

1 Make the following Section a part of the Standard Specifications:

2
3 **“SECTION 657 – ANCHORED WIRE MESH SYSTEM**

4
5 **657.01 Description.** The work contained in this section of the technical
6 specifications consists of furnishing, transporting and constructing a slope
7 stabilization system in accordance with the contract documents and the
8 manufacturer’s standards and requirements. The system shall be installed at the
9 location(s) directed by the Engineer.

10
11 The anchored wire mesh system has been designed to withstand the static
12 and dynamic forces generated from rocks or soil moving under the permanently
13 installed system. The manufacturer shall be regularly engaged in the
14 manufacturing of slope stabilization systems, having documented experience with
15 the manufacturing of slope stabilization systems used in similar application and
16 capacity. The manufacturer shall supply written evidence demonstrating
17 certification of a quality assurance program.

18
19 **657.02 Materials.** All materials for the anchored wire mesh system shall
20 conform to the following requirements.

21
22 **A. High Strength Wire Mesh.** The high strength wire mesh shall be
23 woven construction and shall be diamond shaped. The high strength wire
24 mesh shall be made with 4-mm (0.157-inch) diameter wire, and the ends of
25 each wire shall be formed into a loop and shall be twisted. The loops of the
26 wire mesh shall be fastened together to prevent unraveling of the mesh.

27
28 The wire shall be alloyed high strength carbon steel wire with a
29 minimum tensile strength of 256,000 psi. The wire shall be galvanized with
30 a Zinc/Aluminum coating with a minimum weight of 0.410 oz/ft² (125 g/m²).
31 The coating shall be 95% Zinc and 5% Aluminum.

32
33 The size of the wire mesh opening shall be ± 3.25 inches by ± 5.5
34 inches ($\pm 5\%$), and the depth of the mesh shall be 0.59 inches.

35
36 **B. Mesh Connection Clips (T3 Clips/Compression Claws).** The
37 connection clip T3 shall be fabricated from 4.0 mm high tensile steel wire
38 with a minimum tensile strength of 256,000 psi. The clip shall measure
39 2.36” x 0.83” and has two reversed end hooks on the one side of the
40 clamp. The wire shall be galvanized with a 95% Zinc and 5% Aluminum
41 coating with a minimum weight of 0.41 oz/ft² (125 g/m²).

42
43 **C. Spike Plates.** The spike plates shall be made from 0.4-inch
44 (10-mm) thick steel and shall be hot dipped galvanized with a minimum
45 layer thickness of 85 microns (μm). The spike plate shall be diamond
46 shaped with a width of 7.5 inches and a length of 13 inches.

47
48 **D. Boundary Ropes.** Boundary ropes shall have a diameter of
49 0.375 inches and shall be PVC coated (color shall be black unless
50 directed otherwise by the Engineer). The rope shall be 6X19 construction
51 (or equivalent), IWRC and galvanized with a minimum breaking strength of
52 13,000 pounds. The rope shall meet Federal Specification RR-W-410 or
53 equivalent including galvanizing.
54

55 **E. Drilled Holes.** Drill the holes for the grouted soil/rock anchors
56 (including the anchors for the boundary ropes) in accordance with the
57 minimum dimensions (diameter and depths) shown in the design
58 drawings. The Contractor shall submit deviations from the dimensions
59 shown on the design drawings for acceptance by the Engineer. The
60 Engineer will not permit blasting for installation of the drilled holes.
61

62 **F. Grouted Soil/Rock Anchors.** The grouted soil/rock anchors shall
63 consist of 1.375-inch diameter high-strength Grade 75 solid threaded bar.
64 The length of the grouted soil/rock anchors shall be in accordance with the
65 design drawings.
66

67 **G. Supplemental (Short) Anchors.** Where required (not shown on
68 design drawings), supplemental (short) anchors may be installed in
69 between the grouted soil/rock anchors shown on the design drawings.
70 Supplemental (short) anchors are installed to provide a neat appearance
71 for the anchored wire mesh system only and serve no structural function.
72 The supplemental (short) anchors shall be threaded hollow bar with
73 outside and inside diameters of 1.0 and 0.55 inches, respectively, as
74 required. The supplemental (short) anchors shall have a corrosion
75 allowance of 4 mm (157 mils) sacrificial steel included in their diameter.
76 Where installed by the Contractor, the length of the supplemental (short)
77 anchors shall be at least 6 feet in length.
78

79 **H. Grout.** The soil/rock anchors shall be grouted with non-shrink
80 grout with minimum compressive strength shown on the design drawings.
81 Water used for the grout shall be potable, clean and free of injurious
82 quantities of substances known to be harmful to Portland Cement or the
83 steel anchors.
84

85 **I. Color Coating.** All components of the anchored wire mesh
86 system, such as the high strength steel wire mesh, compression claws
87 (also known as press claws), and spike plates shall have a powder coating
88 of black pigmentation (the Engineer may request for a different color of
89 powder coating). The pigmented powder shall be applied using an
90 electrostatic spray gun or equivalent process. The other exposed parts of
91 the anchored wire mesh system that has not been powder coated shall

have an applied coating of rubberized paint (color shall be black unless otherwise directed by the Engineer) for aesthetic purposes.

J. Miscellaneous Materials. All miscellaneous material associated with the anchored wire mesh slope stabilization system, such as the vendor with the system, shall supply the appropriate wire rope clips, thimbles, etc., (appropriate for use with a PVC coated wire rope) and shall be hot dipped galvanized.

657.03 Pre-Construction Requirements. The Contractor shall submit four (4) copies of the layout and detailed working drawings to the Engineer for review and acceptance. The submittal shall be prepared by the manufacturer of the anchored wire mesh slope stabilization system. The submittal also shall include samples of the materials with the powder coating and color(s) of the high strength wire mesh for selection and acceptance by the Engineer prior to placing an order for the anchored wire mesh system. The Engineer shall have 20 days to review the submittal and provide written comments and acceptance of the submittal. Fabrication of the anchored wire mesh system shall not begin until the Engineer has reviewed and accepted the submittal. The cost for the manufacturer's assistance and drawings required in the submittal shall be included in the cost of the anchored wire mesh system.

The Contractor shall submit an affidavit certifying that the high strength wire mesh meets the project specifications. The affidavit shall be signed by an official authorized to certify on behalf of the manufacturer and shall be accompanied by a mill certificate that verifies physical properties were tested during manufacturing and lists the manufacturer's quality control testing. If the affidavit is dated after award of the contract and/or is not specific to the project, the supplier shall attach a statement certifying that the affidavit addressed to the wholesale company is representative of the material supplied.

The Contractor shall have a qualified and experienced representative from the high strength wire mesh manufacturer available on an as-needed basis during the construction. The representative shall visit the site for consultation at least once during construction.

Calibration curves for jack, pressure gauge, and load cell used for anchor testing shall be submitted to the Engineer for review and approve.

657.04 Construction Requirements.

A. General. As part of the construction requirements, a technical representative from the manufacturer of the anchored wire mesh system shall be present on the site for a minimum of one (1) day during the initial installation of the anchored wire mesh system at no additional cost to the State. All materials for the anchored wire mesh system shall be properly

marked by the manufacturer in order for the Contractor to identify the components easily with the drawings to minimize installation time.

The anchored wire mesh system installation shall consist of the following steps and the manufacturer's recommendations. Where discrepancies exist between the technical specifications of the Special Provisions and the manufacturer's recommendations, the Contractor shall notify the Engineer immediately. The Engineer will provide additional guidance for proceeding with the work upon consultation with the manufacturer's technical representative to resolve the discrepancies.

In general, follow these steps during installation of the anchored wire mesh system.

1. The Contractor shall cut the slope flat and remove all brush, debris and loose rock in accordance with the contract documents.
2. The Contractor shall locate the grouted soil/rock anchors on the slope as shown on the design drawings. Prior to installation of the grouted soil/rock anchors, form hollows of at least 8 inches deep (generally 8 to 12 inches deep) at each grouted soil/rock anchor.
3. The grouted soil/rock anchors shall be installed in accordance with the design drawings. The non-shrink grout shall be mixed with a high-speed colloidal mixer with shearing action. The Contractor shall install supplemental (short) anchors in shallow depressions (generally less than 18 inches deep) in order to pull the anchored wire mesh into the depressions and against the ground.
4. Install the required grouted soil/rock anchors for the boundary ropes at the locations shown on the design drawings. The boundary ropes serve no structural purpose because the boundary ropes are used to pull the edge of the anchored wire mesh tight against the slope (for a neat appearance).
5. Plant hydro-mulch seeding on the face of the slope prior to placement of the erosion control matting.
6. Lay the erosion control matting on the slope by unrolling down the slope in accordance with the manufacturer's recommendations.

- 183 7. Lay the high strength wire mesh on the slope by unrolling
184 down the slope. The rolls can be shortened or lengthened as
185 necessary by removing or adding sections, respectively.
186 Overlap the mesh panels in accordance with the
187 manufacturer's recommendations. Fasten the overlapped
188 mesh panels with two (2) T3 clips at each mesh.

189
190 For obstructions, such as trees that are not removed or
191 concrete blocks or footings for the pipe support, cut the wire
192 mesh, bend the cut wire mesh pieces back, and secure in
193 place with aluminum clamps (follow manufacturer's
194 recommendations).

- 195
196 8. Install the required boundary ropes and fasten the wire mesh
197 to the boundary ropes with compression claws (minimum of
198 one compression claw for every foot). Tighten the boundary
199 ropes and pull tight against the ground or slope.

- 200
201 9. Place the spike plates onto the anchors. Using a hydraulic
202 wrench, tighten the nuts and push the spike plates and wire
203 mesh into the hollows in order to tension the anchored wire
204 mesh to at least 6.7 kips (30 kN). Torque the nuts to the
205 values shown on the design drawings or in accordance with
206 the manufacturer's recommendations.

207
208 **B. Proof Testing of Grouted Soil/Rock Anchors.** Perform proof
209 testing on a minimum of 5 percent of grouted soil/rock anchors. Perform the
210 proof tests on anchors selected by the Engineer. Do not perform the proof
211 testing until the grout for the anchor has cured for at least 72 hours and
212 attained at least the specified 3-day compressive strength of the grout.
213 Testing in less than 72 hours will be allowed only if the Contractor submits
214 compressive strength test results verifying that the anchor grout mixes being
215 used will provide the specified 3-day compressive strengths in the lesser
216 time.

217
218 Testing equipment shall include dial gauges, dial gauge support,
219 jack and pressure gauge, electronic load cell, and a reaction frame.
220 Provide description of test setup and jack, pressure gauge, and load cell
221 calibration curves for review and approval by the Engineer. Measure the
222 anchor head movement with a dial gauge capable of measuring up to
223 0.001 inches. The dial gauge shall have a travel sufficient to allow the test
224 to be done without having to reset the gauge. Visually align the gauge to
225 be parallel with the axis of the anchor and support the gauge
226 independently from the jack or reaction frame.

Perform proof tests by incrementally loading the anchor to a maximum test load of 150 percent of the design pullout capacity indicated on the design drawings. Measure and record the anchor head movement at each load. Monitor the test load by a load cell or a jack pressure gauge with a sensitivity range meeting the requirements of pressure gauges used on the project. At load increments other than maximum test load, hold the load long enough to obtain a stable reading. Incremental loading for proof tests shall be in accordance with the following load schedule. Record the anchor head movements at each load increment.

| PROOF TEST LOADING SCHEDULE | |
|-----------------------------|--------------|
| LOAD | HOLD TIME |
| AL (0.05-DL maximum) | Until Stable |
| 0.25 DL | Until Stable |
| 0.50 DL | Until Stable |
| 0.75 DL | Until Stable |
| 1.00 DL | Until Stable |
| 1.25 DL | Until Stable |
| 1.50 DL (Max. Test Load) | 60 minutes |

The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed 5 percent of the Design Load (DL). The DL is the design pullout capacity indicated on the design drawings. Dial gauges shall be set to "zero" after applying the alignment load. Maintain all load increments within 5 percent of the intended load. The creep period shall start as soon as the maximum test load is applied and the anchor head movement shall be measured and recorded at 1 minute, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes.

657.05 Method of Measurement.

The Engineer will measure the grouted soil anchor for anchored wire mesh system per linear foot of anchor installed. The Engineer will compute the length between existing ground surface at hole center, before drilling, and authorized bottom of hole.

The Engineer will measure the pre-production sacrificial grouted soil anchor verification tests per each completed and accepted by the Engineer.

The Engineer will measure the grouted soil anchor proof tests per each completed and accepted by the Engineer.

261 The Engineer will measure the anchored wire mesh system per square foot
262 of actual finished surface excluding additional mesh required for overlapping.

263
264 The Engineer will measure repairs to lower Hanalei slope nails, if ordered by
265 the Engineer, on a force account basis, in accordance with Subsection 109.06 –
266 Force Account Provisions and Compensation.

267
268 **657.06 Basis of Payment.**

269
270 The Engineer will pay for the grouted soil/rock anchor installed at the
271 contract unit price per linear foot complete in place. The price includes full
272 compensation for furnishing and installing all the materials associated with the
273 grouted soil/rock anchors, and furnishing labor, materials, tools, equipment and
274 incidentals necessary to complete the work. Traffic control requirements during
275 installation of the grouted soil/rock anchors as specified in the Contract
276 Documents will not be measured nor paid for separately and will be considered
277 incidental to the unit price item.

278
279 The price shall be full compensation for drilling the holes to the full depth
280 specified or directed by the Engineer into the materials present at the site,
281 furnishing the reinforcing steel bars, grout, spike plates, plastic cap, labor,
282 materials, equipment, tools, and incidentals necessary to complete the grouted
283 soil/rock anchors at the locations shown on the design drawings.

284
285 The Engineer will pay for the pre-production sacrificial grouted soil anchor
286 verification test upon completion of the test and other related costs to the
287 performance of the verification test. The price shall be full compensation for drilling
288 the holes to the full depth specified or directed by the Engineer into the materials
289 present at the site, furnishing the reinforcing steel bars, grout, and all labor,
290 materials, equipment, tools, and incidentals necessary to perform the verification
291 tests in accordance with the contract.

292
293 The Engineer will pay for the grouted soil anchor proof tests upon
294 completion of the test and other related costs to the performance of the proof test.
295 The price shall be full compensation for furnishing all labor, materials, equipment,
296 tools, and incidentals necessary to perform the proof tests in accordance with the
297 contract.

298
299 The Engineer will pay for the anchored wire mesh system installed at the
300 contract unit price per square foot complete in place. The price includes full
301 compensation for furnishing and installing all the materials including the erosion
302 control matting (excluding the grouted soil/rock anchors), and furnishing labor,
303 materials, tools, equipment and incidentals necessary to complete the work.
304 Traffic control requirements during installation of the anchored wire mesh as
305 specified in the Contract Documents will not be measured nor paid for separately
306 and will be considered incidental to the unit price item.

The price shall be full compensation for furnishing detailed working drawings, labor, materials, equipment, tools, and incidentals necessary to complete the anchored wire mesh system at the locations shown on the design drawings.

The Engineer will make payment under:

| Pay Item | Pay Unit |
|--|---------------|
| Grouted Soil Anchor for Anchored Wire Mesh (20 feet deep with Spike Plate and Cap) _____ | Linear Feet |
| Added Grouted Soil Anchor Length for Anchored Wire Mesh (Up to __ feet deep with Coupler to add to __-foot Soil Nail) _____ | Linear Feet |
| Pre-Production Sacrificial Grouted Soil Anchor Verification Tests _____ | Each |
| Grouted Soil Anchor Proof Tests _____ | Each |
| Anchored Wire Mesh System _____ | Square Feet |
| Repairs to Lower Hanalei Slope Soil Nails | Force Account |

An estimated amount for the force account may be allocated in the proposal schedule under "Repairs to Lower Hanalei Slope Soil Nails", but the actual amount to be paid will be the sum shown on the accepted force account records, whether this sum be more or less than the estimated amount allocated in the proposal schedule."

END OF SECTION