STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS

Land Development Division

APR 18 2016

Date

ADDENDUM NO. 2
TO
INVITATION TO BID

IFB-16-HHL-003
ANAHOLA RESERVOIR IMPROVEMENTS PROJECT

Notice to All Prospective Offerors

This addendum is hereby made a part of the contract documents for the ANAHOLA RESERVOIR IMPROVEMENTS PROJECT, IFB-16-HHL-003, and it shall amend the said contract documents as detailed within this Addendum document.

APPROVED:

Norman L. Sakamoto, Acting Administrator
Land Development Division
Department of Hawaiian Home Lands

Please execute and immediately return the receipt below to the Department of Hawaiian Home Lands via facsimile to: **(808) 620-9299, Mr. Stewart Matsunaga, Master Planned Community Development Manager, Land Development Division.**

Receipt of Addendum No. 2 for ANAHOLA RESERVOIR IMPROVEMENTS PROJECT, IFB No.: IFB-16-HHL-003, is hereby acknowledged.

Print: _____ _____
(Name) (Title)

_____ _____
Name of Firm/Company Date

ADDENDUM NO. 2

IFB-16-HHL-003
ANAHOLA RESERVOIR IMPROVEMENTS PROJECT

INCLUSIONS

This Addendum No. 2 shall incorporate:

1. Addendum 2 Cover (IFB-16-HHL-003)
2. Inclusions (Addendum 2)
3. Minutes of Pre-Bid Meeting Agenda (Anahola) 4-18-16
4. Bid Offer Form (Revised 4-18-16)
5. Section 330198 (SLIP LINING of OUTLET PIPE) Revised 4-15-16
6. Table of Contents (Technical Specifications) Revised 4-15-16
7. Technical Specifications (Anahola Reservoir Improvements Project) Revised 4-18-16
8. *Note- Drawing Sheet C-204, Detail 1/C203 PLAN: Change callout note at 16" outlet pipe to read, "EXIST 16" TUNNEL TO BE SLIPLINED."

ANAHOLA RESERVOIRS IMPROVEMENT PROJECT
IFB-16-HHL-003

Pre-bid Conference & Site Inspection
9:30 a.m., Tuesday, April 5, 2016
State Office Building 2nd Floor Conference Room
3060 Eiwa Street
Lihue, Kauai 96766

MINUTES OF AGENDA

1. INTRODUCTIONS

Department of Hawaiian Home Lands (DHHL)
- Kathleen "Pua" Chin, Hawaiian Homes Commission
- Erna Kamibayashi, Acting Manager, Kauai District Office
- Kaipo Duncan, Land Management Division
- Stewart Matsunaga, Master Planned Community Development Manager

Design Engineer: LYON Associates, Inc.
- Jiro Sumada, Executive VP
- Kenneth Rappolt, P.E.

Construction Management Services: Bowers + Kubota Consulting Inc.
- Brian Bowers, P.E. , President
- Steve Ientile, P.E.

2. PURPOSE OF PRE-BID CONFERENCE

- Project overview
- Review procurement requirements and schedule
- Review bid documents
- Site inspection

3. SCOPE OF WORK (General Description)

This project consists of furnishing all labor, material, equipment and supervision to:

1) As the base bid, Decommission Kealia Field 2 Reservoir and rebuild Kealia Field 1 Reservoir,
2) As additive alternate, Rebuild Upper Anahola Reservoir,
3) As additive alternate, Decommission Lower Anahola Reservoir.

4. PROCUREMENT NOTES:

- This project is not General Excise Tax (GET) exempt; bids shall be inclusive of State GET.

- Should this project become qualified as GET exempt; DHHL shall adjust and reduce the schedule of values by the amount of the State GET, applicable to the County of Kauai.

- Project is subject to the State Department of Labor and Industrial Relations' (DLIR) Wages Rate Schedules, per Chapter 104, Hawaii Revised Statutes.
  The wage rates in the State DLIR Wages Rate Schedule (currently Bulletin No. 487, February 15, 2016) are subject to change, and shall apply throughout the term of the contract.

- A 'Notice of Intention to Bid' and 'Standard Qualification Questionnaire' are both required for submittal no later than the date and time specified in "Deadlines", below.

- Prior to contract award, DHHL shall verify Offeror compliances with Section 3-122-112, Hawaii Administrative Rules, which involves clearances from the DCCA, DLIR, and State and Federal tax offices.

  Failure to either provide the clearances noted in Sec. 3-122-112, HAR, or rectify a non-compliant status within ten (10) business days of notification may be grounds to disqualify a bidder. It is not mandatory, but highly recommended that Offerors register with Hawaii Compliance Express (HCE). To register with HCE, go to:

  http://vendors.ehawaii.gov

- A Bid Security covering 5% of the bid offer is required for this IFB.
  * A personal or company check does not qualify as an "Official Check" in the Bid Offer Form.

- Separate Payment Bond and Performance Bond will be required for the contract, each covering 100% of the contract price.

- See Special Conditions for submittal of Certificate of Liability Insurance, with applicable rates.

5. CONTRACT TERMS AND LIQUIDATED DAMAGES

- The Contract Time of Performance is Five Hundred Forty (540) calendar days from Notice to Proceed. DHHL anticipates three months from bid certification to contract funding certification. Construction Notice to Proceed is anticipated 6-9 months after contract certification, in order to complete geotechnical and historic archaeological studies and State review, prior to commencing construction. Contractor shall hold all prices for this duration. DHHL shall not be held responsible for any delays caused by State reviews.

- Liquidated damages: $1,000.00 per calendar day.

6. QUESTIONS/ANSWERS ISSUED BY LAST ADDENDA

- A written summary of this Pre-Bid conference will be issued by Addendum.

- In order to be addressed by Addendum, questions or requests for clarifications, as well as Requests for Substitutions shall be submitted in writing no later than 4:30 p.m., April 15, 2016, and may be faxed to: 808-620-9299, and E-mailed to: Stewart.t.matsunaga@hawaii.gov.

- Written responses to questions and clarifications will be posted via Addendum on the DHHL website; any verbal responses by DHHL and Consultant shall not be binding.

Interested bidders are responsible to check the DHHL website for the issuance of any Addendum up until the due date for bids. Addendum 2 was updated to include CAD drawings, Plan revision 1 and the Archeological-Historic Survey Report.

7. QUESTIONS AND ANSWERS

Questions submitted prior to Pre-bid meeting:

- The plans call for lining existing miniature tunnels with shotcrete. One at 18" and the other a 3'x 4' arch. I haven't encountered this application before and have been researching how and who can perform that work. Our regular shotcrete contractor does not have equipment to work inside such a small tunnel. I have been researching online but have not located what I assume would be some sort of miniature robotic device. The tunnel applications I have seen online were large enough for the operator to enter.

  Can a Specification Section be provided that addresses shotcrete application with a miniature tunnel?

  Can engineer assist by identify Hawaii contractors that have the ability and required license to apply shotcrete within a miniature tunnel?

  Is there a video inspection of the existing tunnels available for review?

  Response: No video inspection of the tunnel is available; contractors may view the tunnel entrances during the site inspection. Modification to the specification will be considered basin on contractor's proposed means and methods to achieve the tunnel lining.

Prior consultation with: Concrete Technologies, Inc.
1431 Miner Street
P.O. Box 3274
Idaho Springs, Colorado 80452

Consultant may prepare alternate plans and specifications for this work. Any changes will be noted through Addendum.

- Special Condition SC-17 mentions that "a copy of the archaeological field inspection report dated December 4, 2009 is attached. Can this report be posted on the website for review of the recommendations?

  Response: See Addendum 1, link to pdf plans for "Limited Archaeological & Historical Survey"

- I am preparing to request the bid bond for the Anahola Reservoirs Improvement Project but I haven't located the engineer's estimate in the bid documents. Can you please provide the engineer's estimate so that I can fill out the bond request form.

  Response: Contractor should base their bid bond request upon its own estimate. Form Exh. A, Surety Bid Bond allows contractor to state "5% of bid" without specifying the exact dollar amount of the bid. As provided in the Method of Award in bid proposal, DHHL shall provide a "control amount" at bid opening, the amount of funds available.

- Can CAD files be provided?

  Response: A link to Dropbox files will be provided. See Amendment 2.
  Alternatively, contact Kenneth Rappolt, P.E., LYON Associates, Inc. at (808) 695-6415.

Questions from Pre-bid Conference and Site Inspection:

Contractor noted differences between proposal and plan quantities and will submit observations in writing.

Contractor noted that certain section of the technical specification may be missing from the DHHL published IFB. Consultant will provide revisions to DHHL for inclusion into Addendum.

Revision 1 to Plans set included description of 100 year water surface elevation. No other changes to Plan set (dated 3/10/16).

NPDES permit is being prepared by Consultant for DHHL signature. Contractor is responsible for preparation of NPDES revision for submittal of BMPs and other information.

Scheduling issue described above in "Contract Terms and Liquidated Damages"

"Construction Entrance" on site map is not intended to dictate Contractor's entry point and location of BMPs; that is to be determined and coordinated after execution of contract and with the establishment of BMPs.

Grazing animals were observed on roadway access to Kealia Reservoirs and within and around the Anahola Reservoirs. While care will be exercised by bovine owners, Contractor will be responsible for animals hurt or destroyed during construction. Pre-construction meeting will address ingress and egress requirements through various gates and enclosures.

Contractor shall be aware of surrounding trees and vegetation that could cause harm to workers. Liability Insurance certificates shall be effective at all times.

The Anahola Pre-school is in close proximity to construction vehicular traffic. Contractors shall recognize the need for keeping equipment in good working order to avoid excessive smoke, dust, noise, etc.; but most of all being extremely cautious in managing the speed limit adjacent to the Anahola Preschool. Contractor shall prepare an informational flyer with contractor contact numbers to distribute to surrounding community.

8. SITE INSPECTIONS FOLLOWING PRE-BID CONFERENCE

Site map provided.
Any future site inspections shall be coordinated with the Project Manager.
Contractors shall understand that rain and muddy conditions present danger and 4-wheel drive Vehicles are required.

9. DEADLINES

SUBMITTALS	DEADLINES
Notice of Intention to Bid (E-mail or Fax acceptable)	4:30 P.M, April 11, 2016
Standard Qualification Questionnaire (Submittals for previous projects are NOT valid). (E-mail or Fax acceptable)	4:30 P.M, April 11, 2016
Hawaii Products Preference (Form SPO-038), if applicable.	4:30 P.M, April 11, 2016
Written Questions, Requests for Clarification, Requests for Substitution of Materials. (No later than 14 days prior to Bid Opening)	4:30 P.M, April 15, 2016
Last day to Issue Addendum (assuming no change to the IFB's bid opening date.	4:30 P.M., April 20, 2016

BID OPENING • Sealed bids are due at DHHL's Kauai District Office- 3060 Eiwa Street, Room 203, Lihue, Kauai, Hawaii 96766. • The 2:00 P.M. deadline shall be according to the official clock established at the location sealed bids are received. • Bids will be opened shortly after sealed bids are received and read publicly. • Bids submitted after the date and time specified, will be time-stamped, but not accepted nor opened. • All bid forms are included in the IFB package. • Award of contract will be made to the responsible and responsive bidder with the lowest "Total Sum Bid".	2:00 P.M, April 29, 2016

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS

BID OFFER FORM FOR

ANAHOLA RESERVOIR IMPROVEMENTS PROJECT

ANAHOLA, LIHUE, ISLAND OF KAUAI, HAWAII

TAX MAP KEYS:
(4) 4-7-002:004 (PORTIONS)
(4) 4-7-004:002 (PORTIONS)

IFB NO.: IFB-16-HHL-003

Chairman
Hawaiian Homes Commission
Department of Hawaiian Home Lands
91-5420 Kapolei Parkway
Kapolei, Hawaii 96707

The undersigned has carefully examined, read, and understands the terms and conditions in the Plans and Specifications, Special Conditions attached hereto, DHHL Construction General Conditions, and General Conditions specified in the Invitation for Bids (IFB) No. IFB-16-HHL-003. The State of Hawaii's (State) Contract for Goods and Services Based on Competitive Sealed Bids AG-003 Rev. 6/22/2009, AG-008 103D General Conditions, are included by reference and made part hereof and available upon written request to the Procurement Officer. The undersigned herby submits the following offer to perform the work for IFB No. IFB-16-HHL-003 as specified herein, all in accordance with the true intent and meaning thereof.

The undersigned understands and agrees that:

1. The State reserves the right to reject any and all offers and to waive any items that are defective when, in the State's opinion, such rejection or waiver will be in the best interest of the State. A solicitation may be rejected in whole or part when in the best interest of the State.

2. If awarded the contract, all services will be in accordance with Hawaii Revised Statutes (HRS) § 103-55.5, concerning wages and hours of employees on public works construction contracts.

3. In submitting this offer, the Offeror is not in violation of HRS Chapter 84, concerning prohibited State contracts.

4. By submitting this offer, the Offeror certifies that the offer was independently arrived at without collusion and the Offeror did not participate in any practices to restrict competition.

5. It is understood that the failure to receive any addendum shall not relieve the Offeror from any obligation under this IFB.

Date:_____

The undersigned represents that it is: **(Check ✓ one only)**

□ A **Hawaii business** incorporated or organized under the laws of the State of Hawaii; **OR**

□ A **Compliant Non-Hawaii business** not incorporated or organized under the laws of the State of Hawaii, is or shall be registered at the State of Hawaii Department of Commerce and Consumer Affairs Business Registration Division (DCCA-BREG) to do business in the State of Hawaii.

State of incorporation: _____

Offeror is:

□ Sole Proprietor □ Partnership □ Corporation □ Joint Venture □ Other: _____

Federal ID No.:_____

Hawaii General Excise Tax ID No.:_____

Telephone No.:_____

Fax No.:_____

E-Mail Address:_____

Payment address (other than street address below)

_____

(Street Address, City, State, Zip Code)

Business address

_____

(Street Address, City, State, Zip Code)

Respectfully submitted:

_____

Authorized (Original) Signature

_____

Name and Title (Please Type or Print)

*_____

Exact Legal Name of Company (Offeror)

*If Offeror shown above is a "dba" or a "division" of a corporation, furnish the exact legal name of the corporation under which the awarded contract will be executed:

_____

The following bid is hereby submitted to the Department of Hawaiian Home Lands for the Anahola Reservoir Improvement Project consisting of a Base Bid including Allowance Items, and one additive Alternate Bid.

BASE BID (Total for Items 1, 2 and 3)

1. Decommission Kealia Field 2 Reservoir:

Item	Quantity	Unit	Description	Unit Price	Amount
A1-1.	1	LS	Temporary Facilities and Utilities		
A1-2.	1	LS	Temporary Erosion and Pollution Control Measures, including installation of silt fencing and gravel ingress/egress, in place complete		
A1-3.	2.4	AC	Clearing and Grubbing and Disposal		
A1-4.	1	LS	Remove and cap 240 LF 6" PVC pipe		
A1-5.	9,400	CY	Removal/Cut (unclassified excavation) and Grading to desired final grade including compaction.		
A1-6.	1	LS	Plug and fill outlet pipe entrances.		
A1-7.	1	LS	Remove 220 LF barbed wire fence and posts.		
A1-8.	184	SY	Two layers 12-18" rock channel toe protection.		
A1-9.	3,000	SY	Seeding		
				Decommission Kealia Field 2 Subtotal:	

2. Rebuild Kealia Field 1 Reservoir:

Item	Quantity	Unit	Description	Unit Price	Amount
A2-1	1	LS	Temporary Facilities and Utilities		
A2-2	1	LS	Temporary Erosion and Pollution Control Measures, including installation of silt fencing and gravel ingress/egress, in place complete		
A2-3	2.4	AC	Clearing and Grubbing and Disposal		
A2-4	1,011	CY	Removal/Cut (unclassified excavation) and Grading/Levelling to desired final grade including compaction.		
A2-5	2,362	CY	Embankment or Fill materials, in place complete		
A2-6	5,450	SY	Stone Embankment Protection on dam face slopes complete with geotextile fabric. Two layers 9"-12" rock.		
A2-7	277	LF	Gravel underdrain, perforated pipe, and drainage blanket.		
A2-8	1	LS	Drain pipe for underdrain including manhole and headwall in place complete.		
A2-9	105	LF	Slip line and grout outlet tunnel approximately 105 LF.		
A2-10	1	LS	24" diameter HDPE outlet pipe complete with manhole and outlet headwall in place complete.		
A2-11	1,331	LF	Gravel Access road in place complete.		

Item	Quantity	Unit	Description	Unit Price	Amount
A2-12	1	LS	Dam Spillway including concrete sill, stone channel and boulder lining.		
A2-13	1	LS	Outlet works including concrete inlet, foundations, trash screen, sliding outlet gate, steel supported catwalk with security gate.		
A2-14	1	LS	Fencing and cattle gate, complete in place.		
A2-15	5	EA	Warning signs on fence or gate.		
A2-16	1	EA	Warning sign with sign post		
A2-17	2,700	SY	Seeding		
A2-18	1	LS	Set three survey markers		
				Rebuild Kealia Field 1 Subtotal:	

3. <u>Allowance Items</u>

Item	Quantity	Unit	Description	Unit Price	Amount
B-1	Allowance		Geotechnical characterization and report for two sites. See Special Conditions.	48,000.00	48,000.00
B-2	Allowance		Historical Documentation for ALL sites. See Special Conditions.	21,000.00	21,000.00
B-3	Allowance		Unforeseen Site Conditions and/or Regulatory Changes	150,000.00	150,000.00
				Allowance Items Subtotal:	$219,000.00

TOTAL FOR BASE BID AND ALLOWANCE ITEMS: _____

ADDITIVE ALTERNATE
(Rebuild Upper Anahola and Decommission Lower Anahola)

Additive Alternate #1:

1. Rebuild Upper Anahola Reservoir:

Item	Quantity	Unit	Description	Unit Price	Amount
A1-1.	1	LS	Temporary Facilities and Utilities		
A1-2.	1	LS	Temporary Erosion and Pollution Control Measures, including installation of silt fencing and gravel ingress/egress, in place complete		
A1-3.	2.4	AC	Clearing and Grubbing and Disposal		
A1-4.	1,804	CY	Removal/Cut (unclassified excavation) and Grading/Levelling to desired final grade including compaction.		
A1-5.	2,303	CY	Embankment or Fill materials, in place complete		
A1-6.	2,000	SY	Stone Embankment Protection on dam face slopes complete with geotextile fabric. Two layers 9”-12” rock.		
A1-7.	1	LS	Set three Survey Monuments		
A1-8.	80	LF	Repair 3’ x 4’ arched outlet tunnel with 3” shotcrete lining.		

Item	Quantity	Unit	Description	Unit Price	Amount
A1-9.	1	LS	55 LF 24" diameter HDPE outlet pipe complete with outlet headwall and toe stone in place complete.		
A1-10.	1,420	SY	6" thick Gravel Access road in place complete.		
A1-11.	1	LS	Dam Spillway including concrete sill, stone channel and boulder lining.		
A1-12.	1	LS	Outlet works including concrete inlet, foundations, trash screen, sliding outlet gate, steel supported catwalk with security gate.		
A1-13.	300	LF	Barbed wire Fencing		
A1-14.	1	LS	Swing gate, complete in place.		
A1-15.	1	EA	Warning signs on fence or gate.		
A1-16.	2	EA	Warning sign with sign post		
A1-17.	3,000	SY	Seeding		
				Rebuild Upper Anahola Reservoir Subtotal:	

Additive Alternate #2

2. <u>Decommission Lower Anahola Reservoir</u>

Item	Quantity	Unit	Description	Unit Price	Amount
A2-1	1	LS	Temporary Facilities and Utilities		

Item	Quantity	Unit	Description	Unit Price	Amount
A2-2	1	LS	Temporary Erosion and Pollution Control Measures, including installation of silt fencing and gravel ingress/egress, in place complete		
A2-3	2.4	AC	Clearing and Grubbing and Disposal		
A2-4	1	LS	Remove and cap 240 LF 6" PVC pipe		
A2-5	10,172	CY	Removal/Cut (unclassified excavation) and Grading to desired final grade including compaction.		
A2-6	1	LS	Plug and fill outlet pipe entrances.		
A2-7	1	LS	Remove 220 LF barbed wire fence and posts.		
A2-8	184	SY	Two layers 12-18" rock channel toe protection.		
A2-9	3,000	SY	Seeding		
				Decommission Lower Anahola Subtotal:	

TOTAL FOR ADDITIVE ALTERNATE BID (Upper & Lower Anahola): _____

BID SUMMARY

TOTAL BASE BID (Kealia Fields 1 and 2 and Allowance Items): _____

TOTAL ADDITIVE ALTERNATE (Upper Anahola and Lower Anahola): _____

TOTAL SUM BID: _____

TOTAL SUM BID = _____

_____ Dollars ($_____).

The prices herein for the above items shall include all materials, labor, tools, equipment, machinery and all incidentals necessary, inclusive of general excise tax to install or to construct these items in place complete and in accordance with the plans and specifications contained in this IFB.

The CONTRACTOR shall complete all work as specified or indicated in the Contract Documents on or before Eighteen Months (540) calendar days after receiving written Notice to Proceed, subject to extensions, as may be granted. See Special Provisions for Phasing.

HAWAII PRODUCTS PREFERENCE

In accordance with HRS §103D-1002, the Hawaii products preference is applicable to this solicitation. Hawaii Products [are / may be] available for those items noted on the offer form. The Hawaii products list is available on the SPO webpage at http://hawaii.gov/spo, under Toolbox/QuickLinks click on Goods, Services and Construction, then click on Goods, Services and Construction for Vendors, Contractors and Service Providers, under Preferences, click on Preferences pursuant to HRS 103D Part X including Hawaii Products, then click on Preference for Hawaii Products, and select *Hawaii Products List* to view.

Offeror submitting a Hawaii Product (HP) shall identify the HP on the solicitation offer page(s). Any person desiring a Hawaii product preference shall have the product(s) certified and qualified if not currently on the Hawaii products list, prior to the deadline for receipt of offer(s) specified in the procurement notice and solicitation. The responsibility for certification and qualification shall rest upon the person requesting the preference.

Persons desiring to qualify their product(s) not currently on the Hawaii product list shall complete form SPO-038, *Certification for Hawaii Product Preference* and submit to the Procurement Officer issuing the solicitation (IFB or RFP), and provide all additional information required by the Procurement Officer. For each product, one form shall be completed and submitted (i.e. 3 products should have 3 separate forms completed). Form SPO-038 is available on the SPO webpage at http://spo.hawaii.gov/all-forms/. The manufacturers and producers must complete and submit SPO-38 to DHHL. The form must be received by DHHL no later than the due date and time for the 'Notice of Intention to Bid". Submittal by facsimile (808 620-9299) or E-mail to: Stewart.t.matsunaga@hawaii.gov, is acceptable. If DHHL receives and approves SPO-38s relating to this solicitation DHHL will issue an addendum listing the additional certified and qualified Hawaii products.

Bidders may claim a Hawaii product preference for products that it manufactures or produces with its own workforce and equipment. The SPO-38, *Certification for Hawaii Product Preference*, must be submitted in accordance with the procedures described above in order for Bidder to claim a Hawaii product preference for such Hawaii products Bidder intends to use in this work.

When a solicitation contains both HP and non-HP, then for the purpose of selecting the lowest bid or purchase price only, the price offered for a HP item shall be decreased by subtracting 10% for the class I or 15% for the class II HP items offered, respectively. The lowest total offer, taking the preference into consideration, shall be awarded the contract unless the offer provides for additional award criteria. The contract amount of any contract awarded, however, shall be the amount of the price offered, exclusive of the preferences.

Change in Availability of Hawaii product. In the event of any change that materially alters the offeror's ability to supply Hawaii products, the offeror shall notify the procurement officer in writing no later than five working days from when the offeror knows of the change and the parties shall enter into discussions for the purposes of revising the contract or terminating the contract for convenience.

SCHEDULE OF ACCEPTABLE HAWAII PRODUCTS AND DESIGNATION OF HAWAII PRODUCTS TO BE USED			
ACCEPTABLE HAWAII PRODUCTS		HAWAII PRODUCTS TO BE USED Cost FOB Jobsite, Unloaded Including Applicable General Excise and Use Taxes	
Description	Manufacturer	Base Bid	Additive Alternate
		$_____	$_____
		$_____	$_____
		$_____	$_____
		$_____	$_____
		$_____	$_____
		$_____	$_____
		$_____	$_____
		$_____	$_____
		$_____	$_____
		$_____	$_____

It is further understood by the Bidder that if upon being granted Hawaii Products, and being awarded the contract, if the Bidder fails to use such products or meet the requirements of such preference, the Bidder shall be subject to penalties, if applicable.

APPRENTICESHIP AGREEMENT PREFERENCE

Hawaii Revised Statutes §103-55.6 (ACT 17, SLH 2009) provides for a Hawai'i Apprenticeship Preference for public works contracts having an estimated value of $250,000.00 or more. The preference shall be in the form of a 5% bid adjustment applied to the bidder's amount for bidders that are parties to apprenticeship agreements. The estimated value of this public works contract is $250,000.00 or more and the apprenticeship agreement preference **shall** apply.

To be eligible for the preference, the bidder shall:

1. Be a party to an apprenticeship agreement registered with the DLIR at the time the bid is made for each apprenticeable trade the bidder will employ to construct the public works project for which the bid is being made.

    a. The apprenticeship agreement shall be registered and conform to the requirements of HRS Chapter 372.

    b. Subcontractors do not have to be a party to an apprenticeship agreement for the bidder to obtain the preference.

    c. The bidder is not required to have apprentices in its employ at the time the bid is submitted to qualify for the preference.

    d. If a bidder's employee is multi-skilled and able to perform work in more than one trade (for example, a project requires a carpenter and a laborer, and the employee is a carpenter, but is also able to perform the work of a laborer), the bidder need only be a party to the carpenter's apprenticeship agreement and does not need to be a party to the laborer's apprenticeship agreement in order to qualify for the preference. The bidder is not "employing" a laborer, only a carpenter, and so only needs to be a party to the carpenter's apprenticeship agreement.

    e. Qualification for the preference is given on a project-by-project basis and depends upon the specific offer for a specific project. A bidder's employees may vary from project to project and may qualify for the preference on one project but may not qualify on another project. For example, on one project, if the bidder only employs carpenters to perform work in the carpentry and labor trades, then the bidder only needs to be a party to the carpenter's apprenticeship agreement in order to qualify for the preference. However, on another project if the same bidder employs both carpenters and laborers, then the bidder will not qualify for the preference if the bidder is only a party to the carpenter's apprenticeship agreement and not the laborer's apprenticeship agreement.

2. State the trades the bidder will employ to perform the work;

3. For each trade to be employed to perform the work, the bidder shall submit a completed signed original *CERTIFICATION OF BIDDER'S PARTICIPATION IN APPROVED*

APPRENTICESHIP PROGRAM UNDER ACT 17 (*Certification Form 1)* verifying the participation in an apprenticeship program registered with the State Department of Labor and Industrial Relations (DLIR);

4. The *Certification Form 1* shall be authorized by an apprenticeship sponsor of the DLIR list of registered apprenticeship programs. The authorization shall be an original signature by an authorized official of the apprenticeship sponsor; and

5. The completed *Certification Form 1* for each trade must be submitted by the bidder with the offer. A facsimile or copy is acceptable to be submitted with the offer; however, the completed **signed original** must be submitted within five (5) working days of the due date of the offer. If the signed original is not received within this timeframe, the preference may be denied. Previous certifications shall not apply.

Failure to comply with ALL of the conditions noted above, without exception, shall disqualify the Bidder from qualifying for, and thus receiving, benefit of the Hawai‘i Apprenticeship Preference.

The *Certification Form 1* and the List of Construction Trades in Registered Apprenticeship Programs is available on the DLIR website at: http://labor.hawaii.gov/wdd/.

Upon receiving *Certification Form 1*, the DHHL will verify with DLIR that the apprenticeship program is on the list of apprenticeship programs registered with the DLIR. If the program(s) are not confirmed by the DLIR, the bidder will not qualify for the preference.

If the bidder is certified to participate in an apprenticeship program for each trade which will be employed by the bidder for the project, a preference will be applied to decrease the bidder's total bid amount by five per cent (5%) for evaluation purposes.

Should the bidder qualify for other preferences (for example, Hawaii Products Preference), all applicable preferences shall be applied to the bid amount.

While preference for Hawai‘i Apprenticeship will be taken into consideration to determine the low bidder, the contract awarded shall be the original bid amount, exclusive of any preferences. The preference is only for evaluation purposes.

The bidder hereby certifies that it will employ the following apprenticeable trades to perform the work for this project:

LIST OF APPRENTICEABLE TRADES TO BE EMPLOYED	
TRADE	APPRENTICESHIP PROGRAM SPONSOR

(Add additional sheets if necessary)

ALL JOINT CONTRACTORS OR SUBCONTRACTORS TO BE ENGAGED ON THIS PROJECT

The Bidder certifies that the following is a complete listing of all joint Contractors or Subcontractors covered under Chapter 444, Hawaii Revised Statutes, who will be engaged by the Bidder on this project to perform the nature and scope of work indicated pursuant to Section 103D-302, Hawaii Revised Statutes, and understands that failure to comply with this requirement shall be just cause for rejection of the bid.

The Bidder further understands that only those joint Contractors or Subcontractors listed shall be allowed to perform work on this project and that all other work necessary shall be performed by the Bidder with his own employees. If no joint Contractor or Subcontractor is listed, it shall be construed that all of the work shall be performed by the Bidder with his own employees.

The Bidders must be sure that they possess and that the Subcontractors listed in the bid possess all the necessary licenses needed to perform the work for this project. The bidder shall be solely responsible for assuring that all the specialty licenses required to perform the work are covered in his bid.

The Bidder shall include the license number of the joint Contractors or Subcontractors listed below. Failure to provide the correct names and license numbers as registered with the Contractor's Licensing Board may cause rejection of the bid submitted.

Complete Firm Name of Joint Contractor or Subcontractor	License Number	Hawaii Tax ID Number	Nature and Scope of Work to be Performed

(Add additional sheets if necessary)

METHOD OF AWARD

Bidder is required to bid on the entire project. The low bidder shall be determined by the procedures outlined in items 1) through 4) below:

1) Prior to opening of bids, the State will determine the amount of funds available for the project. This amount will be designated the "control amount". The control amount shall be announced at, and prior to the opening of bids.

2) The Base Bid and Alternate, if any, of each Bidder will be adjusted to reflect the applicable preferences in accordance with Chapter 103D, HRS. The Alternate, if any, will then be added to the Base Bid and compared with the control amount.

3) The low bidder shall be the Bidder having the lowest aggregate amount, within the control amount (after application of the various preferences), for the Base Bid plus the Alternate, if any.

4) If adding the Alternate, if any, would make the aggregate amount exceed the control amount for all Bidders, the low bidder shall be the Bidder having the lowest Base Bid after application of the various preferences.

It is further understood and agreed that:

1) The Chairman reserves the right to reject any and/or all bids and waive any defects when, in his opinion, such rejection or waiver will be in the best interest of the State.

2) After determining the low bidder, an award may be made either on the amount of the Base Bid alone, or including the Alternate (exclusive of preferences), if:

   a. It is in the best interest of the State;

   b. Funds are available at time of the award; and

   c. The combination of the Base Bid plus Alternate does not change the apparent low bidder.

3) In the event the Base Bid for all Bidders exceed the control amount, the Chairman reserves the right to negotiate with the lowest responsible and responsive bidder to award a contract within available funds.

4) In the event the award is made for the Base Bid alone, the Chairman reserves the right to amend the contract at a later date to include the Alternate should funds subsequently become available.

OTHER CONDITIONS

1) The liquidated damages per working day for failure to complete the work on time have been determined and are noted in the Special Conditions of the sample contract.

2) By submitting this bid, the undersigned is declaring that his firm has not been assisted or represented on this matter by an individual who has, in a State capacity, been involved in the subject matter of this contract in the past one (1) year.

3) By submitting this bid, the undersigned is declaring that Bidder's own organization will perform at least 20% of the contractor's work. For the purposes of this section, the Contractor's work is defined as: direct cost labor for contractor's forces; direct cost materials installed by the contractor's direct cost labor force; direct cost equipment, either owned or leased, used by the contractor's direct cost labor force; and field overhead cost to include: field supervision, field office trailer (if any), field office equipment and supplies, etc.

4) Upon the acceptance of the bid by the Chairman, the undersigned must enter into and execute a contract for the same and furnish a Performance and Payment Bond, as required by law. These bonds shall conform to the provisions of Sections 103D-324 and 325, Hawaii Revised Statutes, and any law applicable thereto.

5) The quantities given herewith are approximate only and are subject to increase or decrease.

6) The estimated quantities shown for items for which a UNIT PRICE is asked in this bid are only for the purpose of comparing on a uniform basis bids offered for the work under this contract. No claim shall be filed for anticipated profit or loss because of any difference between the quantities of the various classes of work done or the materials and equipment actually installed and the said estimated quantities. Payment on UNIT PRICE items will be made only for the actual number of units incorporated into the finished project at the contract UNIT PRICE.

7) If the product of the UNIT PRICE BID and the number of units does not equal the total amount stated by the undersigned in the Bid for any item, it will be assumed that the error was made in computing the total amount. For the purpose of determining the lowest Bidder, the stated UNIT PRICE alone will be considered as representing the Bidder's intention and the total amount bid on such items shall be considered to be the amount arrived at by multiplying the UNIT PRICE by the number of units.

8) Certification for Safety and Health Programs for Bids in Excess of $100,000. In accordance with Sections 103D-327 and 396-18, Hawaii Revised Statutes, by submitting this bid, the undersigned certifies that his firm will have a written Safety and Health Plan for this project that will be available and implemented by the Notice to Proceed date of this project. Details of the requirements of this plan may be obtained from the Department of Labor and Industrial Relations, Occupational, Safety and Health Division.

9) Any contract arising out of this offer is subject to the approval of the Department of the Attorney General as to form, and to all further approvals, including the approval of the Governor, required by statute, regulation, rule, order, or other directive.

[REMAINDER OF THIS PAGE INTENTIONALLY LEFT BLANK]

Receipt of the following addenda issued by the Department is acknowledged by the date(s) of receipt indicated below:

	Date		Date
Addendum No. 1	_____	Addendum No. 5	_____
Addendum No. 2	_____	Addendum No. 6	_____
Addendum No. 3	_____	Addendum No. 7	_____
Addendum No. 4	_____	Addendum No. 8	_____

It is understood that failure to receive any such addendum shall not relieve the Contractor from any obligation under this IFB as submitted.

Bid Security in the amount of:_____

_____ DOLLARS ($_____)

as required by law, is enclosed herewith in the form of:

(____) Surety Bond (*1)
(____) Legal Tender (*2)
(____) Cashier's Check (*3)
(____) Certificate of Deposit (*3)
(____) Certified Check (*3)
(____) Official Check (*3)
(____) Share Certificate (*3)
(____) Teller's Check (*3)
(____) Treasurer's Check (*3)

Respectfully submitted,

_____
Name of Company, Joint Venture or Partnership

_____
License No.

By_____
Signature (*4)

Title:_____

Date:_____

Address:_____

_____

Telephone No.:_____

(IF A CORPORATION, AFFIX CORPORATE SEAL TO SIGNATURE, BE SURE TO FILL IN ATTACHED LIST OF SUBCONTRACTORS. THIS BID FORM MAY NOT BE ALTERED AND BIDDERS MAY NOT QUALIFY OR CONDITION THEIR BIDS IN ANY WAY.)

PLEASE FILL OUT THE ATTACHED CERTIFICATE OF RESOLUTION GIVING EVIDENCE OF THE AUTHORITY OF THIS OFFICER TO SUBMIT BIDS ON BEHALF OF THE COMPANY.

NOTES:

*1. Surety bond underwritten by a company licensed to issue bonds in this State;

*2. Legal tender; or

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

A. These instruments may be utilized 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 accepted.

*4. Please attach to this page evidence of the authority of this officer to submit bids on behalf of the Company, and also the names and residence addresses of all officers of the Company.

*5. Fill in all blank spaces with information asked for or bid may be invalidated. <u>BID MUST BE INTACT; MISSING PAGES MAY INVALIDATE YOUR BID.</u>

CERTIFICATE OF RESOLUTION

I, _____, Secretary of _____, a Hawaii Corporation, do hereby certify that the following is a full, true and correct copy of a resolution duly adopted by the Board of Directors of said Corporation, at its meeting duly called and held at the office of the Corporation _____, Hawaii, on _____ day of _____, 20___, at which a quorum was present and acting throughout; and that said resolution has not been modified, amended or rescinded and continues in full force and effect.

> "RESOLVED that any individual at the time holding the position(s) of _____, be, and each of them hereby is, authorized to execute on behalf of the Corporation any bid, proposal or contract for the sale or rental of the products of the Corporation or for the services to be performed by the Corporation and to execute any bond required by any such bid, proposal or contract with the United States Government or the State of Hawaii or the City and County of Honolulu, or any County of Municipal Government of said State, or any department or subdivision of any of them."

IN WITNESS THEREOF, I have hereunto set my hand and affixed the corporate seal of said

_____ this ____ day of _____, 20____.

_____
Secretary

END OF BID

SECTION 33 01 98
SLIP LINING OF OUTLET PIPE

PART 1 GENERAL

1.1 SUMMARY

This section of the specifications consists of the requirements and work needed to rehabilitate an existing pipe in a dam system using the slip lining method by providing pipe liner, bulkheads, annular space grouting between the host and slip liner, performance testing as stated herein and providing all labor, materials and equipment necessary to accomplish the work as stated herein. In all instances, rehabilitation shall include installation of liner pipe within an existing host pipe with a continuously grouted annular space. The size, type, and dimensions of the pipe liner shall be selected by the Contractor and submitted for approval and shall include all connections, joints, and other appurtenances as required to complete the work. However, in no case shall the inside diameter be less than 16 inches.

1.2 MEASUREMENT AND PAYMENT

Payment will be made for work performed under this item in accordance with the pipe slip lined as shown in the bid schedule. Payment includes all costs associated with labor, equipment, material, supervision, cleaning, inspection, sheeting, installation, safety, dust/erosion control, testing, site restoration and all other work specified or not which is reasonably required to provide a completed installation. Any item not specified shall be considered incidental to the work. Include all incidental cost in the bid price for the slip liner.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C138/C138M	(2014) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C403/C403M	(2008) Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C495/C495M	(2012) Standard Test Method for Compressive Strength of Lightweight Insulating Concrete
ASTM C497	(2014) Concrete Pipe, Manhole Sections, or Tile
ASTM C581	(2003; E 2008; R 2008) Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures, Intended for Liquid Service
ASTM C939	(2010) Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C942	(2010) Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory

ASTM D2412	(2011) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D3212	(2007; R 2013) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3262	(2011) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D3350	(2012) Polyethylene Plastics Pipe and Fittings Materials
ASTM D3681	(2012; E 2014) Standard Test Method for Chemical Resistance of “Fiberglass” (Glass–Fiber–Reinforced Thermosetting-Resin) Pipe in a Deflected Condition
ASTM D3839	(2014) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D4161	(2014) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F1697	(2009) Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for Machine Spiral-Wound Liner Pipe Rehabilitation of Existing Sewers and Conduit
ASTM F1741	(2008) Standard Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride) (PVC) Liner Pipe for Rehabilitation of Existing Sewers and Conduits
ASTM F2620	(2013) Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F585	(2013) Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers

1.4 ADMINISTRATIVE REQUIREMENTS

1.4.1 Pre-Installation Conference

At the preconstruction meeting discuss the scope-validation, including potential Sub-Contractors to facilitate common agreement and understanding of the work to be performed. At this time, the qualifications of Sub-Contractors, project superintendent or project manager shall be supplied to the Contracting Officer.

1.4.2 Detailed Work Plan

Submit a Detailed Work Plan not less than 30 days prior to commencement of work. The plan shall include but is not limited to the following:

a. Proposed construction sequencing and scheduling

b. Plan for removal of any obstructions encountered

c. Detail Drawings in an approved form, for slip lining system including pipe manufacturer's instructions for installation

d. List of proposed products showing new diameter of slip lining pipe to be installed along with existing pipe diameter

e. Specify all mandrel dimensions, including length, for each pipe to be slip lined

f. Areas requiring special construction techniques

g. Proposed methods for flow control or by-pass to divert excessive flow away from a section of pipe if the need arises during the slip lining process

h. Joints, gaskets, proposed Resins, Coatings, and other pertinent information as applicable

i. Dates of excavation and pipe placement, along with proposed work hours

j. Method for preventing damage to the host and liner pipe using guide rails, pipe invert paving, or other applicable methods when the invert of the host pipe has deteriorated significantly

k. Method for waste grout recovery

l. Detailed plan for dealing with buoyant uplift of the liner pipe during grouting

m. Manufacturer's recommendation regarding methods for repair of damage to liner pipe following installation

n. List of proposed subcontractors

o. Written confirmation that the grouting procedures has been coordinated with the grout installer and the liner pipe manufacturer.

1.4.3 Sequencing and Scheduling

Submit plan for final approval of Construction Progress Schedule prior to commencing construction. Provide 72 hour notice to Contracting Officer prior to placing liner pipe. Do not proceed with slip lining operations for pipe that are likely to reach gauge operation elevation within 5 days as forecast by the National Weather Service. lay out the sequencing of work to minimize work stoppages as a result of high water. Additionally after liner pipe has been placed, make all reasonable attempts to grout the annulus prior to partial or total submergence of the pipe. In the event in which high water submerges a portion of a lined pipe prior to annular grouting, clean out the annular space using high pressure water jetting prior to grouting.

1.5 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor Qualifications;
Grout Contractor Qualifications;
Pipe Inspection Procedures;
Construction Progress Schedule;
CCTV Recordings and Report Logs;
Digital Photographs and Report Logs;
Detailed Work Plan;

Analysis and Calculations;

SD-02 Shop Drawings

Bulkheads;

SD-03 Product Data

Liner Pipe;

Soluble Reactive Silicate Concrete Treatment Product;

UV Protective End Treatment;

SD-05 Design Data

Conveyance Capacity;

Structural Properties;

SD-06 Test Reports

Grout Trial Mix Tests

SD-10 Operation and Maintenance Data

Maintenance;

SD-11 Closeout Submittals

Manufacturer's Warranty;

Post-Installation CCTV Recordings and Report Logs;

Post-Installation Digital Photographs and Report Logs;

1.6 QUALITY ASSURANCE

1.6.1 Qualifications and Supervision

Submit Contractor Qualifications for slip lining piping, documenting their engagement in the successful installation of similar slip lining systems for at least 3 years. Provide an experienced superintendent with experience in installation of similar slip lining systems. The superintendent shall be on site at all times and shall have full authority to direct the means, methods, equipment and personnel and performance of the work.

1.6.2 Grout Contractor Qualifications

Submit Grout Contractor Qualifications in letter form from the foam manufacturer stating that they are an approved applicator for that product, as well as the grout mix design, and test break results for that particular design. Reference paragraph GROUT MATERIALS AND MIXES for grout mix design requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

Prevent injury or abrasion to liner pipe during loading, transportation, and unloading. Do not drop pipe from cars or trucks, nor allow pipe to roll down skids without proper restraining ropes. Use suitable pads, strips, skids, or

blocks for each pipe during transportation and while awaiting installation in the field. Liner pipe shall be moved by machinery in a controlled manner. Do not allow liner pipe to roll down the dam embankment at any time. Handle and store in accordance with the manufacturer's published recommendations.

Remove slip liner pipe with cuts, gashes, nicks, abrasions, or any such physical damage which is deeper than 10 percent of the wall thickness from the site and replace with undamaged pipe at no additional cost to the Government.

1.8 WARRANTY

Submit 1 copies of the signed Manufacturer's Warranty for all products at final completion of the work.

PART 2 MATERIALS

2.1 DESIGN REQUIREMENTS

2.1.1 Conveyance Capacity

Provide slip lining pipe designed to allow the maximum conveyance capacity possible, but in no case provide less capacity than a 16" pipe while maintaining a 1-inch minimum average annular space between the host pipe and liner pipe for grouting. In some cases capacity can be increased by improvement of entrance conditions and any such improvements must be submitted. Submit calculations that demonstrate how capacity is determined for the liner pipe. If there are circumstances which prohibit supplying a slip lining system that provides at least the current conveyance capacity for the pipe to be slip lined, notify the Contracting Officer to determine an appropriate course of action.

2.1.2 Design Criteria

The slip liner pipe system shall be designed by a licensed professional engineer to meet the standards outlined in the following sub-paragraphs. Submit calculations of the system's structural properties prior to construction. Support all assumptions utilized in calculations with product data, test reports, or referenced publications.

a. Design the new slip liner pipe system using the fully flood-loaded levee elevation to establish external hydrostatic pressure.

b. Design the new slip liner pipe system for maximum 5 percent ovality and a maximum allowable long term deflection of 5 percent.

c. Design the new slip liner pipe system using a safety factor of 2.5 for buckling and 2.0 for bending, wall crushing and buoyancy. Analysis for buckling shall be two-fold: to check for buckling from the grouting pressure of the liner pipe; and to check for buckling from external pressure of the underground water table. Ignore the cross-sectional shape distortion of the host pipe in the buckling analysis.

2.1.3 Analysis and Calculations

Submit detailed analysis and calculations, stamped by a licensed P.E., not less than 30 days prior to commencement of work. Demonstrate suitable application of products based on the following parameters:

a. Deflection

b. Confined buckling (for both Grouting case and the Flood Load case)

c. Long-term (50-year) hydrostatic buckling

d. Calculations verifying conveyance capacity and velocity of outlet flow meet the requirements as stated herein

e. Design Calculations showing that the proposed pipe satisfies the current design criteria neglecting any contribution of the host pipe

f. Bulkhead designs and locations including vent and injection port location and proposed materials to be used in bulkhead construction

g. Buoyant force calculations during grouting

h. Grout mix designs per the requirements stated herein

i. Initial set time of grout

j. Estimated grout volume for each pipe

k. The maximum grout injection pressures proposed as well as maximum allowable grout injection pressures as provided by the pipe manufacturer

l. Proposed grout stage volumes

2.2 LINER PIPE

Provide pipe constructed of corrosion resistant, thermoplastic, or thermosetting resin. Suitable pipe lining materials include solid wall High Density Polyethylene Pipe (HDPE), Machine Spiral Wound Poly Vinyl Chloride (PVC) Pipe, and Glass Fiber-Reinforced Plastic Pipe. Secure written product approval from the Contracting Officer before commencing any work.

a. Select liner pipe material to ensure that thermal expansion or contraction does not exceed a total of 0.5 inches for the length of the pipe throughout the range of ambient air temperatures anticipated during the service life of the liner pipe. Assume ambient air temperatures for this item to range from 60 degrees F to 95 degrees F.

b. Submit manufacturer's detailed product data with complete information on liner pipe materials (pipes, joints, gaskets, fittings, entrance bells), physical properties, dimensions, installation minimum/maximum allowable parameters such as maximum recommended external grout pressure, axial compressive stress, minimum bending radius or maximum joint angular deflection, etc. Include a manufacturer's certificate of compliance with specifications for proposed materials.

c. Pipe liner materials other than those stated below may be submitted for consideration and approval by the Contracting Officer based on meeting the design requirements as stated herein.

2.2.1 PVC Pipe (Machine Spiral Wound)

2.2.1.1 Profile Strip

Provide extruded PVC profile strip in accordance with the requirements of ASTM F1697 except as noted below.

a. Contrary to ASTM F1697, composite profile strip comprised of extruded PVC and a ferrous element necessary to provide long-term structural strength of the pipe is prohibited.

b. All profile strips shall be specifically applicable for installation and use in the project environment.

2.2.1.2 Joints

Joints shall meet the requirements of ASTM D3212, and gaskets meeting the requirements of ASTM F477.

a. The joint shall consist of a single, mechanical interlock between profile strips supplemented with sealant and is created continuously as the profile is wound into the pipe.

b. Once wound into place within the host pipe, joints shall be considered completed and the pipe shall not be intentionally or otherwise expanded or permitted to translate in any direction at the joint.

c. The completed liner pipe shall be provided such that neither the outside diameter of the pipe is increased nor the internal diameter of the pipe is decreased at the joint.

d. Joints shall be water-tight over the range of head pressure expected for the pipe.

2.2.2 Solid-Wall High Density Polyethylene Pipe (HDPE)

2.2.2.1 Pipe

a. Pipe and pipe fittings shall be manufactured from high density compounds in accordance with ASTM D3350, cell classification 345464C with a designation of PE 3408 and a minimum Standard Dimension Ratio (SDR) of 32.5.

b. Pipe shall be solid wall with a smooth interior and exterior with no corrugations or ferrous elements.

c. Each pipe segment shall be marked on the inside and outside with a coded number which identifies the manufacturer, SDR, size, materials, machine, date and shift on which the pipe was extruded.

d. Pipe shall be specifically applicable for installation and use in the project environment.

2.2.2.2 Joints

a. Joints shall be water-tight over the range of head pressure expected for the pipe.

b. Joints shall be butt-fused in accordance with ASTM F2620 and the manufacturer's recommendations or shall be capable of being joined into a continuous length by an interlocking method such that joints meet the requirements of ASTM D3212. Screw-type or threaded joints will not be allowed unless a positive lock is included in the joint system or the perimeter of the joint is extrusion welded at the bearing assembly, prior to insertion.

c. Internal beads resulting from butt fusion shall be limited to a 0.25 inch projection perpendicular to the inside wall of the pipe. Trim beads larger than 0.25 inch 360 degrees around the interior of the pipe. External beads resulting from butt fusion need not be trimmed unless the bead projection will negatively impact pipe installation or migration of annulus grout.

2.2.3 Glass Fiber-Reinforced Plastic Pipe

2.2.3.1 Pipe

Provide centrifugally cast fiberglass reinforcement plastic mortar pipe (CCFRMP) in accordance with ASTM D3262, cell classification Type 1, Liner 2, Grade 3. All pipes shall be specifically applicable for installation and use in the project environment.

a. Minimum pipe stiffness shall be 18 psi when tested in accordance with ASTM D2412.

b. The glass shall be a commercial grade of E-type glass fibers with the amount, location and orientation of the chopped glass-fiber reinforcement specifically designed for each application.

c. Sand shall be minimum 98 percent silica kiln-dried and graded.

d. The polyester wall resin shall be an isophthalic, orthophthalic or other approved resin with a minimum tensile elongation of 2 percent.

e. Fiberglass liner shall be shown by tests to be resistant to long-term corrosion. Testing shall be performed in accordance with ASTM D3681 using 1.0N sulfuric acid for sanitary sewage, and ASTM C581 for industrial sewage.

f. Each pipe segment shall be marked on the inside and outside to identify the manufacturer's number, diameter, stiffness, ASTM designation and lot number.

2.2.3.2 Joints

a. Provide pipe with joints designed so that neither the outside diameter of the pipe is increased nor the internal diameter of the pipe is decreased at the joint.

b. Joints shall be water-tight over the range of head pressure expected for the pipe.

c. Joints shall meet the performance requirements of ASTM D4161. Field conntect pipe with low-profile, fiberglass bell-spigot joints or flush fiberglass bell-spigot joints, when the fit requires. Utilize elastomeric sealing gaskets as the sole means to maintain joint water-tightness. Gaskets shall meet the requirements of ASTM F477. Joints at tie-ins, when needed, may utilize gasket-sealed closure couplings.

2.2.4 UV Protective End Treatment

All slip liner pipes constructed of materials that are not UV stabilized (i.e. fiberglass pipe) that terminate at an open end or headwall shall receive a factory-applied coating on the interior surface of the pipe to resist deterioration from ultraviolet radiation. The UV protective coating shall be applied for a distance inside the pipe equal to two times the inside diameter of the liner pipe. In the event that field cutting is necessary, no additional coating will be required for the cut end.

a. Coating color shall be light gray or similar shade subject to approval by the Contracting Officer.

b. Nicks, scratches and minor abrasions to the coating shall be touched up in the field following final installation.

2.3 GROUT MATERIALS AND MIXES

2.3.1 Grout for Annular Space

Provide grout for the annular space in accordance with this Specification and with the manufacturer's published recommendations. The grout shall be nonstructural or structural based upon the type of slip liner system provided. If the pipe liner provided cannot meet the stated requirements for factor of safety against buckling or crushing, then a structural grout must be used regardless of the pipe liner system used in order to fulfill the factor of safety requirements as stated herein.

2.3.2 Grout Mix for Annulus Grouting

2.3.2.1 Cement

Comply with ASTM C150/C150M.

2.3.2.2 Water

Use only potable water to prepare grout.

2.3.2.3 Admixtures

Select admixtures to meet performance requirements, improve pump ability, control set time and reduce segregation. Admixtures shall not be biodegradable.

2.3.2.4 Compressive Strength

2.3.2.4.1 Structural Grout

The grout 28-day compressive strength shall be that determined during the design and submitted for approval. Test 28-day compressive strength in accordance with ASTM C942.

2.3.2.4.2 Nonstructural Grout

The grout shall have a minimum penetration resistance of 100 psi in 24 hours when tested in accordance with ASTM C403/C403M and a minimum compressive strength of 350 psi in 28 days when tested in accordance with ASTM C495/C495M.

2.3.2.5 Mix Design

Design a grout mix and installation procedure to completely fill the annular space based upon, but not restricted to the list below (a. - g.), such that the slip liner pipe will not float (either by external restraint or internal weighting). The grout shall maintain an appropriate viscosity as tested in accordance with ASTM C939. Verify the density in conformance with ASTM C138/C138M or by other methods as approved by the Contracting Officer.

a. Size of annular void

b. Absence or presence of water

c. Sufficient strength and durability to achieve the design requirements as stated herein

d. Provide adequate retardation for placement

e. Provide less than 1 percent shrinkage by volume

f. Distance between grout injection ports

g. Heat of hydration compatible with pipe material in accordance with pipe manufacturer's recommendation

2.3.2.6 Mixers and Pumps

Mix the materials in equipment of sufficient size and capacity to provide the desired amount of grout material for each stage of the grouting operation. The system shall mix the grout to a homogeneous consistency and deliver grout to the injection point under a normal range of operating conditions. The equipment shall be capable of mixing the grout at densities required for the approved procedures and shall also be capable of changing mixing parameters as dictated by field conditions at any time during the grouting operation.

2.3.2.7 Pressure Gauges

a. Pressure gauges shall be suitable for use in the grouting environment and have a working range between 1.5 to 2.0 times the design grout pressures, and have accuracy within 0.5 percent of full range.

b. Provide, at a minimum, one pressure gauge at the point of injection and one pressure gauge at the grout pump.

2.3.3 Grout Trial Mix Tests

Non-structural Grout: Provide Grout Trial Mix Test Results with viscosity, density, 24-hour penetration resistance set time, and 28-day minimum compressive strength. Also provide the grout working time before a 15 percent change in density or viscosity occurs.

2.3.4 Bulkhead Concrete

Design a low slump concrete mix to form a bulkhead at each end of the pipe to retain the annular grout. Low slump concrete shall consist of cement, fine and coarse aggregate, water, and an air-entraining admixture. Concrete shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc. Forms may be used to confine the concrete. The temperature of the in situ concrete (i.e., headwall or gatewell structure), adjacent air, and bulkhead concrete shall be above 40 degrees F during placement.

PART 3 EXECUTION

3.1 PREPARATION AND INSPECTION

The Contracting Officer makes no guarantee regarding the information, data, and physical condition of underground facilities or existing pipe. Before commencing with any work, or ordering any materials, physically measure the length and diameter and inspect the existing pipe designated to receive a pipe liner to verify that the rehabilitation plan is appropriate. Inspect small or unsafe pipes using CCTV. Submit pipe inspection procedures to locate breaks, obstacles and connections in pre-construction submittals for approval. Note all connections and any conditions which may prevent proper installation of the liner. Correct these conditions prior to liner installation. Submit the CCTV Recordings and Report Logs and/or Digital Photographs and Report Logs prior to pipe liner installation. Base the work plan on a thorough review of the inspection video and/or digital photographs and report logs.

3.1.1 Safety

Note any areas that may involve entry and/or work in confined spaces and address in the project Health and Safety Plan.

3.1.2 Control of Flow

Provide for maintenance and control of flow as necessary for effective inspection and satisfactory installation of the slip liner and grout. Such work shall include by-pass pumping or berming and dewatering for submerged pipes. Submit proposed means and methods for control of flow with the pipe inspection procedures.

3.1.3 Bypass Pumping

If required, provide for continuous bypass flow around the section or sections of pipe designated for the liner process. Provide pump and bypass lines of adequate capacity to handle the necessary flow.

3.1.4 Pre-Lining Cleaning

Prior to the CCTV inspection and installation of the slip liner pipe, thoroughly clean the host pipe designated to receive the liner. Cleaning shall constitute removal of all debris, solids, roots, deposits, and other matter which would preclude proper installation of the slip liner pipe and annulus grout. Perform cleaning such that no damage occurs to the host pipe. Handle water used for flushing and cleaning the pipe prior to slip liner system installation to comply with regulatory agencies having jurisdiction regarding erosion prevention and sediment control procedures for storm water discharge.

3.1.5 Insertion and Pulling of Mandrel

Prior to commencing any work, pull a mandrel through all host pipes too small or unsafe to enter in order to check for deformation, joint deflection or obstructions prior to ordering any pipe liner materials. Host pipes large enough and safe to enter may be verified through man-entry, mandrel or both at the Contractor's discretion.

a. The mandrel length of liner pipe shall be equal to the liner pipe joint length.

b. The mandrel shall have an outside diameter not less than that of the proposed slip liner pipe plus 2-inches, shall be equal to the pipe joint length of the liner pipe to be installed and shall have a stiffness equal to or greater than that of the slip liner pipe. When a segment of slip liner pipe is used as a mandrel, it shall not be used as a permanent slip liner pipe.

3.2 EXCAVATION

Perform work utilizing existing points of entry including headwalls, manholes, etc. Excavation along the length of the host pipe (between headwalls/manholes) is strictly prohibited. In the event that it becomes necessary to perform an excavation, obtain written confirmation that an excavation is warranted from the Contracting Officer. If an excavation is required, excavations shall be minimal and comply with local, State, and Federal regulations. Repair any excavation of dam material according to Section 31 00 00 EARTHWORK regarding acceptable fill material, benching and compaction requirements.

3.3 INSTALLATION

3.3.1 General

a. Restore project site to original condition prior to final payment. Include the cost to repair all damages resulting from the work in the base bid.

b. Point repairs, deemed necessary at any point on the existing pipeline prior to slip lining shall be approved by the Contracting Officer prior to start of work, require locating the insertion pit at the point repair location.

d. In all instances, the liner pipe shall be a fixed diameter and shall not be expanded intentionally or otherwise.

e. Maximum and minimum lay lengths shall be in accordance with manufacturer's requirements and any constraints based on work limits.

f. Insertion may proceed from either upstream or downstream as suitable access is available.

g. Use sub-aqueous pipe lubricant meeting the specifications of ASTM C497 Section 12 in accordance with pipe manufacturer's installation instructions. Use only lubricants approved by the pipe manufacturer.

h. Use caution to prevent jagged edges from damaging the slip liner pipe during insertion when the invert of host pipe has deteriorated significantly. In such cases, describe in the work plan how damage to the host and liner pipe will be prevented using guide rails, pipe invert paving, or other applicable methods.

i. Consider thermal expansion/contraction effects such that the ends of the slip liner pipe are flush with the existing headwall/manhole to within 0.5 inch. Where a slip liner pipe meets a gatewell or flapgate, the slip liner pipe cannot project beyond the end of the host pipe. Reasonable attempts shall be made to achieve a flush surface between the slip liner pipe and the host pipe. Delay trimming of the liner pipe for 28 days after completion of grouting.

j. Take necessary precautions to maintain line and grade of the host pipe and avoid flotation of the liner pipe. Construct all blocking, if used, of inert, non-ferrous material, and install in accordance with manufacturer's recommendations.

k. Drilling holes in the slip liner pipe for any reason is prohibited.

l. Prior to grouting, visually inspect all slip liner pipe joints to check the integrity of joints and verify that the liner has not been damaged during installation. Repair if needed using liner manufacturer's recommended procedure.

m. Sealing at manholes, if applicable: A tight seal is required at manholes, openings, or abutments with no annular gaps. Rebuild manholes between linear ends resulting in a smooth, continuous flow line through the manhole.

n. At the completion of construction the exposed ends of the slip lined pipe shall have a clean, finished look with no visible signs of grout vents, injection tubes, etc.

3.3.2 Machine Spiral Wound PVC Pipe

a. Install machine Spiral Wound PVC Liner Pipe in accordance with ASTM F1741, manufacturer's recommendations and the provisions of this Section. In the event of a conflict, the most restrictive of the three shall govern.

b. No mechanical pulling or pushing force (such as backhoe bucket or winch cable) shall be exerted on the ends of the pipe during installation.

c. In all instances, the liner pipe shall be a fixed diameter and shall not be expanded intentionally or otherwise.

3.3.3 Solid-Wall High Density Polyethylene Pipe (HDPE)

a. Install Solid-Wall High Density Polyethylene (HDPE) Liner Pipe in accordance with ASTM F585, manufacturer's recommendations and the provisions of this Section. In the event of a conflict, the most restrictive of the three shall govern.

b. Allow the installed pipe to relax and cool following installation in accordance with manufacturer's recommended time, but not less than 24 hours, prior to any reconnection of lines, grouting of the annulus, or backfilling of the insertion pit. Staged grouting is essential, especially for larger diameter pipes, in order to keep thermal expansion low and to prevent a reduction in the pipe diameter.

c. The slip liner pipe shall be free of foreign inclusions and visible defects such as cracks, creases, unpigmented or nonuniformly pigmented pipe. Cut the ends of the pipe squarely and cleanly so as not to adversely affect joining or connecting. Field cuts shall be de-burred and free of defects.

d. Sections of slip liner pipe shall be joined and inserted into the host pipe until a continuous liner pipe is created along the entire length of the host pipe, in accordance with pipe manufacturer's recommendations.

3.3.4 Glass Fiber-Reinforced Plastic Pipe

Install Glass Fiber-Reinforced Plastic Liner Pipe in accordance with ASTM D3839, manufacturer's recommendations and the provisions of this Section. In the event of a conflict, the most restrictive of the three shall govern.

3.3.5 Bulkheads for Annulus Grouting

a. Once the slip liner pipe has been installed; construct bulkheads in sequence from upstream to downstream at the end of each pipe segment; including gatewells and manholes located intermediately along the pipe length to be slip lined. The bulkhead shall have a minimum length measured along the long axis of the pipe of 1 foot,

or the thickness of the headwall, whichever is greater. The lengths of grouting ports shall be staggered such that the entire run of the pipe can be completely grouted.

b. Shop drawings shall include all locations of the grout/air ports and sketches of the proposed bulkheads, as well as the lengths of each grouting port. Shop drawings shall include manufacturer's literature for accessories and form coating materials. Submit the proposed materials, dimensions, location of grout injection ports, vent tubes, etc.

c. Construct bulkheads a minimum of 24 hours after the completion of the slip liner insertion process to allow for thermal equilibrium between the slip liner pipe and the host pipe conditions and at most 72 hours after completion of the slip liner insertion process to minimize the exposure of the annulus to debris from a rainfall event. The annulus shall be cleaned if a local rainfall event or a river flooding event partially or wholly submerges the pipe prior to bulkhead construction.

d. Place vent holes at the crown and the invert in the downstream bulkhead. An access hole, sized to facilitate the method of grout input and an air vent shall be placed at the crown in the upstream bulkhead. The vent holes in the downstream bulkhead are plugged as soon as grout begins to flow out each hole. The air vent in the upstream bulkhead is kept clear until grout begins to flow out of the vent.

e. The bulkheads shall be hand-finished to a professional quality appearance. After a curing period and pressure washing of the headwalls, a Soluble Reactive Silicate Concrete Treatment Product shall be applied over the entire headwall surface, including the bulkheads.

3.3.6 Annulus Grouting

Following construction of the bulkheads, fill annular space with grout between the ID of the host pipe and the OD on the liner pipe.

a. Notify the Contracting Officer at least 24 hours in advance of grouting operations.

b. Grout the pipe from downstream to upstream, unless prohibited by access, along its entire length with cementitious grout. Place the grout by either gravity flow or by low pressure pumping to completely fill all voids within the annular space without causing deformation of the liner. The grout extends the full length of the pipe.

c. Ensure the liner pipe maintains the designed line and grade while the annulus grout is placed in uniform lifts. Place annulus grout in lifts to avoid floating of the liner and to ensure a uniform grout thickness.

d. The gauged grout pressure at the pipe shall not exceed that of the pipe manufacturer's recommendation or 5 psi, whichever is smaller. Regardless of the pressure, the Contractor is solely responsible for any damage or distortion to the slip liner pipe due to grouting.

e. Remove water in annular space immediately prior to grout pumping to maintain the correct water-cement ratio of the grout mixture.

f. Drilling of additional injection holes from the surface or through the liner pipe to facilitate grouting is prohibited.

g. Continue injection of grout until all of the following conditions have been achieved unless otherwise approved by the Contracting Officer:

(1) The estimated volume of grout has been injected, as measured at the pump.

(2) The exhausted grout recovered at each vent is between 85 and 115 percent of the density of the freshly injected grout.

h. No hardened grout is permitted in the liner pipe invert after completion of grouting operations.

3.4 TESTING AND ACCEPTANCE

3.4.1 Rework

Remove any material that has not received prior approval from the Contracting Officer or is not accepted as suitable work by the Contracting Officer and replaced or repaired to the satisfaction of the Contracting Officer with an approved method/material at the Contractor's sole expense. Materials left in place, but not meeting these Specifications, will be paid for at a reduced price.

3.4.2 Grout Testing

3.4.2.1 Density

Conduct field grout density testing on non-structural grout only. Measure density in accordance with ASTM C138/C138M not less than two times per hour in the field during grouting operations. Grout that exceeds ±3 lb./cubic foot of the design density shall be rejected.

3.4.2.2 Compressive Strength

Engage the services of an independent, ASTM/AASHTO accredited testing laboratory to collect and test specimens associated with the strength requirements of this Section.

3.4.2.2.1 Structural Grout

a. Collect, transport, cure, test and report samples in accordance with ASTM C942, except as stated below.

b. Contrary to ASTM C942, collect and test specimens based on the more restrictive of the following criteria:

(1) One specimen (consisting of one, 3-gang mold) for each grouting event for each pipe collected at approximately the mid-point of the grouting operations.

(2) One specimen (consisting of one, 3-gang mold) for each 500 cubic feet of grout placed for each pipe.

c. Test all specimens for compressive strength at 28 days. Additional specimens and tests may be performed at the Contractor's discretion.

3.4.2.2.2 Nonstructural Grout

a. Collect, transport, cure, test and report samples in accordance with ASTM C495/C495M.

b. Collect four specimens (3 inch x 6 inch cylinders) for each pipe at approximately the mid-point of the grouting operation.

c. Test all specimens for compressive strength at 28 days. Additional specimens and tests may be performed at the Contractor's discretion.

d. Tests and companion specimens associated with oven-dry unit weight (ASTM C495/C495M Item 9) are not required.

3.4.3 Acceptance Inspection

After all work is completed, perform an inspection of the pipe that received a pipe liner, documenting the post-installation conditions. For pipes large enough and safe to enter, a walk-through inspection with digital photography is preferred when confined space entry procedures are followed. Small or unsafe pipes shall be inspected using CCTV. Submit the Post-Installation CCTV Recordings and Report Logs and/or Post-Installation Digital Photographs and Report Logs.

a. Infiltration of ground water or annular grout through the liner pipe will be a basis for non-acceptance.

b. All connections shall be accounted for and be unobstructed.

3.4.3.1 Defects

All defects discovered during the post-installation inspection shall be corrected before the work under the Contract will be considered for Substantial Completion. After the defects, if any, are corrected in accordance with manufacturer's recommendations, the affected pipe segments shall be inspected a second time as a follow-up inspection. All follow-up inspections will be performed by the Contractor, and all costs associated with such follow-up inspections associated with the correction of work shall be borne by the Contractor.

3.4.3.2 Final Acceptance

Provide final digital photographs and/or video and report logs to the Contracting Officer for review and approval of finished work for the pipe slip lined prior to receiving final payment.

3.5 MAINTENANCE

Submit manufacturer's recommendations for care and maintenance upon completion of installation.

-- End of Section --

TECHNICAL SPECIFICATIONS
ANAHOLA RESERVOIRS IMPROVEMENT PROJECT

CONTENTS

DEFINITIONS:

Contractor – General Contractor as awarded by the Department of Hawaiian Home Lands
DHHL – State of Hawaii Department of Hawaiian Home Lands
Project Representative – Design Consultant/Engineer with Lyon Associates, Inc.

END OF SECTION

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS

TECHNICAL SPECIFICATIONS
FOR
AHAHOLA RESERVOIRS IMPROVEMENT PROJECT

ANAHOLA, KAUA'I COUNTY, HAWAII

Reservoir Name	State ID No.	TMK
Kealia Field 1	KA-0067	(4) 4-7-002:004
Kealia Field 2	KA-0064	(4) 4-7-002:004
Upper Anahola	KA-0065	(4) 4-7-004:002
Lower Anahola	KA-0066	(4) 4-7-004:002

IFB NO.: IFB -16- HHL -003

March 16, 2016

Engineer:
LYON ASSOCIATES, INC.
45 North King St., Suite 501, Honolulu, HI 96817 USA

TECHNICAL SPECIFICATIONS
ANAHOLA RESERVOIRS IMPROVEMENT PROJECT

CONTENTS

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Project Representative – Design Consultant/Engineer with Lyon Associates, Inc

END OF SECTION

SECTION - 011100
GENERAL SPECIFICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Work shall consist of furnishing all labor, tools, materials and equipment necessary and required to construct in-place and complete all work as indicated on the drawings and as specified herein.

B. The project consists of geotechnical review, historical documentation, grading, repairs and improvements at (a) Upper Anahola Reservoir and (b) Kealia Field Reservoir 1. The dams will store water based on the requirements from HAR 13-190.10. The work also includes grading and decommissioning of (c) Lower Anahola Reservoir and (d) Kealia Field Reservoir 2. Additionally, the work includes (e) engagement of a geotechnical consultant to perform field investigations to validate the embankment design at Upper Anahola and Kealia Field 1 and (f) engagement of a historian consultant to perform historical documentation of the dam outfall structures.

1.2 NOTICE TO PROCEED

A. Notice to proceed will be issued in two parts. The Contractor will be given Notice to Proceed with item (e) and (f), geotechnical investigation and historical documentation first. This work must be completed and accepted by DHHL prior to issue of Notice to Proceed with the field mobilization, material procurement and construction work, items (a), (b), (c) and (d) above. DHHL reserves the right to revise the construction documents should the geotechnical investigation so recommend. If, warranted, an equitable adjustment in contract price will be made.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 GENERAL

A. Construction Lines, Levels and Grades: The Contractor shall verify all lines, levels and elevations indicated on the drawings before any clearing, excavation or construction begins. Any discrepancy shall be immediately brought to the attention of DHHL, and any change shall be made in accordance with DHHL's instruction. The Contractor shall not be entitled to extra payment for failing to report the discrepancies before proceeding with any work whether within the area affected or not.

B. Examination of Premises: The Contractor shall contact DHHL and obtain permission before visiting the site.

C. Notices: The Contractor shall notify DHHL and give at least three (3) working days notice before starting any work.

D. Disruption of Utility Services: All work related to the temporary disconnection of electrical system shall be pre-arranged with DHHL so that any disruption of such services will be kept to a minimum. In the event temporary power hook-up is required, the Contractor shall provide the necessary services.

E. Contractor's Operations

1. The Contractor must employ, insofar as possible, such methods and means of carrying out the work so as not to cause any interruption or interference to the facility's operations. Where the Contractor's operations would result in interruptions which would hamper the operations of the facilities, the Contractor shall rearrange the schedule of work accordingly.

2. The Contractor shall maintain safe passageway to and from the facility's occupied rooms and other occupied spaces for the user agency personnel and the public at all times.

F. Parking Policy for Contractor

1. The Contractor and its employees will not be allowed to park in zones assigned to facility personnel.

2. Areas to be used by the Contractor shall be as designated by DHHL. Any lawn damaged by the Contractor shall be restored as instructed by DHHL at no cost to the State.

G. Toilet Accommodations: There are no toilet accommodations on site. The Contractor shall provide his own portable covered receptacles.

1. Portable covered receptacles for fecal matter and urine, of the design and number specified by the DOH, shall be provided by Contractor.

2. No employee will be allowed to deposit fecal matter or urine in any place except in these receptacles. Any infringement of this requirement shall result in immediate transfer or discharge of the offender or other disciplinary measures satisfactory to DHHL.

3. All deposits in these receptacles shall be immediately covered by Contractor with a chemical solution prescribed by the DOH. These receptacles, with their contents, shall be collected and removed for disposal. The method of disposal must be satisfactory to the DOH to prevent contamination of any water supply, stream or other bodies of water.

4. The receptacles shall be thoroughly cleaned and filled with the required chemical solution and then returned to the required places for service by Contractor.

H. Protection of Property: The Contractor shall continually maintain adequate protection of all its work from damage and shall protect all property, including but not limited to buildings, equipment, furniture, grounds, vegetation, material, and utility systems located at and adjoining the job site. The Contractor shall repair, replace or pay the expense of repair of damages resulting from its operations.

I. Use of Power Driven Equipment: The Contractor shall take all necessary safety precautions to protect the facility personnel, and the public whenever power driven equipment is used.

J. Safety: The Contractor shall carefully read and strictly comply with the requirements of the Hawaii Occupational Safety and Health Law, Chapter 396, Hawaii Revised Statutes, as amended, is applicable and made a part of the Contract.

K. Clean Up Premises: The Contractor shall clean up and remove from premises all debris accumulated from operations as necessary or as directed. See also Section 7.25 of the General Conditions.

L. Responsibility

1. The State will hold the Contractor liable for all the acts of Subcontractors and shall deal only with the prime Contractor in matters pertaining to other trades employed on the job. The Contractor shall be responsible for coordinating the work of all trades on the job.

2. Should the Contractor discover any discrepancy in the plans or specifications, the Contractor shall immediately notify DHHL before proceeding any further with the work, otherwise, the Contractor will be held responsible for any cost involved in correction of work placed due to such discrepancy.

M. Cooperation with Other Contractors: DHHL reserves the right at any time to contract for or otherwise perform other or additional work within the contract zone limits of this Contract. The Contractor of this project shall, to the extent ordered by DHHL, conduct its work so as not to interfere with or hinder the progress or completion of the work performed by other contractors.

N. Division of the Work: The Divisions and Sections into which these Specifications are divided shall not be considered an accurate or complete segregation of work by trades. This also applies to all work specified within each Section.

O. Drawings and Specifications

1. The contractor shall not make alterations in the drawings and specifications. In the event the Contractor discovers any errors or discrepancies, the Contractor shall immediately notify DHHL in accordance with the General Conditions.

2. Where devices, or items, or parts thereof are referred to in the singular, it is intended that such reference shall apply to as many such devices, items or parts as are required to properly complete the work.

3. Specifications and drawings are prepared in abbreviated form and include incomplete sentences. Omission of words or phrases such as "the Contractor shall", "as shown on the drawings", "a", "an", and "the" are intentional. Omitted words and phrases shall be provided by inference to form complete sentences.

P. Required Submittals

1. Required submittals as specified in the Technical Sections of these specifications include one or more of the following: Shop drawings; material samples; technical data; schedules of materials; schedules of operations; guarantees; operating and maintenance manuals; and as-built drawings.

2. The Contractor shall make a comprehensive list of the required submittals, by Specification Section, and submit this list to Project Representative within 15 days after notice to proceed.

3. As-Built Drawings: When as-built drawings are required for submittal, the following shall apply:

a. As-built drawings, the intent of which is to record the actual in-place construction so that any future renovations or tie-ins can be anticipated accurately, shall be required.

b. All deviations from alignments, elevations and dimensions which are stipulated on the plans shall be recorded in red on the as-built drawings.

c. The following procedure shall be followed:

1) Immediately after these changes are constructed in place, the Contractor shall record them on the field office plans.

2) Within two weeks after final inspection of the project, the Contractor shall transfer the changes marked on the field office plans onto a clean copy of plans using a red pencil. Any deletions shall be so noted and redrawn as necessary. The Contractor shall stamp or mark the tracings "AS-

BUILT", and also sign and date each drawing so marked.

3) The Contractor shall submit the as-built drawings together with the marked-up field office plans to Project Representative.

4) Any as-built drawing which Project Representative determines does not accurately record the deviation shall be corrected by the State, and the Contractor shall be charged for the services.

END OF SECTION

SECTION 011200
GEOTECHNICAL INVESTIGATION

PART 1 GENERAL

This Section includes services of an independent geotechnical consultant selected by DHHL to perform site characterization analysis and to prepare dam modification applications for the State of Hawaii Department of Land and Natural Resources.

1.1 PRICE AND PAYMENT

This work shall be paid for at the accepted lump sum price under the bid allowance indicated in the bid schedule of prices.

1.2 SEQUENCING AND SCHEDULING

1.2.1 Work in this Section shall be accomplished and completed with all reports in final format and accepted by DHHL prior to Notice to Proceed with the remaining work.

1.2.2 Time of performance: 90 days after Notice to Proceed, exclusive of review by DHHL.

1.3 SUBMITTALS

Submit the following for approval:

Design Data
- Design Data

Test Reports
- Geotechnical Report
- Test Reports
- Investigation reports

1.4 SPECIAL INSURANCE REQUIREMENTS

The Geotechnical engineer shall carry professional liability insurance (Errors & Omissions) in the amount of $1 million.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 SCOPE OF SERVICES

Perform site characterization and slope stability analyses necessary for regulatory approval.

3.1.1 Phase 1 - Site Characterization

1. Obtain rights of entry, utility clearance, and regulatory approval for subsurface characterization of embankment and foundation materials.

2. Lower Anahola dam has an active water line near the downstream side of the crest that requires coordination.

3. Drill two geotechnical borings at each embankment, one through the embankment and one near the spillway.

4. Maintain logs of the borings and describe the encountered materials.

5. Obtain disturbed, relatively undisturbed, and high quality Shelby tube samples of the embankment and foundation materials.

6. Install a standpipe piezometer with locking cap in the mid-embankment borings.

7. Measure groundwater levels in the borings.

8. Ship soil samples to a soils laboratory and perform tests to establish strength and permeability parameters for the necessary geotechnical analyses.

3.1.2 Phase 2 - Analyses and Mitigation Engineering

1. Perform slope stability analyses using the measured dam geometry, the stratigraphy revealed by the borings, the phreatic surface elevations measured in the piezometers, and the laboratory test results. Evaluate the relationship between internal groundwater surface elevation and slope stability safety factor.

2. Review project drawings for correcting deficiencies and improving stability, for obtaining operating permits for the reservoirs.

3. Collaborate with the engineer of record to review project drawings and specifications for geotechnical mitigation work and review quantity take off for cut and fill.

4. Prepare a final geotechnical engineering report describing the dam characterization effort, presenting the results of the slope stability and other engineering analyses, and recommending the preferred mitigative construction.

3.1.3 Phase 3 - Permit Support and Consulting

1. Review hydrology reports, permit applications, and drawings prepared by the engineer of record.

2. Attend meetings on Oahu with Dam Safety, DHHL, and other pertinent agencies to present the results of the geotechnical engineering evaluations and to expedite permit approvals.

END OF SECTION

SECTION 011300
HISTORIC DOCUMENTATION

PART 1 GENERAL

1.1 DEFINITIONS

Historic American Engineering Record (HAER) documentation refers to a collection of reports maintained at the Library of Congress for the purpose of recording historical engineering projects in the Unites States. The agricultural dam facilities in this project include hand excavated outlet tunnels that have been deemed by the State Historical Division as having historical significance. This section includes conducting and documenting historical surveys of the four tunnel sites in accordance with HAER standards.

1.2 PRICE AND PAYMENT

Work under this section will be included in the contract allowance entitled HAER REPORT FOR TUNNELS.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL PARK SERVICE

HABS	(1990) HABS STANDARDS

1.4 SEQUENCING AND SCHEDULING

Specification subparagraph text.

1.5 SUBMITTALS

Submit the following for approval: HAER Report

1.6 SCOPE OF SERVICES

Provide services of a qualified historical consultant who shall document and prepare HAER documentation for the four dam outlet tunnel sites.

1.6.1 Qualifications

The consultant preparing the HAER Documentation shall be one who is regularly engaged in performing historical documentation surveys in Hawaii and who has completed HAER Documentation that has been reviewed and approved by the State Historical Preservation Division within the last five years.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

Examine and document the sites and tunnel facilities in accordance with HABS/ HAER Standards.

3.2 PREPARATION

Submit a draft report for review in electronic format. Submit final report after approval of draft. Report shall be submitted in electronic format (PDF).

END OF SECTION

SECTION 015100
TEMPORARY DUST, SEDIMENT
AND EROSION CONTROL

PART 1 - GENERAL

1.1 GENERAL:

A. Related Documents

1. The General Provisions, Special Provisions and General Requirements of the Specifications, apply to the work specified in this section.

2. Provisions contained in the National Pollution Discharge Elimination System permit issued for this project by the State Department of Health.

B. Scope

1. The work includes detailed plans, diagrams, and written site-specific best management practice (BMP); constructing, maintaining, and repairing temporary dust, sediment and erosion control measures at the project site, including local materials sources, work areas and haul roads; control of fugitive dust (defined as uncontrolled emission of solid airborne particulate matter from any source other than combustion); and complying with applicable State and Federal permit conditions.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Mulches: Mulches shall be recycled materials include bagasse, hay, straw, wood cellulose, bark, wood chips, or other materials acceptable to the DHHL. Mulches shall be clean and free of noxious weeds and deleterious materials.

B. Grass: Grass shall be a quick growing species such as rye grass, Italian rye grass, or cereal grasses. Grass shall be suitable to the area and provide a temporary cover that will not compete later with permanent cover. Alternative grasses are allowable if acceptable to the DHHL.

C. Fertilizer and Soil Conditioners: Fertilizer and soil conditioners shall be a standard commercial grade acceptable to the DHHL.

D. Silt Fences: Silt fences shall be synthetic filter fabric mounted on posts and embedded in compacted ground in accordance with contract documents, and shall be in compliance with ASTM D 6462, Standard Practice for Silt Fence Installation.

E. Berms: Berms shall be gravel or sand wrapped with geotextile material. Alternate materials are allowable if acceptable to DHHL.

PART 3 - EXECUTION

3.1 CONSTRUCTION SEDIMENT:

A. Preconstruction Requirements:

1. Dust, Sediment and Erosion Control Meeting. Submit site specific BMP to DHHL. Schedule a dust, sediment and erosion control meeting with Engineer after site specific BMP is accepted in writing by DHHL. Meeting shall be scheduled 14 days before start of construction work. Discuss sequence of work, plans and proposals for dust, sediment and erosion control.

2. Dust, Sediment and Erosion Control Submittals. Submit the following:

a. Written site-specific BMP describing activities to minimize sediment and soil erosion into State waters, drainage or sewer systems. BMP shall include the following:

1) A list of all materials and heavy equipment to be used during earthwork operation.

2) Details of the procedures used for the maintenance and subsequent removal of any erosion or siltation control devices.

3) Fugitive dust control.

4) Methods of storing and handling of oils and other products used for the project.

5) Material storage and handling areas, and other staging areas.

6) Concrete truck washouts.

7) Concrete waste control.

8) Fueling and maintenance of vehicles and other equipment.

9) Tracking of sediment offsite from project entries and exits.

10) Litter management.

11) Toilet facilities.

12) Other factors that may cause dust, sediment and erosion control.

b. Provide plans indicating location of dust, sediment and erosion control devices; provide plans and details of BMPs to be installed or utilized; show areas of soil disturbance in cut and fill and show areas where vegetative practices are to be implemented. Indicate intended drainage pattern on plans. Indicate approximate date when device will be installed and removed.

c. Construction schedule.

d. Name(s) of specific individual(s) designated responsible for dust, sediment and erosion controls on the project site. Include home and business telephone numbers, fax numbers, and e-mail addresses.

e. Description of fill material to be used.

Date and sign BMP. Keep accepted copy on site throughout duration of the project. Revisions to the BMP shall be included with original BMP. Modify contract documents to conform to revisions. Include actual date of installation and removal of BMP. Obtain written acceptance by DHHL before revising BMP.

Follow guidelines in the "Best Management Practices Manual for Construction Sites in Kauai", in developing, installing, and maintaining BMPs for all projects. Follow Kauai County "Rules for Soil Erosion Standards and Guidelines".

B. Construction Requirements.

1. Do not begin work until submittals detailed in 3.1 A2 - Dust, Sediment and Erosion Control Submittals are completed and accepted in writing by DHHL.

2. Install, maintain, monitor, repair and replace site-specific BMP measures, such as for dust, sediment and erosion control; installation and monitoring.

3. Modify and resubmit plans and construction schedules to correct conditions that develop during construction which were unforeseen during the design and pre-construction stages.

4. Coordinate temporary control provisions with permanent control features throughout the construction and post-construction period.

5. Protect exposed or disturbed surface area with mulches, grass seeds or hydro mulch. Spray mulches at a rate of 2,000 pounds per acre. Add tackifier to mix at a rate of 85 pounds per acre. Apply grass seeds at a rate of 125 pounds per acre. For hydro mulch use the ingredients and rates required for mulches and grass seeds.

6. Apply fertilizer to mulches, grass seed or hydro mulch at a rate of 450 pounds per acre. Apply an additional 250 pounds per acre every 90 calendar days.

7. Install velocity dissipation measures when exposing erodible surfaces greater than 15 feet in height.

8. BMP measures shall be in place and operational (such as shaping the earthwork to control and directing the runoff) at the end of workday. Shaping earthwork may include constructing earth berms along the top edges of embankments if acceptable to the DHHL.

9. Install and maintain either or both stabilized construction entrances and wheel washes to minimize tracking of dirt and mud onto roadways. Restrict traffic to stabilized construction areas only. Clean dirt, mud, or other material tracked onto the road immediately. Modify stabilized construction entrances to prevent mud from being tracked onto road. Stabilize entire access roads if necessary.

10. Chemicals may be used as soil stabilizers for either or both erosion and dust control if acceptable to the DHHL.

11. Properly maintain all BMP features. Inspect, prepare a written report, and make repairs to BMP measures at following intervals:

    a. Weekly during dry periods.
    b. Within 24 hours of any rainfall 0.5 inch or greater which occurs in a 24-hour period.
    c. Daily during periods of prolonged rainfall.
    d. When existing erosion control measures are damaged or not operating properly as required by site-specific BMP.
    e. Remove, destroy, replace or relocate any BMP that must be removed, destroyed, replaced or relocated due to potential or actual flooding, or potential danger or damage to project or public.

END OF SECTION

SECTION 024000
DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work includes demolition and removal as indicated in the plans or specified herein. All materials resulting from demolition work, except as indicated or specified otherwise, shall become the property of the Contractor and shall be removed from the limits otherwise directed. The Contractor shall pay for all necessary permits and certificates that may be required in connection with this work.

1.2 WORK INCLUDED

A. Accomplish all demolition, removal, and related work indicated on or required by the drawings, and as specified herein.

B. Work shall include, but not limited to the following:

1. All demolition works shall be as indicated on the Drawings.

2. Clearing and disposing of all debris, rubbish, junk and miscellaneous items.

C. Temporary Environmental Controls shall be implemented prior to commencing demolition work.

1.3 COORDINATION

A. The Contractor shall not begin demolition or deconstruction until authorization is received from DHHL.

B. The Contractor shall carefully coordinate the work in areas where existing facilities are interconnected with new facilities and where existing facilities remain operational.

C. The Contractor shall note that the Drawings used to indicate demolition and reconstruction are based on record drawings of the existing facilities. These record drawings have been reproduced to show existing conditions and to clarify the scope of Work as much as possible. Prior to bidding, the Contractor shall conduct a comprehensive survey at the Site to verify the correctness and exactness of the Drawings, the scope of work, and the extent of auxiliary utilities.

D. The Contractor shall erect and maintain fences, warning signs, barricades, and other devices around the reconstruction as required for the protection of the Contractor's employees and personnel at the Site. The Contractor shall remove such protection when reconstruction activities are complete, or as work progresses, or when directed by the Project Representative.

1.4 EXISTING CONDITIONS

A. Before beginning any demolition or deconstruction work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work and record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal.

1.5 SUBMITTALS

A. Demolition plan and procedures, including operational sequence, shall be submitted to DHHL for approval before work is started. The procedures shall provide for safe conduct of the Work, careful removal and disposition of materials and equipment, protection of existing facilities which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection and reconnection of utility services. The procedures shall include a detailed description and time schedule of the methods and equipment to be used for each operation and the sequence of operation. A storage plan for salvaged items, if required, shall be included.

B. If inspection reveals a safety hazard to workers, the Contractor shall state provisions for securing the safety of the workers throughout the performance of the work.

C. Any copies of any notifications, authorizations and permits required to perform the work.

1.6 DEMOLITION

A. Existing trees, pavement, piping, valves, utilities, and other related appurtenances required to be demolished as part of the work shall be removed and disposed of unless otherwise indicated. Removal of buried structures, utilities, and appurtenances includes the related excavation and backfill as required. Removed items shall be disposed of offsite by the Contractor.

B. Existing civil, landscaping, and structural work disturbed or damaged by reconstruction activities shall be repaired and rehabilitated.

C. Damaged items shall be repaired or replaced with new items to restore items or surfaces to a condition equal to and matching that existing prior to damage.

1.7 DISPOSAL

A. Contractor shall be responsible for the offsite disposal of debris resulting from reconstruction in compliance with local, State, and Federal codes and requirements.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

A. The Contractor shall coordinate demolition and reconstruction work with DHHL. Unless otherwise indicated, the Contractor shall be responsible for the sequence of activities. Work shall be performed in accordance with applicable safety rules and regulations.

B. The Contractor shall verify that any utilities connected to structures, equipment, and facilities to be removed, salvaged, or abandoned are rendered inoperable, replaced with new utilities, or adequately bypassed with temporary utilities before proceeding with demolition and reconstruction.

C. The Contractor shall take precautions to avoid damage to adjacent facilities and to limit the work activities to the extent indicated. If reconstruction beyond the scope indicated is required, the Contractor shall obtain approval from the DHHL prior to commencing.

D. The Contractor shall notify the DHHL or appropriate utilities to turn off affected 3. 9 TITLE OF MATERIALS

A. All salvaged equipment and materials will remain the property of DHHL.

B. All demolished equipment and materials will become the Contractor's property after DHHL's authorization to begin demolition.

3.2 PROTECTION OF EXISTING FACILITIES

A. Before beginning any reconstruction, the Contractor shall carefully survey the existing facilities and examine the Specifications and Drawings to determine the extent of reconstruction and coordination with the work. Existing facilities not subject to reconstruction shall be protected and maintained.

B. Protection of Personnel

1. Persons shall be afforded safe passages around areas of demolition.

2. During demolition, Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.

3. Contractor shall provide temporary barricades and other forms of protection to protect DHHL's personnel and general public from injury due to the demolition work.

C. The Contractor shall carefully consider bearing loads and capacities before placement of equipment and material on Site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the Contractor shall consult with DHHL prior to the placement of such equipment or material.

3.3 BACKFILL

A. Demolition debris shall not be used as backfill material.

3.4 DISPOSAL

A. Demolition and removal of debris shall minimize interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from DHHL. Alternate routes shall be provided around closed or obstructed traffic ways.

B. The Contractor shall legally remove and dispose of site debris, rubbish, and other materials resulting from reconstruction operations. Structures and equipment to be demolished shall be cleaned prior to demolition and the wash water properly disposed of. No trace of these structures shall remain prior to placing of backfill in the areas from which structures were removed.

C. Refuse, debris, and waste materials resulting from demolition and clearing operations shall not be burned.

3.5 OCCUPANCY AND POLLUTION CONTROL

A. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used to limit dust and dirt rising and scattering in the area. The Contractor shall comply with government regulations pertaining to environmental protection.

B. Water shall not be used if it creates hazardous or objectionable conditions such as, flooding, or pollution.

3.6 CLEANING

A. During and upon completion of work, the Contractor shall promptly remove tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by work in a clean, approved condition.

B. Adjacent structures shall be cleaned of dust, dirt, and debris caused by reconstruction, as directed by the DHHL or governing authorities, and adjacent areas shall be returned to condition existing prior to start of work.

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL

A. Summary:

Perform all work in accordance with ACI MCP PACK Parts 2 and 3.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American Concrete Institute (ACI):

ACI MCP PACK	(2010) Manual of Concrete Practice

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C 1064/C 1064M	(2008) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 143/C 143M	(2010) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	(2011) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2010) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C 685/C 685M	(2010) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 94/C 94M	(2010a) Standard Specification for Ready-Mixed Concrete
ASTM C 990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM D 75/D 75M	(2009) Standard Practice for Sampling Aggregates

A. State of Hawaii Department of Transportation Standard Specifications (HSS):

HSS Section 601	Structural Concrete
HSS Section 701	Hydraulic Concrete
HSS Section 703	Aggregates
HSS Section 711	Concrete Curing Materials and Admixtures
HSS Section 712	Miscellaneous

1.3 SYSTEM DESCRIPTION

The DHHL retains the option to sample and test aggregates and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary to assist the DHHL in procurement of representative test samples. Obtain samples of aggregates at the point of batching in accordance with ASTM D 75/D 75M. Sample concrete in accordance with ASTM C172/C172M. Determine slump and air content in accordance with ASTM C 143/C 143M and ASTM C231/C231M, respectively, when cylinders are molded. Prepare, cure, and transport compression test specimens in accordance with ASTM C 31/C 31M. Test compression test specimens in accordance with ASTM C 39/C 39M. Take samples for strength tests not less than once each shift in which concrete is produced from each class of concrete required. Provide a minimum of three specimens from each sample; two to be tested at 28 days for acceptance, and one will be tested at 7 days for information.

A. Strength

Acceptance test results are the average strengths of two specimens tested at 28 days. The strength of the concrete is considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, f'c, and no individual acceptance test result falls below f'c by more than 500 psi.

B. Construction Tolerances
Apply a Class "C" finish to all surfaces except those specified to receive a Class "D" finish. Apply a Class "D" finish to all post-construction surfaces which will be permanently concealed. Surface requirements for the classes of finish required are as specified in Part 4 of ACI MCP PACK.

C Concrete Mixture Proportions

Concrete mixture proportions are the responsibility of the Contractor. Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. Provide materials included in the mixture proportions of the same type and from the same source as will be used on the project. Specified compressive strength f'c shall be as indicated on the structural drawings. The maximum nominal size coarse aggregate is 1-1/2 inch, in accordance with ACI MCP PACK Part 3. The air content shall be between 4.5 and 7.5 percent with a slump between 2 and 5 inches. Submit the applicable test reports and mixture proportions that will produce concrete of the quality required, ten days prior to placement of concrete.

1.4 SUBMITTALS

Submit the following i:

Shop Drawings
Installation Drawings

Product Data
Air-Entraining Admixture
Water-Reducing or Retarding Admixture
Curing Materials
Batching and Mixing Equipment
Conveying and Placing Concrete
Formwork
Forms
Ready-Mix Concrete
Mix Design Data
Curing Compound

Test Reports
Aggregates
Concrete Mixture Proportions
Compressive Strength Testing
Slump

Certificates

Cementitious Materials

Aggregates
Bill of Lading

1.5 QUALITY ASSURANCE

Indicate specific locations of Concrete Placement, Forms, Steel Reinforcement, Accessories, Expansion Joints, Construction Joints, and Contraction Joints on installation drawings and include, but not be limited to, square feet of concrete placements, thicknesses and widths, plan dimensions, and arrangement of cast-in-place concrete section.

PART 2 - PRODUCTS

2.1 MATERIALS

Submit manufacturer's literature from suppliers which demonstrates compliance with applicable specifications for the specified materials.

A. Cementitious Materials
Submit Manufacturer's certificates of compliance, accompanied by mill test reports, attesting that the concrete materials meet the requirements of the specifications in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Also, certificates for all material conforming to EPA's Comprehensive Procurement Guidelines (CPG), in accordance with 40 CFR 247. Provide cementitious materials that conform to the appropriate specifications listed:

1. Portland Cement
ASTM C 150/C 150M, Type I or II.

B. Aggregates
Fine and coarse aggregates shall meet the quality and grading requirements of ASTM C 33/C 33M Class Designations 4M or better. Submit certificates of compliance and test reports for aggregates showing the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

C Admixtures
Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Retest chemical admixtures that have been in storage at the project site, for longer than 6 months or that have been subjected to freezing, at the expense of the Contractor at the request of the Contracting Officer and will be rejected if test results are not satisfactory.

1. Air-Entraining Admixture

Provide air-entraining admixture that meets the requirements of ASTM C260/C260M.

2. Water-Reducing or Retarding Admixture
Provide water-reducing or retarding admixture meeting the requirements of ASTM C 494/C 494M, Type A, B, or D.

D. Water
Use fresh, clean, potable water for mixing and curing, free from injurious amounts of oil, acid, salt, or alkali, except that un-potable water may be used if it meets the requirements of COE CRD-C 400.

E. Reinforcing Steel
Provide reinforcing bars conforming to the requirements of ASTM A615/A615M, Grade 60. Details of reinforcement not shown shall be in accordance with ACI MCP PACK Part 3, Chapters 7 and 12.

F. Expansion Joint Filler Strips, Pre-molded
Expansion joint filler strips, pre-molded shall be sponge rubber conforming to ASTM D 1752, Type I.

G. Joint Sealants - Field Molded Sealants
Joint sealants - field molded sealants shall conform to ASTM C 920, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Provide polyethylene tape, coated paper, metal foil, or similar type bond breaker materials. The backup material needs to be compressible, non-shrink, nonreactive with the sealant, and a non-absorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, clean the joint of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

H. Waterstops

Waterstops shall conform to COE CRD-C 572.

I. Formwork
The design and engineering of the formwork as well as its construction will be the responsibility of the Contractor. Submit formwork design prior to the first concrete placement.

J. Form Coatings

Coat forms, for exposed surfaces, with a non-staining form oil to be applied shortly before concrete is placed.

K. Curing Materials
Provide curing materials conforming to the following requirements.

1 Impervious Sheet Materials

Impervious sheet materials, ASTM C 171, type optional, except polyethylene film, if used, shall be white opaque.

2 Membrane-Forming Curing Compound
ASTM C 309, Type 1-D or 2, Class A B.

2.2 READY-MIX CONCRETE

A. Concrete shall be ready-mix concrete with mix design data conforming to ACI MCP PACK Part 2. Bill of Lading for each ready-mix concrete delivery shall be in accordance with ASTM C 94/C 94M

B. Slump: 1 to 4 inch according to ASTM C 143/C 143M & ACI MCP PACK Part 1.

C. Portland Cement conforming to ASTM C 150/C 150M, Type II.

D. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces

E. Air-Entraining Admixtures conforming to ASTM C260/C260M. Non air-entrained interior concrete shall have a total air content of 2 to 4 percent by volume.

F. Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C 494/C 494M.

2.3 STEEL REINFORCEMENT

A. Deformed Steel Bars

Provide steel bars conforming to ASTM A615/A615M; Grade .60 ksi ACI MCP PACK Parts 2 and 3.

2.4 FORMS

Forms shall be of wood, steel, or other approved material and conforms to ACI MCP PACK, Parts 2 and 3. Provide form release conforming to ACI MCP PACK, Part 4.

2.5 ACCESSORIES

A Curing Compound: Provide curing compound conforming to ASTM C 309.

B. Portland Cement: Conform to HSS Subsection 701.01 - Portland Cement. Type II Portland cement may be used where high early-strength concrete is requirement. Refer to ASTM C150 cement terminology.

C. Aggregates:

1. Course Aggregate: Conform to HSS Subsection 703.02 - Coarse Aggregate for Portland Cement Concrete.

2. Fine Aggregate: Conform to HSS Subsection 703.01 - fine Aggregate for Concrete.

3. Admixtures: Conform to HSS Subsection 711.03(A) - Admixture Material. Shrinkage reducing admixture shall be added to the concrete mix with a minimum dosage requirement of 128 ounces per cubic yard of concrete, to reduce drying shrinkage of concrete and mortar and the potential for subsequent cracking.

4. Water: Conform to HSS Subsection 712.01 - Water.

PART 3 - EXECUTION

3.1 PREPARATION

The surface shall be clean, damp, and free of laitance. Construct ramps and walkways, as necessary, to allow safe and expeditious access for concrete and workmen. Remove snow, ice, standing or flowing water, loose particles, debris, and foreign matter. Earth foundations shall be satisfactorily compacted. Ensure spare vibrators are available. The entire preparation shall be accepted by the DHHL prior to placing.

A. Embedded Items

Secure reinforcement in place after joints, anchors, and other embedded items has been positioned. Arrange internal ties so that when the forms are removed the metal part of the tie is not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete is permitted only when specifically authorized or directed. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

B. Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. Provide smooth form surfaces, free from irregularities, dents, sags, or holes when used for permanently exposed faces. Chamfer all exposed joints and edges, unless otherwise indicated.

C. Production of Concrete

1. Ready-Mixed Concrete

Provide ready-mixed concrete conforming to ASTM C 94/C 94M except as otherwise specified.

2. Concrete Made by Volumetric Batching and Continuous Mixing
Concrete made by volumetric batching and continuous mixing shall conform to ASTM C 685/C 685M.

3. Batching and Mixing Equipment

The Contractor has the option of using an on-site batching and mixing facility. The facility shall provide sufficient batching and mixing equipment capacity to prevent cold joints. Submit the method of measuring materials, batching operation, and mixer for review, and manufacturer's data for batching and mixing equipment demonstrating compliance with the applicable specifications. Provide an Onsite Plant conforming to the requirements of either ASTM C 94/C 94M or ASTM C 685/C 685M.

3.2 CONVEYING AND PLACING CONCRETE

Concrete placement is not permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, deliver the concrete to the site of the work completing the discharge within 1-1/2 hours or 45 minutes when the placing temperature is 86 degrees F or greater unless a retarding admixture is used. Convey concrete from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Deposit concrete as close as possible to its final position in the forms and regulate it so that it may be effectively consolidated in horizontal layers 18 inches or less in thickness with a minimum of lateral movement. Carry on the placement at such a rate that the formation of cold joints will be prevented. Submit methods and equipment for transporting, handling, depositing, and consolidating the concrete prior to the first concrete placement. Perform conveying and placing concrete in conformance with the following:

A. Consolidation

Consolidate each layer of concrete by internal vibrating equipment. Systematically accomplish internal vibration by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by approximately 4 inches. Ensure that the vibrator penetrates rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. Hold

vibrator stationary until the concrete is consolidated and then withdraw it slowly at the rate of about 3 inches per second.

B. Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI MCP PACK Part 2, is expected to exceed 0.2 psf per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures taken as quickly as finishing operations will allow.

C. Lifts in Concrete

Deposit concrete in horizontal layers not to exceed 24 inches in thickness. Carry on placement at a rate that prevents the formation of cold joints. Place slabs in one lift.

3.3 FORM REMOVAL

Do not remove forms before 24 hours after concrete placement, except as otherwise specifically authorized. Do not remove supporting forms and shoring until the concrete has cured for at least 5 days. When conditions require longer curing periods, forms shall remain in place.

3.4 FINISHING

A. Temperature Requirement

Do not finish or repair concrete when either the concrete or the ambient temperature is below 50 degrees F.

B. Finishing Formed Surfaces

Remove all fins and loose materials, and surface defects including filling of tie holes. Repair all honeycomb areas and other defects. Remove all unsound concrete from areas to be repaired. Surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. Brush-coat the prepared area with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filling with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured is the same as adjacent concrete.

C. Finishing Unformed Surfaces

Float finish all unformed surfaces that are not to be covered by additional concrete or backfill, to elevations shown, unless otherwise specified. Surfaces to

receive additional concrete or backfill shall be brought to the elevations shown and left as a true and regular surface. Slope exterior surfaces for drainage unless otherwise shown. Carefully make joints with a jointing tool. Finish unformed surfaces to a tolerance of 3/8 inch for a float finish as determined by a 10 foot

straightedge placed on surfaces shown on the drawings to be level or having a constant slope. Do not perform finishing while there is excess moisture or bleeding water on the surface. No water or cement is to be added to the surface during finishing.

1. Float Finish

Provide float finished surfaces, screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete supports a person's weight without deep imprint, complete floating. Floating shall embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

2 Broom Finish

Screed and float the concrete to required finish plane with no coarse aggregate visible. After surface moisture disappears, broom or brush the surface with a broom or fiber bristle brush in a direction transverse to that of the main traffic or as directed.

3. Expansion and Contraction Joints

Make expansion and contraction joints in accordance with the details shown or as otherwise specified. Provide 1/2 inch thick transverse expansion joints where new work abuts an existing concrete. Provide expansion joints at a maximum spacing of 30 feet on center in sidewalks, unless otherwise indicated. Provide contraction joints at a maximum spacing of 6 linear feet in sidewalks, unless otherwise indicated. Cut contraction joints at a minimum of 1 inch deep with a jointing tool after the surface has been finished.

3.5 CURING AND PROTECTION

Beginning immediately after placement, and continuing for at least 7 days, cure and protect all concrete from premature drying, extremes in temperature, rapid temperature change, mechanical damage, and exposure to rain or flowing water. Provide all materials and equipment needed for adequate curing and protection at the site of the placement prior to the start of concrete placement. Accomplish moisture preservation of moisture for concrete surfaces not in contact with forms by one of the following methods:

a. Continuous sprinkling or ponding.
b. Application of absorptive mats or fabrics kept continuously wet.
c. Application of sand kept continuously wet.
d. Application of impervious sheet material conforming to ASTM C 171.

e. Application of membrane-forming curing compound conforming to ASTM C 309, Type 1-D, on surfaces permanently exposed to view. Accomplish Type 2 on other surfaces in accordance with manufacturer's instructions.

Accomplish the preservation of moisture for concrete surfaces placed against wooden forms by keeping the forms continuously wet for 7 days. If forms are removed prior to end of the required curing period, use other curing methods for the balance of the curing period. Do not perform protection removal if the temperature of the air in contact with the concrete may drop more than 60 degrees F within a 24 hour period.

3.6 TESTS AND INSPECTIONS

A. Field Testing Technicians

The individuals, who sample and test concrete, as required in this specification, shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

B. Inspection Details and Frequency of Testing

1. Preparations for Placing
   Inspect foundation or construction joints, forms, and embedded items in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

2. Air Content

Check air content at least once during each shift that concrete is placed for each class of concrete required. Obtain samples in accordance with ASTM C172/C172M and tested in accordance with ASTM C231/C231M.

3. Slump

Check slump once during each shift that concrete is produced for each class of concrete required. Obtain samples in accordance with ASTM C172/C172M and tested in accordance with ASTM C 143/C 143M.

4. Consolidation and Protection

Ensure that the concrete is properly consolidated, finished, protected, and cured.

C. Action Required

1. Placing

Do not permit placing to begin until the availability of an adequate number of acceptable vibrators, which are in working order and have competent operators, has been verified.

2. Air Content

Whenever an air content test result is outside the specification limits, adjust the dosage of the air-entrainment admixture prior to delivery of concrete to forms.

3. Slump

Whenever a slump test result is outside the specification limits, adjust the batch weights of water and fine aggregate prior to delivery of concrete to the forms. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the submitted concrete mixture proportion.

D. Reports

Report the results of all tests and inspections conducted at the project site informally at the end of each shift. Submit written reports weekly. Deliver within 3 days after the end of each weekly reporting period.

3.7 FORM WORK

Form work shall conform to ACI MCP PACK Parts 2 through 5.

A. Preparation of Form Surfaces

Forms shall be true to line and grade, mortar-tight, and sufficiently rigid to prevent objectionable deformation under load. Form surfaces for permanently exposed faces shall be smooth, free from irregularities, dents, sags, or holes. Chamfer exposed joints and exposed edges. Arrange internal ties so that when the forms are removed, the form ties are not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structure.

B. Form Coating

Coat forms, for exposed surfaces, with a non-staining form release coating applied shortly before concrete is placed. Before the steel case is added to avoid contaminating the reinforcing steel. Forms for unexposed surfaces may be wetted in lieu of coating immediately before the placing of concrete, except that in freezing weather form release coating shall be used.

C. Removal of Forms

Remove forms carefully to prevent damage to the concrete.

3.8 STEEL REINFORCING

Reinforcement shall be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

1. Fabrication

Shops fabricate steel reinforcement in accordance with ACI MCP PACK Parts 2 and 3. Shop details and bending shall be in accordance with ACI MCP PACK Parts 2 and 3.

2. Splicing

Perform splices in accordance with ACI MCP PACK Parts 2 and 3.

3. Supports

Secure reinforcement in place by the use of metal or concrete supports, spacers, or ties.

3.9 EMBEDDED ITEMS

Before placing concrete, take care to determine that all embedded items are firmly and securely fastened in place. Provide embedded items free of oil and other foreign matter, such as loose coatings of rust, paint and scale. Embedding of wood in concrete is permitted only when specifically authorized or directed.

3.10 FIELD TESTING

a. Provide samples and test concrete for quality control during placement. Sampling of fresh concrete for testing shall be in accordance with ASTM C172/C172M.

b. Test concrete for compressive strength at 7 and 28 days for each design mix. Concrete test specimens shall conform to ASTM C 31/C 31M. Perform Compressive strength testing conforming to ASTM C 39/C 39M.

c. Test Slump at the plant site of discharge for each design mix in accordance with ASTM C 143/C 143M.

d. Test air content for air-entrained concrete in accordance with ASTM C231/C231M.

e. Determine temperature of concrete at time of placement in accordance with ASTM C 1064/C 1064M.

END OF SECTION

SECTION 033200
SHOTCRETE

PART 1 - GENERAL

1.1 DESCRIPTON

A. This section describes furnishing and placing shotcrete (pneumatically applied mortar) for channels, paving slopes, constructing portions of structures, texturing concrete surfaces, encasing steel members, and other miscellaneous work. Shotcrete consists of pneumatically applied mortar using either the dry-mix or wet-mix process.

1.2 REFERENCES

A. AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI CP - 60	(2009) Craftman Workbook for ACI Certification of Shotcrete Nozzleman
ACI 506R	Guide to Shotcrete
ACI 506.2	Specifications for Shotcrete

B. ASTM INTERNATIONAL

ASTM A820/A820M	(2011) Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
ASTM C1077	(2014) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C94/C94M	(2014) Standard Specification for Ready-Mixed Concrete
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C150/150M	Standard Specification for Portland Cement
ASTM C566	(2013) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C171	(2007) Standard Specification for Sheet Materials for Curing Concrete

ASTM C685/C685M	(2011) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C989/C989M	(2013) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1140/C1140M	Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels
ASTM C1141	Standard Specification for Admixtures for Shotcrete

C. U. S ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete

1.3 SUBMITTALS

A. Qualifications of shotcrete applicator and personnel performing the work.

B. Mix designs including compressive test data used to establish proportions. Material certificates for shotcrete materials, including cements, aggregates and admixtures. Submit to Testing Laboratory for record purposes.

C. Samples as requested by the Testing Laboratory.

1.4 QUALITY ASSURANCE

A. Perform shotcrete work in accordance with the requirements of ACI 506.2, "Specifications for Materials, Proportioning, and Application of Shotcrete,"

B. Shotcrete Mix Design: Testing laboratory shall, under direction of registered Civil Engineer, design shotcrete mixes. Each mix shall bear the signature and registration number of the responsible Engineer.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Suspend shotcrete operations during high winds, rainy weather, hot weather, or near freezing temperatures when work cannot be protected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PORTLAND CEMENT: Portland cement shall meet the requirements of ASTM C150/C150M, Type I is used. Submit certificate of compliance with all specification requirements.

B. AGGREGATE: Submit Supplier's test reports for aggregates showing the materials meet the requirements of this specification. Aggregates shall conform to ASTM C33/C33M with the combined grading of coarse and fine aggregates conforming to the grading shown below.

PERCENT BY MASS PASSING INDIVIDUAL SIEVES

SIEVE SIZE	GRADING No. 1	GRADING No. 2	GRADING No. 3
3/4 inch	--	--	100
1/2 inch	--	100	80-95
3/8 inch	100	90-100	70-90
No. 4	95-100	75-85	50-70
No. 8	80-100	50-70	35-55
No. 16	80-85	35-55	20-40
No. 30	25-60	20-35	10-30
No. 50	10-30	8-20	5-17
No. 100	2-10	2-10	2-10

* Fine and coarse aggregates shall be batched separately to avoid segregation. "Tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C1260. The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor's proposed mix design proportioning.

C. WATER: Use fresh, clean, potable mixing water or non-potable water which meets the requirements of COE CRD-C 400.

D. ADMIXTURES

1. Admixtures to be used, when required or approved, shall comply with the appropriate sections of ASTM C1141/C1141M. Except as otherwise accepted, soluble admixtures shall be dissolved in water before introduction into the shotcrete mixture.

2. When accelerating admixtures complying with ASTM C1141/C1141M, Type II, Grade 1, are to be used, establish the accelerator compatibility of the job cement and the proposed accelerators using ASTM C266, except as modified herein. The powdered accelerator shall be blended with 1.25 ounces of cement until uniform

and 0.004 gal of water shall then be added. The liquid accelerator shall first be mixed with 0.004 gal of water and then added to 1.25 ounces of cement. Three percent of the proposed accelerator by mass of cement shall be used as a starting point. Mixing shall be accomplished within 15 seconds. The specimen shall be molded within 1 minute of adding the mixing water. If initial set is 2 minutes or less and a final set is 10 minutes or less, the accelerator is considered compatible. If these values are not achieved in the first test, additional tests shall be run using 2 percent and 4 percent of accelerator. Submit document establishing the compatibility of the job cement and the proposed accelerators and certificate of compliance for accelerating admixtures with all specification requirements.

E. CURING MATERIALS

Submit certificate of compliance for curing materials with all specification requirements. Curing materials shall meet the following requirements.

1 Impervious Sheet Materials

ASTM C171, type optional except polyethylene film, if used, shall be white opaque.

2 Membrane-Forming Curing Compound

ASTM C309, Type 1-D or Type 2.

F. REINFORCEMENT

Steel Fiber Reinforcement: Steel fiber reinforcement shall meet the requirements of ASTM A820/A820M.Submit certificate of compliance for fiber reinforcement with all specification requirements.

G. AIR CONTENT

Air-entraining admixture shall be used in such proportion that the air content of the shotcrete prior to gunning shall be plus or minus (±) 1.0 percent as determined by ASTM C231/C231M.

H. AIR SUPPLY

Provide a supply of clean, dry air adequate for maintaining sufficient nozzle velocity for all parts of the work and, if required, for simultaneous operation of a suitable blowpipe for clearing away rebound.

2.2 MIXTURE PROPORTIONS

A. Mixture proportions and test data from prior experience within 5 years, if available, may be submitted for approval. If test data from experience are not available or

accepted, specimens shall be made and tested from mixtures having three or more different proportions. The recommended mixture proportions, sources of materials, and all test results shall be submitted for acceptance. Mixture proportions for non-fiber-reinforced shotcrete shall be selected on the basis of compressive strength tests of cores obtained from test panels fabricated in accordance with ASTM C1140/C1140M and having minimum dimensions of 30 by 30 by 4 inches. Mixture proportions for fiber-reinforced shotcrete shall be selected on the basis of flexural strength and toughness index of 4 by 4 by 14 inch beams sawed from test panels which are fabricated in accordance with ASTM C1140/C1140M and having minimum dimensions of 30 by 30 by 4 inches. Beams shall be continuously moist cured until testing. Otherwise submit the recommended mixture proportions, sources of materials, and all test results, for approval.

2.3 EQUIPMENT

A. Dry Mix Batching And Mixing

Aggregate and cementitious materials may be batched by mass or by volume. Equipment for batching by mass shall be capable of the accuracy specified in ASTM C94/C94M. Volumetric equipment shall be capable of batching with the accuracy specified in ASTM C685/C685M. The mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain placing continuity and be capable of discharging all mixed material without any carryover from one batch to the next.

B. Delivery Equipment for Dry Mix

The equipment shall be capable of discharging the aggregate-cement mixture into the delivery hose and delivering a continuous smooth stream of uniformly mixed material to the discharge nozzle. The discharge nozzle shall be equipped with a manually operated water injection system (water ring) for directing an even distribution of water through the aggregate-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water and shall be convenient to the nozzleman. The water pressure at the discharge nozzle shall be sufficiently greater than the operating air pressure to ensure that the water is completely mixed with the other materials. If the line water pressure is inadequate, a water pump shall be introduced into the line. The water pressure shall be steady (non-pulsating). The delivery equipment shall be thoroughly cleaned at the end of each shift. Equipment parts, especially the nozzle liner and water ring, shall be regularly inspected

C. Wet Mix Batching and Mixing

Batching and mixing shall be accomplished in accordance with the applicable provisions of ASTM C94/C94M. If volumetric batching and mixing are used, the materials shall be batched and mixed in accordance with the applicable provisions of ASTM C685/C685M. The mixing equipment shall be capable of thoroughly mixing

the specified materials in sufficient quantity to maintain continuous placing. Ready-mix shotcrete complying with ASTM C94/C94M may be used.

D. Delivery Equipment for Wet Mix

The equipment shall be capable of delivering the premixed materials accurately, uniformly, and continuously through the delivery hose. Recommendations of the equipment manufacturer shall be followed on the type and size of nozzle to be used and on cleaning, inspection, and maintenance of the equipment.

PART 3 - EXECUTION

3.1 PREPARATION OF SURFACES

A. EARTH

Earth shall be compacted and trimmed to line and graded before placement of shotcrete. Surfaces to receive shotcrete shall be dampened.

B. EXISTING CONCRETE

All unsound and loose materials shall be removed by sandblasting, grinding, or high-pressure water jets before applying shotcrete. Any area to be repaired shall be chipped off or scarified to remove offsets which would cause an abrupt change in thickness without suitable reinforcement. Edges shall be tapered to leave no square shoulders at the perimeter of a cavity. The surface shall be dampened but without visible free water.

C. ROCK

Rock surfaces shall be cleaned to remove loose or drummy material, mud, running water, and other foreign matter that will prevent bond of the shotcrete. The rock surface shall be dampened prior to placement of shotcrete.

D. SHOTCRETE

When a layer of shotcrete is to be covered by a succeeding layer at a later time, it shall first be allowed to develop its initial set. Then all laitance, loose material, and rebound shall be removed by brooming or scraping. Hardened laitance set shall be removed by sandblasting and the surface thoroughly cleaned.

E. CONSTRUCTION JOINTS

Unless otherwise specified, construction joints shall be tapered to a shallow edge form, about 25 mm 1 inch thick. If non-tapered joints are specified, take special care

to avoid or remove trapped rebound at the joint. The entire joint shall be thoroughly cleaned and wetted prior to the application of additional shotcrete.

3.2 PLACEMENT OF SHOTCRETE

A. GENERAL

Place shotcrete using suitable delivery equipment and procedures. The area to which shotcrete is to be applied shall be clean and free of rebound or overspray.

B. PLACEMENT TECHNIQUE

1. Placement Control

   Thickness, method of support, air pressure, and water content of shotcrete shall be controlled to preclude sagging or sloughing off. Shotcreting shall be discontinued or suitable means shall be provided to screen the nozzle stream if wind or air currents cause separation of the nozzle stream during placement.

2. Corners

   Horizontal and vertical corners and any area where rebound cannot escape or be blown free shall be filled first.

C. PLACEMENT AROUND REINFORCEMENT

The nozzle shall be held at such distance and angle to place material behind reinforcement before any material is allowed to accumulate on the face of the reinforcement. In the dry-mix process, additional water may be added to the mixture when encasing reinforcement to facilitate a smooth flow of material behind the bars. Shotcrete shall not be placed through more than one layer of reinforcing steel rods or mesh in one application unless demonstrated by preconstruction tests that steel is properly encased.

D. COVER OF REINFORCEMENT

The following minimum cover shall be provided.

1. For shotcrete used as linings, coatings, slab, or wall: 3/4 inch.

E. PLACEMENT PRECAUTIONS

The following precautions shall be taken during placement.

1. Placement shall be stopped if drying or stiffening of the mixture takes place at any time prior to delivery to the nozzle.

2. Rebound or previously expended material shall not be used in the shotcrete mixture.

3.3 REPAIR OF DEFECTS

A. DEFECTS

Defective areas larger than 48 square inches or 2 inches deep shall be removed and replaced with fresh shotcrete. These defects include honeycombing, lamination, dry patches, voids, or sand pockets. Defective areas shall be removed in accordance with the procedures described in paragraph Existing Concrete and replaced with fresh shotcrete.

1. REPAIRS: All repairs shall be made within 1 week of the time the deficiency is discovered. All unacceptable materials shall be removed and repaired by the procedures described in the following two paragraphs. Voids and holes left by the removal of tie rods in all permanently exposed surfaces not to be backfilled and in surfaces to be exposed to water shall be reamed and completely filled with dry-patching mortar as specified below.

2. MINOR PATCHING: Minor patching may be accomplished with a dry-pack mixture, or with materials as approved by the Contracting Officer. Patches that exceed 0.1 cubic foot in volume shall receive a brush coat of approved epoxy resin meeting ASTM C881/C881M, Type II, as a prime coat. Care shall be taken not to spill epoxy or overcoat the repair surface so that the epoxy runs or is squeezed out onto the surface which will remain exposed to view. Epoxy resin shall be used in strict conformance with manufacturer's recommendations with special attention paid to pot life, safety, and thin film tack time.

B. CORE HOLES

Core holes shall not be repaired with shotcrete. Instead, they shall be filled solid with a dry-pack mixture after being cleaned and thoroughly dampened.

3.4 FINISHING

A. Natural Gun Finish

Unless otherwise specified, provide undisturbed final layer of shotcrete as applied from nozzle without hand finishing.

B. Cutting Screed

After the surface has taken its initial set (crumbling slightly when cut), excess material outside the forms and ground wires shall be sliced off with a downward cutting motion using a sharp-edged cutting screed.

C. Flash Coat

A thin coat of shotcrete containing finer sand applied from a distance greater than normal shall be applied to the surface as soon as possible after the screeding.

D. Float and Trowel Finish

Final surface finish shall be provided using wood float, rubber float or steel trowel. Troweling of thin sections of shotcrete shall be avoided unless both troweling and commencement of moisture curing take place within a relatively short period after placement of shotcrete.

3.5 CURING AND PROTECTION

A. Initial Curing

Immediately after finishing, shotcrete shall be kept continuously moist for at least 3 days. One of the following materials or methods shall be used:

1. Ponding or continuous sprinkling.

2. Absorptive mat or fabric, sand, or other covering kept continuously wet.

3. Curing Compounds. On natural gun or flash finishes, use the coverage application requirement of 100 square feet/gallon or twice the manufacturer's requirement, whichever is less. Curing compounds shall not be used on any surfaces against which additional shotcrete or other cementitious finishing materials are to be bonded unless positive measures, such as sandblasting, are taken to completely remove curing compounds prior to the application of such additional materials.

B. Final Curing

Additional curing shall be provided immediately following the initial curing and before the shotcrete has dried. One of the following materials or methods shall be used:

1. Continue the method used in initial curing.

2. Application of impervious sheet material conforming to ASTM C171.

C. Formed Surfaces

If forms are to be removed during curing period, one of the curing materials or methods listed in paragraph Initial Curing shall be used immediately. Such curing shall be continued for the remainder of the curing period.

D. Duration of Curing

Curing shall be continued for the first 7 days after shotcreting or until the specified compressive flexural strength of the in-place shotcrete as determined by specimens obtained and tested in accordance with ASTM C42/C42M is achieved.

E. Temperature Consideration

The air temperature in contact with the shotcrete shall be continuously maintained at a temperature above 40 degrees F for at least 3 days after placement. No shotcrete shall be applied when the concrete surface or air in contact with the concrete surface is 40 degrees F.

3.6 TEST

A. Strength Test

Test specimens shall be initially cured onsite, then shall be transported in an approved manner to an approved testing laboratory meeting the requirements of ASTM C1077 within 48 hours of scheduled testing time.

B. Aggregate Moisture

Prior to batching the shotcrete and at least once during a shift in which shotcrete is being batched, the coarse and fine aggregate moisture content shall be determined in accordance with ASTM C566. The batch weights of both the aggregates and mixing water shall be appropriately adjusted to account for the available free moisture in the aggregates. The amount of free moisture in the aggregates, expressed as kg pounds of water per cubic meter yard, shall be recorded on the batching ticket and delivered to the Contracting Officer prior to placement during the shift. The Contracting Officer will have the option to request additional aggregate moisture content tests for each of the required tests.

C. Grading

The grading of the coarse and fine aggregate shall be determined in accordance with ASTM C136. The fine and coarse aggregate grading shall be determined prior to batching the shotcrete and at least once during a shift in which shotcrete is being batched. The Contracting Officer will have the option to require one additional sieve analysis test for aggregate type.

D. Thickness

The minimum shotcrete thickness shall be as shown in the drawings. The unhardened shotcrete shall be checked for thickness using a probe by the nozzleman or laborer at the time of placement. These thickness checks shall be at 15-minute intervals and all low or thin areas shall be corrected by applying additional shotcrete.

E. Mixture Proportions

Record and check mixture proportions at least once per shift for weigh batching. Record and check mixture proportions as recommended by ASTM C685/C685M at least once per shift for volumetric batching and continuous mixing plants.

F. Preparation

Prior to each placement of shotcrete, the Contractor's inspector shall certify in writing or by an approved checkout form that cleanup and preparations are in accordance with the plans and specifications.

G. Air Content

Air content tests shall be conducted on wet-mix shotcrete according to ASTM C231/C231M with a frequency of not less than once each shift nor less than once for each 40 cubic meters 50 cubic yards of shotcrete placed through the nozzle. Tests shall be conducted on samples taken as the wet shotcrete mixture is placed in the delivery equipment

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Description: This section includes specifications for metal fabrications and miscellaneous metalwork as indicated. Metal fabrications and miscellaneous items and their related components to be provided under this section includes; wide flange, steel plates, steel beams, channels, structural steel, anchor bolts; and accessories as required to complete the work.

B. Section Includes:

1. Installation
2. Galvanizing Repair
3. Field Painting

C. Related Sections:

1. Section 055200 - Metal fastenings

1.2 REFERENCES

ASTM INTERNATIONAL (ASTM)

ASTM A27	Standard Specification For Steel Casting, Carbon, for General Application
ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A384	Standard Practice of Safeguarding Against War page and Distortion During Hot- Dip Galvanizing of Steel Assemblies

ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot- Dip Galvanized Coating

A. The Society for Protective Coatings (SSPC)

SSPC-PA- 1	Shop, Field, and Maintenance Painting of Steel
SSPC-SP- 3	Power Tool Cleaning
SSPC-SP- 1	Solvent Cleaning

1.3 SUBMITTALS

DHHL approval is required for submittals. Submit the following:

A. Shop Drawings: Submit fully detailed shop drawings of metal fabrication and miscellaneous metal work showing sizes, details of fabrication and construction, methods of assembly, locations of anchors, accessories and installation details.

B. Product Data: Submit manufacture's product data for all manufactured items and products.

1.4 QUALITY CONTROL

A. Work Quality:

1. Shop and field work shall be performed by mechanics, craftsperson's, and workers skilled and experiences in the fabrication and installation of the metalwork involved.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Materials: Shapes: Standard structural section, shapes, and plates, as indicated, shall conform to ASTM A36.

B. Welding Rods/Electrodes: Conform to the requirements of Section 11-Metal Fastenings.

C. Casting: ASTM A27, as applicable to the work.

D. Anchors and Bolts: ASTM A307, or A 563, as applicable. Bolts and nuts shall be hot-dip galvanized in accordance with ASTM A153.

PART 3 - EXECUTION

3.1 FABRICATION

A. Metalwork shall be fabricated by firms or shops experienced and skilled in the custom fabrication and construction of metal fabrications and miscellaneous metalwork.

B. Welded connections shall be made in conformance with requirements of Section 11 - Metal Fastening. Where exposed to view, welds shall be ground down and dressed smooth do that the shape and profile of the item welded is maintained.

C. Forms and fabricate the work to meet installation conditions. Include anchors, fasteners, and accessories to secure the work in place, as indicated.

D. The Contractor may furnish standard manufactured products for components when applicable, provided that such products meet space limitations and installation conditions.

3.2 GALVANIZING

A. Steel and ferrous metal items exposed to moisture, and items indicated on Design Plans shall be galvanized after fabrication by the hot-dip process in accordance with ASTM A123. Weight of zinc coating shall conform to the requirements specified under "Weight of Coating" in ASTM A123.

B. Safeguarding against steel embrittlement shall conform to the applicable requirements of ASTM A123.

C. Safeguarding against warpage and distortion of steel members shall conform to the applicable requirements of ASTM A384.

D. Shop- galvanized metalwork necessitating field welding that in any manner removes the original galvanizing shall be restored by field galvanizing repair in accordance with ASTM A780.

E. Bolts for attachment of galvanized items shall be galvanized in accordance with ASTM A153.

3.3 CLEANING AND PAINTING

A. Non-galvanized Metalwork:

1. After fabrication and immediately before shop painting, ferrous metal work shall be power tool cleaned in accordance with SSPC- SP 3 to remove mill scale, rust, grease, oil, and other foreign matter. Welds shall be thoroughly wire brushed.

2. After power tool cleaning and just before shop painting, ferrous metalwork shall be washed with solvent to remove dust and residue in accordance with SSPC-SP-1.

3. After cleaning and solvent washing, ferrous metalwork shall be shop painted with one coat of corrosion- inhibitive metal primer in accordance with SSPC-PA-1. Materials and application shall conform to SSPC- Paint 13, Red or Brown One- Coat Shop Paint.

B. Galvanized Metalwork:

1. Galvanized metal surfaces shall then be given a shop coat of galvanized primer in conformance with SSPC-PA- 1. Materials and application shall conform to SSPC- Paint 5, Zinc- Dust, Zinc Oxide and Phenolic Varnish Paint.

3.4 INSTALLATION

A. Install metal fabrications and miscellaneous metalwork in accordance with the design plans and the shop drawings, using mechanics and worker skilled and experienced in the installation of the type of work involved.

B. Install metal fabrications and miscellaneous metalwork with all accessories furnished by the fabricator, as required for complete and finished installations.

C. Perform field welding, where required, in accordance with Section 11 - Metal Fastenings.

3.5 GALVANIZING REPAIR

A. Galvanized surfaces that have become damaged from welding, handling, or installation shall be repaired immediately after installation with galvanizing repair material in accordance with ASTM A780.

3.6 FIELD PAINTING

A. After installation, exposed painted surfaces, field welds, and other abraded or damaged primed surfaces shall be prepared as required and touched up with an additional coat of the same primers for ferrous and galvanized surfaces as herein before specified for shop painting. Spray-paint all touch-up work.

END OF SECTION

SECTION 055200
METAL FASTENINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Description: This section includes specifications for welding of structural metal fabrications and miscellaneous metalwork, including sheet steel, as indicated. This section also includes qualification of welders and welding procedures, inspections, and tests of welds.

B. Section Includes:

1. Field Quality Control

1.2 REFERENCES

ASTM International (ASTM)

ASTM E165	Standard Test method for Liquid Penetrant Examination

American Welding Society (AWS)

ANSI/AWS A2.4	Standard Symbols for Welding, Brazing, and Nondestructive Examination
ANSI/AWS A3.0	Standard Welding Terms and Definitions
ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS D1.3	Structural Welding Code – Sheet Steel
ANSI/AWS QC1	Standard for AWS Certification of Welding Inspectors

1.3 SUBMITTALS

DHHL Engineer approval is required for submittals. Submit the following:

A. For Shop drawings: Employ the standard welding symbols of AWS A2.4 and the standard welding terms of AWS A3.0.

B. Welder Qualifications: Submit certified copies of qualification test records for each welder, welding operator, and tack welder to be employed in the Work. Comply with requirements of ANSI/AWS D1.1, Section 4.

1. Submit welders' identification marks (I.D.) for each welder along with qualifications.

C. Welding Procedures: Prior to commencement of welding, submit the procedure that will be used for qualifying welding procedures. For procedures other than those prequalified in accordance with ANSI/AWS D1.1, submit a copy of procedure qualification records in accordance with the qualification requirements of ANSI/AWS D1.1, Section 4.

D. Welding Records and Data:

1. Retain all radiographs upon completion of fabrication.

2. Retain certifications that magnetic particle and dye- penetrate inspections have been satisfactorily completed.

3. Submit descriptive data for field welding equipment.

E. Mills Certificates: Retain mill certificates and certified copy of reports for all analysis and tests required by referenced ASTM and AWS specifications.

1.4 QUALITY ASSURANCE

A. Qualifications of Welders: Welders, Welding operators, and tack welders shall be qualified in accordance with ANSI/AWS D1.1, Section 4 “Qualification.”

B. Qualification of Welding Procedures: Welding procedures shall be prequalified or qualified in accordance with ANSI/AWS D1.1, Section 4 “Qualification”

C. Qualifications of Welding Inspector: Welds to be inspected by the Contractor shall be inspected and certified by a Contractor-employed AWS Certified Welding Inspector (CWI), certified in accordance with AWS QC1.

PART 2 - PRODUCTS

2.1 WELDING ROD/ELECTRODES

A. Electrodes for structural plates and shapes shall conform to ANSI/AWS A5 Series Standards and shall be coated rods or wire of size and classification number as recommended by their manufacturers for the positions and other conditions of actual use. Matching filler metal requirements shall conform to ANSI/AWS D1.1, Table 3.1 and Table 4.9.

B. Electrodes for sheet steel shall conform to ANSI/AWS A5 Series Standards and shall be coated rods or wire of size and classification number as recommended by their manufacturers for the positions and other conditions of actual use. Matching filler metal requirements shall conform to ANSI/AWS D1.3, Table 1.2.

2.2 SHOP DRAWINGS

A. Perform shop welding as indicated in accordance with ANSI/AWS D1.1, and ANSI/AWS D1.3, as applicable to the work.

PART 3 - EXECUTION

3.1 SHOP QUALITY CONTROL

A. Inspections and Tests by the Contractor

1. Visual Inspection: All welds shall be visually examined in accordance with ANSI/AWS D1.1, Section 6 and 7.8, as applicable. Quality of welds and standards of acceptance shall be in accordance with ANSI/AWS D1.1, as applicable.

2. Acceptance or Rejection of Welds:

a. Where inspection frequency is specified 10 percent, if reject occurs in the first 10-percent sample, select a second 10- percent sample and test. If no failure occurs in the second percent sample, accept the represented welds.

b. Rework and retest the reject welds in the first 10-percent sample. If a failure occurs in the second 10-percent sample, test 100 percent of the welds. Rework and retest all rejected welds.

c. Where inspection frequency is specified 50 percent, adopt the same procedure.

3. Liquid Penetrant Inspection: Liquid dye penetrant inspection of welds shall conform to ASTM E165. Liquid penetrant inspection may be used for detecting discontinuities that are open to surface.

4. Test Results: Test result information shall be forwarded to the Engineer immediately after results are available, stating the acceptance or rejection of fabricated components, so that repairs and reinspection or testing may be performed as soon as possible.

5. Repairs: Unacceptable welds shall be repaired in accordance with ANSI/AWS D1.1, Section 5.26. Repaired or corrected welds shall be reinspected or retested as specified for the original welds.

B. Shop Inspections and Tests by the DHHL:

1. All welds are subject to inspection and tests by the DHHL. Welds to be inspected and tested by the Engineer will be selected at random.

2. The DHHL will make the test results available to the contractor.

3.2 FIELD CONTROL

A. Inspections and Tests:

1. Perform tests of field welds as herein specified for shop welds.

2. The Engineer will perform visual inspections of field welds as herein specified for shop welds

B. Field Welding: Field welding shall be performed as herein specified for shop welds.

END OF SECTION

SECTION 10 14 53
SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A499	(1989; R 2008) Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails
ASTM A563	(2007a; R2014) Standard Specification for Carbon and Alloy Steel Nuts
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C94/C94M	(2014b) Standard Specification for Ready-Mixed Concrete
ASTM F436	(2011) Hardened Steel Washers

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA SHS	(2004; Supplement 2012) Standard Highway Signs
MUTCD	(2009) Manual on Uniform Traffic Control Devices

1.2 GENERAL

All signs must be in accordance with the MUTCD. Any signs not detailed on the drawings must be in accordance with the FHWA SHS.

1.3 SUBMITTALS

Submit the following for approval:

Product Data

Shop drawing of sign layout and lettering

PART 2 PRODUCTS

2.1 TRAFFIC SIGN POSTS

2.1.1 Steel Flanged Channel Section (U-Shape)

Fabricate steel posts from steel conforming to ASTM A36/A36M or ASTM A499 and with a minimum yield strength of 30 ksi and a minimum tensile strength of 50 ksi. Punch or drill 5/16 to 3/8 inch diameter holes spaced at 1 or 2 inch centers along the centerline of the web prior to galvanizing for the entire length of the post. Galvanize posts after punching in accordance with ASTM A123/A123M.

2.1.2.1 High-Strength Bolts, Nuts and Washers

High strength bolts must conform to ASTM A325. Nuts must conform to ASTM A563. Washers must conform to ASTM F436. High strength bolts, nuts and washers must be zinc coated.

2.2 FLAT ALUMINUM SIGN PANELS

Aluminum sign panels must conform to ASTM B209, alloy-temper 6061-T6 or 5052-H38. The blanks must be free from laminations, blisters, open seams, pits, holes, other defects that may affect their appearance or use. The thickness must be uniform and the blank commercially flat.

2.3 LETTERS, NUMERALS, ARROWS, SYMBOLS, AND BORDERS

Apply letters, numerals, arrows, symbols, and borders on the signs as indicated.

2.4 HARDWARE

Bolts, nuts, post clips, lock and flat washers must be either aluminum alloy or commercial quality stainless steel, hot-dip galvanized or cadmium plated after fabrication. Provide fiber washers of commercial quality.

2.5 CONCRETE

ASTM C94/C94M, using 3/4 inch maximum aggregate, and having minimum compressive strength of 3000 psi at 28 days.

PART 3 EXECUTION

3.1 SIGN POSTS

3.1.1 Steel Flanged Channel Section

Embed steel sign base posts in concrete as indicated.

3.2 SIGN PANELS

Clean, degrease and etch the face of metal panels. Replace any damaged sign panels at no additional cost to the Government.

3.3 LOCATION AND POSITION OF SIGNS

Locate and erect all signs in accordance with the drawings. .

END OF SECTION

SECTION 311100
CLEARING AND GRUBBING

PART 1 -- GENERAL

1.1 DESCRIPTON

A. This section describes clearing, grubbing, protecting trees, vegetation, and objects designated to remain, removing and disposing of vegetation, debris, and unwanted material from right-of-way, easements, road approaches, project and borrow pit sites, and other areas designated in the contract documents or by DHHL.

1.2 SUMMARY

A. This section covers the requirements for clearing and grubbing, within the areas shown on the plan or as directed by DHHL outside the clearing limits. Also included is the protection from injury or defacement of trees and other objects designated to remain and treatment or removal of damaged trees.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 PRESERVATION OF PROPERTY

A. The areas to be cleared and grubbed shall be to the dimensions shown on the Drawings. Every precaution shall be taken to prevent injury to such growth as well as adjacent property line of the project site.

3.2 PROTECTION

A. Roads and Walks

Keep roads and walks free of dirt and debris at all times.

B. Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

C. Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify DHHL immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify DHHL in ample time to minimize interruption of the service.

3.3 CLEARING

A. Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared.

B. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint.

3.4 PRUNING

A. Prune and trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as approved by DHHL . Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches.

3.5 GRUBBING

A. Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.6 REMOVAL AND DISPOSAL OF MATERIALS

A. All materials cleared shall be hauled away from the site and disposed of by the Contractor. No materials shall be dumped on private or public property without proper authority.

END OF SECTION

SECTION 312400
EXCAVATION AND EMBANKMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all labor, materials and equipment necessary to excavate, import, dispose, and compact fill material within the limits of grading designated on the Contract. Work includes services of a Geotechnical Engineer The Contractor shall hire a geotechnical engineer licensed in the State of Hawaii to oversee construction of the new buttress fill.

B. Work in this Section includes construction of pervious drainage blanket filter layers and sub drain as specified in SECTION 334000, installation of geotextile fabric in SECTION 313500 and placement of ground water monitoring wells and piezometers as recommended by the Geotechnical report.

C. Subsurface explorations for soil conditions are performed under this contract as specified in SECTION 011200.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

A. ASTM INTERNATIONAL (ASTM)

ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2216	(2010) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D698	(2012; E 2014) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.)

ASTM F667 (2012) Large Diameter Corrugated Polyethylene Pipe and Fittings

B. U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 1110-2-1906 (1986) Laboratory Soils Testing

PART 2 - PRODUCTS

2.1 MATERIALS

The origin of any fill material does not determine where it may be used in the embankment. Materials for embankment fills shall be secured from required excavations and from approved barrow areas. The intention is to use the most suitable materials obtainable from these sources. Material to be wasted will be specifically designated at the time the material is excavated. Materials containing brush, roots, sod or other perishable materials will not be considered suitable. The suitability of the materials shall be subject to approval and their disposition in the embankment will be as directed. Mixing of materials during the excavating process at the borrow area may be required. Classification of soils will be in accordance with ASTM D2487.

B. Earth Fill

Material imported or excavated on the property may be utilized in the fill, provided each material conforms to the specifications herein. Roots, tree branches, and other deleterious materials missed during clearing operations shall be removed from the fill. Fill material shall be non-expansive soil with a plasticity index not greater than 20. It shall be free of rocks and soil clumps greater than 3 inches in maximum dimension and free of organic and other deleterious materials. The deeper natural soils with moisture contents considerably above optimum level shall be aerated or other satisfactory methods to achieve optimum water content and adequate compaction levels.

Representative samples of the materials to be utilized as compacted fill shall be tested by the Contractor at an approved soils engineering laboratory and submitted for evaluation by the Soils Engineer to determine their physical properties. Samples of the proposed materials shall be submitted for approval.

C Rocks

Rocks larger than 3 inches in maximum dimension shall be taken offsite or placed in the deeper fill areas or slope protection. In no case, however, shall these rocks be placed within 3 feet of the finish grade or subgrade or have a minimum soil cover less than the diameter of the rock, whichever is greater. The rocks should not be nested in concentrated pockets.

A. Filter Drainage Layers (Drainage Blanket)

Filter materials shall be composed of tough, durable particles; shall be reasonably free from thin, flat and elongated pieces; and shall contain no organic matter nor soft, friable particles in quantities considered objection-able by the Contracting Officer. Filter materials shall consist of sand, gravel, or crushed stone, well graded between the limits specified below.

SIEVE SIZE	PEPERCENT BY WEIGHT PAPASSSSING
1-1/2”	90-100
3/4”	50-90
#4	15-50
100	0-5

Gradation of the material shall be determined in accordance with ASTM D2487. All points on individual grading curves obtained from representative samples of filter material shall lie between the boundary limits as defined by smooth curves drawn through the tabulated grading limits plotted on a mechanical analysis diagram. The individual grading curves within these limits shall not exhibit abrupt changes in slope denoting skip grading, scalping of certain sizes or other irregularities which would be detrimental to the proper functioning of the filter

B. Perforated corrugated polyethylene (PE) pipe and fittings (Subdrain)

ASTM F667 for pipe. Fittings shall be manufacturer's standard type and shall conform to the indicated specification. Pipe perforations inlet area shall be a minimum of 0.5 square inch per linear foot. Manufacturer's standard perforated pipe which essentially meets these requirements may be substituted with prior approval of HHLD.

C. Piezometer

Not Used

D. Settlement Gauge

Not Used

E. Surface Reference Marks

2” diameter bronze survey mark set on reinforcing bar with concrete collar.

PART 3 - EXECUTION

3.1 PROCEDURES

A. Finish the excavation and embankment area to smooth and uniform surfaces. Do not disturb the material outside the limits of grading .

B. Comply with all local, State, and Federal laws, regulations, standards, and guidelines related to grading, soil erosion, and sediment controls.

3.2 EXCAVATION

A. Slopes: Finish cut slopes to two (2) horizontal to one (1) vertical or flatter and to the required lines and slopes except where indicated otherwise. Maintain slopes, whether old or new, with true and smooth surfaces.

B. Each excavated embankment slope bench shall not exceed two (2) feet in height.

C. Use surplus excavated material approved by the DHHL as fill for the buttress and to fill localized depressions as shown in the Contract Drawings or as ordered by the DHHL.

D. If the Contractor imports earth fills for use as the buttress fills, the Contractor shall notify the DHHL in writing of the location of the borrow site in sufficient time in advance to allow for samples to be obtained and tests performed to determine the suitability of the proposed alternate fill material.

E. The Contractor shall hire a geotechnical engineer licensed in the State of Hawaii to obtain samples and conduct testing to determine the suitability of alternate fill material.

F. The Contractor shall complete embankments before arranging the disposal of surplus excavation. the Contractor shall not dispose surplus material unless authorized by the DHHL.

G. Surplus material authorized by the DHHL for disposal shall become the Contractor's property and be removed from the property. Disposal of surplus material shall be considered incidental to the contract items.

3.3 EMBANKMENT

A. Construct embankments within the project limits, including preparation of the area receiving the approved fill material.

B. Place and compact approved fill material within the project area where unsuitable material was removed; and placing and compacting of embankment materials in holes, pits, and localized depressions within the project area.

C. Finish fill slopes at two (2) horizontal to one (1) vertical except where indicated on the Contract Drawings

D. Use only approved fill material in the construction of embankment and backfill

E. Do not place rocks, boulders, or cobbles greater than six (6) inches in diameter ; broken concrete; solid materials; large roots; or organic debris in embankment areas.

F. Continuously bench slopes steeper than five (5) horizontal to one (1) vertical on hillsides or build embankments one-half (1/2) width at a time,.

G. Benching shall be of sufficient width to permit operation of placing and compacting equipment. Begin each horizontal cut at the intersection of the original ground and the vertical sides of the previous cuts.

H. Place embankment fill material in horizontal layers not exceeding twelve (12) inches in loose thickness and compacted to 6-inch lifts at a minimum of 95 percent relative compaction and moisture conditioned to within two (2) percent of optimum water content per ASTM D-1557 before placing the next layer.

I. Construct the center of embankment layers higher than the sides. Construct side hill embankments with the intersection with original ground as high point of the layer. Uniformly slope to the outer side. Do not exceed the cross fall of layers one (1) foot in twenty (20) feet.

J. Until the final acceptance of the Contract, maintain embankments to the grade and cross section shown in the Contract Drawings. Contractor is responsible for the stability of the constructed embankments. Replace portions that become displaced or damaged at no cost to the DHHL.

K. The DHHL will consider heavy rain a cause for shutting down grading operations.

L. Prior to placement of buttress toe fills, the existing ground under the footprint of the proposed fills shall be excavated allowing the buttress fills to be keyed into the ground at the toe of the embankment. The excavated key areas shall be proof rolled and a layer of nonwoven geotextile fabric, TenCate Geosynthehics Mirafi 180N or equal, shall be placed over the entire prepared keyed footprint and embankment surface to be covered by the buttress toe fills.

M. The existing embankment surface shall be keyed and benched prior to placement of rock as indicated in the Contract Drawings.

N. Placement of fills shall be completed on an excavated slope benched prior to excavation of benches further upslope.

O. The excavated bench areas shall be proof rolled and a layer of nonwoven geotextile fabric, TenCate Geosynthetics Mirafi 180N or equal, shall be placed over the

entire prepared benched embankment surface footprint to be covered by the buttress toe fills.

P. Overlapping ends of the adjacent geotextiles fabric shall be sewn to have two (2) feet minimum overlap to prevent separation of shifting during placement and compaction of fills. shall ensure that the geotextile fabric is not punctured or torn during placement or compaction of the buttress fills.

Q. To separate the lower rock and the upper compacted earth fills of the buttress, the bench atop the earth fill buttress across the entire existing embankment face shall be covered with a layer of nonwoven geotextile fabric, TenCate Geosynthetics Mirafi 180N or equal. To avoid puncture or tears of the separating geotextile fabric, the rock layer shall be graded with smaller sized rocks and cobbles beneath the fabric layer. A 12-inch thick minimum cushion layer comprised of clean gravel shall be placed between the geotextile fabric and the rock fills. Ensure that the geotextile fabric is not punctured or torn during placement or compaction of fills.

R. A layer of seepage/runoff collection sub-drainage blanket with a perforated drainage pipe shall be installed at the base of the buttress fill within the keyed and benched excavation to provide for critical drainage relief and allow for periodic monitoring of seepage quantities and turbidity. The perforated drainage pipe shall be constructed within the keyed excavation and shall run parallel to the toe under the entire buttress fill length along the embankment as shown in the Contract Drawings.

S. The perforated drainage pipe shall be placed in a bedding of clean and free-drainage, self compacting, granular backfill passing through a 1-inch sieve and containing less than 5 percent fines. A minimum granular through a 1-inch sieve and containing less than 5 percent fines. The slotted section of the perforated drainage pipe shall be placed i a downward facing direction to prevent clogging. The slotted drainage pipe and granular backfill shall be completely wrapped in a nonwoven geotextile fabric, TenCate Geosynthetics Mirafi 180N or equal. A minimum overlap of two (2) feet is required at all locations where ends of the filter fabrics meet to prevent drainage aggregate from contamination.

3.6 COMPACTION

A. Embankment shall be compacted to 95% of the materials maximum dry density as determined by ASTM D1556 or ASTM D6938

3.7 SLIDES

In the event of slides, in any part of the embankment prior to final acceptance of the work, remove material from the slide area, as directed, and rebuild such portion of the embankment. In case it is determined that the slide was caused through the fault of the Contractor, the removal and disposal of material and the rebuilding of the embankment shall be performed

without cost to the Government; otherwise this work will be paid for at the applicable contract unit prices for borrow excavation and compacted fill or backfill.

3.8 PIEZOMETERS

Piezometer casing and riser pipes shall be installed by Contractor under SECTION 011200.
The installation of the piezometer instruments in the casings will be done under observation by the Geotechnical Engnieer.

No separate payment will be made for such protection or for special measures required in connection with the installation of these devices; all costs thereof shall be included in the contract prices bid for related items of work.

3.9 LOCATION AND INSTALLATION OF SETTLEMENT GAGES

Furnish and install settlement gages for determining foundation settlement during construction. Type, arrangement and location of gages shall be as shown. The areas in which adjustment in quantities will be made as a result of foundation settlement are as indicated on the plans. The base plate shall be placed on a level surface of well compacted foundation material. Determine the elevations of the base plates before placing fill material and again within 48 hours after completion of the embankment. The elevation of the stem shall be determined immediately before and immediately after each extension is added. These elevations will be verified by DHHL. Care shall be taken to install the stem plumb. Extend the stem in increments as the embankment rises but at no time shall the top of the stem be lower than 2 feet above the surface of the embankment. Conduct these operations in such a manner that the gages will not be damaged. Suitable guard posts shall be placed around the gages for protection. Fill around the stem shall be compacted to the same density and moisture content as the surrounding material. Any settlement gage damaged or destroyed due to fault or negligence shall be restored or replaced at no additional cost to DHHL. No additional payment will be made for compaction of fill around and over the settlement gages or for interference with the Contractor's operations resulting from the settlement gage installations.

3.10 SURFACE REFERENCE MARKS.

Furnish and install surface reference marks as shown. Furnish the horizontal and vertical location of each reference mark with respect to established bench marks at the time of installation until completion of the contract. Conduct these operations in such a manner that the reference marks will not be disturbed or damaged. Any reference mark disturbed or damaged due to negligence on the Contractor's part shall be replaced or repaired and the correct horizontal and vertical locations shall be furnished at the Contractor's expense.

END OF SECTION

SECTION 313500
SLOPE PROTECTION

PART 1 -- GENERAL

1.1 DESCRIPTION

A. Slope protection consist of rock 18 inch thick or as indicated. The slope protection shall be placed in conformance with these specifications, the special provisions, and the details and dimensions shown on the plans or as directed by the DHHL.

1.2 SCOPE OF WORK

A. The work comprises the provision of all labor, materials, tools, transportation, instrumentation and etc. necessary to construct the Slope Protection/Revetment in accordance to the drawings and to the quality standards set in the specifications, inclusive of material and performance tests where these are specified.

1.3 PREPARATION OF SITE

A. All topsoil shall be stripped and, where required for further use, stockpiled in an area provided by the DHHL and agreed by the Engineer.

B. All trees, fallen timber, vegetation, loose stone, fencing and similar debris shall be cleared completely ahead of any subsequent construction works.

1.4 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. the publications are referred to in the basis designation only.

ASTM INTERNATIONAL (ASTM)

C88:	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
C127:	Specific Gravity and Absorption of Coarse Aggregate.
C295:	Petrographic Examination of Aggregates for Concrete.
C535:	Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
D1141:	Substitute Ocean Water.
D4491	Water Permeability of Geotextiles by Permittivity.

D4533 Trapezoid Tearing Strength of Geotextiles.

D4595 Tensile Properties of Geotextiles by the Wide-Width Strip Method.

D4632 Grab Breaking Load and Elongation of Geotextiles.

D4751 Determining Apparent Opening Size of a Geotextile.

D4833 Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

U.S ARMY CORPS OF ENGINEERS (COE)

COE: Handbook for Cement and Concrete (CRD).

COE CRD-C 148: Method of Testing Stone for Expansive Breakdown on Soaking in Ethylene Glycol.

1.5 SUBMITTALS

A. Contractor shall provide submittals in conformance with the requirements of the General and Special Conditions.

B. Manufacturer's Catalog Data:

1. Geotextile Fabric

C. Construction Equipment List: Rock Placing equipment

D. Samples

1. Geotextile Fabric
2. Bedding Stone
3. Submit the above, for approval prior to initial delivery to the job site.

E. Test Reports

1. Specific gravity.
2. Absorption.
3. Soundness.
4. Gradation.
5. Wetting and drying.
6. Abrasion loss.
7. Accelerated expansion.
8. Submit the above for armor stone, under layer stone, and bedding stone, for approval prior to delivery to the job site.

F. Certificates of Compliance

G. Field Test Report

1. Gradation: Submit for approval for each shipment of stone material used.
2. Inspection Report
3. Record Drawings

1.6 DELIVERY AND STORAGE

A. Deliver and store materials in a manner to prevent contamination and segregation.

PART 2 -- PRODUCTS

2.1 DEFINITIONS

A. ROUNDED STONE: Stone which is obtained from alluvial deposits and nearly spherical and well rounded.

B. ANGULAR STONE: Stone which is obtained from bedrock deposits and is angular in shape.

2.2 ARRANGEMENTS

A. The Contractor shall make all arrangements, pay all royalties, and secure all permits for the procurement, furnishing and transporting of stone. The Contractor shall vary the quarrying/excavation, processing, loading and placing operations to produce the sizes and quality of stone specified. If the stone being furnished by the Contractor does not fully meet all the requirements of these specifications, the Contractor shall furnish, at no additional cost to the DHHL, other stone meeting the requirements of these specifications.

2.3 APPROVAL

A. No materials shall be used in the works unless they have been a approved by the DHHL.

B. Before any stone is produced from a source for completion of the Work under this Contract, the source of stone must be submitted for approval. Materials which do not comply with the specifications will be rejected.

C. Only rocks from a source approved by the DHHL shall be used in the Works of this Contract.

2.4 SOURCE DEVELOPMENT

A. Before a proposed source or sources of stone will be considered for sampling and testing, the Contractor must demonstrate that the source has sufficient stone to fulfill the Contract requirements. If sufficient amounts of stone conforming to

these specifications are not available from a source or sources used in the Work, the Contractor shall submit stone from another source for approval.

2.5 STONE DOCUMENTATION

A. Authorization of a proposed stone source will be based on test results and/or service records. In general, current test results shall be required. In special cases, however, the Contracting Officer or his approved representative may elect to use either past test results or a combination of service records along with test results from other agencies or private laboratories. A service record is considered to be acceptable if stone from the proposed source has remained sound and functional after at least 10 years of exposure on a project similar to the one to be constructed under these specifications.

2.6 QUALITY COMPLIANCE TESTING

A. Samples for testing shall be obtained a minimum of 45 days in advance of the time when the stone will be required in the Work. Stone from a proposed source or sources shall be tested by an independent testing laboratory for quality compliance. All test samples (500 pounds minimum) shall be representative of the stone source and shall be obtained by the Contractor in the presence of the Inspector and delivered at the Contractor's expense to a testing laboratory approved by the DHHL. The cost of testing will be at the Contractor's expense.

2.7 STONE QUALITY

A. Stone shall meet the following test requirements

Test Method	Requirements	
Specific Gravity (Bulk SSD)	ASTM C127	2.65 minimum
Absorption	ASTM C127	2.0% maximum
Wetting and Drying	SPD Test Procedure	No Fracturing
Sulfate Soundness	ASTM C88	10% maximum loss
Abrasion Loss	ASTM C535	50% maximum loss
Accelerated Expansion	COE CRD C 148	15% maximum loss

B. In addition to the above tests, the stone shall be subjected to a petrographic and X-ray diffraction analysis in accordance with ASTM C295. The stone must not contain any expansive clays.

1. Test procedure for wetting and drying test. The entire sample is carefully examined and representative test specimens are selected. The sample should be large enough to produce two cut slabs, 1 inch thick (+1/4 inch) with a minimum surface area of 30 square inches on one side. Two chunks approximately 3 by 4 inches are also chosen. The slabs and chunks are carefully examined under a low power microscope and all

visible surface features are noted and recorded. The specimens are then oven dried at 140 deg F for 8 hours, cooled and weighed to the nearest tenth of a gram. The test specimens are photographed to show all surface features before the test. The chunks and slabs are then subjected to 15 cycles of wetting and drying. One slab and one chunk are soaked in fresh tap water, the other slab and chunk are soaked in saltwater prepared in accordance with ASTM D1141. Each cycle consists of soaking for 16 hours at room temperature and then drying in an oven for 8 hours at 140 deg F.

2. After each cycle the specimens are examined with the low power microscope to check for opening or movement of fractures, flaking along edges, swelling of clays, softening of rock surfaces, heaving of micaceous minerals, breakdown of matrix material and any other evidence of weakness developing in the rock. The cycle in which any of these actions occurs is recorded. After 15 cycles, the slabs and chunks are again carefully examined and all changes in the rocks are noted and recorded. The test specimens together with all particles broken off during the test are oven dried, weighed and photographed.

3. The test shall be made on 50 particles, each weighing 180 grams, +25 grams, in lieu of the gradation given in ASTM C88.

4. Weakening and loss of individual surface particles is permissible unless bonding of the surface grains softens and causes general disintegration of the surface material.

5. Stone which has a loss greater than the specified limit will be accepted if the Contractor demonstrates that the stone has a satisfactory service record.

2.8 GRADATION SAMPLING AND TESTING

A. A gradation test shall be performed by an approved testing laboratory on samples selected by the Contracting Officer and his approved representative. The DHHL reserves the right to perform check tests and to use the Contractor's sampling and testing facilities to make the tests. Each sample shall consist of not less than 5 tons of materials and shall be selected at random from the production run. One gradation test is required at the beginning of production prior to delivery of stone to the project. All sampling and gradation tests performed by the Contractor shall be in the presence of the Inspector. Sampling and gradation test results shall be submitted for approval.

1. Gradation Curves: All points on individual grading curves shall be between the boundary limits as defined by smooth curves drawn through specified grading limits plotted on a mechanical analysis of diagram. The individual grading curves shall not exhibit abrupt changes in slope denoting skip grading or scalping of certain sizes. Specified grading of

all material shall be met both at the source and as delivered to the Project. In addition, material not meeting the required grading due to segregation or degradation during placement shall be rejected. If best results show that stone does not meet the required grading, the hauling operation will be stopped immediately and will not resume until processing procedures are adjusted and a gradation test is completed showing gradation requirements are met. All gradation tests shall be at the expense of the Contractor.

B. Shape: All new stone shall be angular material with a shape, which assures interlocking with adjacent stone. Stone 100 pounds in weight and larger shall have the greatest dimension not greater than 3 times the least dimension.

2.9 MATERIALS

A. Stone: Hard, dense, durable, and reasonably well graded within the following limits. Bulk specific gravity, absorption, and soundness.

STONE GRADATION

Sieve Designation U.S. Std. Square Mesh	Individual Percentage By Weight, Passing
12 inches	70-100
8 inches	30-70
4 inches	0-30

2.10 GEOTEXTILE FILTER FABRIC

A. Pervious sheet, woven of polypropylene monofilament yarns calendered after weaving so that the filaments retain their relative positions with respect to each other. Cloth shall be a minimum of 15 mils thick and weigh approximately 8.0 ounces/square foot. The yarn shall be 85 percent propylene and shall contain stabilizers and inhibitors added to the base plastic to make the filaments resistant to ultraviolet and/or heat exposure. Provide material with a service record of at least 5 years in projects generally of similar nature. Provide rolls of minimum 30 feet wide.

B. Provide geotextile filter fabric that meets or exceeds the following properties:

1. Grab Tensile Strength (minimum): ASTM D4632.

   a. MD at Ultimate = 400 lbs.
   b. CMD at Ultimate = 335 lbs.
   c. MD Elongation at Ultimate = 20 Percent
   d. CMD Elongation at Ultimate = 15 Percent

2. Wide-Width Tensile Strength: ASTM D4595.

a. MD at Ultimate = 230 lbs/in.
b. CMD at Ultimate = 225 lbs/in.

3. Trapezoidal Tear Strength: ASTM D4533.

a. MD at Ultimate = 145 lbs.
b. CMD at Ultimate = 125 lbs.

4. Puncture Strength: ASTM D4833 = 125 lbs.

5. UV Resistance: ASTM D4355 = 80 Percent of strength after 500 hours

6. Apparent Opening Size: ASTM D4751

a. AOS = U.S. Sieve No. 30.

7. Permittivity: AST< D4491 = 1.50 sec^{-1}.

8. Percent Open Area: COE-02215-86.

a. POA = 8 Percent.

9. Flow Rate: ASTM D4491 = 115 $gal./min./ft.^{2}$.

C. Anchor Pins: Steel, 3/16 inch diameter by 20 inches long, hot dip galvanized, with round washers.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. All material used in the works shall be subjected to inspection and test as provided in the Conditions of Contract and elsewhere in the specifications.

B. Verify site conditions are as indicated on the drawings. Notify the Engineer if site conditions are not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.

3.2 BASE PREPARATION

A. Do not begin placement of bedding until the grade on which it is to be placed has been approved by the DHHL and his approved representative. Perform preparatory excavating, filling, compacting and grading of the base for the bedding to the lines, slopes, and elevations indicated on the drawings or as directed.

1. Submit for approval the method of placement before commencement of placing operations.

3.3 INSTALLATION

A. Geotextile Filter Fabric: Place filter fabric in one continuous sheet from the top of the slope to the bottom. Side laps shall be a minimum of 2 feet wide. Secure material to the slope with pins and washers spaced 10 feet on center each way, and spaced 5 feet on center for side laps. Place fabric with 12 inch tucks approximately every 15 feet to prevent excessive tension due to placement of the riprap.

B. Revetment Construction: Care shall be taken to place the riprap of the various classifications so they will make a compact mass, and form uniform blankets of the thickness, lines, slopes and elevations as shown on the contract drawings. Stones placed by clamshell or similar device shall be lowered to rest before dumping. Placing stones by dumping into chutes or by similar methods likely to cause segregation of the various sizes will not be permitted. Do not drop any revetment material from a height of greater than 3 ft.

C Bedding Stone: Thickness of the bedding stone shall be within minus 3 inches or plus 3 inches of the thickness shown on the drawings. Spread bedding material uniformly on the prepared filter fabric to the lines and grades indicated on the drawings or as directed. Place material by methods which will not segregate particle sizes within the bedding. Damage to the surface of the bedding base or filter fabric during placing of the bedding shall be repaired before proceeding with the work. Compaction of the bedding will not be required, but it shall be finished to present a reasonably even surface free from mounds or windrows.

1. Grading: The larger stones shall be well distributed and the entire mass of stones shall be generally graded to conform to the gradation specified in paragraph entitled "Materials". The finished revetment shall be free from objectionable pockets of small stones and clusters of larger stones. Hand placing to a limited extent may be required but only to the extent necessary to secure the results specified above.

2. Tolerances: A tolerance of minus 6 inches or plus 12 inches from the lines and grades shown on the drawings will be allowed in the finished surface of the revetment placed under water except that either extreme of such tolerance shall not extend over an area greater than 225 square feet. A tolerance of minus 6 inches or plus 6 inches from the lines and grades shown on the drawings will be allowed in the finished surface of the armor stone layer placed in the dry except that either extreme of such tolerance shall not be continuous over an area greater than 100 square feet. The desired distribution of the various sizes of stones throughout the mass may be obtained, at the option of the Contractor, either by selective

loading at the quarry or other source, by controlled dumping of successive loads during final placing, or by a combination of these methods.

D. Rejected Stone: Rejected stone is defined as stone not suitable as to quality and/or size distribution for any class of stone required to complete the Work. Any rejected stone shall be promptly removed from the construction site at no expense to the DHHL. Any areas containing rejected stone will be considered as incomplete work.

3.4 MAINTENANCE

A. Maintain the slope protection until accepted by the Contracting Officer and his approved representative. Any material displaced by any cause shall be replaced, at no expense to the DHHL, to the lines and grades shown on the drawings and specified herein.

END OF SECTION

SECTION 313717
RIPRAP NON-GROUTED

PART 1 - GENERAL

1.1 SUMMARY

A. Description: This section includes furnishing and placing of cement mortar and rocks on prepared surfaces, as shown on the plans and as specified herein.

B. Section Includes:

1. Examination
2. Preparation
3. Riprap Placement
4. Protection

C. Related Sections:

1. Section 313500 Slope Protection

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C127	(2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM C97	(2007) Standard Test Method for Absorption and Bulk Specific Gravity of dimensioned stone.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T85	Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
AASHTO T96	Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T104	Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

COUNTY OF KAUAI

STANDARD SPECIFICATIONS	Standard Specifications for Public Works Construction, September 1986, as amended.

1.3 DEFINITIONS

A. Riprap (also known as rip rap, rubble, revetment, shot rock, or rock armor): Consists of a flexible channel or bank lining or facing consisting of a well graded mixture of rock, broken concrete or other material, usually dumped or hand-placed, which provides protection from erosion." (FHWA-IP-89-016).

B. Drop Rock: Consists of riprap placed by dumping.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate work with the agency having jurisdictional authority over the Work Area. Coordinate jurisdictional authority submittal requirements with submittals required herein.

B. Pre- Installation Meetings:

1. Arrange and hold a pre-installation meeting a minimum of 30 days prior to start of work covered herein. Attendees shall at a minimum include the Contractor, jurisdictional authority, and the DHHL.

2. Provide an overview of the planned work schedule and planned operations, including graphics and equipment lists necessary how and methods by which the Work will be undertaken.

C. Sequencing: Except as noted otherwise in other Sections, sequencing of riprap work shall be the responsibility of the Contractor.

1.5 SUBMITTALS

A. Work Plan:

1. Submit for the DHHL review riprap work plan for work to be performed prior to commencement of work and prior to submittal to jurisdictional authority.

2. At least 14 days before the planned date of the pre-installation meeting, provide the DHHL with an agenda and sample of distribution materials for review and comment.

3. The work plan shall describe the method of demolition, if any, subgrade preparation and placement of the rock.

B. Product Data: Certificate of compliance from proposed rock supplier that the material or materials proposed meet the quality required and gradation limits specified.

C. Samples:

1. As required, representative sample of proposed rock shall be collected from proposed source and submitted at least 60 days before beginning of riprap placement. Size of rock sample required shall be based on the maximum size of material to be used. Sampling of materials and submittal to independent testing laboratory shall be at the sole discretion of the DHHL. Any testing performed by the DHHL does not relieve the Contractor of complying with the quality and size requirements.

2. A material change in riprap characteristics or source will require, at the DHHL sole discretion, additional samples and testing.

3. Make the riprap source site available for the DHHL inspection and provide assistance as necessary for the DHHL to procure representative samples for its own evaluation purposes.

D. Test and Evaluation Reports:

1. Laboratory testing required herein shall be by an independent, third-party laboratory accredited to perform the required testing.

2. Provide the DHHL with originals or certified copies of test reports of required riprap testing.

1.6 QUALITY ASSURANCE

A. Approved materials shall not be substituted without prior written approval from the DHHL.

B. Preconstruction Testing: The DHHL reserves the right to perform testing on any of the materials proposed or used in the Work to assess conformance with the requirements of these Specifications. Testing performed by the DHHL does relieve the Contractor of performing the testing specified in these Specifications.

C. Qualifications:

1. Suppliers:

a. Riprap supplier shall be a duly licensed business conforming to the requirements of the state or municipality in which it is located.

b. Suppliers shall be in conformance with all prevailing and applicable environmental and pollution control requirements, with no outstanding citations for non-compliance.

2. Laboratory Testing: Accreditation by AASHTO or the Hawaii Department of Transportation (HDOT) shall be deemed acceptable.

D. Field Samples:

1. The DHHL at its discretion will take samples from the field, including on-site stockpiles of the materials to be used, for conformance evaluation.

2. No materials shall be used which, after approval, have become unfit for use, as determined by the DHHL.

3. The DHHL reserves the right to reject non-conforming materials at any time until the final acceptance.

E. Restoration:

1. Work areas shall be restored in accordance with Contract Document requirements.

2. Damage to the existing facilities as a result of the Contractor's work shall be replaced or repaired in-king at no cost to the DHHL.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Ensure that only approved materials are delivered to the work site, including staging areas.

2. Duplicate copies of the trip or load tickets shall be maintained in the Contractor's field office and upon request, made available to the DHHL.

3. Materials not conforming to these requirements or otherwise found to be deficient by the DHHL shall immediately be removed from the work area, including staging areas.

B. Storage and Handling Requirements: Stone for riprap shall be maintained in discrete and orderly stockpiles. Stockpiling areas shall be prepared as to minimize run-on and co-mingling with on-site materials that would make the materials unsuitable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. See Government Furnished Materials above.

B. Riprap: shall be hard durable and free of fracture, angular in shape, weather-resistant, and free from overburden, spoil, friable materials and organic material. Stone shall meet or exceed the following requirements:

1. The stones shall be angular in shape with the following additional requirements:

a. Not more than *25* percent of the stones reasonably well distributed throughout the gradation shall have a length more than 2.5 times the breadth or thickness.

b. No stone shall have a length exceeding 3.0 times its breadth or thickness.

2. Size: Weight distribution of pieces provided as determined by ASTM C97.

3. Specific gravity of the stone shall be at least 2.5 when tested in accordance with AASHTO T85.

4. Water absorption: 3.0 percent maximum when tested in accordance with AASHTO T85.

5. Resistance to abrasion: Grade B maximum when tested in accordance with AASHTO T96.

6. Soundness: 20 percent maximum loss when tested in accordance with AASHTO T104.

C. Geotextiles, where required, shall conform to the requirements of Section 313500 – Slope Protection

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine site areas and inspect conditions prior to the start of the Work, and notify the DHHL of conditions detrimental to the proper and timely completion of the Work.

B. Call for an inspection by the DHHL, at least 1 week in advance, to obtain approval of the prepared subgrade before proceeding with the riprap placement.

C. The subgrade to receive riprap immediately prior to placement shall conform to the compaction and elevation tolerances indicated for the material involved.

3.2 PREPARATION

A. Protect In-Place Conditions:

1. Protect existing work from damage and harm during prosecution of this Work.

2. Remove and replaced materials, including drainage blanket, geotextile, and riprap that has been placed and then subsequent become damaged or otherwise during the Contractor's operations.

B. Surface Preparation:

1. Prepare surface locations for new riprap.

2. All material including riprap, not suitable for use on the Contract shall be removed and disposed of away from the work site.

3. Excavate or construct fill slopes to the required cross-section, lines, and grades.

4. Remove loose materials and buried debris protruding from subgrade, and backfill to required cross-section, lines, and grades.

5. As required, place drainage material and geotextile, both of which shall be subject to DHHL review and acceptance.

6. Geotextile fabric placement shall be as specified on the drawings. Where no explicit direction is given on the drawings, geotextile installation shall be according to manufacturer's recommendations.

7. Broken Portland Cement concrete and asphalt shall not be placed in fill or backfill.

8. Where riprap is to be applied to existing rock surfaces, clean off mud, debris, and loose fragments.

3.3 RIPRAP PLACEMENT

A. Stones shall be placed so as to result in a minimum of voids and a stable interlocking structure.

B. Stone shall not be placed until the DHHL and the geotechnical engineer have surveyed subgrade preparations for conformance with subgrade preparation requirements.

C. Place stone riprap by machine to full course thickness in one operation upward from bottom of slope.

1. Prevent displacement of underlying materials.

2. Dumping of stone riprap or rolling stones down the slope is prohibited.

3. Damage to underlying geotextile shall be repaired to the DHHL satisfaction before work is allowed to proceed.

D. Distribute stones to prevent large accumulations of either large or small-sized stones.

E. Manually supplement machine placement of stone to choke in voids.

F. Fill Spaces between larger stones to produce nearly even surface with minimum of voids.

G. Complete stone riprap placement, in conjunction with slope construction or reconstruction without appreciable lag, which may subject the surface to erosion.

H. Tolerances:

1. Rearrange individual stones as necessary to ensure that finished configuration conforms to required lines, grades, and thickness.

2. Rearrange individual stones by mechanical equipment or hand as necessary to match dimensions shown in Contract Documents.

I. Removal of Rejected stone:

1. If a newly placed stone or reset stone is found defective in quality, size, shape, weight or placement, the Contractor shall promptly remove the defective stone and replace it with a new stone or reset the required stone to the satisfaction of DHHL, at no increase in contract price.

PART 4 PAYMENT

4.1

A. Payment

Payment for riprap and stone satisfactorily placed will be made at the applicable contract lump sum price for riprap in place complete. . Prices and payments shall constitute full compensation for furnishing, hauling, handling, placing, and maintaining the riprap stone until final acceptance by DHHL. No separate payment will be made for the stockpiling of stone and all cost in connection with stockpiling shall be included in the contract unit price for riprap and stone.

END OF SECTION

SECTION 321500
GRAVEL SURFACE COURSE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions, Special Provisions and General Requirements of the Specifications, apply to the work specified in this section extent referenced. The publications are referred to within the text by the basic designation.

1.2 SUBMITTALS:

Engineer's approval is required for every submittal. Submit the following:

A. List of proposed equipment to be used in the performance of construction work including descriptive data.

B. Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the test are performed. Test results from samples, not less than 30 days before material is required for the work. Results of laboratory tests for quality control purposes, for approval, prior to using the material.

1.3 QUALITY ASSURANCE:

A. Sampling and testing is the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial laboratory.

1. Sampling

a. Take samples for material gradation, liquid limit, and plastic limit tests in conformance with ASTM D 75/D 75M. When deemed necessary, the sampling will be observed by the Engineer.

2. Testing

a. Make aggregate gradation in conformance with ASTM C 117, ASTM C 136, and ASTM D 422. Sieves shall conform to ASTM E 11.

b. Determine liquid limit and plasticity index in accordance with ASTM D 4318.

3. Approval of Materials

a. Select the source of the material to be used for producing gravel 15 days prior to the time the material will be required in the work. Tentative

approval of materials will be based on appropriate test results on the gravel source. Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted surface course.

4. Equipment

a. All plant, equipment, and tools used in the performance of the work covered by this section will be subject to approval by the Engineer before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, and meeting the grade controls, thickness controls, and smoothness requirements set forth herein.

1.4 ENVIRONMENTAL REQUIREMENTS:

A. It is the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the Engineer. Surface damaged by rainfall, or other weather conditions shall be brought to a satisfactory condition by the Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Gravel

1. Provide gravel consisting of clean, sound , durable particles of natural gravel, crushed gravel, crushed stone, sand, slag, soil, or other approved materials processed and blended or naturally combined. Provide gravel free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign materials. The Contractor is responsible for obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein after all compaction operations have been completed.

a. Coarse Gravel

1) The material retained on the No. 4 sieve shall be known as coarse gravel. Coarse aggregates shall be reasonably uniform in density and quality. The coarse gravel shall have a percentage of wear not to exceed 50 percent after 500 revolutions as determined by ASTM C 131. The amount of flat and/or elongated particles shall not exceed 20 percent. A flat particle is one having a ratio of width to thickness greater than three, an elongated particle is one having a ratio of length to width greater than three. When the coarse gravel is supplied

from more than one source, gravel from each source shall meet the requirements set forth herein.

b. Fine Gravel

1) The material passing the No. 4 sieve shall be known as fine aggregate. Fine aggregate shall consist of screenings, sand, soil, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

c. Gradation Requirements

1) Gradation requirements specified in TABLE I shall apply to the completed gravel surface. It is the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing compacting, and other operations. TABLE I shows permissible grading for granular material used in gravel surface. Sieves shall conform to ASTM E 11.

TABLE 1: GRADATION FOR GRAVEL SURFACE COURSE	
Sieve Designation	Percentage by Weight Passing Square-Mesh Sieve
1 in	100
3/8 in	50-85
No. 4	35-65
No. 10	25-50
No. 40	15-30
No. 200	8-15

B. LIQUID LIMIT AND PLASTICITY INDEX REQUIREMENTS

1. The portion of the completed gravel surface course passing the No. 40 sieve shall have a maximum liquid limit of 35 and a plasticity index of 4 to 9.

PART 3 - EXECUTION

3.1 OPERATION

A. OPERATION OF GRAVEL SOURCES

1. Perform clearing, stripping, and excavating. Operate the gravel sources to produce the quantity and quality of materials meeting these specification requirements in the specified time limit. Finalized gravel sources on private lands in agreement with local laws or authorities.

B. STOCKPILING MATERIALS

1. Prior to stockpiling the material, clear and level the storage sites. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Stockpile gravel in such a manner that will prevent segregation. Gravel and binders obtained from different sources shall be stockpiled separately.

C. COMPACTION

1. Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated herein as present laboratory maximum density. Compact each layer of the gravel surface course with approved compaction equipment, as required in the following paragraphs. The water content during the compaction procedures shall be maintained at optimum or at the percentage specified by the Project Engineer. In locations not accessible to the rollers, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer through the full depth is compacted to at least 100 percent of laboratory maximum density. Remove any materials that are found to be unsatisfactory and replace them with satisfactory material or rework them to produce a satisfactory material.

D. PREPARATION OF UNDERLYING COURSE

1. Clean of all foreign substances the underlying course. At the time of surface course construction, the underlying course shall contain no foreign materials. Ruts or soft yielding spots in the underlying course areas having inadequate compaction and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade and recompacting to at least 100 percent of the maximum laboratory density determined in accordance with ASTM D 1557. The completed underlying course subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the surface course is placed.

E. GRADE CONTROL

1. During construction, the lines and grades including crown and cross slope indicated for the gravel surface course shall be maintained by means of line and grade stakes by the Contractor.

F. MIXING AND PLACING MATERIALS

1. The materials shall be mixed and placed to obtain uniformity of the material and a uniform optimum water content for compaction. Make adjustments in mixing, placing procedures, or in equipment to obtain the true grades, to

minimize segregation and degradation, to obtain the desired water content, and to ensure a satisfactory surface course.

G. LAYER THICKNESS

1. Place the gravel material on the underlying course in layers of uniform thickness. When a compacted layer of 6 inches is specified, the material shall be placed in a single layer, no layer shall exceed 6 inches when compacted.

H. SMOOTHNESS TEST

1. The surface of each layer shall not show any deviations in excess of 3/8 inch when tested with a 10 foot straightedge applied both parallel with and at right angles to the centerline of the area. Deviations exceeding this amount shall be corrected by removing material, replacing with new material, or reworking existing material and compacting, as directed.

I. THICKNESS CONTROL

1. The completed thickness of the gravel surface course shall be within 1/2 inch, plus or minus, of the thickness indicated on plans. The thickness measurement shall be made by test holes at least 3 inches in diameter through the aggregate surface course. When the measured thickness of the gravel surface course is more than 1/2 inch deficient in thickness, correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting, as directed,at no additional expense to the Owner. Where the measured thickness of the aggregate surface course is more than 1/2 inch thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 1/4 inch of the thickness indicated. When the average job thickness fails to meet this criterion, make corrections by scarifying, adding or removing mixture of proper gradation, and reblading and recompacting, as directed,at no additional expense to the Owner.

J. DENSITY TESTS

1. Measure density in the field in accordance with ASTM D 6938. For the method presented in ASTM D 6938 the calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration of the ASTM publication. Tests performed in accordance with ASTM D 6938 result in a wet unit weight of soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 6938. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph

Calibration of ASTM D 6938, on each different type of material being tested at the beginning of a job and at intervals, as directed.

K. WEAR TEST

1. Perform wear tests in conformance with ASTM C 131.

L. MAINTENANCE

1. Maintain the gravel surface course in a condition that will meet all specification requirements until accepted.

END OF SECTION

SECTION 323100
WIRE FENCES AND GATES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The Contractor shall provide gauge #12, 3 strands barbed wire, T-posts and Schedule 40 Galvanized Iron Pipe gate, complete in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. Commercial Standards

1. ASTM International (ASTM):

ASTM A116	(2011) Standard Specifications for Metallic - Coated, Steel Woven Wire Fence Fabric
ASTM A121	(2013) Metallic - Coated Carbon Steel Barbed Wire
ASTM A153/A153M	(2009) Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	(2013) Standard Specifications for Steel fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	(2009) Standard practice for repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C94/C94M	(2014) StandardSpecification for Ready-Mixed Concrete
ASTM F1083	(2013) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F626	(2014) Standard Specification for Fence Fittings

1.3 SUBMITTALS

A. Shop Drawings

1. Manufacturer's technical data, product specifications, standard details, certified product test results, installation instructions and general recommendations, including the following items:

   a. Fence Installation Drawings
   b. Location of corner, end and posts.
   c. Gate

2. Scaled layout of fence and accessories, including erection/installation drawings showing fence height, post layout, including sizes and sections; post setting and bracing configuration, details, barbed wire support outriggers; and other accessories which may be necessary, including the following items:

   a. Fence Installation
   b. Location of corner, end and posts.
   c. Gate

B. Product information
   a. Barbed Wire
   b. T- Post (Galvanized)

C . Certificates
   a. Fence Reports
   b. Zinc Coating
   c. Barbed Wire
   d. Concrete
   e. Steel Posts (Galvanized)

D. Installation Instructions
   a. Manufacturer's instructions for the fence installation and accessories.
   b. Erection/installation drawings along with manufacturer's catalog data for complete fence assembly and accessories.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Line Posts for Barbed Wire Fence. Provide metal posts and gate posts conforming to ASTM A702, type T, zinc-coated, length as indicated, and accessories conforming to ASTM A702.

B. Metal Pipe for steel fence gate. ASTM F 1083. Schedule 40, size as indicated.

C. Barbed Wire

Provide barbed wire conforming to ASTM A121 12 ½ gauge zinc-coated, Type Z, Class 3, standard grade barbs. Design Number 12-2-4-14F.

C. Concrete

ASTM C94/C94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 2,500 psi at 28 days. Provide grout consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

PART 3 - EXECUTION

3.1 FENCE INSTALLATION

A. Lines and Grade

Install fence to the lines and grades indicated. Clear the area on either side of the fence line to the extent indicated. Space line posts equidistant at intervals not 10 feet. Set terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Provide continuous wire between terminal posts. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A780/A780M.

B. Concrete Footing

Set metal gate posts into concrete footing (12 inches diameter with a depth of 24 inches). Pour concrete into the footing with a metal posts set in it. Set posts for support of removable fence sections into sleeves that provide a tight sliding joint and hold posts aligned and plumb without use of lead or setting material.

C. Metal Post Installation

Gate posts (Galvanized Iron Pipe) shall be set in concrete and shall be set in holes not less than the diameter (2 inches diameter) shown on the drawings. Thoroughly consolidate concrete and grout around each post, free of voids and finished to form a dome. Allow concrete and grout to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only and protect with drive caps when setting.

3.2 CLEAN-UP

Remove waste fencing materials and other debris from the work site each workday.

END OF SECTION

SECTION 323200
SECURITY GATE

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The Contractor shall provide chain link fence security gates including 3 strands barbed wire and appurtenant Work, complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Chain link security gates, 3 strands barbed wire, accessories, fittings, and fastenings shall be product of a single manufacturer.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. Commercial Standards

1. ASTM International (ASTM):

ASTM A90	Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A116	Metallic - Coated, Steel Woven Wire Fence Fabric
ASTM A121	Metallic - Coated Carbon Steel Barbed Wire
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A392	Zinc-Coated Steel Chain Link Fence Fabric
ASTM A702	Steel fence Posts and Assemblies, Hot Wrought
ASTM A780	Standard practice for repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM F567	Standard Practice for Installation of Chain-Link Fence

ASTM F626	Fence Fittings
ASTM F900	Industrial and Commercial Swing Gates
ASTM F1083	Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

1.3 QUALIFICATIONS

A. Manufacturer's Qualifications: Chain link security gates shall be product of a single manufacturer which has been successfully engaged in the production of such item for a period of at least five years.

B. Installer's Qualifications: Installation of the chain link security, gates, and operators shall be by the manufacturer or by a licensed contractor registered with the manufacturer.

1.4 SUBMITTALS

A. Shop Drawings

1. Manufacturer's technical data, product specifications, standard details, certified product test results, installation instructions and general recommendations, including the following items:

    a. Security Gate assembly
    b. Security Gate hardware and accessories

2. Scaled layout of security fence and accessories, including erection/installation drawings showing fence height, post layout, including sizes and sections; post setting and bracing configuration, details, of gates, barbed wire support outriggers; and other accessories which may be necessary, including the following items:

    a. Security Gate assembly
    b. Location of gate security
    c. Security gate assembly and accessories

B. Assembly and Installation Instructions

1. Manufacturer's instructions that detail proper assembly and materials in the design for security gate, hardware and accessories.

2. Erection/installation drawings along with manufacturer's catalog data for complete security gate assembly, hardware assembly and accessories.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Security Gate Fabric

1. General

a. Fencing material shall conform to the requirements of ASTM A116.

b. Security gate frame shall be 2 3/8 - inch (O.D) galvanized steel conforming to ASTM F1083.

c. Security gate fabric height shall be as indicated.

d. Security gate materials shall be hot-dip galvanized after fabrication.

e. Security gate shall be provided with 3 strand barbed wire as indicated.

f. Galvanized coating damaged during transit or construction of the security gate shall be repaired by application of zinc-rich cold galvanizing coating. The zinc-rich cold galvanizing coating shall contain 90 percent or more metallic zinc by weight in dry film. The coating shall be applied at sufficient wet film thickness to achieve 3 to mils total dry film thickness.

g. Barbed wire shall be galvanized and conform to ASTM A121, security gate grade. barbed wire shall be 3 strand, No. 12-1/ 2 gauge zinc coated steel or iron wire with 4-point barbs of No. 14 gauge wires spaced not more than 5 inches apart.

h. Fabric tie Wires shall be 9 gauge galvanized steel wire of the same finish as the fabric. Ties shall be spaced 14 inches apart on post and 24 inches apart on top and bottom of frame.

2. Steel fabric

a. Security gate fabric shall be No. 9 gauge steel wire, 2 -inch mesh, with knuckled top and bottom selvages conforming to ASTM A116.

b. fabric finish: Fabric shall be galvanized in conformance with ASTM A392, Class II, with no less than 2 ounces zinc per square foot of coated surface.

3. Framing and Accessories

a. Steel Framework: Unless otherwise indicated, framework components shall be fabricated of galvanized steel pipe conforming to ASTM F1083.

1) Fittings and accessories shall be galvanized in accordance with ASTM A153 with zinc weights per Table I of that standard, except that no

coating shall be less than 1.8 ounces zinc per square foot of coated surface.

2) Pipe for use as structural support for fencing shall conform to ASTM F1083.

3) Galvanizing repair material shall be cold-applied zinc-rich coating conforming to ASTM A780.

2.2 SECURITY GATE

A. General

1. Gate assembly shall be fabricated as indicated.
2. Gates shall have smooth bottom edges.
3. Hardware and accessories shall be provided for each gate, galvanized in conformance with ASTM A153.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to commencing installation, require installer to inspect the area and conditions within which work of this section will be performed.

3.2 INSTALLTION

A. General

1. Installation of security gate and appurtenances shall be installed as shown on the drawings.

END OF SECTION

SECTION 329219
SEEDING

PART 1 GENERAL

1.1 SCOPE

A. It is the intent of seeding to produce a stable erosion controlling turf on newly graded embankment surfaces. Scope includes 90 day maintenance period following acceptance of seeded area.

1.2 DEFINITIONS

A. Stand of Turf 95 percent ground cover of the established species.

1.3 SUBMITTALS

A. Submit the following.

Product Data:
Fertilizer
Include physical characteristics, and recommendations.

Certificates
State certification and approval for seed

1.4 DELIVERY, STORAGE, AND HANDLING

A. Seed Protection Protect from drying out and from contamination during delivery, on-site storage, and handling.

B. Fertilizer and Seed Delivery - Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws.

C. Storage - Seed, Storage - Store in cool, dry locations away from contaminants.

D. Topsoil - Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil

E Handling - Do not drop or dump materials from vehicles.

1.5 TIME RESTRICTIONS AND PLANTING CONDITIONS

A. Restrictions - Do not plant when the ground is muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.6 TIME LIMITATIONS

A. Exposed areas shall be seeded within 30 days of acceptance of final grading.

B. Seed - Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

A. Classification Provide State-approved seed mixture of Bermuda and Rye of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weed seed content, and inert material.

2.2 TOPSOIL

A. On-Site Topsoil

Topsoil shall be existing surface soil stripped and stockpiled on-site.

2.3 FERTILIZER

A. Granular Fertilizer - Organic, granular controlled release fertilizer formulated for grass.

B. Hydroseeding Fertilizer - Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months

2.4 MULCH

A. Mulch shall be free from noxious weeds, mold, and other deleterious materials.

B. Wood Cellulose Fiber Mulch - Use recovered materials of either paper-based (100 percent) or wood-based (100 percent) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2 . Use with hydraulic application of grass seed and fertilizer

2.5 WATER

A. Source of water shall be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

B. Provide water as required to insure proper germination of grass and survival to insure a complete stand of turf throughout the maintenance period. The Contractor shall perform irrigation in a manner that promotes the health, and growth of turf and that complies with all Federal, State, and local water agencies and authorities directives.

PART 3 EXECUTION

3.1 PREPARATION

A. Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.2 TOPSOIL

A. Provide 4 inches of on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.3 SEEDING

A. Seed Application Seasons and Conditions - Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowin

B. Seed Application Method - Seeding method shall be broadcasted and drop seeding or hydroseeding.

C. Broadcast and Drop Seeding - Seed shall be uniformly broadcast at the rate recommended by seed supplier.

D. Hydroseeding - First, mix water and fiber. Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. Fiber shall be added at 1,000 pounds, dry weight, per acre. Then add and mix seed and fertilizer to produce a homogeneous slurry. When hydraulically sprayed on the ground, material shall form a blotter like cover impregnated uniformly with grass seed. Spread with one application with no second application of mulch

E. Watering - Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out

3.4 PROTECTION OF TURF AREAS

A. Immediately after turfing, protect area against traffic and other use.

3.5 RESTORATION

A. Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

3.6 ESTABLISHMENT PERIOD

A. Turf establishment period will commence on the date that inspection by the Contracting Officer shows that the new turf furnished under this contract has been satisfactorily installed to a 95 percent stand of coverage. The establishment period shall continue for a period of 45 days.

3.7 MAINTENANCE PERIOD

A. Provide maintenance of turfed area for a period of 90 days following acceptance of the seeded area. Begin maintenance immediately after turf has been installed. Inspect areas once a week during the installation and establishment period and perform needed maintenance promptly

B. Provide slope erosion control maintenance to prevent undermining of all slopes in newly turfed and natural growth areas. Maintenance tasks include immediate repairs to weak spots in sloped areas, and maintaining clean, clear and graded berms and terraces to intercept and direct water flow to prevent development of large gullies and slope erosion. Eroded areas shall be filled with amended topsoil and replanted with the same plant species. Erosion control damaged due to slope erosion shall be reinstalled.

3.8 FINAL INSPECTION

A. Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the establishment period. Final inspection will be based upon satisfactory health and growth of plants and on the following:

END OF SECTION

SECTION 334000
DRAINAGE STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

Description: Constructing, and adjusting manholes, and other types of drainage structures. Manholes, and other types of drainage structures are hereinafter referred to as "structures" otherwise noted.

A. Section Includes:

1. Drains
2. Manholes, frames and covers
3. Underdrains
4. Perforated Drains
5. Lined Drainage Ditch and Concrete Spillways
6. Culverts and headwalls
7. Excavation and Backfill for drainage structures

1.2 REFERENCES

A. Standard Specifications for Public Works Construction, September 1986 Department of Public Works, County of Kauai (Standard Specifications)

B. Standard Details for Public Work Construction, September 1984 (Standard Details)

C. State of Hawaii Department of Transportation, Standard Specifications (HSS):

HSS Section 603	Culverts and Storm Drains
HSS Section 605	Underdrains
HSS Section 706	Drain Pipe

D. City and County of Honolulu/Federal Projects Special Provision to Section 712 (March 30, 2006)

E. City and County of Honolulu/Federal Projects Special Provision to Section 717 (March 30, 2006)

F. American Association of State Highway and Transportation Officials, Material Specification M-294, Polyethylene Drainage Pipe. (AASHTO M-294)

1.3 SUBMITTALS

A. Submit joint detail and joining method for culverts in accordance with HSS subsection 603.03(D) - Joining Culverts.

B. Certificates of Compliance: Submit certification that all materials used shall conform to the standards and specifications of the jurisdictional agencies and utility owners.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manholes: Conform to Standard Specifications for Public Works Construction Sections 25, 2. Manhole frames and covers shall be traffic rated when located in a roadway.

B. Underdrains: perforated corrugated polyethylene pipe , HSS 706.12. ASTM F 667

C. Drain pipe: Conform to HSS Subsection 706.14, polyethylene pipe (smooth inside liner). AAHSTO M294, Type SP.

D. Lined Drainage Ditch and Concrete Spillways: Conform to Standard Specifications for Public Works Construction Section 27.2.

E. Trench backfill: Standard Specifications for Public Works Construction Sections 11.3

PART 3 - EXECUTION

3.1 CULVERTS AND STORM DRAINS

F. Fabricate, furnish, and install culverts in accordance with City and County of Honolulu Standard Specifications for Public Works Construction Section 24 and Standard Details for Public Works Construction.

3.2 MANHOLES

A. Construct drainage manholes, in accordance with City and County of Honolulu Standard Specifications for Public Works Construction Section 25.

3.3 UNDERDRAINS

A. Furnish and install underdrains in accordance with City and County of Honolulu Standard Specifications for Public Works Construction Section 28 and Standard Details for Public Works Construction or HSS Subsection 605.03 – Construction. Furnish and place perforated pipes with the perforations downward.

3.5 LINED DRAINAGE DITCH AND CONCRETE SPILLWAYS

A. Construct lined drainage ditches and spillways in accordance with City and County of Honolulu Standard Specifications for Public Works Construction Section 27 and Standard Details for Public Works Construction.

3.6 EXCAVATION AND BACKFILL

A. Excavation and backfill for storm drain manholes and drainage structures, and excavation and backfill trenches for storm drain pipes shall be in accordance with Standard Specifications for Public Works Construction Sections 11 and 13.

B. Structure and trench backfill for storm drain manholes, pipes, and drainage structures shall be in conform

3.7 DRAINAGE STRUCTURES

A. Manholes and Inlets: Construction shall be of reinforced concrete, plain concrete or precast reinforced concrete, precast concrete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

B. Walls and Headwalls: Construction shall be as indicated.

C. Steel Ladder Installation: Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

END OF SECTION

SECTION 334005
SLUICE GATE

PART 1 - GENERAL

1.1 GENERAL

A. Description:

1. This section covers stainless steel flow control sluice gates and operators.

B. General:

1. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper, operating condition in full conformity with the drawings, specification, instructions and recommendations of the equipment manufacturer unless exceptions are noted by DHHL.

2. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete, properly operating installation, and shall be latest standard product of a manufacturer regularly engaged in the production of fabricated gates.

1.2 GOVERNING STANDARDS

A. Except as modified herein, sluice gate and operators shall conform to the applicable requirements of AWWA C561, latest edition.

1.3 QUALITY ASSURANCE

A. The manufacturer shall have experience in the production of substantially similar equipment, and shall show evidence of satisfactory operation in at least 50 installations. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirements of the latest edition of ASME, Section IX.

B. Gate shall be shop inspected for proper operation before shipping.

C. The manufacturer shall be ISO 9001:2000 certified.

1.4 SUBMITTALS

A. The contractor shall submit manufacturer's catalogue for approval by the DHHL, drawings showing the principal dimensions, general construction and materials to be used in the gate lift mechanism.

1.5 PERFORMANCE

A. Leakage: Sluice gate shall be substantially water tight under the design head conditions. Under the design seating head, the leakage shall not exceed 0.05 gal. per minute per foot of seating perimeter. Under the design unseating head, the leakage for heads of 20 ft. or less shall not be exceed 0.1 gal. per minute per foot of perimeter. For unseating heads greater than 20 ft., the allowable leakage shall not exceed the rate per foot of perimeter specified by the following equation:

Maximum Allowable Leakage

Gallons per minute per foot of perimeter: = 0.10 + (0.0025) x (unseating head in feet - 20)

B. Design Head

1. The sluice gate shall be designed to withstand the design head shown in the schedule.

C. Seal Performance Test

1. The gate's sealing system shall have been tested through a cycle test in an abrasive environment and should show that the leakage requirements are still obtained after 25, 000 cycles with a minimum deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sluice Gate

1. Gate shall be either self-contained or non-self-contained of the rising stem configuration as shown.

2. Wall thimble shall be stainless steel and supplied by the gate manufacturer. Material thickness shall be according to the manufacturer's recommendations and shall be of sufficient resistance to handle the operating forces.

3. Frame: The gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The guide slot shall be made of UHMWPE (ultra high molecular weight polyethylene).

The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the tunnel.

4. Slide: The slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gate's span under the design head.

5. Guides and Seals: The guides shall be made of UHMWPE (ultra high molecular weight polyethylene) and shall be of such length as retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position.

   Side and top seals shall be made of UHMWPE (ultra high molecular weight polyethylene) of the self adjusting type. A continuous compression cord shall ensure contact between the UHMWPE guide and the gate in all positions. The sealing system shall maintain efficient sealing in any position of the slide and allow the water to flow only in the opened part of the gate.

   The bottom seal shall be made of resilient neoprene set into the bottom member of the frame and shall from a flush-bottom.

B. Operators and Stem

1. The operating stem shall be of stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lbs effort on the crank or hand wheel.

2. Stem Guides: Provide stem guide fabricated from type 304L (or 316L) stainless steel. The guide shall be equipped with an UHMWPE bushing. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/r ration shall not be greater than 200.

3. Stem Cover: Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents and a clear Mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

4. Lifting Mechanism: Manual operators shall be provided by the gate manufacturer.

   All bearings and gears shall be totally enclosed in a weather tight housing. The pinion shaft of crank-operated mechanisms shall be constructed of stainless steel and supported by roller or needle bearings.

   Each manual operator shall be designed to operate the gate under the maximum seating and unseating heads by using a maximum effort of 40 lbs on the crank or hand wheel, and shall be able to withstand, without damage, an effort of 80 lbs.

The crank shall be removable and fitted with a corrosion-resistant rotating handle. the maximum crank radius shall be 15 inches and the maximum hand wheel diameter shall be 24 inches.

5. Yoke: Self-contained gates shall be provided with a yoke made of structural members or formed plates. The maximum deflection of the yoke shall be 1/360 of the gate's span.

PART	MATERIAL
Frame, yoke, stem guides, slide, stem extension	Stainless steel ASTM A-240 Type 304L or 316L
Side seals, stem guide liner	Ultra high molecular weight polyethylene (UHMWPE) ASTM D-4020
Compression cord	Nitrile ASTM D-2000 M6BG 708, A14, B14, Eo14, EO34
Bottom seal	Neoprene ASTM D-2000 Grade 2 BC-510
Threaded stem	Stainless steel ASTM A-276 Type 303 MX or 316
Fasteners	ASTM F593 and F594 GR1 for type 304 and GR2 for type 316
Pedestal, handwheel, crank	Tenzaloy aluminum
Gasket (between frame and wall)	EPDM ASTM 1056
Stem Cover	Polycarbonate ASTM D-3935
Lift nut, couplings	Manganese bronze ASTM B584 UNS-C86500

PART 3 - EXECUTION

3.1 EXECUTION

A. Installation

1. Sluice gate and appurtenances shall be handled and installed in accordance with the manufacturer's installation instructions and as shown on the drawings.

B. Filed Test

1. Following the completion of each sluice gate installation, the gate shall be operated through at least two complete open/close cycles.

2. Sluice gate shall be checked for leakage by the Contractor. the leak shall be not more than that specified herein. The Contractor shall correct the leak (if more than that specified at no additional cost to DHHL.

END OF SECTION