming to ASTM F-477 with four radial lugs spaced 90 degrees apart for mechanical restrain of spigot-bell restraint.

Screw the threaded joints and apply an accepted non-hardening, putty-type joint compound. Avoid undue strain on plastic material. On plastic to steel connections, make the steel connections first. Tighten the threaded joints about one turn past hand-tight with a strap wrench.

Install the plastic pipes to allow for expansion and contraction as recommended by the manufacturer's instructions and procedures.

(3) Valves and Valve Boxes. Construct the valve manifolds shown in the contract.

If the contract shows multiple installations of valves in a large single valve box, the Contractor may, at its option, install the valve in individual valve boxes. Install the valves with a two inch clearance from valve box walls.

Install the valve boxes with their tops one inch above the surface of surrounding grade. In concrete walks or traffic islands, flush the top of the valve boxes with the surrounding grade.

The Contractor may substitute plastic valve boxes for portland cement concrete valve boxes.

(4) Valve Keys. Furnish to the Engineer upon completion of the project:

(a) Four long shank keys or wrenches for flow adjustment of manual control valves and

(b) Four valve keys for four inch or larger gate valves.

(5) Electric Automatic Controllers. House each controller in a stainless steel NEMA 3R pedestal type enclosure. Install the controller on a portland cement concrete foundation or wall mounted shown in the contract. The concrete for the foundation shall be Class B and shall conform to Section 601 - Structural Concrete. The Engineer will permit hand mixing of foundation concrete.

Each controller shall have an individual neutral conductor to its respective valves.

Submit a complete maintenance and operations manual for each type of controller to the Engineer before the plant establishment period.

A complete schematic wiring diagram for each controller shall be a part of the maintenance manual. The diagram shall show in detail the circuits and parts. Also, submit one copy of said diagram in a heavy plastic envelope and attached to the inner portion of each controller cabinet door.

Electrical equipment requiring modifications to conform to the contract shall have such modifications made at the factory before shipment to the project.

(6) Valve Assembly Unit. The valve assembly unit shall be of the same size as the pipeline that said unit serves.

(B) Water Service Connection. Install the water service connection according to the requirements of the appropriate County Water Supply or

governing agency. Furnish and install the service lateral, service connection, meter, meter box, shut-off valve, valve box and miscellaneous items necessary to complete the connection. This includes excavation, backfilling and tapping into the water main.

(C) Relocation of Existing Sprinkler Lines. The Contractor cannot reuse the existing lines, install all new material.

(D) Electric Service. The electric company will provide electric services to the irrigation system from its facilities or existing facilities shown in the contract. The electric services include the equipment and features shown in the contract. Apply to the electric company for the required services under the applicable rate schedule. The Engineer will pay such charges the electric company levies. The Contractor shall pay energy charges up to the time of final acceptance of the project.

(E) Field Test. Before the acceptance of the work, conduct the following tests on the automatic sprinkler system circuits in the presence of the Engineer:

(1) Test for continuity of each circuit.

(2) Test for grounds in each circuit.

(3) A megger test on each circuit between the circuit ground. The insulation resistance shall not be less than the values specified in Section 110-20 of the Code.

(4) A functional test to show that the system functions as specified or as intended herein.

Replace or repair faulty material or installation revealed by these tests according to the contract. Repeat the same tests until no fault appears.

(F) Sprinkler Heads. Install the sprinkler heads at the locations shown in the contract or as modified and accepted by the Engineer.

The Contractor shall locate:

(1) lawn spray heads or lawn pop-up spray heads six inches away from curbs, sidewalks, and pavements;

(2) shrubbery spray heads twelve (12) inches away from curbs, sidewalks and pavement; and

(3) jet sprinkler heads or rotary pop-up jet sprinkler heads five feet away from curbs, sidewalks, edge of shoulder or pavement or

(4) as specified by the Engineer.

Install lawn pop-up spray heads and rotary pop-up jet sprinkler heads on swing joints or flexible swing joints. All sprinklers shall have a built-in check valve installed in its body or as part of it's riser to minimize low-head drainage due to elevation changes within the system.

(G) Installation of Electrical Materials.

(1) Equipment List and Drawings. Within thirty (30) days following the award of the contract, submit for acceptance 6 copies of a list of materials and equipment that the Contractor will incorporate in the work. The list shall include the name of the manufacturer, data and catalog number of equipment, detailed scale drawings and wiring diagrams of the systems and proposed deviations from the contract. If required, submit for acceptance samples of the materials that the Contractor will use at no cost to the State.

(2) Excavation and Backfill. Excavation and backfill shall conform to Section 206 - Excavation and Backfill for Conduits and Structures.

(3) Concrete for Transformer and Equipment Cabinet Pads, Cabinet Bases, and Conduit Encasement. Concrete for transformer and equipment cabinet pads, cabinet bases, and conduit encasement shall be Class B. They shall conform to Section 601 - Structural Concrete. Reinforcing steel shall conform to Section 602 - Reinforcing Steel. Welded wire fabric reinforcement shall conform to Subsection 709.01(C).

Forms shall be true to the lines and grades as accepted. Forms shall be rigid. Brace the forms securely in place. Place the conduits and anchor bolts in the proper position and to the proper height. Hold the conduits and anchor bolts in place with a template until the concrete sets. Allow the concrete pads to cure for seven (7) days and the concrete for conduit encasement to cure for seventy-two (72) hours.

Concrete pads shall be level and have a steel trowel finish. Notify the electric company twenty-four (24) hours before placement of concrete for transformer pads or conduit encasement.

(4) Circuits.

(a) Buried Conductors. The Contractor may bury or install circuits operating at a nominal potential of 30 volts directly or in conduit. Unreel direct burial wires and cables alongside the trench and place carefully on the bottom of the trench. The Engineer will not permit unreeling and pulling the cable into the trench from one end. Before backfilling, verify that the cable is free of kinks and sharp bends. Install wiring within conduits when rock is encountered, under paving, or through walls.

The Engineer will permit splices only in electrical pullboxes marked "Electric" or valve boxes housing electric control valves. Make the splices to provide a watertight joint of dielectric value at least equal to the conductor insulation.

Leave at least two feet of slack in each conductor at each splice and at each remote control valve. Bundle directly buried wires with nylon straps at five-foot intervals.

(b) Conductors in Conduits. Install circuits operating at a potential above 30 volts nominal in conduit. Before installing the wire or cable in conduit, pull a suitable wire brush, swab and mandrel through the conduit to remove extraneous matter. Verify that the conduit system is free of obstructions. Pull the cable directly into the conduit from the shipping coil or reel before installation. Do not uncoil and lay the cable on the ground. Make the pulls in one direction. Use only lubricants recommended by the manufacturer of the wire or cable or accepted by the Engineer. Do not leave the wires and cables under tension nor tight against bushings or fittings. When using pulling grips, remove the damaged ends when pulling the wire or cable. Do not pull the cable with its end open. Maintain the seal.

Cables shall be continuous from pulling point to pulling point. The Engineer will not permit splices elsewhere. Make splices and taps with standard splicing kits of type recommended by the cable manufacturer. Splices shall be waterproof and of dielectric value at least equal to that of the insulation of the conductors joined.

(c) Conductors. Conductors shall be of the size shown in the contract or larger as recommended by the manufacturer of the controllers furnished for this project. Minimum size for common or neutral conduit shall be #12 AWG UL/UF wire.

Tag each conductor in each pullbox and each conductor terminal at each controller and remote control valve with a small permanent identification tag or band. The tags or bands shall be embossed, non-ferrous metal, or rigid plastic. The embossed symbols shall contrast with the background color. Identification on each tag or band shall include the controller station, and number or letter designation of the controller serving the remote control valve.

(d) Bonding and Grounding. Ground noncurrent-carrying parts of the electrical system, including metallic portions of conduit systems, equipment and device enclosures, and equipment frames.

(e) Conduits. Metallic conduit shall be rigid zinc-coated steel. Non-metallic conduit shall be PVC conduit or bituminous-fiber duct (BFD). Non-metallic conduit encased in concrete shall be PVC Schedule 40, thin wall type for the BFD kinds. Non-metallic conduit directly buried shall be PVC Schedule 40, heavy wall type for the BFD kind. Apply the conduit types shown in the contract.

Install the rigid metal conduit according to Article 346 of the Code. Use white and tinted ready-mix paint on the threads of joints. Repair the zinc-coated surfaces according to Subsection 501.03(G)(2) - Repairing of Damaged Zinc-Coated Surfaces.

Cut rigid PVC conduit with a hack-saw. Square and trim the cut ends to remove rough edges. Construction shall be of the solvent-weld type. Make the solvent-weld joints according to the conduit manufacturer's recommendations and as accepted by the Engineer. The Engineer will permit preassemblying sections of conduits.

Cut the bituminous-fiber lengths with tapering tools recommended by the manufacturer. Couplings shall be of the same material as the conduit that the couplings join.

Do not use such force as to damage the coupling. Install the ducts to drain toward either one or both pullboxes or manhole.

Make directional changes in non-metallic conduit runs with curved equipment using accepted deflection couplings or with short lengths of straight ducts and couplings. The deflection angle between two adjacent lengths of duct shall not exceed six (6) degree nor shall the bends give a radius of less than twelve (12) times the nominal size of the conduit unless using factory-made ells.

Use only hand shovels in compacting the concrete jacket unless the Engineer authorizes other methods. Cure the concrete for at least seventy-two (72) hours before permitting vehicular traffic to run over the concrete.

(5) Pullbox. Space the pullboxes shown in the contract or at a maximum spacing of two hundred fifty (250) feet. Install pullboxes with their tops one inch above the surface of the surrounding grade. In concrete walks or traffic islands, flush the top of the pullboxes with the surrounding grade.

(I) Water Service. Arrange with the appropriate County Water Department for the water service. The Contractor shall pay for the water and service charges during the period of use of the sprinkler system. For water service from existing State water system, the Contractor shall install a water meter to establish the Contractor's prorate usage and cost.

(J) Acceptance. The Engineer will not accept the sprinkler system until the end of the nine (9) month plant establishment period following the one hundred twenty (120)-day planting period for a total of one year. The sprinkler system shall be operating according to the contract for the section the Engineer is accepting.

Operate the automatic type sprinkler system in the automatic mode for at least three (3) weeks before acceptance. Repair the breakdowns in the system occurring during this period at no cost to the State.

(K) Workmanship. Install materials and equipment according to the contract. Remove and replace material when specified in writing by the Engineer at no cost to the State.

A licensed plumbing Contractor, a licensed Landscape Contractor or a licensed C-37 Irrigation Contractor shall do the irrigation pipe work. A Licensed Electrical Contractor or an experienced journeyman electrician shall do the electrical work. The contract defines plumbing and electrical work and the Contractor shall conform to "Title 16, Chapter 80, Rules Relating to Electricians and Plumbers, Chapter 448E, HRS", and "Chapter 448E, HRS, Electricians and Plumbers".

616.04 Method of Measurement. The Engineer will not measure the sprinkler system for payment.

616.05 Basis of Payment. The Engineer will pay for the accepted sprinkler system on a contract lump sum basis.

The Contractor shall pay for the water used before the acceptance of the project or until the termination of the maintenance period for the plantings, whichever is later.

The price includes full compensation for furnishing and installing the sprinkler system; excavating; backfilling; restoration of work area, installing concrete, pipe sleeves in retaining walls; connecting to existing sprinkler systems; installing pipe fittings, valve and pressure regulator boxes, service connections; making the required tests; and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

The unit price for sprinkler head includes the riser, swing joint, fittings and other necessary items to connect to the lateral line.

The Engineer will pay for the accepted high voltage work above 30 volts on a contract lump sum basis. The price includes full compensation for work done from the electric company's facilities up to the controller(s) or the State distribution panel; hookup; and furnishing labor, materials, equipment, tools, and incidentals necessary to complete the work.

The Engineer will pay for the accepted low voltage work up to 30 volts on a contract lump sum basis. The price includes full compensation for work done from the sprinkler control valves to the controller(s) or the State distribution panel; hookup; and furnishing labor, materials, equipment, tools, and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Sprinkler System	Lump Sum
High Voltage Work	Lump Sum

Low Voltage Work Lump Sum

The Engineer will not make additional lump sum payment due to overruns or under runs in comparison with the estimated quantity shown in the pay item description."

END OF SECTION

Amend Section 617 - Planting Soil to read as follows:

"**SECTION 617 - PLANTING SOIL**

617.01 Description. This section is for furnishing and placing of screened amended planting soil in designated areas according to the contract.

617.02 Materials.

The contractor shall use the excavated material for processing as planting soil. The planting soil shall be of the same composition and structure throughout. The contractor shall screen the planting soil through a ½ inch screen, add and mix in soil amendments.

(A) Selected Materials. The Contractor shall remove soil obtained from within highway right-of-way. The Engineer will consider them as selected material according to Section 203 - Excavation and Embankment. The Contractor shall dispose of unsuitable soil for planting according to roadway excavation.

(B) Screened Soil. Screen the selected excavated material through a ½ inch screen. The screened soil shall be amended by thoroughly mixing organic compost, crushed coral and fertilizer into the screened soil.

Stockpiling or screening or mixing of soil shall not be allowed on project site.

Transport the amended screened planting soil from the stockpile site to the final position for spreading. The soil shall have sufficient moisture so as when delivered to the site and/or final position there will be no dust plume created during the entire operation.

The screened soil shall be free of materials that may be deleterious to planting, including stones, noxious seeds, roots, sticks and weeds, and especially nut grass.

(C) Organic / In-organic Compost and Fertilizer Requirements.

(1) Organic Compost. Organic compost may be bagasse, hay, straw, wood cellulose, bark, or wood chips, and must be fully composted organic planting medium or horticultural soil from organic waste. Organic compost materials shall conform to the Subsection 712.45 - Mulch and Soil Amendments.

(2) **Crushed Coral.** Crushed coral shall be calcium carbonate in the form of crushed coral, pond waste, fine beach sand, or agricultural lime and shall be ground to pass through a 10 mesh screen or be of finer texture.

(3) **Fertilizer.** Fertilizer shall conform to the Subsection 712.18 - Fertilizer.

617.03 Construction Requirements.

(A) Soil Preparation Procedure. All amendments shall be approved by the Engineer before incorporation. Blend all amendments into the screened soil in the presence of the Engineer as indicated blow:

(1) **Organic Compost.** Mix the organic compost into the screened soil at a rate of 1,000 lb per 10 cu yds.

(2) **Crushed Coral.** Mix the screened calcium carbonate into the screened soil at a rate of 200 lbs per 10 cu. yds.

(3) **Fertilizer.** Mix into the screened soil at a rate of 15 lbs per 10 cu. yds.

This soil amending and approval procedure shall not be deleted, substituted nor amended in any manner. No blending of amendments shall be done on the project site.

Any additional soil needed for top-dressing shall be supplied and applied by the Contractor and shall be taken from the same source and processed the same way. The Contractor shall screen and amend his top-dressing soil according to the contract.

Notify the Engineer ten (10) days prior to transporting any top-dressing soil from the designated stock piled sites. The screened planting soil shall not be used unless it is amended.

(B) Preparation of Areas to Receive Planting soil.

(1) **Clearing.** Before placing planting soil, the contractor shall remove construction debris, litter, and vegetation and adjust the existing grade in the planting areas.

(2) **Excavation.** The contractor to excavate planting areas meant to receive planting soil in preparation for planting operation for tree, shrub planting and grassing. The excavated areas allow

for placement of four (4)-inch thick layer of screened amended planting soil. The four (4)-inch thickness shall be measured downward from the finish grades as shown on the plans.

(B) Placement of Planting Soil. The Contractor shall place planting soil for use in planting trees, shrubs, and grasses in the prepared excavated planting areas to provide the four (4)-inch cap over the planting area according to the contract for the planting and as required. The Contractor shall use planting soil for planting holes excavated for trees and shrubs according to the contract for the planting and as required.

Grades shall be smooth and even on a uniform plane with no abrupt changes or pockets especially in preparation for the placement of the erosion control mat and planting. Remove all rocks over one inch in diameter and soil clods that don't break up. Maintain positive surface drainage in all areas, fill in any low spots which may collect standing water. After initial settlement, the finish planting soil grade shall be 1/4 inch to ½ inch lower than the adjacent curb or concrete drainage swale.

The Contractor shall control all dust from its operations.

617.04 Method of Measurement. The Engineer will not measure planting soil for payment.

617.09 Basis of Payment. The Engineer will pay for the accepted planting soil on a contract lump sum basis.

The price includes full compensation for preparing the areas to receive planting soil, including clearing and grubbing; excavating the top four (4) inches of existing soil; pre-planting weed control; fine grading; laboratory testing and written recommendation; augmentation by fertilizers and amendments; storing, furnishing, depositing, spreading, and shaping the planting soil; and furnishing labor, material, tools, equipment, and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Planting soil	Lump Sum"

END OF SECTION

Amend **Section 618 - Grassed Surfaces** to read as follows:

"SECTION 618 - GRASSED SURFACES

618.01 Description. This work includes preparing the areas designated in the contract and planting with grass according to the contract.

618.02 Materials.

(A) Grass. The grass that the Contractor will place shall be Zoysia 'El Toro' (Zoysia japonica 'El Toro'). The Contractor shall get the grass as sod, weed free and freshly harvested. The Engineer will not accept the grass unless the Contractor plants and water the grass within twenty-four (24) hours after harvesting the sod.

The sod will be cut into grass plugs two (2) inches square for planting in the area with erosion control matting

The sod will be shreaded into grass sprigs material four (4) to six (6) inches long with a developed root system. They shall be thoroughly watered then covered and kept moist until planted.

(B) Tackifier. Tackifier for the hydromulch operation shall be a Sodium Acrylate/Acrylamide Copolymer introduced into the hydromulch slurry at a rate of 3 pounds per acre of mix.

(C) Hydromulch. Mulch to be used for hydromulch shall be specifically processed fiber containing no growth or germination inhibiting factors. After addition and agitation in the hydraulic equipment with water and other additives not detrimental to plant growth, the fibers will form a homogeneous slurry. When hydraulically sprayed on the sprigs, the fibers shall form a blotter-like ground cover which readily absorbs water and allows infiltration to the underlying soil. In every application, complete coverage of the soil shall be attained. Mulch shall be applied at the minimum rate of 2,000 pounds per acre.

Other materials shall conform to the following:

Planting Soil	617.02
Commercial Fertilizer	712.18
Mulch and Soil Amendments	712.45
Metal Staples	663.03

618.3 Construction Requirements.

(A) General. The work covered under this Section shall include the furnishing of all labor, equipment, materials, and incidentals necessary for grass planting of Zoysia 'El Toro', complete in place, in strict accordance with this Section of the Specifications and applicable Plans.

(B) Ground Preparation. Before planting, the contractor shall:

(1) install planting soil per Section 617 - Planting soil, and

(2) install erosion control matting per Section 663 - Erosion Control Matting.

Grass planting shall commence immediately after the soil preparation and the erosion control mat application has been completed and approved by Engineer.

The Contractor shall keep the planting areas free of trash and debris. The Contractor shall grade the planting areas to the dimension and elevations shown in the contract or as ordered.

(C) Planting.

(1) Plugs. Zoysia 'El Toro' grass shall be planted by distributing two (2)-inch square plugs on triangular spacing at twelve (12) inches on center (maximum) in the area with erosion control matting. A small four (4)-inch cut shall be made in the erosion control mat and plugs planted in the soil beneath, once planted the plugs shall be stapled to the ground with a metal staple. The four (4)-inch cut shall be repaired by stapling with metal staples at two (2)-inch maximum spacing as shown the detail.

The Contractor shall apply the water the same day of planting in such quantities to moisten the soil to the depth of the planted grass. The Contractor shall make additional application so that the Contractor keeps the planted areas continually damp to the grass depth and until the commencement of plant establishment work.

(2) Sprigs. Sprigs shall be planted in the areas without the erosion control matting. Sprigs shall be evenly broadcast at the rate of fifteen (15) bushels per one thousand (1,000) square feet (minimum) in preparation for the hydromulching cover.

(D) Hydromulching. (Non erosion control matting area)

(1) The Contractor shall apply grass sprigs and hydromulch within two (2) days after completion of slopes when the exposed face becomes fifteen (15) feet in height. The Contractor shall notify the Engineer not less than twenty (24) hours in advance of any hydromulching operation. The Contractor shall not hydromulch until the Engineer accepts the area. Acceptance shall include inspection of fine grading to provide for the collection and disposal of surface and subsurface water to protect planting areas against unnecessary erosion. Acceptance shall not relieve the Contractor of his / her responsibility to restore any damage to the grade until the planted areas are accepted. Following the Engineer's acceptance, hydromulching of the approved planting areas shall begin promptly.

(2) Evenly distribute Zoysia 'El Toro' grass sprigs on the prepared planting area. The hydromulch equipment shall be capable of mixing all the necessary ingredients to a uniform mixture and to apply the slurry to provide uniform coverage. The equipment shall have a built-in agitation system with an operating capacity sufficient to keep the mix in uniform distribution until pumped from the tank. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with hydraulic discharge spray nozzles which provide a uniform distribution of the slurry. Areas inaccessible to hydromulching application shall be planted by hand broadcasting and planting sprigs.

(3) The Contractor shall apply water immediately following mulching to moisten the soil and mulch. Watering shall continue to insure proper germination and growth. The Contractor shall water in a way that will prevent erosion. Watering equipment shall be of a type that will not cause damage to the planted areas. The Contractor shall correct the water systems that cause erosion or runoff.

If the slope erodes or silt moves, the Contractor shall remove the eroded material immediately. The Contractor shall restore the areas eroded to a depth greater than two (2) inches or to a width greater than three (3) inches to the original grade.

(E) Planting Period. A one hundred twenty (120) day planting period shall begin immediately after the Engineer inspects the area to be accepted and accepts the area as planted satisfactorily in accordance with

the Contract Documents. The minimum planting area that shall be required for inspection and acceptance as being satisfactory shall be 25% of the total contract area to be planted. During the planting period the Contractor shall provide ninety-five (95) percent coverage with healthy grass. The contractor shall re-plant areas that do not show a thorough "catch". The Engineer may suspend the counting of days until the plants are replanted and in the opinion of the Engineer are healthy and growing.

During this planting period, the Contractor shall be responsible for the planted areas. This shall include watering, cutting of the grass, removal and disposal of trash and debris, insects and disease control and protection.

The Engineer may suspend the counting of days anytime the work becomes unsatisfactory.

At the completion of planting period and prior to the beginning of the formal plant establishment period, an Inspection shall be held. The Engineer and Contractor shall be present at the inspection. Request this inspection of the Engineer at least ten (10) working days prior to the completion of work in order that a mutually agreeable time for inspection may be arranged. The Engineer may reject the contractor's request for inspection should the Engineer feel that the landscaping is not ready for inspection.

At the time of inspection, the Contractor shall have all the areas under the Contract free of weeds, dead leaves and trash.

After the Contractor has planted and satisfactory completed the one hundred twenty (120) day planting period of a minimum of twenty-five (25)% of the total contract area to be planted, that planted area upon written notice from the Engineer can be cared for as specified under Subsection 618.3(F) - Plant Establishment Period.

The Contractor shall complete the planting by the end of the contract time.

(F) Plant Establishment Period. A plant establishment period is when the Contractor takes care of the planted area for nine (9) acceptable months from the accepted completion date of the planting period.

During the plant establishment period, the Contractor shall water, fertilize, weed, replace unsuitable grass, spray for diseases and insects, top dress with approved amended screened soil, and perform any other work necessary to maintain all plants in a healthy growing condition. The

Contractor shall cut the grass whenever the average height of the grass becomes six (6) inches in height. Cut the grass to an average of three (3) inches.

The Contractor shall be responsible for the protection of all planted areas during the 9 month plant establishment period. All dead grass shall be removed and shall be replanted immediately.

The Contractor shall remove and dispose of papers, trash and debris that accumulates in the planted areas. The Contractor shall care for the planted area so as to present a neat and clean condition.

The Engineer will credit the Contractor a plant establishment day when the work in the planted are is satisfactory in accordance with the contract even if the Contractor did not work daily.

The Engineer will not credit the Contractor plant establishment days when the Contractor fails to adequately do plant establishment work according to the contract.

The Contractor shall correct the water systems that cause erosion or runoff and deemed unacceptable by the Engineer. If the planted area or its surroundings are eroding due to the watering method, the Contractor shall immediately remove the runoff material and restore the area to the original grade and condition.

During the last week of the plant establishment period, the Contractor shall fertilize the all planting areas as follows:

10 - 30 - 10 at a rate of 6 lbs. per 1,000 sq. ft.

Besides the application during the last week of the plant establishment period, apply fertilizer:

(1) at least three (3) times during the plant establishment period,

(2) at intervals not closer than six (6) weeks, and

(3) At a rate of not less than three hundred (300) pounds per acre per application.

At the completion of the nine (9) month plant establishment period, an inspection shall be performed. Request the inspection in writing to the Engineer ten (10) calendar days prior to the completion of the plant establishment period in order that a mutually agreeable time for inspection

may be arranged. The Contractor and the Engineer shall be present at the inspection.

The Contractor shall replant the areas that found not to be in healthy growing condition. The Contractor shall replant and grow the are according to the contract.

The Engineer will decide the acceptability of the planted areas when the plant establishment period ends. The Contractor shall promote the grass to healthy growth condition. Acceptance of the grass planting after plant establishment period shall be contingent upon the following:

(1) Final acceptance will be upon providing ninety-eight (98) percent coverage with three (3) inch tall, healthy grass. Any area of one foot square or more in which grass has failed to grow shall be re-grassed;

(2) All germinated areas shall be healthy and living at the end of plant establishment period;

(3) Weeds shall not exceed an area greater than ten (10) percent in any grass area;

(4) Grass shall be cut unless otherwise noted on plans;

(5) All depressions shall be filled to proper grade and area re-grassed as required; and

(6) All erosion control matting shall be maintained.

The Contractor shall be responsible for protecting the planted areas until final acceptance of this work. Repair damages by pedestrians or vehicular traffic or other causes at no cost to the State except conditions as covered in Subsection 107.20 - Contractor's Responsibility for Work.

If, after the Final Inspection of the plant establishment period, the Engineer is of the opinion that all work has been performed in accordance with the Plans and Specifications, written notice of acceptance and completion will be given. If all or certain portions of the work are not acceptable under the terms and intent of the Plans and Specifications, the area will not be accepted, and the plant establishment period shall be extended at no cost to the State until the defects in the work have been corrected and the work is accepted by the Engineer.

If all grassing areas are approved and accepted at this inspection by the Engineer, the Contractor shall be relieved of further maintenance.

618.13 Method of Measurement. The Engineer will not measure the grassed surfaces for payment.

618.14 Basis of Payment. The Engineer will pay for the accepted grassed surfaces on a contract lump sum basis.

The price includes full compensation for, watering, adding soil amendments, furnishing equipment, materials, tools, labor, and incidentals necessary to complete this work.

The Engineer will make payment under:

Pay Item	Pay Unit
Grassed Surfaces Zoysia 'El Toro' Grass in the planting area over Erosion Control Matting	Lump Sum
Grassed Surfaces Zoysia 'El Toro' Grass w/ Hydromulch in the remaining planting areas	Lump Sum

(A) Partial Payment Schedule for Planting Period with Plant Establishment Period. The Engineer will pay the accepted quantities for:

(1) 60% of the contract bid price upon completion of Planting;

(2) 15% of the contract bid price in three payments of 5% for satisfactory progress during the Planting Period;

(3) 15% of the contract bid price in 6 monthly payments of 2-1/2% for satisfactory progress during the Plant Establishment Period.

(4) 10% of the contract bid price at final acceptance of the Plant Establishment Period.

The Engineer will not make additional lump sum payment due to overruns or underruns in comparison with the estimated quantity shown in the proposal. The Engineer will make additional lump sum payments only if the Engineer specifies an alternation in the work."

END OF SECTION

Amend **Section 619 - Planting and Transplanting** to read as follows:

"SECTION 619 - PLANTING

619.01 Description. This work includes furnishing and planting trees and shrubs at the specified locations according to the contract.

619.02 Materials. Materials shall conform to the following:

Planting Soil	617.02
Commercial Fertilizer	712.18
Mulch and Soil Amendments	712.45
Metal Staple	663.03

The species and size of palm trees and shrubs will be the type shown in the contract or as ordered.

(A) Plant Materials.

(1) Plant Names. Trees and shrubs furnished under this item shall be true to name. The trees and shrubs shall follow standard names as adopted by the American Joint Committee on Horticultural Nomenclature and Special Publication No. 50, 'In Gardens of Hawaii,' published by the B. P. Bishop Museum.

(2) Quantities. Provide sufficient quantities of plant materials needed to complete the work as shown on the Planting Plans and indicated in the drawings. Quantities indicated on the Plant List are approximate and are provided for the convenience of the Contractor. The Planting Plan shall have precedence over the Plant List.

(3) Form and Shape of Plants. All plant materials shall be uniform and have a habit of growth that is normal for the species and shall be sound, healthy, vigorous and free from insect pests, plant disease and injuries. Plant material shall not be root bound. Trees and shrubs in containers of the size specified shall have sufficient roots to hold earth together intact after removal from containers without being rootbound.

Palm trees will be straight and of uniform shape, unless otherwise specified. Palm trees shall be free of trunk abrasions,

sunscalds, disfiguring fresh cuts over 3/4 inch which have not completely closed.

The Engineer will not permit thin, weak plants

(4) Size of Plants. All materials shall equal or exceed the measurements specified in the Plans which are minimum acceptable sizes. The figures shown in the proposal are the minimum height of the plants.

The height of plant shall be the vertical measurement of plant from the ground upward as the species stand in its natural position in the nursery. The measurements shall not include the fine or slender terminal leader, twig, or branch growth. They shall stop where the main parts of the plant ends. The brown trunk height shall be the vertical measurement of palm tree from grade to the base of the newest emerging spear. Materials shall be measured before pruning with fronds in normal condition. The measurements of leggy plants shall be between and including the smallest and greatest dimension specified.

(5) Selection, Tagging, and Ordering Plant Material. Submit a request for inspection and documentation to the Engineer that all plant material has been ordered at least one month prior to start of work under this Section. Such approval shall not impair the right of inspection and rejection during progress of the work. Submit request for inspection of plant material at place of growth for conformity to Specifications to the Engineer.

If any plant specified is not obtainable, submit a written substitution request to the Engineer. Substitutions of plant materials will not be permitted unless authorized in writing by the State.

(B) Trim Guard. Trim guard shall be commercially made polyethylene with U.V. inhibitors. They may be vented and shall have slow ratchet release configuration to expand as palm tree grows with tab slot design to be linked together for expansion.

(C) Plastic Edging. Plastic edging shall be staked in place with metal stakes as specified on detail and joined at Sections and at corners with connectors by same the manufacturer.

(D) Planting tablets. Planting tablets shall be commercial slow release tablets (20-10-5) or equal unless otherwise detailed on plans.

(E) Inorganic Mulch. Inorganic mulch shall be gravel and used within and under the shrub planting over weed barrier under the viaduct along the chain link fencing as shown on the Plans and Details. Gravel and weed barrier shall conform to the Subsection 658.02 (A) and (C).

619.03 Construction Requirements.

(A) Advance Preparation of Planting Areas. Upon written notice from the Engineer, the Contractor shall prepare the planting areas. The contractor shall make sure the planting soil and erosion control mat are in place per plan and specifications.

(B) Planting Time. The Contractor shall not plant if the weather or other conditions does not permit.

(C) Plant and Tree Holes. Reasonable care shall be exercised to have the palm tree and shrub pits dug and soil prepared prior to moving plants to their respective locations for planting to ensure that they will not be unnecessarily exposed to drying elements or to physical damage. The diameter of all plant pits shall be as detailed on the Plans.

If encountered, the Contractor shall break up coral, rock, or hard pan to a depth of not less than twelve (12) inches below the normal depth of the hole.

The Contractor shall be responsible for the disposal of surplus material from subsoil excavations made for tree pits and holes for shrubs.

If drainage conditions of plant pits appear unsatisfactory, test drainage by filling with water. Conditions permitting the retention of water in the planting pit for more than six hours time shall be brought to the attention of the Engineer.

(D) Planting.

(1) General. All palm trees and shrubs shall be set at such a level that after settlement, they will be flush with finished grade of the surrounding ground. Trees and shrubs shall be set in the planting pit(s) planted in the specified backfill which shall be thoroughly settled by watering and tamping. Backfill mix for all trees and shrubs shall consist of the prepared screened and amended planting soil according to Section 617 - Planting Soil. The backfill shall be tamped down but not compacted.

After backfilling, no more than halfway up the rootball, soak pit with water and place the required number of slow release planting tablets, per manufacturer's recommendation, evenly around the rootball, approximately two (2) inches from root tips.

Backfill rest of hole with the specified backfill mixture. Firm down backfill, but do not pack. Immediately after planting, thoroughly soak planting pit with water.

A two (2)-inch berm shall be constructed around each palm tree except on a slope where the berm will be only on the down slope side of the plant pit and under the erosion control mat. Each shrub shall be set upright and faced to provide the best appearance possible.

(2) Planting Over Erosion Control Matting. Provide supervision, by the manufacturer's representative for erosion control matting, at the start up of planting operation over erosion control matting. Make an "X" shape cut through the Erosion Control Matting to install a shrub or tree per the details.

Do not place excavated soils from planting hole on the Erosion Control Matting. This may result in damage to the matting and reduced erosion control performance. Use the specified screened and amended planting soil as backfill for the planting hole.

After planting, fold the matting back into place. Staple the matting to close the cut around the trunk of the plant as close as possible without damaging the plant. Continue placing staples every 6" working outwards until all cuts have been securely fastened & closed.

Contractor is responsible to install additional Erosion Control Matting, if necessary, to protect all exposed soil due to mounding associated with plants rootball installation per Section 633 - Erosion Control Matting.

(3) Watering. Water the plants the same day of planting. Apply water in a moderate stream until the backfill soil around and below the roots or ball of earth around the roots of each plant is thoroughly saturated. After the first watering, water the plants as often and in sufficient amount as conditions may require.

When a sprinkler system is installed, the Contractor may use and operate such system. Maintain the system and pay for the water used until the end of plant establishment period.

(4) Planting period. A one hundred twenty (120)-day planting period shall begin immediately after the Engineer inspects the area to be accepted and accepts the area as planted satisfactorily in accordance with the Contract Documents. Planting period for trees and shrubs shall take place concurrently with a one hundred twenty (120)-day planting period for the grassed areas as specified in Section 618-Grass Surfaces.

Replace plants that fail to develop a healthy growth or destroyed during the planting period. Water, cultivate, weed, prune, and apply pesticide, if required, to the plants after completion of planting in designated areas.

At the completion of planting period and prior to the beginning of the nine (9) months plant establishment period, an Inspection shall be held. Request this inspection of the Engineer at least ten (10) working days prior to the completion of work in order that a mutually agreeable time for inspection may be arranged. The Engineer may reject the contractor's request for inspection should the Engineer feel that the landscaping is not ready for inspection.

At the time of inspection, the Contractor shall have all the areas under the Contract free of weeds, dead leaves and trash, neatly cultivated and raked. All plant basins shall be in good order. Remove empty containers and debris accumulating from planting from the project when completing the planting.

If, after the inspection, the Engineer is of the opinion that all work has been performed in accordance with the Plans and Specifications, written notice of preliminary acceptance will be given. All deficiencies shall be corrected and all planting approved by the Engineer before the issuance of a commencement date of the plant establishment period.

Satisfactorily complete the planting period by the end of the contract time and/or substantial completion.

(E) Plant Establishment Period. A plant establishment period is when the Contractor takes care of the planted area for nine (9) acceptable months from the accepted completion date of the planting period. The Contractor

shall be responsible for the protection of all planted areas during the nine (9) month plant establishment period.

During the plant establishment period, the Contractor shall water, fertilize, cultivate, weed, prune, and apply pesticide, if required. If the contractor injures, damages, destroys, or fails to develop healthy plants, the contractor shall replace those plants. The Contractor shall remove the dead or unsatisfactory plants promptly from the project. The Contractor shall complete the replacement within two (2) weeks after notice that the plant is not acceptable.

Besides the applications during the planting period, the Contractor shall apply fertilizer at least three (3) times during the plant establishment period at intervals not closer than two and a half (2-1/2) months at the rate of :

(a) Palm Trees - Apply in the presence of the Engineer, one-third pound per inch diameter of trunk

(b) Shrubs -one-third (1/3) pound per plant.

The Contractor shall remove and dispose of surplus earth, papers, trash and debris that accumulates in the planted areas. The Contractor shall care for the planted areas so to present a neat and clean condition.

The Engineer will credit the Contractor a plant establishment day when the work in the planted are is satisfactory in accordance with the contract even if the Contractor did not work daily.

The Engineer will not credit the Contractor plant establishment days when the Contractor fails to adequately do plant establishment work according to the contract.

(F) Acceptance. The Engineer will decide the acceptability of the plant material furnished and planted as specified when the establishment period ends. The Contractor shall employ means to preserve the plants in a healthy growing condition. The Engineer will hold a semi-final inspection to decide the acceptability of the plant material ninety (90) days before the end of the plant establishment period.

The contractor shall replace dead and unsatisfactory plants in kind or quantity and size with live healthy plants installed as originally specified. The Contractor shall use alternate or substitute varieties pf plants only if accepted by the Engineer.

The Engineer will hold a final inspection of plant material ninety (90) days after completing the replacement planting.

916.13 Method of Measurement. The Engineer will measure trees, and shrubs at the contract unit price per each.

619.14 Basis of Payment. The Engineer will pay for the accepted quantities of trees and shrubs at the contract unit price per each.

The price includes full compensation for preparing the planting areas; watering; planting and transplanting; topdressing; furnishing plants; placing and /or planting materials; maintaining and establishing the plants; and furnishing equipment, materials, tools, labor and incidentals necessary to complete the work.

The Engineer will pay the accepted quantities for:

(1) 60% of the contract bid price upon completion of Planting;

(2) 15% of the contract bid price in three payments of 5% for satisfactory progress during the Planting Period;

(3) 15% of the contract bid price in 6 monthly payments of 2-1/2% for satisfactory progress during the Plant Establishment Period; and

(4) 10% of the contract bid price at final acceptance of the Plant Establishment Period.

The Engineer will not make additional lump sum payment due to overruns or underruns in comparison with the estimated quantity shown in the proposal.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Planting trees,__(Species),_____high	Each
Planting Shrubs,__(Species),_____high	Each
Planting Shrubs,__(Species),_____high w/ 2" layer gravel over weed barrier	Each
Plastic Edging	Linear Foot"

END OF SECTION

Make the following Section a part of the Standard Specification:

"SECTION 636 - FIELD OFFICE AND PROJECT SITE LABORATORY

636.01 Description. This work includes furnishing, placing, or erecting, maintaining and subsequently relocating new, portable, weatherproof trailers used as field offices by the Engineer, and a new, portable, weatherproof trailer to be used as project site laboratory by the Engineer.

636.02 Materials. Furnish and install new material necessary to complete this work. All lumber shall be new and pressure treated douglas fir.

636.03 Construction Requirements.

(A) General. The Field Office and Project Site Laboratory trailers provided shall conform to the following requirements and as directed by the Engineer.

(1) Within 10 days after the contract is awarded, submit catalog cuts and/or shop drawings for the Engineer's approval. The Engineer will determine the exact location of the trailers on site. Complete the buildings within 2 weeks after the Notice to Proceed date or later if approved or directed by the Engineer. Treat the ground under the buildings for termites. The method of treatment shall be approved by the Engineer.

(2) The Engineer and its staff will have exclusive use of the buildings. If the contractor is allowed to share the same area as the Engineer, separate the buildings used by the Engineer from buildings used by the Contractor. None of the facilities of the State field office/laboratory complex shall be shared with the Engineer.

(3) Conform to all local laws, ordinances, rules, and regulations pertaining to dismantling, transporting, placing, and erecting office trailers, constructing covered platforms and walkway, stairs and ADA ramps and installing utility connections. Transporting shall include all office furnishings and objects located with in the spatial limits of the field office and laboratory complex.

(4) Paint the walkway, walkway cover, stairs and ADA ramp (walkway system). The walkway system shall have one prime coat and two coats of exterior paint. The Engineer will select the paint color. Non-slip coating shall be used for the exterior floors. Install anti-slip tape, the approximate width and length of the stairs in size, on all the stair treads and at the top of the stairs. Install anti-slip

tape, the approximate width of the ramp, for the entire length of the ramp.

(5) Provide a combination meter socket panel designated for single phase 3-wire solid neutral 120/240 volt service with a 4-jaw meter socket and a 250 amp main breaker. The panel shall be surface mounted, weatherproof and raintight.

(6) Maintain the trailers, buildings, walkway system surrounding ground of the trailers and buildings, all furnishings, appliances, and other equipment in good order and provide rubbish pickup service twice a week for a period not to exceed 90 calendar days beyond the date of final acceptance of the completed project by the State. The Field Offices and Project Site Laboratory may be used by Project and Testing Engineers of adjacent projects or other state personnel at no cost to the other Contractors or State.

(7) The Field Offices and Project Site Laboratory and their contents shall become the property of the State upon completion of the project with the exception of the high-speed Internet connection system. The Contractor shall relocate all trailers when directed by the Engineer. Re-block up the trailers and provide stairs and walkways similar to the previously installed elevated walkway system. The previously installed walkway system material may be used. Reconnect all existing utilities except for the internet connection.

(8) Mount the trailers with the wheels off the ground and provide uniform, level, and rigid concrete foundations for the trailer and structures.

(9) Provide galvanized expanded metal sheet, 9 gauge, welded to an angle iron frame welded to the trailer for all exterior windows. This device shall cover the entire window.

(10) Provide a fully-covered, 800-square foot fully covered walkway with six (6) stairs, one (1) ADA-compliant ramp, and railings all around the perimeter of the walkway, stairs and ramp. The railing shall have a top and mid rail and shall be approximately three tall and splinter-free. The walkway cover's roofing material shall consist of 3/4 douglas fir Exterior Ply A-A, two (2) layers of 30-pound felt and one (1) layer of 90- pound roofing paper. The walkway floor shall be the same elevation as the field office or laboratory. The walkway cover shall be level and the same elevation as the adjacent trailer's roof. The stairs and ramp shall

each have a concrete landing the width of the stairs and ramp, respectively. Substitution of other materials in lieu of wood for the walkway system may be accepted by the Engineer upon review.

(11) Clean the building sites and leave the sites in a clean and presentable condition after removal or relocation of the buildings.

(12) Provide one outside sink with faucet and two (2) hose bibs. Provide one 3' x 8' storage bin with shelves and doors on the long side that open the entire side.

(13) The Engineer may choose to relocate some of the field office's operations to the church's location the contractor shall treat that location as a field office and proved the required services at no additional cost. However, any additional installation fees by the sewer and utility companies shall be paid by the Engineer on a force account basis.

(B) Field Offices. Provide each Field Office with a single phase 3-wire solid neutral 120/240 volt circuit breaker load center surface mounted with:

1 - 250 amp main breaker
1 - 20 amp breaker 2/pole
4 - 20 amp breaker single pole
6 - 15 amp breaker single pole

Install fluorescent lighting with illumination of not less than 50 foot candles throughout and 8 exterior weatherproof, 120 volts, high pressure sodium lights mounted on 6" x 6" x 20 foot treated lumber posts with concrete footings as directed by the Engineer. The exterior lights shall be controlled by timer.

(1) Configuration. The Field Offices shall each consist of a trailer 12 feet wide and 50 feet long, partitioned to provide one 20-foot long room, one 18-foot long room, and one 12-foot long room. A passage doorway with door with lock shall be provided in each partitioned wall between the rooms. Each trailer shall have two exterior (2) doors. Flooring surface inside the field office shall be vinyl tile. Each room shall have a minimum of six (6) grounded outlets, and one light switch. The exterior fluorescent lighting shall have a minimum of three light switches. Provide three outlets along the walkway. Location of the switches and outlets shall be directed by the Engineer.

Provide and maintain two separate buildings, including a locking door and window for use as a toilet facility. The buildings shall be connected to elevated walkway and floor shall be at approximately same elevation as the walkway. The roof shall be the same elevation as the adjacent trailer and walkway cover. The toilet facility shall be at least 32 square feet in area and have an air assisted flush type toilet, washbasin, force air ventilation, and all related plumbing fixtures necessary. One interior and one exterior incandescent lighting fixture shall also be provided that operates on the same switch. Furnish a paper towel dispenser, toilet paper holder, mirror, wastebasket, grounded electrical outlet, and shelf. The toilet facility shall be for the exclusive use of the State.

Tie in and maintain water and sewage disposal system. Connect the pipes according to the plumbing ordinances of the appropriate County and the State Department of Health. Reconnect water and sewage disposal system after relocation of field office and laboratory,

Provide and maintain potable water system and necessary foundation and steps for each field office compound for a period not to exceed 90 calendar days beyond the date of final acceptance of the completed project by the State. Comply with the ordinances of the appropriate County and the State Department of Health. Provide four (4) water spigots and one (1) laundry tray sink outside of each field office.

Provide and install the following for each field office trailer and the project site laboratory:

5 each - Standard office desk with 6 drawers, one extension on each side of the desk.

Dimensions: 2' - 6" x 5' - 0" x 2' - 6" high.
8 each - Standard office chairs with backrests and padded areas at least 2-½" thick with 5 casters.

2 each - Dry erase board with marker rail.
Dimensions: 6' - 0" width x 4' - 0" height.

3 each - Folding tables.
Dimensions: 30" x 72"

4 each - Stacking type chairs.

2 each - Legal size file cabinets with four drawers.

2 each - 10" diameter clock.

2 each - Door mats.

Plan rack and shelves as required by the Engineer.

Blinds for all windows.

Submit catalog cuts of the furniture and accessories for the Engineer's approval.

All doors shall have a heavy duty dead bolt lock and a separate heavy-duty cylindrical lever handle entrance lock. The entrance lock shall have an outside deadlocking latch bolt operated by a key and a pushing turn button. All locks for the buildings shall be keyed alike. Provide ten (10) sets of keys.

Provide six separate; dedicated telephone lines on a rotary system with 16 touch tone speakerphone type instruments. In addition, provide two (2) additional lines (one for a fax machine and one for a modem) for a total of eight incoming lines. Phones shall have a built-in intercom system, hold, and the ability to transfer calls to other phones. The phone system shall have the ability to page for people over two Contractor-provided loudspeakers mounted outside the trailers. The phone system shall have the ability to use 30 phones on the system. Provide a digital answering machine system for the field office with the capacity of not less than 60 minutes of messages and automatic time and date stamp. The answering machine shall have the capability to answer after any of the lines ring a set amount whether or not the other lines are being used and shall not lose any messages or functions due to an electrical failure. The answering machine shall be incorporated into the supplied field office telephone system. All lines and instruments shall be located as directed by the Engineer. Provide training in the use of phones when requested by the Engineer. The Contractor shall pay for the telephone service 90 calendar days beyond the date of final acceptance of the project. All telephone lines shall be accessible by all phones in the field offices and laboratory.

Provide one (1) high-speed Internet connection system; with a minimum maximum download speed of 2000 kbps and a minimum upload maximum speed of 384 kbps no later than 5 days after completion of the field office. The Contractor shall pay for Internet service 60 calendar days beyond completion of the punch list or the Establishment Period for all items planted under Sections 618 and 619, whichever is later. The high-speed Internet connection system; may be DSL or cable or as approved

by the Engineer. The high-speed Internet connection system shall be able to hook up a minimum of 10 individual computers giving simultaneous Internet access to all computers. Provide all hardware and software and setup to provide required level of service. Connection points shall be located as directed by the Engineer. Dismantle or relocate system during the project when directed by the Engineer.

Provide and maintain a burglar alarm system for the field offices and project site laboratory. The burglar alarm system shall be able to detect and give off an alarm for smoke and fire as well as intruders. The burglar alarm system shall conform to the following requirements:

(1) All perimeter openings shall be protected.

(2) All interior space shall be protected by the system.

(3) The trailers shall be monitored during all non-working hours and days by a central station located on the Island of Oahu.

(4) The communication system shall consist of a primary and secondary independent system. The secondary system shall be automatically activated when the primary system is out of service.

(5) The monitoring service shall be provided by a firm that has provided this type of service for at least 5 consecutive years on the Island of Oahu and possesses a valid State Contractor's license, Classification C-15.

(6) The Contractor shall pay for the burglar alarm service 90 calendar days beyond the date of final acceptance of the project.

Submit to the Engineer for approval the proposed security plan, the name of the firm providing the monitoring service and other documentation indicating conformance with the requirements.

Provide and maintain two air conditioner central air units of not less than 15,000 BTU rating for each field office. Service, maintain and clean the air conditioning units a minimum of once every three months and as directed by the Engineer.

(C) Project Site Laboratory. Provide a trailer 12 feet x 24 feet as a Project Site Laboratory with foundation and steps, potable water, and electrical fluorescent lighting with illumination of not less than 50 foot candles throughout and two exterior weatherproof, 120 volts, high

pressure sodium lights mounted on 6" x 6" x 20 foot treated lumber posts with concrete footings as directed by the Engineer.

Provide and maintain one air conditioner central air units of not less than 15,000 BTU rating for project site laboratory. Service, maintain and clean the air conditioning units a minimum of once every three months and as directed by the Engineer.

All specifications for the field offices shall apply to the project site laboratory, except the laboratory shall have two (2) additional telephones which shall be part of the State field office/ project laboratory complex telephone system which shall utilizes the six (6) telephone lines that the field office uses, a lso, n o a dditional I nternet c onnection s ystem w ill b e required for the laboratory as well as additional telephone lines for the fax and modem the devices. The devices that use these types of communication lines shall utilize the lines provided with the field office.

Furnish the project site laboratory with a uniform, rigid foundation, such as provided by a cube of concrete weighing not less than 200 pounds, used as a testing base with the top surface in a horizontal plane and at floor level. Location will be as determined by the Engineer.

Furnish one laundry tray sink with running water and drain inside the laboratory, and one electric stove.

Furnish one (1) modified cargo container storage shed.
Outside Dimensions: 10'-0" long x 8'-0" wide x 8'-6" high.
Cargo doors with heavy-duty padlock and three (3) sets of keys.
Two (2) heavy-duty industrial steel shelving units, 75" high x 3 6" wide x 24" deep, six (6) steel shelves per unit, with four (4) of six shelves adjustable.

Furnish a concrete base for the shaker.

Provide a single phase 3-wire solid neutral 120/240 volt circuit breaker load center surface mounted with the following:

1 - 80 amp main breaker
1 - 20 amp breaker 2/pole
1 - 20 amp breaker single pole
1 - 15 amp breaker single pole

(D) Maintenance of Facilities. Maintain in good working order or replace should it be stole, lost, or if in the opinion of the Engineer not meet required performance, all the facilities for the State field offices and

laboratory; all appliances, high speed internet connection system and other equipment; restroom facilities and all other utility services.

Provide toilet articles and paper towels, when requested, services for twice weekly rubbish pickup, office cleaning and cutting, removing and disposing of overgrown weeds and vegetation.

The maintenance and support of the State field offices, project site laboratory facilities, etc. shall be provided for the duration of the project and not to exceed 90 calendar days beyond the date of the final acceptance of the completed project.

636.04 Basis of Measurement. The Engineer will not measure the field offices and project site laboratory for payment.

The Engineer will measure additional maintenance of the State field office/ project laboratory complex not mentioned in this section and therefore not included in the lump sum price of field offices and laboratory on a force account basis according to Subsection 109.04 - Extra and Force Account Work.

636.05 Basis of Payment. The Engineer will pay for the accepted field offices and project site laboratory on a contract lump sum basis.

The price includes full compensation for submitting catalog cuts and/or shop drawings; complying with local laws, ordinances, rules and regulations; obtaining the necessary permits and licenses; publishing or posting the required notices; furnishing and placing the trailers; modified cargo container storage shed with shelves and locks, constructing all covered platforms, walkways, walkway cover, ADA ramp and stairs; providing a meter socket panels; providing a partition and a passage doorway in the partitioned walls; providing and maintaining a toilet facilities and potable water; furnishing and installing pipes and appurtenances to connect to the closest County sewer main; providing electrical lighting, air conditioning and its maintenance, telephone service, high-speed Internet connection system and burglar alarm system; relocating and setup of the trailers; moving of the contents of the trailers to a location designated by the Engineer, replacement of anything supplied under this section and furnishing labors, materials, tools, equipment and incidentals necessary to complete the work.

The contract lump sum amount also includes all utility costs including the service, fees for the burglar alarm system, telephone, high-speed Internet connection, water and electricity. The contract lump sum amount shall also include costs for the disconnection and reconnection of all utilities with the exception of the high-speed Internet connection. All material supplied shall

become the property of the State after final inspection and acceptance of the project.

The maximum bids allowable for the Two Field Offices and the Project Site Laboratory are $108,000.00 ($54,000.00 Each) and $30,000.00, respectively. If the proposal submitted by the bidder indicates an amount in excess of the allowable maximum for either or both items, the indicated amount or the amounts shall be reduced to the allowable maximum, as appropriate. The 'Sum of All Items' in the proposal schedule shall be adjusted to reflect any such reduction. For the purposes of comparing bids and determining the contract price to be inserted in the contract awarded to the bidder so awarded, the 'Sum of All Items' adjusted according to the foregoing shall be used and the bidder's proposal shall be deemed to have been submitted for the amounts as reduced and adjusted in accordance herewith.

The Engineer will pay for the accepted maintenance of field offices and laboratory not accounted for in this section on a force account basis according to Subsection 109.04 - Extra and Force Account Work. The lump sum price includes maintaining the field office and laboratory facilities, surrounding grounds, furnishings, appliances, and other equipment; and providing rubbish pickup service.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Field Offices (Not to Exceed $108,000.00 for Two Field Offices)	Lump Sum
Project Site Laboratory (Not to Exceed $30,000.00)	Lump Sum
Maintenance of Field Offices and Laboratory	Force Account"

END OF SECTION

SECTION 645 - TRAFFIC CONTROL DEVICES

Make the following amendments to said Section:

(I) Amend the title to read as "**SECTION 645 - WORK ZONE TRAFFIC CONTROL**"

(II) Amend **Table 645-I - For Traffic Control Plan** to read as follows:

TABLE 645-I - FOR TRAFFIC CONTROL PLAN

POSTED SPEED LIMIT (M.P.H.)	SIGN SPACING (D) (FEET)	TAPER LENGTH (T) (FEET)		LONGI-TUDINAL BUFFER SPACE (B) (FEET)	SPACING OF CONES OR DELINEATORS (FEET)		
		W = 12' OR LESS *	W = GREATER THAN 12' *		TAPER	TANGENT	WORK AREA
20	250	200	W x 17	35	20	20	10
25	250	200	W x 17	55	25	25	10
30	250	250	W x 20	85	30	30	10
35	250	250	W x 20	120	35	35	10
40	500	350	W x 30	170	40	40	10
45	500	550	W x 45	220	45	45	10
50	1000	600	W x 50	280	50	50	10
55	1000	700	W x 55	335	55	55	10

* W = width of lane or shoulder

(III) Amend **645.03 Construction Requirements** by adding the following:

"The Contractor shall furnish the following Police Officers used as part of their traffic control work. The number of Police Officers listed shall be provided whenever work is done in the general vicinity of the locations listed or when the event is occurring. Police Officers shall be on-site before the work and/or event takes place to receive instructions and remain on-site until all traffic control is removed and traffic is running through the area normally. If two or more locations is having work performed at one time then the total number of Police Officers shall the sum of Police Officers listed for those two or more locations/event. The Engineer has the right at no additional cost to move Police Officers to other location(s) or to control other events.

LOCATION OR EVENT	NUMBER OF POLICE OFFICERS
Interstate Route H-1 full closure inbound and outbound	14
Interstate Route H-1 full closure inbound lanes	8
Interstate Route H-1 full closure outbound lanes	6
Interstate Route H-1 lane closure inbound	4
Interstate Route H-1 lane closure outbound	4
Waiau Interchange including Pearl City off-ramp and Moanalua Road	4
Waimalu Gardens	3
Kaanohi Street	2
Kaahele Street	2
Kaahumanu Street	2
Other streets	2

Furnish one (1) tow truck whenever a lane closure is performed, except for full Westbound or Eastbound Interstate Route H-1 freeway closure, for the entire duration of the lane closure. Station the tow truck in a location that will not impede traffic flow through the work area. The location of the tow truck shall also be such that any stalled or disabled vehicle in the Westbound Route H-1 freeway lanes between the Halawa Interchange and the beginning of the project (Interstate Route H-1 Baseline Station 74+20±) can be expeditiously reached and removed. Tow and drop off vehicle and transport the driver and any passengers to a suitable location approximately within two and a half (2-1/2) miles driving distance of the Waiau Interchange. The drop off location shall also be off the freeway and outside of work areas. Suitable drop-off location(s) shall be established by the Contractor and found acceptable by the Engineer prior to construction. Provide the towing service and transportation of the driver and any passengers at no cost to the driver of the vehicle, and at no additional cost to the State.

Traffic control devices including cones, barricades, warning signs with supports, lights, and temporary signals shall conform to 'The Hawaii Administrative Rules, Title 19, Subtitle 5, Chapters 127, 128 and 129', the MUTCD and Section 104 - Scope of Work. Reflectorization for protective devices such as cones, barricades, delineators, and signs, shall conform to Subsection 712.20 - Signs.

Do not use steel drums and steel barrels for traffic controls in construction and maintenance work zones.

As of 10/01/2003, all barricades, lights for barricades, signs with sign supports and vertical panels without lights shall require an FHWA approval letter certifying that the device is NCHRP Report 350 compliant. Do not use barricades, signs with sign supports, and other traffic control devices purchased before 10/01/2000 that are not certified to be NCHRP Report 350 compliant after 10/01/2003.

Upon request of the Engineer, furnish a self-certified NCHRP Report 350 compliant letter from the vendor for each type of single-piece traffic cone, single-piece drum, tubular marker and delineator.

(A) Signs.

(1) General. Install signs ahead of the place where operations may interfere with the use of the road by traffic and at intermediate points where the new work crosses or coincides with an existing road.

Place such signs as specified by the contract and as specified and accepted by the Engineer.

Submit to the Engineer 8 sets of FHWA approval letter certifying that the signs and sign supports are NCHRP Report 350 compliant.

(B) Barricades.

(1) General. Apply and install the barricades according to the contract.

Provide, erect, and maintain necessary barricades, suitable and sufficient lighting devices, signs and other traffic control devices, and precautions for the protection of the work and safety of the public.

Protect roadways closed to traffic, illuminate obstructions during hours of darkness, and provide warning signs to control and direct traffic according to the contract.

Submit to the Engineer 8 sets of FHWA approval letter certifying that the barricades are NCHRP Report 350 compliant.

Barricades shall be in good condition. Submit barricades for acceptance by the Engineer for use within the project limits according to this section. Barricade application and installation shall be according to the contract and as specified by the Engineer.

Provide sand bags if required or specified by the Engineer. All sand bags and their method of installation shall comply with the MUTCD and be accepted by the Engineer prior to use. Do not place sand bags on the striped barricade rail.

Install steady burn and/or flashing lamps on selected barricades used during hours of darkness. Locations shall be according to the contract and specified by the Engineer. Attach the lamps on the barricade ends closest to the traveled way. Lamps shall be visible to the motorist.

Do not install signs on barricades unless the sign on barricade system has been crash tested, accepted under NCHRP Report 350, and accepted by the Engineer.

The Contractor may use the accepted barricades for temporary detours, construction phasing, or other temporary traffic control work.

The Contractor may use the accepted barricades used in temporary detours or construction phasing for permanent locations according to the contract.

Upon completion of the construction work, leave the barricades in place, relocate the barricades, or remove and dispose the barricades according to the contract or as specified by the Engineer. Barricades left in place or relocated to new permanent locations shall become the property of the State. Barricades removed and disposed of shall become the property of the Contractor.

(2) Reflectorization. Reflectorize barricade rails and the attachment with reflective sheeting according to Subsection 712.20(C)(4) - Type III or IV Retroreflective Sheeting (High or specified and accepted by the Engineer.

Reflectorize both vertical faces of each barricade rail according to the contract.

(3) Color. Rails, frames and braces shall be white. The front and back faces of barricade rails shall have 6 inch wide alternate colored and white stripes sloping downward toward the traveled way at an angle of 45 ^{O} with the vertical. The colored stripes shall be either orange or red according to the following requirements:

(a) Use orange and white stripes for construction, detour or maintenance work.

(b) Use red and white stripes on roadways with no outlet such as dead-ends and cul-de-sacs, ramps or lanes closed for operational purposes, or permanent or semi-permanent closure or termination of a roadway.

(4) Maintenance. Keep the barricades in good condition throughout their usage during construction.

(a) To maintain their effectiveness and appearance, repair, clean or replace the required barricades as specified by the manufacturer guidelines and as specified by the Engineer.

(b) Immediately replace lost, stolen or damaged barricades, lamps and sand bags.

Clean and repair the barricades used during construction phasing, temporary detours or other temporary traffic control work before relocating to permanent locations according to the contract or as specified by the Engineer.

The Engineer will not make payment for repair work or cleaning of barricades. The Engineer shall decide the suitable condition of each barricade and when each barricade needs repairing or cleaning.

(C) Traffic Delineators. Install traffic delineators to show the temporary alignment of detour roads according to the contract or as specified by the Engineer.

Upon request of the Engineer, submit to the Engineer an FHWA approval letter certifying that the device is NCHRP Report 350 compliant.

Maintain the traffic delineators and keep the traffic delineators clean and in good repair. Replace lost, stolen or damaged traffic delineators immediately.

At the end of a detour phase, relocate the traffic delineators and keep the traffic delineators clean and in good condition to the next detour phase. At the end of the construction period, leave in place or remove the traffic delineators according to the contract or as specified by the

Engineer. The traffic delineators will become the property of the Contractor when no longer required on the project.

(D) Cones. Install traffic cones according to the contract or as specified by the Engineer.

Upon request of the Engineer, submit to the Engineer an FHWA approval letter certifying that the cones are NCHRP Report 350 compliant.

Maintain the traffic cones and keep the traffic cones clean and in good repair. Replace lost, stolen or damaged traffic cones as needed."

(IV) Amend **645.04 Method of Measurement** to read as follows:

"645.04 Method of Measurement. The Engineer will measure Additional Police Officers And/Or Additional Traffic Control Devices such as hiring the services of additional Police Officers that the Engineer requested; furnishing, installing, maintaining and removing the additional devices; and inserting the legal notices required by the Engineer on a force account basis according to the contract and as specified by the Engineer.

The Engineer will not measure the amount of Police Officers listed in 645.03 for payment. Nor will any administrative fees be paid that is charged by the Special Duty. In addition, any supervisory police officers (i.e., sergeants, lieutenants, or captains) which are required by the Honolulu Police Department, shall not be measured for payment by the Engineer. The Engineer will not measure traffic control, barricade or barricade with lamp(s), traffic delineator, and construction and maintenace of detours for payment."

(V) Amend **645.05 Basis of Payment** to read as follows:

"645.05 Basis of Payment. The Engineer will pay for additional Police Officers and/or additional traffic control devices that was in addition to what was required by the contract documents on a force account basis according to Subsection 109.04 - Extra and Force Account Work. The Engineer will compute the actual amount paid for force account work according to Subsection 109.04 - Extra and Force Account Work. The amount may be more or less than the estimated amount shown in the proposal. The force account work includes hiring the services of additional Police Officers beyond the minimum required in subsection 645.03 that the Engineer requested. Also, the furnishing, installing, maintaining and removing the additional devices; doing extra work directed by the Engineer that will increase the safety of the public on the roadway and/or increase the flow of traffic, or minimize the inconvenience to the public, inserting the legal notices; furnishing labor, materials, tools, equipment, adjustments to existing conditions or facilities necessary to provide improved safety for the public or HDOT employees, and incidentals necessary to complete the work.

The Contractor shall submit a paid invoice for the legal notice as well as all items bought, rented leased or hired.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Additional Police Officers and/or Additional Traffic Control Devices	Force Account"

The Engineer will not pay for the amount of Police Officers listed in 645.03 separately. The Engineer will consider the cost for the amount of Police Officers listed in 645.03 as included in the contract price of the various contract items. The cost includes hiring the services of the Police Officers. In addition, any supervisory police officers (i.e., sergeants, lieutenants, or captains) which are required by the Honolulu Police Department, shall not be paid for separately. The Engineer will consider the cost for any required supervisory police officers as included in the contract price of the various contract items.

The Engineer will not pay for Furnishing Tow Truck During Lane Closures separately. The Engineer will consider the cost for Furnishing Tow Truck During Lane Closures as included in the contract price of the various contract items. The cost is for furnishing the tow truck and driver for the duration of each lane closure; removing vehicles and their drivers and passengers and dropping them off at the pre-established and accepted drop-off locations; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

The Engineer will not pay for Traffic Control separately. The Engineer will consider the cost for Traffic Control as included in the contract price of the various contract items. The cost is for hiring the services of the flaggers and/or Police Officers; planning and submitting traffic control plans; furnishing, installing, maintaining and removing all traffic controls shown in the traffic control plans; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

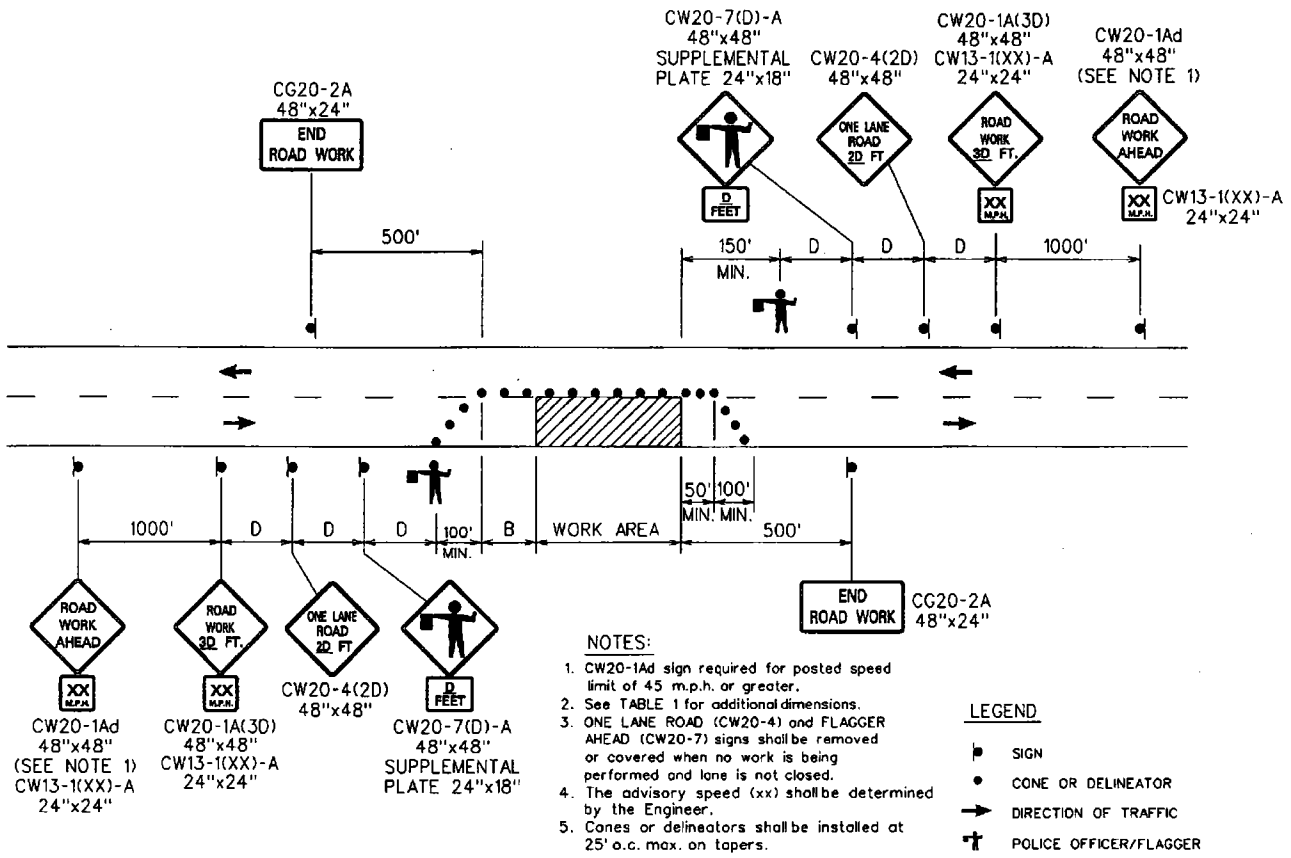
The Engineer will not pay for Barricade or Barricade With Lamp or Arrow Boards separately. The Engineer will consider the cost for Barricade or Barricade With Lamp or Arrow Boards as included in the contract price of the various contract items. The cost is for furnishing, delivering, installing, maintaining, relocating, and removing the barricade or arrow boards and furnishing and installing sand bags and other accepted weights; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

The Engineer will not pay for delineators separately. The Engineer will consider the cost for delineators as included in the contract price of the various

contract items. The cost is for furnishing; installing; cleaning; maintaining correct placement; removing when required; and furnishing and installing sand bags or other accepted weights; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

The Engineer will not pay for construction and maintenance of detours separately. The Engineer will consider the cost for construction and maintenance of detours as included in the contract price of the various contract items. The cost is for replacing installed traffic delineators that are lost, stolen, or damaged and not due to the Contractor's negligence; relocating of traffic delineators to the next detour phase; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work."

(V) Replace Figures 1 through 6 dated 5/01/93 with the attached Figures 1 and 2 dated r2/97 and Figures 3 through 7 dated r10/96.



NOTES:

1. CW20-1Ad sign required for posted speed limit of 45 m.p.h. or greater.
2. See TABLE 1 for additional dimensions.
3. ONE LANE ROAD (CW20-4) and FLAGGER AHEAD (CW20-7) signs shall be removed or covered when no work is being performed and lane is not closed.
4. The advisory speed (xx) shall be determined by the Engineer.
5. Cones or delineators shall be installed at 25' o.c. max. on tapers.

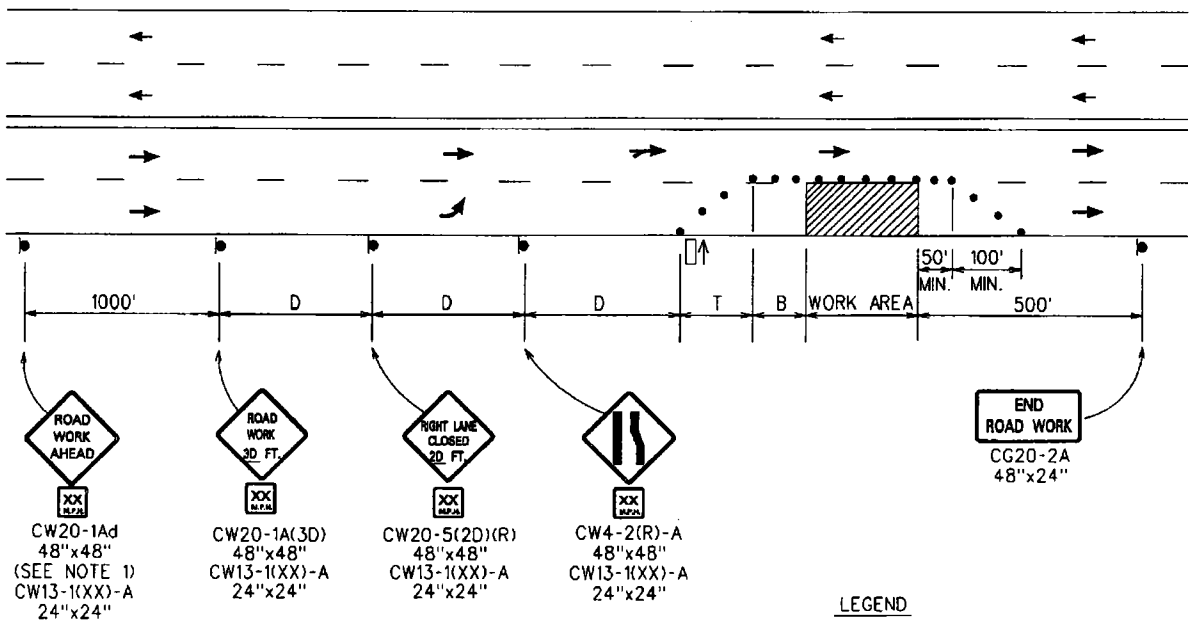
LEGEND

- SIGN
- CONE OR DELINEATOR
- DIRECTION OF TRAFFIC
- POLICE OFFICER/FLAGGER

TWO-LANE HIGHWAY - ONE LANE CLOSED

FIGURE 1 - TRAFFIC CONTROL PLAN

R11/97



NOTES:

1. CW20-1Ad sign required for posted speed limit of 45 m.p.h. or greater
2. See TABLE 1 for additional dimensions.
3. The advisory speed (xx) shall be determined by the Engineer.

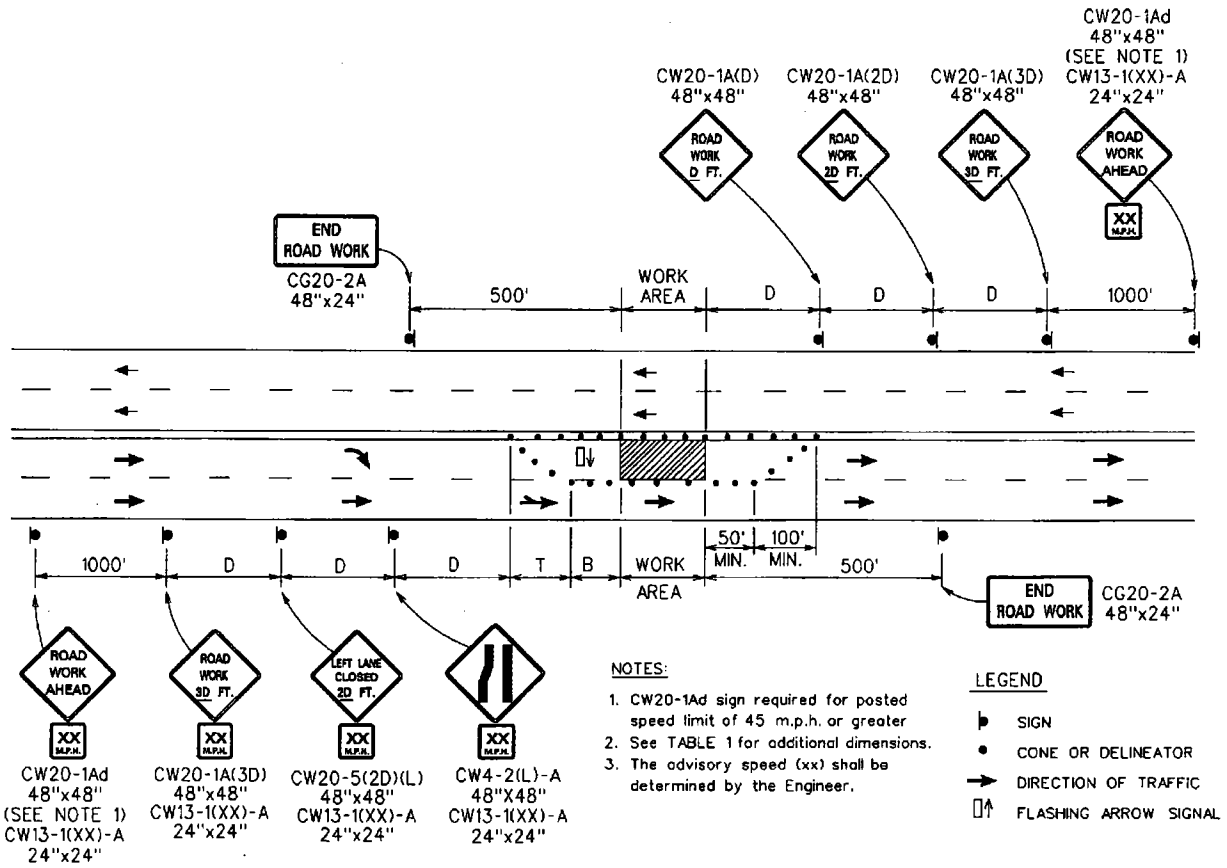
LEGEND

- SIGN
- CONE OR DELINEATOR
- DIRECTION OF TRAFFIC
- FLASHING ARROW SIGNAL

MULTILANE UNDIVIDED HIGHWAY - RIGHT LANE CLOSED

FIGURE 2 - TRAFFIC CONTROL PLAN

R2/97

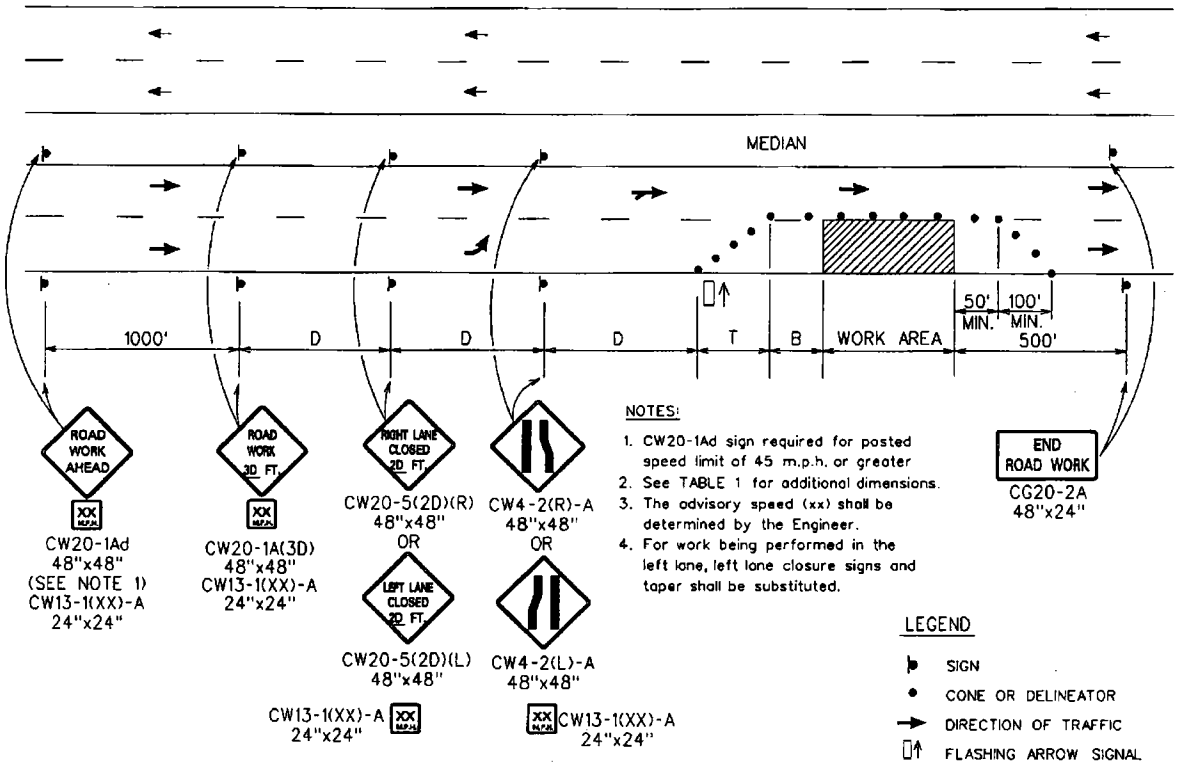


MULTILANE UNDIVIDED HIGHWAY - LEFT LANE CLOSED

FIGURE 3 - TRAFFIC CONTROL PLAN

R10/96

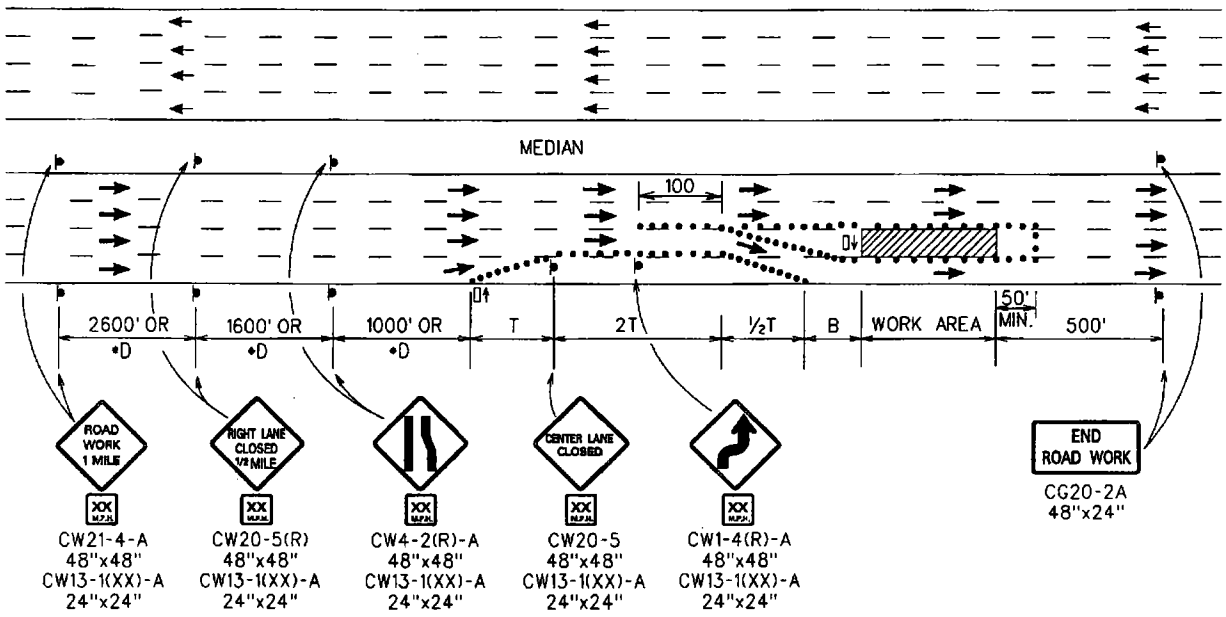
10/16/03



MULTILANE DIVIDED HIGHWAY - ONE LANE CLOSED

FIGURE 4 - TRAFFIC CONTROL PLAN

R10/96



NOTES:

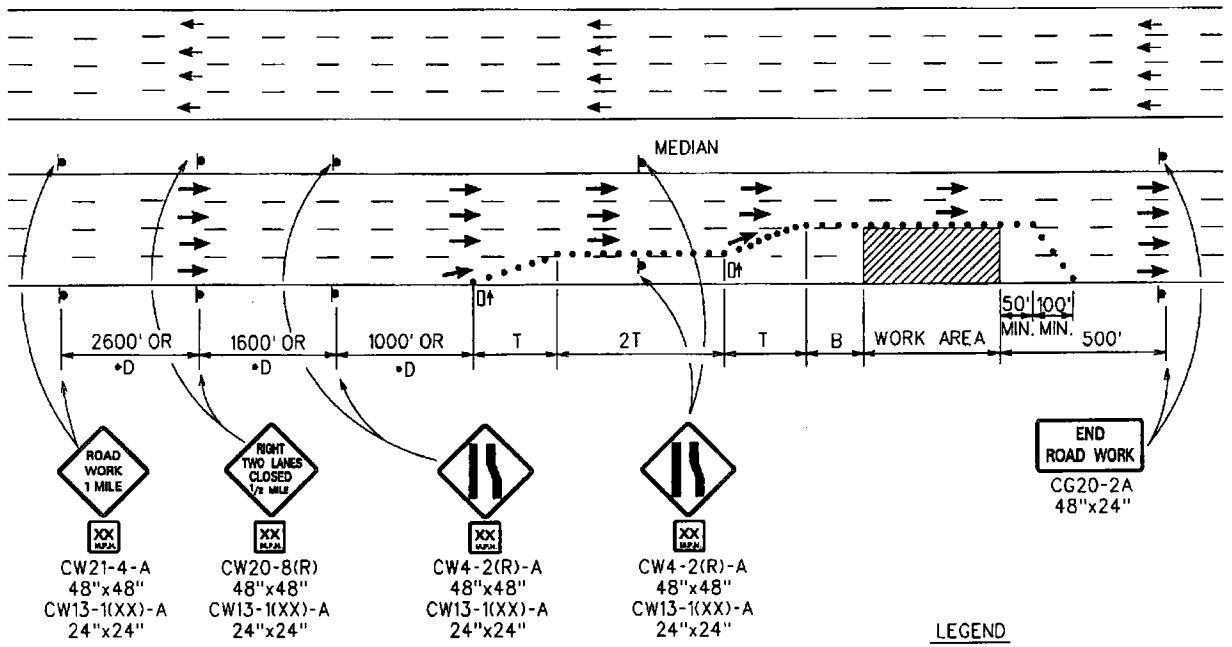
1. For work being performed in the left center lane, use mirror image of above with appropriate left lane closure signs and taper.
2. For undivided highways, delete advance warning signs shown posted in median area.
3. The advisory speed (xx) shall be determined by the Engineer.
4. See TABLE 1 for additional dimensions.
*5. For posted speeds of 40 m.p.h. or less, use sign spacings and taper lengths from TABLE 1 and change signs CW21-4-A and CW20-5(R) to CW20-1A(3D) and CW20-5(2D)(R) as shown in Figure 4.

LEGEND

- SIGN
- CONE OR DELINEATOR
- DIRECTION OF TRAFFIC
- FLASHING ARROW SIGNAL

MULTILANE HIGHWAY - CENTER LANE CLOSED

FIGURE 5 - TRAFFIC CONTROL PLAN

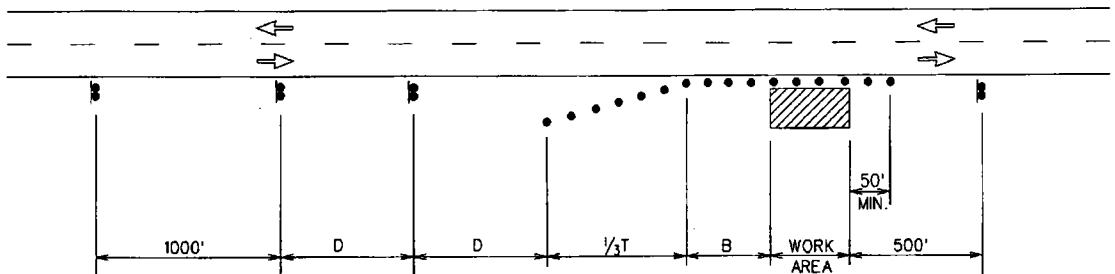


NOTES:

1. For work being performed in the left center lane, use mirror image of above with appropriate left lane closure signs and taper.
2. For undivided highways, delete advance warning signs shown posted in median area.
3. The advisory speed (xx) shall be determined by the Engineer.
4. See TABLE 1 for additional dimensions.
•5. For posted speeds of 40 m.p.h. or less, use sign spacings and taper lengths from TABLE 1 and change signs CW21-4-A and CW20-8(R) to CW20-1A(3D) and CW20-8(2D)(R) respectively.

MULTILANE HIGHWAY - MULTIPLE LANE CLOSED

FIGURE 6 - TRAFFIC CONTROL PLAN



NOTES:

1. This plan may be used only if all road work, including equipment and workers are off the travel way.
2. See TABLE 1 for additional dimensions.
3. Engineer will determine if Advisory speed sign is necessary.
4. Contractor will provide necessary adjustments to accomodate Bicyclists and Pedestrians.
5. CW20-1Ad sign required for posted speed limit of 45 MPH or greater.
6. Signing is not required if the work area including equipment and workers, is outside the clear zone distance, as specified in the latest AASHTO Roadside Design Guide.

LEGEND

- Cone or Delineator
- Direction of traffic
- Sign

WORKING ON SHOULDER OR ROADSIDE

FIGURE 7 - TRAFFIC CONTROL PLAN

R10/96

excess bonding agent to pool or accumulate. The epoxy bonding agent shall be tacky when the concrete is placed.

The area to receive concrete shall be dry and free from water. Dewater as required to keep the area free from water prior to and during the pouring of concrete.

Trowel the concrete to form a smooth, dense surface finish. Fill all voids beneath the culvert invert with concrete. Score the concrete culvert lining one-eighth inch wide, 0.75-inch deep laterally at 20 feet maximum on-center. If the Contractor opts to score by sawcutting, sawcut within four (4) hours after the concrete pour.

Cure concrete in accordance with the requirements of Subsection 503.03 (L) - Curing Methods. Allow the concrete placed in the culvert to cure for a minimum of 48 hours before allowing water to flow through the culvert.

After the concrete has cured and been scored laterally, apply two coats of emulsified asphalt to both edges of lining and to the 0.75-inch scores. Clean the metal and concrete surfaces to be coated. The asphalt coating applied at the juncture of the lined and unlined culvert surface shall be 18 inches minimum width, or as specified by the Engineer, along the length of the culvert lining. The finished coating shall be a continuous film free of voids, gaps or pin holes.

653.04 Method of Measurement. The Engineer will not measure the structural plate culvert lining for payment.

653.05 Basis of Payment. The Engineer will pay for the accepted structural plate culvert lining at the contract lump sum price complete in place.

The price includes full compensation for the structural plate culvert lining, including applying epoxy bonding agent; welding, furnishing and installing angle iron and reinforcing steel; providing bracing; preparing damaged pipe surface; dewatering; furnishing and installing concrete; scoring concrete lining; applying asphalt coating; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work, as shown on plan sheet numbers AC 7.41 to AC 7.44.

The Engineer will make payment under:

Pay Item	**Pay Unit**
_____-Inch Structural Plate Culvert Lining	Lump Sum"

END OF SECTION

Make the following Section a part of the Standard Specifications:

"SECTION 656 - SOIL NAIL RETAINING WALL

656.01 Description. The Work shall consist of constructing permanent soil nail retaining walls as specified herein and shown on the Plans. The Contractor shall furnish all labor, materials, and equipment required for completing the Work. The Contractor shall select the method of excavation, drilling method and equipment, and grouting procedures to meet the performance requirements specified herein.

Soil nailing work shall include excavating in accordance with the staged lifts shown in the Plans; drilling soil nail drill holes to the specified minimum diameter, length, and orientation indicated on the Plans; providing, placing and grouting the reinforcing bars into the drill holes; placing drainage elements; placing shotcrete reinforcement; applying shotcrete construction facing over the reinforcement; attaching bearing plates and nuts; and performing nail testing. Shotcrete construction facing and wall drainage construction are covered in Section 628 - Shotcrete.

The term "Soil Nail" as used in these specifications is intended as a generic term and refers to a reinforcing bar grouted into a drilled hole installed in any type of ground conditions including soil and rock. Soil nail walls are built from the top down in existing ground.

Soil and rock properties, strength parameters, partial safety factors, design requirements and other criteria are shown on the Plans.

656.02 Soil Nail Contractor's Experience Requirements and Submittal.

The qualifications of the soil nailing Contractor shall conform to the minimum experience requirements below.

The soil nailing Contractor shall submit a project reference list verifying the successful completion of at least three permanent soil nail retaining wall projects during the past 3 years totaling at least 15,000 square feet of wall face area and at least 150 permanent soil nails. A brief description of each project with the Owner's name and current phone number shall be included.

The soil nailing Contractor shall have on his/her staff sufficient personnel having experience in the construction of permanent soil nail retaining walls. As a minimum, the on-site supervisor and drill rig operators shall have experience installing permanent soil nails on at least three projects over the past 3 years.

At least 30 calendar days before starting the wall or pre-production verification testing of nails, the soil nail Contractor shall submit 8 copies of the completed project reference list and a list identifying the on site supervisors and drill rig operators assigned to the project. The personnel list shall contain a summary of each individual's experience and be complete enough for the Engineer to determine whether each individual satisfies the required qualifications. The Engineer will approve or reject the submission. Work shall not be started nor materials ordered until the Engineer's written approval of the Contractor's qualification is given.

The Engineer may suspend the Work if the Contractor uses non-approved personnel for the Work. If work is suspended, the Contractor shall be fully liable for all resulting costs and no adjustment in contract time will result from the suspension.

656.03 Materials.

(A) General. No asbestos containing materials or equipment shall be used under this Section. The Contractor shall ensure that all materials and equipment incorporated in the project are asbestos-free.

(B) Materials. Furnish materials new and without defects. Remove defective materials from the job site at no additional cost to the State. Materials for soil nail structures shall consist of the following:

(1) Solid Bar Nail Tendons. ASTM A615, Grade 60, Deformed bar continuous without splices or welds. New, straight, undamaged, and fully encapsulated, as shown on the Plans. Threaded a minimum of 6 inches on the wall anchorage end to allow for proper attachment of bearing plate and nut. Threading shall be continuous spiral deformed ribbing provided by the bar deformations.

(2) Encapsulation. Minimum 0.1-inch thick corrugated HDPE (AASHTO M252) or corrugated PVC (ASTM D1784). Encapsulation shall provide at least 0.25 inches of grout cover over the reinforcing bar. Encapsulation shall be resistant to ultra violet light degradation, normal handling stresses, and grouting pressures. The encapsulation shall be fabricated in the factory with a proper end cap on one side.

(3) Centralizers: Manufactured from Schedule 40 PVC pipe or tube, steel or other material not detrimental to the nail steel (wood shall not be used); securely attached to the nail bar, sized to position the nail bar within 1 inch of the center of the drill hole; sized to allow tremie pipe insertion to the bottom of the drill hole; and sized to allow grout to freely flow up the drill hole.

(4) Nail Grout. Grout for the soil nail retaining walls shall conform to Section 681.04(E) – Grout, of the project Special Provisions.

(5) Admixtures. ASTM C494. Admixtures that control bleed, improve flowability, reduce water content and retard set may be used in the grout subject to review and acceptance by the Engineer. Accelerators are not permitted. Expansive admixtures may only be used in grout used for filling sealed encapsulations. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations.

(6) Cement. ASTM C150, Type I, II, III or V.

(7) Fine Aggregate. ASTM C33

(8) Film Protection. Polyethylene film per AASHTO M171.

(9) Structural Concrete. Refer to Section 503 and Section 601.

(10) Shotcrete. Refer to Section 628.

(C) Materials Handing and Storage. Store cement to prevent moisture degradation and partial hydration. Do not use cement that has become caked or lumpy. Store aggregates so that segregation and inclusion of foreign materials are prevented. Do not use the bottom 6 inches of aggregate piles in contact with the ground.

Store steel reinforcement on supports to keep the steel from contacting the ground. Damage to the exposed nail steel as a result of abrasion, cuts, nicks, welds, and weld splatter shall be cause for rejection. Do not ground welding leads to nail bars. Protect nail steel from dirt, rust, and other deleterious substances prior to installation. Heavy corrosion or pitting of the exposed nails shall be cause for rejection. Place protective wrap over anchorage end of nail bar to which bearing plate and nut will be attached to protect the nail during handling, installation, grouting and shotcreting.

656.04 Construction Site Survey.

Prior to the start of any wall construction activity, the Contractor and Engineer shall jointly inspect the site to observe and document the pre-construction condition of the site, existing structures, and facilities. During construction, the Contractor shall observe the conditions above the soil nail wall on a daily basis for signs of ground movement in the vicinity of the wall. Immediately notify the Engineer if signs of movements, such as new cracks in existing structures, increased size of old

cracks or separation of joints in structures, foundations, streets or paved and unpaved surfaces, are observed.

If the Engineer determines that the movements exceed those anticipated for typical soil nail wall construction and require corrective action, the Contractor shall take corrective actions necessary to stop the movement or perform repairs.

656.05 Submittals. Upon approval of the soil nailing Contractor's qualifications submittal set forth in Section 656.02, submit 8 copies of the following information, in writing, to the Engineer for review and approval.

Provide the following submittal items at least 30 calendar days prior to initiating the soil nail wall construction (or pre-production verification tests on sacrificial test nails):

(A) The proposed start date and proposed detailed wall construction sequence including the following:

(1) Plan describing how surface water will be diverted, controlled and disposed of.

(2) Proposed methods and equipment for excavating the soil and/or rock to the staged excavation lifts indicated in the Plans, including the proposed grade elevations for each excavation lift shown on a wall elevation view.

(3) Measures to ensure wall and slope stability during various stages of wall construction and excavation where discontinuous rows of nails will be installed (if applicable); information on space requirements for installation equipment; temporary shoring plans (if applicable); information on provisions for working in the proximity of underground facilities or utilities (if applicable).

(4) Proposed nail drilling methods and equipment.

(B) Nail non-shrink grout mix design including the following:

(1) Type of Portland cement.

(2) Aggregate source and gradation.

(3) Proportions of mix by weight and water-cement ratio.

(4) Manufacturer, brand name and technical literature for proposed admixtures.

(5) Compressive strength test results per ASTM C109 supplied by a qualified independent testing laboratory verifying the specified minimum 3 and 28-day grout compressive strengths. Previous test results for the proposed grout mix completed within one year of the start of grouting may be submitted for initial verification and acceptance of the required compressive strengths and start of production work.

(C) Proposed nail grout placement procedures and equipment.

(D) Proposed nail testing methods and equipment setup including the following:

(1) Details of the jacking frame and appurtenant bracing.

(2) Details showing methods of isolating test nails during shotcrete application (i.e., methods to prevent bonding of the soil nail bar and the temporary shotcrete facing during testing).

(3) Details showing methods of providing the temporary unbonded length and of grouting the temporary unbonded length of test nails after completion of testing.

(4) Equipment list.

(E) Identification number and certified calibration records for each test jack and pressure gauge and load cell to be used. Jack and pressure gauge shall be calibrated as a unit. Calibration records shall include the date tested, identification number, and the calibration test results and shall be certified to an accuracy of at least 2 percent of the applied certification loads by a qualified independent testing laboratory within 180 days prior to submittal.

(F) Manufacturer Certificates of Compliance for the soil nail centralizers.

(G) Shop drawings for falsework (formwork) in accordance with Section 503.

The Contractor will not be allowed to begin wall construction or incorporate materials into the work until the submittal requirements are satisfied and found acceptable to the Engineer. Changes or deviations from the approved submittals must be resubmitted for approval. No adjustments in contract time will be allowed due to incomplete submittals.

Upon delivery of the encapsulated nail bars to the project site, provide Certified mill test results for the encapsulated nail bars from each heat specifying the ultimate strength, yield strength, elongation and composition.

656.06 Construction Requirements.

(A) Pre-Construction Meeting. A pre-construction meeting will be scheduled by the Engineer and held prior to the start of wall construction (or pre-production verification tests on sacrificial test nails). The Engineer, prime Contractor, soil nail Contractor and Owner's Geotechnical Engineer shall attend the meeting. The excavation Contractor, shotcreting Contractor and survey Contractor, if different than the prime or soil nail Contractor, shall also attend. Attendance is mandatory.

The pre-construction meeting will be conducted to clarify the construction requirements for the work, to coordinate the construction schedule and activities, and to identify contractual relationships and delineation of responsibilities amongst the prime Contractor and the various Subcontractors – particularly those pertaining to wall excavation, nail installation and testing, excavation and wall alignment survey control, and shotcrete facing construction. Soil nail wall construction requires excavation in staged lifts and excavation in the vicinity of the wall face requires special care and effort compared to general earthwork excavation. The Contractor shall take this into account during bidding.

(B) Site Drainage Control. Provide positive control and discharge of all surface water that will affect construction of the soil nail retaining wall. Maintain all pipes or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost to the State. Upon substantial completion of the wall, remove surface water control pipes or conduits from the site. Alternatively; with the approval of the Engineer, pipes or conduits that are left in place, may be fully grouted and abandoned or left in a way that protects the structure and all adjacent facilities from migration of fines through the pipe or conduit and potential loss of ground.

The regional groundwater table is anticipated to be below the level of the wall excavation based on the available geotechnical information. Localized areas of perched water or seepage may be encountered during excavation at the interface of geologic units or from localized groundwater seepage areas. These perched groundwater conditions shall not be considered as "differing site conditions" by the Contractor.

Immediately contact the Engineer if unanticipated existing subsurface drainage features and/or structures are discovered during excavation.

Suspend work in these areas until remedial measures meeting the Engineer's approval are implemented. Capture surface water runoff flows (and flows from existing subsurface drainage structures) independently of the wall drainage network and convey them to an outfall structure or storm sewer, as approved by the Engineer. Cost of remedial measures required to capture and dispose of water resulting from encountering unanticipated man-made subsurface drainage features and/or structures will be paid for as Extra Work.

(C) Excavation. Coordinate the work and the excavation such that the soil nail wall is safely constructed. The Contractor shall protect, at all times, the existing structures and features behind the soil nail walls during excavation for the soil nail wall. Perform the wall construction and excavation sequence in accordance with the Plans and approved submittals. The Contractor shall exercise care in the excavation for the soil nail retaining walls due to the cobbly and rocky nature of the subsurface materials at the soil nail retaining wall locations to minimize substantial excavation overbreak, which will require subsequent backfill with shotcrete at no additional cost to the State. No excavations steeper than those specified herein or shown on the Plans shall be made above or below the soil nail wall without the written approval of the Engineer.

(D) Excavation and Wall Alignment Survey Control. The Contractor shall be responsible for providing both the survey reference and control points along the top of the wall alignment as well as the necessary survey and alignment control during excavation of each lift, locating and drilling each drill hole within the allowable tolerances, and for performing the wall excavation and nail installation in a manner that will allow for constructing the shotcrete construction facing to the specified minimum thickness and such that the permanent concrete facing can be constructed to the specified minimum thickness and to the line and grade indicated in the Plans. Where the as-built location of the front face of the shotcrete construction facing exceeds the allowable tolerance from the wall control line shown on the Plans, the Contractor shall be responsible for determining and bearing the cost of remedial measures necessary to provide proper attachment of nail head bearing plate connections and satisfactory placement of the permanent concrete facing, as called for on the Plans.

(E) General Excavation. Complete clearing, grubbing, grading and excavation above and behind the wall (if required) before commencing wall excavation. Do not over excavate the original ground behind the wall or at the ends of the wall, beyond the limits shown on the Plans. Do not perform general excavation that will affect the soil nail wall until wall construction starts. General excavation shall be coordinated with the soil nailing work and

the excavation shall proceed from the top down in a horizontal staged excavation lift sequence with the ground level for each lift excavated no more than mid-height between adjacent nail rows, as illustrated on the Plans. Do not excavate the full wall height to the final wall alignment as shown on the Plans but maintain a working bench of native material to serve as a platform for the drilling equipment. The bench shall be wide enough to provide a safe working area for the drill equipment and workers.

(F) Soil Nail Wall Structure Excavation. Structure excavation in the vicinity of the wall face will require special care and effort compared to general earthwork excavation. The excavation Contractor shall take this special structure excavation requirement into account during bidding. Due to the close coordination required between the soil nail Contractor and the excavation Contractor, the excavation Contractor shall perform the structure excavation for the soil nail wall under the direction of the soil nail Contractor.

Excavate to the final wall face using procedures that will: (1) prevent over excavation; (2) prevent ground loss, swelling, air slaking, or loosening; (3) prevent loss of support for completed portions of the wall; and (4) prevent loss of soil moisture at the face. Costs associated with additional thickness of shotcrete or concrete or other remedial measures required due to irregularities in the cut face, excavation over-break due to the nature of the on-site materials (cobbly and rocky materials) or inadvertent over excavation, shall be borne by the Contractor.

The exposed unsupported final excavation face cut height shall not exceed the vertical nail spacing plus the required reinforcing lap or the short-term stand-up height of the ground, whichever is less. The Contractor shall complete excavation to the final wall excavation line and shall apply the shotcrete in the same work shift, unless otherwise approved by the Engineer. Application of the shotcrete may be delayed up to 24 hours if the Contractor can show that the delay will not adversely affect the excavation face stability. A polyethylene film over the face of the excavation may reduce degradation of the cut face caused by changes in moisture. Damage to the existing structures or structures included in the Work shall be repaired and paid by the Contractor where approval is granted for the extended face exposure period.

Excavation to the next lift shall not proceed until nail installation, temporary shotcrete facing placement, attachment of bearing plates and nuts and nail testing has been completed and accepted in the current lift. Nail grout and shotcrete shall have cured for at least 72 hours or attained at least their specified 3-day compressive strength before excavating the next underlying lift. Excavating the next lift in less than 72 hours will only be

allowed if the Contractor submits compressive strength test results, for test performed by a qualified independent testing laboratory, verifying that the nail grout and shotcrete mixes being used will provide the specified 3-day compressive strengths in the lesser time.

Notify the Engineer immediately if raveling or local instability of the final wall face excavation occurs. Unstable areas shall be temporarily stabilized by means of buttressing the exposed face with an earth berm or other methods. Suspend work in unstable areas until remedial measures are developed.

(G) Wall Discontinuities. Where the Contractor's excavation and installation methods result in a discontinuous wall along any nail row, the ends of the constructed wall section shall extend beyond the ends of the next lower excavation lift by at least 10 feet. Slopes at these discontinuities shall be constructed to prevent sloughing or failure of the temporary slopes. If sections of the wall are to be constructed at different times, prevent sloughing or failure of the temporary slopes at the end of each wall section.

(H) Excavation Face Protrusions, Voids or Obstructions. Remove all portions of cobbles, boulders, rubble or other subsurface obstructions encountered at the wall final excavation face that will protrude into the shotcrete construction facing and permanent concrete facing. Determine method of removal of face protrusions, including method to safely secure remnant pieces left behind the excavation face and for promptly backfilling voids resulting from removal of protrusions extending behind the excavation face. Notify the Engineer of the proposed method(s) for removal of face protrusions at least 24 hours prior to beginning removal. Voids, over-break or over-excavation beyond the plan wall excavation line resulting from the removal of face protrusions or excavation operations shall be backfilled with shotcrete or concrete, as approved by the Engineer. Removal of face protrusions and backfilling of voids or over-excavations shall be considered incidental to the work.

(I) Nail Installation. Determine the required drill hole diameter(s), drilling method, grout composition and installation method necessary to achieve the nail pullout resistance(s) specified herein or on the Plans, in accordance with the nail testing acceptance criteria in the Nail Testing section.

No drilling or installation of production nails will be permitted in any soil/rock unit until successful pre-production verification testing of sacrificial test nails is completed in that unit and approved by the Engineer. Install verification test nails using the same equipment, methods, nail inclination and drill hole diameter as planned for the production nails. Perform pre-

production verification tests on sacrificial test nails in accordance with the Verification Testing Section prior to ordering materials, starting wall excavation and prior to installation of production nails in the specific lift in which the designated verification test nails are located. The number and location of the verification tests will be as indicated on the Plans or specified herein.

Verification test nails may be installed through either the existing slope face prior to the start of wall excavation, drill platform work bench, stabilization berm or into slot cuts made for the particular lift in which the verification test nails are located. Slot cuts will only be large enough to safely accommodate the drill and test nail reaction setup. Subject to the Engineer's approval, verification test nails may also be installed at angle orientations other than perpendicular to the wall face or at different locations than specified, as long as the Contractor can demonstrate that the test nails will be bonded into the ground that is representative of the ground at the verification test nail locations designated on the Plans or herein. Install the production soil nails before the construction of the permanent concrete facing.

The Contractor shall place a sealing layer (flashcoat) of shotcrete or steel fiber reinforced shotcrete to protect and stabilize the face of the excavation as shown on the Plans. Cost of the sealing layer (flashcoat) of shotcrete or steel fiber reinforced shotcrete shall be measured and paid for under Section 628, "Shotcrete."

The Engineer may add, eliminate, or relocate nails to accommodate actual field conditions. Cost adjustments associated with these modifications shall be made in accordance with the General provisions of the Contract. The cost of any redesign, additional material, or installation modifications resulting from actions of the Contractor shall be borne by the Contractor.

(J) Drilling. The specified size drill holes for the soil nails shall be made at the locations, orientations, and lengths shown on the plans or as directed by the Engineer. The Contractor has the option to make adjustments in the diameter of the drill holes, upon written approval of the Engineer, at no additional cost provided that the resulting change in the drill hole size will achieve the nail pullout resistance(s) specified herein and in the Plans. The adjusted soil nail shall be capable of sustaining a minimum load of 3.2 kips per lineal foot of the soil nail length and the diameter of the drilled hole shall not be less than 6 inches.

Subsurface exploration at the locations of the soil nail retaining walls was conducted at selected locations as part of the project. The Contractor may assume that the subsurface materials to be encountered at the soil nail

retaining wall locations will consist of the geologic formations identified in the boring logs shown on the Plans. It shall be noted that highly weathered basalt rock stratum shown on the Plans may include core stones of relatively hard, less weathered rock (possible spheroidal weathering). The Contractor shall anticipate the presence of cobbles, boulders, and hard rock at the site.

The Contractor shall thoroughly investigate the site for himself/herself and select the appropriate drilling equipment and methods for the drilling. Use of drilling muds such as bentonite slurry to assist in drill cutting removal is not allowed but compressed air may be used. Care shall be exercised by the Contractor to avoid disturbing the existing structures and features behind the soil nail retaining wall when compressed air is used for the drilling. Where hard drilling conditions such as rock, cobbles, boulders, or obstructions are encountered, percussion or other suitable drilling equipment capable of drilling and maintaining stable drill holes through such materials shall be used. The Engineer will not make separate payment for excavation of materials of different densities and character (hardness) or employment of special tools and procedures necessary to install the soil nails.

Immediately suspend or modify the drilling operations if ground subsidence is observed, if the soil nail wall is adversely affected, or if adjacent structures and/or features are damaged from the drilling operation. Immediately stabilize the adverse conditions at no additional cost to the State.

(K) Nail Bar Installation. Provide fully encapsulated nail bars in accordance with the schedules included in the Plans. Provide centralizers sized to position the bar within 1 inch of the center of the drill hole. Position centralizers as shown on the Plans so that the maximum center-to-center spacing does not exceed 10 feet. Also, locate centralizers within 2 feet from the top and bottom of the drill hole. Securely attach centralizers to the fully encapsulated bar so that they will not shift during handling or insertion into the drill hole, will still allow grout tremie pipe insertion to the bottom of drill hole, and will allow grout to flow freely up the hole.

Inspect each fully encapsulated nail bar before installation and repair or replace damaged bars. Check uncased drill holes for cleanliness prior to insertion of the soil nail bar. Insert fully encapsulated nail bars with centralizers into the drill hole to the required length without difficulty and in a way that prevents damage to the drill hole, bar, or corrosion protection. Do not drive or force partially inserted soil nails into the hole. Remove nails that cannot be fully inserted to the design depth and clean the drill hole to allow unobstructed installation.

When using cased or hollow stem auger drilling equipment, which does not allow for the centralizers to pass through the casing or auger stem, the Contractor may delete the centralizers if the neat cement grout pumped through the casing is placed using grout pressures greater than 150 psi or if the sand-cement grout placed through the stem of the auger has a slump of 9 inches or less.

(L) Nail Installation Tolerance.

(1) Nail location and orientation tolerances are as follows:

(a) Nail head location, deviation from plan design location: 6 inches in any direction.

(b) Nail inclination, deviation from plan: + or - 3 degrees.

(c) Location tolerances are applicable to only one nail and not cumulative over the large wall area. Center nail bars within 1 inch of the center of the drill hole.

(2) Soil nails that do not satisfy the specified tolerances, due to the Contractor's installation methods, will be replaced at no additional cost to the State. Backfill abandoned nail drill holes with tremied grout. Nails that encounter unanticipated obstructions during drilling shall be relocated, as approved by the Engineer. Cost of drilling and backfilling drill holes abandoned due to unanticipated obstructions will be paid as Extra Work. Drilling through cobbles, boulders, and hard basalt rock formation shall be anticipated by the Contractor and shall not be considered unanticipated obstructions by the Contractor.

(M) Grout Mix Design. Submit the proposed nail grout mix design to the Engineer for review and approval in accordance with the submittal section.

(N) Grout Testing. Previous test results for the proposed grout mix completed within one year of the start of work may be submitted for initial verification of the required compressive strengths for installation of pre-production verification test nails and initial production nails. During production, nail grout shall be tested by the Contractor in accordance with ASTM C109 at a frequency of no less than one test for every 10 cubic yards of grout placed for each day of grout placement. Provide grout cube test results to the Engineer within 24 hours of testing.

(O) Grouting Equipment. Grout equipment shall produce a uniformly mixed grout free of lumps and undispersed cement, and shall be capable of continuously agitating the mix. Use a positive displacement grout pump

equipped with a pressure gauge, which can measure at least twice but no more than three times the intended grout pressure. Size the grouting equipment to enable the entire nail to be grouted in one continuous operation. Place the grout within 60 minutes after mixing or within the time recommended by the admixture manufacturer, if admixtures are used. Grout not placed in the allowed time limit will be rejected.

(P) Grouting Methods. Grout the drill hole after installation of the nail bar. Each drill hole will be grouted within 24 hours of completion of drilling, unless otherwise approved by the Engineer. Inject the grout at the lowest point of each drill hole through a grout tube, casing, hollow-stem auger, or drill rods. Keep the outlet end of the conduit delivering the grout below the surface of the grout as the conduit is withdrawn to prevent the creation of voids. Completely fill the drill hole in one continuous operation. Cold joints in the grout column are not allowed except at the top of the test bond length of proof tested production nails.

During casing removal for drill holes advanced by either cased or hollow-stem auger methods, maintain sufficient grout level within the casing to offset the external groundwater/soil pressure and prevent hole caving. Maintain grout head or grout pressures sufficient to ensure that the drill hole will be completely filled with grout and to prevent unstable soil or groundwater from contaminating or diluting the grout. Record the grout pressures for soil nails installed using pressure grouting techniques. Control grout pressures to prevent excessive ground heave or fracturing.

Remove the grout and nail if grouting is suspended for more than 30 minutes or does not satisfy the requirements of this specification or the Plans, and replace with fresh grout and undamaged nail bar at no additional cost to the State.

(Q) Nail Testing. Perform both verification and proof testing of designated test nails. A minimum of 15 verification tests (not including pre-production verification tests on sacrificial test nails) shall be conducted during the production work. Verification testing on production nails shall be conducted in accordance with the procedures and loading schedule provided in the "Pre-Production Verification Testing on Sacrificial Test Nails." Perform proof testing on at least 10 percent of the production nails in the presence of the Engineer at the locations shown on the plans or designated by the Engineer in the field during construction. A verification test nail successfully completed during production work shall be considered equivalent to a proof test nail and shall be accounted for in determining the number of proof tests required. Perform pre-production verification tests on sacrificial test nails at locations shown on the Plans or listed herein. Perform proof tests on

production nails at locations selected by the Engineer. Do not perform nail testing until the nail grout and shotcrete construction facing have cured for at least 72 hours and attained at least their specified 3-day compressive strength. Testing in less than 72 hours will only be allowed if the Contractor submits compressive strength test results, for tests performed by a qualified independent test laboratory, verifying that the nail grout and shotcrete mixes being used will provide the specified 3-day compressive strengths in the lesser time.

(R) Proof test Nail Unbonded Length. Provide temporary unbonded lengths for each test nail. Isolate the test nail bar from the shotcrete construction facing and/or the reaction frame used during testing. Isolation of a test nail through the shotcrete construction facing shall not affect the location of the reinforcing steel under the bearing plate. Accepted proof test nails may be incorporated as production nails provided the temporary test unbonded length is fully grouted subsequent to testing. Submit the proposed test nail isolation methods, methods for providing an unbonded test length, and methods for grouting the unbonded length subsequent to testing to the Engineer for review and approval in accordance with the Submittal section. Where temporary casing of the unbonded length of test nails is provided, install the casing in a way that prevents any reaction between the casing and the grouted bond length of the nail and/or stressing apparatus.

(S) Testing Equipment. Testing equipment shall include dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The load cell is required for the creep test portion of the verification test. Provide description of test setup and jack, pressure gauge, and load cell calibration curves in accordance with Submittals section.

Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. If the reaction frame will bear directly on the shotcrete construction facing, design it to prevent cracking of the shotcrete. Independently support and center the jack over the nail bar so that the bar does not carry the weight of the testing equipment. Align the jack, bearing plates, and stressing anchorage with the bar such that unloading and repositioning of the equipment will not be required during the test.

Apply and measure the test load with a hydraulic jack and pressure gauge. The pressure gauge shall be graduated in 50 psi increments or less. The jack and pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. Jack ram travel shall be sufficient to allow the test to be done without resetting the equipment.

Monitor the nail load during verification tests with both the pressure gauge and the load cell. Use the load cell to maintain constant load hold during the creep test load hold increment of the verification test.

Measure the nail head movement with a dial gauge capable of measuring up to 0.001 inches. The dial gauge shall have a travel sufficient to allow the test to be done without having to reset the gauge. Visually align the gauge to be parallel with the axis of the nail and support the gauge independently from the jack, wall or reaction frame. Use two dial gauges when the test setup requires reaction against a soil cut face.

(T) Pre-Production Verification Testing of Sacrificial Test Nails. Pre-production verification testing shall be performed in the presence of the Engineer prior to ordering of materials for production nails and installation of production nails to verify the Contractor's installation methods and nail pullout resistance. Perform pre-production verification test at the locations and elevations shown on the Plans, unless otherwise approved by the Engineer. Perform a minimum of two (2) verification tests for each different drilling/grouting method proposed to be used by the Contractor, at each location. Verification test nails will be sacrificial and not incorporated as production nails.

Changes in the drilling or installation method by the Contractor may require additional verification testing as determined by the Engineer and shall be provided at no additional cost to the State. Construct verification test nails using the same equipment, installation methods, nail inclination, and drill hole diameter as planned for the production nails. Payment for additional verification tests required due to differing site conditions, if determined by the Engineer, shall be paid as extra work.

Test nails shall have both bonded and temporary unbonded lengths. Prior to testing, only the bonded length of the test nail shall be grouted. The temporary unbonded length of the test nail shall be at least 3 feet. The bonded length of the test nail shall be determined based on the production nail bar grade and size such that the allowable bar structural load is not exceeded during testing, but shall not be less than 10 feet. The allowable bar structural load during testing shall not be greater than 90 percent of the yield strength for Grade 60. The Contractor shall provide larger verification test bar sizes, if required to safely accommodate the 10 feet minimum test bond length and testing to 2 times the allowable pullout resistance requirements, at no additional cost to the State.

The verification test bonded length (LBV) shall not exceed the test allowable bar structural load divided by 2 times the allowable pullout resistance value. The following equation shall be used for determining the

verification test nail maximum bonded length to be used to avoid structurally over-stressing the verification test nail bar size:

$LBV = C\ f_Y\ A_s / 2\ Q_d$, or 10 feet, whichever is greater.

LBV = Maximum Verification Test Nail Bonded Length (feet)
C = 0.9
f_Y = Bar Yield (60 ksi)
A_s = Bar Steel Area (square inches)
2 = Pullout resistance safety factor
Q_d = Allowable pullout resistance (3.2 kips/lineal foot of grouted nail length, specified herein or on the Plans)

The Design Test Load (DTL) during verification testing shall be determined by the following equation:

DTL = Design Test Load (kips) = L_{BV} X Q_d
L_{BV} = As-built bonded test length (feet)
Q_d = Allowable pullout resistance (3.2 kips/lineal foot of grouted nail length)
MTL = 2.0 x DTL = Maximum Test Load (kips)

Verification test nails shall be incrementally loaded to a maximum test load of 200 percent of the Design Test Load (DTL) in accordance with the following loading schedule. The soil nail movements shall be recorded at each load increment.

VERIFICATION TEST LOADING SCHEDULE	
LOAD	HOLD TIME
AL (0.05-DTL maximum)	1 minute
0.25 DTL	10 minutes
0.50 DTL	10 minutes
0.75 DTL	10 minutes
1.00 DTL	10 minutes
1.25 DTL	10 minutes
1.50 DTL (Creep Test)	60 minutes
1.75 DTL	10 minutes
2.00 DTL (Maximum Test Load)	10 minutes

The alignment load (AL) shall be the minimum load required to align the testing apparatus and shall not exceed 5 percent of the Design Test Load (DTL). Dial gauges shall be set to "zero" after the alignment load has been applied.

Each load increment shall be held for at least 10 minutes. The verification test nail shall be monitored for creep at the 1.50 DTL load increment. Nail movements during the creep portion of the test shall be measured and recorded at 1 minute, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes. The load, during the creep test, shall be maintained within 2 percent of the intended load by use of the load cell.

(U) Proof Testing of Production Nails. Perform proof testing on at least 10 percent of the production nails in the presence of the Engineer at the locations designated by the Engineer in the field during construction. A verification test nail successfully completed during production work shall be considered equivalent to a proof test nail and shall be accounted for in determining the number of proof tests required.

Production proof test nails shall have both bonded and temporary unbonded lengths. Prior to testing, only the bonded length of the test nail shall be grouted. The temporary unbonded length of the test nail shall be at least 3 feet. The bonded length of the test nail shall be determined based on the production nail bar grade and size such that the allowable bar structural load is not exceeded during testing, but shall not be less than 10 feet. The allowable bar structural load during testing shall not be greater than 90 percent of the yield strength for Grade 60 bars.

The proof test bonded length (L_{BP}) shall not exceed the test allowable bar load divided by 1.5 times the allowable pullout resistance value, or above minimum lengths, whichever is greater. The following equation shall be used for sizing the proof test nail bonded length to avoid over-stressing the production nail bar size.

$L_{BP} = C\ f_y A_s / 1.5\ Q_d$, or above minimum lengths, whichever is greater.

L_{BP} = Maximum Proof Test Nail Bonded Length (feet)
C = 0.9 for Grade 60 bars
f_Y = Bar Yield Stress (60 ksi)
A_s = Bar Steel Area (square inches)
1.5 = Pullout resistance safety factor
Q_d = Allowable pullout resistance (3.2 kips/lineal foot of grouted nail length)

The Design Test Load (DTL) during proof testing shall be determined by the following equation:

DTL = Design Test Load (kip) = $L_{BP} X\ Q_d$
L_{BP} = As-built bonded test length (feet)

Q_d = Allowable pullout resistance (3.2 kips/lineal foot of grouted nail length)
MTL = 1.5 X DTL = Maximum Test Load (kip)

Proof test shall be performed by incrementally loading the proof test nail to a maximum test load of 150 percent of the Design Test Load (DTL). The nail movement at each load shall be measured and recorded by the Engineer in the same manner as for verification tests. The test load shall be monitored by a load cell or a jack pressure gauge with a sensitivity range meeting the requirements of pressure gauges used for verification test nails. At load increments other than the maximum test load, the load shall he held long enough to obtain a stable reading. Incremental loading for proof tests shall be in accordance with the following load schedule. The soil nail movements shall be recorded at each load increment.

PROOF TEST LOADING SCHEDULE	
LOAD	**HOLD TIME**
AL (0.05-DTL maximum)	Until Stable
0.25 DTL	Until Stable
0.50 DTL	Until Stable
0.75 DTL	Until Stable
1.00 DTL	Until Stable
1.25 DTL	Until Stable
1.50 DTL (Maximum Test Load)	See Below

The alignment load (AL) shall be the minimum load required to align the testing apparatus and shall not exceed 5 percent of the Design Test Load (DTL). Dial gauges shall be set to "zero" after the alignment load has been applied.

All load increments shall be maintained within 5 percent of the intended load. Depending on performance, either 10 minute or 60 minute creep tests shall be performed at the maximum test load (1.50 DTL). The creep period shall start as soon as the maximum test load is applied and the nail movement shall be measured and recorded at 1 minute, 2, 3, 5, 6, and 10 minutes. Where the nail movement between 1 minute and 10 minutes exceeds 0.04 inches, the maximum test load shall be maintained an additional 50 minutes and movements shall be recorded at 20, 30, 50, and 60 minutes.

(V) Test Nail Acceptance Criteria. A test nail will be considered acceptable by the Engineer when:

(1) For the verification tests, a total creep movement of less than 0.08 inch per log cycle of time between the 6 and 60 minute readings is measured during creep testing and the creep rate is linear or decreasing throughout the creep test load hold period.

(2) For the proof tests, a total creep movement of less than 0.04 inch is measured between the 1 and 10 minute readings or a total creep movement of less than 0.08 inch is measured between the 6 and 60 minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.

(3) The total measured movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the test nail unbonded length.

(4) A pullout failure does not occur at the maximum test load. Pullout failure is defined as the load at which attempts to further increase the test load simply result in continued pullout movement of the test nail. The pullout failure load shall be recorded as part of the test data.

Successful proof tested nails meeting the above test acceptance criteria may be incorporated as production nails, provided that (1) the unbonded length of the test nail drill hole has not collapsed during testing, (2) the minimum required drill hole diameter has been maintained, (3) the specified corrosion protection is provided, and (4) the test nail length is equal to or greater than the scheduled production nail length. Test nails meeting these requirements shall be completed by satisfactorily grouting up the unbonded test length. Maintaining the temporary unbonded test length for subsequent grouting is the Contractor's responsibility. If the unbonded test length of production proof test nails cannot be satisfactorily grouted subsequent to testing, the proof test nail shall become sacrificial and shall be replaced with an additional production nail installed at no additional cost to the State.

(W) Test Nail Rejection. If a test nail does not satisfy the acceptance criterion, the Contractor shall determine the cause.

(X) Verification Test Nails. The Engineer will evaluate the results of each verification test. Installation methods that do not satisfy the nail testing requirements will be rejected. The Contractor shall propose alternative methods and install replacement verification test nails. Replacement test nails shall be installed and tested at no additional cost to the State.

(Y) Proof Test Nails. The Engineer may require the Contractor to replace some or all of the installed production nails between a failed proof

test nail and the adjacent passing proof test nail. Alternatively, the Engineer may require the installation and testing of additional proof test nails to verify that adjacent previously installed production nails have sufficient load carrying capacity. Contractor modifications may include, but are not limited to, the installation of additional proof test nails; increasing the drill hole diameter to provide increased capacity; modifying the installation or grouting methods; reducing the production nail spacing from that shown on the Plans and installing more production nails at a reduced capacity; or installing longer production nails if the pullout capacity behind the failure surface controls the allowable nail design capacity. Installation and testing of additional proof test nails or installation of additional or modified nails as a result of proof test nail failure(s) will be at no additional cost to the State.

(Z) Nail Installation Record. Records documenting the soil nail wall construction will be maintained by the Contractor, unless specified otherwise. The Contractor shall provide the Engineer with as-built drawings showing as-built nail locations and as-built shotcrete construction facing line and grade within 5 days after completion of the temporary shotcrete facing.

656.07 Method of Measurement.

(A) Furnishing Specialty Equipment. The Engineer will not measure furnishing specialty equipment for payment.

(B) The Engineer will measure soil nails per linear foot including the pre-production verification tests on sacrificial test nails. The length to be paid will be the length measured along the bar centerline from the back face of the shotcrete construction facing to the bottom tip end of nail bar as shown on the plans. No separate measurement will be made for verification test nails and proof tests, which shall be considered incidental to soil nail installation.

(C) The Engineer will measure structure excavation for soil nail wall as structure excavation under Section 206 – Excavation and Backfill for Conduits and Structures.

(D) The Engineer will measure shotcrete construction facing and wall drainage under Section 628 - Shotcrete.

(E) The Engineer will measure concrete footing and facing for soil nail retaining wall permanent facing under Section 503 – Concrete Structures.

656.08 Basis of Payment.

(A) Furnishing Specialty Equipment. The Engineer will pay for the accepted furnishing specialty equipment on a lump sum basis complete in

place. The price includes full compensation for furnishing and moving the specialty equipment and necessary tools and equipment to the project, setting the equipment up at the locations and removing the equipment from the project.

The Engineer will make payment of 60% of the contract amount for this item when all specialty equipment and supplies are available at the project site and ready to conduct the pre-production verification tests on sacrificial test nails.

The Engineer will make payment for the remaining 40% of the contract amount when all the soil nails have been installed, tested, and accepted by the Engineer.

(B) The Engineer will pay for the accepted quantities of soil nails including the pre-production verification tests on sacrificial test nails at the contract unit price per linear foot. Payment will be full compensation for all labor, equipment, materials, shop drawings and calculations, field tests and incidentals necessary to perform the wall alignment survey control and construct the soil nails in accordance with the contract.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Furnishing Specialty Equipment	Lump Sum
Soil Nails (No. ___ Bar)	Linear Foot

The Engineer will pay for structure excavation for soil nail wall as structure excavation under Section 206 – Excavation and Backfill for Conduits and Structures.

The Engineer will pay for shotcrete construction facing and wall drainage under Section 628 – Shotcrete.

The Engineer will pay for concrete footing and facing for the soil nail retaining wall permanent facing under Section 503 – Concrete Structures."

END OF SECTION

Make the following Section a part of the Standard Specifications:

"SECTION 657 – SOIL STABILIZATION BY JET GROUTING

657.01 Description. This section includes requirements for constructing stabilized soil-cement jet grout columns, consisting of soil mixed with cement grout, by the jet grouting method for support of a portion of the existing highway embankment and the new highway embankment at selected locations shown on the Contract Documents. The work includes drilling test probes, mobilizing specialty equipment for jet grouting, determining suitable jet grouting procedures and grout mixes, performing a test program and evaluating the test results, installing production jet grout columns, installing instrumentation and monitoring settlement, providing traffic control, restoration, and clean up and disposal of waste materials resulting from jet grouting including all labor, equipment, and materials to complete this work as specified herein.

The term "Jet Grouting" refers to the process of creating stabilized soil-cement columns in place utilizing a grout mix delivered at pressure through a special drill bit that has high-speed horizontal jets. High-pressure water or water and air jets are used to excavate columns in the materials to be stabilized. The soil-cement columns are constructed by withdrawing the rotating drill bit at a slow, constant speed; cutting the soil with water and air jets; pumping a tremie cement grout slurry and mixing it simultaneously with soil cuttings through the drill bit; and thoroughly mixing the soil cuttings and grout to produce continuous columns of consistent geometry and quality.

The term "Jet Grout Columns" refers to jet-grouted stabilized soil-cement columns constructed to support the weight of the existing and future highway embankment loads to reduce the load transfer of the embankment loads onto the soft foundation soils at the locations designated on the Contract Documents.

The term "Bearing Material" refers to soil or rock deposits with adequate strength and low compressibility to provide support for long-term loads transmitted by the jet grout columns.

657.02 Qualifications of Jet Grouting Contractor. The Jet Grouting Contractor shall be capable of performing the work specified and shall have the following minimum experience requirements below.

Because of the expertise required to successfully complete the soil stabilization by jet grouting according to the contract, a qualified Jet Grouting Contractor shall install the jet grout columns. The Jet Grouting Contractor shall have installed jet grout columns in soft cohesive soils in at least five projects completed in the last three years on which the Contractor has installed a minimum of 2,000 cubic yards of soil stabilization by jet grouting of a diameter and depth similar to those shown in the contract. The Jet Grouting Contractor shall have

supervisory personnel who participated in the construction of jet grout columns similar to the type proposed for a duration of at least three years within the last 10 years. Those supervisory personnel shall be on the project for the entire duration of the jet grouting operation.

657.03 Materials. All materials for soil stabilization by jet grouting shall conform to the following requirements.

(A) Grout. Grout shall be a mixture of Portland cement, water, and bentonite or other admixtures, if required. The grout shall be mixed in a grout plant, which combines dry cement and water in predetermined proportions. Grout mix shall have a consistency that is fluid and pumpable. It shall be proportioned to provide the required strength and mixing consistency. The grout utilized shall provide jet grout columns that meet the requirements specified in this section.

(B) Cement. Portland cement, ASTM C 150, Type I or II. The cement shall be adequately protected from moisture and contamination while in transit and storage at the job site.

(C) Bentonite. Premium grade Wyoming sodium Montmorillonite, or equal, manufactured in accordance with American Petroleum Institute (API) Standard 13A. Grout mix shall not contain more than two (2) percent bentonite, by dry weight and cement, and shall contain an adequate amount of cement to meet the strength requirements specified in this section.

(D) Water. Fresh and potable water shall be used.

(E) Admixtures. Admixtures may be used as necessary to satisfy specified strength and permeability requirements and as required to improve pumpability, to control set time, and to prevent segregation and bleeding. Admixtures shall conform to ASTM C 494 requirements.

(F) Grout Mix. The grout mix utilized shall provide jet grout columns that meet the requirements specified in this section, as confirmed by the test program results specified herein.

Deliver all materials in undamaged and unopened containers bearing the manufacturer's original label. Store and handle grout materials in accordance with the manufacturer's recommendations.

657.04 Equipment.

(A) Drilling Equipment. All jet grouting equipment used for drilling boreholes; lowering, raising, and rotating grout tubes; mixing grout; injecting grout and air-water; and grout tubes shall have proven performance records

for use in performing similar jet grouting work and shall be suitable for the Work.

(B) Mixers. Grout mixers, holding tanks, mixing plan, and associated equipment shall be of a type and capacity for producing a uniform grout mixture at the times, and in the quantities required for the timely prosecution of the work.

(C) Jet Pumps. Pumps shall be high pressure pumps capable of delivering the grout at the flow rates and pressures required for the performance of the work in accordance with this section.

(D) Recording Equipment. Provide automatic recording equipment with a digital readout that will provide instantaneous, simultaneous records of the jet grouting parameters for each jet grout column at vertical intervals no greater than 0.5 feet. As a minimum, the digital drilling and grouting parameter recorder shall provide the following information: Date and time, depth, density of injected grout, cumulative injected volume of grout, grout injection pressure, grout injection rate of flow, air injection pressure, air injection rate of flow, and drill string revolutions per minute. A printed copy of the records shall be provided with the daily shift reports.

(E) Other. Spare parts and/or equipment shall be available on site to maintain jet grouting equipment in satisfactory operating condition at all times during execution of the jet grouting work. Any jet grout hole or column lost or damaged as a result of mechanical failure or equipment, inadequacy of grout, air, or water supplies, or improper drilling or injection procedures or anything that results in the jet grout hole or jet grout column, that in the opinion of the Engineer, does not meet the requirements of the Contract Documents shall be re-grouted, or backfilled with cement grout and/or replaced with another hole or jet grouted column at no additional cost to the State, using a remedial repair that is acceptable to the Engineer.

657.05 Pre-Construction Requirements.

(A) Experience Information. The Jet Grouting Contractor shall submit the following information to the Engineer for review and approval within 30 days after award of contract.

(1) The Jet Grouting Contractor shall submit a project reference list verifying the successful completion of at least five projects utilizing jet grouting in soft cohesive soils during the past three years totaling at least 2,000 cubic yards of soil stabilization by jet grouting. A brief description of each project with the Owner's name, contact person, and current phone number shall be included. Work shall not start nor

materials ordered until the Engineer's written acceptance of the Contractor's qualification is given.

(2) The Jet Grouting Contractor shall submit a list identifying the on site superintendent and drill rig operators assigned to the project. A full-time jet-grouting superintendent, who has been in charge of supervising jet grouting operations on at least five similar jet grouting projects, shall be assigned to the project. The personnel list shall contain a summary of each individual's experience, which shall state the person's duties and position title on that particular project, and be complete enough for the Engineer to determine whether each individual satisfies the required qualifications. The Engineer will review and comment on the personnel list submittal. If the submittal is acceptable, then the Engineer will respond in writing on the acceptability of the submittal. If the submittal is not acceptable then the submittal will be returned and the Contractor will address all of the State's comments. The response shall include, if necessary, but shall not be limited to, the replacement of listed personnel. Modification to the personnel list shall be done at no additional cost to the State. No changing of the jet grouting superintendent will be allowed without the submittal and review of the replacement and its acceptance.

(3) The Jet Grouting Contractor shall submit a list identifying the AASHTO accredited independent testing agency to be utilized for the project. All testing shall be performed by an AASHTO accredited independent testing agency, which can certify compliance with the requirements of ASTM E 329. The laboratory shall be able to demonstrate experience performing the laboratory tests required herein.

The Engineer may suspend the Work if the Contractor uses personnel or a testing laboratory for the Work that has not been found acceptable by the Engineer. If work is suspended, the Contractor shall be fully liable for all resulting costs and no adjustment in contract time will result from the suspension.

(B) Work Plans and Grouting Methods. Submit a detailed work plan at least 30 days prior to the work describing the proposed grouting methods and equipment to be used including the following. Provide sufficient detail to allow the Engineer to be the sole judge of whether or not the proposed equipment, materials, and procedures will meet the requirements of this Contract. No jet grouting work shall start until the work plan and grouting method have been accepted in writing by the Engineer.

(1) Description of grout plant, equipment, and manufacturer's literature describing their capabilities.

(2) Methods and equipment proposed for drilling jet grout column holes.

(3) Arrangement and description of grout mixing, recording, and injection equipment, layout of jet grout columns based on the typical layout shown on the Contract Documents, and other details to illustrate the plan for setting up at each location where jet grouting is required.

(4) Schedule and sequence for completing jet grouting test program and production jet grouting work.

(5) Grout mix design, sources of mix materials, admixtures (including manufacturer's literature), and material data demonstrating compliance with requirements specified herein. Grout mix design shall include target range for specific gravity, Marsh Viscosity, and/or bleed that will produce acceptable grout strength. Provide 7 and 28-day design compressive strengths for neat cement grout mix.

(6) Quality control procedures including record keeping, field testing, sampling, and laboratory testing of completed jet grout columns.

(7) Manufacturer's catalogs of the required instrumentation equipment to be supplied and details of the proposed installation methods. The actual locations of the instrumentation required will be determined by the Engineer after evaluating the information from the test probes and the Contractor's submittal showing the exact locations of the production jet grout columns.

(8) NPDES Best Management Practices for all of the Contractor's jet grouting and related work.

(C) Jet Grout Test Program. The Contractor shall perform a test program based on the test jet grout column layout as shown on the Contract Documents. The Contractor shall demonstrate that the procedures for the test program, such as the proposed jet grouting methods and equipment, will produce acceptable results. Provide details of the sampling and testing programs to determine quality and properties of the jet grout columns installed. Subject to the results of the test program, the Engineer, at its sole discretion, may require the Contractor to modify the jet grout procedures and equipment to achieve acceptable results. Depending on the test program results, and extent of modifications necessary, the Contractor may be required to construct another test section, which shall be at no additional cost to the State. The location will be selected by the Engineer.

(1) As part of the test program, the Contractor shall drill the test probes, each extending to depths of about 30 to 90 feet below the ground surface, at the approximate locations shown on the Contract Documents. The drill rig used to perform the test probes (including all sampling and testing equipment) shall have the capability to extend to depths of at least 120 feet below the ground surface. The test probes shall be for the purpose of obtaining additional subsurface information for the soil stabilization by jet grouting and to verify the subsurface conditions at the site. The locations of the test probes are as indicated on the Contract Documents. Soil samples (or continuous core samples using triple tube core barrels) shall be obtained from the test probes generally at 5-foot intervals in accordance with ASTM D 1586 and ASTM D 2113, or whenever directed by the Engineer. The test probes shall be performed in the presence and continuous monitoring of the Engineer. The Contractor shall provide the Engineer a minimum of 7 days advance notice to schedule the observation and logging of the test probes.

(2) The minimum unconfined compressive strength of the jet grout columns shall be 200 and 400 psi at 7 and 28 days, respectively, for the soil-cement material for jet grout columns.

(3) Conduct a test program to evaluate the proposed grouting methods and the ability of the proposed grout mix to produce jet grout columns meeting the diameter, depth, and material property requirements shown on the Contract Documents, the submittals found acceptable by the Engineer, and as specified herein. Test program shall be conducted and evaluated including the results of 28 day strength tests and found acceptable by the Engineer prior to starting production jet grouting work. The location of the test section is as shown on the Contract Documents. The Contractor may re-locate the test section location if found acceptable by the Engineer in writing. The new location shall be within 100 feet (laterally) of available boring data, or the Contractor will provide pertinent subsurface data to the required test depths. The relocation of the test section and the supplying of the required pertinent subsurface data shall be at no additional cost to the State.

(4) The purpose of the test program shall be for the Contractor to determine appropriate jet grouting systems and grouting parameters for grout mix, grout pressures, rotational speed, lifting rate, grout flow rate, number and size of jet nozzles, and drilling methods, for the anticipated conditions where jet grouting is required. In addition, it the test program shall also demonstrate that the Contractor's means and methods meet the requirements of the Contract Documents. During

the testing program, the Contractor shall utilize the same suitable jet grouting equipment available including water jet, and water/air jet, as it intends to use for its production jet grouting work.

(5) The jet grout test program shall be designed by the Contractor to verify the following items:

(a) The range of jet grout column diameters, inclination angles, jet grouting depths, and strengths that can be achieved.

(b) Maximum pressures that can be used before ground surface heave occurs.

(c) A minimum of one test section with the layout configuration as shown on the Contract Documents shall be performed. The test section shall consist of a minimum of three jet grout columns each 80 feet deep, that are constructed using the same procedures and equipment proposed for the production jet grouting work. All test jet grout columns shall be installed from near the existing ground surface to allow for later excavation for physical inspection. Excavation to expose the jet grout columns of the test section (after the jet grout columns have hardened sufficiently) shall not be sooner than 7 days after the jet grout columns have been constructed.

(d) A minimum of six "feeler" pipes consisting of a minimum 1-inch diameter steel pipe shall be installed within the jet grout columns of the test section, as shown on the Contract Documents or as modified by the Engineer prior to jet grouting. The steel "feeler" pipes shall extend to the maximum depth of the jet grout columns of the test section.

(e) Execute the test program in accordance with the submittals found acceptable by the Engineer. The Contractor shall expose the upper 20 feet of the jet grout columns in the test section for physical inspection by the Engineer. Measure the jet grout column diameter and compare with the design parameters. Excavation to expose the jet grout columns of the test section shall be after the jet grout columns have hardened sufficiently and shall not be sooner than 7 days after the jet grout columns have been constructed.

(f) After the test jet grout columns have set up sufficiently, obtain continuous core samples (full depth of the jet grout column) from the jet grout columns of the test section (as

shown on the Contract Documents) using the methods specified in the paragraph entitled "Core Samples." The Engineer will inspect the core samples and check for segregation. Select six samples from each test jet grout column cored and perform compression tests on four of the samples in accordance with ASTM D 1633 or ASTM D 2850, as appropriate. Acceptance or rejection of the unconfined compressive strength of the jet grout column will be based on the average unconfined compressive strength test results of the four core samples obtained from the same jet grout column. The lowest unconfined compressive strength of the four core samples shall not be less than 80 percent of the minimum compressive strength indicated in the contract documents. In addition, only one of the four cores tested shall be below the minimum compressive strength indicated in the contract documents.

(g) If the results of the test program are not satisfactory, the Engineer may require modifications to the jet grout column construction procedures, material and equipment. Depending on the extent of the modifications, the Contractor shall be required to construct another test section, at no additional cost to the State until the Contractor's test program produces satisfactory results. The Contractor shall not start construction of any production jet grout columns until it receives written acceptance from the Engineer of the construction procedures, materials, and equipment developed in the testing program that produced acceptable results.

657.06 Construction Requirements.

(A) General Jet Grouting Procedures. Jet grout injection, grout rod rotation and extraction rates shall be sufficient to produce jet grout columns meeting the minimum diameter of 60 inches, depth and material property requirements specified in the contract documents, i.e., production jet grouting columns shall have the same material property requirements as the test jet grout columns except if noted in this subsection. Use the same equipment, materials, and procedures as those determined in the test program to achieve satisfactory results to perform production jet grouting work. The general procedure for constructing each individual jet grout column shall be as follows:

(1) The jet grout rod shall be advanced to the depth indicated on the drawings and accepted submittals (or as modified by the Engineer based on the test probes).

(2) The grout shall be pumped through the rods and water/air pumped through the nozzles. The rods shall be slowly rotated and withdrawn in prescribed increments as determined in the test program creating the jet grout column.

(3) Excess grout and soil from jet grouting operations shall be contained in mud tanks or by other methods found acceptable by the Engineer to facilitate rapid cleanup of work area at the end of each shift and to prevent pollution. Dispose of all excess grout and soil at a site located outside project limits. . If encountered, contaminated soil and groundwater shall be disposed of in accordance with the applicable sections of the contract documents.

(4) The drilling and grouting sequence shall allow adequate set time between jet grout columns to complete a properly grouted zone.

(5) The Contractor shall implement best management practices in performing jet grouting work and to avoid any discharge of grout or return slurry into storm drainage structures or waters of Hawaii.

(6) Equipment for mixing, holding, and pumping grout shall be in a secure location and shall be operated to minimize spillage of material and release of dust into the environment. No water, waste, grout, bentonite or soil shall be allowed on the highway, and road pavements, sidewalks or be allowed to enter storm drains or waters of Hawaii.

(7) At the completion of daily jet grouting operations, thoroughly clean site and dispose of all debris, water, waste grout, and spilled material and clean and restore the pavement to allow passage of traffic.

(B) Construction Requirements. Use the same equipment, materials, and procedures as in the test program, which achieved satisfactory results to perform production jet grouting work and was found acceptable by the Engineer. No jet grout columns shall be constructed without all the required instruments and monitoring devices operating accurately and properly. The Contractor shall check all required instruments and monitoring devices at the start of jet grouting to assure that they are operating accurately and properly. No soil stabilization by jet grouting work shall start or continue if the required instruments and monitoring devices are not operating accurately and properly. The general procedure for constructing each individual jet grout column shall be as follows:

(1) **Jet Grout Zones.** The jet grout zones shall be constructed to the depths and minimum extent as indicated on the drawings or as

modified by the Engineer in the submittals found acceptable by the Engineer. The jet grout columns shall be vertical and/or inclined as required to avoid existing utilities or other surface features. Inclined columns shall not be flatter than 1:10 (horizontal to vertical).

(2) Unsatisfactory Jet Grout Columns. Additional replacement jet grout columns shall be installed, as directed by the Engineer, at no additional cost to the State, if the performance requirements of the jet grout columns specified in the contract documents are not achieved.

(3) Jet Grout Column Locations.

(a) The jet grout column locations shall be drawn to scale based on the typical jet grout layout shown on the Contract Documents and numbered for the entire area requiring soil stabilization and shall be submitted to the Engineer for acceptance. The Engineer shall determine the size of the plan sheets and the scale of the drawing. The jet grout column locations shall be surveyed, checked, and marked on the ground by the Contractor before the start of drilling and after installation. The jet grout column layout shall be based on the minimum jet grout column diameter shown on the Contract Documents and the submittal found acceptable by the Engineer. The Engineer may request adjustments to the jet grout column locations or inclination in the field to avoid utilities or other obstructions. The Contractor shall make these adjustments, when accepted by the Engineer, and document these modifications on as-built drawings. The location of each jet grout column shall be noted and recorded on the daily shift report.

(b) Obstructions. If the drill hole cannot be completed to the depth shown on the Contract Documents because of the presence of an man-made obstruction, grouting operations for that hole shall be temporarily suspended and the situation immediately reported to the Engineer. When directed by the Engineer, relocate the hole and install one or more inclined or vertical jet grout columns that provide at least the same zone of treatment as the original drill hole. If the obstruction is not a live utility or a structural member, and is penetrable by rotary drilling methods, the drilling/grouting operation shall be continued. The presence of obstructions shall be noted and recorded on the daily shift reports.

(5) Jet Grout Column Inclination.

(a) Jet Grout Columns installed shall be vertical. Only when utilities or other man-made obstructions are encountered may the jet grout columns to be inclined to avoid those conflicts. The inclination of each jet grout column shall be noted and recorded on the daily shift report. The maximum inclination of the jet grout column shall not be flatter than 1:10 (horizontal to vertical) and shall also be within the inclination range determined by the test program unless accepted by the Engineer in writing.

(b) Before the start of drilling, the correct inclination of the mast shall be checked using a level by the operator. Measurements shall be made in at least two directions that are 90 degrees apart from each other.

(c) The drilling/grouting rods shall be of sufficient stiffness to ensure that the deviation of jet grout columns from the theoretical axis is maintained at 1:200 (horizontal to vertical) or less.

(6) Jet Column Depth and Height. Jet grout column depth and height shall be as indicated on the Contract Documents and the submittals found acceptable by the Engineer. If the plans and the submittals have a conflict, the Engineer will determine which jet grout column depth and height will be used. To ensure that the correct jet grout column depth elevations are achieved in the jet grouting process, jet grout column depth elevations shall be converted to jet grout column depths on a hole by hole basis by the Contractor. This information will then be provided to the drill operator for use in determining the correct depths to be used in the field.

(a) The jet grout column depth shall be measured with respect to ground level by observing the length of the rods inserted. Markings shall be located on the drill mast in 1-foot increments to assist the drill operator in determining the exact depth. In addition, the jet grout column depth shall be verified with an electronic depth meter and shall be recorded by the digital drilling and grouting parameter recorder and a printed report of the data shall be included with the daily shift reports.

(b) The depth to the bottom and height of each jet grout column shall be noted and recorded on the daily shift report.

(7) **Grout Mixing.** A mixing plant shall be used for the preparation of the grout. The mixing plant shall consist of cement silo, high-speed grout mixer, grout agitator, grout pumps and control unit, as required. The plant shall be capable of supplying a uniform grout mixture in the quantities required for timely prosecution of the work.

(a) Mix cement, water, and any admixtures in the proportions indicated in the submittals accepted by the Engineer. If bentonite is used, add bentonite to water and mix thoroughly to fully hydrate prior to adding cement. Time of mixing shall be as required to fully hydrate the cement but not less than 5 minutes. Any grout after 90 minutes of mixing shall not be used and shall be wasted and properly disposed.

(b) The grout mix proportions for each jet grout column shall be noted and recorded on the daily shift reports.

(8) **Grout Injection Rate and Pressure.**

(a) The grout injection rate shall be monitored by counting the strokes of the piston pump in a fixed period of time and shall be confirmed by using an electronic flow meter.

(b) Use automatic recording equipment to measure the volume of grout injected into each jet grout column.

(c) The grout injection pressure shall be monitored with calibrated pressure gauges mounted on the injection lines. Prior to the start of each jet grout column, the pressure shall be checked to verify that there is no blockage in the jet grout rods. Maintain an adequate supply of backup pressure gauges to replace broken or defective gauges without delaying the work.

(d) The grout injection rate, volumes injected, and injection pressure for each jet grout column shall be noted and recorded on the daily shift reports. The grout injection rate, the volume of grout injected, and injection pressures shall be recorded by the digital drilling and grouting parameter recorder and a printed report of the data shall be included with the daily shift reports.

(9) **Air/Water Pressure.** The air pressure shall be checked on the pressure gauges mounted on the compressor and drill rig. The air pressure shall be noted and recorded for each jet grout column on the daily shift reports. The air pressure shall also be recorded by the

digital drilling and grouting parameter recorder and a printed report of the data shall be included with the daily shift reports.

(10) Rotation and withdrawal Rate.

(a) The rate of rotation shall be controlled by adjusting the rotary head speed. It shall be checked by counting the number of rotations of the drilling/grouting rods in a fixed period of time and shall be recorded by the digital drilling and grouting parameter recorder and a printed report of the data shall be included with the daily shift reports.

(b) The rate of withdrawal shall be controlled by an electronic sensor mounted on the mast. It shall be checked measuring the length of the drilling/grouting rods extracted in a fixed period of time and shall be recorded by the digital drilling and grouting parameter recorder and a printed report of the data shall be included with the daily shift reports.

(c) The rate of rotation and withdrawal of jet grout rods shall be noted and recorded for each jet grout column on the daily shift reports.

(11) Prevention of Ground Heave. The Contractor is responsible to control ground heave during jet grouting. In order to prevent ground heave during jet grouting, the drilling shall be carried out with an oversize drill bit with respect to the drilling/grouting rods.

The annulus between the rods and the borehole shall be kept free at all times during the grouting. In case the return of the spoil becomes partially blocked, grouting shall be stopped and the blockage shall be cleared by the Contractor before grouting operations are resumed.

(12) Materials and Sampling. During the installation of all production jet grout columns, quality control sheets shall be submitted to the Engineer to document the results of the tests carried out on grout and soil-cement samples. Test results shall be submitted, as they are completed, but no later than a seven days after they are completed.

(C) Jet Grouting Reports. Prepare and submit daily shift reports for the jet grouting test program and the production jet grouting. The Contractor's proposed report forms shall be submitted to the Engineer for approval prior to the start of work. As a minimum, the reports shall include the following:

(1) Indicate the equipment used on site, including grout batch plant, drill rig, power supply and drill tooling.

(2) Indicate the location of the jet grouting work by station and indicate on a sketch or drawing.

(3) Jet grout column identification including column number, diameter, length, location, and inclination.

(4) Time and date of beginning and completion of each jet grout column. Note any interruptions or delays and the causes of these interruptions or delays.

(5) Grout mix data, including mix proportions and other materials used in the construction of the jet grout column.

(6) Grout flow rates, grout pressure, density and total grout quantity used to construct each jet grout column.

(7) Water/air jet pumping pressures used to construct each jet grout column.

(8) Rates of rotation and withdrawal of jet rods for each jet grout column including the jet grout column bottom depth.

(9) Number and identification of grout and soil-cement samples obtained.

(10) Other pertinent observation, such as utilities, presence of obstructions, loss of spoil/grout return, grout escape, ground heave, or other unusual behavior during drilling or grouting.

(11) As-built drawings indicating the locations of jet grout columns installed and temporary restoration details for the highway pavement.

(D) **Quality Control.** All quality control testing for the grout mix, grout and soil-cement samples, core samples etc., mentioned below in this sub-section shall be done by the Contractor's AASHTO accredited independent testing laboratory, which was found acceptable by the Engineer.

(1) **Grout Mix.** Grout mix uniformity shall be verified by the Contractor by unit weight (density) measurements of the mixed grout by mud balance, Marsh Viscosity, and/or bleed from samples taken from the grout return line in the presence of the Engineer. Testing shall be performed in accordance with API Standard 13B test method. Testing frequency shall be at least one group of tests for every two

hours that grout is mixed and pumped. Complete and accurate records shall be kept to verify that grout mix is acceptable.

(2) Grout and Soil-Cement Samples.

(a) During the execution of the production jet grout columns, the Contractor shall measure the following items daily on the liquid samples of grout:

1. Unit Weight,

2. Marsh Viscosity, or

3. Bleeding at 1 and 2 hours.

(b) The following wet samples shall be taken by the Contractor at locations designated by the Engineer for testing (costs for all testing will be considered incidental to the jet grouting work):

1. Two sets of three samples each (6 samples total) of the cement grout used for the construction of one of the jet grout columns shall be fabricated in accordance with ASTM C 109. The Engineer will select a total of 10 jet grout columns for which samples shall be fabricated and tested by the Contractor.

2. Two sets of three wet samples (6 samples total) of the soil-cement mixture shall be obtained from within the jet grout column before it has reached its initial set. These "wet" samples shall be taken from locations and depths designated by the Engineer by the Contractor. The Engineer will select a total of 10 jet grout columns for which wet samples shall be obtained and tested by the Contractor.

3. Each of these samples shall be stored in a damp environment at constant temperature in accordance with applicable ASTM procedures (ASTM D 1632) by the Contractor's laboratory. Cylinder molds shall be sized accordingly, to provide a representative sample of soil-cement. Pieces of debris, gravel, coral, or clay balls should be screened off using an appropriate sieve, as determined appropriate by the Engineer.

4. After the samples have cured sufficiently, they shall be taken to the Contractor's AASHTO accredited independent testing laboratory for testing.

5. For each jet grout column being tested two grout samples and two soil-cement samples shall be subjected to a compressive strength test at 7 days in accordance with ASTM C 39 or C 109 and ASTM D 1633, respectively. The remaining samples taken from that jet grout column shall be subjected to compressive strength test at 28 days following the appropriate ASTM testing procedures.

(3) Core Samples. In addition to the wet samples, when the jet grouting has reached sufficient strength, a total of twenty (20) jet grout columns shall have vertical core samples taken from the full depth of the treated zone. The locations will be selected by the Engineer (generally located within the outer one-third of the jet grout column). Recovery of the core within the treated zone shall not be less than 85% or the Contractor shall core additional holes until the recovery requirement is met. This shall be done at no additional cost to the State. The drill hole resulting from the coring operations shall be grouted with sand-cement grout to seal the hole and is incidental to the core samples.

(a) The coring or sampling operations shall be scheduled according to the jet grouting and construction activities schedule and performed with suitable equipment in the presence of the Engineer.

(b) Triple tube core barrels with thin walls shall be employed to obtain a continuous core sample of the jet grout columns. The nominal size of the core barrel shall be 2.5-inch ID or greater. Drilling shall be performed using rotary wash or air rotary methods by an experienced driller familiar with performing triple tube coring of weakly cemented soils or soft rocks.

(c) All cores and samples shall be taken to the Contractor's AASHTO accredited independent laboratory where they shall be stored in a moist environment at constant temperature in accordance with ASTM D 1632. Extreme care shall be exercised in handling the cores at the site, in transport, and at the laboratory such that the cores do not become disturbed or otherwise damaged prior to testing.

(d) The cores of jet grout columns shall be examined for continuity of the treatment by the Engineer. The Engineer will designate what portion of the core shall be used for the compressive strength test and then those portions of the core shall be subjected to unconfined compressive strength tests at 28 days. A minimum of four unconfined compressive strength tests shall be performed for each cored location. Acceptance of the minimum unconfined compressive strength of the jet grout column will be based on the average unconfined compressive strength test results of the four core samples obtained from the same jet grout column. The lowest unconfined compressive strength of one of the core samples shall not be less than 80 percent of the minimum compressive strength indicated in the contract. The remaining three core samples shall meet or exceed the minimum compressive strength indicated in the contract. All testing results shall be recorded on a quality control sheet.

(e) If samples tested do not meet specified strength requirements or if the unconfined compressive strength of any of the core samples is less than 80 percent of the minimum compressive strength, then additional replacement jet grout columns shall be installed, or other provisions shall be implemented, as accepted by the Engineer, to compensate for the lower strength jet grout columns at no additional cost to the State.

(4) Steel "Feeler" Pipes. To evaluate the diameter of the jet grout columns, a "feeler" pipe consisting of a minimum 1.0-inch diameter steel pipe shall be installed in ten (10) percent of the total number of jet grout columns. The steel 'feeler' pipes shall be installed in jet grout columns designated by the Engineer prior to jet grouting the jet grout column. The steel "feeler" pipes shall extend to the maximum depth of the jet grout columns. The steel "feeler" pipes shall also extend to the maximum radius of the jet grout columns to evaluate the radial extent of the jet grouting. The Contractor shall monitor the steel "feeler" pipes in the presence of the Engineer to evaluate if the jet grouting parameters need to be adjusted to meet the specified requirements.

(E) Instrumentation and Monitoring. The multi-level vibrating wire piezometers, the settlement plates equipped with vibrating wire pressure sensors and the data collection system shall be compatible with each other and work seamlessly with each other without any additional hardware or software not provided with these instruments.

(1) Multi-level Vibrating Wire Piezometers. The Contractor shall retain the services of an experienced Geotechnical Engineer (QUALIFICATIONS?) to furnish and install a minimum of six multi-level vibrating wire piezometers. The six multi-level vibrating wire piezometers shall be installed in accordance with the manufacturer's recommendations in the subsurface prior to production jet grouting work. Piezometers shall utilize vibrating wire pressure transducer technology capable of being installed in a drilled borehole. Vibrating wire piezometers shall be capable of measuring water pressures between -10 and 120 feet of water pressure with an accuracy of plus or minus 0.1%. Cables for the vibrating wire piezometers shall be of sufficient length to extend from the designated depths to a secured shelter or enclosure located beyond the toe of the embankment. Each set of multi-level vibrating wire piezometers shall consist of three individual piezometers with the first level starting at the top of the jet grout column and at depths of about 8 and 20 feet below the top of the jet grout columns. The exact locations of the six multi-level vibrating wire piezometers will be determined by the Engineer based on the test probe information and the submittal showing the actual locations of the production jet grout columns. The locations of the six multi-level vibrating wire piezometers generally will be in the center between three adjacent jet grout columns.

(2) Settlement Plates Equipped with Vibrating Wire Pressure Sensor. The Contractor shall retain the services of an experienced Geotechnical Engineer (QUALIFICATIONS?) to furnish and install a minimum of twelve settlement plates equipped with vibrating wire pressure sensors in accordance with the manufacturer's recommendations. The exact locations of the of twelve settlement plates equipped with vibrating wire pressure sensors will be determined by the Engineer. The settlement plates equipped with vibrating wire pressure sensors shall be embedded below the existing ground surface by about 3 feet and shall be backfilled with sand. The settlement plates and associated equipment shall be installed a minimum of 10 days prior to any embankment activities (including RSS and SRW-2) and after the production jet grouting work. Each settlement plate shall be equipped with a vibrating wire pressure sensor attached to the settlement plate and is connected via two liquid filled tubes, extending laterally, to a reservoir placed within a

remote readout enclosure or shelter located on stable ground (at least 40 feet away from the toe of the embankment). The vibrating wire pressure sensor shall be capable of measuring up to 20 feet of elevation differential with an accuracy of plus or minus 0.1%. Cables for the vibrating wire pressure sensors on the settlement plates shall be of sufficient length to extend from the designated depths to a shelter or enclosure located beyond the toe of the embankment (RSS and/or SRW-2).

(3) Instrumentation Monitoring. A data collection system capable of remote data collection, readout, and storage shall be provided and shall be connected to the vibrating wire piezometers and vibrating wire pressure sensors. The data collection system shall be capable of obtaining at least one reading every 10 minutes. The Contractor shall download the data from the data collection system on a weekly basis and shall submit the data to the Engineer in an electronic format and media chosen by the Engineer. Data from the piezometers shall be monitored and downloaded on a weekly basis starting from the jet grouting operations, throughout the construction period and extending at least 4 months after the embankment (RSS and/or SRW-2) has attained the finished subgrade elevation (bottom of pavement structural section). All instrumentation damaged by the Contractor's operations, or in the opinion of the Engineer is not performing as required shall be replaced at the Contractor's expense within 7 days.

657.07 Method of Measurement.

(A) Furnishing Jet Grouting Equipment. The Engineer will not measure furnishing jet grouting equipment for payment.

(B) Jet Grout Test Program. The Engineer will not measure the jet grout test program (excluding the test probes) for payment.

(C) Test Probes. The Engineer will measure the test probes per linear foot. The Engineer will measure the vertical distance between the ground surface and the final tip elevation accepted by the Engineer of the test probes. The Engineer will maintain a test probe log for payment.

(D) Instrumentation and Monitoring. The Engineer will not measure the instrumentation and monitoring program for payment.

(E) Jet Grout Columns. The Engineer will measure jet grout columns per linear foot. The Engineer will measure the length along the centerline of the jet grout columns. The length shall be the elevation difference between the top of jet grout column and the final tip elevation of the jet grout column

that have both been accepted by the Engineer. The Engineer will maintain a log of the jet grout column construction for payment. The Engineer will not measure any length of jet grout columns constructed due to unauthorized grouting.

657.08 Basis of Payment.

(A) Furnishing Jet Grouting Equipment. The Engineer will pay for the accepted furnishing jet grouting equipment on a lump sum basis complete in place. The price includes full compensation for furnishing and moving the jet grouting equipment and necessary tools and equipment to the project, setting the equipment up at the locations and removing the equipment from the project.

The Engineer will make payment of 60% of the contract amount for this item when all jet grouting equipment and supplies are available at the project site and ready to conduct the Test Program.

The Engineer will make payment for the remaining 40% of the contract amount when all the jet grout columns haves been placed up to the top of the jet grout column elevation and accepted.

(B) Jet Grout Test Program. The Engineer will pay for the accepted jet grout test program on a lump sum basis (excluding the test probes) complete in place.

The price includes full compensation for all laboratory testing, installing the test jet grout columns to the required diameter and depths, excavating to expose the test jet grout columns, coring, sampling, and testing of the core samples, backfilling of the test jet grout column areas and furnishing labor, materials, equipment, tools and incidentals (including quality control and traffic control measures) necessary to complete the work.

(C) Test Probes. The Engineer will pay for the accepted test probes at the contract unit price per linear foot complete in place.

The price includes full compensation for drilling the test probes to the required depths and backfilled with grout, obtaining all necessary permits and clearance of utility lines, and furnishing all materials, including labor, equipment, and incidentals necessary to complete the work as specified and as shown on the Contract Documents, or designated by the test program or Engineer including surface restoration, traffic control, and disposal of soils generated from the drilling of the test probes.

(D) Instrumentation and Monitoring. The Engineer will pay for the accepted instrumentation and monitoring on a lump sum basis complete in place.

The price includes full compensation for furnishing and installing all the required instrumentation, in accordance with the manufacturer's recommendations, by an experienced Geotechnical Engineer and taking all the readings at the specified minimum intervals for the duration noted, and furnishing labor, materials, equipment, tools and incidentals necessary to complete the work.

(E) Jet Grout Columns. The Engineer will pay for the accepted jet grout columns at the contract unit price per linear foot complete in place. The Engineer will not pay for unsatisfactory jet grout columns, and the Engineer will not pay for any unauthorized length of additional jet grout columns.

The price includes full compensation for installing the jet grout columns to the required diameter and depths, installing steel "feeler" pipes, coring, sampling, and testing of the core samples, and furnishing all materials, including labor, equipment, and incidentals necessary to complete the work as specified and as shown in the Contract including quality control measures, surface restoration, traffic control, and disposal of all waste grout and excess spoils.

The Engineer will make payment under the following:

Pay Item	Pay Unit
Furnishing Jet Grouting Equipment	Lump Sum
Jet Grout Test Program	Lump Sum
Test Probes	Linear Foot
Instrumentation and Monitoring	Lump Sum
Jet Grout Columns (___)	Linear Foot"

END OF SECTION

Make the following Section a part of the Standard Specifications:

"SECTION 660 - COMPOSITE EPOXY RESIN-FIBER SYSTEM

660.01 Description. This work includes furnishing the composite system, consisting of epoxy resin-fiber composite with coated exterior surfaces. The composite system shall be constructed by applying layers of fabric saturated with epoxy resin. The retrofit shall be constructed in bands ranging from 6" to 54" in width. Composite system shall be approved by the Engineer prior to ordering or installation.

660.02 Qualifications of Composite System Supplier.

Composite system materials shall be supplied by a composite system supplier with demonstrated expertise in the installation of such systems and a minimum of 3 years experience with the composite system.

Testing information from the accepted composite system supplier to demonstrate system durability of the actual composite system to be used shall be submitted.

660.03 Materials. Materials shall conform to the following:

(A) Composite Casing. Composite casing shall conform to the requirements in Table 1.

TABLE 1 – COMPOSITE GROSS LAMINATE PROPERTY REQUIREMENTS				
PROPERTY at 72 ± 2° F	**Typical Test Value**	**Composite Material Design Values**	**Capacity Reduction Factor**	**ASTM Test Method**
Ultimate Tensile Strength min. in primary fiber directions, psi	83,400	60,000	0.72	D 3039
Elongation at Break percent	2.0	2.0		D 3039
Tensile Modulus psi	3.79×10^6	3×10^6	0.79	D 3039
Ultimate Tensile Strength @90° to primary fibers psi	6,250	5,000	0.80	D 3039

Minimum ratio of Fiber Volume to Total Volume shall be 35% and shall comply with ASTM Test Method D 2584.

(B) Finish Coating. Finish coating shall be an acrylic paint, sheet rock, non-cementicious plaster, or other coating approved by the composite manufacturer and the Engineer.

(C) Expanded Polystyrene. Polystyrene shall conform to 705.12 Expanded Polystyrene and Hardboard.

(D) Cement Grout. Cement grout shall conform to 712.04 Grout.

(E) Epoxy. The epoxy used as a saturant, primer or filler shall be approved by the composite manufacturer and the Engineer.

660.04 Construction Requirements.

(A) Working Drawings. Complete working drawings shall be submitted for each installation of the composite system. The working drawings shall contain details of the number and thickness of layers, properties of materials used, joint and/or end details and locations of fabric to be placed by hand methods, and all other information required for the proper installation of the system, including primary fiber orientation.

(B) Storage. All materials shall be stored in accordance with accepted supplier storing conditions.

(C) Method of Construction. Composite system shall be installed by an experienced applicator certified by the composite system manufacturer. The applicator shall demonstrate a minimum of three years experience in field composite system installations.

(1) Surface Preparation. Existing plants and other materials shall be removed and the surface area shall be cleaned of all loose dirt and other debris. Material removed from the surface of the column to receive the composite system shall become the property of the contractor and shall be removed from the job site. The surface to receive the composite system shall be free from fins, sharp edges and protrusions that will cause voids behind the installed composite or that, in the opinion of the Engineer, will damage the fibers. Existing uneven surfaces to receive composite system shall be filled with cement grout or other material approved by the Engineer. The contact surfaces shall be completely dry at the time of application of the composite.

(2) Mixing Epoxy and Saturating Fiber. The temperature of the epoxy components shall be between 45 and 95 degrees F at the time of mixing and application. The composite shall be applied when the relative humidity is less than 90 percent at the site and the surface temperature is more than 5 degrees F above dew point.

Both epoxy resin and fabric shall be measured accurately, combined, and deposited uniformly at the rates shown on the approved working drawings and per manufacturer's recommendations. The composite system shall be comprised of fibers and epoxy resin.

If, in the opinion of the Engineer, the composite system is damaged by the elements, it shall be replaced or repaired by the Contractor at the Contractor's expense.

(3) Application of Composite System. Surfaces to receive the composite system shall be prepared as described in Section 660.04 (C) (1) Surface Preparation.

Subject to approval by the Engineer in writing, the Contractor may provide suitable enclosures to permit application and curing of the composite systems during inclement weather. Provisions shall be made to control atmospheric conditions artificially inside the enclosures within limits specified for application and curing of the composite.

Prior to application of the composite systems, the area of the column to be encased shall be completely coated with a 5 mil minimum thick coat of system-compatible resin.

Components which have exceeded their shelf life shall not be used.

Composite column system casings shall not support combustion.

During construction of composite column system casings, the Contractor shall maintain a daily installation data log. The daily wrapping data log shall be available for review by the Engineer, and a copy furnished to the Engineer at completion of installation and construction for each day's production. The data log shall provide materials traceability and process records for each composite column system casing installation and shall include all of the following information:

(a) Casing identification with bridge name, construction and installation requirements, including plans and drawings, or referenced thereto.

(b) Material information including product description, date of manufacture, and lot or batch numbers.

(c) Fabrication, inspection and verification data for the manufacturing and construction operations including, wrap counts, composite thickness measurements, installation time, towpreg band pitch measurements, ambient temperature and humidity readings at beginning, middle and end of each installation shift, curing process including full documentation of time and temperature of curing ramping and at final processes including full documentation of time and temperature of curing ramping and at final curing temperature and thickness measurements of any protective coating applied to the completed composite following installation.

The components of the epoxy resin system may be proportioned and mixed by automatic equipment. Provisions shall be made for checking the accuracy of proportions and mixing. The composite shall be applied within one hour after a batch has been mixed. Both epoxy resin and fabric shall be measured accurately, combined, and applied uniformly according to the manufacturer's recommendation. The fabric shall be applied by using a uniform

constant tensile force procedure that is distributed across the entire width of the fabric. Successive layers of composite materials shall be placed before the onset of gelation of the previous layer of epoxy to achieve complete bond between layers.

The primary fibers of the fabric shall not deviate from a horizontal line by more than 1/2 inch per foot, and the transverse fibers shall be approximately perpendicular to the primary fibers. The epoxy application rate for each layer of composite shall be such as to ensure complete saturation of the fabric. Gaps between adjoining fabric layers shall be filled with epoxy. Undulation in the surfaces of composite column casings shall not exceed 1/4 inch per foot in any direction. Each layer of composite shall not exceed the thickness recommended by the manufacturer.

Except as otherwise specified, entrapped air beneath each layer shall be released and rolled out before the epoxy sets and each individual layer and ending of composite shall be firmly bedded and adhered to the preceding layer or substrate. The cured composite shall have uniform thickness and density, bond between layers, and lack of porosity. The composite system shall be protected from exposure to rainfall or water for a period of at least 48 hours.

(4) Finishing Composite Surfaces. Cleaned surfaces of composite shall receive two finish coats of paint, an approximate thickness of 4 mils. Coating to be an acrylic paint furnished by the composite system manufacturer. Other coatings may be used upon approval of the composite manufacturer and Engineer. Color will be determined by the Engineer.

(5) Curing Composite Material. Composite system shall be allowed to cure in ambient conditions. Temperature cure ranges and times to be determined by the manufacturer. The cured composite shall have uniform thickness and density, bond between layers, and lack of porosity. The system shall be protected from damage, debris, and contact with water during the curing period, a minimum of 24 hours.

(D) Inspection. A representative of the composite system manufacturer shall periodically observe all aspects of preparation, mixing, and application of materials, including the following:

(1) Material container labels

(2) Surface preparation

(3) Mixing of epoxy

(4) Application of epoxy to the fiber

(5) Application of composite system

(6) Curing of composite material

(E) Defects. All defects (including bubbles, delaminations, and fabric tears), shall be repaired unless otherwise allowed by the Engineer. Two types of repairs shall be performed:

(1) **Small defects.** Small defects (on the order of 6" in diameter) shall be injected or backfilled with epoxy.

(2) **Large defects.** Large defects shall be repaired as required according to the manufacturer's recommendations.

Remedial measures shall be taken in the event of insufficient material properties. For installations with material properties determined to be below the minimum specification values, the composite thickness shall be increased by the same percentage as the deficiency of the material's elastic modulus.

(F) Sampling and Testing. A record lot number of composite fabric shall be kept. A "sample batch" shall consist of two 12 inch by 12 inch "samples" of composite. A minimum of two "sample batches" shall be made daily. The two "sample batches" will be taken at appropriate times during the day so as to ensure the maximum material deviance in the components of the composite. An independent testing facility approved by the Engineer shall perform the tests. The testing laboratory shall precondition samples at 140 degrees Fahrenheit for 48 hours before testing. "Samples" shall be tested at random, at the Engineer's discretion with a minimum per batch or day. Testing results shall be made available within 3 weeks of sample submission. The testing shall provide the following;

(1) Ultimate tensile strength

(2) Tensile modulus

(3) Percent elongation

15% of all "sample batches" shall be tested. If one 12" x 12" "sample" fails (on average), specimens from the same "sample" will be

tested. If these specimens also fail (on average), the other 12" x 12" from the same "sample batch" will be tested. In the extreme case that this sample also fails, the remaining sample batch for that day will be tested and appropriate remedial measures taken to ensure integrity of the system from the failed "sample batch". In addition, 25% of the remaining sample batches will then be tested by the same criteria.

660.05 Method of Measurement. The Engineer will measure the composite epoxy resin-fiber system by the per square foot based on the surface area of column to be encased in accordance with the dimensions shown on the plans or ordered by the Engineer.

660.06 Basis of Payment. The Engineer will pay for the accepted composite epoxy resin-fiber system at the contract price unit per square foot. The contract price shall include full compensation for furnishing all labor, materials, tools, equipment, and all other incidentals necessary to complete work, as well as work involved in furnishing and installing or constructing the application completed in place, including surface preparation, painting, removing and disposing of plants, furnishing and installation of expanded polystyrene material and other necessary materials.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Composite Epoxy Resin-Fiber System for _____	Square Foot "

END OF SECTION

The following Section shall be made part of the Standard Specifications:

"SECTION 663 - EROSION CONTROL MATTING

663.01 Description. This work includes furnishing and installing an erosion control mat according to the contract.

663.02 Materials.

(A) General. The erosion control matting shall be a multi-layered geosynthetic netting specifically designed for erosion control as a long-term installation. The erosion control matting shall provide erosion protection for at least 36 months during vegetation establishment. The matting shall allow grass or other natural ground cover to grow and take root through the matting. The internal matrix material color shall be green or brown and the outer net material shall be black.

(B) Physical Properties. The erosion control matting shall have the following minimum physical properties:

(1) Materials shall be manufactured from either polyethylene, polypropylene, polyolefin or nylon.

(2) Thickness of the erosion control matting shall be 0.30 inches minimum according to ASTM D 5199.

(3) Ultraviolet Stability. ASTM D 4355 (tensile strength retained after 1000 hours) 80%.

(4) Porosity. (Calculation based upon weight, thickness and specific gravity) minimum 95%.

(5) Resiliency. (Thickness retained after 3 cycles of a 100 psi load for 60 seconds followed by 60 seconds without load-thickness measured 30 minutes after load removed by ASTM D 1777) 75% minimum.

(6) Tensile Strength. ASTM D 5305, 2-inch Strip Test, 95 x 95 lbs/foot minimum.

(7) Elongation. ASTM D 5305, 2-inch Strip Test, 70% x 70% maximum.

(C) Brochures and Manufacturer's Certification. The manufacturer of the erosion control matting shall submit brochures and certifications stating the quality of the material meet the intended use on the project. The certification shall clearly show the product number or other similar control number, which match the markings on the product delivered to the site. The manufacturer shall furnish certified test reports with each shipment attesting that the erosion control matting meets the requirements of the specification for material physical properties. Samples of the erosion control matting shall also be submitted to the Engineer.

663.03 Construction Requirements.

(A) General. Protect the permanent exposed soil face of the reinforced soil slope with an erosion control matting.

(B) Installation.

(1) Site Preparation. Grade, install 4-inch layer of topsoil per SECTION 617 – TOPSOIL, and compact the slope face properly. Remove all materials such as rocks and vegetation that would interfere with the soil and the erosion control matting.

(2) Anchor Trenches. Anchor trenches shall be as recommended by the manufacturer. The trenches shall be a minimum of 16 inches deep and 8 inches wide before placing the erosion control matting. Backfill and compact trenches properly to the original requirements of the slope.

(3) Planting. Install the erosion control matting prior to planting operations and avoid disturbance by work crews.

Install additional Erosion Control Matting, if necessary, to protect all exposed soil due to mounding associated with plants rootball installation.

(4) Placement. Place the erosion control matting according to the manufacturer's recommendations and supervision. Provide supervision by the manufacturer at the start up and initial installation. The matting roll ends shall be overlapped a minimum of 18 inches. The adjacent edges of the matting shall be overlapped a minimum of 3 inches.

(5) Anchoring. Anchor the erosion control matting at overlaps with 12-inch x 2-inch x 12-inch 8G metal staples. The distribution of

the staples shall be a minimum of two per square yard. The Engineer will not allow wood anchors, such as pegs or stakes of any kind, which extend above the ground surface. Alternate anchoring methods will be allowed if approved by the matting manufacturer and accepted by the Engineer.

For installation in rock area, anchor matting according to the manufacturer's recommendations.

(6) Repairs. Correct tears and holes, except the grass sprig planting holes, sprinkler head and valve locations, in the erosion control matting with a minimum of 3-foot overlap in each direction of the damage. Re-hydromulch the repaired area if ordered by the Engineer. Repair and/or replace the damaged or defective erosion control matting at no cost to the State.

(7) Installation Plan. Submit an installation plan prior to any work on the slope.

663.04 Method of Measurement. The Engineer will measure accepted erosion control matting per square yard. Additional area for overlaps shall not be measured separately.

663.05 Basis of Payment. The Engineer will pay for the accepted erosion control matting at the contract unit price per square yard, complete in place. The price includes full compensation for furnishing and installing additional area for overlaps, all accessories including staples and the anchor trenches, and furnishing all material, equipment, labor and tools required to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Erosion Control Matting	Square Yard"

END OF SECTION

Make the following Section a part of the Standard Specifications:

"SECTION 667 – CLOSED CIRCUIT TELEVISION (CCTV) INTERGRATION

667.01 Description. This section shall consist of all work and materials necessary to integrate the existing Closed Circuit Television (CCTV) systems of the City and County of Honolulu, Department of Transportation Services (DTS) and the State of Hawaii, Department of Transportation (HDOT). The work shall include coordinating all equipment and labor necessary to integrate all existing HDOT CCTV sites into the DTS's future Pelco CCTV master system located at the Traffic Control Center (DTS-TCC), 740 Kinalau Place, Honolulu. The work shall also include coordinating all equipment and labor necessary to integrate all existing DTS CCTV sites into the HDOT's existing Javelin CCTV master system located at the H3 Tunnel Operations Center (HDOT-TOC).

Each center, DTS-TCC and HDOT-TOC, should be able to remotely control the other center's existing analog matrix video switcher. This control shall include being able to select an input and direct it to one of four switch output ports, as well as control camera pan tilt and zoom functions of cameras connected to both switches. The video switch at HDOT-TOC is a Javelin Model JO2020VGF installed in 1995. The video switch at the DTS-TCC will be a Pelco Model CM9760-256X64.

667.02 Material and Equipment. All materials shall be of new, of equal or better quality of materials specified and approved herein. All CCTV system equipment not specifically listed but required for a compliant, operable and integrated system shall be supplied, as required, by the Contractor at no additional cost to the State. For ease of maintenance and parts replacement, select equipment from a single manufacturer as much as possible.

(A) CCTV Control and Display System. The CCTV control system software shall be the 360 Surveillance, Camera Cameleon Quad 1D, advanced CCTV control and display system or equivalent. The CCTV control and display system shall be installed and fully operational within 90 working days from notice to proceed (NTP).

(1) Operating System/Configuration. The CCTV control system software shall be a PC-based Graphical User Interface (GUI) that operates on a Microsoft Windows platform.

(a) The server and client system shall be shipped from the factory as a fully configured system including integrated PC, Windows 2000, (Service Pack 2) operating system, and all hardware and software

required for the performance parameters described below.

Minimum PC Characteristics.

PC Processor	1.8 GHz Pentium 4 (Intel)
RAM	512 MB
Hard Drive	60 Gb
Video Card	Dual Monitor VGA card 32MB RAM
CD/DVD	4X DVD+RW/R and 16XDVD-ROM
I/O Ports	Four (4) USB 2.0 ports, two of which are easily front-accessible
	10/100 Ethernet Networking
	10 each RS-232 serial ports (2 internal and 8 external)
	4 each RS-422 serial ports.
Slots	Four (4) PCI slots
Mouse	Optical Scroll Wheel Mouse

(2) Display Configuration.

(a) The system shall feature a multi-monitor design, capable of supporting up to four PC monitors on a single workstation.

(b) One workstation monitor shall be dedicated for display of facility site maps and the standard Windows desktop, while additional monitors shall be used to display and control four full-motion, full-quality video outputs each from selected sources.

(c) Each PC control/display monitor shall display up to four full-motion, full-quality video windows.

(d) PC mouse controls shall provide seamless control across the boundary between the system monitors.

(e) The system's PC video display monitor(s) shall be divided into four quadrants, each providing live, uncompressed video display for selected video sources.

(f) The video display shall provide controls to adjust the color, balance and contrast of each video image.

(g) A minimum of two (2), 17-inch LCD Flat Panel with a resolution of 1280x1024 shall be provided per workstation. The monitor shall be capable of displaying 1024x768 pixels at 60Hz as one of its modes.

(3) **Graphical Configuration.** The CCTV control interface shall utilize a graphical system configuration screen to define how CCTV equipment is physically connected to the system, and to store performance parameters for each piece of equipment.

(4) **Drivers.** The control system shall use a device driver model to allow equipment from multiple manufacturers to be controlled from a single interface. The Contractor's bid shall include a list of supported CCTV manufacturers including specific equipment model numbers.

A multi-host protocol driver is needed for interfacing to the Javelin Video Switcher thru the Javelin CCTV Controller.

(5) **Maps.** Facility site map images shall be displayed on the main system screen and may be edited by system administrators to include various CCTV device icons, and links to related site maps.

(a) All device icons displayed on the system control screens shall be fully scalable with text labels that may be displayed or hidden from view.

(b) The CCTV control system shall include utilities for importing site maps in any of several formats including JPEG (.jpg), Bitmap (.bmp), Windows Metafile (.wmf), and Enhanced Metafile (.emf).

(c) If more than one map is used for a facility, system administrators shall be able to define hyperlink areas that will allow access to other maps or macros by double-clicking the mouse button.

(d) The mouse pointer shall change to a hand when held over a hyperlink area to indicate the presence of the hyperlink.

(6) Camera Control.

(a) Camera Selection shall be made in a drag-and-drop fashion using the PC's mouse.

(b) CCTV camera icons on any of the control system site maps shall be used to route video to the control systems display window or any other display or recording device connected to the system by selecting it with the mouse and dragging it to the appropriate destination device icon.

(c) Cameras offering pan, tilt, zoom, iris and focus controls, shall be controlled using the PC scroll mouse.

(d) PTZ operations shall be performed directly in the video window(s) within the workstation display.

(e) Preset positions for CCTV cameras will be assigned and recalled from a dynamic pull-down menu that shall feature only those presets available (assigned) for the camera being viewed.

(f) Up to 500 presets per camera shall be accessible (to the maximum supported by the camera).

(g) If PTZ unit and interface is capable of these features, camera movements shall follow the operator's mouse movements in a continuous, omni-directional, variable speed fashion.

(h) Advanced Property Pages shall be available for each piece of CCTV equipment that offers advanced settings for functionality such as auto iris, temperature, color balance, window blanking and PTZ speed settings.

(i) The maximum amount of latency between the activation of a pan tilt zoom control, the subsequent movement of a camera and the resulting movement is seen on the operators display shall be no more than 500 milliseconds.

(7) Other Devices.

(a) Ethernet to Serial Converter. Device shall provide communications between the network socket program and corresponding asynchronous port, this will allow the user to open the serial port and read or write raw data from an Ethernet host to the remote serial device by using an open TCP/IP socket.

(b) The CCTV control interface shall be able to route video sources to up to 1024 external video monitors, VCRs and speakers using a simple drag & drop system.

(c) Device selection windows shall be editable to resemble the physical arrangement of corresponding devices within the control room or facility environment.

(d) Cameras displayed on external monitors shall be controlled via simultaneous workstation display or by using the keyboard arrow keys.

(e) The CCTV control system shall provide an interface for VCRs and other recording devices that offer serial communication control.

(f) A device-specific control strip shall be provided within the workstation display.

(8) Image Capture

(a) The CCTV control system shall have the ability to capture images upon demand, preprogrammed event/time/date or according to alarm input conditions.

(b) Captured images shall be stored in adjustable-quality JPEG (.jpg) formats.

(c) A complete set of image and alarm management tools shall be provided to sort, print, and electronically transfer captured images.

(d) A file transfer protocol (FTP) utility shall be provided for sending captured images to web servers for Internet distribution.

(9) **Automation Events – Macros, Schedules, and Sequences**

(a) The CCTV control interface shall provide preset, sequence, and scripted macro automation utilities.

(b) Sequences shall allow for a group of events to occur in a specific order on a specific video window or external monitor.

(c) Sequence events shall include: viewing a camera for a specified time, moving a camera to a preset position, capturing images, and FTP operations.

(d) Sequences shall be edited using a simple drag & drop spreadsheet-style interface.

(e) Macros shall allow groups of events to occur on the workstation video window and/or external monitors.

(f) Macro events shall include, but will not be limited to: viewing a camera on a specific monitor, running a sequence on a specific monitor, loading specific camera settings, performing recording device functions, generating digital output signals, running external applications, and sending serial control data to another system.

(g) A scheduling utility shall be provided for executing macros at a specific times or dates.

(h) Scheduling features shall include options such as hourly, daily, weekly and monthly, and specialized settings such as sunrise/sunset.

(10) **Alarms.** CCTV control system shall be capable of alarm events that are configurable to run specific macro events, and shall log incidents along with associated captures.

Alarm device logic shall be configurable, along with the event message, and macro action on alarm.

(11) **Security.** The CCTV control system shall provide security features through user logon passwords and configurable user privileges.

(12) **Client/Server.**

(a) Clients shall be required to login with a username and password stored on the server.

(b) The software shall have the capability to allow or disable camera control based on user priority and locks.

(c) Each user shall have an assignable user priority for use in camera arbitration.

(B) **Communication Equipment**. The following items shall be furnished by the Contractor and delivered to the Engineer. Installation of said items will be conducted by the Engineer:

(1) **Fiber Optic Video Multiplexer.** Provide a digital 4-channel video multiplexing system. The module shall be capable of multiplexing 4 channels of full color video in real time in NTSC, PAL or SECAM formats. The module shall require no in-field electrical or optical adjustments or in-line attenuators to ease installation. The modules shall utilize 8 bit digital encoding and decoding for high quality video transmission that exceeds the requirements of EIA RS-250C for medium-haul video transmission. The modules shall provide power, optical carrier detect / link lock, video input overload (for each channel), video input sync presence (for each channel), video output overload (for each channel) video output sync presence (for each channel) status indicating LED's for monitoring proper system operation. The modules shall provide automatic re-settable solid-state current limiters and independent voltage regulators on each module to reduce the chance of a single point failure of the system. The module shall be hot swappable in a rack mount system to reduce complete system shut down during maintenance or repair. The module shall have a lifetime warranty to reduce system life cycle cost in an event of a module failure.

(2) **Rack Mount Card Cage.** The Card Cage system for holding fiber optic rack equipment shall provide a power status indicating LED for monitoring proper system operation. The module shall have an mean time between failure (MTBF) of >100,000 hours and operate in an environment of –40° C to +74° C and relative humidity between 0% to 95% (non-condensing). The module shall be UL and ULC listed and the circuit board shall be UL 94 flame rated and meet all PCI standards. All PC boards shall be designated with part number, PC board number and show appropriate revision number. Housing shall be of all metal construction. All LED indicators and both electrical and mechanical connections shall be identified with silk-screened labels. The module shall have a lifetime warranty to reduce system life cycle cost in an event of a module failure.

(3) **Gigabit Ethernet Switch.** The Contractor shall provide a Gigabit Ethernet Switches at the locations indicated on the plans. These switches shall be enterprise grade equipment capable of non-blocking wire speed switching. Each switch shall be rack mounted in existing racks in either a 1 or 2 Rack Unit format. Each unit shall have twenty-four 10/100 Base-T (RJ-45) ports and two Gigabit Interface Converter (GBIC) ports.

The GBIC ports shall be populated with 1000 Base-LHA modules with a range of 50 Kilometers. They shall be configured for single mode fiber and have ST type connectors.

The Gigabit Ethernet Switch shall support the following protocols and standards.

(a) **IEEE General:**

IEEE 802.1D - 1998 Spanning Tree Protocol
IEEE 802.1p CoS prioritization
IEEE 802.1Q VLAN tagging, automatic VLAN learning, Generic VLAN Registration Protocol (minimum 64 VLANS)
IEEE 802.1W Rapid Spanning Tree
IEEE 802.3 – 2002 10BASE-T
IEEE 802.3u 100BASE-TX
IEEE 802.3x Full Duplex with Flow Control
IEEE 802.3z 1000BASE-X

IEEE 802.3ac Frame Extensions for Virtual Bridged Local Area Network Tagging
IEEE 802.3ad Link Aggregation

(b) IETF Standards:

RFC 854 Telnet
RFC 826 ARP
RFC 793 TCP
RFC 792 ICMP
RFC 791 IP
RFC 783 TFTP
RFC 768 UDP
RFC 2178 OSPF
RFC 2131 BootP/DHCP relay
RFC 1812 Router requirements
RFC 1583 OSPF v2
RFC 1542 BootP
RFC 1519 CIDR
RFC 1293 Inverse ARP
RFC 1256 IRDP router discovery
RFC 1256 ICMP
RFC 1157 SNMP
RFC 1122 Host requirements

(c) RIP

RFC 1058 (RIP)
RFC 1723 (RIPv2)

(d) IP Multicast

RFC 2236 IGMP v2

(e) IETF Standards MIB Support

RFC 1493 BRIDGE-MIB
RFC 1724 RIPv2
RFC 1757 RMON-MIB (4 Groups)
RFC 1850 OSPF MIB1
RFC 1907 SNMPv2
RFC 2011 IP-MIB
RFC 2012 UDP-MIB
RFC 2013 TCP-MIB
RFC 2096 IP-FORWARD-MIB
RFC 2233 IF-MIB

RFC 2571 SNMP-FRAMEWORK-MIB
RFC 2572 SNMP-MPD-MIB
RFC 2573 SNMP-TARGET-MIBSNMP-NOTIFICATION-MIB
RFC 2574 SNMP-USER-BASED-SM-MIB
RFC 2575 SNMP-VIEW-BASED-ACM-MIB
RFC 2576 SNMP-COMMUNITY-MIB
RFC 2665 ETHERLIKE-MIB
RFC 2668 MAU-MIB
RFC 2674 p/Q BRIDGE-MIB
RFC 2737 ENTITY-MIB

(f) Management

RFC 1157 SNMPv1/v2c
RFC 1213 MIB-II
RFC 1354 (IP forwarding table MIB)
RFC 1493 Bridge MIB
RFC 1573 (Interface Evolution)
RFC 1643 (Ethernet MIB) Configuration logging
RFC 1724 RIPv2 MIB
RFC 1757 RMON 4 groups: Stats, History, Alarms & Events
RFC 2021 RMON2 (probe config)
RFC 2239 (802.3 MAU MIB)
RFC 854 Telnet

(g) Telnet Management

RFC 2233 Interface MIB
RFC 2096 IP Forwarding
RFC 791 IP
RFC 792 ICMP
RFC 768 UDP
RFC 783 TFTP
RFC 826 ARP
RFC 951 BOOTP
RFC 2131 DHCP
Message logging
Security

(h) Denial of Service Protection

RFC 2267 Network Ingress Filtering
RPF (Unicast Reverse Path Forwarding) control

SYN attack protection
Uni-directional session control
CERT and "rootshell" immunity testing including:-
CERT (http://www.cert.org)

CA-97.28.Teardrop_Land - Teardropand "LAND" attack-IP Options Attack
CA-98-13-tcp-denial-of-service
CA-98.01.smurf
CA-96.26.ping
CA-96.21.tcp_syn_flooding
CA-96.01.UDP_service_denial
CA-95.01.IP_Spoofing_Attacks_and _Hijacked_Terminal_Connections-

Host Attacks
(http://www.rootshell.org/beta/exploits.html)

Syndrop
Nestea
Latierra
Newtear
Bonk
Winnuke
Simping
Sping
Ascend
Stream
Rape

(i) Physical Requirements

Height 1 or 2 RU, Width 17.25"
Operating Temperature: 0 ° to 40 ° C
Storage Temperature: -40 ° to 70 °
Operating Humidity: 10% to 95% relative humidity, non-condensing
Power Supply: 75 watt maximum
AC Line Frequency: 50 Hz to 60 Hz
Input Voltage Operations: 100 - 120VAC; 200 - 240 VAC, auto-ranging
Current Rating: 100-120VAC: 0.74 A max; 200-240VAC: 0.37 A max

(j) Safety

UL 1950 3rd Edition, Listed (Safety of ITE)
EN60950:1992/A1-4:1997+ZB/ZC Deviations (Safety of ITE)
IEC 950 (CB) Report and Certificate (Safety of ITE)
CSA 22.2#950-95 (Safety of ITE)
Low Voltage Directive (LVD)
AS/NZS 3260 (Product Safety Standard)
EN60825-1 (Safety of Lasers Products)
FCC CFR 21 (Laser Products)
CSA 22.2 No 950-95 (Safety of ITE)
AS/NZS 3262 Compliance - IEC 950 with AU deviations

(k) EMI/EMC

FCC CFR 47 part 15 Class A (USA EMC standard)
EN 55024:1998 includes IEC
Low Voltage Directive (LVD)
24e2 - C-tick (AS/NZS 3548)
Underwriters Laboratories (USA and Canada)

(l) Environmental

EN60068
Low Voltage Directive (LVD)

(m) Reliability

Minimum 50000hrs MTBF to Mil HDBK

(4) Multi-port Serial Card. The Multi-port Serial Card shall meet the following criteria:

(a) Uses one 32-bit PCI card slot

(b) In addition to ports already available in the existing PC, provide a minimum of four (4) additional serial ports.

(c) EIA RS-232 and supports speeds up to 460.8 Kbps

(d) Capable of full duplex operation and multi-strike surge suppression on every signal

(e) Capable of Plug-and-Play support for Windows 95/98/Me/XP/2000

(f) Utilizes 16C654 UART's and a 64 byte FIFO

(g) Minimum four (4) DB-9M DTE connectors accessible on card or via fan-out cable.

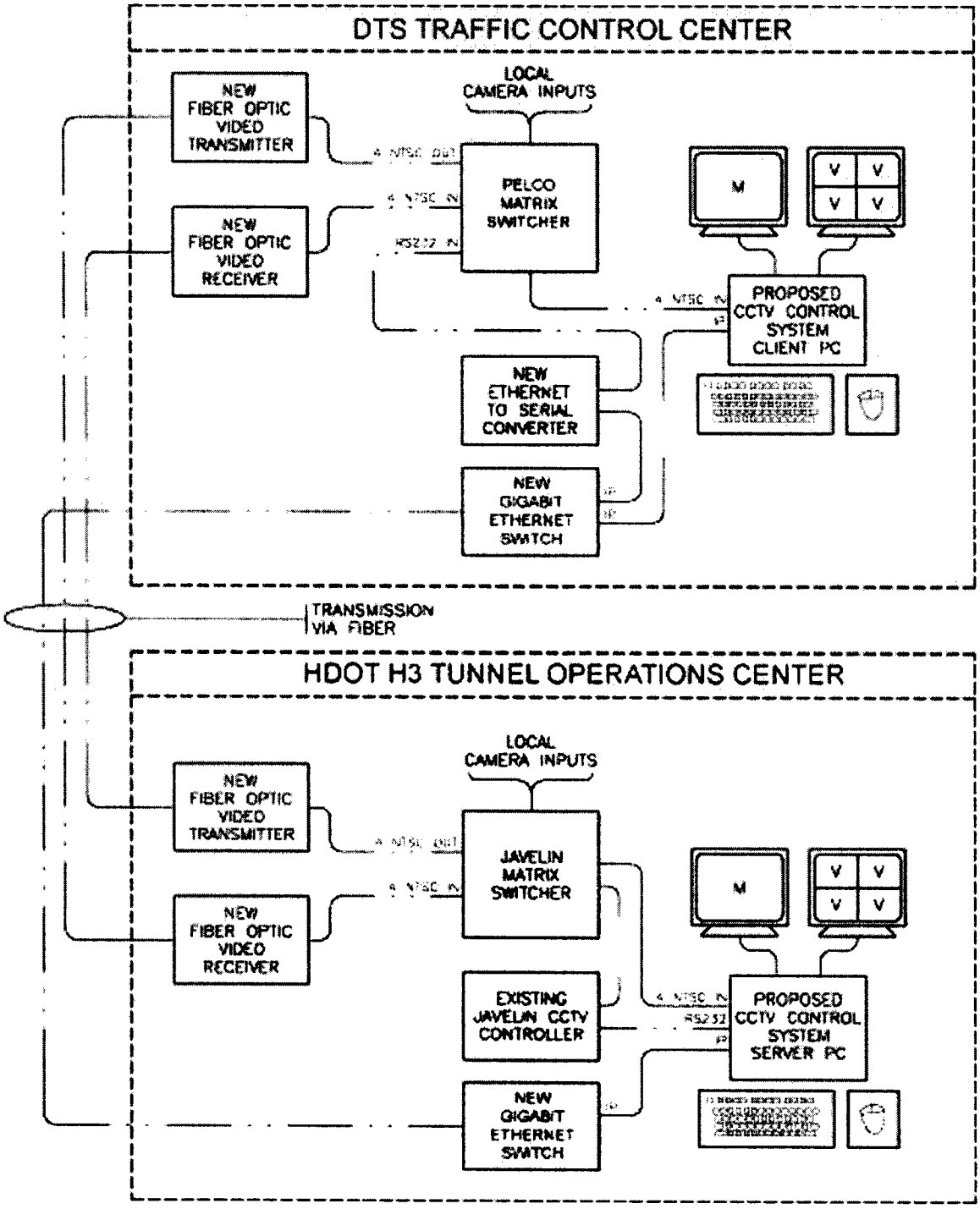
(5) Cable.

(a) Control Cable. RS232 compatible, 2 pair, 22 AWG, stranded copper, PVC jacket.

(b) RG59. U-type, solid, 20 AWG, coaxial cable, 75 ohm, plenum rated. BNC-BNC connectors where indicated.

(c) Category 6. Plenum rated, unshielded twisted pair, 4 pair, 24 AWG, solid bare copper.

(C) Proposed Camera System Block Diagram. The following system block diagram is provided for the Contractors use and details the anticipated configuration of the proposed system. The Contractor shall submit a proposed system block diagram within 20 working days of NTP including any supporting text that describes the proposed system solution.



667.03 Construction Requirements.

(A) Contractor Qualifications. In the bid response the Contractor shall submit written proof that the following experience requirements are being met.

(1) **Software Manufacturer.** Developers who have been regularly engaged in the integration of CCTV systems of the types to be installed for at least 3 years shall produce all software.

(2) **References.** A minimum of three (3) references shall be provided where the CCTV control system is currently in use and is of a similar configuration to this project.

(3) **Non-Responsive Bids.** The provision of inadequate manufacturer qualifications and reference information shall be grounds for rejection of the Contractor's proposed system bid.

(B) **Construction Coordination.** The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Engineer of any discrepancy before performing any work.

(C) **Cooperation with Other Trades and Conflict in Work**

(1) Contractor shall examine all drawings and proposed work and coordinate his work with other trades. Work conflicts shall be brought to the attention of the Engineer and work rearranged or modified in accordance with their decision.

(2) If changes in indicated locations or arrangements of work are required, they shall be made by Contractor without additional charge to the State provided that these changes were ordered before work is installed and no extra material or labor are required.

(3) Should the Contractor determine that extra material and labor will be required to accommodate any rearrangement, he shall first submit detailed estimate of cost for the required changes and proceed with work only upon written authority of the Engineer.

(D) **Omissions.** It is the intent of the plans and specifications to provide a complete installation. Should there be omissions, the Contractor shall call the attention of the Engineer to such omissions in 15 days advance of the date of bid opening so that the necessary corrections can be made. Once project award,

Contractor shall accept responsibility for providing a complete and working system.

(E) Submittal.

(1) As soon as practicable and within 20 days after award of contract and before installation of any materials or equipment is begun, Contractor shall submit to the Engineer annotated descriptive data showing the specific manufacturer, model, type, manufacturer's warranty and size of each item the Contractor proposes to furnish. No consideration shall be given to partial lists submitted from time to time. Do not commence work until the design of the system and the various components have been approved.

(2) Approval of materials will be based on manufacturer's published rating. Any materials and equipment, which are not in accordance with these specifications, may be rejected.

(3) **Operating and Maintenance Instructions.** Four (4) bound complete sets of instructions containing the manufacturer's operating and maintenance instructions for each system and subsystem shall be furnished. Each set shall be permanently bound and shall have a hard cover. Two (2) complete sets shall be furnished at the time the test procedure is conducted, and the remaining sets shall be furnished before the Contract is complete. The instructions shall include, but shall not be limited to the following:

(a) Table of Contents

(b) Wiring and control diagrams, with data to explain the detailed operation and control of each component.

(c) A control sequence describing the start-up, operation and shutdown procedures.

(d) Operating and maintenance instructions for each system and subsystem.

(e) Manufacturer's bulletins, cuts and descriptive literature.

(f) Recovery procedures and software to restore system in the event of system corruption for hardware failures.

1. Original OS Software or backup/recovery copy

2. Original Application Software or backup/recovery copy

3. All user/setup parameter/configuration files

4. Any other files/software required to restore system to full operational status in the event of corruption/failure of Hard disk.

(4) **Acceptance Test**. The Contractor shall submit the Acceptance Test Document 30 working days in advance of the Acceptance Testing. The Contracting Officer shall return all review comments within 15 working days. Acceptance testing shall not proceed until the Acceptance Test Document is fully approved by the Contracting Officer.

(F) **Product Delivery, Storage and Handling.** Furnish new equipment, materials and accessories bearing the manufacturer's identification. Coordinate deliveries to avoid interference or construction delays. Protect products during delivery, storage, installation, and the remainder of the Contract period after installation.

(G) **Installation.**

(1) **Equipment.** The exact installation locations for all equipment shall be verified with the Contracting Officer prior to installation.

(2) **Data Entry.**

(a) The Contractor shall enter all data and system level programming needed to make the CCTV system operational to include naming conventions as appropriate to the system. This would include designated names and locations for CCTV cameras, workstations, etc.

(b) The Contractor shall identify and request from the Contracting Officer any and all data necessary to make the system fully operational. The Contractor shall request this information on appropriate forms with spaces for the State to respond. The State shall have at least 15 working days to respond.

(H) System Programming, Setup and Startup.

(1) The CCTV system shall be complete and ready to operate prior to State final acceptance of the system. The Contractor shall be responsible for preparing all systems for user operation.

(2) The Contractor shall load all initial user data base configuration as defined in this section into all programmable systems up to the Commissioning day of beneficial use of the system. The Contracting Officer will assist in establishing procedural guidelines and in defining terminology and conditions unique to the State's operation.

(I) Training

(1) Training Courses

(a) The Contractor and designate State and City Representatives shall be provided two training courses. One Course shall be a minimum of four (4) hours in length, taught on the installed CCTV system equipment and structured for system managers/configuration personnel. The length of this course shall be increased/decreased as required to provide a full and complete understanding, by the Contracting Officer and designated State and City Representatives, of the system.

1. The Contractor shall provide these training courses in the State facility on the fully operable system.

2. This training shall include, but not be limited to all operating system procedures, data base functions, applications and programs, system configuration, and video switching and recording functions.

(b) The second course shall be a minimum of four (4) hours in length and shall be structured for the system monitoring personnel. This course may be required to be presented a maximum of eight (8) times to accommodate shift workers. Persons attending this course will be the State's and City's Traffic Surveillance monitoring personnel and must be structured to accommodate their level of computer based system operation knowledge. The length of this course shall be increased/decreased as required to provide a full and complete understanding, by the State's and City's Traffic Surveillance monitoring personnel.

(2) Training Materials

(a) System Configuration and Programming manuals shall be provided to system managers/configuration personnel attending the first four-hour course. This may be a single manual or multiple manuals in a three ring binder. The manual(s) shall be comprehensive and contain appropriate information for all equipment in the system.

(b) The Contractor shall provide Operators Reference guides for each system operator. This guide may be in the form of a manual, a booklet or a laminated reference card. The Contracting Officer shall approve format and contents at least 30 days prior to the start of training.

(J) Systems Acceptance

(1) System acceptance shall be a formal structured demonstration by the Contractor that all specification requirements have been met and a formal acceptance by the Contracting Officer acknowledging that fact on an item-by-item basis.

(2) The Contracting Officer will conduct final acceptance testing of the CCTV system with the assistance of the Contractor. The Contractor shall have appropriate personnel, both management and technical, present during this testing with the previously prepared and accepted Acceptance Test Document.

(3) The Final Acceptance Testing shall consist of, as a MINIMUM, the following items and procedures.

(a) Upon written notification from the Contractor that the system is completely installed, integrated and operational, and training is completed, the Contracting' Officer shall conduct a final acceptance test of the entire system.

(b) During the course of the final acceptance test by the Contracting Officer, the Contractor shall be responsible for demonstrating that, without exception, the completed and integrated system complies with all contract requirements. ALL PHYSICAL AND FUNCTIONAL REQUIREMENTS OF THE PROJECT SHALL BE DEMONSTRATED AND SHOWN.

(c) In order to sufficiently demonstrate the system's functionality, the State's operator on duty and his/her supervisor will be requested to perform certain daily operations inherent to the system. These operations may include, but not limited to, CCTV camera selection to a specific monitor, operating the Pan/Tilt/Zoom function of cameras so equipped and responding to and acknowledging alarms. The State's Supervisor will be requested to perform such tasks as entering configuration programming into the system, building camera and/or monitor zones for salvo switching, adding a CCTV camera to the matrix. Assigning an alarm point to automatically call up a camera, building time zones and similar routine functions. As all of these operations depend heavily on the training provided by the Contractor, this acceptance test shall also serve as one indicator of the completion of the required Contractor training requirement.

(d) City supervisors and operators will be required to perform similar functions from client workstation.

(e) The functionality of the various interfaces between systems and/or equipment shall be demonstrated. This may include, but not limited to correct camera selection when certain alarms are received from within the CCTV system and when certain alarms

are received from external alarm and/or access systems as well as "Loss of Video" alarms from the matrix switcher if so equipped, video motion from the multiplexers, out of tape alarms from the VCR and similar occurrences.

(f) Upon successful completion of the final test or subsequent retest and/or punch list retest, the Contracting Officer shall issue a letter of final acceptance.

(g) The Contracting Officer retains the right to suspend and or terminate testing at any time when the system fails to perform as specified. Furthermore, in the event it becomes necessary to suspend the test, the Contractor shall work diligently to complete/repair all outstanding items to the condition specified in the Specification and as indicated on the plans. The Contractor shall supply the Contracting Officer with a detailed completion schedule outlining phase-by-phase completion dates and a tentative date for a subsequent retest. During the final acceptance test, no adjustments, repairs or modifications to the system will be conducted without the permission of the Contracting Officer.

(K) Guarantee and Certificate

(1) The Contractor shall guarantee and certify in writing the following items:

(a) All equipment, accessories and material furnished for a period of one (1) year from the date of final acceptance against all defects in material and workmanship. If any equipment, device or material fails or does not operate satisfactorily, the Contractor will be notified, and shall be required to correct the defect and damage to other work caused by such defect immediately and at no additional cost to the State.

(b) The above guarantee shall not be interpreted as voiding, limiting or reducing any equipment or device manufacturer's warranty or guarantee permitted by law.

667.04 Method of Measurement. The Engineer will not measure the advanced closed circuit television (CCTV) control and display system for payment. The Engineer will measure the communication equipment per each delivered.

667.05 Basis of Payment. The Engineer will pay for the accepted advanced closed circuit television (CCTV) control and display system on a lump sum basis. The price includes full compensation for connecting, testing, and furnishing equipment, tools, labor, materials (including but not limited to CCTV Control System Server PC, CCTV Control System Client PC, monitors, Ethernet to Serial Converter, etc.), and incidentals necessary to complete the specified work. It is the Contractor's responsibility to include all necessary materials and labor to complete a fully operational system.

The Engineer will pay for the communication equipment at the contract unit price per each. The price includes full compensation for submitting the equipment list; furnishing the equipment; and delivering to the Engineer.

The Engineer will consider additional materials and labor, needed to complete the installation of the system and not shown in the contract as included in the bid price of the various contract items.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Advanced CCTV Control & Display System	Lump Sum
Communication Equipment _____	Each

END OF SECTION

Make the following section part of the Standard Specifications:

"SECTION 668 – TRAFFIC SURVEILLANCE AND MONITORING SYSTEM

668.01 Description. This section shall consist of all work and materials necessary to complete a fully operational CCTV system for traffic control and surveillance of various sites shown on the plans. Work shall involve coordinating equipment and labor necessary to incorporate and integrate selected CCTV sites into the City and County of Honolulu, Department of Transportation Services' (DTS) existing Burle CCTV master system located at the Traffic Control Center (DTS-TCC) at 740 Kinalau Place, Honolulu. Work shall also include coordinating all equipment and labor necessary to install State-furnished CCTV equipment at selected sites. The expanded CCTV system will assist State Department of Transportation (HDOT) personnel to monitor traffic conditions, mitigate traffic congestions, and set the appropriate traffic plans to best suit and improve the traffic progression along Honolulu's busiest arterials.

The CCTV system shall consist of remotely controlled color cameras and a fiber optic link between the DTS-TCC and the State of Hawaii, Department of Transportation, H-3 Tunnel Operations Center (HDOT-TOC). All camera equipment integrated into the existing DTS CCTV system shall be compatible with the existing DTS CCTV system in terms of hardware and software.

There shall be a locally based supplier of the CCTV system and fiber optic hardware, who shall have at least 3 (three) years experience from the project advertisement, in installing and setting up of CCTV and fiber optic systems over $250,000, specifically for traffic-highway applications. The CCTV firm shall be responsible for testing all fiber optic hardware and cables to provide a documented optical budget loss analysis for each link to and from a hub station. The CCTV supplier will be responsible for all hookup, assignments, dedication, testing, matching, and splicing of the fiber optic cables, unless otherwise indicated. All fiber optic splice points shall be spliced color-for-color whenever matching pairs are available. Pigtails shall be spliced on all fiber optic members, which attach to fiber optic hardware and components, with ST-compatible connectors. The CCTV supplier shall be fully responsible for all splices, budget loss, attenuators, appropriate fiber hardware, accessories, and pigtail connections for a fully operational system. All other hardware, equipment, and labor necessary shall be considered incidental.

The Fiber Optic Contractor shall be a locally based installer who shall have at least 3 (three) years experience, from the project advertisement, in installing fiber optic cables over $250,000, specifically for outdoor overhead joint-pole and underground applications. The firm shall also track and document the installation data and tension measurements when installing the fiber optic cables.

Any tension measurements, which exceed the manufacturer's recommendation, will be considered means for the cable rejection. The Fiber Optic Contractor shall be fully responsible for the quality and integrity of the installed cable and the operability of the final fiber optic cable product.

The CCTV systems and related fiber optic cable installation shall be fully operational within 90 working days from Notice To Proceed (NTP).

668.02 Construction Requirements.

(A) Equipment List and Drawings. The bidder shall submit the equipment list according to Subsection 106.13 - Ordering of Certain Materials.

Upon completion of the work, submit an "As Built" or corrected plan showing in detail the construction changes.

(B) Excavation and Backfill. Excavation and backfill shall conform to Section 206 - Excavation and Backfill for Conduits and Structures.

Do the necessary excavation to prevent damage to pavements, sidewalks and other improvements. Place the material from the excavation to prevent damage and obstruction to vehicular and pedestrian traffic and interference with surface drainage.

668.03 Video and Fiber Optic Hardware. For bidding purposes, the qualified, as stated in Section 668.01, CCTV Supplier shall furnish and install the following items and quantities, unless otherwise indicated. All other equipment necessary to complete a fully operational system will be considered incidental to the cost of the camera site equipment.

(A) DTS Camera Site Equipment. The Contractor shall, at each of the sites where shown on the plans, furnish and install, but not limited to, the following items. All camera equipment shall be compatible with the existing DTS CCTV system.

1 Ea., Cabinet shall be a Caltrans Traffic Signal 332A anodized aluminum cabinet with a 19" rack, 20-amp circuit breaker set-up, surge-protected and noise-isolation 6-outlet strip, and thermo-control fan. Furnish and Install power cables from existing signal cabinet or new Hawaiian Electric Company (HECO) service point.

1 Ea., Remote Receiver/Driver, PVC enclosure with power, camera, pan-tilt cables bundled, and special connectors.

1 Ea., Color Camera Package, ½" Format, Zoom Lens, Auto-Iris/Manual Override, 7.5 to 75 mm FL, Video Output 1 volt p-p, 75 ohms, MIL connectorized.

1 Ea., Sunshield

1 Ea., Pressurized Environmental Housing.

1 Ea., Pan and Tilt Drive

1 Ea., Side or Top Mount Bracket.

1 Ea., Transmitter for Video/RS422 Combined, Modular Type, 1 M/M Fiber, 6.5 kM Range.

1 Ea., Rack Mounted 48 Splice Capacity Tray, with all necessary splice fittings and pigtails.

Incidentals: Furnish and install all necessary conduit, cables and hardware for power, control data, and video. Local CCTV Power requires Type TC, 3#12 XHHW, 600V, PE jacket; Control requires 2 pair, 22 AWG, stranded, shielded outdoor PE jacket; Video requires RG59/U, outdoor, 20 solid AWG. Coaxial-cable inline electrical protection and isolation device will be included as part of this bid item. Where No. 4 and 6, power cables and service meters are necessary, the said items will be paid for as a separate unit, where as the TC, 3#12 cable will be considered incidental to the cost of the camera site equipment. All other equipment and labor necessary to complete a fully operational system will be the Contractor's responsibility and considered incidental to the cost of the camera site bid.

(B) HDOT Camera Site Equipment. Where shown on the plans, furnish and install a Caltrans Traffic Signal 334 anodized aluminum cabinet with a 19" rack, 20-amp circuit breaker set-up, surge-protected and noise-isolation 6-outlet strip, and thermo-control fan. Furnish and Install power cables from existing signal cabinet or new Hawaiian Electric Company (HECO) service point.

In addition, install all State-furnished camera equipment necessary to complete a fully operational system. State-furnished equipment shall include, but not limited to, the CCTV camera, sunshield, pressurized environmental housing, remove receiver/driver, pan and tilt drive, camera

mounting bracket, video transmitter, rack-mounted splice trays, and RF receiver/transmitter unit.

All necessary cables between the CCTV cabinet and camera will be paid via force account.

668.04 Fiber Optic Cable. The fiber optic cables, which will be used to transmit video and data signals, will consist of single-mode and multi-mode fibers. Cables will be installed in existing conduits, new conduits, and overhead in the gain area reserved for the traffic signal systems under joint pole agreements. The Contractor shall furnish and install fiber optic cable suitable, and meeting standards, for underground and aerial lashing installations. The fiber optic cables shall meet the following specifications:

Stranded Loose Tube Cables. General Considerations. The cable shall meet the requirements of the United States Department of Agriculture Rural Utilities Service (RUS) 7 CFR 1755.900 and the ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1992.

(A) Multi-mode Cables. The multi-mode fiber utilized in the cable specified herein shall meet EIA/TIA-492AAA-1989, "Detail Specification for 62.5 um core diameter 125 um cladding diameter Class 1a multi-mode, graded index optical waveguide fibers."

Core diameter: 62.5 $\pm$ 3.0 um
Cladding diameter: 125 $\pm$ 2.0 um
Core to cladding offset: $\leq$ 3.0 um
Cladding non-circularity: $\leq$ 2.0%
Core non-circularity: $\leq$ 5%
Coating diameter: 245 $\pm$ 10 um
Colored Fiber Diameter: nominal 250 um
Attenuation Uniformity: No point discontinuity greater than .020 dB at either 850 nm or 1300 nm.
Refractive index profile: Graded index
Numerical aperture: 0.275 $\pm$ 0.015

(B) Single-mode Cables. The dispersion unshifted single-mode fiber utilized in the cable specified herein shall conform to the following specifications:

Cladding diameter: 125 um $\pm$ 1.0 um
Core-to-cladding offset: $\leq$ 0.6 um
Cladding Non-circularity: $\leq$ 1.0%
Coating diameter: 245 $\pm$ 10 um

Colored fiber diameter: Nominal 250 um
Attenuation uniformity: No point discontinuity greater than 0.10 dB at either 1310 nm or 1550 nm.
Attenuation at the water peak: The attenuation at 1383 $\pm$ 3 nm shall not exceed 2.1 dB/kM.
Cutoff wavelength: The cabled fiber cutoff wavelength shall be < 1260 nm.
Mode-field diameter: 9.30 $\pm$ 0.50 um at 1310 nm
10.50 $\pm$ 1.00 um at 1550 um
Zero Dispersion wavelength: $\leq$ 1301.5 nm
Zero Dispersion Slope: $\leq$ 0.092 ps/(nm^{2}kM)
Fiber polarization mode dispersion: $\leq$ 0.5ps$\sqrt{}$kM

The coating shall be a dual layered, UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically strippable.

(C) Fiber Optic Connector Cable. Single-mode, single strand, 40-foot cable length with ST-ST compatible connectors.

(D) Fiber Specification Parameters.
Required fiber grade: Maximum individual fiber attenuation.
Multi-mode - The minimum normalized bandwidth of multi-mode optical fibers shall be $\geq$ 160 MHz-km at 850 nm and $\geq$ 500 MHz-km at at 1300 nm.
Single mode – The maximum dispersion shall be $\leq$ 3.2 ps/nmkM from 1285 to 1330 nm and shall be < 18 ps/nm-kM at 1550 nm.
All optical fibers shall be proof tested by the fiber manufacturer to a minimum load of 0.7 GN/m^2 (100 kpsi) .

(E) Specifications for Outdoor Cable Construction. Optical fibers shall be inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 3.0 nm.

Each buffer tube shall contain up 12 fibers.

The fibers shall not adhere to the inside of the buffer tube.

Each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."

The fiber shall be colored with ultraviolet (UV) curable links.

Buffer tubes containing fibers shall be color coded with distinct and recognizable colors in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."

Buffer tube colored stripes shall be inlaid in the tube by means of co-extrusion required. The nominal stripe width shall be 1 mm.

In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material, Colors shall not cause fiber to stick together.
The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrink back requirements of 7 CFR 1755.900.

Fillers may be included in the cable core to lend symmetry to the cable cross section where needed. Fillers shall be placed so that they do not interrupt the consecutive positioning of the buffer tubes. In dual layer cables, any fillers shall be placed in the inner layers. Fillers shall be nominally 3.0 mm in outer diameter.

The central anti-buckling member shall consist of a dielectric, glass reinforced plastic (GRP) rod. The purpose of the central member is to prevent buckling of the cable. The GRP rod shall be over coated with a black colored thermoplastic when required to achieve dimensional sizing to accommodate buffer tubes/fillers.

Each buffer tube shall be filled with a non-hygroscopic, non-nutritive electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.

Buffer tubes shall be stranded around the dielectric central member. Water blocking yarns shall be applied longitudinally along the central member during stranding.

Two polyester yam binders shall be applied contra helically with sufficient tension to secure each buffer tube layer to the dielectric central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking and dielectric with low shrinkage.

For single layer cables, a water blocking tape shall be applied longitudinally outside of the stranded tubes/fillers. The tape shall be held in place by a single polyester binder yarn. The water blocking tape shall

be non-nutritive to fungus, electrically conductive and homogenous. It shall also be free from dirt and foreign matter.

The cable shall contain at least one ripcord under the sheath for easy sheath removal of all-dielectric cable. The cable shall contain at least one ripcord under the inner sheath and under the steel armor for armored cable. The ripcord color shall be orange for non-armored sheaths.

Tensile strength shall be provided by dielectric yarns. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

All dielectric cables shall be sheathed with medium density polyethylene (MDPE). The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water blocking tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C and Grade J4, E7, and E8. The jacket or sheath shall be free of holes, splits, and blisters. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

Cable jackets shall be marked with manufacturer's name, sequential meter or foot marking month and year of manufacture, and a telecommunication handset symbol, as required by Section 350G of the National Electrical Safety Code (NESC). The actual length of the cable shall be with the exception 0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing one or more coextruded white stripes shall be printed in light blue. The height of the markings shall be approximately 2.5 mm.

The maximum pulling tension shall be 2700 N (608 lbft) during installation (short term) and 890 N (200 lbft) long term installed.

The shipping, storage, and operating temperature range of the cable shall be -40C to +70C.

(F) Quality Assurance Provision. All cabled optical fibers > 1000 meters in length shall be 100% attenuation tested. Attenuation of each fiber shall be provided with each cable reel.

The cable manufacturer shall be ISO 9001 registered..

(G) Packaging. Top and bottom ends of the cable shall be available for testing.

Both ends of the cable shall be sealed to prevent the ingress of moisture. Each reel shall have a weather resistant reel tag attached identifying the reel and cable.

The reel tag shall include the following information:

Cable number	Gross Weight
Shipped length in meters	Job order number
Product Number	Date cable tested

Each cable shall be accompanied by a cable data sheet. Cable data shall include manufacturer number, billable length, bandwidth specs and measured attenuation of each fiber.

(H) Fiber Optic Adapter Panel. Six-pack panel, cabinet-mounted, loaded with ST-compatible adapters. Adapter panel shall be compatible with, and have the capability to be mounted in, the existing BICC Network Solutions cabinet located at the HDOT-TOC.

668.05 Installation Requirements.

(A) Fiber Optic Cable. The qualified Fiber Optic Contractor, as stated in Section 668.01, shall install the new fiber optic cable overhead on existing power poles and in conduits as shown on the plans. Contractor will be responsible for all work and equipment required to install the messenger cable on existing joint poles for the overhead portion of the fiber installation. For the underground portion, the Contractor will be responsible for furnishing and pulling the new fiber in PVC intertie ductlines.

Fiber optic splice locations are permitted only at splice points where splice cabinets are shown on the plans. Fiber optic fibers shall be spliced in every cabinet location, and it is the responsibility of the CCTV Contractor to maintain a continuous run throughout the system. Pigtails with ST-compatible connectors will be provided where necessary for transmitters, receivers, and multiplexer attachments.

Provide documented historical cable pulling data indicating tensile pressure exerted on the cable during the installation. All fibers shall be spliced at camera cabinets, hubs, and splice cabinets and shall have no more than .07 dB loss per splice based on the appropriate system

operating wavelength. As part of the final testing and acceptance prior to hookup of fiber transmitters and muxs submit OTDR readings to the Engineer for review.

All necessary equipment and plug-in, fiber optic pigtails, fittings, enclosures, and work to complete an operational system shall be furnished and installed by the Contractor, unless otherwise indicated, at no added cost, and will be considered included and in the cost of the other bid items.

(B) Camera Control Cabinet Foundations and Pullboxes. Construct the foundations and boxes required carefully at the locations designated. Pour the foundations and boxes in areas that the Contractor has carefully excavated to receive the foundations and boxes. Construct each unit as detailed in the contract and connect each unit properly with the facilities of which each unit is a component part.

Mix, place, and cure the concrete according to Section 601 – Structural Concrete, and Section 503 - Concrete Structures. The Engineer will allow hand mixing.

Give the pullbox frames and covers two coats of asphaltic base paint after installation.

(C) Conduits. Underground conduits shall be concrete encased, PVC Schedule 40.

Install the ducts to drain towards pullboxes.

Make directional changes in the conduits, such as bends and changes to clear obstructions with curved segments using accepted deflection couplings or with short lengths of straight ducts and couplings. The deflection angle between two adjacent lengths of ducts shall not exceed 6°. The bends shall not have a radius of less than 12 times the nominal size of the conduit. The Contractor may use factory-made ells.

Cut the rigid PVC conduits with a hacksaw. Square and trim the ends after cutting to remove rough edges. The connections shall be of the solvent weld type. Make the solvent weld joints according to the conduit manufacturer's recommendations and as accepted.

Use the rigid PVC conduit for drilling or jacking.

Thread the PVC fittings for connecting PVC conduit to rigid metal

conduit on the metal conduit side.

Seal the ends of the duct with plugs at the end of each day of work where problems interrupt the duct installation work and where ducts are subject to submergence in water.

Keep the conduits clean during construction.

Use only hand shovels in compacting concrete encasements. Cure the concrete for at least 72 hours before permitting vehicular traffic to run over the concrete.

Provide each conduit run with a No. 10 gage flexible, zinc-coated pull wire extending through its entire length. Double an additional two feet back into the conduit at each end of the run. Conduits and sleeves entering pullboxes shall end flush in the wall with ends ground smooth. Plug the conduits and sleeves temporarily.

Ends of conduit runs shall extend at least 24 inches past the face of curb or edge of pavement unless the ends end in the pullboxes. Locate the ends accurately by special markers, markings on curb, or as specified by the Engineer. Show these locations on the "As-Built" plans required under Subsection 668.02(A) – Equipment List and Drawings.

The entire length of a conduit run between pullboxes or standards shall be of one type of material.

The completed duct lines shall be subject to a field test. Pass a bullet-shaped test mandrel about 14 inches long with a diameter 0.5 inch less than the inside diameter of the ducts through the entire length of each duct run. The Engineer will consider scouring found on the mandrel deeper than one thirty-secondth inch an indication of burrs and/or obstructions in the duct run. Normal abrasion between the duct line and bottom of mandrel is not an indication of burrs and/or obstructions in the duct run. Remove such burrs and/or obstructions. Pass the test mandrel through again. Repeat the process until the Contractor gets a satisfactory result.

Use PVC coated rigid steel conduits for all exposed construction except risers at utility poles. Use Schedule 80 PVC conduits for risers at joint utility poles.

(D) Wiring. Wiring shall conform to the appropriate articles of the Code. Arrange the wiring within cabinets and pullboxes neatly. Encase the wiring installed underground in conduits. Before installing the wires and cables in

conduits, pull a wire brush, swab and mandrel through each conduit for the removal of extraneous matter and verification of the absence of obstructions and debris from the conduit system.

Pull the cables directly from their cores or reels into the conduits. Do not pull off and lay the cables on the ground before installation. Make the pulls in one direction only. Lubricants used shall be as recommended by the cable manufacturer or accepted by the Engineer. Leave the wires or cables under tension nor tight against bushings or fittings.

Remove the damaged ends resulting from the use of pulling grips soon after pulling the cable. Maintain the cable end seals. Do not pull the open-ended cables through the conduits. Cables shall be continuous from pulling point to pulling point. The Engineer will not permit splices. Make the splices, taps and terminations with pressure-indented connectors or lugs as appropriate or as specified herein. Tape or seal the ends of the spare conductors as accepted.

Run the conductors continuously from the terminal block located in a cabinet to a similarly located terminal block without splices. Leave at least five feet of slack in each conductor at each standard and at least two feet of slack at each pullbox.

Join the conductors by a "western union" type splice. Use the connectors for splicing conductors No. 8 AWG, or larger. Solder the splices by the pouring or dipping method.

Pencil the conductor insulation well, trim the conductor insulation to conical shape, and roughen the conductor insulation before applying splice insulation.

Splice insulation includes layers of thermoplastic electrical insulating tape not over 0.007-inch thick applied to a thickness equal to and well lapped over the original insulation. The splice insulation shall conform to Federal Specifications MIL-I-7798. Leave at least two feet of slack for each conductor at each splice.

Furnish the cables on reels and handle the cables with great care to avoid damage to the conductors or the jacket.

Tape the cable ends to exclude moisture and shall remain so until the Contractor attaches the terminal equipment. For cable connections in terminal cabinets, use Bell Telephone System or equivalent connectors accepted for outside use.

Pull the cable in the conduit with a cable grip designed to provide a firm hold on the exterior covering of the cable. Pull the cable with a minimum dragging on the ground or pavement. Use powdered soapstone, talc, or other accepted lubricants to ease the pulling of the cable.

(E) Bonding and Grounding. Make the metallic cable sheaths, conduits and standards mechanically and electrically secure to form a continuous system. Ground the system effectively. Bonding and grounding jumpers shall be No. 8 AWG copper wire or equivalent copper strap of the same cross-sectional area.

Ground the conduits and the neutral wires at the service points as required under the Code, except that grounding conductors shall be No. 6 AWG or equal.

Install a copper-clad steel or pure copper ground rod three-quarter inch diameter by ten feet long alongside each camera control cabinet concrete base.

The Contractor shall connect them with No. 6 AWG wire to the No. 8 AWG ground wire loop and power system neutral.

On wood poles, ground all equipment mounted less than 8 feet above ground surface.

(F) Services Provided By The County.

(1) DTS will be responsible for the following:

(a) Making all splices and connections in pullboxes and cabinet locations where indicated.

(b) Inspecting the CCTV construction.

(2) With the above work, the Contractor shall be responsible for the following:

(a) Arrange for phases of work with the appropriate County agency or as specified by the Engineer.

(b) Give at least three days of advance notice to the appropriate County agency when phases of the work requires the services of that agency.

(G) Restoring Pavements and Other Improvements. Restore the existing pavements and other improvements such as driveways, sidewalks, curbs and gutters disturbed by excavation to their original condition according to the contract. Materials used for restoration work shall be equal to or better in quality than the materials the Contractor will replace, and matching in thickness, texture, and color whenever applicable. The grades of the restored surfaces shall conform to the existing grades.

(H) Warranty. Materials and equipment installed for permanent construction shall be new. The contract contemplates the use of first-class material and equipment throughout the performance of the contract.

Secure from the manufacturer(s), a warranty or warranties guaranteeing equipment from defects in materials, design and workmanship for not less than 12 months from the date of acceptance.

When requiring adjustments or repairs during the warranty period, adjust or repair the existing unit within 24 hours from the time of notification.

When requiring repairs that need factory corrections during the warranty period, replace the existing unit with an accepted temporary operational replacement unit within 24 hours from the time of notification until the Contractor can install the new unit. Install the new, identical non-defective unit within 30 days from the time of notification.

668.06 Method of Measurement. The Engineer will measure the DTS camera site equipment, HDOT camera control cabinet, cabinet concrete base, installation of State-furnished camera site equipment, pullbox, junction box, HECo meter assembly and fiber optic connector cables per each. The 2" conduits for the cabinet concrete base will not be measured but considered part of the concrete base unit.

The Engineer will measure the fiber optic cables, power cables, CCTV ductline and CCTV conduit per linear foot.

The Engineer will not measure the fiber optic cable splicing at the HDOT-TOC for payment.

The Engineer will measure the cables between the camera cabinet and State-furnished camera equipment and miscellaneous CCTV system testing and and troubleshooting on a force account basis according to Subsection 109.04 – Extra and Force Account Work.

668.07 Basis of Payment. The Engineer will pay for the accepted DTS camera site equipment at the contract unit price per each complete and in place. The price includes full compensation for submitting the equipment list and drawing; furnishing and mounting the camera control cabinet; furnishing, assembling, wiring and housing the camera and auxiliary equipment; bonding and grounding; testing, providing turn-on service; submitting warranty; and furnishing tools, labor, materials, equipments and other incidentals necessary to complete the work.

The Engineer will pay for the accepted HDOT camera control cabinet at the contract unit price per each complete in place. The price includes full compensation for submitting the equipment list and drawing; furnishing and mounting the cabinet; bounding and grounding; submitting warranty; and furnishing tools, labor, materials, equipments and other incidentals necessary to complete the work.

The Engineer will pay for the accepted cabinet concrete base at the contract unit price per each complete in place. The price includes full compensation for excavating and backfilling; forming; furnishing and placing the reinforcing steel; mixing, placing and curing the concrete; furnishing and setting the anchor bolts; furnishing and installing the 2" conduits between the cabinet concrete base and CCTV pullbox; restoring pavements; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the installation of State-furnished camera site equipment at the contract unit price per each complete in place. The price includes full compensation for assembling, wiring and housing the camera and auxiliary equipment; bonding and grounding; testing, providing turn-on service; submitting warranty; and furnishing tools, labor, materials, equipments and other incidentals necessary to complete the work.

The Engineer will pay for the accepted pullbox at the contract unit price per each complete in place. The price includes full compensation for submitting the equipment list and drawing; furnishing and installing the pullbox at the designated locations; excavating and backfilling; coating the frames and covers; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted junction box at the contract unit price per each complete in place. The price includes full compensation for submitting the equipment list and drawing; furnishing and installing the junction box at the designated locations; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted HECo meter assembly at the contract unit price per each complete in place. The price includes full compensation for submitting the equipment list and drawing; furnishing and installing the metering equipment, apparatus and mounting frame; excavating and backfilling; pouring concrete; restoring sidewalks, pavements and appurtenances damaged or destroyed during construction; making required tests; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted fiber optic connector cables at the contract unit price per each. The price includes full compensation for submitting the equipment list and drawing; furnishing the cable; and delivering to the Engineer.

The Engineer will pay for the accepted fiber optic and power cables at the contract unit price per linear foot complete in place. The price includes full compensation for submitting the equipment list and drawing; furnishing, installing, splicing and taping the cable, as required; making the connections; providing turn-on service; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted CCTV ductline at the contract unit price per linear foot complete in place. The price includes full compensation for sawcutting, excavating and backfilling; furnishing, installing, bonding and grounding the conduits; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted CCTV conduit at the contract unit price per linear foot complete in place. The price includes full compensation for furnishing, installing, bonding and grounding the conduits; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted fiber optic cable splicing at the HDOT-TOC on a contract lump sum basis. The price includes full compensation for submitting the equipment list and drawing; furnishing and installing the fiber optic adapter panel; making the required fusion splices; making required tests; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted cables between the camera control cabinet and State-furnished camera on a force account basis according to Subsection 109.04 – Extra and Force Account Work. The price includes full

compensation for furnishing, installing, splicing and taping the cable, as required; making the connections; providing turn-on service; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted miscellaneous CCTV system testing and troubleshooting on a force account basis according to Subsection 109.04 – Extra and Force Account Work. The price includes providing equipment, tools, labor, materials necessary, at the direction of the Engineer, to complete a fully operational CCTV system.

The Engineer will consider additional materials and labor, needed to complete the installation of the system and not shown in the contract as included in the bid price of the various contract items.

The Engineer will make payment under:

Pay Item	**Pay Unit**
DTS Camera Site Equipment ___	Each
HDOT Camera Control Cabinet	Each
Cabinet Concrete Base	Each
Install State-Furnished Camera Site Equipment	Each
_____ Pullbox	Each
_____ Junction Box	Each
HECO Meter Assembly	Each
Fiber Optic Connector Cable	Each
Fiber Optic Cable _____	Lin. Ft.
Power Cable _____	Lin. Ft.
CCTV Ductline _____	Lin. Ft.
CCTV Conduit _____	Lin. Ft.
Fiber Optic Cable Splicing At HDOT-TOC	Lump Sum

Cables Between Camera Control Cabinet And State-Furnished Camera	Force Account
Miscellaneous CCTV System Testing And Troubleshooting	Force Account"

END OF SECTION

Make the following Section a part of the Standard Specifications:

"SECTION 681 –TIEBACK

681.01 General.

(A) Description. This work includes furnishing, installing and testing tiebacks and accessories at locations shown in the Contract Documents. This work includes permanent tiebacks at the northern abutment retaining wall at Austin Bishop Separation. Supply all labor, equipment and material necessary to properly complete the installation of tiebacks, so as to attain the specified load capacities identified in the Contract Documents. Work includes the following:

(1) Provide bond length and stressing length to meet the requirements specified in the Contract Documents.

(2) Provide materials and equipment for installing tiebacks to carry the design loads shown in the Contract Documents.

(3) Prestressing all tiebacks and testing tiebacks, as specified in the Contract Documents.

(B) Definitions.

(1) Tieback. A high strength steel tendon, fitted with an anchorage at the exposed end and a grouted anchor permitting force transfer to the ground on the other end.

(2) Anchorages. Portion of the tieback, including anchor head, anchor plate and protective cap, which is used to transfer load from the retaining wall to the tieback.

(3) Bonded Length. Portion of the tieback that transfers the tensile force from the tieback to the ground.

(4) Stressing Length. Portion of tieback that is in smooth sheathing.

(5) Smooth Sheathing. Enclosure around pre-stressing steel to prevent permanent bond between the pre-stressing steel and the surrounding grout, and to provide corrosion protection.

(6) Permanent Tieback. A tieback used in support of the permanent retaining wall system and that is provided with double corrosion protection.

(7) Secondary Grout. Grout that is injected into the anchor hole to cover the stressing length of the tieback and providing corrosion protection for the high strength steel.

681.02 Submittals.

(A) Working Drawings and Data. At least 30 days prior to beginning work, working drawings and data shall be submitted to the Engineer and shall include, but not limited to, the following:

(1) Tieback schedule giving:

(a) Tieback number.

(b) Design load and lock off load for each tieback.

(c) Type and size of tiebacks.

(b) Bonded length.

(e) Stressing length.

(2) A drawing of the tieback system and corrosion protection including:

(a) Centralizers and their locations.

(b) Anchorage details.

(c) Tieback corrosion protection system for the anchorage, bonded length and stressing length.

(3) Calculations: Design calculations shall be submitted for review. For tiebacks, design calculations shall include a determination of the bonded length for each tieback. The bonded length shall be determined based on the maximum test load shown in the Contract Documents.

(4) Proposed sequence for tieback installation.

(5) Manufacturer's mill test reports for all the tieback's stress bar or strands.

(6) Application literature from cement grout suppliers giving details on setting times as a function of temperature, strength gain with time, and recommended storage, mixing and placement procedures.

(7) Applicable manufacturer certification and/or literature for anchorage fittings and accessories.

(8) Detailed description of the proposed procedures, including specific makes and models of equipment to be used for drilling, placing, grouting, and prestressing tiebacks. Drilling procedures shall include proposed hole diameter and method for supporting hole during tieback installation.

(9) Detailed description of proposed procedures and applicable manufacturer's literature for the equipment to be used for testing tiebacks, including but not limited to the following:

(a) Diagrams showing arrangement of the testing equipment relative to the tieback and anchorage hardware.

(b) The method for locking-off the required transfer load.

(c) Calibration data for the system of jack and gauges.

(d) The proposed equipment set-ups for monitoring elongations during tests of tiebacks.

(10) During the grouting operations, the following data shall be recorded by the Contractor and submitted to the Engineer:

(a) Type of mixer and grout pump.

(b) Type of cement.

(c) Water/cement ratio.

(d) Types of additives and their concentrations in mix.

(e) Grout injection pressure.

(f) Test sample strength.

(g) Volume of grout placed.

(11) The Contractor shall also submit a report to the Engineer within 20 working days after completion of the tieback work. The reports shall contain as-built drawings showing the locations of the tiebacks, total tieback lengths, bonded lengths, and results of all performance and proof tests.

(12) A Manufacturers Material Safety Data Sheet (MSDS) must be submitted for each product.

681.03 Quality Assurance

(A) Qualifications. The Contractor shall submit records documenting a minimum of five years experience in tieback installation of similar or greater scope as required for this project. The qualifications of the tieback installation Contractor shall conform to Subsection 102.01 - Prequalification of Bidders.

(B) Damage, such as abrasions, cuts, nicks welds, weld spatters or corrosion and pitting, will be a cause for rejection of the tieback element. Rejected elements shall be replaced at no additional cost to the State in terms of either material replacement or resulting time delays.

(C) Project Conditions.

(1) The Contractor shall be fully responsible for the safety of workers and representatives of the Engineer observing the installation and testing of the tiebacks.

(2) The Contractor shall be responsible for providing tiebacks of the required load capacity, which adequately meet all tieback test acceptance criteria. Deficient tiebacks shall be replaced or additional tiebacks installed, as determined by the Engineer, at no additional cost to the State. In addition, any cutting, reinforcement, coating repair, or other work required to install a replacement tieback shall be performed at no additional cost to the State.

(D) The work shall also conform to the recommendations and specifications of the Post-Tensioning Institute's (PTI) "Post-Tensioning Manual," "Specification for Grouting of Post-Tensioned Structures," and "Recommendations for Prestressed Rock and Soil Anchors" and FHWA Geotechnical Engineering Circular No. 4 "Ground Anchors and Anchored System."

681.04 Materials.

(A) Steel tendons for tiebacks shall be:

(1) Steel bars conforming to ASTM A-722, "Uncoated High-Strength Steel Bars for Prestressed Concrete;"

(2) Seven-wire strand conforming to ASTM A-416, "Uncoated Seven-Wire Low-Relaxation Strand for Prestressed Concrete," Grade 270.

The smooth sheath encapsulating the tendons shall be able to safely withstand deformations occurring during transportation, installation, stressing, testing, and transferring load to the tendons.

The bonded length of a tendon for permanent tiebacks shall not be less than the lengths shown on the Plans.

The stressing length of a tendon for permanent tieback shall not be less than the lengths shown on the Plans.

A corrugated plastic sleeve shall encapsulate the entire length of the tendon of permanent tiebacks. The sleeve shall have a minimum wall thickness of 0.06 inches. A Portland cement grout shall completely cover the tendon within the corrugated plastic sleeve. A suitable end cap shall be securely fastened at the end of the corrugated sleeve.

The maximum load applied to the tendon shall not exceed 75 percent of the guaranteed ultimate tensile strength of the tendon. The design load shall not exceed 53 percent of the guaranteed ultimate tensile strength of the tendon.

(B) Plastic Sheaths/Sleeves.

(1) Smooth and corrugated sheaths/sleeves shall be high-density polyethylene (HDPE) conforming to ASTM D 3350 and having a minimum strength of 7,000 psi. The corrugated sleeves shall also conform to the technical bulletin 7 "Corrugated Plastic Ducts for Internal Bonded Post-Tensioning," January 2000 Edition. The materials shall be free of water soluble chlorides and other ingredients that might enhance corrosion, hydrogen embrittlement, or stress corrosion on the prestressing steel. The plastic shall be non-reactive with the grout and its ingredients.

(2) The plastic sheath/sleeve shall be gas and watertight, and resistant against chemical attack, and aging.

(C) Steel. Steel, except steel tendons, shall conform to the requirements of ASTM A36.

(D) Cement. Portland cement for tieback grout shall be Type I, Type II, or Type III as specified in Section 701.01 – Hydraulic Cement.

(1) Cement shall be kept under cover and in a dry condition.

(2) The lowest practical water cement ratio with acceptable workability shall be used for the grout mix.

(E) Grout.

(1) Grouts shall be prepackaged in moisture proof containers. Grout bags shall indicate application, date of manufacture, lot number and mixing instructions. Any change of materials or material sources requires new testing and certification of the conformance of the grout with this Specification. A copy of the Quality Control Data Sheet for each lot number and shipment sent to the job site shall be provided to the Contractor by the grout supplier and furnished to the Engineer. Materials with a total time from manufacture to usage in excess of six months shall be tested and certified by the supplier that the product meets the QC Control Specifications before use or the material shall be removed and replaced.

(2) The grout material shall be mixed in accordance with the manufacturer's recommendations.

(3) The grout shall not contain aluminum powder or components, which produce hydrogen, carbon dioxide or oxygen gas.

(4) The grout shall meet or exceed the specified physical properties stated herein as determined by the following standard and modified ASTM test methods conducted at normal laboratory temperature (65 – 78 °F) and conditions.

Property	Test Value	Test Method
Total Chloride Ions	Max. 0.08% by weight of cementitous material	ASTM C 1152
Fine Aggregate (if utilized)	99% passing the No. 50 Sieve (300 micron)	ASTM C 136*
Hardened Height Change @ 24 hours and 28 days	0.0% to +0.2%	ASTM C 1090**
Expansion	□2.0% for up to 3 hours	ASTM C 940
Wet Density - Laboratory	Report maximum and minimum obtained test value lb/ft^3	ASTM C 185
Wet Density - Field	Report maximum and minimum obtained test value lb/ft^3	ASTM C 138
Compressive Strength 28 days (Average of 3 cubes)	□7,000 psi	ASTM C 942
Initial Set of Grout	Min. 3 hours Max. 12 hours	ASTM C 953
Fluidity Test *** Efflux Time from Flow Cone		
(a) Immediately after mixing	Min. 20 Sec. Max. 30 Sec.	ASTM C 939
	Or Min. 9 Sec. Max. 20 Sec.	ASTM C 939****

Property	Test Value	Test Method
(b) 30 minutes after mixing with remixing for 30 sec.	Max. 30 Sec.	ASTM C 939
	Or Max. 30 Sec.	ASTM C 939****
Bleeding @ 3 hours	Max. 0.0 percent	ASTM C 940*****
Permeability @ 28 days	Max. 2500 coulombs At 30 V for 6 hours	ASTM C 1202

* use ASTM C117 procedure modified to use a #50 sieve. Determine the percent passing the #50 sieve after washing the sieve.

** Modify ASTM C1090 to include verification at both 24 hours and 28 days.

*** Adjustments to flow rates will be achieved by strict compliance with the manufacture's recommendations.

**** Grout fluidity shall meet wither the standard ASTM C939 flow cone test or the modified test described herein. Modify the ASTM C939 test by filling the cone to the top instead of to the standard level. The efflux time is the time to fill a one liter container placed directly under the flow cone.

***** Modify ASTM C940 to conform with the wick induced bleed test as followings:

(a) Use a wick made of a 20 inches length of ASTM A416 seven wire 0.5 inch diameter strand. Wrap the strand with 2 inches wide duct or electrical tape at each end prior to cutting to avoid splaying of the wires when it is cut. Degrease (with acetone or hexane solvent) and wire brush to remove any surface rust on the strand before temperature conditioning.

(b) Condition the dry ingredients, mixing water, prestressing strand and test apparatus overnight at 65 to 75 °F.

(c) Mix the conditioned dry ingredients with the conditioned mixing water and place 800 ml of the resulting grout into the 1,000 ml graduate cylinder. Measure and record the level of the top of the grout.

(d) Completely insert the strand into the graduate cylinder. Center and fasten the strand so it remains essentially parallel the vertical axis of the cylinder. Measure and record the level of the top of the grout.

(e) Store the mixed grout at the temperature range listed above in (b).

(f) Measure the level of the bleed water every 15 minutes for the first hour and hourly for two successive readings thereafter.

(f) Calculate the bleed water, if any, at the end of the three hour test period and the resulting expansion per the procedures outlined in ASTM C940, with the quantity of bleed water expressed as a percent of the initial grout volume. Note if the bleed water remains above or below the top of the original grout height. Note if any bleed water is absorbed into the specimen during the test.

(5) Perform a conditioned laboratory high temperature grout fluidity test as described below using production grouting equipment utilizing both mixing and storage tanks. Grouts must conform to the requirements for grout physical properties including initial fluidity test. For the test to be successful, the grout must have an efflux time of not greater than 30 seconds at the end of the one hour test period. Efflux time may be determined by either ASTM C939 or the modified ASTM C939 described herein.

(a) Perform the test in a temperature conditioned laboratory. Condition the room, grout, water, duct, pump,

mixer and all other equipment to be used to a temperature of 90 °F for a minimum of 12 hours prior to the test.

(b) Use 400 feet (± 10 feet) of duct (tube) for the test. Use a duct with a nominal inside diameter of 1 inch.

(c) Mix the grout to the specified water content. Pump the grout through the duct until the grout discharges from the outlet end of the duct and is returned to the pump.

(d) Start the one hour test period after the duct is completely filled with grout. Record the time to circulate the grout through the duct. Constantly pump and recirculate the grout into the commercial grout mixer storage tank.

(e) Pump and recirculate the grout for a minimum of one hour.

(f) Record at 15 minute intervals throughout the test period, the pumping pressure at the inlet, grout temperature, and fluidity at the discharge outlet.

(6) Perform the ACTM as outlined in Appendix B of the "Specification for Grouting of Post-Tensioning Structures" published by the Post-Tensioning Institute. Report the time to corrosion for both the grout being tested and the control sample using a 0.45 water-cement ratio neat grout. A grout shows a longer average time to corrosion in the ACTM than the control sample and the time to corrosion exceed 1,000 hours is considered satisfactory.

(7) Except as otherwise specified in this Section 681, the grout shall comply with the requirements of the Post-Tensioning Institute's "Specification for Grouting of Post-Tensioned Structures."

(F) Centralizers and Spacers.

(1) Centralizers shall be placed at 10-foot intervals in the bonded length, with the bottom centralizer located 5 feet from the bottom of the bonded length, so that no less than 0.5 inches of grout cover is achieved along the tendon.

(2) Bar spacers shall be used in the bonded length of tiebacks, and placed at ten foot intervals, with the bottom spacer located five feet from the bottom of the bonded length. Spacers shall be used to separate elements of multi-element tendons.

(3) Centralizers and spacer may be made of any material, except wood, that is not deleterious to the prestressing steel or plastic sheath.

(4) Centralizers and spacers shall permit the free flow of grout to pass through in the tieback hole.

(G) Miscellaneous Steel Hardware.

(1) Steel plates shall conform to ASTM A36.

(2) All bolts, nuts and washers shall be galvanized and conform to the tendon manufacturer's specifications.

(3) Trumpets shall consist of steel pipe conforming to ASTM A53.

(4) All anchorage components shall develop at least 95 percent of the minimum guaranteed ultimate strength of the tieback tendon.

(5) Prestressing steel couplers shall be capable of developing 100% of the ultimate strength of the prestressing steel.

(H) Equipment.

Equipment for mixing grout shall be a high speed colloidal mixer with shearing action.

The grouting equipment shall be capable of continuous mixing and shall produce a grout free of lumps. The grout pump shall be equipped with a grout pressure gauge at the point of connection of the grout delivery line to the tieback hole capable of measuring at least 150 psi or twice the actual pressure used.

681.05 Construction Requirements.

(A) Preparation.

(1) Tendons shall be fabricated in accordance with approved Working Drawings and shall be free of dirt, detrimental rust, or other deleterious substances. Tendons shall be on wooden or concrete block while waiting and during installation.

(2) The bonded length shall be degreased prior to installation. No solvent residue shall remain on the tendon. Solvents shall not be allowed to contaminate the soil. The Contractor shall include its control method in its BMP submittal.

(B) Construction Control.

(1) The tieback shall be properly inspected before placement into the borehole. While inserting the tieback into the hole, it shall be protected from any damage, especially damage to the corrosion protection media.

(2) Tiebacks shall be inserted freely to the prescribed length in the hole. They shall not be driven into the hole or cut off for insertion.

(3) The stressing length of a tieback shall not be shortened to less than the minimum length shown on the plans or specified herein.

(4) The centralizers shall ensure that the tendon be positioned concentric in the hole.

(5) Grout pressure shall be measured at the point of injection. The grout gate mechanism shall be cleaned prior to delivery to the site and periodically during the project to prevent clogging.

(6) Grout components shall be mechanically mixed for 5 to 10 minutes to ensure proper dispersion of cement.

(7) The established water cement ratio shall be accurately controlled.

(8) Pumping and injection of the grout shall commence immediately after mixing.

(9) Grouting shall continue until the returning grout escaping from the hole is free of any additional ingredient(s) that were not part of the grout being injected.

(10) The trumpet shall extend well over the tendon sheathing. It shall remain undamaged during placement and stressing. The tendon shall not contact the trumpet at the bearing plate.

(C) Installation

(1) The hole for permanent tiebacks shall be drilled at locations indicated on the plans.

(2) The hole diameter shall be determined by the Contractor to produce the required load capacities and grout cover, but the hole diameter shall not be less than 6 inches. The tieback hole shall extend a minimum of 1 foot beyond the tendon length to be installed.

(3) The Contractor shall be responsible for maintaining an obstruction-free and open hole for grouting the tieback. The

Contractor shall be solely responsible for determining the drilling method, grouting pressures, and tieback bonded length to satisfy the tieback testing acceptance criteria in accordance with the design loads. The grouting pressure and grouting method shall be based on consideration of existing ground conditions.

Subsurface exploration near the locations of the permanent tieback anchors was conducted at selected locations as part of the project. The Contractor may assume that the subsurface materials to be encountered at the permanent tieback anchor locations will consist of the geologic formations identified in the boring logs shown on the Plans. It shall be noted that highly weathered basalt rock stratum shown on the Plans may include core stones of relatively hard, less weathered rock (possible spheroidal weathering). The Contractor shall anticipate the presence of cobbles, boulders, and hard rock at the site.

The Contractor shall thoroughly investigate the site and select the appropriate drilling equipment and methods for the drilling. Use of drilling muds such as bentonite slurry to assist in drill cutting removal is not allowed but compressed air may be used. Care shall be exercised by the Contractor to avoid rock and other debris from leaving the hole and endangering the public. Also, avoid disturbing the existing structures and features behind the permanent tieback anchors when compressed air is used for the drilling. Where hard drilling conditions such as rock, cobbles, boulders, or obstructions are encountered, percussion or other suitable drilling equipment capable of drilling and maintaining stable drill holes through such materials shall be used. The Engineer will not make separate payment for excavation of materials of different densities and character (hardness) or employment of special tools and procedures necessary to install the tiebacks.

(4) The drilling method used shall result in the following:

(a) Cause minimum disturbance to the surrounding ground and not resulting in any ground loss.

(b) Not result in collapse of the hole during drilling.

(c) Maintain the position and inclination of the drilled hole, allow the hole to reach the design depth, and produce the design diameter of the drilled hole.

(5) Temporary casing shall be used if the hole tends to collapse during drilling or placement of the tieback. The temporary casing shall be withdrawn as grout is placed. Drilling of the tieback hole shall

be monitored for the presence of soft zones or cavities in the ground mass penetrated over the length of the bond zone. The presence of such zones shall be noted on the daily record of work.

(6) The Contractor shall immediately revise his operations to prevent reoccurrence of obstructed or otherwise unsatisfactory holes and modify tieback installation procedures as required.

(7) Any damage to existing site conditions by such operations shall be cause for immediate halting of operations and repair to the satisfaction of the Engineer. The Contractor shall immediately revise his operations to prevent reoccurrence of such damage.

(8) Grout shall be injected at the lowest point of the tieback hole by using a tremie pipe. Grouting shall proceed such that the hole is filled without formation of air voids, grouting progressively from the bottom to top.

(9) The grout in the stressing length zone shall be the same as that for the bonded length zone. Grouting of the stressing length shall be done by gravity-flow or low pressure pumping. Grout shall terminate one foot before the anchor plate area prior to stressing and testing. Final grouting up to the anchor plate shall be completed upon completion of testing and stressing. The Contractor shall provide the fittings or components needed to accomplish this.

(10) If grout loss from the drilled hole exceeds five times the volume of the annular space between the drilled hole and tieback, then tieback installation shall be discontinued and the tendon removed from the hole and cleaned. The Contractor shall fully pressure grout the drilled hole with cement grout at a pressure of at least 5 psi, redrill the hole 24 hours after the grout sets, and install tieback as described herein.

The Engineer will pay for this work under Contract Item No. 681.1010 – Reinstallation of Tieback Anchors due to Grout Loss and Additional Performance Tests according to Subsection 109.04 – Extra and Force Account (F.A.) Work.

(D) Tieback Testing.

(1) Each tieback shall be tested.

(2) Copies of all test results and graphs shall be transmitted to the Engineer as each test is completed. Final copies of all test results shall be included in the tieback work completion report.

(3) Tiebacks shall be tensioned by direct pull with a hollow ram hydraulic jack or a model recommended by the anchor manufacturer, so mounted as to prevent bending of the tieback. Tensioning of a tieback shall not commence until the cement grout has set and has achieved its design strength.

(4) Jacks shall have ram travel at least equal to the theoretical elastic elongation of the stressing length plus the bonded length at the maximum test load. A pressure gauge shall be used with each jack. Gauges shall be calibrated with a single jack. All gauges shall be accurate enough to read 100 psi changes in pressure. For performance tests, the jack used shall have two (2) calibrated gauges: a master gauge and backup gauge. The pump shall be capable of applying each load increment in less than 60 seconds.

(5) A load cell, which has been calibrated by a certified independent testing laboratory no more than 20 days prior to the start of the testing, shall be used to measure the applied load and changes in load during the load-hole portion of the performance tests. There will be no substitute for the load cell during conduct of the performance tests. The Contractor shall provide the Engineer with the calibration curve for the load cell prior to testing.

(6) For the performance tests, the master gauge and backup gauge shall be connected to the same pressure hose between the pump and jack and be used to measure the applied loads. If the load measured by the master gauge and backup gauge differ by more than ten (10) percent, the jack, master gauge and backup gauge shall be recalibrated as a unit at no additional expense to the State.

(7) The weight of the jack and load cell shall be supported externally and not by the tendon.

(8) Use a micrometer dial gauge, with 0.001-inch precision and minimum 2 inches of travel, aligned perpendicular to the loading head to measure elongation of the tendon. The dial gauge shall be supported on an extension of the tendon head.

(9) All testing shall be performed in the presence of the Engineer. Notice shall be given to the Engineer not less than 24 hours prior to the start of a test.

(10) Maintain each load increment or decrement for at least 1 minute, or until movement ceases.

(11) Performance Test.

(a) Performance test a minimum of the three tiebacks on the top row and three tiebacks on the bottom row installed for retaining wall support. The Engineer will designate which tiebacks shall be performance tested.

(b) The performance tests will include stressing and monitoring a tieback. During testing, tieback movement, measured at the anchor head, shall be monitored for each load increment to the nearest 0.001 inches from an independent, fixed reference point. The loading sequence shall be as follows:

PERFORMANCE TEST LOADING SCHEDULE	
Cycle	**Load** P = Design load (as shown on the plans) AL = Alignment Load = 0.05P
1	AL 0.25P AL
2	AL 0.25P 0.50P AL
3	AL 0.25P 0.50P 0.75P AL
4	AL 0.25P 0.50P 0.75P 1.00P AL
5	AL 0.25P 0.50P 0.75P 1.00P 1.25P AL

PERFORMANCE TEST LOADING SCHEDULE	
Cycle	**Load** P = Design load (as shown on the plans) AL = Alignment Load = 0.05P
6	AL 0.25P 0.50P 0.75P 1.00P 1.25P 1.50P (Hold) AL
Final	Adjust to Transfer Load (Lockoff Load)

(c) The lockoff load shall be as shown on the Plans.

(d) The maximum test load shall be held for 10 minutes. Total movements with respect to a fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5, 6 and 10 minutes. If the total movement between the 1-minute and 10-minute readings exceeds 0.040 inches, the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 15 minutes, 20, 25, 30, 40, 50, and 60 minutes.

(e) The Contractor shall plot the tendon head movement versus load for each load increment. The Contractor shall also plot the creep movement for the load-hold stage as a function of the logarithm of time. The Engineer will review these data from each performance test to determine whether the tieback is acceptable.

(f) Where, in the opinion of the Engineer, additional performance tests are needed, the Contractor shall perform additional performance tests on the adjacent tieback to be installed. The Engineer will pay for this work under Contract Item No. 681.1010 – Reinstallation of Tieback Anchors Due to Grout Loss and Additional Performance Tests according to Subsection 109.04 Extra and Force Account (F.A.) Work.

(12) Proof Test

(a) All tiebacks not performance tested shall be proof tested. The requirements for loading and monitoring for proof

tests are the same as for performance tests, except that the load sequence shall be as shown in the following:

PROOF TEST LOADING SCHEDULE
P = Design Load AL = Alignment Load (0.05P)
AL
0.25P
0.50P
0.75P
1.00P
1.25P
1.50P
AL
Adjustment of test load to lockoff load

(b) For proof tests, maintain proof load for at least 10 minutes. The jack shall be re-pumped as necessary in order to maintain a constant load. The load-hold period shall start as soon as the maximum test load is applied and the ground anchor movement shall be measured and recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the ground anchor movement between the 1-minute and 10-minute readings exceed 0.040 inches, the maximum test load shall be held for an additional 50 minutes. If the load-hold is extended, the ground anchor movement shall be recorded at 15 minutes, 20, 30, 40, 50 and 60 minutes. A graph shall be constructed showing a plot of ground anchor movement versus load for each increment in the proof load test. The graph format shall be approved by the Engineer prior to use.

(13) Supplementary Extended Creep Test.

(a) For permanent tiebacks at the abutment at the Austin Bishop Separation, creep test the first three tiebacks installed for retaining wall support.

(b) The creep test shall be conducted by incrementally loading and unloading the anchor in accordance with the schedule of the Performance Test, except that at each new load maximum, the load shall be held constant in accordance with the following schedule.

Load	Observation Period (minutes)
AL	
0.25P	10
0.50P	30
0.75P	30
1.00P	45
1.25P	60
1.50P	300
Notes: P = Design Load AL = Alignment Load = 0.05P	

(c) The times for reading the creep movements shall be 1, 2, 3, 4, 5, 6, 10, 15, 20, 25, 45, 60, 75, 90, 100, 120, 150, 180, 210, 240, 270 and 300 minutes (where appropriate).

(d) If the creep rate exceeds 0.080 inches per logarithmic cycle, the observation period may be extended in an attempt to determine if the creep rate will diminish to the 0.080 inches per logarithmic cycle of time.

(e) The Contractor shall plot the creep movement for the load-hold stage as a function of the logarithm of time. The Engineer will review this data from each creep test to determine whether the tieback is acceptable.

(14) Lift-Off Readings. After applying the lock-off load to the tieback and prior to removing the jack, a lift-off load reading shall be made. The load determined from the lift-off reading shall be not less than the specified lock-off load, but not more than 5 percent of the specified lock-off load. If the load is not within minus zero percent to plus 5 percent of the specified lock-off load, the anchorage shall be reset and another lift-off reading shall be made.

(E) Acceptance Criteria.

(1) A performance-tested or proof-tested tieback anchor will be acceptable if the following criteria are satisfied.

(a) Displacement of the tendon head shall be greater than 0.8 (PL_s/AE) where,

P = applied load
L_s = length from jack pulling head to bottom of stressing length
A = total cross sectional area of steel tendon
E = modulus of elasticity of steel tendon

(b) Displacement of the tendon shall be less than $P(L_s+L_b/2)/AE$ where,

L_b = bonded length of tendon

However, anchors with longer apparent free lengths will not be rejected if the cause of the behavior has been investigated and satisfactorily explained.

(c) Creep per log cycle $(d_2- d_1) / \log (t_2/t_1)$ shall be less than 0.040 inches between the 1 and 10-minute readings and 0.080 inches between the 6 and 60-minute readings, where,

d_1 = measured displacement at time t_1
d_2 = measured displacement at time t_2
t_1 = time of first displacement measurement
t_2 = time of second displacement measurement

(2) Tiebacks not meeting Criterion (a) shall not be incorporated into the structure. Those not meeting Criterion (b) or (c) may be accepted to work at loads less than design values. The acceptable load for these tiebacks will be determined by the Engineer.

(F) Record of Work. Documentation of all work done shall be recorded accurately and completely. This shall include drilling of the tieback hole, grouting, testing and stressing of tiebacks, equipment used for testing and their calibration data, type of steel tendons, materials and procedures used for corrosion protection of strands or tendon bars.

681.06 Method of Measurement.

The Engineer will not measure furnishing specialty equipment for payment.

The Engineer will measure permanent tieback anchors per each tieback. The Engineer will not measure replacement anchors installed to replace or to supplement unacceptable anchors.

Additional work for Reinstallation of Tieback Anchors due to Grout Loss and Additional Performance Tests will be measured on a force account basis.

681.07 Basis of Payment.

(A) The Engineer will pay for the accepted furnishing specialty equipment on a lump sum basis complete in place. The price includes full compensation for furnishing and moving the specialty equipment and necessary tools and equipment to the project, setting the equipment up at the locations and removing the equipment from the project.

The Engineer will make payment of 60% of the contract amount for this item when all specialty equipment and supplies are available at the project site and ready to conduct the installation of the permanent tieback anchors.

The Engineer will make payment for the remaining 40% of the contract amount when all the permanent tieback anchors have been installed, tested, and accepted by the Engineer.

(B) The Engineer will pay for the accepted permanent tieback anchors at the contract price per each tieback anchor. The price includes full compensation for furnishing all labor, materials, tools, equipment and incidentals, and doing all work necessary to complete the permanent tiebacks, as specified.

Tieback anchor testing is considered incidental work related to the Permanent Tiebacks, and no separate or additional payment will be made.

(C) Additional work for Reinstallation of Tieback Anchors due to Grout Loss and Additional Performance Tests will be paid from an allowance provided in the proposal. The actual amount paid will be computed as set forth in Subsection 109.04 Extra and Force Account (F.A.) Work, whether this amount is more or less than the estimated amount in the proposal.

Payment will be made under:

Pay Item	**Pay Unit**
Furnishing Specialty Equipment	Lump Sum
Tieback Anchors for _____	Each
Reinstallation of Tieback Anchors due to Grout Loss and Additional Performance Tests	Force Account"

END OF SECTION

Make the following Section a part of the Standard Specifications:

"SECTION 690 - REMOVAL OF LEAD-CONTAINING OR ASBESTOS-CONTAINING MATERIALS

690.01 Description. This section is for removing, handling, transporting and disposing of lead-containing or asbestos-containing materials and debris associated with existing drain pipes on the Waimalu Viaduct (Westbound), in compliance with all applicable laws and regulations concerning lead, including all incidental and pertinent operations.

690.02 Materials. None specified.

690.03 Construction Requirements.

(A) References. All work under this contract, and any other trade work conducted with the project, shall be performed in strict accordance with all applicable federal, state and local regulations, standards and codes governing removal of lead-containing materials, and transportation and disposal of lead-containing materials. The most recent edition of any relevant regulation, standard, document or code shall be in effect.

Applicable statutory and regulatory requirements shall include, but not be limited to, the following:

(1) Title 29, Code of Federal Regulations, section 1926.62, entitled "Lead Exposure in Construction; Interim Final Rule."

(2) Department of Labor and Industrial Relations: State of Hawaii, Occupational Safety and Health Standards; Title 12, Subtitle 8, Chapter 148.1, (also known as chapter 12-148.1, Hawaii Administrative Rules, entitled "Lead Exposure in Construction."

(3) Title 29 Code of Federal Regulations Part 1910.134, Respiratory Protection.

(4) Federal Register: Vol. 54, No. 131; Tuesday, July 11, 1989. Department of Labor, Occupational Safety and Health Administration; 29 CFR Parts 1910, 1915, 1917, and 1918; Occupational Exposure to Lead; Statement of Reasons; Final Rule.

(5) Title 40 Code of Federal Regulations Part 61, National Emissions Standards for Hazardous Air Pollutants.

(2) Collect and properly containerize all LCM debris created by the pipe removal activities daily. Comply with all federal, state and local regulations for the proper packaging and disposal of lead-containing waste including but not limited to 40 CFR 260 to 268, 49 CFR 172 and 49 CFR 178.

(H) Work Area Preparation.

(1) Treatment of Surfaces. During removal activities, industry standard dust control methods shall be used to control dust.

(2) Barriers. Standard barriers such as construction warning tape, fencing, etc. shall be used to prevent the general public access onto the work site.

(3) NESHAP Compliance. Compliance with the requirements of EPA's NESHAP regulation is required for this project. The Contractor shall be responsible for proper notification of the removal of the pipes with LCM to the EPA and the State Department of Health.

(4) Worker Training and Protection. Ensure that all personnel working on site during the removal work are properly trained and protected as required by law. Ensure that all State personnel and the public are equally protected from hazardous material.

(I) Testing and Monitoring.

(1) The Lead Specialist will wipe sample surrounding areas of viaduct structure or features to remain prior to the start of the pipe removal work. Wipe sampling will be in compliance with the HUD Guidelines.

(2) The Lead Specialist or Monitoring Specialist will perform area air monitoring for lead in and around the work area to ensure that the concentration of lead does not exceed the action level as described below.

(3) Clearance wipe sampling of the surrounding viaduct structure or features to remain will be performed by the Construction Manager.

(4) TCLP testing of waste materials such as pipe, caulking, debris, disposable PPE, plastic, etc. shall be performed by the Lead Specialist prior to disposal.

(3) Minimum Requirements. The MCB end treatment shall meet the following minimum requirements:

(a) The end treatment shall be a non-redirective, gating crash cushion.

(b) The end treatment shall be designed to attach to the end of the MCB without the need to anchor the end treatment to the roadway surface.

(c) The end treatment shall be moveable.

(4) Crash Cushion Object Marker. Retroreflective sheeting shall be installed on a crash cushion whenever an object marker is not provided by the manufacturer. Make crash cushion object markers according to the dimensions and notes shown in the contract. Retroreflective sheeting material shall conform to Subsection 712.20(c)(4) - Type III or IV Retroreflective Sheeting.

(C) Paint. Paint shall be pre-mixed reflectorized white traffic paint with drop-on beads, and shall conform to Subsection 708.06 - White and Yellow Traffic Paint.

694.03 Storage, Maintenance, Delivery and Termination. Upon completion of the contract, remove the barriers and end treatments from the site to a location agreed upon by the Lessor and the Contractor. Remove the barriers and end treatments within five (5) working days after the final inspection of the completed project by the State.

Until such time as the barriers and end treatments have been returned to the Lessor, store the barriers and end treatments in a location and under conditions agreed to by the Lessor, at no additional cost to the State.

Maintain the barriers and end treatments until final delivery to the Lessor at no additional cost to the State.

694.04 Construction Requirements.

Preserve and protect existing facilities that the Contractor may affect by the MCB system installation. Replace the barrier and end treatments that the Contractor damages due to its operation at no cost to the State.

Paint the barrier as shown on the plans.

694.05 Method of Measurement. The Engineer will not measure the MCB system for payment.

694.06 Basis of Payment. The Engineer will pay for the accepted MCB system on a contract lump sum basis.

The price includes full compensation for the leased MCB and MCB end treatment as a single complete system, furnished, installed, painted and maintained according to the contract; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Moveable Concrete Barrier (MCB) System	Lump Sum"

END OF SECTION

Make the following Section a part of the Standard Specifications:

"SECTION 696 - WEIGH-IN-MOTION SYSTEM

696.01 Description. The work of this section shall consist of furnishing, installing, and testing a piezoelectric Weigh-In-Motion (WIM) system on Interstate Route H-1 including; installing and testing piezoelectric sensor; arranging for a representative from Piezo sensor's manufacturer to supervise installation of Piezo sensors; installing and testing vehicle detector loops and cable wiring; installing conduits, pullboxes, transformer, and controller cabinet; constructing a controller cabinet foundation; providing electrical and communication service connections; providing systems integration testing; and providing training. The WIM system will be used to monitor and to capture traffic data on Interstate Route H-1 inbound and outbound lanes such as: vehicle volume; vehicle speed; vehicle axle and total weights; and vehicle classification by number of axles, axle spacing, and vehicle length. All work shall be in accordance with the requirements specified herein and as indicated in the Contract Plans, or as directed by the Engineer.

(A) Definitions.

(1) Bit. The elementary unit of electronic data storage.

(2) Byte. A unit of data storage equal to eight (8) bits.

(3) Distribution. The directional distribution of traffic compared to the traffic in two directions during a period, usually peak hour, and expressed in percent.

(4) Equipment. The word "equipment" is an all-inclusive term which refers either to individual machines or components or to a complete data processing system.

(5) IFP. Invitation For Proposal (or Bid).

(6) K. The ratio of the traffic volume during the design hour (DHV), to the 24-hour volume and expressed in percent. For the State of Hawaii, Department of Transportation, Highways Division, the peak hour is used.

(7) Kilobyte (KB). One thousand bytes; in reference to memory storage systems, one kilobyte equals 1,024 bytes.

(8) Megabyte (MB). One million bytes; in reference to memory storage systems, one megabyte equals 1,048,576 bytes.

(9) Peak-Hour. The one hour period which constitutes the highest total volume for consecutive intervals within a period of an hour. For surveys conducted at quarter hour intervals, the peak hour is based on the highest four (4) consecutive interval volumes within a one hour period.

(10) Peak-Hour Factor (PHF). The peak-hour factor is determined by the following expression:

[n] multiplied by the [the highest interval volume during the peakhour] divided by [the peak-hour volume],

where [n] is the number of intervals surveyed during the hour. For example, n = 4 for quarter hour intervals.

(11) Polling. Dial-up and retrieval of traffic data stored in the field station recorder.

(12) Static. Method of weighing trucks, whereby the truck being weighed must stop on the scale in order to weigh individual axles or tandem axle groups.

(13) Weigh-In-Motion System. Method of weighing trucks, whereby the truck being weighed can be moving at highway speeds over the in-road sensors in order to weigh individual axles.

(B) Submittals. Working drawings and documentation for the Weigh-In-Motion System shall be submitted in accordance with Subsection 105.02 - Contract Plans and Working and Shop Drawings.

(1) Working Drawings.

(a) Equipment Assembly Drawings

(b) UL Listing

(c) Wiring Diagrams, Interconnect Diagrams, Schedules, and Schematics.

(d) Block Diagrams

(e) As-Built Drawings

(2) Materials Lists.

(3) Testing Schedule.

(4) Inventory List.

(5) Operation & Maintenance Manuals.

(6) Test Procedures.

(7) Test Report.

(C) Design Requirements. The design work for equipment procured under this contract shall include the selecting, packaging, installing, wiring, interconnecting, testing, and documenting of the equipment and materials such that the final equipment installation results in a Weigh-In-Motion system that meets or exceeds all of the requirements defined herein as well as all other requirements of the contract.

(1) Design, Construction, Patents and Warranty.

(a) Codes and Standards. The equipment covered by this specification and the materials of construction shall be designed, fabricated, inspected and tested in accordance with, but not limited to, the following listed codes, standards, specifications and guidelines, including all addenda in effect at the time the purchase order is placed, unless otherwise stated in this specification:

ASME - American Society of Mechanical Engineers
ANSI - American National Standards Institute
ASTM - American Society for Testing and Materials
AISC - American Institute for Steel Construction
AWS - American Welding Society
AFBMA - Antifriction Bearing Manufacturers Association
ASME - American Society of Mechanical Engineers
ANSI - American National Standards Institute ISA-Instrument Society of America
IEEE - Institute for Electrical and Electronics Engineers
NBS - National Bureau of Standards
NEC - National Electric Code
NEMA - National Electrical Manufacturers Association
OSHA - Occupational Safety and Health Administration
SMA - Scale Manufacturers Association
TMG - Traffic Monitoring Guide
UBC - Uniform Building Code
SSPC - Steel Structures Painting Council

These codes and standards set forth the minimum requirements which may be exceeded by the Contractor if, in his judgement and with the Engineer's approval, superior designs or materials are required for successful and continuous operation of the Contractor's equipment as required by the Contract Documents.

The Contractor agrees, represents and warrants that all services, designs, equipment and material sold or otherwise provided to the State by the Contractor comply with all applicable Federal, State or local laws, resolutions, codes, specifications and standards including those specified above.

The Contractor represents and warrants to the State that the material and services hereunder comply with the latest revisions of the Occupational Safety and Health Act of 1970 (OSHA and all applicable standards thereunder).

In the event of any apparent conflict among standards, codes or this specification, the Contractor shall refer the conflict to the Engineer for written resolution.

The Engineer shall have the option to incorporate requirements resulting from changes in codes, standards and regulations between the date of the execution of the contract and the date the Contractor initiates fabrication. Advising the Engineer of resulting effect is the Contractor's responsibility.

(b) General Design and Construction Considerations. These general provisions shall apply to all items of mechanical equipment supplied under this specification.

Every item of equipment in the design, construction, and operation of the system supplied by the manufacturer, shall have been furnished for at least two (2) years to be able to show a record of successful operation.

All parts and components of mechanical equipment shall be designed for satisfactory service in continuous duty without excessive wear, under the specified operating conditions, for a period of not less than one year. Any part of the mechanical equipment that shows undue or excessive wear, or that fails due to normal operating conditions within the first year of operation after final acceptance, shall be

considered as evidencing defective material or defective workmanship.

All parts of mechanical equipment shall be amply proportioned for all stresses which may occur during operations, and for any additional stresses which may occur during fabrication and erection. Iron castings shall be tough, close-grained gray iron in accordance with ASTM A 48. Structural steel shall conform to ASTM A 36.

All equipment and machinery furnished under this Contract shall be the latest improved design suitable for the service specified. All equipment and machinery shall be designed and constructed to operate under the specified requirements with a minimum of maintenance, renewals, and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum wear, vibration and noise when properly installed.

All lubrication fittings, if applicable, shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards and without requiring unusual or hazardous access platforms. Lubrication fittings shall be mounted together wherever possible. Pressure grease lubricated fittings shall be "Zerk" hydraulic type.

(c) Patents. The Contractor shall hold harmless, indemnify, defend and where appropriate, insure and save the State, its officers, agents, servants, and employees from any liability of any nature or kind for or on account of the use of any copyrighted composition, secret process, patented or unpatented invention, article or appliance furnished or used in the performance of this contract.

(d) Warranty. Materials and equipment furnished by the Contractor shall be of first class and new. The Contractor shall secure from the manufacturer or manufacturers of all the equipment furnished and delivered, a warranty or warranties guaranteeing all equipment from defects in materials, design and workmanship for a period of not less than 12 months from the date of acceptance. Such warranty or warranties shall be assigned to the State.

Should any defect be encountered during the warranty period, the manufacturer will be notified and he shall promptly correct such defect at no additional cost to the State. If the defect requires factory correction, the manufacturer shall so inform the Engineer, who will then transport the defective equipment to the manufacturer or the manufacturer's representative's office. The manufacturer shall repair or replace the defective equipment within three (3) weeks from the date of receipt of such defective equipment. Bidders shall include a copy of their warranty covering the proposed equipment as part of the bid requirements. The cost of warranty or warranties shall be incidental to the contract.

(2) Delivery. The Contractor shall coordinate delivery of the WIM system with the Engineer. The WIM equipment Contractor shall provide supervision for the installation of the system in the roadway to the State's roadway construction Contractor.

696.02 Materials.

(A) Weigh-In-Motion (WIM) System. The eleven lane, piezoelectric sensor, WIM system shall perform vehicle classification, including but not, limited to the thirteen (13) FHWA vehicle types, and data for environmental impact analysis per FHWA requirements. The variables used in the software shall be adjustable by the user to modify the classification scheme. The WIM system hardware and software must feature high flexibility in terms of measuring various combinations of trucks, data registration, and data recording. For axle registration, piezoelectric sensors are connected for measurement and classification of axle loads.

The data shall be retrievable via serial interface onto a portable unit used for this purpose or directly into an IBM PC-compatible microcomputer running Windows 2000 or NT via a modem. These units will also be used for communication with the WIM scale system's central processor to set data collection parameters.

(1) General Requirements. The WIM system shall be installed in the eleven traffic lanes (five inbound and six outbound) of Interstate Route H-1 at the location shown on the Contract Plans. The WIM system contains a set of piezoelectric sensor and loop detectors. The WIM system shall determine the weight of each axle of the vehicles, measure vehicle speed, and classify the number of axles in accordance with the specifications. The WIM system shall meet ASTM E 1318-02 for a Type II system.

The WIM system shall monitor traffic on a continuous basis and shall consist of two separate, but integrated subsystems. One of the subsystems is housed in a roadside controller cabinet, and the other located at the State of Hawaii Department of Transportation (HDOT) Planning Branch Office, 869 Punchbowl Street, Honolulu, Hawaii. The data shall be collected and stored in an electronic unit and polled by a remote computer system at the HDOT Planning Office on a daily basis. The remote computer system is not a part of this contract package.

(2) WIM System Components.

(a) WIM Data System Requirements.

1. In-Road WIM Sensor System. A Piezo Sensor System is the type of WIM sensor system required for this project.

a. The WIM sensors shall have an operating life of a minimum of one (1) year. Failure during this period shall require replacement at the Contractor's expense for furnishing, delivering and installing the replacement equipment, system, and components.

b. The WIM sensor systems shall be installed by the Contractor under the supervision of the manufacturer's representative for the Piezo system. The components furnished shall be completely compatible with the existing system without special adapters or interface devices. All necessary components, process, system modifications, and installation requirements shall be provided as incidentals to the system.

c. Piezo WIM Sensor System. The following are requirements for the Piezoelectric (Piezo Sensor) WIM system:

i. Configuration. Piezoelectric WIM sensors shall be installed in the roadway for each lane in both traffic directions. Lanes adjacent to the median may experience contra-flow conditions.

ii. Class 1 BL unencapsulated piezoelectric sensors must be supplied complete with custom length lead-in coaxial cable with pre-made termination connectors. The sensor design and installation technique must have been proven reliable in conditions (soil and environmental), similar to those in Hawaii. The sensors shall be compatible with the existing controller and tested for linearity.

iii. Piezo Sensor shall be Class I Weigh in Motion Sensor, 12-foot length, complete with coaxial lead cable (non-spliced). The sensor shall have 16 gauge flat braided silver plated copper wire center core with highly compressed piezoelectric copolymer P(VDF-TrFE) and outer sheath of 0.16-inch thick brass meeting CDA-260 and ASTM B87-88 requirements. The sensor shall be approximately 0.26-inches wide with a maximum thickness of 0.063-inches (plus/minus 0.05 inches). Insulation resistance between core and shield shall be greater than 500M ohms. Piezoelectric coefficient shall be greater or equal to 20 pC/N nominal.

a) The piezo sensors shall be embedded in a grout with clips for mounting at 6-inch intervals. The sensors shall be of the type suitable for the application. The piezo lead-in cables and piezo sensors shall be installed in slots cut in the road surface, approximately 3/4" wide x 3/4" deep and provided with supporting clips at 6-inch centers.

b) The sensor shall be laid in the groove at 3/8-inches below the surface of the roadway. The sensor shall be secured in place along the entire length of the

sensor in the slot by quick-setting grout clips.

c) Sensor shall be manufactured to produce uniform, high amplitude piezoelectric output with signal to noise ratio of 10:1 minimum.

d) Groove shall be constructed in strict accordance with specifications of the manufacturer. Sensor shall be installed straight and flat in groove.

e) The voids of the groove shall be epoxy filled. The epoxy grout fill shall be prepared in accordance with the manufacturer's instructions, pre-mix the resin before combining, and trowel finish to match finished grade. Hot tar shall not be used. When the epoxy is fully cured, grind finish the grout to insure a flat and level finish, without concave portions. The grout curing requirements of the manufacturer shall be complied with and traffic loading shall not be permitted until the grout is fully cured.

f) Passive signal cable shall be RG 58 rated for underground direct burial, with outer jacket of 0.187-inch outside diameter and nominal capacitance of 27 pF/Ft, with factory termination to sensor and BNC connector. Each cable shall have field measured custom length to suit the installation conditions. In the event that the cables provided have insufficient length to reach the equipment

harness, the cables shall be rejected and splicing to lengthen the cable will not be allowed.

g) Sensor shall be installed in clean saw cut grooves in strict conformance to the sensor manufacturer's installation requirements.

h) Hot tar shall not be used. Installation of encapsulating material shall be allowed to cure, shall be ground flat, and no concave portions shall be accepted.

i) Traffic shall not be allowed on the completed system until all conditions of the installation are approved by the manufacturer's representative with the acceptance by the Engineer. Thereafter, testing in accordance with the manufacturer's requirements shall be completed before public traffic is allowed.

j) Grooves shall be made by wet cutting. Dry cutting shall not be allowed.

k) Overall length of the passive cable shall be 300-feet maximum. Provide loop of 5-feet in handhole for each cable.

l) In the event that heating of the encapsulating material is allowed by the Engineer, the temperature of the material shall not be allowed to exceed 170 degrees F. In the event that the temperature exceeds the maximum allowed, the entire

sensor system installed shall be replaced.

m) Provide adequate power for all test equipment to meet the detailed and specific requirements of the manufacturer for all tests required for certification and acceptance. Provide all necessary equipment to perform the required tests.

iv. The sensors shall at a minimum meet the requirements for Class 1 piezoelectric sensors as outlined in FHWA Report No. DP-88-76-006.

v. At least two (2) 12-foot piezoelectric sensors must be supplied for each lane for both directions at the site specified herein.

vi. The sensors shall be able to withstand at least one million cycles.

vii. The sensors shall include all mounting hardware and installation grout. The supplied installation grout must be suitable for installation in both asphalt and portland cement pavements. The installation grout must require no special equipment to facilitate installation. The grout must have a short curing time (less than 75 minutes) to minimize lane closure time. The grout should be of a sufficient consistency to prevent "running" when being applied on road surfaces with a drainage cross-slope. Particulate matter within the grout must not separate or settle. The grout must not shrink during the curing process.

d. Sensor (induction) loops shall be furnished and installed in each traffic lane, to measure speed and length of vehicles and also to classify vehicles in conjunction with the axle

detectors. Refer to the configuration shown in the construction plans.

e. After installation, the Contractor shall furnish written test results for each loop showing:

f = Frequency of Loop (KHz)
L = Inductance of Loop (uH)
R = Resistance of Loop (Ohm)
Meg Test = Loop insulation resistance should be > 100M ohm

f. If the number and configuration of the in-roadway sensors, and sensor loops, need to be modified from the number and configuration shown in the construction plans, the Contractor shall inform the State at the time of submitting the proposal, or earlier, and submit Shop Drawings of the revised configuration for approval.

g. Grout and Epoxy. All grout and epoxy used for the classification and axle sensor installation must be approved by the sensor manufacturer and the Engineer.

(b) Vehicle Detector Loops and Vehicle Detector Electronics. Two vehicle detector loops are installed per lane, for measuring the speed and the vehicle length. Install vehicle detector loops in the roadway according to the Contract Plans, or as directed by the Engineer and as required by the WIM system manufacturer.

Furnish and install vehicle detector loop electronics in the roadside controller cabinet and connected to the vehicle detector loop lead-in wires in the controller cabinet.

From the controller cabinet, an interconnecting cable shall connect the controller cabinet electronics with the central processing and recording electronics.

(c) WIM Evaluation and Data Collection Unit (Central Unit). The WIM evaluation and data collection unit (central unit) shall receive the electrical signals from the WIM system

and evaluate and record the data specified in the Statistics Program that complies with the TMG requirements.

The WIM evaluation unit (central unit) shall be housed in a water and dust-protected steel enclosure. This unit shall be installed in a weather-proof, compact outer cabinet with a steel door and padlock.

The central unit shall be modular with plug-in units. The central unit shall include the following:

1. Power supply module.

2. CPU, 400 Mhz minimum.

3. Random Access Memory (RAM) 32 MB minimum.

4. Multi-channel analog/digital converter, 12 bit (AID).

5. Digital I / O board .

6. Multi-channel signal conditioner board.

7. Vehicle detector loops (amplifiers).

8. Serial Interface.

9. Modem. The full duplex modem shall provide the following:

a. Automatic speed detection and switching between the various data transfer speeds. The modem shall be able to handle data transfer speeds of at least 19.2K BPS.

b. Compatible with the AT(Hayes)command set.

c. Data compression and error correction capabilities.

d. Operate reliably in a temperature range of -20°C to 70°C / -4°F to 158°F.

e. Operate on power source of 8 to 40 volts DC, or 110 volts AC.

(d) Portable Terminal. A portable terminal shall-be provided to connect to the "Terminal" socket of the central unit at the roadside controller cabinet for special tests, adjustments, and for programming purposes.

The portable terminal shall have the same functions as a desktop microcomputer unit with the following minimum features: 96 character ASCII set, RS-232C serial interface, and an alphanumeric (16-digit) display. The terminal shall operate on 5 to 6 volts DC. The programming requirements for the terminal are outlined in these Contract Documents. It shall be also be possible to connect a desktop microcomputer terminal to the central unit, as an option.

(e) WIM Controller Cabinet. The WIM controller cabinet shall house all required communications and control equipment necessary to control the WIM and to remotely communicate with the Department of Transportation, Highways Division, Planning Branch via modem.

The WIM controller cabinet shall consist of a ground mounted Model 332 Controller Cabinet cable of housing and mounting the data collection unit.

Each 332 cabinet shall meet the following additional requirements:

1. Cabinet shall be fabricated from 0.125 anodized aluminum.

2. Cabinet's main breakers shall be rated as 50 amps.

3. Front and back fluorescent lights shall be activated upon opening any door.

4. Convenience GFI receptacles shall be provided.

5. Door locks shall be compatible with the Department of Transportation, Highways Division's keying system. Coordinate keying system requirements with the Engineer prior to placing order.

6. Labeling shall be by silk-screening only.

7. Attach one each 24" x 36" cabinet print in a weatherproof plastic jacket to front and back cabinet doors.

Internal wiring shall be modified to meet the functional needs of the WIM.

(f) Electrical Conductors. Electrical conductors shall be as follows:

1. **Type 1**. Home-run cable tie in loop detector stubs to the cabinet. Polyethylene insulated, stranded-tinned-copper 14 AWG; 2 conductor cable; stranded tinned-copper drain wire; aluminum polyester shielded; polyethylene jacketed; 600 volts rated; IMSA Spec. 50-2 certified.

2. **Type 2**. Detector-loop cable for installation into the roadway sawcut; 12 AWG stranded THHN; 600 volts; inserted into a polyethylene yube, 0.25-inch maximum diameter IMSA Spec 51-5 certified. Cable shall be inclusive in the detector loop bid.

3. The remaining cables required for the installation of the WIM station shall be as required by the manufacturer.

(g) Surge Protection. Surge protection devices against lightning, and other transient high voltages shall be provided by the contractor as listed below.

1. **AC Line Protector.** Surge suppression shall be provided for all components of the WIM station in accordance with the manufacturer's recommendations. The surge suppresser(s) shall consist of multi-component suppression circuits constructed from torroidal chokes, ferrite rod-core inductors, HF/VHF capacitors and multiple layers of metal oxide varistors enclosed within a metal housing. The surge suppresser(s) shall conform to the performance requirements identified within IEEE 587/ANSI C62.41 and shall be listed under UL 1283, UL 1363 and UL 1449.

2. Phone Line Protector. Surge suppression shall be provided for all telephone and/or data lines entering the WIM station in accordance with the manufacturer's recommendations. The surge suppresser(s) shall consist of silicon breakover devices for protection against high-voltage transients and solid-state resettable fuses for protection against sneak and fault currents. The surge suppresser(s) shall provide line-to-line and line-to-ground protection and shall be listed under UL 497A.

3. Loop Inputs.

4. Grounding. All cable conduits shall be metallic and bonded with #8 bare copper wire. A ground rod shall be placed in the pullboxes and shall have an impedance to ground of less than 25 ohms. The ground rod shall be bonded to the control cabinet with #6 bare copper wire.

(B) Other Materials.

(1) Concrete. Concrete shall conform to the requirements of Section 601 - Structural Concrete. Concrete for concrete jacket around systems conduit ducts shall be rapid-set, f'c of 3,000 psi in 24 hours.

(2) Paint. Paint shall conform to the requirements of Section 708 - Paints.

(3) Other materials shall conform to the following:

Trench Backfill Material	Section 206
Galvanizing	Section 501
Reinforcing Steel	Section 602
Pullboxes	Section 712
Conduits	Section 712
Cables, Conductors, and Wires	Section 712
Controller Equipment	Section 712

696.03 Construction Requirements.

(A) Equipment List and Drawings. Submit the equipment list according to Subsection 106.13 - Ordering of Certain Materials.

Upon completion of the work, submit an 'As Built' or corrected plan showing in detail the construction changes.

(B) Excavation and Backfill. Excavation and backfill shall conform to Section 206 - Excavation and Backfill for Conduits and Structures. Place the material from the excavation to prevent damage and obstruction to vehicular and pedestrian traffic and interference with surface drainage.

(C) Trenchless Sleeves. Trenchless sleeves shall conform to Section 680 - Trenchless Sleeves.

(D) Installation.

(1) Provide supervision for the installation and testing of the WIM system.

(a) Install piezoelectric sensors under supervision of the Manufacturer's representative.

(b) Install underground conduits and pullboxes for the WIM communication and power systems (110 VAC) to roadside controller cabinet.

(c) Install WIM vehicle detector loops.

(d) Install controller cabinet foundation, controller cabinet, and transformer.

(e) Provide final hook-up of all electrical and other connections for each piece of equipment and the proper attachment of any sub-assemblies to the equipment so that the equipment is operable and ready for use by the State.

(2) Controller and Cabinet. Mount the controller cabinet according to the contract. Assemble, wire, and house the controller and auxiliary equipment specified in the cabinet.

(3) Vehicle Detectors. Vehicle detectors shall be inductive loop detectors installed according to details shown in the contract. The saw cut groove shall be air blown to remove debris before inserting the loop cable. The loop cable shall be continuous within the roadway. Splice in the pullbox. Fill the saw cut groove with epoxy sealer or hot applied rubberized sealant.

As accepted by the Engineer, the Contractor may use a sealant designed for use as a protective seal for traffic inductive loop detectors installed in asphalt concrete or concrete pavements.

(4) Controller Foundations and Pullboxes. Construct the foundations and boxes required carefully at the locations designated. Pour the foundations and boxes in areas that the Contractor has carefully excavated to receive the foundations and boxes. Construct each unit as detailed in the contract and connect each unit properly with the facilities of which each unit is a component part.

Mix, place, and cure the concrete according to Section 601 - Structural Concrete, and Section 503 - Concrete Structures. The Engineer will allow hand mixing.

Set the anchor bolts for the foundations to fit the controller cabinet base to be installed.

Give the pullbox frames and covers two (2) coats of asphaltic base paint after installation.

(5) Conduits. Conduits shall be installed by horizontal directional drilling or concrete encased as shown in the contract. Conduits shall be PVC unless noted otherwise on the plans.

Install the ducts to drain towards either one or both pullboxes.

Intake directional changes in the conduits, such as bends and changes to clear obstructions with curved segments, shall be made using accepted deflection couplings or with short lengths of straight ducts and couplings. The deflection angle between two adjacent lengths of ducts shall not exceed 6°. The bends shall not have a radius of less than 12 times the nominal size of the conduit. The Contractor may use factory-made ells.

Square and trim the ends after cutting to remove rough edges. The connections shall be of the solvent weld type. Make the solvent

weld joints according to the conduit manufacturer's recommendations and as accepted.

Seal the ends of the duct with plugs at the end of each day of work, whenever problems interrupt the duct installation work and whenever ducts are subject to submergence in water.

Keep the conduits clean during construction.

Use only hand shovels in compacting concrete encasements. Cure the concrete for at least 72 hours before permitting vehicular traffic to run over the concrete.

Provide each conduit run with a No. 10 gage flexible, zinc-coated pull wire extending through its entire length. Double an additional two feet back into the conduit at each end of the run. Conduits and sleeves entering pullboxes shall end flush in the wall with ends ground smooth. Plug the conduits and sleeves temporarily.

Give the exterior portions of the direct burial steel conduits not encased in concrete two (2) coats of asphaltic base paint.

The entire length of a conduit run between pullboxes or standards shall be of one type of material.

The completed duct lines shall be subject to a field test. Pass a bullet-shaped test mandrel about 14 inches long with a diameter 0.5 inch less than the inside diameter of the ducts through the entire length of each duct run. The Engineer will consider scouring found on the mandrel deeper than one thirty-secondth inch an indication of burrs and/or obstructions in the duct run. Normal abrasion between the duct line and bottom of mandrel is not an indication of burrs and/or obstructions in the duct run. Remove such burrs and/or obstructions. Pass the test mandrel through again. Repeat the process until the results meet the satisfaction of the Engineer.

(6) Wiring. Wiring shall conform to the appropriate articles of the Code. Arrange the wiring within cabinets and pullboxes neatly. Encase the wiring installed underground in conduits. Before installing the wires and cables in conduits, pull a wire brush, swab and mandrel through each conduit for the removal of extraneous matter and verification of the absence of obstructions and debris from the conduit system.

Pull the cables directly from their cores or reels into the conduits. Do not pull off and lay the cables on the ground before installation. Make the pulls in one direction only. Lubricants used shall be as recommended by the cable manufacturer or accepted by the Engineer. Leave the wires or cables under tension nor tight against bushings or fittings.

Remove the damaged ends resulting from the use of pulling grips soon after pulling the cable. Maintain the cable end seals. Do not pull the open ended cables through the conduits. Cables shall be continuous from pulling point to pulling point. The Engineer will not permit splices. Make the splices, taps and terminations with pressure-indented connectors or lugs as appropriate or as specified herein. Tape or seal the ends of the spare conductors as accepted.

Leave at least five feet of slack of each conductor within each pullbox.

Join the conductors by a 'western union' type splice. Use the connectors for splicing conductors No. 8 AWG, or larger. Solder the splices by the pouring or dipping method.

Pencil the conductor insulation well, trim the conductor insulation to conical shape and roughen the conductor insulation before applying splice insulation.

Splice insulation includes layers of thermoplastic electrical insulating tape not over 0.007-inch thick applied to a thickness equal to and well lapped over the original insulation. The splice insulation shall conform to Federal Specifications MIL-I-7798. On high voltage and multiple lighting conductor splices, apply two (2) layers of synthetic oil resistant rubber tape conforming to ASTM D 119 over each conductor before placing the thermoplastic tape. Cover the splice well with at least two (2) layers of asphaltic impregnated open mesh fabric tape and a coating of high grade insulating paint or similar material. Leave at least two feet of slack for each conductor at each splice.

Furnish the cables on reels and handle the cables with great care to avoid damage to the conductors or the jacket.

Install the communications cable, connect the communication cable to terminals, and wire the communication cable to the proper equipment to produce a closed loop network suitable for operating

within the traffic signal control system. Cable runs shall be continuous between controller cabinets without splices.

Tape the cable ends to exclude moisture and shall remain so until the Contractor attaches the terminal equipment. For cable connections in terminal cabinets, use Bell Telephone System or equivalent connectors accepted for outside use.

Pull the cable in the conduit with a cable grip designed to provide a firm hold on the exterior covering of the cable. Pull the cable with a minimum dragging on the ground or pavement. Use powdered soapstone, talc, or other accepted lubricants to ease the pulling of the cable.

(7) Bonding and Grounding. Make the metallic cable sheaths, conduits and standards mechanically and electrically secure to form a continuous system. Ground the system effectively. Bonding and grounding jumpers shall be No. 8 AWG copper wire or equivalent copper strap of the same cross-sectional area.

Bond the standards by a bonding strap attached to an anchor bolt or a three-sixteenth inch or larger, brass or bronze bolt installed in the lower portion of the shaft.

Ground the conduits and the neutral wires at the service points as required under the Code, except that grounding conductors shall be No. 6 AWG or equal.

Install a copper-clad steel or pure copper ground rod five-eighth inch diameter within each pullbox.

Connect ground rod with No. 6 AWG wire to the No. 8 AWG ground wire loop and power system neutral.

(E) Painting. Paint the controller cabinet, if of metal other than aluminum, with one coat of accepted metal primer and two coats of aluminum paint conforming to AASHTO M 69.

Supply the aluminum controller cabinet with polished natural aluminum finish. The cabinet shall not require painting.

(F) Electric and Phone Services. Electric power shall be 120 volts, single phase, 60 cycle. Install the service underground in a steel conduit of the size shown in the contract from the local power company's pole to the controller.

Furnish and install service connections such as conduits, weatherhead, wires, and meter loops, and comply with the power company's requirement for electric service. The cost of service connections shall be at no cost to the State.

Furnish and install service connections such as conduits and wires, and comply with the telephone company's requirements for a single analog dedicated line service. The cost of service connections shall be at no cost to the State.

(G) Inspection and Testing.

(1) Preliminary Arrangements. The equipment shall be given requisite factory tests as necessary to determine that the workmanship and materials are free from defects and to establish that the design and construction are satisfactory.

The Contractor shall be responsible for setting up and conducting shop test of equipment to establish compliance of the Contract Documents and all applicable codes and standards. Furnish certified reports showing the results of all such tests. Test facilities shall be subject to prior inspection by the Engineer. Notify the Engineer at least 15 working days before the scheduled start of a test so that the Engineer may elect to witness any or all such tests. The Contractor shall be responsible for proper protection of equipment to prevent damage during testing and shall bear all repair or replacement costs of any item damaged as a result directly or indirectly of the test.

Unless otherwise noted in the Contract Documents, shop testing and inspection of the components or the complete system shall be in accordance with the Contractor's standard practice. Supply a list of all the Contractor's standard testing with the bid. The State shall not be charged for any of the preliminary testing.

(2) Inspection. The State reserves the right to inspect all material during fabrication and before shipment and shall have access to the manufacturer's or Contractor's plant as required.

(3) Load Testing and Calibration. The Contractor shall be responsible for coordinating actual load tests of the WIM system with the Department of Transportation, Highways Division, Planning Branch; and for calibrating the WIM system to meet the acceptable accuracy requirements, as required by the Department of Transportation, Highways Division, Planning Branch.

(4) System Accuracy and Calibration Testing.

(a) After installation of piezo sensors, furnish written test results for each piezo sensor showing:

1. Test of resistance between the center conductor (of lead-in cable) and the outside ground is infinity.

2. Tests of each sensor on the milli-volt range of a multi-meter registers some deflection when a vehicle passes over the sensor.

(b) Notify the Engineer when the sensors for the traffic classification data system are ready for acceptance testing. Within 30 days of receiving written notification, the Engineer will conduct the following acceptance tests with the State's equipment. The Engineer will notify the Contractor in writing of the results of the tests and acceptance of system.

1. Vehicle Volume. The system shall measure and record vehicles with no greater than 2 percent error, based on at least 100 samples and compared with visual observations or other means.

2. Vehicle Type Classification. The system shall measure and record vehicles by type with no greater than 2 percent error, based on at least 100 samples, including the minimum 10 test passes by the Test Vehicle(s) and comparing with visual observations.

3. Vehicle speed, Axle Spacing and Vehicle Length.

a. The system must be calibrated with vehicles of known speed, axle spacing and total length dimensions and meet the following accuracy criteria.

b. The Test Vehicle(s) shall be weighed at a commercial, certified scale, or if one is not available, by the State's static platform scale.

c. The system shall be tested using test vehicles provided by the Contractor. Drivers for the test vehicles shall also be provided by the

Contractor. The test vehicles shall include as a minimum the following categories: 2S, 2D, 3X and 3S2. The WIM system shall meet ASTM E 1318-02 for a Type II system.

(5) Acceptance Test. The Contractor shall be responsible for coordinating actual load testing of the WIM system with the Department of Transportation, Highways Division, Planning Branch for calibrating the WIM system.

The test will demonstrate the operation of each weigh-bridge, digital indicator and data file management system. The test will be considered to be successful if the operating functions are demonstrated to be in working order and there is no damage, duress or malfunction sustained by the equipment during the test.

The acceptance test period shall commence upon the notification by the Contractor, in writing, that the system is ready for official testing. The test period shall terminate upon satisfactory performance, according to the testing provisions, but no later than the contract completion date, unless any extension is authorized and the Contractor is notified by the Engineer in writing.

The State's Acceptance Test consists of a series of live test demonstrations of provisions specified in this contract. The live test demonstrations shall be based on the Contractor executing a variety of weighing tests and shall include the following:

(a) Weighing of Test Truck and Comparing with a Commercial Static Scale. The test shall demonstrate the operation of each part of the WIM system, including the accuracy of the weight readings, the signal and control system, report output and data file management. The test will be considered to be successful if the operating functions are demonstrated to be in working order, the weighings within manufacturer's claims and there is no damage, duress or malfunction sustained by the equipment during the testing. At least three (3) cycles of weighings of the test truck shall be conducted. The test truck will be provided by the Contractor. The cost of weighing the test truck at a commercial scale shall be borne by the Contractor.

Upon successful completion of the Acceptance Test, the Engineer will promptly notify the Contractor, in writing, of the acceptance of the WIM system.

(6) Acceptance of WIM System.

(a) The WIM system shall not be accepted and charges shall not be paid by the State until the system has successfully met the State's Acceptance Test, as specified in Subsection 696.03(F)(4)(a).

(b) Inspection. The State reserves the right to inspect all material during fabrication and before shipment and shall have access to the manufacturer's or Contractor's plant as required.

(7) Training of State Personnel. The Contractor shall provide detailed classroom and on-the-job training for up to ten (10) designated State personnel in operating the WIM system so that the personnel become adequately proficient in the operations of the system.

The training facility will be provided by the State. Training shall be conducted in sessions lasting a maximum of 6 hours each.

(8) Restoring Pavements and Other Improvements. Restore the existing pavements and other improvements disturbed by excavation to their original condition according to the contract. Materials used for restoration work shall be equal to or better in quality than the materials the Contractor will replace, and matching in thickness, texture, and color whenever applicable. The grades of the restored surfaces shall conform to the existing grades.

(9) Warranty. Materials and equipment installed for permanent construction shall be new. The contract contemplates the use of first-class material and equipment throughout the performance of the contract.

Secure from the manufacturer(s), a warranty or warranties guaranteeing equipment from defects in materials, design and workmanship for not less than 12 months from the date of acceptance.

When requiring adjustments or repairs during the warranty period, adjust or repair the existing unit within 24 hours from the time of notification.

When requiring repairs that need factory corrections during the warranty period, replace the existing unit with an accepted temporary operational replacement unit within 24 hours from the time of notification until the Contractor can install the new unit. Install the new, identical non-defective unit within 30 days from the time of notification.

696.04 Method of Measurement. The Engineer will not measure the WIM system for payment.

696.05 Basis of Payment. The Engineer will pay for the accepted WIM system on a contract lump sum basis. The price includes full compensation for designing, furnishing, installing and testing the WIM system, complete in place, including: stakeout; excavating and backfilling for structures; excavating and backfilling trenches; pipe penetrations through walls and barriers; furnishing and installing concrete; furnishing and installing pullboxes, frames, and covers; furnishing, installing and assembling conduits in banks as indicated; furnishing and installing warning tape; furnishing, installing and testing piezoelectric sensor; furnishing, installing and testing vehicle detector loops; constructing controller cabinet foundation; furnishing and installing controller cabinet and transformer; installing conduit risers from trenchless sleeves; furnishing and installing WIM evaluation and data collection unit; furnishing and installing portable terminal; providing electrical and communication service connections; providing training of State personnel; furnishing and installing loop detector cables; furnishing and installing piezoelectric sensor cables; providing calibration and systems integration testing; restoring existing pavements, private property, other improvements and/or any other facilities affected by the construction of the WIM system; furnishing warranty; and furnishing equipment, tools, labor, materials and incidentals necessary to complete the work.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Weigh-In-Motion System	Lump Sum

The Engineer will pay for trenchless sleeves for the WIM system under Section 680 - Trenchless Sleeves.

The Engineer will pay for traffic control for the WIM system installation under Section 645 - Work Zone Traffic Control if additional traffic control is determined by the Engineer to be required."

END OF SECTION

SECTION 705 – JOINT MATERIALS

Make the following amendment to said Section:

(I) Amend **Subsection 705.06 Waterproofing** to read as follows:

"**705.06 Waterproofing**

(A) Primer. Primer shall conform to ASTM D 41.

(B) Fabric. Fabric for waterproofing shall conform to ASTM D 1668.

(C) Asphalt. Asphalt for waterproofing shall conform to ASTM D 449."

END OF SECTION

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
104.1000	Lane Rental Incentive	Allow	Allow	Allow	$2,000,000.00
108.1000	Incentive Allowance	Allow	Allow	Allow	$2,925,000.00
202.0010	Removal of Two Residential Structures (T.M.K. 9-8-26:09)	L.S.	L.S.	L.S.	$_____
202.0020	Removal of One Residential Structure (T.M.K. 9-8-26:47)	L.S.	L.S.	L.S.	$_____
202.0030	Removal of One Residential Structure (T.M.K. 9-8-26:65)	L.S.	L.S.	L.S.	$_____
202.0040	Removal of One Residential Structure (T.M.K. 9-8-26:69)	L.S.	L.S.	L.S.	$_____
202.0110	Removal of At Grade Existing Concrete Barriers	L.S.	L.S.	L.S.	$_____
202.0111	Removal of 96-Inch Sectional Plate Culvert	L.S.	L.S.	L.S.	$_____
202.0112	Removal of 24-Inch RCP Pipe	L.S.	L.S.	L.S.	$_____
202.0113	Removal of 6-Inch Perforated PVC Pipe & Cleanouts	L.S.	L.S.	L.S.	$_____
202.0114	Removal of Grated Drop Inlet	L.S.	L.S.	L.S.	$_____
202.0115	Removal of Storm Drain Manhole	L.S.	L.S.	L.S.	$_____
202.0116	Removal of 8-Foot x 6-Foot Outlet Structure	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
202.0117	Removal of Guardrail	L.S.	L.S.	L.S.	$_____
202.0118	Removal of Six-Foot Chain Link Fence	L.S.	L.S.	L.S.	$_____
202.0119	Removal of 4-Foot Wide Concrete Ditch	L.S.	L.S.	L.S.	$_____
202.0120	Removal of 10-Foot Wide Concrete Ditch	L.S.	L.S.	L.S.	$_____
202.0121	Removal of 4-Foot Wide Lined Ditch	L.S.	L.S.	L.S.	$_____
202.0122	Removal of Retaining Wall	L.S.	L.S.	L.S.	$_____
202.0123	Removal of Concrete Slab (TMK: 9-8-26: 60)	L.S.	L.S.	L.S.	$_____
202.0124	Removal of 9-Inch Thick Grouted Rubble Paving	L.S.	L.S.	L.S.	$_____
202.0125	Removal of Concrete Driveway	L.S.	L.S.	L.S.	$_____
202.0126	Removal of Rolled Curb	L.S.	L.S.	L.S.	$_____
202.0127	Removal of A.C. and Base Course	L.S.	L.S.	L.S.	$_____
202.0128	Removal of CRM Wall	L.S.	L.S.	L.S.	$_____
202.0129	Removal of 2-Inch A.C. Pavement	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
202.0130	Removal of CMU Wall	L.S.	L.S.	L.S.	$_____
202.0131	Removal of A.C. Swale (Ramp E)	L.S.	L.S.	L.S.	$_____
202.0132	Removal of Concrete Swale (Ramp E)	L.S.	L.S.	L.S.	$_____
202.0201	Removal of Existing Concrete Barrier	L.S.	L.S.	L.S.	$_____
202.0202	Removal of Portion of Existing Concrete Deck	L.S.	L.S.	L.S.	$_____
202.0203	Removal of Portion of Existing Concrete Deck for Replacement Concrete by Shotblasting	L.S.	L.S.	L.S.	$_____
202.0204	Removal of Portion of Existing Concrete Deck for Replacement Concrete by Hydrodemolition	L.S.	L.S.	L.S.	$_____
202.0205	Removal of Portion of Existing Concrete Wingwall	L.S.	L.S.	L.S.	$_____
202.0206	Removal of Portion of Existing Portland Cement Concrete Pavement and Asphalt Concrete Pavement for Approach Slab	L.S.	L.S.	L.S.	$_____
202.0207	Removal of Inlet Structure at Sta. 89+10	L.S.	L.S.	L.S.	$_____
202.0208	Removal of Portion of Existing Abutment Footing for AW-1	L.S.	L.S.	L.S.	$_____
202.0209	Removal of Existing Concrete Barrier (Austin-Bishop)	L.S.	L.S.	L.S.	$_____
202.0210	Removal of 36-inch RCP Pipe	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
202.0211	Removal of Thru Gutter	L.S.	L.S.	L.S.	$_____
202.9601	Removal of 8-Inch Water Line	L.S.	L.S.	L.S.	$_____
202.9602	Removal of 8-Inch Gate Valve	L.S.	L.S.	L.S.	$_____
202.9603	Removal of Valve Box, Frame and Cover	L.S.	L.S.	L.S.	$_____
202.9604	Removal of 6-Inch Sewer Lateral	L.S.	L.S.	L.S.	$_____
202.9605	Removal of 8-Inch Sewer Pipe	L.S.	L.S.	L.S.	$_____
202.9606	Removal of 10-Inch Sewer Pipe	L.S.	L.S.	L.S.	$_____
202.9607	Removal of Existing Sewer Manhole	L.S.	L.S.	L.S.	$_____
202.9608	Removal of 4-Inch Gas Line	L.S.	L.S.	L.S.	$_____
203.0110	Roadway Excavation	27,191	Cu. Yd.	$_____	$_____
206.0000	Structure Excavation for Drainage System	8,261	Cu. Yd.	$_____	$_____
206.0601	Additional Foundation Over-Excavation	F.A.	F.A.	F.A.	$50,000.00
206.2040	Trench Excavation for Water System	146	Cu. Yd.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
206.2050	Trench Excavation for Sewer System	467	Cu. Yd.	$_____	$_____
206.2060	Trench Excavation for 4-Inch Gas Line	33	Cu. Yd.	$_____	$_____
206.5001	Structure Excavation for Noise Barrier Wall - 1	480	Cu. Yd.	$_____	$_____
206.5002	Structure Excavation for Noise Barrier Wall - 2	330	Cu. Yd.	$_____	$_____
206.5003	Structure Excavation for Noise Barrier Wall - 3	240	Cu. Yd.	$_____	$_____
206.5004	Structure Excavation for AW-1	500	Cu. Yd.	$_____	$_____
206.5005	Structure Excavation for Soil Nail Retaining Wall - 1	410	Cu. Yd.	$_____	$_____
206.5006	Structure Excavation for Soil Nail Retaining Wall - 2	4,400	Cu. Yd.	$_____	$_____
206.5007	Structure Excavation for Soil Nail Retaining Wall - 3	2,000	Cu. Yd.	$_____	$_____
206.5008	Structure Excavation for Soil Nail Retaining Wall - 4	780	Cu. Yd.	$_____	$_____
206.5009	Structure Excavation for Concrete Barrier Wall - 1	1,060	Cu. Yd.	$_____	$_____
206.5010	Structure Excavation for Concrete Barrier Wall - 2	590	Cu. Yd.	$_____	$_____
206.5011	Structure Excavation for Concrete Barrier Wall - 3	150	Cu. Yd.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
206.5012	Structure Excavation for Concrete Barrier Wall - 4	350	Cu. Yd.	$_____	$_____
206.5013	Structure Excavation for Concrete Barrier Wall - 5	1,600	Cu. Yd.	$_____	$_____
206.6000	Structure Excavation for Abutments, Wingwalls, and Retaining Wall "B"	580	Cu. Yd.	$_____	$_____
206.6001	Structure Excavation for Bent Footings	2,200	Cu. Yd.	$_____	$_____
206.6002	Structure Excavation for Columns (Austin-Bishop)	135	Cu. Yd.	$_____	$_____
206.7200	Structure Backfill for Abutments, Wingwalls, and Retaining Wall "B"	460	Cu. Yd.	$_____	$_____
206.7201	Structure Backfill for Bent 11 Column Footing (Class D Concrete)	42	Cu. Yd.	$_____	$_____
206.7202	Controlled Low Strength Material for Column Footings	218	Cu. Yd.	$_____	$_____
206.7254	Structure Backfill for AW-1	25	Cu. Yd.	$_____	$_____
206.7255	Structure Backfill for AW-1 (Class "D" Concrete)	40	Cu. Yd.	$_____	$_____
206.7256	Structure Backfill for Soil Nail Retaining Wall - 1	40	Cu. Yd.	$_____	$_____
206.7257	Structure Backfill for Soil Nail Retaining Wall - 2	400	Cu. Yd.	$_____	$_____
206.7258	Structure Backfill for Soil Nail Retaining Wall - 3	220	Cu. Yd.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
206.7259	Structure Backfill for Soil Nail Retaining Wall - 4	110	Cu. Yd.	$_____	$_____
206.7260	Structure Backfill for Concrete Barrier Wall - 1	420	Cu. Yd.	$_____	$_____
206.7261	Structure Backfill for Concrete Barrier Wall - 2	300	Cu. Yd.	$_____	$_____
206.7262	Structure Backfill for Concrete Barrier Wall - 3	58	Cu. Yd.	$_____	$_____
206.7263	Structure Backfill for Concrete Barrier Wall - 4	215	Cu. Yd.	$_____	$_____
206.7264	Structure Backfill for Concrete Barrier Wall - 5	514	Cu. Yd.	$_____	$_____
206.8200	Filter Material for Abutments and Wingwalls	11	Cu. Yd.	$_____	$_____
206.8202	Filter Material for Concrete Barrier Walls	90	Cu. Yd.	$_____	$_____
206.9010	Foundation Grouting	F.A.	F.A.	F.A.	$40,000.00
208.0100	Leveling Surfaces	F.A.	F.A.	F.A.	$100,000.00
209.0100	Water Pollution and Erosion Control	F.A.	F.A.	F.A.	$750,000.00
211.1000	Reinforced Soil Slope	L.S.	L.S.	L.S.	$_____
305.0100	15" Aggregate Subbase	1,519	Cu. Yd.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
305.0200	12" Aggregate Subbase	434	Cu. Yd.	$_____	$_____
305.0300	6" Aggregate Subbase	2,695	Cu. Yd.	$_____	$_____
306.0100	Untreated Permeable Base Course	3,303	Cu. Yd.	$_____	$_____
312.0100	Plant Mix Glassphalt Concrete Base Course	6,420	Ton	$_____	$_____
401.0100	Asphalt Concrete Pavement, Mix No. IV	2,580	Ton	$_____	$_____
401.0200	Asphalt Concrete Pavement, Mix No. V	134	Ton	$_____	$_____
411.1010	13 1/2-Inch, Concrete Pavement	3,904	Cu. Yd.	$_____	$_____
411.1020	12 1/2-Inch, Concrete Pavement	1,996	Cu. Yd.	$_____	$_____
411.2000	Transverse Contraction Joint	15,000	Lin. Ft.	$_____	$_____
501.0210	Structural Steel for Luminaire Support Bracket at Pono Street, Pomohana Place, and Detour Road	10	Each	$_____	$_____
501.0211	Structural Steel for Overhead Sign Support	L.S.	L.S.	L.S.	$_____
501.2010	8-Inch Pipe Support Hangers	30	Each	$_____	$_____
501.2011	12-Inch Pipe Support Hangers	9	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
503.1080	Concrete for Abutments Retrofit (Austin-Bishop)	L.S.	L.S.	L.S.	$_____
503.1090	Concrete for Abutments, Wingwalls, and Retaining Wall "B" including Type 1 Corbel	L.S.	L.S.	L.S.	$_____
503.1091	Concrete for Abutments, Wingwalls, and Retaining Wall "B" Footings	L.S.	L.S.	L.S.	$_____
503.1092	Concrete for Viaduct Deck Including Drop Inlets on Bridge But Excluding Closure Pour	L.S.	L.S.	L.S.	$_____
503.1093	Concrete for Bent Caps	L.S.	L.S.	L.S.	$_____
503.1094	Concrete for Columns	L.S.	L.S.	L.S.	$_____
503.1095	Concrete for Bent Footings	L.S.	L.S.	L.S.	$_____
503.1096	Concrete for Closure Pour	L.S.	L.S.	L.S.	$_____
503.1097	Concrete for Seat Extender at Abutments	L.S.	L.S.	L.S.	$_____
503.1098	Concrete for Collar at Pier Columns (Austin-Bishop)	L.S.	L.S.	L.S.	$_____
503.1401	Concrete for AW-1	L.S.	L.S.	L.S.	$_____
503.1402	Concrete for Barrier-Wall at Austin-Bishop Separation	L.S.	L.S.	L.S.	$_____
503.1403	Concrete for Soil Nail Retaining Wall - 1	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
503.1404	Concrete for Soil Nail Retaining Wall - 2	L.S.	L.S.	L.S.	$_____
503.1405	Concrete for Soil Nail Retaining Wall - 3	L.S.	L.S.	L.S.	$_____
503.1406	Concrete for Soil Nail Retaining Wall - 4	L.S.	L.S.	L.S.	$_____
503.1407	Concrete for Concrete Barrier Walls - 1 and 2	L.S.	L.S.	L.S.	$_____
503.1408	Concrete for Concrete Barrier Walls - 3, 4, and 5	L.S.	L.S.	L.S.	$_____
503.1409	Concrete for Noise Barrier Wall - 1 Footing	L.S.	L.S.	L.S.	$_____
503.1410	Concrete for Noise Barrier Wall - 2 Footing	L.S.	L.S.	L.S.	$_____
503.1411	Concrete for Noise Barrier Wall - 3 Footing	L.S.	L.S.	L.S.	$_____
503.1416	Concrete for Concrete Barrier Walls - 1 and 2 Footings	L.S.	L.S.	L.S.	$_____
503.1417	Concrete for Concrete Barrier Walls - 3, 4 and 5 Footings	L.S.	L.S.	L.S.	$_____
503.1910	Concrete for Approach Slabs (1st Phase)	L.S.	L.S.	L.S.	$_____
503.1911	Concrete for Approach Slabs Including Type II Corbel (2nd Phase)	L.S.	L.S.	L.S.	$_____
503.2051	Concrete for Reinforced Concrete for Jacket for 8" Waterline	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
503.2052	Concrete for Reaction and Test Blocks (Class B)	L.S.	L.S.	L.S.	$_____
503.8000	Mechanical Grooving	L.S.	L.S.	L.S.	$_____
504.4100	Type Keehi IVM Prestressed Concrete Girders	L.S.	L.S.	L.S.	$_____
507.7000	Concrete Railings on Bridge	1,300	Lin. Ft.	$_____	$_____
507.7002	Concrete Median Barriers (Austin-Bishop)	80	Lin. Ft.	$_____	$_____
511.0100	Furnishing Drilled Shaft Drilling Equipment	L.S.	L.S.	L.S.	$_____
511.0200	Obstructions	80	Hours	$_____	$_____
511.0300	Load Test	2	Each	$_____	$_____
511.0400	Trial Shaft	150	Lin. Ft.	$_____	$_____
511.0500	Permanent Casing (27-Inch I.D. Corrugated Aluminum Pipe)	200	Lin. Ft.	$_____	$_____
511.0600	Permanent Casing (48-Inch Diameter)	500	Lin. Ft.	$_____	$_____
511.0700	Permanent Casing (60-Inch Diameter)	1,600	Lin. Ft.	$_____	$_____
511.0800	Standard Shaft Excavation (20-Inch Diameter)	450	Lin. Ft.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
511.0910	Standard Shaft Excavation (48-Inch Diameter)	440	Lin. Ft.	$_____	$_____
511.0920	Special Shaft Excavation (48-Inch Diameter)	170	Lin. Ft.	$_____	$_____
511.0930	Rock Excavation (48-inch Diameter)	460	Lin. Ft.	$_____	$_____
511.1010	Standard Shaft Excavation (60-Inch Diameter)	1,750	Lin. Ft.	$_____	$_____
511.1020	Special Shaft Excavation (60-Inch Diameter)	1,850	Lin. Ft.	$_____	$_____
511.1030	Rock Excavation (60-inch Diameter)	600	Lin. Ft.	$_____	$_____
511.1100	Drilled Shaft (Type 20)	450	Lin. Ft.	$_____	$_____
511.1200	Drilled Shaft (Type 27)	200	Lin. Ft.	$_____	$_____
511.1300	Drilled Shaft (Type 48B)	270	Lin. Ft.	$_____	$_____
511.1400	Drilled Shaft (Type 48C)	980	Lin. Ft.	$_____	$_____
511.1500	Drilled Shaft (Type 60A)	850	Lin. Ft.	$_____	$_____
511.1600	Drilled Shaft (Type 60B)	870	Lin. Ft.	$_____	$_____
511.1700	Drilled Shaft (Type 60C)	2,030	Lin. Ft.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
511.1800	Coring Samples (Integrity Testing)	750	Lin. Ft.	$_____	$_____
513.0101	CMU Noise Barrier Walls	1,900	Sq. Yd.	$_____	$_____
530.0101	Segmental Retaining Wall No. 1	L.S.	L.S.	L.S.	$_____
530.0102	Segmental Retaining Wall No. 2A	L.S.	L.S.	L.S.	$_____
530.0103	Segmental Retaining Wall No. 2B	L.S.	L.S.	L.S.	$_____
530.0104	Segmental Retaining Wall No. 2C	L.S.	L.S.	L.S.	$_____
540.1000	Replacement Concrete for Frame A - Honolulu Half	L.S.	L.S.	L.S.	$_____
540.1001	Replacement Concrete for Frame A - Waianae Half	L.S.	L.S.	L.S.	$_____
540.1002	Replacement Concrete for Frame B	L.S.	L.S.	L.S.	$_____
540.1003	Replacement Concrete for Frame C	L.S.	L.S.	L.S.	$_____
540.1004	Replacement Concrete for Frame D	L.S.	L.S.	L.S.	$_____
540.1005	Tensile Bond Test	180	Each	$_____	$_____
602.0050	Reinforcing Steel for AW-1	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
602.0051	Reinforcing Steel for Barrier-Wall at Austin-Bishop Separation	L.S.	L.S.	L.S.	$_____
602.0052	Reinforcing Steel for Soil Nail Retaining Walls	L.S.	L.S.	L.S.	$_____
602.0053	Reinforcing Steel for Concrete Barrier Walls	L.S.	L.S.	L.S.	$_____
602.0054	Reinforcing Steel for Concrete Barrier Wall Footings	L.S.	L.S.	L.S.	$_____
602.0055	Reinforcing Steel for Noise Barrier Walls	L.S.	L.S.	L.S.	$_____
602.0056	Reinforcing Steel for Noise Barrier Wall Footings	L.S.	L.S.	L.S.	$_____
602.0090	Reinforcing Steel for Abutments, Wingwalls, and Retaining Wall "B" Including Type 1 Corbel	L.S.	L.S.	L.S.	$_____
602.0091	Reinforcing Steel for Abutments, Wingwalls, and Retaining Wall "B" Footings	L.S.	L.S.	L.S.	$_____
602.0092	Reinforcing Steel for Viaduct Deck Including Drop Inlets on Bridge But Excluding Closure Pour	L.S.	L.S.	L.S.	$_____
602.0093	Reinforcing Steel for Bent Caps	L.S.	L.S.	L.S.	$_____
602.0094	Reinforcing Steel for Columns	L.S.	L.S.	L.S.	$_____
602.0095	Reinforcing Steel for Bent Footings	L.S.	L.S.	L.S.	$_____
602.0096	Reinforcing Steel for Closure Pour	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
602.0097	Reinforcing Steel for Seat Extender at Abutments	L.S.	L.S.	L.S.	$_____
602.0098	Reinforcing Steel for Approach Slabs (1st Phase)	L.S.	L.S.	L.S.	$_____
602.0099	Reinforcing Steel for Approach Slabs Including Type II Corbel (2nd Phase)	L.S.	L.S.	L.S.	$_____
602.0100	Reinforcing Steel for Abutments Retrofit (Austin-Bishop)	L.S.	L.S.	L.S.	$_____
602.0101	Reinforcing Steel for Collar at Pier Columns (Austin-Bishop)	L.S.	L.S.	L.S.	$_____
603.0010	Bed Course Material for Culvert	939	Cu. Yd.	$_____	$_____
603.0210	8-Inch Ductile Iron Pipe, Class 52	723	Lin. Ft.	$_____	$_____
603.0220	12-Inch Ductile Iron Pipe, Class 52	65	Lin. Ft.	$_____	$_____
603.0310	6-Inch Polyvinyl Chloride Pipe, SDR 35	64	Lin. Ft.	$_____	$_____
603.0320	8-Inch Polyvinyl Chloride Pipe, SDR 35	192	Lin. Ft.	$_____	$_____
603.0330	12-Inch Polyvinyl Chloride Pipe, SDR 35	15	Lin. Ft.	$_____	$_____
603.1010	24-Inch Reinforced Concrete Pipe, Class III	21	Lin. Ft.	$_____	$_____
603.1020	36-Inch Reinforced Concrete Pipe, Class III	36	Lin. Ft.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
603.1030	24-Inch Reinforced Concrete Pipe, Class III, or 24-Inch High Density Polyethylene Pipe, Type S	2,658	Lin. Ft.	$_____	$_____
603.1040	30-Inch Reinforced Concrete Pipe, Class III, or 30-Inch High Density Polyethylene Pipe, Type S	189	Lin. Ft.	$_____	$_____
603.1050	36-Inch Reinforced Concrete Pipe, Class III, or 36-Inch High Density Polyethylene Pipe, Type S	663	Lin. Ft.	$_____	$_____
603.2010	Column Drain Cleanout	22	Each	$_____	$_____
603.2020	Drain Cleanout to Grade	7	Each	$_____	$_____
603.4010	Concrete Collar for 24-Inch Drain Connection	1	Each	$_____	$_____
603.4020	Concrete Collar for 36-Inch Drain Connection	1	Each	$_____	$_____
603.5010	Clean Existing Culverts	F.A.	F.A.	F.A.	$750,000.00
604.0210	Inlet Structure, 2 feet to 2.99 feet	1	Each	$_____	$_____
604.0220	Inlet Structure, 11 feet to 11.99 feet	1	Each	$_____	$_____
604.0310	Type A Storm Drain Manhole, 5 feet to 5.99 feet	1	Each	$_____	$_____
604.0320	Type A Storm Drain Manhole, 6 feet to 6.99 feet	2	Each	$_____	$_____
604.0330	Type A Storm Drain Manhole, 8 feet to 8.99 feet	1	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
604.0340	Type A Storm Drain Manhole, 10 feet to 10.99 feet	1	Each	$_____	$_____
604.0402	Standard Valve Box For Gate Valve	3	Each	$_____	$_____
604.0403	Air Relief Valve Box	1	Each	$_____	$_____
604.0410	Type B Storm Drain Manhole, 4 feet to 4.99 feet	1	Each	$_____	$_____
604.0411	Type B Storm Drain Manhole, 5 feet to 5.99 feet	1	Each	$_____	$_____
604.0510	Type E Storm Drain Manhole, 6 feet to 6.99 feet	1	Each	$_____	$_____
604.0610	Special Storm Drain Manhole, 4 feet to 4.99 feet	1	Each	$_____	$_____
604.0620	Special Storm Drain Manhole, 5 feet to 5.99 feet	2	Each	$_____	$_____
604.0630	Special Storm Drain Manhole, 6 feet to 6.99 feet	1	Each	$_____	$_____
604.0640	Special Storm Drain Manhole, 7 feet to 7.99 feet	2	Each	$_____	$_____
604.0650	Special Storm Drain Manhole, 8 feet to 8.99 feet	2	Each	$_____	$_____
604.0660	Special Storm Drain Manhole, 15 feet to 15.99 feet	1	Each	$_____	$_____
604.0670	Adjust Storm Drain Manhole Frame and Cover	1	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
604.4302	Adjusting Sewer Manhole Frame and Cover	5	Each	$_____	$_____
604.4550	Adjusting Valve Box Frame and Cover	4	Each	$_____	$_____
604.5020	Type A1 Grated Drop Inlet, 5 feet to 5.99 feet	5	Each	$_____	$_____
604.5030	Type A1 Grated Drop Inlet, 6 feet to 6.99 feet	3	Each	$_____	$_____
604.5040	Type A1 Grated Drop Inlet, 7 feet to 7.99 feet	2	Each	$_____	$_____
604.5050	Type A1 Grated Drop Inlet, 8 feet to 8.99 feet	1	Each	$_____	$_____
604.5060	Type A1 Grated Drop Inlet, 10 feet to 10.99 feet	1	Each	$_____	$_____
604.5070	Type A1 Grated Drop Inlet, 14 feet to 14.99 feet	1	Each	$_____	$_____
604.5120	Type A2 Grated Drop Inlet, 5 feet to 5.99 feet	6	Each	$_____	$_____
604.5130	Type A2 Grated Drop Inlet, 6 feet to 6.99 feet	4	Each	$_____	$_____
604.5140	Type A2 Grated Drop Inlet, 7 feet to 7.99 feet	1	Each	$_____	$_____
604.5150	Type A2 Grated Drop Inlet, 13 feet to 13.99 feet	1	Each	$_____	$_____
604.5230	Type A3 Grated Drop Inlet, 7 feet to 7.99 feet	3	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
604.5240	Type A3 Grated Drop Inlet, 9 feet to 9.99 feet	1	Each	$_____	$_____
604.5250	Type A3 Grated Drop Inlet, 12 feet to 12.99 feet	1	Each	$_____	$_____
604.5310	Type A4 Grated Drop Inlet, 10 feet to 10.99 feet	1	Each	$_____	$_____
604.5410	Type A5 Grated Drop Inlet, 9 feet to 9.99 feet	1	Each	$_____	$_____
604.6010	Type D Catch Basin, 4 feet to 4.99 feet	1	Each	$_____	$_____
604.6020	Type D Catch Basin, 5 feet to 5.99 feet	2	Each	$_____	$_____
604.7010	Type B4 Steel Frame and Grate	11	Each	$_____	$_____
604.7020	Type B6 Steel Frame and Grate	1	Each	$_____	$_____
604.7030	Type B8 Steel Frame and Grate	1	Each	$_____	$_____
604.8010	Column Outlet Structure, Type A	9	Each	$_____	$_____
604.8020	Column Outlet Structure, Type B	1	Each	$_____	$_____
604.8030	Column Outlet Structure, Type C	2	Each	$_____	$_____
604.8040	Trench Drain	418	Lin. Ft.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
605.0110	6-Inch Underdrain Pipe	6,910	Lin. Ft.	$_____	$_____
605.0301	Underdrain Outlet Type 1	2	Each	$_____	$_____
605.0302	Underdrain Outlet Type 2	1	Each	$_____	$_____
605.2010	Underdrain Cleanout Type A	6	Each	$_____	$_____
605.2020	Underdrain Cleanout Type B	3	Each	$_____	$_____
605.2030	Underdrain Cleanout Type C	6	Each	$_____	$_____
605.2040	Underdrain Cleanout Type D	6	Each	$_____	$_____
605.2050	Underdrain Cleanout Type E	9	Each	$_____	$_____
605.2060	Underdrain Cleanout Type F	2	Each	$_____	$_____
606.1010	Strong Post W-Beam Guardrail	58	Lin. Ft.	$_____	$_____
606.2010	End Anchorage Type ET-2000	1	Each	$_____	$_____
606.3010	State Furnished Portable Concrete Barrier	25	Each	$_____	$_____
607.1010	Six-Feet, Chain Link Fence with Top Rail	4,639	Lin. Ft.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
607.1020	Six-Feet, Chain Link Fence without Top Rail	94	Lin. Ft.	$_____	$_____
607.1030	Eight-Feet, Chain Link Fence without Top Rail	2,168	Lin. Ft.	$_____	$_____
607.1040	Eight-Feet, Chain Link Fence with Barbed Wire	1,559	Lin. Ft.	$_____	$_____
607.3001	Chain Link Gate, Six Feet High and Four Feet Wide	2	Each	$_____	$_____
607.3002	Chain Link Gate, Six Feet High and Ten Feet Wide	1	Each	$_____	$_____
607.3010	Chain Link Gate, Eight Feet High and Fifteen Feet Wide	3	Each	$_____	$_____
607.3020	Chain Link Gate, Eight Feet High and Sixteen Feet Wide	2	Each	$_____	$_____
607.3030	Chain Link Gate, Eight Feet High and Twenty Feet Wide	1	Each	$_____	$_____
607.3040	Chain Link Gate, Eight Feet High and Twenty-four Feet Wide	3	Each	$_____	$_____
608.0100	Concrete Sidewalk	772	Sq. Yd.	$_____	$_____
609.0110	Curb and Gutter, Type 2DG	794	Lin. Ft.	$_____	$_____
609.0120	Rolled Curb	285	Lin. Ft.	$_____	$_____
609.0130	Thru Gutter	45	Lin. Ft.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
609.0210	Concrete Header	480	Lin. Ft.	$_____	$_____
610.0110	15-Foot Wide Reinforced Concrete Driveway	1	Each	$_____	$_____
610.0111	20-Foot Wide Reinforced Concrete Driveway	1	Each	$_____	$_____
610.0112	40.3-Foot Wide Reinforced Concrete Driveway	1	Each	$_____	$_____
612.0110	Grouted Rubble Paving for GRP Blanket, Including 6-Inch Bed Course	280	Cu. Yd.	$_____	$_____
612.0120	Grouted Rubble Paving for 6' x 6' GRP Pad	7	Cu. Yd.	$_____	$_____
614.0100	Standard Street Survey Monuments	2	Each	$_____	$_____
616.0610	Sprinkler System	L.S.	L.S.	L.S.	$_____
616.0620	High Voltage Work	L.S.	L.S.	L.S.	$_____
616.0630	Low Voltage Work	L.S.	L.S.	L.S.	$_____
617.0900	Planting Soil	L.S.	L.S.	L.S.	$_____
618.1510	Grassed Surfaces, Zoysia 'El Toro' Grass in the planting area over Erosion Control Matting	L.S.	L.S.	L.S.	$_____
618.1520	Grassed Surfaces, Zoysia 'El Toro' Grass w/ Hydromulch in the remaining planting area	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
619.1710	Plastic Edging	800	Lin. Ft.	$_____	$_____
619.1750	Planting Trees, Loulu Palm (Pritchardia hillebrandii), 7 Gal., 2' High-Brown Trunk	30	Each	$_____	$_____
619.1751	Planting Trees, Foxtail Palm (Wodyetia bifurcata), 25 Gal., 3' High-Brown Trunk	12	Each	$_____	$_____
619.1752	Planting Trees, Alexander Palm (Archontophoenix alexandrae), 25 Gal., 3' High-Brown Trunk	20	Each	$_____	$_____
619.1753	Planting Trees, Chinese Fan Palm (Livistona chinensis), 5 Gal., 18" High-Brown Trunk	20	Each	$_____	$_____
619.1754	Planting Trees, MacArthur Palm (Ptychosperma macarthurii), 25 Gal., 3' High-Brown Trunk	18	Each	$_____	$_____
619.1755	Planting Shrubs, Oleander 'Red'. 'Pink', & 'Salmon' (Nerium oleander), 24" high	670	Each	$_____	$_____
619.1756	Planting Shrubs, Naupaka (Scaevola taccada), 24" high	50	Each	$_____	$_____
619.1757	Planting Shrubs, Plumbago (Plumago auriculata), 24" high	440	Each	$_____	$_____
619.1758	Planting Shrubs, False Eranthemum (Pseudoeranthemum carruthersii), 24" high, with 2-inch layer of gravel mulch and weed barrier w/in planter bed.	1,470	Each	$_____	$_____
621.0200	Panel for Destination Sign	1,062	Sq. Ft.	$_____	$_____
621.3000	Type VI Footing for Destination Sign	12	Each	$_____	$_____
621.4000	Relocation of Existing Destination Sign	4	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
621.4100	Relocation of Existing Regulatory Sign	7	Each	$_____	$_____
621.4200	Relocation of Sign	8	Each	$_____	$_____
621.4600	2.50-Inch Galvanized Square Tube	10	Each	$_____	$_____
621.4700	Breakaway Sign Post and Foundation for Destination Sign	4	Each	$_____	$_____
621.4800	Galvanized Steel Post for Ground-Mounted Destination and Expressway Sign	235	Lin. Ft.	$_____	$_____
621.5100	Regulatory and Warning Sign 10 Sq. Ft. or Less with Post	6	Each	$_____	$_____
621.5200	Type II Object Markers	4	Each	$_____	$_____
621.7020	Construction Sign - "Notice to Motorists"	L.S.	L.S.	L.S.	$_____
622.0051	Highway Lighting Standard with 40 Foot Luminaire Mounting Height, Breakaway Transformer Base, 15 Foot Bracket Arm, Luminaire and Foundation, Mounted in Grade	6	Each	$_____	$_____
622.0052	Highway Lighting Standard with 40 Foot Luminaire Mounting Height, Non-Breakaway Transformer Base, 15 Foot Bracket Arm, Luminaire and Foundation, Mounted on Wall	26	Each	$_____	$_____
622.0053	Highway Lighting Standard with 40 Foot Luminaire Mounting Height, Non-Breakaway Transformer Base, 15 Foot Bracket Arm, Luminaire and Foundation, Mounted on Viaduct	9	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
622.0054	Highway Lighting Standard with 35 Foot Luminaire Mounting Height, Breakaway Transformer Base, 15 Foot Bracket Arm, Luminaire and Foundation, Mounted in Grade	3	Each	$_____	$_____
622.0055	Highway Lighting Standard with 35 Foot Luminaire Mounting Height, Non-Breakaway Transformer Base, 15 Foot Bracket Arm, Luminaire and Foundation, Mounted on Wall	2	Each	$_____	$_____
622.0056	Highway Lighting Standard with 30 Foot Luminaire Mounting Height, Non-Breakaway Transformer Base, 8 Foot Bracket Arm, Luminaire and Foundation, Mounted in Grade	1	Each	$_____	$_____
622.0057	Highway Lighting Standard with 30 Foot Luminaire Mounting Height, Non-Breakaway Transformer Base, 8 Foot Bracket Arm, Luminaire and Foundation, Mounted in Grade in C&C right of Way	3	Each	$_____	$_____
622.0061	Underpass Lighting Luminaire, Wall Mounted	10	Each	$_____	$_____
622.0062	Underpass Lighting Luminaire, Ceiling Mounted	6	Each	$_____	$_____
622.0063	Highway Signage Lighting Luminaire	15	Each	$_____	$_____
622.0064	Relocate Highway Lighting Luminaire with Bracket Arm Mounted on Wood Pole	2	Each	$_____	$_____
622.0601	Remove Highway Lighting Standard in Grade, Abandon Foundation	28	Each	$_____	$_____
622.0602	Remove Highway Lighting Standard on Concrete Barrier, Demolish Foundation	6	Each	$_____	$_____
622.0603	Remove Highway Lighting Standard on Viaduct Railing, Demolish Foundation	6	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
622.0604	Remove Underpass Lighting Luminaire	24	Each	$_____	$_____
622.0605	Remove Highway Signage Lighting Luminaire	2	Each	$_____	$_____
622.0801	Type "A" Highway Lighting Pullbox	3	Each	$_____	$_____
622.0802	Type "B" Highway Lighting Pullbox	6	Each	$_____	$_____
622.0803	Type "B" Communications Pull Box	2	Each	$_____	$_____
622.0804	Type "C" Highway Lighting Pullbox	2	Each	$_____	$_____
622.0805	Adjust Pullbox Frame and Cover	2	Each	$_____	$_____
622.0901	24" x 18" x 10" Cast Highway Lighting Junction Box	1	Each	$_____	$_____
622.0902	30" x 10" x 6" Cast Highway Lighting Junction Box	7	Each	$_____	$_____
622.0903	30" x 10" x 6" Cast Communications Junction Box	20	Each	$_____	$_____
622.0904	12" Square x 8" Deep Stainless Steel Junction Box	3	Each	$_____	$_____
622.0905	6" Square x 4" Deep stainless Steel Junction Box	13	Each	$_____	$_____
622.3002	Two-4-Inch HECO Ductline	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
622.5031	One 4-Inch, One 2-Inch, PVC Schedule 80 Conduit Ductline Encased in Concrete for Highway Communication System	L.S.	L.S.	L.S.	$_____
622.5032	One 2-Inch PVC Schedule 80 Conduit Ductline Encased in Concrete for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.5033	Two 2-Inch PVC Schedule 80 Conduit Ductline Encased in Concrete for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.5034	Three 2-Inch PVC Schedule 80 Conduit Ductline Encased in Concrete for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.5035	One 2-Inch PVC Schedule 40 Conduit Ductline Encased in Concrete for Street Lighting System	L.S.	L.S.	L.S.	$_____
622.5036	One 3-Inch PVC Schedule 80 Conduit Ductline in Concrete Structure for Highway Communication System	L.S.	L.S.	L.S.	$_____
622.5037	One 2-Inch PVC Schedule 80 Conduit Ductline in Concrete Structure for Highway Communication System	L.S.	L.S.	L.S.	$_____
622.5038	Two 2-Inch PVC Schedule 80 Conduit Ductline in Concrete Structure for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.5043	One 1-Inch PVC Coated Galvanized Rigid Steel Conduit for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.6001	#2 AWG Conductors for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.6002	#6 AWG Conductors for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.6003	#10 AWG Conductors for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.6004	#6 AWG Grounding Conductor for Highway Lighting System	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
622.6005	#8 AWG Grounding Conductor for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.6008	#10 AWG Grounding Conductor for Highway Lighting System	L.S.	L.S.	L.S.	$_____
622.8102	Detour Road Temporary Lighting System	L.S.	L.S.	L.S.	$_____
622.9001	Service Equipment Enclosure, Metering Equipment, Apparatus and Control Devices	L.S.	L.S.	L.S.	$_____
622.9002	Concrete Transformer Pad	L.S.	L.S.	L.S.	$_____
623.0010	Loop Detector Sensing Unit (6 Ft. x 6 Ft.), Two Loops	1	Each	$_____	$_____
624.0172	8-Inch Gate Valve (Class 150)	3	Each	$_____	$_____
624.0173	3/4-Inch Air Relief Valve	1	Each	$_____	$_____
624.1806	Ductile Iron Fittings	4,905	Lb.	$_____	$_____
624.9000	8-Inch Ductile Iron Pipe, Class 52	251	Lin. Ft.	$_____	$_____
625.1010	Plain Pre-Cast Sewer Manhole, 7 feet to 7.99 feet	1	Each	$_____	$_____
625.1011	Plain Pre-Cast Sewer Manhole, 8 feet to 9.99 feet	1	Each	$_____	$_____
625.1020	Cast-In-Place Sewer Manhole, 7 feet to 7.99 feet	1	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
625.1021	Cast-In-Place Sewer Manhole, 8 feet to 8.99 feet	3	Each	$_____	$_____
625.2010	10-Inch Vitrified Clay Sewer Pipe	125	Lin. Ft.	$_____	$_____
625.2020	15-Inch Vitrified Clay Sewer Pipe	212	Lin. Ft.	$_____	$_____
625.3000	Reinforced Concrete Jacket for 15-Inch Sewer Pipe	52	Lin. Ft.	$_____	$_____
625.4000	Bed Course Material for Crushed Rock Cradle	30	Cu. Yd.	$_____	$_____
625.5000	Repair Existing Sewer Manhole Lining and Seal	L.S.	L.S.	L.S.	$_____
628.0100	Shotcrete	2,700	Sq. Yd.	$_____	$_____
629.1010	1-Inch Permanent Barrier Guidance Striping (Paint)	L.S.	L.S.	L.S.	$_____
629.1030	4-Inch Pavement Striping (Tape, Type III or Thermoplastic Extrusion)	L.S.	L.S.	L.S.	$_____
629.1050	8-Inch Pavement Striping (Tape, Type III or Thermoplastic Extrusion)	L.S.	L.S.	L.S.	$_____
629.1060	12-Inch Pavement Striping (Tape, Type III or Thermoplastic Extrusion)	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
629.1130	Pavement Words (Tape, Type III or Thermoplastic Extrusion)	1	Each	$_____	$_____
629.1140	Pavement Symbol (Tape, Type III or Thermoplastic Extrusion)	12	Each	$_____	$_____
629.2010	Type A Pavement Marker	L.S.	L.S.	L.S.	$_____
629.2030	Type C Pavement Marker	L.S.	L.S.	L.S.	$_____
629.2040	Type D Pavement Marker	L.S.	L.S.	L.S.	$_____
629.2070	Type H Pavement Marker	L.S.	L.S.	L.S.	$_____
635.0010	Microcomputer System (Not to Exceed $10,000.00)	L.S.	L.S.	L.S.	$_____
636.0010	Field Offices (Not to Exceed $108,000.00 for Two Field Offices)	L.S.	L.S.	L.S.	$_____
636.0020	Project Site Laboratory (Not to Exceed $30,000.00)	L.S.	L.S.	L.S.	$_____
636.0030	Maintenance of Field Offices and Laboratory	F.A.	F.A.	F.A.	$80,000.00
638.0100	Cellular Phones (Not to Exceed $900.00 Each for Seven Phones)	L.S.	L.S.	L.S.	$_____
638.0200	Cellular Phone Additional Charges	F.A.	F.A.	F.A.	$1,000.00

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
640.0110	Lined Drainage Ditch, Type "A"	3,094	Lin. Ft.	$_____	$_____
640.0120	Lined Drainage Ditch, Type "B"	611	Lin. Ft.	$_____	$_____
640.0130	Lined Drainage Ditch, Type "C"	760	Lin. Ft.	$_____	$_____
640.0140	Lined Drainage Ditch, Type "D"	83	Lin. Ft.	$_____	$_____
640.0150	Lined Drainage Ditch, Type "F"	422	Lin. Ft.	$_____	$_____
640.0160	Lined Drainage Ditch, Type "G"	10	Lin. Ft.	$_____	$_____
640.1010	Reconstruct Existing Concrete Ditch	4	Lin. Ft.	$_____	$_____
640.2010	Column Outlet Swale, Type A	66	Lin. Ft.	$_____	$_____
640.2020	Column Outlet Swale, Type B	50	Lin. Ft.	$_____	$_____
645.0100	Additional Police Officers And/Or Additional Traffic Control Devices	F.A.	F.A.	F.A.	$1,500,000.00
647.1001	Three 5-Inch HECO Ductline	220	Lin. Ft.	$_____	$_____
647.1002	Two 5-Inch HECO Ductline	95	Lin. Ft.	$_____	$_____
647.1003	One 5-Inch HECO Ductline	25	Lin. Ft.	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
647.1004	One 3-Inch HECO Ductline	330	Lin. Ft.	$_____	$_____
647.3000	5' x 7' HECO Handhole	2	Each	$_____	$_____
647.4000	HECO Pole Riser	3	Each	$_____	$_____
647.5000	Demolish HECO Handhole	1	Each	$_____	$_____
647.6000	Remove HECO Pole Riser	2	Each	$_____	$_____
649.1001	Two 4-Inch Verizon Ductline	390	Lin. Ft.	$_____	$_____
649.1002	One 4-Inch Verizon Ductline	30	Lin. Ft.	$_____	$_____
649.1003	One 2-Inch Verizon Ductline	70	Lin. Ft.	$_____	$_____
649.2001	One 4-Inch Oceanic Cable Ductline	180	Lin. Ft.	$_____	$_____
649.3001	4' x 6' Verizon Handhole	1	Each	$_____	$_____
649.3002	3' x 5' Verizon Handhole	2	Each	$_____	$_____
649.3003	2' x 6' Oceanic Cable Handhole	1	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
649.4001	Verizon Pole Riser	3	Each	$_____	$_____
649.4002	Oceanic Cable Pole Riser	1	Each	$_____	$_____
649.5000	Demolish Verizon Handhole	3	Each	$_____	$_____
649.6000	Remove Verizon Pole Riser	3	Each	$_____	$_____
649.7000	Relocate Oceanic Cable Metering Equipment	1	Each	$_____	$_____
650.0100	Curb Ramps, Type B	2	Each	$_____	$_____
652.0020	1 1/2 - Inch Cold Planing	96	Sq. Yd.	$_____	$_____
652.0030	2 - Inch Cold Planing	2,622	Sq. Yd.	$_____	$_____
653.0100	162-Inch Structural Plate Culvert Lining	L.S.	L.S.	L.S.	$_____
654.1000	Cable Restrainer Assembly	18	Each	$_____	$_____
655.0001	Drilling Holes and Installing Dowel Reinforcing Bars for AW-1	24	Each	$_____	$_____
655.1000	Drilling Holes and Installing Dowel Reinforcing Bars into Existing Deck	2,500	Each	$_____	$_____
655.1001	Drilling Holes and Installing Dowel Reinforcing Bars into Existing Girder	74	Each	$_____	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
655.1002	Drilling Holes and Installing Dowel Reinforcing Bars into Existing Bent Cap	650	Each	$_____	$_____
655.1003	Drilling Holes and Installing Dowel Reinforcing Bars into Existing Abutment Walls	30	Each	$_____	$_____
655.1004	Drilling Holes and Installing Dowel Reinforcing Bars into Existing Abutment Wall Footings	28	Each	$_____	$_____
655.1005	Drilling Holes and Installing Dowel Reinforcing Bars for Seat Extender at Abutment	846	Each	$_____	$_____
655.1006	Drilling Holes and Installing Dowel Reinforcing Bars for Approach Slab	34	Each	$_____	$_____
655.1007	Drilling Holes and Installing Dowel Reinforcing Bars for Abutment Retrofit (Austin-Bishop)	1,652	Each	$_____	$_____
655.1008	Drilling Holes and Installing Dowel Reinforcing Bars for Concrete Collar at Pier Columns (Austin-Bishop)	168	Each	$_____	$_____
655.1009	Drilling Holes and Installing Dowel Reinforcing Bars for Concrete Barriers (Austin-Bishop)	168	Each	$_____	$_____
656.0001	Furnishing Specialty Equipment	L.S.	L.S.	L.S.	$_____
656.0100	Soil Nails (No. 9 Bar)	1,400	Lin. Ft.	$_____	$_____
656.0101	Soil Nails (No. 10 Bar)	4,800	Lin. Ft.	$_____	$_____
656.0102	Soil Nails (No. 11 Bar)	7,600	Lin. Ft.	$_____	$_____
657.0100	Furnishing Jet Grouting Equipment	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
657.0200	Jet Grout Test Program	L.S.	L.S.	L.S.	$_____
657.0300	Test Probes	1,400	Lin. Ft.	$_____	$_____
657.0400	Instrumentation and Monitoring	L.S.	L.S.	L.S.	$_____
657.0500	Jet Grout Columns (Area A)	11,000	Lin. Ft.	$_____	$_____
657.0600	Jet Grout Columns (Area B)	600	Lin. Ft.	$_____	$_____
657.0700	Jet Grout Columns (Area C)	1,100	Lin. Ft.	$_____	$_____
658.0100	Gravel Blanket in Load-Bearing Area	239	Cu. Yd.	$_____	$_____
658.0200	Gravel Blanket in Landscape Area	1,410	Cu. Yd.	$_____	$_____
660.1000	Composite Epoxy Resin-Fiber System for Pier Column Retrofit (Austin-Bishop)	2,130	Sq. Ft.	$_____	$_____
663.1000	Erosion Control Matting	11,000	Sq. Yd.	$_____	$_____
664.0100	Furnish and Install Emergency Telephone	2	Each	$_____	$_____
664.0210	Install Relocated Emergency Telephone Base Assembly	1	Each	$_____	$_____
664.0220	Remove and Reinstall Relocated Emergency Telephone Call Box Unit Assembly	F.A.	F.A.	F.A.	$10,000.00

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
670.1000	Glass Fiber Reinforced Polymer Rebar	L.S.	L.S.	L.S.	$_____
671.1000	Preconstruction Survey	L.S.	L.S.	L.S.	$_____
680.0100	Trenchless Sleeves for Systems Crossings	L.S.	L.S.	L.S.	$_____
681.1000	Furnishing Specialty Equipment	L.S.	L.S.	L.S.	$_____
681.1001	Tie Back Anchors for AW-1	24	Each	$_____	$_____
681.1002	Reinstallation of Tieback Anchors Due to Grout Loss and Additional Performance Tests for AW-1	F.A.	F.A.	F.A.	$40,000.00
694.0010	Moveable Concrete Barrier (MCB) System	L.S.	L.S.	L.S.	$_____
695.0100	Moveable Concrete Barrier Transfer Machine (MCBTM)	L.S.	L.S.	L.S.	$_____
696.0100	Weigh-In-Motion System	L.S.	L.S.	L.S.	$_____
697.0010	5-Passenger Sport Wagon	72	Veh/Month	$_____	$_____
699.1000	Mobilization (Not to Exceed 10% of the Sum of All Items Excluding the Bid Price of This Item, Furnishing Drilled Shaft Equipment, Microcomputer System, Field Offices and Project Site Laboratory, Cellular Phone, Furnishing Jet Grouting Equipment, and Force Account Items).	L.S.	L.S.	L.S.	$_____
699.2000	Mobilization (Not to Exceed 10% of the Sum of All Items, Excluding the Bid Price of This Item and Force Account Items)	L.S.	L.S.	L.S.	$_____

PROPOSAL SCHEDULE

	ITEM	APPROX QUANTITY	UNIT	UNIT PRICE	AMOUNT
a.	Sum of All Items				$_____
b.	Either Furnish Foreign Steel Not to Exceed Minimal Amount (Fill in '0') or Furnish Foreign Steel in Excess of Minimal Amount (Fill in 25% X a)				$_____
c.	SUBTOTAL				$_____
d.	Contract Time X Road User Cost _____ Calendar Days X $19,500.00/Calendar Day				$_____
e.	AMOUNT FOR COMPARISON OF BIDS (c+d)				$_____

NOTES: Bidders must complete items a through e, including the Contract Time, in calendar days. The Contract Time shall not exceed the maximum specified on Page P-1.

Bidders must complete all unit prices and amounts. Failure to do so may be grounds for rejection of bid.

Proposal items for "Interstate Route H-1 Seismic Retrofit, Austin-Bishop Separation and Waiau Interchange, F.A.I.P. No. BR-H1-1(241)" project are indicated by "(Austin-Bishop)" in item description. All other items are for the "Interstate Route H-3, H-3 Finish (Unit VIII), F.A.I.P. No. I-H3-1(75) Unit VIII" project.