STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ADDENDUM NO.1

FOR

**HAWAII BELT ROAD
KUPAPAULUA BRIDGE WIDENING
FEDERAL-AID PROJECT NO. BR-019-2(38)
DISTRICT OF HAMAKUA
ISLAND OF HAWAII**

FY 2002

Amend the Bid Documents as follows:

1. SPECIAL PROVISIONS

   a. Replace Section 511-Drilled Shafts, pages 511-1a thru 511-20a dated 9/24/98, with the attached Section 511-Drilled Shafts, pages 511-1a thru 511-20a dated 4/15/02.

2. PROPOSAL SCHEDULE

   a. Replace page P-10 dated r2/19/02 with the attached page P-10 dated r6/28/02.

3. PLANS

   a. Replace Plan Sheet Nos. 2, 17, 46, 50, 53 and 73 with the attached Plan Sheet Nos. ADD.2, ADD.17, ADD.46, ADD.50, ADD.53 and ADD.73.

   b. Add the attached Plan Sheets Nos. ADD.43S-1 and ADD.43S-2.

   c. Plan Sheet No. 60, Partial Section at Centerline of New Roadway 1/S-17, delete "Symmetrical about Centerline" and replace with "Centerline of Arch".

Please acknowledge receipt of the Addendum No. 1 by recording the date of its receipt in the space provided on page P-4 of the Proposal.

for BRIAN K. MINAAI
Director of Transportation

Amend Section 511 - Drilled Shafts to read as follows:

"SECTION 511 - DRILLED SHAFTS

511.01 Description. This section is for installing, drilling, reinforcing, concreting, and crosshole sonic logging of drilled shafts in the locations shown on the plans.

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 = 4,000 pounds per square inch.

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. Provide CSL access tubes conforming to the following:

(1) Access tubes shall be at least 2.0 inches inside diameter Schedule 40 pipe conforming to ASTM A53, Grade A or B, Type E, F, or S.

(2) Use access tubes having a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of the 1.3 inches maximum diameter source and receiver probes used for the testing. Ensure that access tubes are watertight, free from corrosion with clean internal and external faces to ensure good bonding between the drilled shaft concrete and the access tubes. Fit the access tubes with watertight caps on the top and bottom.

(3) Access tube acceptance will be based on manufacturer's certification that the furnished material meets the requirements of this special provision.

(D) Grout. After completion of the crosshole sonic logging tests, fill the access tubes with Portland Cement grout conforming to Section 712.04 -

Grout.

511.03 Qualifications of Drilled Shaft Contractor. The Drilled Shaft Contractor shall conform to Subsection 102.01 - Prequalification of Bidders and below. At the time of bid, the Contractor shall submit a signed statement that the Drilled Shaft Contractor has inspected both the project site and the subsurface information including soil or rock samples made available in the contract documents.

(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 drill shaft. The Drilled Shaft Contractor shall have installed at least three projects completed in the last three 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 Preconstruction 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 drill shaft projects completed in the past three 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) Name and experience record of the drill operators assigned to this project.

(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 casing or sheeting or drilling of the shaft.

(C) Installation Plan. At least one month before constructing the drilled shafts, submit an installation plan for acceptance by the Engineer. This plan shall provide information on the following:

(1) List of proposed equipment such as 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,

(4) Details of casing installation and removal methods,

(5) When the contract requires slurry, details of the methods to mix, circulate and desand slurry,

(6) Details of methods to clean the shaft excavation,

(7) Details of reinforcement placement including support and centralization methods,

(8) Details for attaching the crosshole sonic logging test access tubes to the reinforcing cage,

(9) Details of concrete placement including proposed operational procedures for free fall, tremie, or pumping methods,

(10) Details for grout placement in the crosshole sonic logging test access tubes after testing is completed, and

(11) Details of required load tests including 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 14 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 a test shaft. Position this trial shaft away from production shafts in the location shown in the contract or as specified by the Engineer. Drill the trial shaft to the maximum depth shown in the contract.

Failure to show the Engineer the adequacy of methods and equipment shall be reason for the Engineer to require alterations in equipment and/or method by the Contractor. Additional trial holes required to show the adequacy of altered methods of construction or equipment shall be at no 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 test shaft without consent of the Engineer.

The trial shaft shall be converted to the load test shaft. Fill the trial shaft holes with reinforced concrete similar to the construction of the foundation drilled shaft with reinforcing similar to drilled shaft DS-1.

511.05 Construction Requirement.

(A) Construction Sequence. Complete the excavation to footing elevations before shaft construction begins. Repair the disturbances caused by shaft installation to the footing area before pouring the footing.

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 for shafts to the dimensions and elevations shown in the contract. Its 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.

(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 locations, and to 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.

Maintain a construction method log during shaft excavation. The log shall contain information such as:

(a) excavation diameters,

(b) type of material excavated with the elevations 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

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.

Furnish drilled shaft concrete required to fill excavations for the shafts dimensioned in the contract at no 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 ten feet or 20% beyond the depths shown in the contract whichever is greater.

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, blasting materials and other equipment as necessary to construct the shaft excavation to the size and depth required. The Engineer will permit blasting only if stated in the contract or authorized in writing by the Engineer.

(b) Sidewall Overreaming. When the sidewall of the hole has softened, swelled, or degraded, sidewall overreaming is required. Overreaming thickness shall be a minimum of 0.5 inch 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.

(3) Classified Excavation. When designated in the contract, do the classified excavation under the standard and special excavation items. The Engineer will pay for obstruction removal separately.

(a) Standard Excavation. Standard excavation is excavation done with conventional tools. Conventional tools include augers fitted with soil or rock teeth, drilling buckets, and overreaming (belling buckets) 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.

(b) Special Excavation. Special excavation is excavation that requires special tools and/or procedures to advance the 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. Get the refusal rate using the standard excavation tools and equipment when hole advancement is less than one foot after 15 minutes of continuous drilling at full power.

The Engineer will consider special excavation, except obstructions removal, despite the density or character of materials met.

(4) Unclassified Excavation. When the contract designates drilled shaft excavation as unclassified, provide the necessary equipment to remove and dispose of materials met in forming the drilled shaft excavation. Rock drilling/coring equipment will be required for drilled shafts extending through hard basalt layers. The Engineer will not make separate payment for excavation of materials of different densities and character or employment of special tools and procedures necessary to excavate. The Engineer will not pay for obstruction removal separately.

(5) Obstructions Removal. Remove obstructions at drilled shafts locations when authorized by the Engineer. Such obstructions shall include man-made materials such as old concrete foundations and natural materials such as boulders.

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 cost to the State including costs associated with hole degradation due to removal operations or the time the hole remains open.

(6) Coring Samples (Shaft Excavation). Take soil samples or rock cores when shown in the contract or as specified by the Engineer. Extract the soil samples with a split or undisturbed sample tube. Cut the rock cores with an acceptable double or triple tube core barrel.

Cut to a minimum of 10 feet below the bottom of the drilled shaft excavation at the time the shaft excavation is about complete. When required by the Engineer, extend the depth of the coring up to a total depth of 20 feet. Measure the rock core and standard penetration test samples, identify visually, and describe on its log. Place the samples in suitable containers, identify by shaft location, elevation, and project number. Deliver the samples with its field log to the Engineer within 24 hours after completing the exploration.

The Engineer will inspect the samples or cores and decide the final depth of required excavation based on the Engineer's evaluation of the materials suitability. Furnish two copies of the typed final Contractor's log to the Engineer when the shaft excavation is accepted.

(D) Casings.

(1) General. Casings shall be steel, 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 shaft cutoff 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 between an elevation two 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:

(a) the curing of the concrete continues for the full 72 hours 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 pounds per square inch.

(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 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 five 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 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 mineral slurries in the drilling process. The 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. 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 mineral slurry thoroughly with clean fresh water and adequate time (as prescribed by the mineral manufacturer) allotted for dehydration before introducing the mineral 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 borehole. 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: 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 shafts 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 four hours of slurry use.

TABLE 511-1 - 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**	64.3Y**-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 bore hole as resolved by the American Petroleum Institute sand content test.

c. Submit changes for acceptance in writing by the Engineer.

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 three meters up the shaft. Extract samples until two consecutive samples produce acceptable values for density, viscosity, pH, and sand content.

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 mineral slurry as specified in the contract. Do not pour the concrete until resampling 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 mineral 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.

(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 inch 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 Engineer will decide the shaft cleanliness by visual inspection for dry shafts or other methods deemed appropriate to the Engineer for wet shafts.

Also, for dry excavations the maximum depth of water shall not exceed three 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(J). 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 three 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 according to 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 two-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.

(H) Access Tubes for Crosshole Sonic Logging (CSL) Tests. Install access tubes to allow for performance of CSL tests. Attach CSL access tubes securely to the interior of the reinforcement cage as near to parallel in each drilled shaft and in the pattern shown on the plans. Extend the access tubes from the bottom of the reinforcement cage to at least two feet above the top of the shaft. Joints required to achieve full length access tubes shall be watertight. Take care to prevent damaging the access tubes during reinforcement cage installation. Fill the tubes with potable water as soon as possible after concrete placement (but no later than one day) and reinstall the top watertight caps. Upon completion of the CSL tests, fill the access tubes with grout.

(I) Concrete Placement.

(1) General. Place the concrete through a tremie, 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. The concrete shall remain in a workable plastic state throughout the two hour placement limit. A longer placement time may be requested provided that the concrete remains in a workable plastic state throughout the placement time and applicable requirements of Subsection 511.02(A) are met.

Before placing the concrete, provide test results of a trial mix and a slump loss test. An accepted testing laboratory shall conduct the test using accepted methods. Supply a concrete mix that will maintain a slump of four inches or greater. Conduct the trial mix and slump loss tests using concrete and under ambient temperatures appropriate for site conditions.

(2) Concreting by Tremie. Tremies may be used for concrete placement in wet or dry excavations. Tremies shall include a tube of sufficient length, weight, and diameter to discharge concrete at the shaft base elevation. The tremie shall not contain 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 10 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 costs 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 four 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 costs 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 three inches. The Engineer will not permit 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 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 three 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 6.0 inches above and no more than 3.0 inches below plan position.

(4) Casing diameters shown in the contract refer to outside diameter (OD) 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 using a series of telescoping casings, size the casing so that the minimum shaft diameters listed above can be maintained.

(5) The top elevation of the shaft shall have a tolerance of ± 1.0 inch from the plan top of shaft elevation.

(6) The dimensions of casing are subject to American Pipe Institute tolerances applicable to regular steel pipe.

(7) 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 accepted combination of the following methods:

(a) Overdrill the shaft excavation to a larger diameter to permit accurate placement of the reinforcing steel cage with the required minimum concrete cover.

(b) Increase the number or size of the reinforcing steel.

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 as design analysis. A Hawaii Licensed Professional Engineer shall sign the redesign drawings and computations. Correct out of tolerance drilled shaft excavations including engineering analysis and redesign at no cost to the State.

(K) Drilled Shaft Load Tests. The use of load tests, the number of load tests and locations shall be as shown in the contract or as specified by the Engineer. When specified in the contract, complete static load tests before constructing production drilled shafts. Allow 7 working days after completing the last load test before the Engineer provides estimated drilled shaft tip elevations for production shafts.

Obtain the services of a Hawaii Licensed Professional Engineer with satisfactory load test experience:

(1) to conduct the test according to the contract,

(2) record data, and

(3) furnish reports of the test results to the Engineer.

Load the load test shaft to a maximum test load equal to two times the design strength limit state, or to plunging failure, whichever occurs first. Plunging failure is a deflection of the shaft head equal to 5% of the shaft diameter.

Do not begin static load testing until attaining a compressive strength of 3,400 pounds per square inch. Load-test the drilled shafts in the order specified by the Engineer. Complete the static load tests as described in ASTM D 1143 (Compression Test) quick test method or as modified herein. Supply equipment necessary to conduct the static test. Design the loading frame apparatus to ease the maximum load plus an adequate safety factor.

Notify the Engineer within 10 calendar days of contract award of the load testing schedule.

The Engineer will require load cells for drilled shaft load tests. Load cells shall be of adequate size to measure the maximum load to the applied shaft. Equip the load cell with an adequate readout device. Before load testing begins, furnish a certificate from an accepted testing laboratory showing the calibration for the load cell within the preceding 6 months for stages of loading and unloading. The accuracy of the load cell shall be within 1% of the true load.

After completing the test, cut off the test shafts and reaction shafts at an elevation two feet below the finished ground surface. The portion of the shafts cut off and removed shall remain the property of the Contractor.

(L) Crosshole Sonic Logging Test.

The State will perform crosshole sonic log testing and analysis on all completed drilled shafts. The State will require advance notice from the Contractor to schedule all crosshole sonic log testing. The Contractor shall give at least 5 working days notice to the Engineer of the time the concrete in each shaft will be sufficiently cured to allow for crosshole sonic log testing.

The testing will be performed after the shaft concrete has cured at least 24 hours. Additional curing time prior to testing may be required if the shaft concrete contains admixtures, such as set retarding admixture or water reducing admixture. The additional curing time prior to testing required under these circumstances shall not be grounds for additional compensation or extension of time to the Contract.

Crosshole sonic log testing will be conducted on all foundation drilled shafts. The first foundation drilled shaft constructed at each abutment will be tested first.

The Engineer will determine final acceptance of each shaft, based on the crosshole sonic log test results and analysis for the tested shafts, and will provide a response to the Contractor within 3 working days after receiving the test results and analysis submittal.

The Contractor shall not commence subsequent shaft excavations until receiving the Engineer's approval and acceptance of the first shaft, based on the results and analysis of the crosshole sonic log testing for the first shaft.

The Engineer will have final authority to accept or reject each drilled shaft based on CSL test results. For any shaft determined to be unacceptable, submit a repair plan to the Engineer for approval. Any modifications to the dimensions of the drilled shafts shown on the contract plans that are proposed in the repair plan will require calculations and working drawings stamped by a licensed professional engineer registered to practice in the State of Hawaii. Furnish materials and work, including engineering analysis and redesign, needed to correct unacceptable drilled shafts at no cost to the State. The Engineer will not give additional time to the Contractor for repairing any defective drilled shaft. Do not begin repair operations before remedial procedures or designs are approved by the Engineer.

If directed by the Engineer, drill a core hole in any questionable quality shaft to explore the shaft condition. Use a coring method that provides complete core recovery and minimizes abrasion and erosion of the core (e.g., double or triple tube core barrels). Fill all core holes with grout after the evaluation process. All costs for coring and grouting shall be borne by the Contractor.

511.06 Method of Measurement. The Engineer will not measure furnishing drilled shaft drilling equipment for payment.

The Engineer will measure the load test per each.

The Engineer will measure the following per linear foot complete in place:

(1) Drilled Shafts. The length shall be the difference between the plan top of shaft elevation and the final bottom of shaft elevation.

(2) Unclassified Shaft Excavation. The Engineer will measure the unclassified shaft excavation along the centerline of the shaft. The Engineer will measure the length from the plan top of shaft elevation to the plan bottom shaft tip elevation or final bottom of shaft elevation, whichever is shalllower.

(3) Unclassified Extra Depth Excavation. The Engineer will measure from the shaft estimated tip elevation shown in the contract to the final authorized and accepted bottom of shaft elevation.

(4) Drilled Shaft Sidewall Overreaming. The Engineer will measure the drilled shaft sidewall overreaming between the elevation limits shown in the contract or authorized by the Engineer. The Engineer will not measure additional shaft concrete due to overreaming.

(5) Trial Shaft Holes. The Engineer will measure the difference between the existing ground surface elevation at the center of the test shaft hole before drilling and authorized bottom elevation of the hole.

511.07 Basis of Payment. The Engineer will pay for furnishing drilled shaft drilling equipment at the contract lump sum price. The price includes full compensation for furnishing and moving the drilling equipment to the project; setting the equipment up at the locations; removing the equipment from the project;

and furnishing labors, materials, tools, and incidentals necessary to complete the work. The Engineer will pay for 60% of the amount bid for this item when the drilling equipment is on the job site, assembled, and ready to drill foundation shafts. The Engineer will pay for the remaining 40% of the amount bid when the Contractor has drilled the shafts, and the Contractor has placed the shaft concrete up to the top of the shafts.

The Engineer will pay for the accepted load tests at the contract unit price per each complete in place. The price includes full compensation for load tests, furnishing instrumentation to conduct load test, collecting load test data, reporting the load test when required, and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

The Engineer will pay for the accepted drilled shafts at the contract unit price per linear foot for drilled shaft of the diameter specified. The price includes full compensation for furnishing and installing concrete and reinforcing steel; for furnishing and installing CSL test access tubes; for furnishing and installing grout used to fill the CSL test access tubes after testing; and furnishing labor, materials, equipment, tools, and incidentals necessary to complete the drilled shaft.

The Engineer will pay for the accepted unclassified shaft excavation at the contract unit price per linear foot for drilled shafts of the diameter specified. The price includes full compensation for furnishing and installing the temporary casing, removing and disposing of excavated materials, using slurry as necessary, using drilling equipment, blasting, using special tools and drilling equipment to excavate the shaft to the depth shown in the contract, and furnishing labors, materials, equipment, tools and incidentals necessary to complete the work.

The Engineer will pay for the accepted unclassified extra depth excavation at the contract unit price per linear foot of the diameter specified. The price includes full compensation for the costs of excavating below the bottom of shaft elevations shown in the contract except the additional costs included under the associated pay items for permanent casing. Work under this item is the same as that described under unclassified shaft excavation and additional work of excavating below the plan bottom of shaft elevation. The Engineer will pay for compensation under this item only when the Engineer authorizes the extra depth excavation.

The Engineer will pay for the accepted drilled shaft sidewall overreaming at the contract unit price per linear foot. The price includes full compensation for furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work. Additional shaft concrete due to sidewall overreaming shall be considered incidental to sidewall overreaming.

The Engineer will pay for the accepted trial shaft holes of the specified diameter at the contract unit price per linear foot. The price includes full compensation for excavating the trial shaft holes through to the bottom of shaft elevation shown in the contract or as authorized by the Engineer; providing inspection facilities; for converting the accepted trial shaft hole to the load test shaft by furnishing and installing the concrete and reinforcing steel; restoring the site as required, and furnishing labors, materials, tools, equipment, and incidentals necessary to complete the work. The Engineer will not pay for trial shaft holes that the Contractor failed to show to the Engineer the adequacy of its proposed methods and equipment.

The Engineer will make payment under:

Pay Item	**Pay Unit**
Furnishing Drilled Shaft Drilling Equipment (_________ Each)	Lump Sum
Load Test	Each
Drilled Shaft _________	Linear Foot
Unclassified Shaft Excavation (_________)	Linear Foot
Unclassified Extra Depth Excavation (_________)	Linear Foot
Drilled Shaft Sidewall Overreaming (_________)	Linear Foot
Trial Shaft Holes	Linear Foot

The Engineer will not make additional lump sum payment due to overruns or underruns in comparison with the estimated quantity shown in the pay item description. The Engineer will make additional payment only if the Engineer specifies an alteration in the work."

END OF SECTION

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
511.0600	FURNISHING DRILLED SHAFT DRILLING EQUIPMENT (1 EACH)	L.S.	L.S.	L.S.	$ ________
602.0091	REINFORCING STEEL IN BRIDGE (INCLUDING ABUTMENT WALLS, WING WALLS, STAIRS, AND BRIDGE FOOTINGS) (1,050,000 LBS.)	L.S.	L.S.	L.S.	$ ________
606.3110	GUARDRAIL, TYPE 3 - SINGLE WITH STEEL POST	106	LIN.FT.	$ ________	$ ________
606.3112	GUARDRAIL, TYPE 3 - THRIE BEAM - INCLUDING TRANSITION	50	LIN.FT.	$ ________	$ ________
606.7000	TERMINAL SECTION, TYPE FLEAT-350	2	EACH	$ ________	$ ________
606.7001	TERMINAL SECTION, TYPE A FLARE	2	EACH	$ ________	$ ________
621.1000	REFLECTOR MARKER, TYPE RM-3	12	EACH	$ ________	$ ________
621.1010	REFLECTOR MARKER, TYPE RM-4(L)	2	EACH	$ ________	$ ________
621.1020	REFLECTOR MARKER, TYPE RM-4(R)	2	EACH	$ ________	$ ________
621.2000	MILE POST MARKER WITH POST (BI-DIRECTIONAL)	1	EACH	$ ________	$ ________
621.3000	CONSTRUCTION SIGN	12	EACH	$ ________	$ ________
621.3100	CONSTRUCTION SIGN WITH ONE POST	8	EACH	$ ________	$ ________
621.3200	CONSTRUCTION SIGN WITH TWO POSTS	18	EACH	$ ________	$ ________