GENERAL:

A. WORKMANSHIP AND MATERIALS SHALL CONFORM TO THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 10TH EDITION. HOWEVER, WHERE REFERENCE IS MADE TO PERFORMANCE CONFORMING TO OTHER STANDARDS THE MORE STRINGENT SHALL APPLY.
B. THE CONTRACTOR SHALL TAKE FIELD MEASUREMENTS AND VERIFY FIELD CONDITIONS AND SHALL COMPARE SUCH FIELD MEASUREMENTS AND CONDITIONS WITH THE DRAWINGS BEFORE COMMENCING THE WORK. REPORT IN WRITING TO THE ENGINEER ALL INCONSISTENCIES OR OMISSIONS.
C. THE CONTRACTOR SHALL BE RESPONSIBLE FOR METHODS OF CONSTRUCTION, WORK AND JOB SAFETY. THE CONTRACTOR SHALL PROVIDE TEMPORARY SHORING AND BRACING AS REQUIRED FOR STABILITY OF STRUCTURAL MEMBERS AND SYSTEMS.
D. DETAILS NOTED AS TYPICAL ON STRUCTURAL DRAWINGS SHALL APPLY IN ALL CONDITIONS UNLESS SPECIFICALLY SHOWN OR NOTED OTHERWISE.
E. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING THE WORK OF ALL TRADES.
F. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTION OF THE ADJACENT PROPERTIES, STRUCTURES, STREETS, AND UTILITIES DURING THE CONSTRUCTION PERIOD. ANY DAMAGE OR DETERIORATED PROPERTY SHALL BE RESTORED TO THE CONDITION PRIOR TO THE BEGINNING OF WORK OR BETTER AT NO COST TO THE STATE.

DESIGN CRITERIA:

A. LIVE LOADS
   1. 1000 PSF
B. SOILS
   1. EARTH PRESSURES
      a. ACTIVE:
         i. SATURATED UNRESTRAINED: 84.5 PCF
      b. PASSIVE SATURATED: 92.5 PCF
   2. TIEBACK BOND STRENGTH: 400 PSF

REINFORCING STEEL:

A. NEW REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO ASTM A1035/A1035M, GRADE 100.
B. CLEAR CONCRETE COVERAGE FOR REINFORCING BARS SHALL BE AS FOLLOWS, UNLESS OTHERWISE NOTED:
   1. FOOTING, WALL, ETC. CAST AGAINST EARTH: ---------- 3"
   2. FOOTING, WALL ETC. FORMED AND EXPOSED TO EARTH: --------- 2"
   3. WALL FACES EXPOSED TO EARTH OR WEATHER: ---------- 2"
   4. ALL OTHERS: ---------- 2"
C. SPLICES:
   1. REINFORCING STEEL SHALL BE SPLICED ONLY WHERE INDICATED ON PLANS. PROVIDE LAP SPLICE LENGTH PER TYPICAL DETAILS AND SCHEDULE, UNLESS OTHERWISE NOTED.
   2. MECHANICAL SPLICE CONNECTORS SHALL DEVELOP IN TENSION 125 PERCENT OF THE SPECIFIED MINIMUM YIELD STRENGTH OF REINFORCING BARS.
D. BAR BENDS AND HOOK SHALL BE "STANDARD HOOKS" IN ACCORDANCE WITH AASHTO 5.10.2.3.

FOUNDATION:

A. FOUNDATION DESIGN FOR TIEBACK ANCHORS IS BASED ON THE GEOTECHNICAL REPORT BY KOKUA GEOTECHNICAL DATED MAY 8, 2026.
B. CONTRACTOR SHALL PROVIDE DESIGN AND INSTALLATION OF ALL CRIBBING, SHEETING, AND SHORING NECESSARY TO PRESERVE EXCAVATIONS AND EARTH BANKS. SHORING SHALL CONFORM TO OSHA REGULATIONS.
C. EXCAVATIONS FOR STRUCTURES AND FOOTINGS SHALL BE APPROVED BY THE LICENSED GEOTECHNICAL ENGINEER IN STATE OF HAWAII (PROVIDED BY CONTRACTOR) PRIOR TO PLACEMENT OF CONCRETE AND REINFORCING.
D. ENGINEERED FILL AND BACKFILL SHALL BE IN ACCORDANCE WITH SECTION 703.20 OF THE HAWAII STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, 2005 EDITION.
E. FILL SHOULD BE MOISTURE CONDITIONED TO WITHIN TWO PERCENT OF THE OPTIMUM MOISTURE CONTENT AND PLACED IN HORIZONTAL LIFTS NOT TO EXCEED SIX INCHES. FILL SHALL BE COMPACTED TO MINIMUM 90% RELATIVE DENSITY AS MEASURED BY HDOT TM-100 AND HDOT TM-300.
F. CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN AND INSTALLATION OF ALL SHORING REQUIRED TO PRESERVE EXCAVATIONS.

CONCRETE:

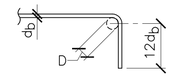
A. CONCRETE CONSTRUCTION SHALL CONFORM TO AMERICAN CONCRETE INSTITUTE ACI 318.
B. CONCRETE SHALL BE NORMAL WEIGHT AND SHALL HAVE THE FOLLOWING MINIMUM 28 DAYS COMPRESSIVE STRENGTH OF 4000 PSI.
C. ALL INSERTS, ANCHOR BOLTS, PLATES, ETC. EMBEDDED IN CONCRETE SHALL BE H.D. GALVANIZED UNLESS OTHER WISE NOTED.
D. CONDUITS, PIPES, AND SLEEVES PASSING THROUGH CONCRETE AREA NOT CONFORMING TO TYPICAL DETAILS SHALL BE LOCATED AND SUBMITTED TO THE ENGINEER FOR APPROVAL.
E. UNLESS OTHERWISE NOTED, CHAMFER ALL CONCRETE EDGES 3/4".
F. CONCRETE DELIVERY TICKETS SHALL RECORD ALL FREE WATER IN THE MIX: AT BATCHING BY PLANT, FOR CONSISTENCY BY DRIVER, AND ANY ADDITIONAL REQUEST BY CONTRACTOR IF PERMITTED BY THE MIX DESIGN.
G. REINFORCING BARS, ANCHOR BOLTS, INSERTS AND OTHER ITEMS TO BE CAST IN THE CONCRETE SHALL BE SECURED IN POSITION PRIOR TO PLACEMENT OF CONCRETE.
H. WATER TO CEMENT RATIO SHALL NOT EXCEED 0.45.
I. TREMIE CONCRETE SHALL BE INCLUDED FOR CONCRETE TO BE INSTALLED UNDERWATER.
J. MAXIMUM AGGREGATE SIZE OF TREMIE CONCRETE SHALL NOT EXCEED ¼" OF TREMIE PIPE DIAMETER.
K. TREMIE CONCRETE SHALL BE INSTALLED WITHOUT INTERRUPTION.
L. USE ANTI-WASH AGENT FOR CONCRETE POURED UNDERWATER.
M. A CORROSION INHIBITING ADMIXTURE SHALL BE INCLUDED IN THE CONCRETE MIX FOR ALL CONCRETE. THE ADMIXTURE SHALL BE RHEOCRETE CNI CORROSION INHIBITOR FROM BASF, DCIS CORROSION INHIBITOR FROM GRACE CONSTRUCTION PRODUCTS OR AN APPROVED EQUAL. ADDITION OF CORROSION INHIBITING ADMIXTURE SHALL BE AS RECOMMENDED BY THE MANUFACTURER.

STRUCTURAL STEEL

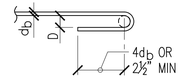
A. FABRICATION AND ERECTION OF STRUCTURAL STEEL SHALL CONFORM TO THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION MANUAL OF STEEL CONSTRUCTION, FIFTEENTH EDITION.
B. STRUCTURAL STEEL SHALL CONFORM TO ASTM A36 UNLESS OTHERWISE NOTED.
C. STEEL WIDE FLANGE SECTIONS SHALL CONFORM TO ASTM A992.
D. PLATES AND BARS SHALL CONFORM TO ASTM A36.
E. WELDS AND WELDING PROCEDURES SHALL CONFORM TO THE STRUCTURAL WELDING CODE AWS D1.1 OF THE AMERICAN WELDING SOCIETY.
F. WELDING SHALL BE PERFORMED BY WELDERS PREQUALIFIED FOR WELDING PROCEDURES TO BE USED.
G. ALL ANCHOR BOLTS, PLATES, AND OTHER ITEMS TO BE CAST IN CONCRETE SHALL BE HOT-DIP GALVANIZED ACCORDING TO ASTM A153 UNLESS OTHERWISE NOTED.
H. ALL STEEL SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION ACCORDING TO ASTM A123.
I. SHEET PILE SHALL CONFORM TO ASTM A690 GRADE 50 FOR MARINE USE.
J. CONTRACTOR SHALL USE SHEET PILE SYSTEM AND CONNECTORS FROM A SINGLE MANUFACTURER.

MINIMUM SPLICE AND DEVELOPMENT LENGTHS					
BAR SIZE	CONCRETE STRENGTH = 4,000 PSI				
	LAP SPLICE		DEVELOPMENT		
	TOP BARS	OTHER BARS	STRAIGHT		WITH STANDARD HOOK
			TOP BARS	OTHER BARS	
#4	37"	28"	28"	22"	12"
#5	46"	35"	35"	27"	16"

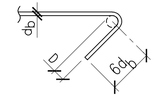
NOTES:
1. LENGTHS ARE FOR CONCRETE WITH REBAR SPACED AT 6 BAR DIAMETERS MINIMUM. INCREASE LENGTHS BY 25% FOR BARS SPACED LESS THAN 6 BAR DIAMETERS.
2. "TOP BARS" ARE HORIZONTAL BARS WITH 12" OR MORE OF CONCRETE CAST BELOW.



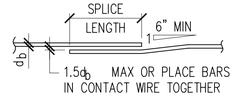
90° BEND



180° BEND



135° BEND



BAR LAP

D = $6d_b$ FOR #8 AND SMALLER

1 / S-1 TYPICAL REBAR SPLICE AND DEVELOPMENT LENGTH SCHEDULE

NOT TO SCALE

ABBREVIATIONS

(E)	EXISTING
V.I.F.	VERIFY IN FIELD
	INDICATES CONCRETE

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED
1	1	REVISED DESIGN CODE, REMOVED DUPLICATE REINFORCING STEEL NOTES	1/4	5/12/26	

SAEID POURJALALI
LICENSED PROFESSIONAL ENGINEER
No. 11475-S
HAWAII, U.S.A.

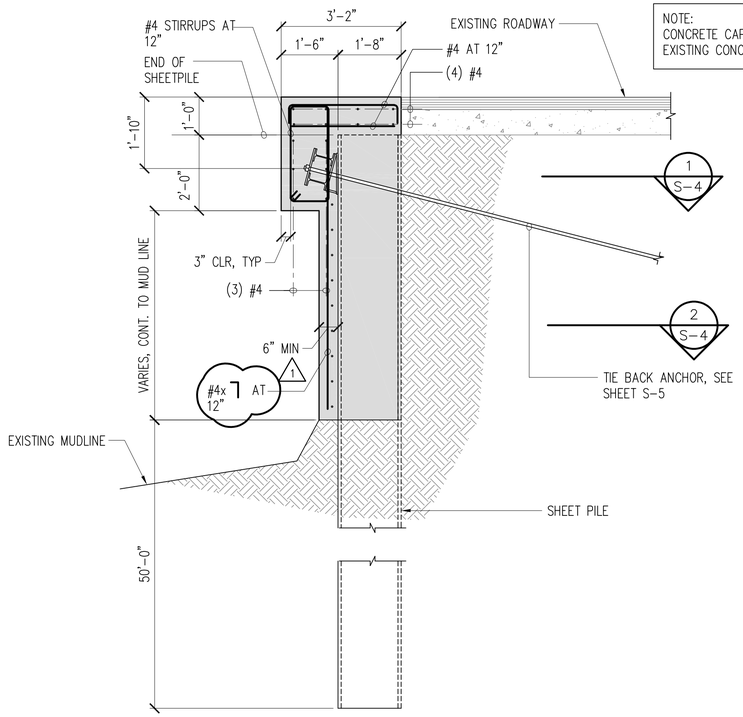
EXPIRATION DATE OF THE LICENSE 4/30/2028
THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LAHAINA SMALL BOAT HARBOR BOAT RAMP REMOVAL & BULKHEAD EXTENSION

STRUCTURAL NOTES

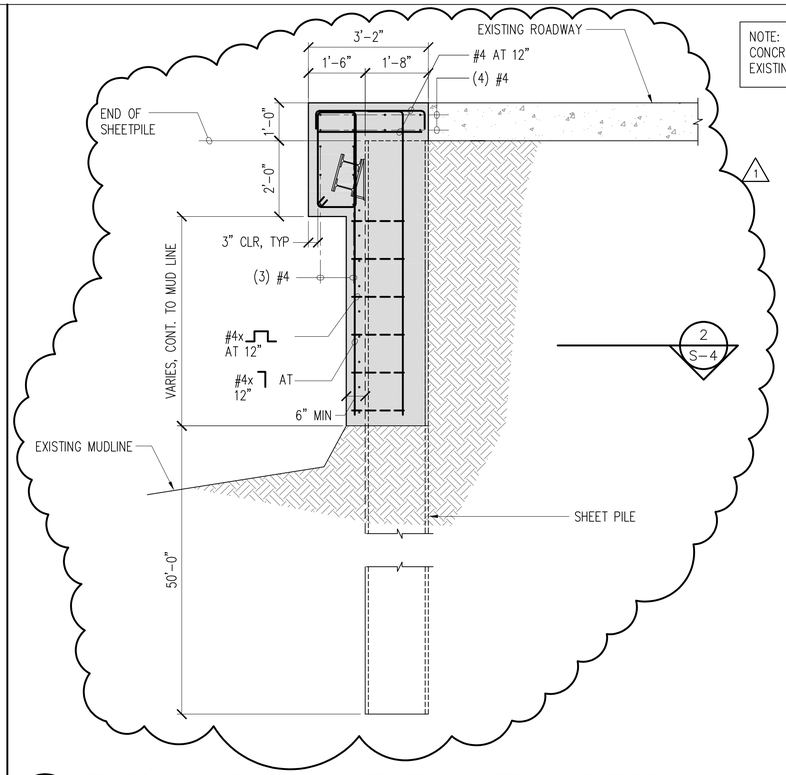
DESIGNED: CS	SUBMITTED:
DRAWN: CAD	DATE: 6 May 2026
CHECKED: SP	SCALE: AS SHOWN
APPROVED:	DRAWING NO. S-1
CHIEF ENGINEER	DATE



NOTE:
CONCRETE CAP AT THE TOP OF WALL SHALL MATCH THE EXISTING CONCRETE CAP FINISH GRADE.

1 S-3 TYPICAL SEA WALL SECTION AT TIEBACK

SCALE: 1/2" = 1'-0"



NOTE:
CONCRETE CAP AT THE TOP OF WALL SHALL MATCH THE EXISTING CONCRETE CAP FINISH GRADE.

2 S-3 TYPICAL SEA WALL SECTION WITHOUT TIEBACK

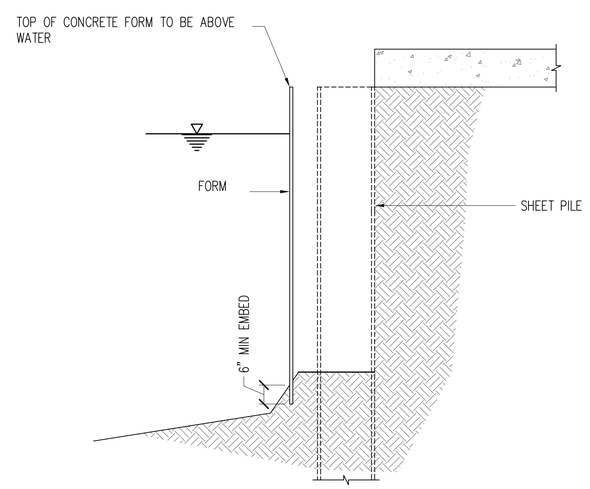
SCALE: 1/2" = 1'-0"

MINIMUM STEEL SHEET PILE PROPERTIES			
GRADE 1	PROPERTIES PER LINEAR FOOT OF WALL		
	SECTIONAL AREA IN^2/FT	PLASTIC SECTION MODULUS IN^3/FT	MOMENT OF INERTIA IN^3/FT
ASTM A690, GRADE 50	11.00	81.57	697.3

NOTES:
1. SHEET PILE LAYOUT IS AN APPROXIMATE AND IS SHOWN FOR ILLUSTRATION PURPOSE. SHEET PILE LAYOUT WILL VARY BASED ON ACTUAL SHEET PILE CONFIGURATION AND INSTALLATION.
2. TIEBACK SPACING DIMENSION MAY BE SHIFTED PLUS OR MINUS 2" TO LOCATE TIEBACK NEAR CENTER OF SHEET PILE CROWN OR VALLEY. DIAGONAL TIEBACK SHALL BE ADJUSTED TO PENETRATE SHEET PILE AT EITHER FLANGE OR WEB, NOT BOTH. ENGINEER SHALL MAKE ADJUSTMENTS TO THE LAYOUT AND DETAILS AT NO ADDITIONAL COST TO THE STATE.
3. CONTRACTOR SHALL COORDINATE LAYOUT OF TIEBACK, SHEET PILE, AND DEADMAN TO MEET ALL DRAWING AND SPECIFICATION REQUIREMENTS.

3 S-3 SHEET PILE PROPERTIES

SCALE: NOT TO SCALE



4 S-3 SUGGESTED CONSTRUCTION SEQUENCE

SCALE: 1/2" = 1'-0"

NOTES:
1. DEWATERING MAY BE REQUIRED AND SHALL BE INCLUDED IN THE COST OF CONCRETE INSTALLATION. CONTRACTOR SHALL NOT DISCHARGE THE DEWATERING EFFLUENT BACK INTO THE STREAM OR STORM DRAIN SYSTEM OR STATE RECEIVING WATER SYSTEM.
2. SEQUENCE OF CONSTRUCTION:
   a. INSTALL BMPS
   b. INSTALL SHEET PILING
   c. LOCATE TIEBACK ON SHEET PILES
   d. INSTALL TIEBACKS
   e. INSTALL CONCRETE WALL WITH TREMIE CONCRETE PER PROVIDED DETAIL

0' 1' 2' 3' 4' 5' 6'
1/2" = 1'-0"

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED
1	1	HOOKED VERTICAL BAR, ADDED U BAR, REVISED SHEET PILE ASTM AND GRADE	2/4	5/12/26	

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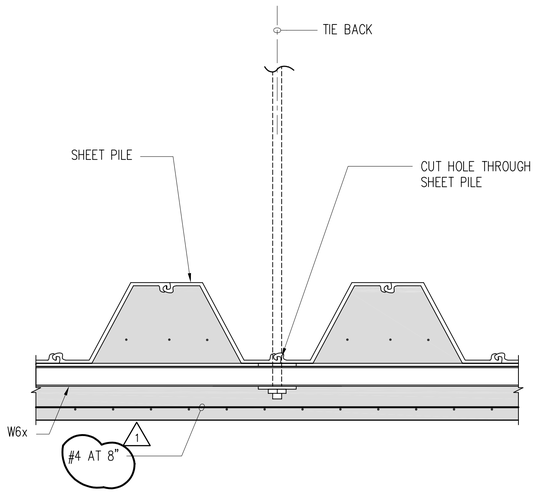
SEA WALL SECTION

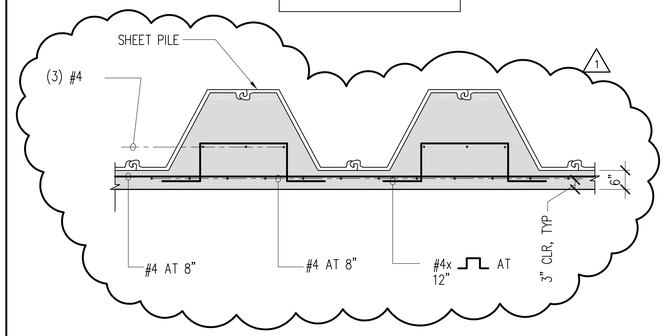
DESIGNED: CS	SUBMITTED:
DRAWN: CAD	DATE: 6 May 2026
CHECKED: SP	SCALE: AS SHOWN
APPROVED:	DRAWING NO. S-3
CHIEF ENGINEER	DATE



1 S-4 **SHEET PILE AT TIEBACK**

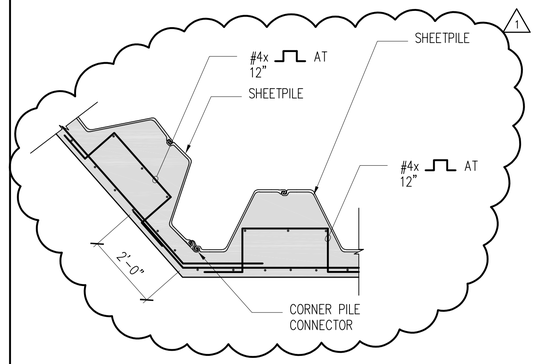
NOT TO SCALE

NOTE:
CONTRACTOR MAY INSTALL SHEETPILE CONNECTOR AS NEEDED AT NO ADDITIONAL COST TO THE STATE



2 S-4 **SHEET PILE SECTION**

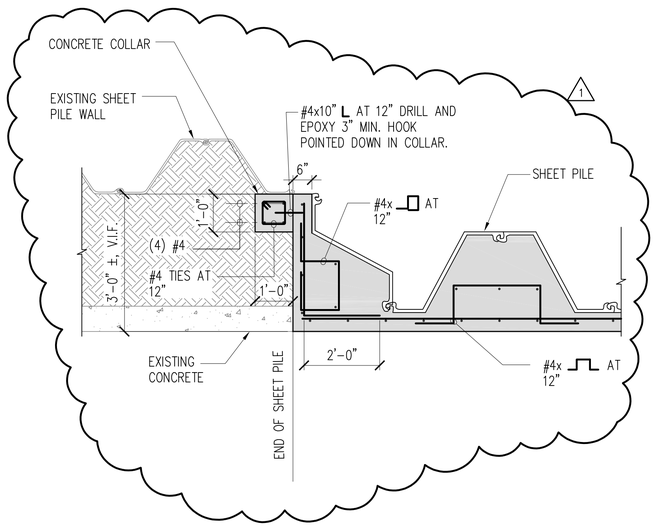
NOT TO SCALE



NOTE:
1. CONTRACTOR TO INSTALL CORNER PILE CONNECTOR PER MANUFACTURER'S RECOMMENDATIONS.
2. CORNER PILE CONNECTOR ANGLE VARIES FROM 90 DEGREES TO 140 DEGREES

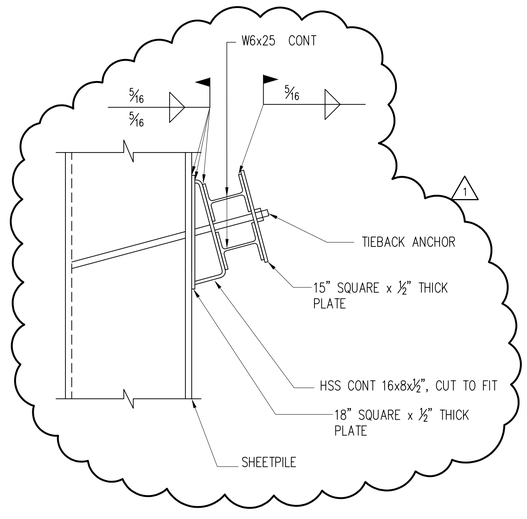
3 S-4 **SHEET PILE AT BEND/RETURN**

NOT TO SCALE



4 S-4 **SHEET PILE AT EXISTING WALL**

NOT TO SCALE



5 S-4 **TIEBACK ANCHOR CONNECTION DETAIL**

NOT TO SCALE

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED
1	1	ADDED U BAR AT SHEETPILE AND RETURN, REVISED SPACING, REVISED WELD CALLOUTS	3/4	5/12/26	

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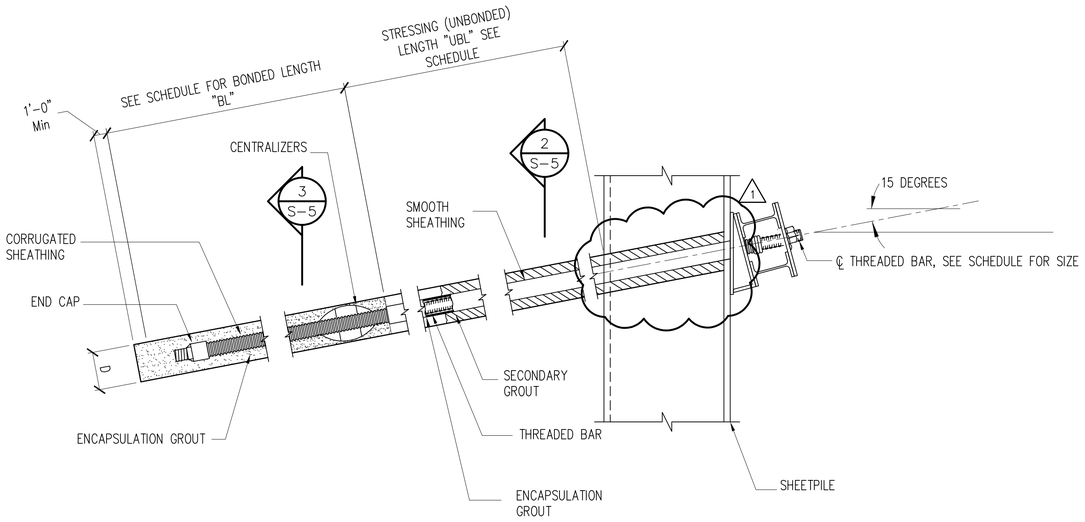
LAHAINA SMALL BOAT HARBOR BOAT RAMP REMOVAL & BULKHEAD EXTENSION

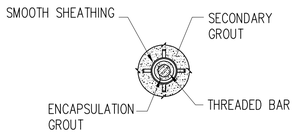
SHEET PILE DETAILS

DESIGNED: CS	SUBMITTED:
DRAWN: CAD	DATE: 6 May 2026
CHECKED: SP	SCALE: AS SHOWN
APPROVED:	DRAWING NO. S-4
CHIEF ENGINEER	DATE



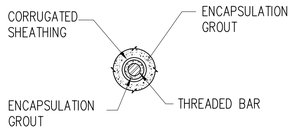
1 S-5 **TIEBACK ANCHOR DETAIL**

NOT TO SCALE



2 S-5 **SECTION**

NOT TO SCALE



3 S-5 **SECTION**

NOT TO SCALE

TIEBACK ANCHOR NOTES:

1. TIEBACK ANCHOR THREADED BAR SHALL BE ASTM A722, TYPE II, GRADE 150 AND BE GALVANIZED PER ASTM A153. SEE SCHEDULE FOR BAR DIAMETER. YIELD STRENGTH SHALL NOT BE REDUCED BY MORE THAN 5% AFTER GALVANIZING. IN ADDITION, ANGLE COMPENSATING NUTS OR BEVEL WASHER SET SHALL BE GALVANIZING PER ASTM A123.
2. SEE SCHEDULE FOR REQUIRED TIEBACK ANCHOR DESIGN LOAD, DL, TEST LOAD, TL, AND LOCK OFF LOAD, LL.
3. GROUT TUBES SHALL BE PLACED THRU THE STEEL BEARING PLATE. SIZE AND LOCATIONS SHALL ENSURE FULL GROUTING OF HOLE. THE CONTRACTOR SHALL SUBMIT GROUTING DETAILS FOR APPROVAL BY THE ENGINEER.
4. CENTRALIZERS SHALL BE PLACED AT 5-FEET INTERVALS IN THE BONDED LENGTH, WITH THE BOTTOM CENTRALIZER LOCATED 2 FEET FROM THE BOTTOM OF THE BONDED LENGTH.
5. DRILLING OF THE TIEBACK ANCHOR HOLES MAY ENCOUNTER LOOSE/SOFT FILL EXTREMELY WEATHERED BASALT ROCK AND HARD UNWEATHERED BASALT ROCK. SPECIAL DRILLING TOOLS FOR DRILLING INTO THE COBBLES, BASALT, BOULDERS ROCK FORMATION WILL BE REQUIRED. TEMPORARY CASING OF THE DRILLED HOLES FOR THE TIEBACK ANCHORS MAY BE REQUIRED WHEN CAVE-IN CONDITIONS OCCUR DURING THE DRILLING OF THE TIEBACK ANCHOR HOLES, ESPECIALLY IN THE LOOSE/SOFT FILL AND THE EXTREMELY WEATHERED BASALT ROCK AT THE SITE.
6. ENCAPSULATION AND SECONDARY GROUT SHALL ATTAIN A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI PRIOR TO STRESSING. TESTING FOR COMPRESSIVE STRENGTH SHALL CONFORM TO ASTM C-109 MORTAR AND SAND.
7. SMOOTH AND CORRUGATED SHEATHS/SLEEVES SHALL BE HIGH-DENSITY POLYETHYLENE (HDPE) CONFORMING TO ASTM D 3350 AND HAVING A MINIMUM STRENGTH OF 7,000 PSI AND 0.06 IN WALL THICKNESS.
8. WHEN LIFTING THE TIEBACK ANCHORS FOR INSTALLATION INTO THE HOLES, MULTIPLE PICK POINTS SHALL BE USED TO AVOID BENDING OR DAMAGING THE THREADED BAR AND/OR ENCAPSULATION GROUT.
9. TIEBACK ANCHOR THREADED BAR SHALL BE NEW AND FREE OF ANY SURFACE DAMAGES, KINKS, AND SHARP BEND.
10. A GEOTECHNICAL ENGINEER HIRED BY THE CONTRACTOR, LICENSED IN THE STATE OF HAWAII, SHALL BE PRESENT TO MONITOR THE INSTALLATION AND TESTING OF TIEBACK ANCHORS. CONTRACTOR SHALL COORDINATE THE INSTALLATION AND TESTING SCHEDULE WITH THE PROJECT ENGINEER.
11. PERFORMANCE TESTS ON THE FIRST TWO INSTALLED TIEBACK ANCHORS AND REMAINING TEN PERCENT SHALL BE PERFORMED. SEE SPECIFICATIONS FOR DETAILS.
12. ALL OTHER TIEBACK ANCHORS SHALL BE PROOF TESTED. SEE SPECIFICATIONS FOR DETAILS.
13. CONTRACTOR SHALL VERIFY ALL UTILITIES IN THE PROJECT AREA PRIOR TO TIEBACK INSTALLATION. THE CONTRACTOR SHALL REPORT IN WRITING TO THE ENGINEER ALL UTILITY CONFLICTS PRIOR TO TIEBACK INSTALLATION.

TIEBACK ANCHOR SCHEDULE								
ANCHOR	"A"	"D"	"S"	"UBL"	"BL"	"DL"	"TL"	"LL"
WALL	1"	8"	5'	10'-0"	25'-0"	25	37.5	20

Legend:
A = ANCHOR THREADED BAR DIAMETER (IN)
S = MAX HORIZONTAL ANCHOR SPACING (FT)
UBL = UNBONDED LENGTH (FT)
BL = BONDED LENGTH (FT)
DL = DESIGN LOAD (KIPS)
TL = TEST LOAD (KIPS)
LL = LOCK OFF LOAD (KIPS)
D = MIN. ANCHOR TIEBACK HOLE DIA. (IN)

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED
1	1	SHOW GROUT THROUGH SHEETPILE	4/4	5/12/26	

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TIEBACK ANCHOR DETAILS

DESIGNED: CS	SUBMITTED:
DRAWN: CAD	DATE: 6 May 2026
CHECKED: SP	SCALE: AS SHOWN
APPROVED:	DRAWING NO. S-5
CHIEF ENGINEER / DATE	