



Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

097.13 DPWH
10.17.2020

OCT 14 2020

DEPARTMENT ORDER)

NO. **100**)
Series of 2020)

**SUBJECT: New and Updated Standard Plans
for Various Flood Control, Urban
Drainage and Coastal Structures
(CY 2015-2019)**

In line with the issuance of Department Order No. 179 series of 2015, re: DPWH Design Guidelines, Criteria and Standards (DGCS), 2015 Edition, new and updated standard plans for the design of various flood control, urban drainage and coastal structures are now available for reference.

The issuance of these standard plans aims to ensure the safety, cost effectiveness and development of high quality detailed design for water engineering projects incorporating the industry's best practice in design adaptable to local requirements. The said plans shall serve as guide for District Engineering Offices, Regional Offices, Project Management Office Clusters and Engineering Consultants in the preparation of water engineering plans based on the revised design guidelines.

The new and updated standard plans for water engineering projects are as follows:

I. NEW

1. Seawall (4 sheets)
 - a. Seawall with Boulders Toe Protection
 - b. Seawall with Sheet Piles
 - c. Seawall using Geotubes
2. Hexapod Spurdike (1 sheet)
3. Polyvinyl Chloride (PVC) Sheet Pile (1 sheet)
4. Two (2) meter Reinforced Concrete Pipe Culvert (RCPC) (2 sheets)
5. Combination of Bored/Steel Sheet Pile for Bank protection (3 sheets)
6. Rubble Mound Breakwater (2 sheets)
7. Rubble Mound Jetty with Geotube Core (3 sheets)

II. UPDATED

1. Slope Protection Works (3 sheets)
 - a. Details of Different Types of Revetment
 - b. Details of Curtain Walls and Berm
 - c. Details of Foot Protection Works of Revetment
2. Details of Gates (2 sheets)
 - a. Flap Gate
 - b. Slide Gate
3. Pile hurdles (2 sheets)
4. Bio-Engineering for Slope Protection Application (3 sheets)
5. Reinforced Concrete Sheet Pile (1 sheet)

6. Steel Sheet Pile (U-Type & Z-Type) (1 sheet)
7. Earthdike/Levee (2 sheets)
8. Drainage Culvert with Flap Gate (3 sheets)
9. 2m to 6m Gravity Wall (5 sheets)

The aforementioned plans can be downloaded from the DPWH Intranet (<http://dpwhnet>) under Bureau of Design - Standard Design.



MARK A. VILLAR
Secretary

5.1.2 LLL/ECM/AMD

Department of Public Works and Highways
Office of the Secretary



WIN0R01536



Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
Bonifacio Drive, Port Area, Manila

STANDARD PLANS OF SEAWALL

- a. SEAWALL WITH BOULDERS TOE PROTECTION
- b. SEAWALL WITH SHEET PILES
- c. SEAWALL WITH GEOTUBE

SUBMITTED BY:


LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIV., B.O.D.

RECOMMENDING APPROVAL:


DANTE B. POTANTE
DIRECTOR IV, B.O.D.

APPROVED BY:


RAUL C. ASIS
UNDERSECRETARY
FOR TECHNICAL SERVICES

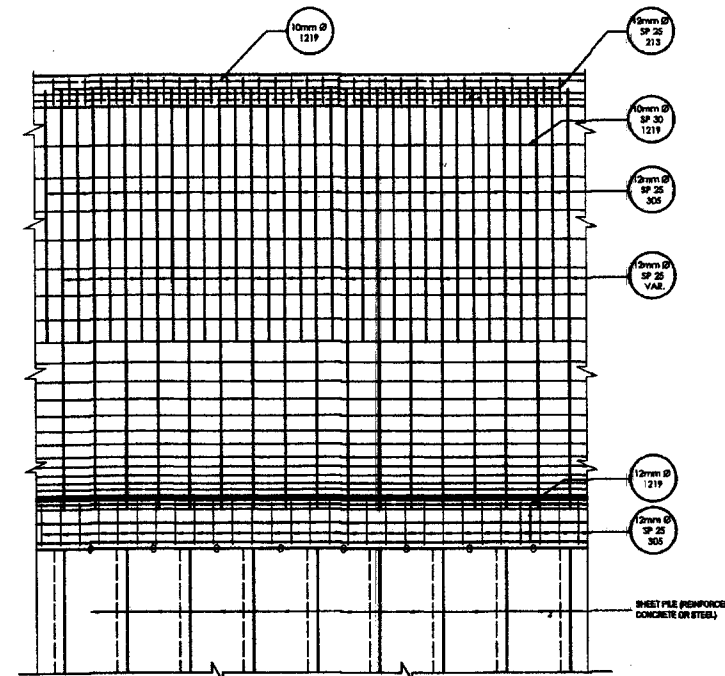

ROGELIO L. SINGSON
SECRETARY

Department of Public Works and Highways
Office of the Secretary

WIN6R01228

1. ALL DIMENSIONS, ELEVATIONS AND DISTANCES ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. REFERENCE DATUM SHALL BE BASED ON THE MEAN LOWER LOW WATER (M.L.L.W.)
ELEVATION = 10.0m.
3. ALL CONCRETE MORTARE SHALL BE CLASS "A" (1:2:4 MIX) FOR R.C. WAVE DEFLECTOR AND SLAB ON FILL WALKWAY.
4. ALL REINFORCING STEEL BARS SHALL BE DEFORMED BARS WITH DEFORMATION CONFORMING TO ASTM A615 AND OF INTERMEDIATE GRADE 40 WITH MINIMUM YIELD STRENGTH $f_y = 278 \text{ MPa}$ (40,000 psi).
5. REINFORCING BARS SHALL BE COLD BENT.
6. REINFORCING BARS SHALL HAVE 75mm COVER FOR THE R.C. WAVE DEFLECTOR AND SLAB ON FILL WALKWAY.
7. CONNECTION OF ANCHOR BARS SHALL BE WELDED AT LEAST THREE AND A HALF TIMES (3 $\frac{1}{2}$) THE DIAMETER OR SIZE OF BARS BUT NOT LESS THAN 75mm. ALL INTERSECTIONS OF REINFORCING BARS MUST BE ELECTRICALLY SPOT WELDED IN LIEU OF TYING THEM WITH U BAR.
8. ALL WELDING SHALL BE BUTT WELD-FILLET WELD UNLESS OTHERWISE SPECIFIED. WELDING ELECTRODES SHALL BE SHIELDED-ARC TYPE HEAVILY COATED WITH CLASSIFICATION No. E-6010 OF THE AMERICAN WELDING SOCIETY.
9. FIGURES SHALL COVER OVER SCALED DIMENSIONS IN CASE OF DISCREPANCIES.
10. THE ENGINEER IN-CHARGE MUST REQUIRE SUBMITTAL OF AGGREGATES AND CONCRETE SAMPLES AS PRESCRIBED BY CURRENT REGULATIONS.
11. THE DIRECTOR OF BUREAU OF DESIGN SHALL BE INFORMED ACCORDINGLY IF THERE ARE SIGNIFICANT CHANGES IN ELEVATIONS OF PROPOSED SEAWALL WHICH WOULD REQUIRE REVISION OF PLANS.

12. TENSILE STRENGTH OF THE HYDRAULIC GEOTEXTILE TUBE AND PROBION CONTROL AND BASALT REINFORCEMENT GEOTEXTILE SHALL BE PROPERLY DETERMINED.
13. ARMOUR ROCK CLASS SPECIES :
- a. CLASS I ROCKS MUST WEIGH NOT LESS THAN 1,900 kg. PER CUBIC METER SOLID (SPECIFIC GRAVITY - 4.8) OR APPROXIMATELY 18.25 KILONEWTON (400) PER CUBIC OF SOLID MATERIAL.
 - b. CLASS I ROCK MUST BE ANGULAR.
 - c. PIECES OF CLASS I ROCKS SHALL WEIGH NOT LESS THAN 1 TON (1,000 Kgs.)
14. FILTER CLOTH _____
- a. POLYESTER OR POLYPROPYLENE _____ 100%
 - b. MECHANICALLY HEAT BONDED
 - c. NON-MOVEN A COMPOSE OF CONTINUOUS FILAMENT
 - d. EFFECTIVE OPENING SIZE _____ 110 MICRONS (Max.)
 - e. THICKNESS UNDER PRESSURE 2000PSI _____ (0.50mm (20in.))
 - f. WEIGHT _____ 200 gsm²
 - g. MULTIDIRECTIONAL TENSILE STRENGTH _____ 2000 NMM
 - h. CURT PUNCHING STRENGTH _____
15. LENGTH OF SHEET PILES SHALL CONSIDER THE CALCULATED DEPTH OF SCOURING.









○ TYPICAL SECTION OF SEAWALL

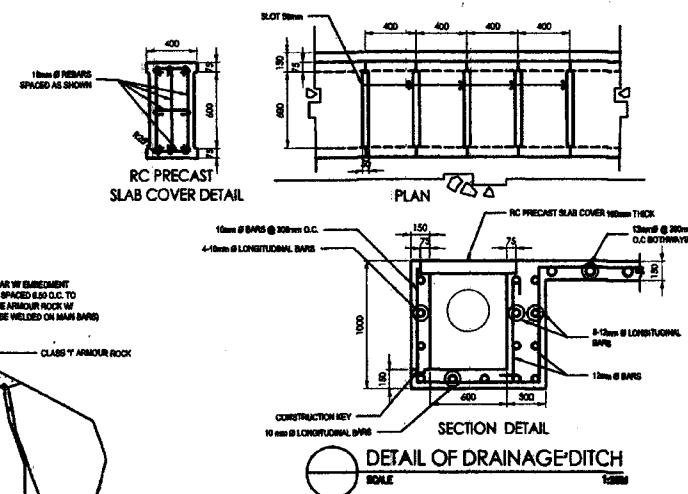
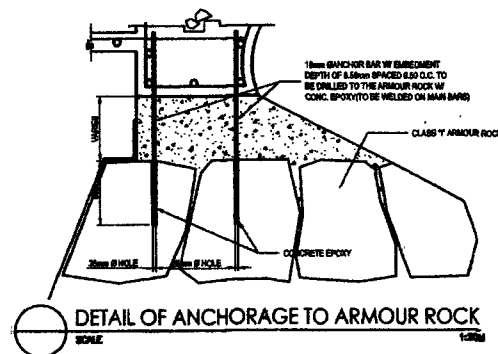
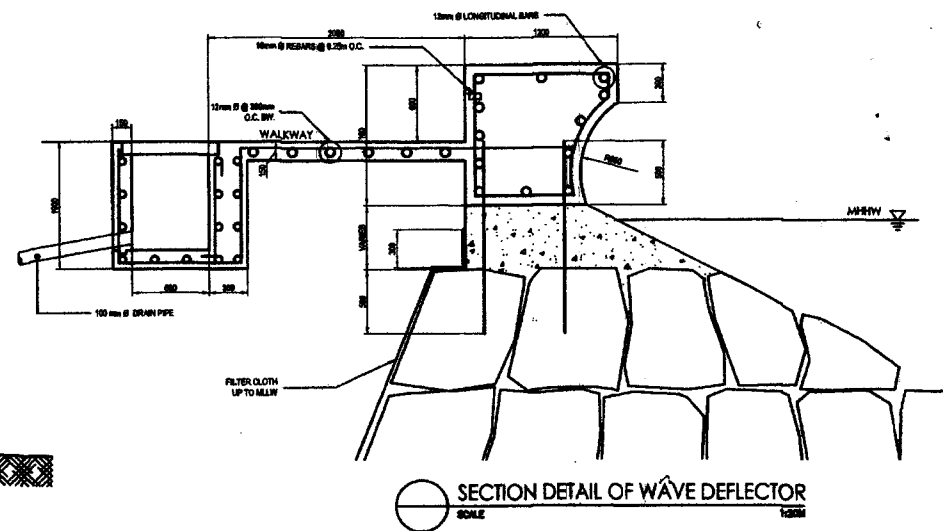

PART _____ **ELEVATION** _____
SCALE _____ **1:200**

NOTE:
CONFIGURATION/TYPE OF SLOPE PROTECTION WORKS & LENGTH OF
TOE PROTECTION SHALL BE BASED ON STABILITY ANALYSIS & SCOUR
ANALYSIS RESPECTIVELY.





Department of Public Works and Highways
Office of the Secretary

WIN6R01228

 <p> REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS BUREAU OF DESIGN WATER PROJECTS DIVISION RODRIGO DELA CRUZ AVENUE, SOUTH ADOLE, MARINA </p>	SHEET CONTENTS:	SHEET TITLE:	PREPARED BY:	DATE:	SIGNATURE:	REVIEWED BY:	RECOMMENDING APPROVAL:	APPROVED BY:	SET NO.	SHEET NO.
	- TYPICAL SECTION	TYPICAL STD. DRAWING OF	DESIGNER: MARK DELICOURT P. BAREL	1/20/18					STD	1
	- PART ELEVATION	SEA WALL W/ SHEET PILE	DRAWN: R. R. BORDA			LEONARDO L. LINGAN	DANTE B. POTANTE	PAUL C. ASIS	REWALL	4
			CHECKED: MARTINIANO M. DE LA CRUZ, Jr.			CHIEF, WATER PROJECTS DIV. B.O.D.	DIRECTOR H. A. ...	UNDER SECRETARY ...	SECRETARY	

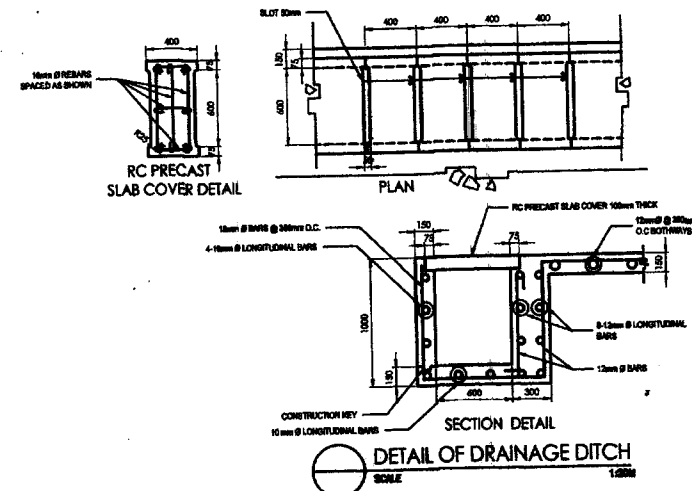
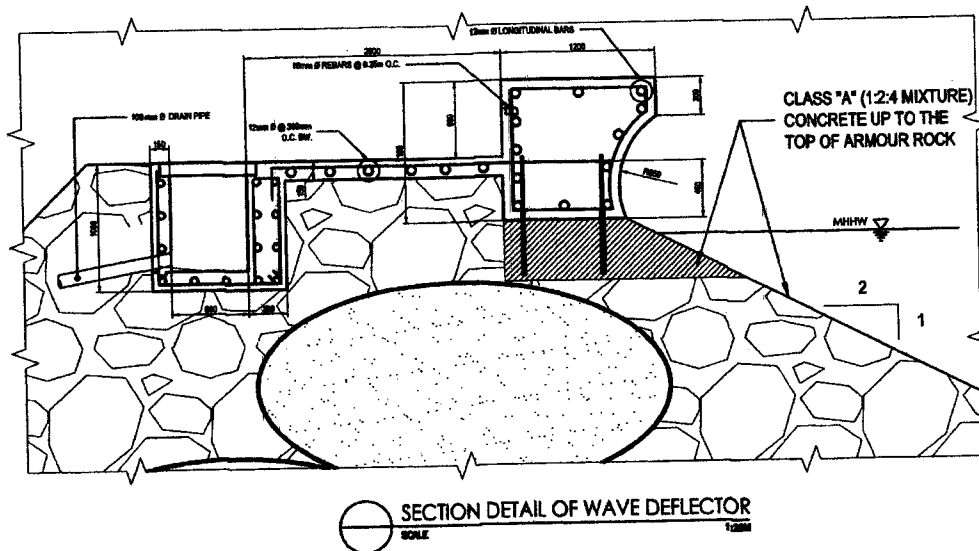
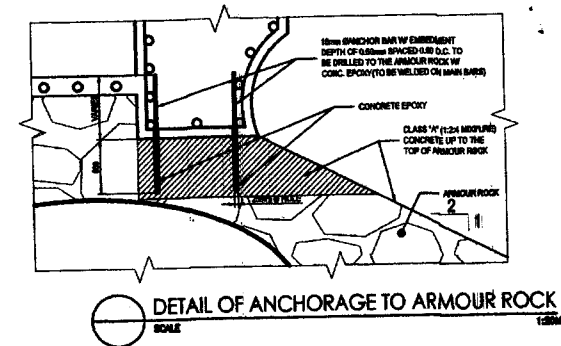
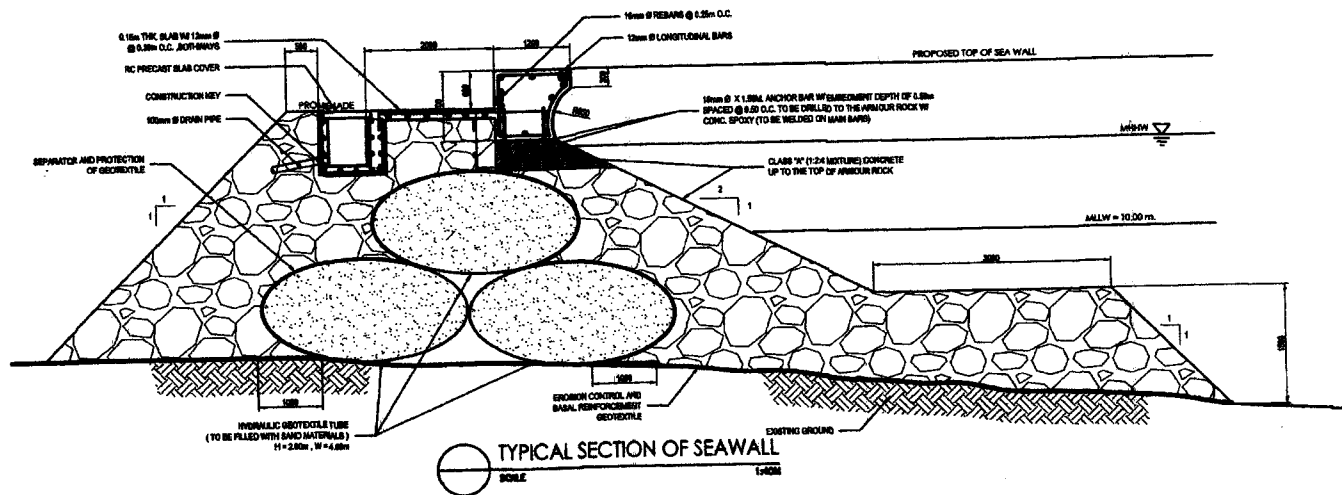




SHEET CONTAINS:	SHEET TITLE:	PREPARED BY:	DATE:	SIGNATURE:	REVIEWED BY:	RECOMMENDING APPROVAL:	APPROVED BY:	SET NO.	SHEET NO.
<ul style="list-style-type: none"> - TYPICAL SECTION - PART ELEVATION 	TYPICAL STD. DRAWING OF SEA WALL W/ SHEET PILE AND HYDRAULIC GEOTEXTILE TUBE FILLER	DESIGN: MARK GERRICH P. BAYAL DRAWN: R. E. TORRES CHECKED: MARTIN ROJO M. DE LA CRUZ, JR.	4/20/05	 LEONARDO L. LINGAN CHIEF, PORT PROJECTS DIV./D.O.	 DANTE B. POTANCE DIRECTOR, D.O.	 PAUL C. ASIS ASST. DIR. OF TECHNICAL SERVICES	 ROGELIO J. SINGSON SECRETARY	STD SMALL	3 4

[illegible]

WIN6R01228



NOTE:
CONFIGURATION TYPE OF SLOPE PROTECTION WORKS & LENGTH OF
TOE PROTECTION SHALL BE BASED ON STABILITY ANALYSIS & SCOUR
ANALYSIS, RESPECTIVELY.

Department of Public Works and Highways
Office of the Secretary
WIN6R01228



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
REPARADO ISLAND, PORT AREA, MANILA

SHEET CONTENTS:
- SECTION DETAIL OF WAVE DEFLECTOR
- DETAIL OF DRAINAGE DITCH
- TYPICAL SECTION
- DETAIL OF ANCHORAGE TO ARMOUR ROCK

SHEET TITLE:
TYPICAL STD. DRAWING OF SEA WALL
W/ BOULDER TOE PROTECTION WORK
AND HYDRAULIC GEOTEXTILE TUBE
FILLER

PREPARED BY:
DESIGN: MARK SEBASTIAN P. BAYAL
DRAWN: J.E. BAYAL
CHECKED: MARTIN MARILYN DELA CRUZ, J.

DATE: 1/20/2023
SIGNATURE: [Signature]

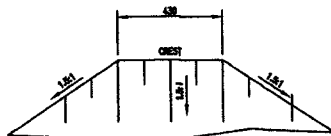
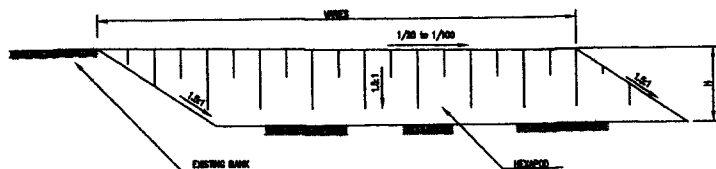
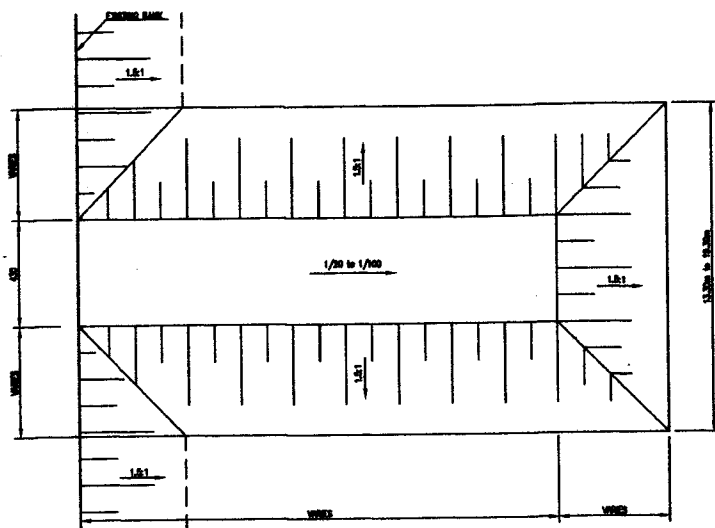
REVIEWED BY:
LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIVISION

RECOMMENDING APPROVAL:
DANTE B. POTANKE
DEPUTY CHIEF, WATER PROJECTS DIVISION

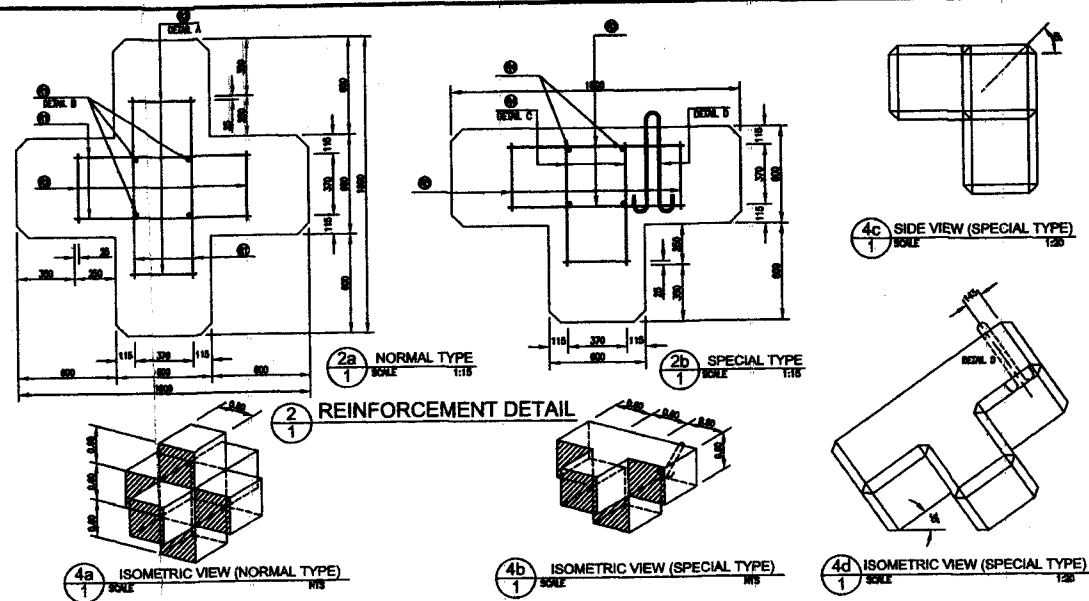
APPROVED BY:
MARC C. ABIS
SECRETARY

APPROVED BY:
ROGELIO L. SINGSON
SECRETARY

SET NO. 1
SHEET NO. 4



1 HEXAPOD SPUR DIKE DETAILS



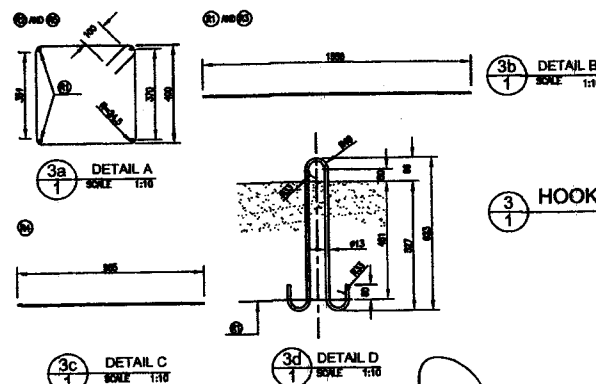
4 GENERAL LAYOUT PLAN OF HEXAPOD

REINFORCEMENT BAR OF HEXAPOD UNIT PIECE (NORMAL TYPE)

	TYPE	LENGTH mm	NO.	UNIT WEIGHT kg/m	WEIGHT PER BAR kg/bar	TOTAL WEIGHT kg
R1	D10	1100	12	.817	.878	8.144
R2	D10	800	8	.817	1.111	8.889
TOTAL =						14.033

REINFORCEMENT BAR OF HEXAPOD UNIT PIECE (SPECIAL TYPE)

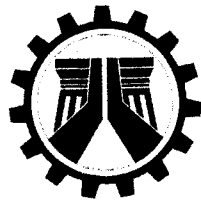
	TYPE	LENGTH mm	NO.	UNIT WEIGHT kg/m	WEIGHT PER BAR kg/bar	TOTAL WEIGHT kg
R3	D10	1100	4	.817	.878	2.715
R4	D10	700	8	.817	.878	3.878
R5	D10	1000	4	.817	1.111	4.444
TOTAL =						11.037



GENERAL NOTES:

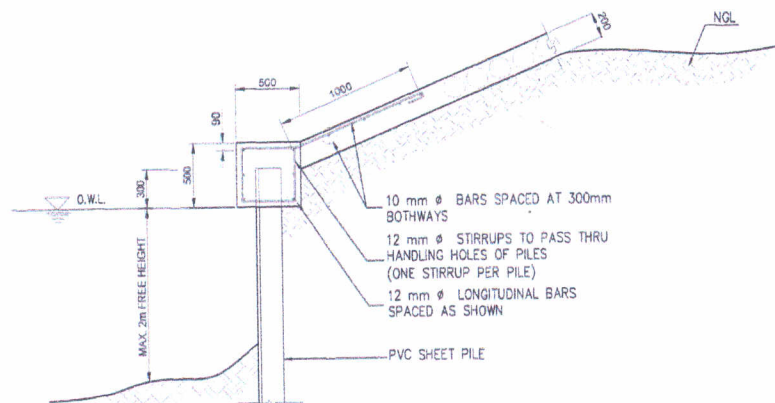
- 1) BASICALLY SPUR DIKE HEIGHT "H" SHALL BE 3.00m TO 5.00m.
- 2) SPUR DIKE CREST WIDTH SHOULD BE KEPT 4.3m THAT IS 2 PCS. OF WIDTH OF HEXAPOD ON RANDOM PILES.
- 3) SPUR DIKE GRADIENT DEPENDS ON GROUND CONDITION.
- 4) USUALLY NORMAL TYPE IS USED. SPECIAL TYPE SHOULD BE APPLIED AT BOTTOM OR SIDE ONLY UPON THE DIRECTION OF THE ENGINEER AND CANNOT BE APPLIED AT EXPOSED PORTION, SUCH AS CREST, ETC.
- 5) CONCRETE CLASS "B". CONCRETE SHALL BE CLASS "B" WITH MAXIMUM AGGREGATES SIZE OF 20mm AND SLUMP OF 80-100mm.
- 6) ALIGNMENT OF THE SPUR DIKE SHALL BE PERPENDICULAR TO THE BANK.
- 7) THE ARRANGEMENT OF HEXAPOD SHALL BE RANDOM PILED UP TYPE.
- 8) NORMAL DENSITY OF HEXAPOD IS 29.7 pcs/100m² ON USING NORMAL TYPE ONLY.

	REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS BUREAU OF DESIGN WATER PROJECTS DIVISION CORRAL DRIVE, PORTLAND, MANILA	SHEET CONTENTS: - HEXAPOD SPUR DIKE DETAILS - HOOK DETAIL - REINFORCEMENT DETAIL	SHEET TITLE: TYPICAL STANDARD DRAWING OF HEXAPOD SPUR DIKE	PREPARED BY: DESIGN: MARTIN M. ALONSO DRAWN: JUAN C. POTANTE CHECKED: MARCELINO A. CARLOTA	DATE: SIGNATURE: REVIEWED BY: LEONARDO L. LINGAN CHIEF, WATER PROJECTS DIV., B.O.D.	RECOMMENDING APPROVAL: DAVID B. POTANTE CHIEF, W.P.D., B.O.D.	APPROVED: SAUL C. ASIS UNDER SECRETARY FOR TECHNICAL SERVICES	SET NO. STD HEXAPOD	SHEET NO. 1 1
--	---	---	--	---	---	---	--	---------------------------	---------------------



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

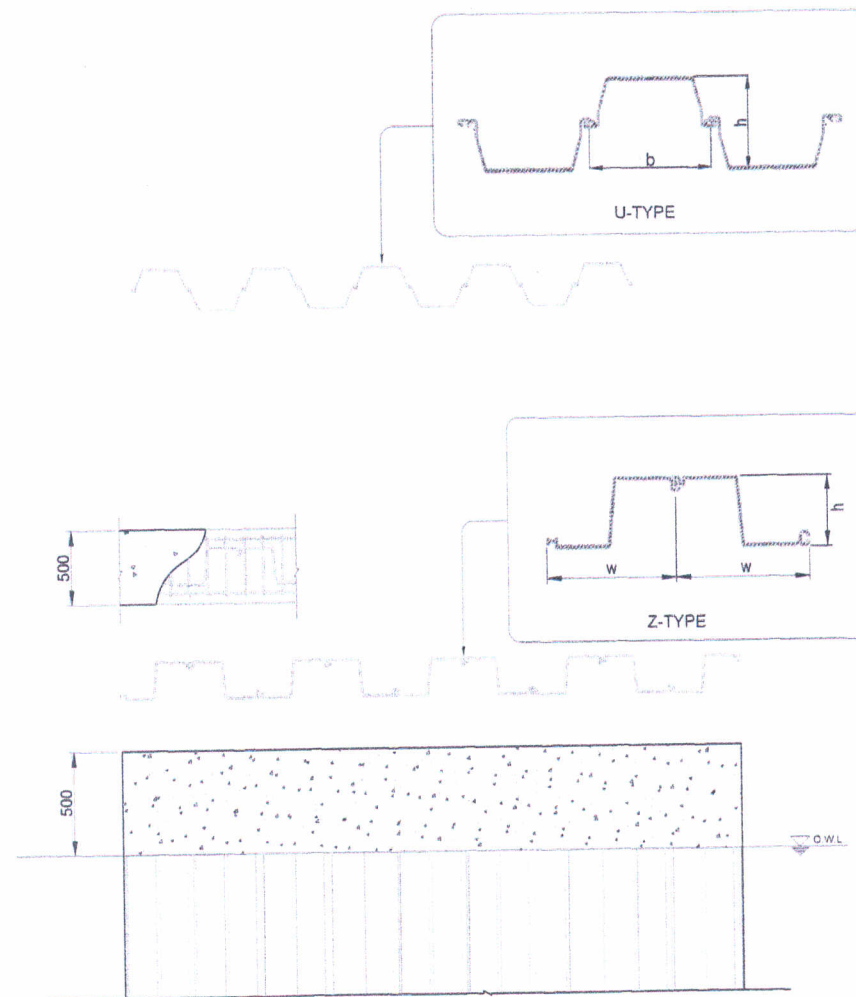
STANDARD POLYVINYL CHLORIDE (PVC) SHEET PILE FOR REVETMENTS



PILE CAP DETAIL
NOT TO SCALE

GENERAL NOTES:

1. USE OF POLYVINYL CHLORIDE (PVC) SHEET PILES SHALL BE BASED ON AN ESTIMATED COST COMPARISON WITH OTHER TYPES OF SHEET PILES, E.G. CONCRETE AND STEEL, FOR POTENTIAL COST SAVINGS AND SHALL MEET ALL THE PERFORMANCE REQUIREMENTS FOR THE SPECIFIC APPLICATION, INCLUDING STRENGTH, STIFFNESS, INSTALLATION, INTERLOCK INTEGRITY, DURABILITY AND LONGEVITY. SUCH PILE SHALL NOT BE USED WHEN LARGE IMPACTS DURING THE DESIGN LIFE ARE POSSIBLE, I.E. LARGE DEBRIS AND VESSEL.
2. THE PVC SHEET PILES AND OTHER APPURTENANT MATERIALS SHALL CONFORM TO THE REQUIREMENTS AND SPECIFICATIONS PRESCRIBED IN DEPARTMENT ORDER 244, SERIES OF 2016 RE: DPWH STANDARD SPECIFICATION FOR ITEM 523 - POLYVINYL CHLORIDE (PVC) SHEET PILES.
3. THE LENGTH AND SECTION MODULUS OF THE PVC SHEET PILE SHALL BE BASED ON THE RESULTS OF THE GEOTECHNICAL INVESTIGATION AND STABILITY ANALYSIS.
4. THE FREE HEIGHT OF THE PVC SHEET PILE SHALL NOT EXCEED TWO (2) METERS TO LIMIT POTENTIAL DEFLECTION.
5. THE CONTRACTOR SHALL FURNISH AND DRIVE TEST PILES OF THE REQUIRED DIMENSIONS AT THE LOCATIONS DESIGNATED BY THE ENGINEER. FOR EACH SHIPMENT, THE CONTRACTOR SHALL SUBMIT MILL CERTIFICATES PROVIDED BY THE PVC SHEET PILE MANUFACTURER PRIOR TO INSTALLING.
6. ALL PVC SHEET PILES SHALL BE DRIVEN AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER. EXCAVATIONS FOR THE FOUNDATION ON WHICH THE PVC SHEET PILES ARE TO BE DRIVEN SHALL BE COMPLETED BEFORE THE PILE DRIVING, UNLESS OTHERWISE SPECIFIED OR APPROVED BY THE ENGINEER.
7. SPLICING OF PVC SHEET PILES SHALL NOT BE ALLOWED.



ELEVATION
NOT TO SCALE



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BOULEVARD DRIVE, PORT SANITARIA

SHEET TITLE
STANDARD POLYVINYL
CHLORIDE (PVC) SHEET PILE
FOR RETENEMENTS

SHEET CONTENTS:
GENERAL NOTES, PILE CAP DETAIL
AND ELEVATION

DESIGN
DRAWN
CHECKED

PREPARED BY:
MARK GONZALEZ P. BARRIL
DESIGNER
JAN CHRISTOPHER A. TILSON
DESIGNER
RICHELLE FELIPE L. LIM
CHECKER

DATE
SIGNATURE
REVIEWED BY
RECOMMENDING

APPROVAL:
LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIVISION
BUREAU OF DESIGN

LEA N. DEFINIMO
DESIGNER IN CHARGE
BUREAU OF DESIGN

GILBERTO S. REYES
ASSISTANT SECRETARY
FOR TECHNICAL SERVICES

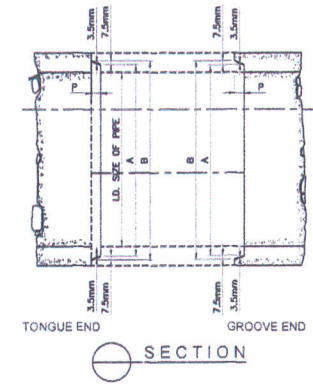
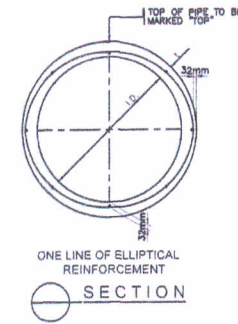
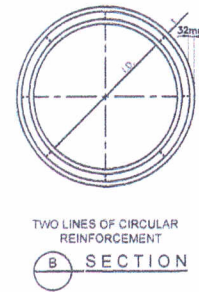
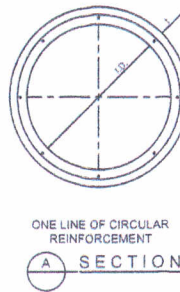
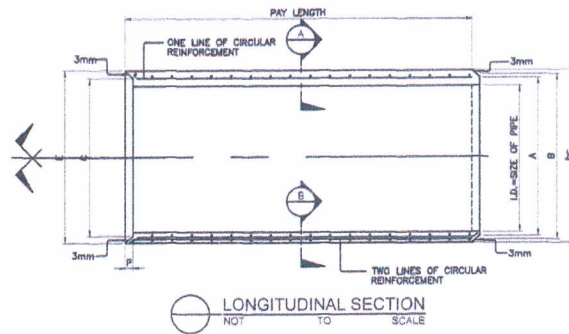
EMIL R. SADAIN, CESO I
UNDER SECRETARY FOR OPERATIONS
AND TECHNICAL SERVICES

APPROVED BY
SHEET NO.
SHEET NO.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

STANDARD TWO (2) METER REINFORCED CONCRETE PIPE CULVERT



PERMISSIBLE VARIATION :

- INTERNAL DIAMETER (I.D.) OF PIPE SHALL VARY NOT MORE THAN + 1% OR 9.50mm WHICHEVER IS GREATER FROM THE DESIGN DIAMETER.
- WALL THICKNESS - THE WALL THICKNESS SHALL NOT BE LESS THAN THAT SHOWN IN THE DESIGN BY MORE THAN 5% OR 4.50mm WHICHEVER IS GREATER.
- LENGTH OF TWO OPPOSITE SIDES - VARIATION IN LAYING LENGTHS OF TWO OPPOSITE SIDES OF PIPE SHALL NOT EXCEED OF 16mm IN ANY LENGTH OF PIPE.
- LENGTH OF PIPE - THE UNDERRUN IN LENGTH OF A SECTION OF PIPE SHALL NOT BE MORE THAN 10.40mm/m WITH A MAXIMUM OF 13mm IN ANY LENGTH OF PIPE.

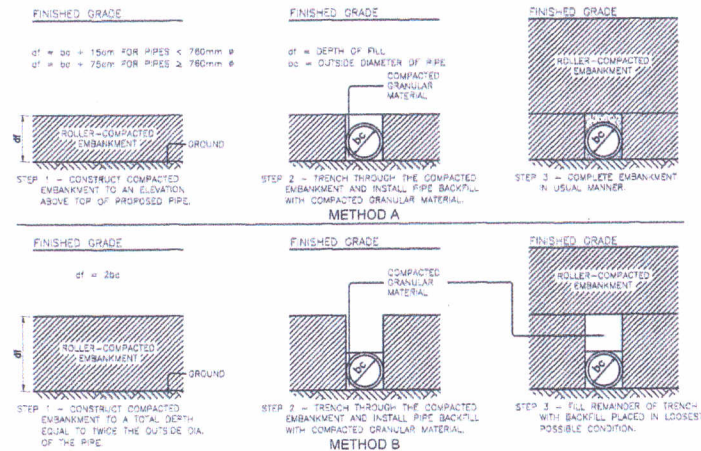
NOTE:

- THE SPACING (CENTER TO CENTER) OF ADJACENT RINGS OF CIRCUMFERENTIAL REINFORCEMENT IN A CAGE SHALL NOT EXCEED 101mm.
- FOR 810mm OR MORE, WALL THICKNESS, THE BELL OR THE SPIGOT OF THE JOINT SHALL CONTAIN AT LEAST ONE CIRCUMFERENTIAL REINFORCEMENT.

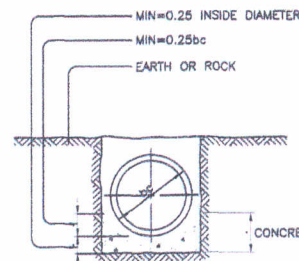
NOTE:

- FOR 63mm OR LESS, WALL THICKNESS PROTECTIVE COVERING SHALL BE 18mm.
- FOR 63mm OR GREATER, WALL THICKNESS CIRCULAR REINFORCEMENT SHALL BE PLACED 35% TO 50% OF WALL THICKNESS FROM THE INNER SURFACE.

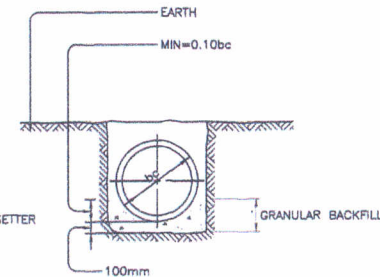
REINFORCED CONCRETE PIPE CULVERT DETAILS



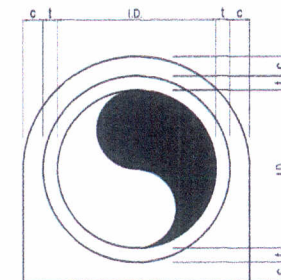
METHODS OF INSTALLATION



CONCRETE CRADLE BEDDING



ORDINARY BEDDING



I.D.	MACHINE MADE	HAND MADE	C
910	86	114	150
1220	110	-	160
1520	127	-	160

COLLARING DETAILS



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE: STANDARD TWO (2) METER REINFORCED CONCRETE PIPE CULVERT
SHEET CONTENTS: REINFORCED CONCRETE PIPE CULVERT DETAILS, METHODS OF INSTALLATION, TYPICAL BEDDING FOR CONDUITS AND COLLARING DETAILS

PREPARED BY: MARK MARSON P. BARRIL
DESIGN: CRABBA RICH V. ESPORTU
DRAWN: JANI CHRISTOPHER A. TILSON
CHECKED: RICHIELE FELIPE I. LUI

DATE: 10/10/2019
SIGNATURE: [Signature]
REVIEWED BY: LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIVISION
BUREAU OF DESIGN

RECOMMENDING APPROVAL: LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIVISION
BUREAU OF DESIGN
GILBERTO S. REYES
ASSISTANT SECRETARY
FOR TECHNICAL SERVICES

APPROVED BY: EMIL K. SADRIN, CESO I
CHIEF, SECRETARY FOR LAND OPERATIONS
AND TECHNICAL SERVICES

SET NO: 1
SHEET NO: 2

STANDARD STRENGTH REINFORCED CONCRETE PIPE CULVERT (CLASS II)																								
SIZE OF PIPE (mm)		CONCRETE 281 kg/cm ² (4,000 lb/in ²)																						
M	WALL THICKNESS (mm)	TONGUE (mm)	GROOVE (mm)	DEPTH (mm)	MINIMUM REINFORCEMENT cm ² /2m OF PIPE		VERTICAL REINFORCEMENT		MINIMUM REINFORCEMENT cm ² /2m OF PIPE		VERTICAL REINFORCEMENT		MINIMUM REINFORCEMENT cm ² /2m OF PIPE		VERTICAL REINFORCEMENT		STRENGTH TEST REQUIREMENTS kg/m							
					WALL A				WALL B				WALL C				THREE EDGE BEARING METHOD LOAD IS PROVIDED IN THIS COLUMN							
					CIRCULAR REINFORCEMENT	ELLIPTICAL REINFORCEMENT	INNER CAGE	OUTER CAGE	CIRCULAR REINFORCEMENT	ELLIPTICAL REINFORCEMENT	INNER CAGE	OUTER CAGE	CIRCULAR REINFORCEMENT	ELLIPTICAL REINFORCEMENT	INNER CAGE	OUTER CAGE								
																	I.D.	t	A	B	C	E	P	UNDER LOAD
900	0.90	10.20	1003	1022	1010	1029	0.64	6	2.6	6.4	6-8mmø	6-8mmø	5.0	3.0	5.6	6-8mmø	6-8mmø	3.0	3.0	3.4	6-8mmø	6-8mmø	4587	6581
1050	1.05	11.40	1168	1187	1175	1194	0.64	8.8	4	7.6	6-8mmø	6-8mmø	6.4	3.8	7.2	6-8mmø	6-8mmø	4.2	3.0	4.6	6-8mmø	6-8mmø	5352	8028
1200	1.20	12.70	1334	1353	1340	1359	0.64	9	5.4	9.8	6-8mmø	6-8mmø	7.6	4.6	8.4	6-8mmø	6-8mmø	6.0	3.6	6.4	6-8mmø	6-8mmø	6116	9174
1500	1.50	15.20	1664	1683	1670	1690	0.64	12.8	7.6	14	6-8mmø	6-8mmø	10.6	6.4	11.8	6-8mmø	6-8mmø	9.4	5.6	10.2	6-8mmø	6-8mmø	7645	11488

STANDARD STRENGTH REINFORCED CONCRETE PIPE CULVERT (CLASS IV)																							
SIZE OF PIPE (mm)		CONCRETE 281 kg/cm ² (4,000 lb/in ²)																					
M	WALL THICKNESS (mm)	TONGUE (mm)	GROOVE (mm)	DEPTH (mm)	MINIMUM REINFORCEMENT* cm ² /2m OF PIPE				VERTICAL REINFORCEMENT				MINIMUM REINFORCEMENT cm ² /2m OF PIPE				VERTICAL REINFORCEMENT				STRENGTH TEST REQUIREMENTS kg/m		
					WALL A				WALL B				WALL C				STRENGTH TEST REQUIREMENTS kg/m						
					CIRCULAR REINFORCEMENT	ELLIPTICAL REINFORCEMENT	INNER CAGE	OUTER CAGE	CIRCULAR REINFORCEMENT	ELLIPTICAL REINFORCEMENT	INNER CAGE	OUTER CAGE	CIRCULAR REINFORCEMENT	ELLIPTICAL REINFORCEMENT	INNER CAGE	OUTER CAGE							
I.D.	t	A	B	C	E	P	CIRCULAR REINFORCEMENT	ELLIPTICAL REINFORCEMENT	INNER CAGE	OUTER CAGE	CIRCULAR REINFORCEMENT	ELLIPTICAL REINFORCEMENT	INNER CAGE	OUTER CAGE	CIRCULAR REINFORCEMENT	ELLIPTICAL REINFORCEMENT	INNER CAGE	OUTER CAGE	THREE EDGE BEARING METHOD				
							UNDER LOAD	OUTER LOAD			UNDER LOAD	OUTER LOAD			UNDER LOAD	OUTER LOAD			LOAD TO PROVIDE 6 TENSILE STRESS	ULTIMATE LOAD			
900	0.90	100	1003	1022	1010	1029	0.64	-	-	-	-	12.8	7.6	14.0	6-8mmø	6-8mmø	6.0	3.6	6.4	6-8mmø	6-8mmø	9174	13761
1050	1.05	113	1168	1187	1175	1194	0.84	-	-	-	-	14.8	8.8	16.6	6-8mmø	6-8mmø	8.4	5.0	9.4	6-8mmø	6-8mmø	10703	16055
1200	1.20	125	1334	1353	1340	1359	0.64	-	-	-	-	17.8	10.6	19.5	6-8mmø	6-8mmø	11.0	6.6	12.2	6-8mmø	6-8mmø	12232	18349
1500	1.50	150	1664	1683	1670	1690	0.64	-	-	-	-	25.0	19.0	28.0	6-8mmø	6-8mmø	17.4	10.4	19.4	6-8mmø	6-8mmø	15291	22936

NOTE:

THE CLASS OF PIPE REPRESENT THE MINIMUM D-LOAD NEEDED TO PRODUCE A 0.30 MILLIMETER CRACK ON A THREE EDGE BEARING TEST W/C IS DESIGNATED IN ASTM-C76 OR AASHTO M170 STRENGTH TEST REQUIREMENTS PER CLASS.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
RODRIGO DELA ROSA AVENUE, MANILA

SHEET TITLE

STANDARD TWO (2) METER
REINFORCED CONCRETE PIPE
CULVERT

SHEET CONTENTS

STANDARD STRENGTH REINFORCED
CONCRETE PIPE CULVERT
DIMENSIONS, REBAR SCHEDULE,
CONCRETE STRENGTH AND TEST
REQUIREMENTS (CLASS II AND IV)

PREPARED BY

DESIGN: MARK GONZALEZ P. BAPIL
DRAWN: JUAN CHRISTOPHER A. TUBASON

CHECKED: RIE-USELL FELIPE - LIA
PROJECT: 14

DATE

SIGNATURE

REVIEW BY

RECOMMENDING APPROVAL

APPROVED BY

SET NO.

SHEET NO.

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

2

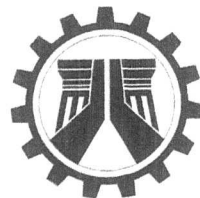
2

2

2

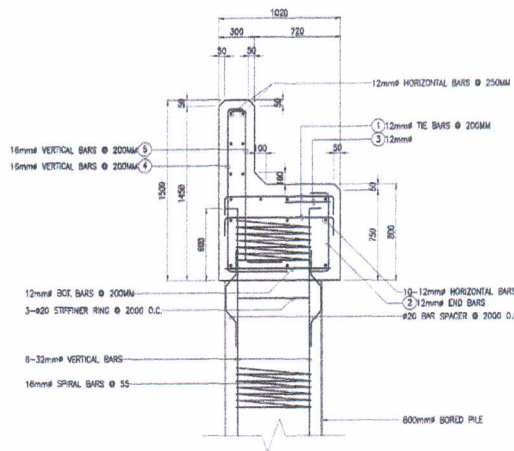
2

2

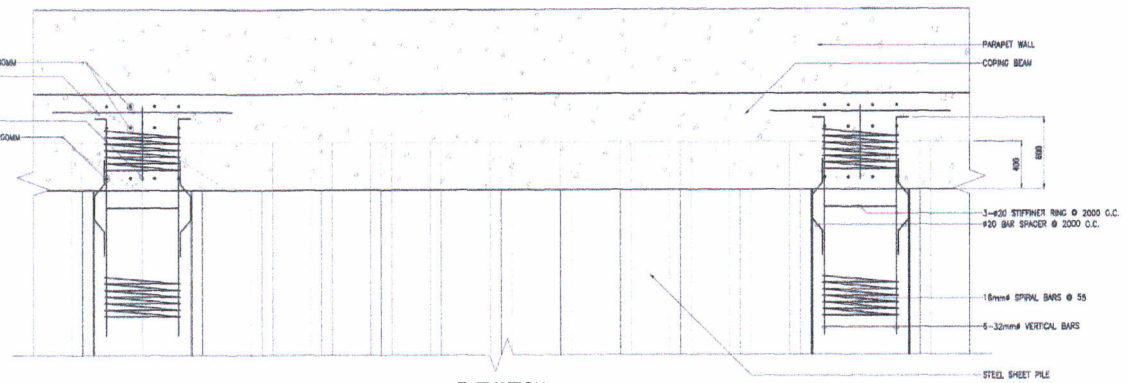
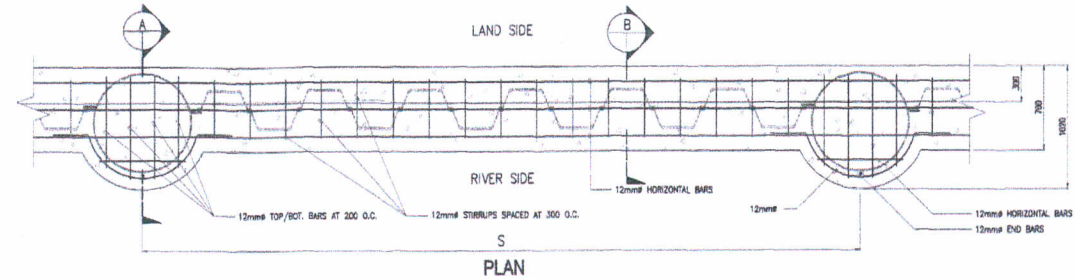


REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

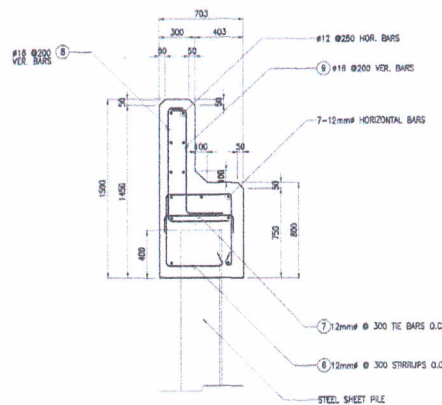
STANDARD COMBINATION OF BORED/STEEL SHEET PILE FOR BANK PROTECTION



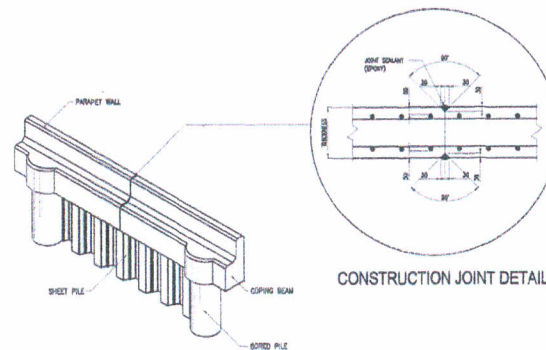
A TYPICAL REINFORCEMENT DETAILS OF PARAPET WALL
SCALE 1:20m



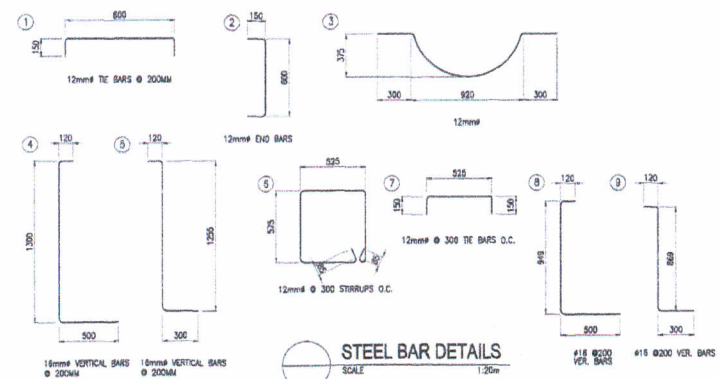
ELEVATION TYPICAL DETAILS OF PILE COPING
SCALE 1:20m



B TYPICAL REINFORCEMENT DETAILS OF PARAPET WALL
SCALE 1:20m



ISOMETRIC VIEW OF REVETMENT
SCALE 1:20m



STEEL BAR DETAILS
SCALE 1:20m



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
KORONADO DRIVE, PORT AREA, MANILA

SHEET TITLE:
STANDARD COMBINATION OF
BORED/STEEL SHEET PILE FOR BANK
PROTECTION

SHEET CONTENTS:
TYPICAL REINFORCEMENT DETAILS
OF PARAPET WALL, ISOMETRIC VIEW
OF REVETMENT, STEEL BAR DETAILS
& TYPICAL DETAILS OF PILE COPING

PREPARED BY:
DESIGN: MARK GERSON P. BARTOL
CRISTINA P. BARTOL
DRAWN: JAY CHRISTOPHER A. TUMON
CHECKED: RICHARD L. LAM

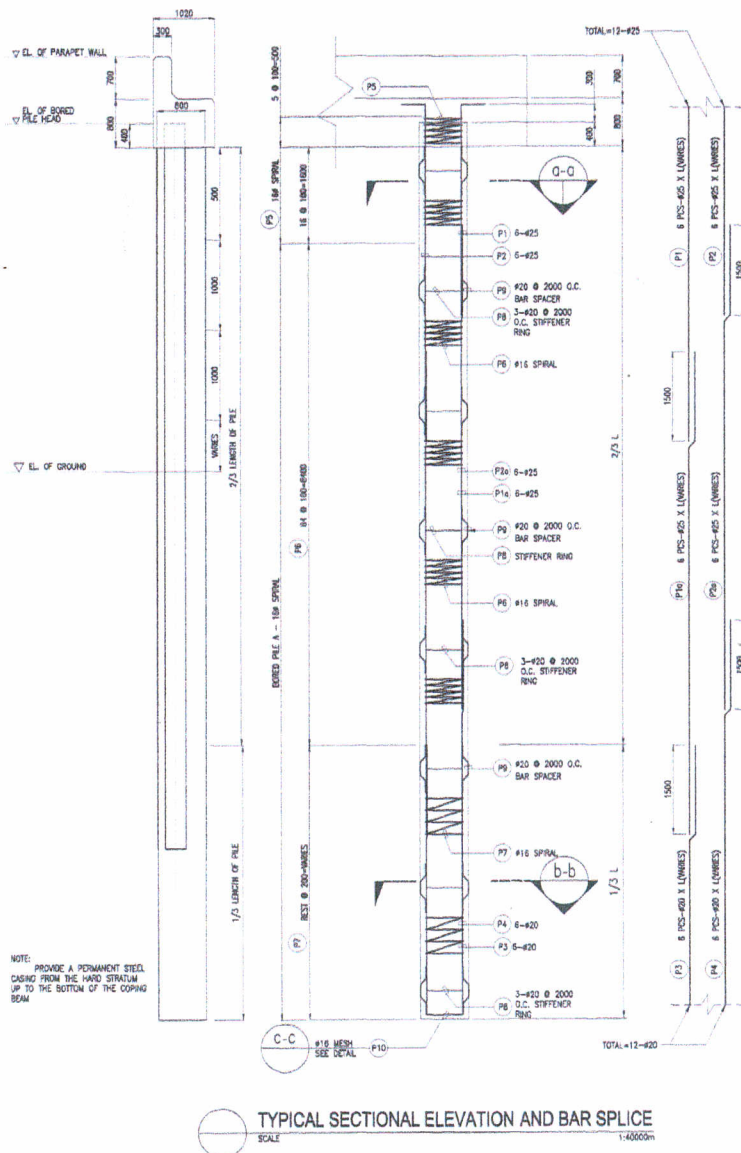
DATE:
SIGNATURE:
REVIEWED BY:
LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIVISION
BUREAU OF DESIGN

RECOMMENDING APPROVAL:
LEA N. DELPILARDO
OFFICER-IN-CHARGE
BUREAU OF DESIGN

APPROVED BY:
GILBERTO S. REYES
ASSISTANT SECRETARY
FOR TECHNICAL SERVICES

EMIL K. SADAN, CESO I
UNDER SECRETARY FOR LAND OPERATIONS
AND TECHNICAL SERVICES

SET NO:
SHEET NO:
STD 1/3



SCHEDULE OF REINFORCEMENT FOR STANDARD 15M LENGTH BORED PILE											
BAR BENDING DIAGRAM											
PILE DIAMETER (mm) = 800											
PILE LENGTH, L (mm) 15000											
BAR MARK	DA (mm)	QUANTITY	SPACING (mm)	BAR BENDING SHAPE	BAR DIMENSIONS (mm)	LENGTH EACH BAR (mm)	TOTAL BAR LENGTH (m)	UNIT WEIGHT (kg/m)	TOTAL WEIGHT (kg)	CONCRETE (m³)	
P1	25	8	as shown	A	6000	36,000	36,000	3.853	138,720	7.340	
P2	25	8	as shown	A	3000	3000	23,400	3.853	90,170		
P1a	25	8	as shown	A	8100	8100	48,600	3.853	187,270		
P2a	25	8	as shown	A	8100	8100	48,600	3.853	187,270		
P3	20	8	as shown	A	4600	4600	27,600	2.468	68,070		
P4	20	8	as shown	A	6700	6700	40,300	2.468	99,140		
P5	16	21	as shown	B	900	100 (min) 200 (max)	1885	39.590	1,578		
P6	16	24	as shown	B	800	100 (min) 200 (max)	1885	169.340	1,578		
P7	16	22	as shown	B	900	100 (min) 200 (max)	1885	41.470	1,578		
P8	20	24	2000	D	1630	800	2430	56.330	2,468		
P9	20	48	2000	C	200	100	800	38.400	2,468		
P10	16	10	150	A	900	800	8,000	8.090	1,578		
TOTAL (GRADE 60)									1398,480		

NOTE: THE ALLOWABLE BEARING CAPACITIES OF BORED PILES AT NORMAL CONDITION SHALL BE AS SHOWN BELOW:

PILE DIAMETER (mm)	PILE LENGTH (m)	REQUIRED ULTIMATE BEARING CAPACITY (kN)	ALLOWABLE BEARING CAPACITY (kN)
800	15.000	2134.940	1067.470

THE DIAMETER OF THE BORED PILE AND REINFORCING BAR SIZES, ARRANGEMENT AND SPACING INDICATED ARE STANDARD FOR THE INTENDED LENGTH OF 15 METERS UNDER NORMAL CONDITIONS AND SHALL BE SUBJECTED FOR ANALYSIS IN CASE THE NECESSARY BEARING CAPACITY INDICATED ABOVE IS NOT MET AND LONGER PILES ARE REQUIRED.

NOTES:

A. GENERAL:

INDICATED DIMENSIONS SHALL GOVERN AND DISTANCES OR SIZES SHALL NOT BE SCALED FOR CONSTRUCTION PURPOSES.

B. MATERIALS:

1. MINIMUM COMPRESSIVE STRENGTH OF CONCRETE @ 28 DAYS SHALL BE, $f'_c = 21$ MPa.

2. ALL REBARS SHALL BE GRADE 60, $f_y = 414$ MPa.

C. SPLICING:

1. SPLICING OF MAIN BARS SHALL BE STAGGERED ALTERNATELY BETWEEN ADJACENT BARS SO AS NOT TO OCCUR AT THE SAME HORIZONTAL PLANE IN ACCORDANCE TO ASTM A630.2.2.

2. SPLICES IN SPIRAL REINFORCEMENT SHALL BE LAP SPLICES OF 60 BAR DIAMETER. IN THIS CASE, LAP SPLICES FOR #20 SPIRAL SHALL BE 1000mm WHILE #25mm SHALL BE ADOPTED FOR #16 SPIRAL.

3. ANCHORAGE OF SPIRAL REINFORCEMENT SHALL BE PROVIDED BY 1 1/2 EXTRA TURNS OF SPIRAL BAR AT EACH END OF SPIRAL UNIT.

D. CAST-IN-PLACE (CIP) CONCRETE PILE:

1. THE CONSTRUCTION OF CIP PILES SHALL FOLLOW THE REQUIREMENTS OF SPECIFICATIONS FOR CAST-IN-PLACE PILES OR DRILLED SHAFTS.

2. THE ACTUAL LENGTHS OF PILES SHALL BE BASED ON THE SOIL CONDITIONS ENCOUNTERED DURING BORING WHICH WILL YIELD THE REQUIRED BEARING CAPACITY.

3. BOTTOM OF PILES SHALL BE EMBEDDED AT LEAST THREE PILE DIAMETER (3D) INTO HARD STRATA WITH AN H-VALUE OF AT LEAST 20 CAPABLE OF DEVELOPING THE REQUIRED ULTIMATE BEARING CAPACITY. IF THE ABOVE CONDITION CANNOT BE MET DURING CONSTRUCTION, THE DESIGNER SHALL BE NOTIFIED FOR ADJUSTMENT OF PILE LENGTH IF NECESSARY.

4. AN ON-SITE SUBSURFACE INVESTIGATION SHALL ALSO BE UNDERTAKEN DURING CONSTRUCTION FOR CONFIRMATION/VERIFICATION OF SOIL DATA USED IN THE DESIGN.

5. DRILLED SHAFT SHALL BE CONSTRUCTED IN A STABLE WAY WITHOUT SLOUGHING THE SOIL AND EXAMINE GROUND WATER. THE HOLE SHALL BE INSPECTED FOR STRAIGHTNESS AND SHALL BE CLEAN OF ALL LOOSE MATERIAL THAT HAVE ACCUMULATED AT THE BOTTOM AFTER DRILLING OPERATIONS. IF BORED PILE CANNOT BE CONSTRUCTED IN DRY CONDITIONS, COMBINATION OF TEMPORARY CASING OR WET METHOD USING BENTONITE MAY BE USED.

6. CONCRETING OF BORED PILE SHALL BE BY TROWEL METHOD. IN CASE OF DRY CONDITION, THE UPPER 3 METERS OF THE CONCRETE SHALL BE CONSOLIDATED BY VIBRATOR.

7. DETAILED METHODOLOGY AND PROCEDURE FOR THE BORED PILE CONSTRUCTION SHALL BE SUBMITTED BY THE CONTRACTOR FOR APPROVAL BY THE ENGINEER AT LEAST ONE WEEK BEFORE START OF BORED PILING WORKS.

8. THE CONSTRUCTION OF CIP PILES SHALL FOLLOW THE REQUIREMENTS OF SPECIFICATIONS FOR CAST-IN-PLACE PILES OR DRILLED SHAFTS.

9. THE ACTUAL LENGTHS OF PILES SHALL BE BASED ON THE SOIL CONDITIONS ENCOUNTERED DURING BORING WHICH WILL YIELD THE REQUIRED BEARING CAPACITY.

10. BOTTOM OF PILES SHALL BE EMBEDDED AT LEAST THREE PILE DIAMETER (3D) INTO HARD STRATA WITH AN H-VALUE OF AT LEAST 20 CAPABLE OF DEVELOPING THE REQUIRED ULTIMATE BEARING CAPACITY. IF THE ABOVE CONDITION CANNOT BE MET DURING CONSTRUCTION, THE DESIGNER SHALL BE NOTIFIED FOR ADJUSTMENT OF PILE LENGTH IF NECESSARY.

11. AN ON-SITE SUBSURFACE INVESTIGATION SHALL ALSO BE UNDERTAKEN DURING CONSTRUCTION FOR CONFIRMATION/VERIFICATION OF SOIL DATA USED IN THE DESIGN.

12. DRILLED SHAFT SHALL BE CONSTRUCTED IN A STABLE WAY WITHOUT SLOUGHING THE SOIL AND EXAMINE GROUND WATER. THE HOLE SHALL BE INSPECTED FOR STRAIGHTNESS AND SHALL BE CLEAN OF ALL LOOSE MATERIAL THAT HAVE ACCUMULATED AT THE BOTTOM AFTER DRILLING OPERATIONS. IF BORED PILE CANNOT BE CONSTRUCTED IN DRY CONDITIONS, COMBINATION OF TEMPORARY CASING OR WET METHOD USING BENTONITE MAY BE USED.

13. CONCRETING OF BORED PILE SHALL BE BY TROWEL METHOD. IN CASE OF DRY CONDITION, THE UPPER 3 METERS OF THE CONCRETE SHALL BE CONSOLIDATED BY VIBRATOR.

14. DETAILED METHODOLOGY AND PROCEDURE FOR THE BORED PILE CONSTRUCTION SHALL BE SUBMITTED BY THE CONTRACTOR FOR APPROVAL BY THE ENGINEER AT LEAST ONE WEEK BEFORE START OF BORED PILING WORKS.

15. THE CONSTRUCTION OF CIP PILES SHALL FOLLOW THE REQUIREMENTS OF SPECIFICATIONS FOR CAST-IN-PLACE PILES OR DRILLED SHAFTS.

16. THE ACTUAL LENGTHS OF PILES SHALL BE BASED ON THE SOIL CONDITIONS ENCOUNTERED DURING BORING WHICH WILL YIELD THE REQUIRED BEARING CAPACITY.

17. BOTTOM OF PILES SHALL BE EMBEDDED AT LEAST THREE PILE DIAMETER (3D) INTO HARD STRATA WITH AN H-VALUE OF AT LEAST 20 CAPABLE OF DEVELOPING THE REQUIRED ULTIMATE BEARING CAPACITY. IF THE ABOVE CONDITION CANNOT BE MET DURING CONSTRUCTION, THE DESIGNER SHALL BE NOTIFIED FOR ADJUSTMENT OF PILE LENGTH IF NECESSARY.

18. AN ON-SITE SUBSURFACE INVESTIGATION SHALL ALSO BE UNDERTAKEN DURING CONSTRUCTION FOR CONFIRMATION/VERIFICATION OF SOIL DATA USED IN THE DESIGN.

19. DRILLED SHAFT SHALL BE CONSTRUCTED IN A STABLE WAY WITHOUT SLOUGHING THE SOIL AND EXAMINE GROUND WATER. THE HOLE SHALL BE INSPECTED FOR STRAIGHTNESS AND SHALL BE CLEAN OF ALL LOOSE MATERIAL THAT HAVE ACCUMULATED AT THE BOTTOM AFTER DRILLING OPERATIONS. IF BORED PILE CANNOT BE CONSTRUCTED IN DRY CONDITIONS, COMBINATION OF TEMPORARY CASING OR WET METHOD USING BENTONITE MAY BE USED.

20. CONCRETING OF BORED PILE SHALL BE BY TROWEL METHOD. IN CASE OF DRY CONDITION, THE UPPER 3 METERS OF THE CONCRETE SHALL BE CONSOLIDATED BY VIBRATOR.

21. DETAILED METHODOLOGY AND PROCEDURE FOR THE BORED PILE CONSTRUCTION SHALL BE SUBMITTED BY THE CONTRACTOR FOR APPROVAL BY THE ENGINEER AT LEAST ONE WEEK BEFORE START OF BORED PILING WORKS.

22. THE CONSTRUCTION OF CIP PILES SHALL FOLLOW THE REQUIREMENTS OF SPECIFICATIONS FOR CAST-IN-PLACE PILES OR DRILLED SHAFTS.

23. THE ACTUAL LENGTHS OF PILES SHALL BE BASED ON THE SOIL CONDITIONS ENCOUNTERED DURING BORING WHICH WILL YIELD THE REQUIRED BEARING CAPACITY.

24. BOTTOM OF PILES SHALL BE EMBEDDED AT LEAST THREE PILE DIAMETER (3D) INTO HARD STRATA WITH AN H-VALUE OF AT LEAST 20 CAPABLE OF DEVELOPING THE REQUIRED ULTIMATE BEARING CAPACITY. IF THE ABOVE CONDITION CANNOT BE MET DURING CONSTRUCTION, THE DESIGNER SHALL BE NOTIFIED FOR ADJUSTMENT OF PILE LENGTH IF NECESSARY.

25. AN ON-SITE SUBSURFACE INVESTIGATION SHALL ALSO BE UNDERTAKEN DURING CONSTRUCTION FOR CONFIRMATION/VERIFICATION OF SOIL DATA USED IN THE DESIGN.

26. DRILLED SHAFT SHALL BE CONSTRUCTED IN A STABLE WAY WITHOUT SLOUGHING THE SOIL AND EXAMINE GROUND WATER. THE HOLE SHALL BE INSPECTED FOR STRAIGHTNESS AND SHALL BE CLEAN OF ALL LOOSE MATERIAL THAT HAVE ACCUMULATED AT THE BOTTOM AFTER DRILLING OPERATIONS. IF BORED PILE CANNOT BE CONSTRUCTED IN DRY CONDITIONS, COMBINATION OF TEMPORARY CASING OR WET METHOD USING BENTONITE MAY BE USED.

27. CONCRETING OF BORED PILE SHALL BE BY TROWEL METHOD. IN CASE OF DRY CONDITION, THE UPPER 3 METERS OF THE CONCRETE SHALL BE CONSOLIDATED BY VIBRATOR.

28. DETAILED METHODOLOGY AND PROCEDURE FOR THE BORED PILE CONSTRUCTION SHALL BE SUBMITTED BY THE CONTRACTOR FOR APPROVAL BY THE ENGINEER AT LEAST ONE WEEK BEFORE START OF BORED PILING WORKS.

29. THE CONSTRUCTION OF CIP PILES SHALL FOLLOW THE REQUIREMENTS OF SPECIFICATIONS FOR CAST-IN-PLACE PILES OR DRILLED SHAFTS.

30. THE ACTUAL LENGTHS OF PILES SHALL BE BASED ON THE SOIL CONDITIONS ENCOUNTERED DURING BORING WHICH WILL YIELD THE REQUIRED BEARING CAPACITY.

31. BOTTOM OF PILES SHALL BE EMBEDDED AT LEAST THREE PILE DIAMETER (3D) INTO HARD STRATA WITH AN H-VALUE OF AT LEAST 20 CAPABLE OF DEVELOPING THE REQUIRED ULTIMATE BEARING CAPACITY. IF THE ABOVE CONDITION CANNOT BE MET DURING CONSTRUCTION, THE DESIGNER SHALL BE NOTIFIED FOR ADJUSTMENT OF PILE LENGTH IF NECESSARY.

32. AN ON-SITE SUBSURFACE INVESTIGATION SHALL ALSO BE UNDERTAKEN DURING CONSTRUCTION FOR CONFIRMATION/VERIFICATION OF SOIL DATA USED IN THE DESIGN.

33. DRILLED SHAFT SHALL BE CONSTRUCTED IN A STABLE WAY WITHOUT SLOUGHING THE SOIL AND EXAMINE GROUND WATER. THE HOLE SHALL BE INSPECTED FOR STRAIGHTNESS AND SHALL BE CLEAN OF ALL LOOSE MATERIAL THAT HAVE ACCUMULATED AT THE BOTTOM AFTER DRILLING OPERATIONS. IF BORED PILE CANNOT BE CONSTRUCTED IN DRY CONDITIONS, COMBINATION OF TEMPORARY CASING OR WET METHOD USING BENTONITE MAY BE USED.

34. CONCRETING OF BORED PILE SHALL BE BY TROWEL METHOD. IN CASE OF DRY CONDITION, THE UPPER 3 METERS OF THE CONCRETE SHALL BE CONSOLIDATED BY VIBRATOR.

35. DETAILED METHODOLOGY AND PROCEDURE FOR THE BORED PILE CONSTRUCTION SHALL BE SUBMITTED BY THE CONTRACTOR FOR APPROVAL BY THE ENGINEER AT LEAST ONE WEEK BEFORE START OF BORED PILING WORKS.

36. THE CONSTRUCTION OF CIP PILES SHALL FOLLOW THE REQUIREMENTS OF SPECIFICATIONS FOR CAST-IN-PLACE PILES OR DRILLED SHAFTS.

37. THE ACTUAL LENGTHS OF PILES SHALL BE BASED ON THE SOIL CONDITIONS ENCOUNTERED DURING BORING WHICH WILL YIELD THE REQUIRED BEARING CAPACITY.

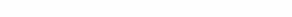
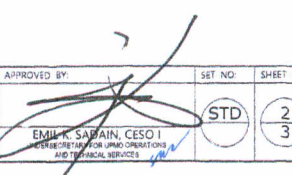
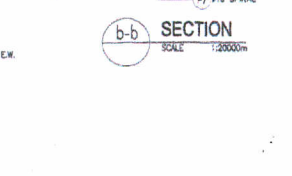
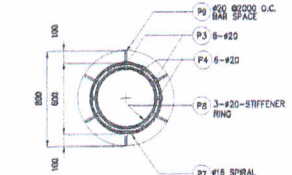
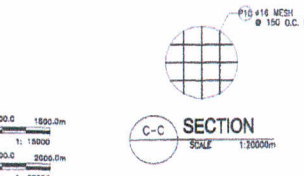
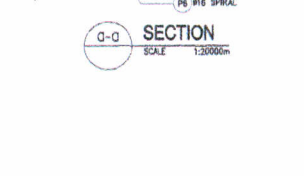
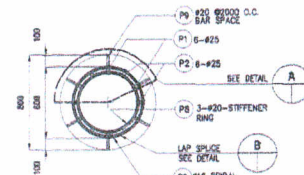
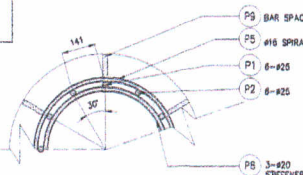
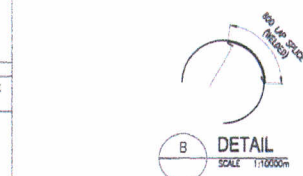
38. BOTTOM OF PILES SHALL BE EMBEDDED AT LEAST THREE PILE DIAMETER (3D) INTO HARD STRATA WITH AN H-VALUE OF AT LEAST 20 CAPABLE OF DEVELOPING THE REQUIRED ULTIMATE BEARING CAPACITY. IF THE ABOVE CONDITION CANNOT BE MET DURING CONSTRUCTION, THE DESIGNER SHALL BE NOTIFIED FOR ADJUSTMENT OF PILE LENGTH IF NECESSARY.

39. AN ON-SITE SUBSURFACE INVESTIGATION SHALL ALSO BE UNDERTAKEN DURING CONSTRUCTION FOR CONFIRMATION/VERIFICATION OF SOIL DATA USED IN THE DESIGN.

40. DRILLED SHAFT SHALL BE CONSTRUCTED IN A STABLE WAY WITHOUT SLOUGHING THE SOIL AND EXAMINE GROUND WATER. THE HOLE SHALL BE INSPECTED FOR STRAIGHTNESS AND SHALL BE CLEAN OF ALL LOOSE MATERIAL THAT HAVE ACCUMULATED AT THE BOTTOM AFTER DRILLING OPERATIONS. IF BORED PILE CANNOT BE CONSTRUCTED IN DRY CONDITIONS, COMBINATION OF TEMPORARY CASING OR WET METHOD USING BENTONITE MAY BE USED.

41. CONCRETING OF BORED PILE SHALL BE BY TROWEL METHOD. IN CASE OF DRY CONDITION, THE UPPER 3 METERS OF THE CONCRETE SHALL BE CONSOLIDATED BY VIBRATOR.

42. DETAILED METHODOLOGY AND PROCEDURE FOR THE BORED PILE CONSTRUCTION SHALL BE SUBMITTED BY THE CONTRACTOR FOR APPROVAL BY THE ENGINEER AT LEAST ONE WEEK BEFORE START OF BORED PILING WORKS.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BUREAU OF DESIGN WATER PROJECTS DIVISION

SHEET TITLE:
STANDARD COMBINATION OF
BORED/STEEL SHEET PILE FOR BANK
PROTECTION

SHEET CONTENTS:
TYPICAL SECTIONAL ELEVATION AND BAR
SPLICE, SCHEDULE OF REINFORCEMENT
FOR STANDARD 15m LENGTH BORED PILE
& GENERAL NOTES

PREPARED BY:
DESIGN: MARK GERRON, P. ENG.
DRAWN: JANI CHRISTOPHER A. TUBON
CHECKED: RICHELLE FELICE L. LIM

DATE: 10/10/2023
SIGNATURE: [Signature]
REVIEWED BY: [Signature]

RECOMMENDING APPROVAL:
LEONARDO L. LINGAN
CHIEF WATER PROJECTS DIVISION
BUREAU OF DESIGN

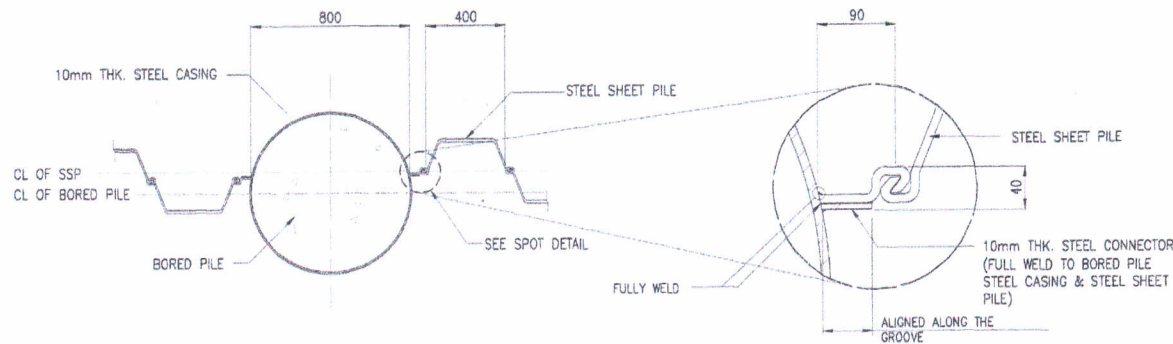
APPROVED BY:
NEA N. DELFINADO
OFFICER-IN-CHARGE
BUREAU OF DESIGN

APPROVED BY:
GILBERTO S. REYES
ASSISTANT SECRETARY
FOR TECHNICAL SERVICES

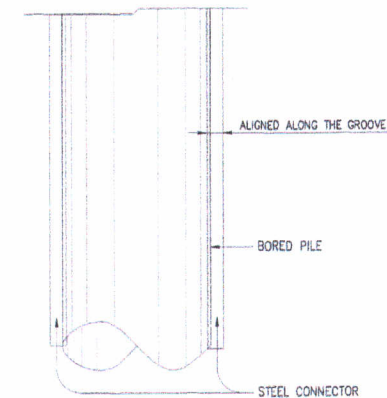
APPROVED BY:
EMIL K. SARIN, CESO I
ASSISTANT SECRETARY FOR LAND OPERATIONS
AND TECHNICAL SERVICES

SHEET NO.: STD
SHEET NO.: 2/3

PLAN



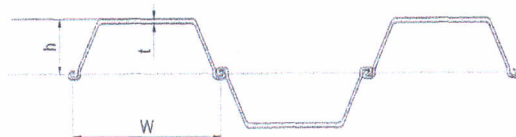
ELEVATION



TYPICAL BORED PILE TO SSP CONNECTION DETAIL
NOT TO SCALE

GENERAL NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH ALL PROVISIONS IN ITEM 1716-PIILING AND ITEM 1717-SHEET PILES OF DPWH STANDARD SPECIFICATIONS.
2. BEFORE ANY WORK BEGINS IN ENVIRONMENTALLY SENSITIVE AREAS, TEMPORARY EROSION CONTROL MEASURES AND PROPER MANAGEMENT PRACTICES SHALL BE IN PLACE.
3. ALL TEMPORARY FENCING FOR PROTECTED AREAS SHALL BE INSTALLED PRIOR TO COMMENCEMENT OF WORK.
4. LOW GROUND DISTURBING EQUIPMENT SHALL BE UTILIZED IN ENVIRONMENTALLY SENSITIVE AREAS AS APPROVED BY THE CIVIL ENGINEER-IN-CHARGE.
5. STEEL SHEET PILES SHALL MEET THE REQUIREMENTS OF AASHTO M 202 (ASTM A328), OR AASHTO M 223. THE JOINTS SHALL BE PRACTICALLY WATER-TIGHT WHEN THE PILES ARE IN PLACE.
6. SHEET PILES SHALL BE DRIVEN TO ELEVATION SHOWN IN THE PLAN OR AS DIRECTED BY ENGINEER-IN-CHARGE.
7. THE REQUIREMENTS GOVERNING THE INSTALLATION OF SHEET PILING SHALL CONFORM IN GENERAL TO THOSE GOVERNING BEARING PILES AS SET FORTH UNDER ITEM 400-PIILING OF DPWH STANDARD SPECIFICATION.
8. THE LENGTH AND SECTION MODULUS OF STEEL SHEET PILE SHALL BE BASED ON THE RESULT OF THE GEOTECHNICAL INVESTIGATION AND STABILITY ANALYSES.



W = WIDTH, h = HEIGHT, t = THICKNESS

STEEL SHEET PILE DETAIL
NOT TO SCALE

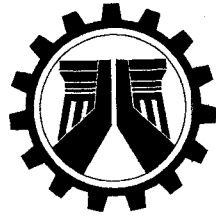
NOTE:

1. THE STEEL CONNECTOR TO BE WELDED ALONGSIDE OF THE STEEL CASING OF THE BORED PILE SHALL HAVE A LENGTH EQUAL TO THE LENGTH OF THE ADJACENT STEEL SHEET PILE.
2. ALL SURFACES TO BE WELDED SHOULD BE FREE OF PAINT, SLAG, LOOSE SCALE, RUST AND OTHER FOREIGN MATERIALS.
3. GROOVE WELD SHALL EXTEND THE FULL LENGTH DIAMETER OF THE BORED PILE CASING DESIGN CRITERIA:
WELDING (SMAW PROCESS)
CAPACITY OF WELDING = $0.707t + 0.3Fu$
ALLOWABLE SHEARING STRESS = $0.30Fu$
MILD STEEL ELECTRODE, LOW HYDROGEN AWS/ASME: E7018
TENSILE STRENGTH = 595 MPa
YIELDING STRENGTH = 450 MPa
 $Fu = 483 \text{ MPa}$
4. THE CENTERLINE OF SSP SHALL HAVE PARALLEL DISTANCE FROM THE CENTERLINE OF THE BORED PILE OF AT LEAST HALF THE HEIGHT OF THE SSP BUT NOT GREATER THAN $\frac{1}{8}$ OF THE DIAMETER OF THE BORED PILE.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
SUBOFFICE: DRIVE PORT AREA, MALABAKI

SHEET TITLE	SHEET CONTENTS	PREPARED BY	DATE	SIGNATURE	REVIEWED BY	RECOMMENDING APPROVAL	APPROVED BY	SET NO.	SHEET NO.
STANDARD COMBINATION OF BORED/STEEL SHEET PILE FOR BANK PROTECTION	TYPICAL BORED PILE TO SSP CONNECTION DETAIL, SHEET PILE DETAIL AND GENERAL NOTES	DESIGN: MARIA GERSON P. BARRIL DRAWN: JANI CHRISTOPHER A. TUGOSAY CHECKED: RICHARD R. FELMER			LEONARDO L. LINGAN CHIEF, WATER PROJECTS DIVISION BUREAU OF DESIGN	LENA DELFINADOR OFFICER IN CHARGE BUREAU OF DESIGN	GILBERTO S. REYES ASSISTANT SECRETARY FOR TECHNICAL SERVICES EMILIO S. SODAIN, CESO I CHIEF, SUBOFFICE FOR LAND OPERATIONS AND TECHNICAL SERVICES	STD	3/3



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

STANDARD RUBBLE MOUND BREAKWATER

GENERAL NOTES

I. DESIGN CRITERIA AND SPECIFICATIONS

1. DPWH DESIGN GUIDELINES, CRITERIA AND STANDARDS 2015 - VOLUME II AND III
2. UNITED STATES ARMY CORPS OF ENGINEERS (USACE) COASTAL ENGINEERING MANUAL, 2011
3. PHILIPPINE PORTS AUTHORITY MANUAL, 2009

II. DESIGN CONDITIONS

1. BEDDING LAYER THICKNESS (t_{BL}) CONSIDERATIONS: (USE WHICHEVER IS GREATER)
 - a. FOR WAVE ATTACK STABILITY
 - 2 - 3 TIMES THE DIAMETER OF LARGE STONES OF THE EXISTING SEABED
 - 100mm FOR COARSE SAND
 - 200mm FOR GRAVEL
 - b. FOR FOUNDATION STABILITY
 - 600mm (MINIMUM THICKNESS)
2. BEDDING LAYER SHOULD EXTEND 1500mm HORIZONTALLY BEYOND THE TOE COVER.
3. ARMOR AND UNDER LAYER MATERIALS ARE QUARRY STONES.
4. WAVE HEIGHT, H , SHALL BE DETERMINED BASED ON THE CALCULATIONS. FOR THIS STANDARD PLAN, H IS EQUAL TO THE SIGNIFICANT WAVE HEIGHT, $H_{1/10}$.
5. THE TOE BERM WIDTH (B_t) SHOULD BE THE MAXIMUM OF $2H$ OR $0.4h$ (USE LOWER WATER LEVEL) AND AT LEAST 3 STONES WIDE.

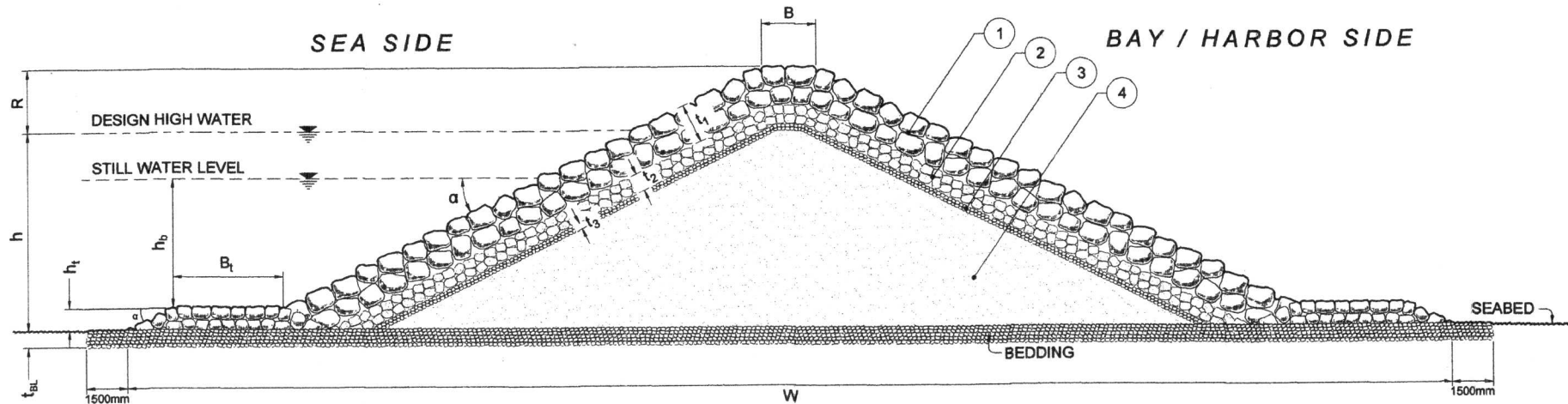
6. THE WEIGHT OF THE STONES PER LAYER SHALL BE CALCULATED BASED ON THE PROCEDURES INDICATED IN THE USACE COASTAL ENGINEERING MANUAL, 2011.

NO.	MINIMUM ROCK WEIGHT	LAYER	THICKNESS
1	W_s	ARMOR LAYER	t_1
2	$W_s / 10$	FIRST UNDER LAYER	t_2
3	$W_s / 200$	SECOND UNDER LAYER	t_3
4	$W_s / 4000$	CORE	-

7. THE REQUIRED DESIGN ANALYSES (SLOPE STABILITY AND OVERALL STABILITY, ETC.) SHALL BE CONDUCTED.

III. LEGEND

B = CREST WIDTH	B_t = TOE BERM WIDTH
R = RUN-UP HEIGHT	α = INCLINATION ANGLE OF BREAKWATER
h = DESIGN HIGH WATER HEIGHT	t_n = LAYER THICKNESS
t_{BL} = BEDDING LAYER THICKNESS	W_s = STONE WEIGHT
h_t = TOE BERM HEIGHT	H = WAVE HEIGHT
h_b = DEPTH OF WATER FROM TOP OF TOE BERM TO STILL WATER LEVEL	W = WIDTH



TYPICAL SECTION
SCALE: 1:75 mts.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:
**STANDARD RUBBLE
MOUND BREAKWATER**

SHEET CONTENTS:
**GENERAL NOTES AND
TYPICAL SECTION**

DESIGNED BY: MARK JOYEN TOLENTINO
DARYL PAUL B. DE LA ROSA
CATHARINE DAY G. GARCIA
TERESA E. DUMAROG

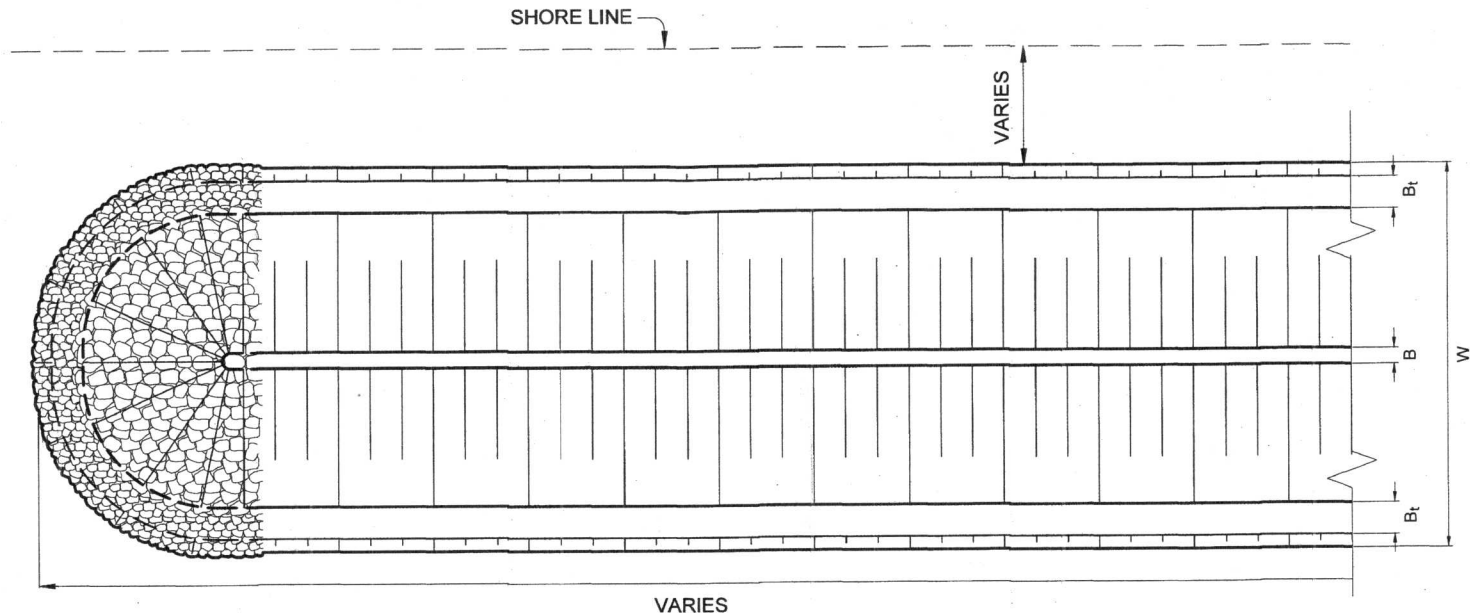
SUBMITTED BY: LEONARDO L. LINGAN
Chief, Water Projects Division
Bureau of Design

RECOMMENDING APPROVAL: LIA A. DELEINAGOS, CESO IV
Officer-in-Charge
Bureau of Design

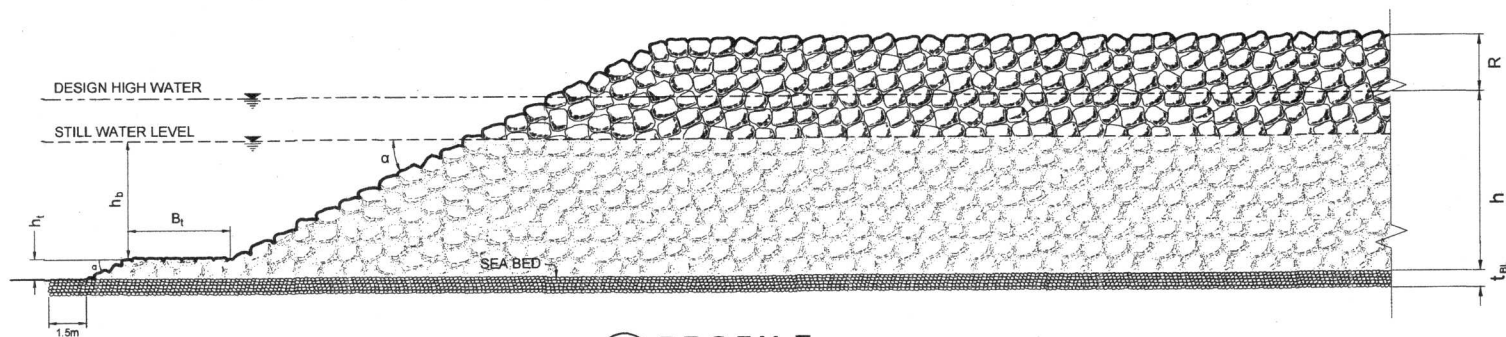
APPROVED: GILBERTO S. REYES
Officer-in-Charge
Office of Management
for UPDO Compliance and Technical Support

SET NO. **STD**
SHT. NO. **1**
2

SEP 26 2018



PLAN
SCALE: 1:300 mts.



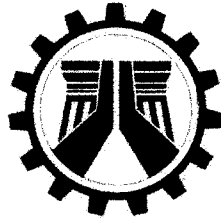
PROFILE
SCALE: 1:95 mts.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:	SHEET CONTENTS	DESIGNED:	SUBMITTED:	RECOMMENDED & APPROVAL:	APPROVED:	SET NO.	SHT. NO.
STANDARD RUBBLE MOUND BREAKWATER	PLAN AND PROFILE	MARK JOVEL TOLENTINO Engineer III DARTY J. DE LA ROSA Engineer II MARK GERSON P. BARIL Engineer II CATHY ANN G. DUQUE Engineer II TERESA L. BARRIO Engineer II	LEONARDO L. LINGAN Chief, Water Projects Division Bureau of Design	LEONARDO L. LINGAN Chief, Water Projects Division Bureau of Design	GILBERTO S. REYES Chief, Water Projects Division Bureau of Design	STD	2

SEP 28 2016



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

STANDARD RUBBLE MOUND JETTY WITH GEOTUBE CORE

GENERAL NOTES

I. DESIGN CRITERIA AND SPECIFICATIONS

1. DPWH DESIGN GUIDELINES, CRITERIA AND STANDARDS 2015 - VOLUMES II AND III
2. DPWH STANDARD SPECIFICATIONS FOR PUBLIC WORKS AND HIGHWAYS, 2013 EDITION
3. UNITED STATES ARMY CORPS OF ENGINEERS (USACE) COASTAL ENGINEERING MANUAL, 2011
4. PHILIPPINE PORTS AUTHORITY MANUAL, 2009

II. DESIGN CONDITIONS

1. ORIENTATION OF JETTY IS PERPENDICULAR TO THE SHORELINE: HENCE, OVERTOPPING IS ALLOWED AND MUST BE PROVIDED WITH FREEBOARD OF AT LEAST 1.0m FROM HIGH-HIGH WATER LEVEL
2. CONSIDER NON-BREAKING WAVES ONLY
3. DESIGN WAVE HEIGHT SHALL BE DETERMINED BASED ON THE ANALYSIS
4. BEDDING LAYER MUST BE ATLEAST 1.5m BEYOND THE TOE OF THE COVER STONE.

III. MATERIAL AND CONSTRUCTION REQUIREMENTS

1. ARMOUR COVER

THE WEIGHTS AND LAYER THICKNESS FOR THE ARMOUR COVER SHALL BE AS SPECIFIED IN THE PLAN & SCHEDULE. QUARRY STONES SHALL BE ROUGH AND ANGULAR. EXPOSED ARMOUR ROCKS SHALL BE CLASS II ROCKS WITH A MINIMUM OF 500KG PER PIECE OR AS SPECIFIED IN THE SCHEDULE. TOE PROTECTION OR SUBMERGED ROCKS SHALL BE CLASS I ROCKS WITH A MINIMUM OF 2000 KG PER PIECE OR AS SPECIFIED IN THE SCHEDULE. NO STONE SHALL HAVE A LONGEST DIMENSION LESS THAN TWO NOR MORE THAN THREE TIMES ITS SHORTEST DIMENSION AS DETERMINED ALONG PERPENDICULAR AXES PASSING THROUGH THE APPROXIMATE CENTER OF GRAVITY.

2. CORE MATERIAL

THE CORE MATERIAL (CLASS II AND/OR CLASS III ROCKS) SHALL HAVE A WEIGHT OF $\geq 3.75\text{KG}$ PER PIECE AS SPECIFIED IN THE SCHEDULE. QUARRY STONES SHALL BE ROUGH AND ANGULAR.

3. STONE PLACEMENT

EACH STONE WILL BE INDIVIDUALLY PLACED BY EQUIPMENT SUITABLE FOR LIFTING, MANIPULATING AND PLACING STONES OF THE SIZE AND SHAPE SPECIFIED. EACH STONE SHALL BE PLACED WITH ITS LONGEST AXIS PERPENDICULAR TO THE ARMOR SLOPE. PLACING EFFORTS SHALL ENSURE THAT EACH STONE IS FIRMLY SET AND SUPPORTED BY UNDERLYING MATERIALS AND ADJACENT STONES. LOOSE STONES SHALL BE RESET OR REPLACED.

4. BEDDING / GRAVEL LAYER

STONES SHOULD BE WELL BLENDED. THE STONES WITH THE LARGEST DIMENSION, GRATER THAN THREE TIMES THE LEAST DIMENSION SHOULD NOT CONSTITUTE MORE THAN 10 PERCENT OF THE TOTAL.

MATERIALS SHOULD BE INERT TO CHEMICAL AND BIOLOGICAL DEGRADATION IN SEA WATER.

GRADATION REQUIREMENTS OF THE BEDDING LAYER OF FILTER BLANKET SHALL BE D15 (FILTER) ≤ 5 D85 (FOUNDATION); i.e. THE DIAMETER EXCEEDED BY THE COARSEST 85 PERCENT OF THE FILTER MATERIAL MUST BE LESS THAN OR EQUAL TO FIVE TIMES THE DIAMETER EXCEEDED BY THE COARSEST 15 PERCENT OF THE FOUNDATION MATERIAL. QUARRY SPALLS RANGING IN SIZE FROM 0.45 KG TO 23 KG WILL GENERALLY SUFFICE IF THE BEDDING LAYER IS PLACED ON A FILTER CLOTH OR A COARSE GRAVEL (OR CRUSHED STONE) FILTER LAYER WHICH MEETS THE STATED FILTER DESIGN CRITERIA.

THE FOLLOWING STANDARD TESTS SHALL BE CONDUCTED TO ESTABLISH MATERIAL DURABILITY:

ABRASION TEST	:	ASTM C-535 OR EQUIVALENT
TOUGHNESS TEST	:	ASTM C-170 OR EQUIVALENT
HARDNESS TEST	:	ASTM C-235 OR EQUIVALENT
APPARENT SPECIFIC GRAVITY AND ABSORPTION TEST	:	ASTM C-127 OR EQUIVALENT

5. GEOTEXTILES

GEOTEXTILES SHALL BE WOVEN AND/ OR NONWOVEN FABRIC AS SPECIFIED IN THE DRAWINGS SPECIALLY ENGINEERED TO PROVIDE EXCELLENT ROBUSTNESS, UV PROTECTION AND DURABILITY IN MARINE AND HYDRAULIC CONDITION (SEE DRAWINGS AND SPECIFICATIONS). THE GEOTEXTILES TO BE USED SHALL HAVE HIGH MODULUS AND EXTREMELY HIGH STRENGTH AT LOW STRAIN. IT MUST HAVE A GOOD WATER PERMEABILITY AND IS RESISTANT TO CHEMICAL AND BACTERIOLOGICAL ATTACK. PLACEMENT AND MATERIAL STRENGTH IS AS SPECIFIED IN THE SECTION DRAWINGS.


6. GEOTUBES

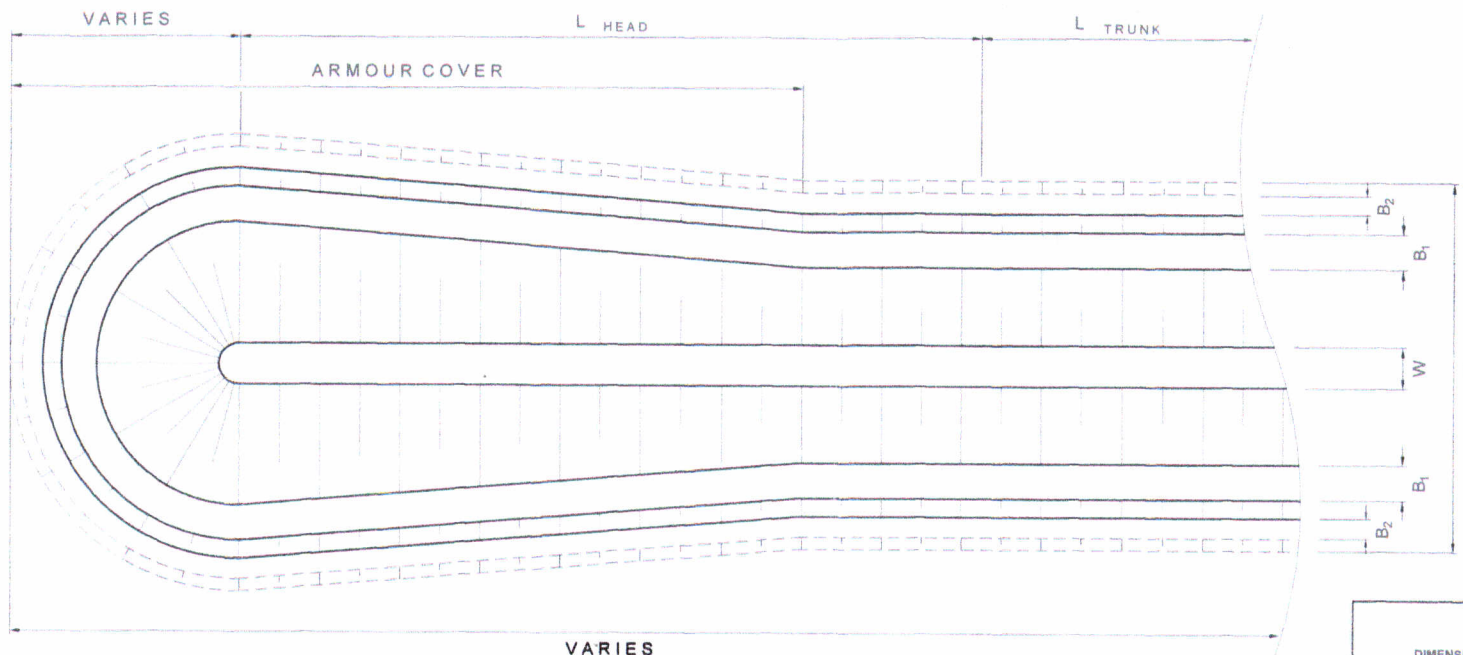
GEOTUBES TO BE USED SHALL BE MANUFACTURED FROM HIGH MODULUS POLYPROPYLENE ENGINEERED FABRICS COMBINED WITH HIGH CAPACITY SEAMS TO PRODUCE TUBULAR CONTAINERS WITH ENSURED INTEGRITY DURING FILLING AND DURING OPERATIONAL LIFE. THE TENSILE STRENGTH IS AS SPECIFIED ON THE SECTION DRAWINGS. GEOTUBES MANUFACTURED FROM POLYESTER FIBER SHALL NOT BE ACCEPTED. THE GEOTUBE SUPPLIER/ MANUFACTURER SHALL CERTIFY COMPLIANCE OF THESE REQUIREMENTS.

7. SAND INFILL

THE SAND INFILL MATERIAL SHALL CONSIST OF NATURALLY OCCURRING OR PROCESSED MATERIAL WHICH AT THE TIME OF FILLING IS CAPABLE OF FULFILLING THE SPECIFIED REQUIREMENTS TO PROVIDE MASS AND INTEGRITY. THE FILL MATERIAL SHALL NOT CONTAIN MATERIALS SUSCEPTIBLE TO VOLUME CHANGE (i.e. MARINE MUD, SWELLING CLAYS AND COLLAPSIBLE SOILS), PEAT, VEGETATION, TIMBER, ORGANIC, SOLUBLE OR PERISHABLE MATERIAL, TOXIC, COMBUSTIBLE OR DANGEROUS MATERIAL, METAL, RUBBER OR OTHER UNSUITABLE MATERIAL.

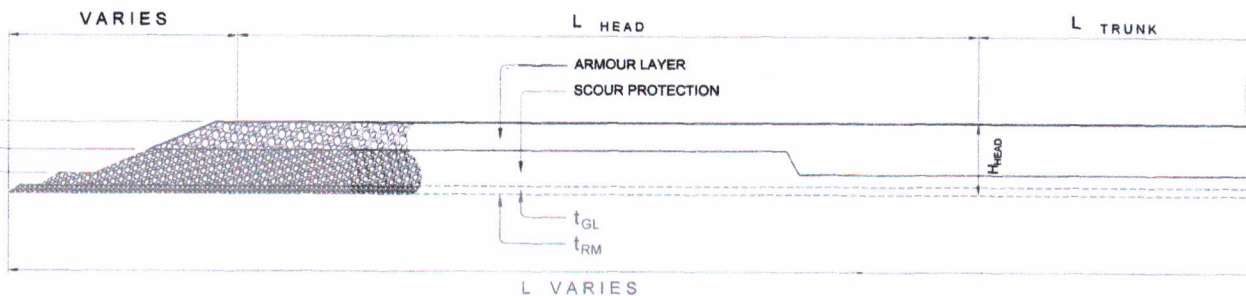
8. ALL QUANTITIES SHALL BE VERIFIED DURING CONSTRUCTION. ALL DIMENSIONS, ELEVATIONS AND STATIONING SHALL BE VERIFIED BEFORE THE START OF CONSTRUCTION.

 REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS BUREAU OF DESIGN WATER PROJECTS DIVISION BONIFACIO DRIVE, PORT AREA, MANILA	SHEET TITLE:	SHEET CONTENTS:	PREPARED:	SUBMITTED:	RECOMMENDING APPROVAL:	APPROVED:	SET NO.	SHT. NO.
	STANDARD RUBBLE MOUND JETTY WITH GEOTUBE CORE	GENERAL NOTES	DARYL PAUL B. DE LA ROSA Engineer's	LEONARDO L. LINGAN Chief, Water Projects Division Bureau of Design	ARSTARZO M. DOROV Officer-in-Charge Bureau of Design	EMIL K. SEDAIN Undersecretary for Planning, Operations and Technical Services	STD	1
			DRAWN:					3
			CHECKED:	MARCO ANTONIO TOLENTINO Engineer's				



VARIES

PLAN
SCALE: 1:300 mts.



VARIES

L HEAD

L TRUNK

ARMOUR LAYER
SCOUR PROTECTION

L VARIES

PROFILE
SCALE: 1:95 mts.

DIMENSION (M)	ARMOUR ROCK	
	TYPE A	
	STRUCTURE TRUNK	STRUCTURE HEAD
HEIGHT	H _{TRUNK}	H _{HEAD}
CREST WIDTH	W _{TRUNK}	W _{HEAD}
BERM 1	B ₁ TRUNK	B ₁ HEAD
BERM 2	B ₂ TRUNK	B ₂ HEAD
BASE WIDTH	B _{TRUNK}	B _{HEAD}
BEDDING LAYER	t _{GL} TRUNK	t _{GL} HEAD
REINFORCEMENT MAT	t _{RM} TRUNK	t _{RM} HEAD



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:

STANDARD RUBBLE MOUND
JETTY WITH GEOTUBE CORE

SHEET CONTENTS

PLAN & PROFILE

PREPARED:

DAVYD PALL B. DE LA ROSA
Engineer II

DRAWN:

MARK JAVEN B. TOLENTINO
Engineer II

CHECKED:

TENSIE E. DAGURO
Engineer II

SUBMITTED:

LEONARDO L. LINGAN
Chief, Water Projects Division
Bureau of Design

RECOMMENDING APPROVAL:

ARISTARCO M. DORON
Office-in-Charge
Bureau of Design

APPROVED:

EMIL K. SADAAN
Undersecretary for IT and Operations
and Training Services

SET NO.

STD

SHT. NO.

2
3




Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
Bonifacio Drive, Port Area, Manila

STANDARD SLOPE PROTECTION WORKS

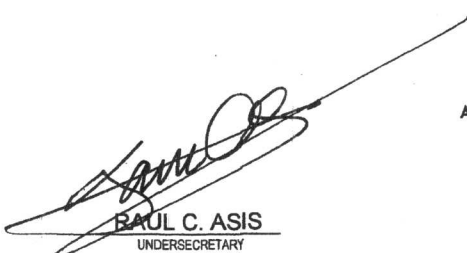
- a. Details of Different Types of Revetment
- b. Details of Curtain Walls and Berm
- c. Details of Foot Protection Works of Revetment

SUBMITTED BY:


LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIV., B.O.D.

RECOMMENDING APPROVAL:


DANTE B. POTANTE
DIRECTOR IV, B.O.D.

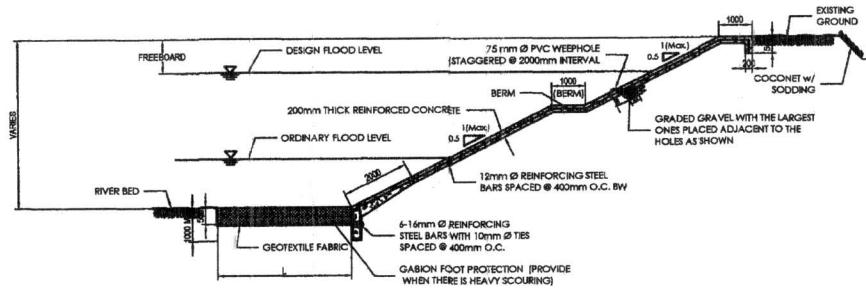

RAUL C. ASIS
UNDERSECRETARY
FOR TECHNICAL SERVICES

APPROVED BY:

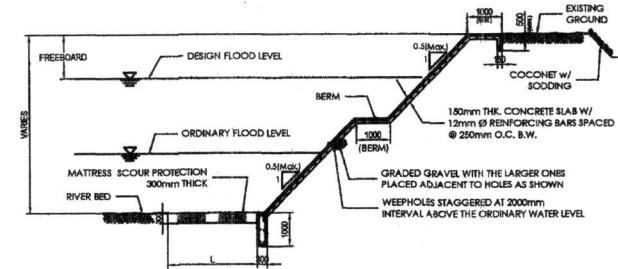

ROGELIO L. SINGSON
SECRETARY

Department of Public Works and Highways
Office of the Secretary

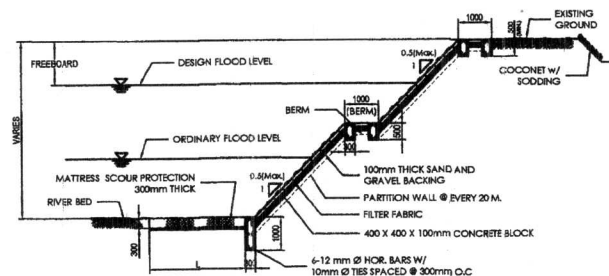
WIN6R01229



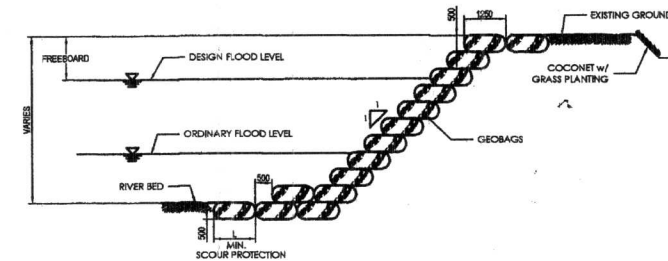
9 REINFORCED CONCRETE REVETMENT
SCALE: 1:80 M.



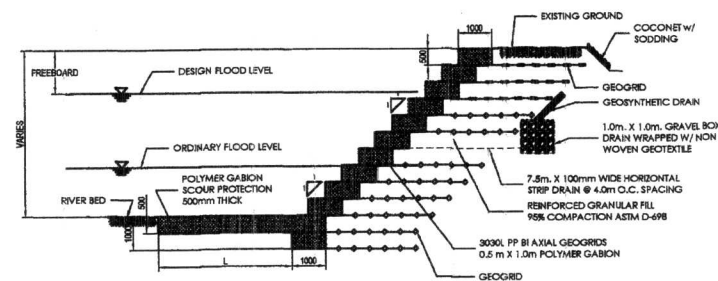
10 REINFORCED CONCRETE REVETMENT
SCALE: 1:80 M.



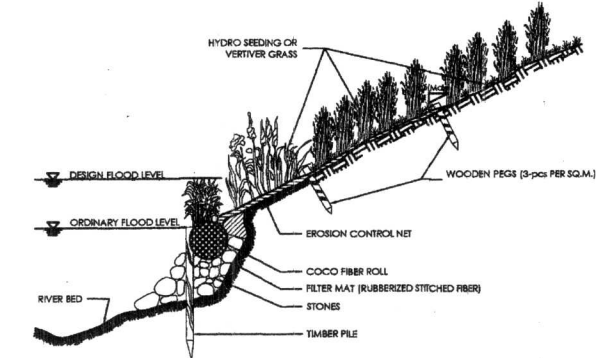
11 CONCRETE BLOCK
SCALE: 1:80 M.



12 GEO BAG
SCALE: 1:80 M.



13 MSE GABION
SCALE: 1:80 M.



14 BIO ENGINEERING (TYPE I)
SCALE: 1:80 M.

NOTE:

1. CONFIGURATION/TYPE OF SLOPE PROTECTION WORKS & LENGTH OF TOE PROTECTION SHALL BE BASED ON STABILITY ANALYSIS & SCOUR ANALYSIS, RESPECTIVELY.
2. LENGTH AND STRENGTH OF GEOGRID SHALL BE BASED ON DESIGN ANALYSIS AND CALCULATION.

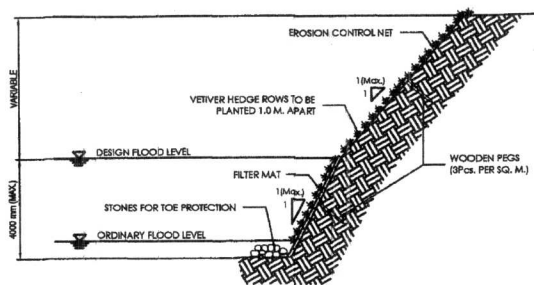
Department of Public Works and Highways
Office of the Secretary

WIN6R01229

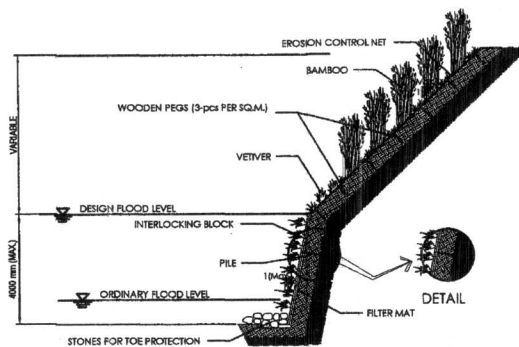


REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:	SHEET TITLE:	PREPARED BY:	DATE:	SIGNATURE:	REVIEWED BY:	RECOMMENDING APPROVAL:	APPROVED BY:	SET NO.	SHEET NO.
TYPICAL SECTIONS	TYPES OF REVETMENTS	DESIGN: YEOGORO M. CERALDE ENGINEER		<i>[Signature]</i>	LEONARDO L. LINGAN CHIEF, WATER PROJECTS DIV., B.O.D.	DANTE B. POTANTE DIRECTOR IV, B.O.D.	RAUL C. ASIS UNDERSECRETARY FOR TECHNICAL SERVICES	ROSELIO L. SINGSON SECRETARY	STD RVTHNT
		DRAWN: R.R. RONDA DRAFTSMAN		<i>[Signature]</i>					2 3
		CHECKED: MARCELIANO A. CARLOTA II SUPERVISOR							



15 BIO ENGINEERING (TYPE II)
SCALE: 1:30 M.

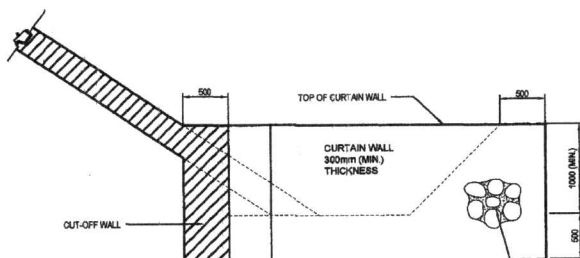


16 BIO ENGINEERING (TYPE III)
SCALE: 1:30 M.

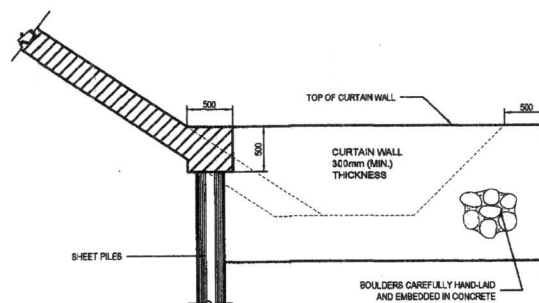
- NOTES:
1. PROVIDE 1.0 M. WIDE BERM FOR REVETMENT HEIGHT GREATER THAN 4.0 M. TO BE LOCATED MIDWAY OF REVETMENT HEIGHT.
 2. FREEBOARD SHALL BE BASED ON THE DGOS AS WELL AS ON THE MEMORANDUM DATED JUNE 21, 2011 OF BRLB.
 3. SPECIFIC GRAVITY FOR STONES FOR LOOSE BOULDER APRON SHALL BE 2.5.
 4. LENGTH OF SCOUR PROTECTION SHALL BE BASED ON THE RESULTS OF SCOUR ANALYSIS.
 5. SLOPE STABILITY ANALYSIS SHALL BE PREPARED FOR FILL/EMBANKMENT/SEDIMENT BANKS TO BE PROVIDED WITH REVETMENTS WITH HEIGHT OF 3.0 M AND ABOVE.
 6. COCONUT IS USED TO PROVIDE IMMEDIATE SURFACE STABILIZATION DURING THE PERIOD OF GERMINATION AND PLANT ESTABLISHMENT.
 7. COCOFIBER LOOSE FASCINES ARE COMPRESSED COCO FIBER IN A NYLON NETTING TO FORM "LOGS" APPEARANCE. COCOFIBER MAY BE STRATEGICALLY INSTALLED ON LONG SLOPES TO REDUCE IN LENGTH AND TO ACT AS INTERCEPTOR DRAINS TO POOL UP & SLOW DOWN WATER LONG ENOUGH TO ANY SEDIMENT THAT IS IN THE WATER TO SETTLE OUT.
 8. VETIVER IS A WORLD RENOWNED GRASS KNOWN FOR ITS EXTENSIVE ROOTING SYSTEM WHICH REACH UP TO 4 M. DOWNWARD.
 9. HYDROSEED IS HYDRATIONALLY APPLIED SEED MIX W/ WATER, MULCH, BINDING AGENT & FERTILIZERS TO EASILY ESTABLISH VEGETATION ON TREATED AREA. HYDROSEED IS APPLIED WHERE AREA IS TOO BIG FOR SEEDING OR MANUAL SEED BROADCASTING AND WHERE SITE IS INACCESSIBLE OR TOO DANGEROUS TO PLANT.

10. ALLOWABLE DESIGN VELOCITIES

REVETMENT TYPE	ALLOWABLE DESIGN VELOCITY (m/s)
1	3.0
2	3.0
3	5.0
4	5.0
5	5.0
6	6.5
7	5.0
8	5.0
9	>6.0
10	>6.0
11	5.0
12	3.0
13	5.0
14	3.0
15	3.0
16	3.0

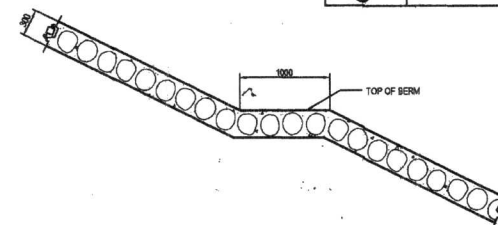


DETAIL OF CUT-OFF WALL WITH CURTAIN WALL

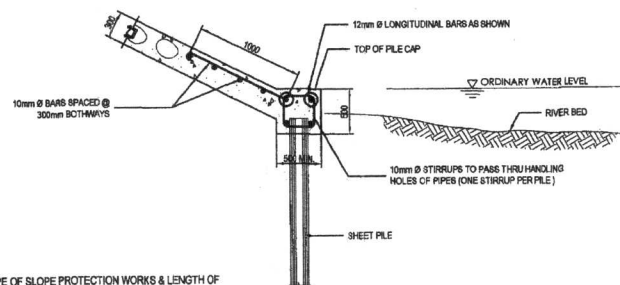


DETAIL OF SHEET PILE WALL WITH CURTAIN WALL

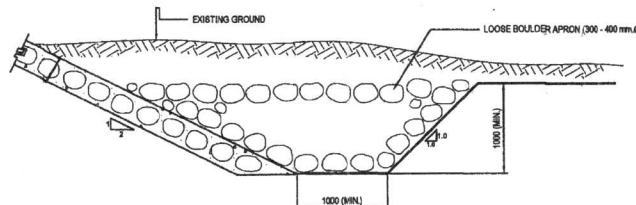
DETAILS OF CURTAIN WALL AND BERM
SCALE: 1:30 M.



DETAIL OF BERM

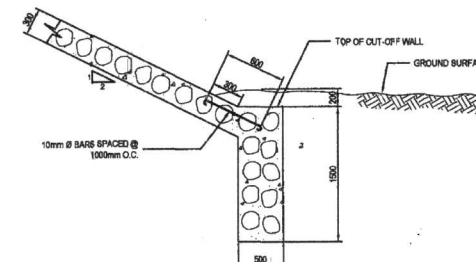


TYPE - A (SHEET PILE)



TYPE - B (LOOSE BOULDER APRON)

TYPES OF FOOT PROTECTION WORKS FOR REVETMENTS
SCALE: 1:30 M.



TYPE - C (CUT-OFF WALL)

NOTE:
CONFIGURATION/TYPE OF SLOPE PROTECTION WORKS & LENGTH OF TOE PROTECTION SHALL BE BASED ON STABILITY ANALYSIS & SCOUR ANALYSIS, RESPECTIVELY.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:

- TYPICAL SECTIONS
- DETAIL OF CURTAIN WALL & BERM
- TYPES OF FOOT PROTECTION FOR REVETMENTS

SHEET TITLE:

TYPES OF REVETMENTS

PREPARED BY:

DESIGN: TEODORO M. CERALDE
DRAWN: F. S. RONDA
CHECKED: MARCELIANO A. CARLOTA II

DATE:

SIGNATURE

REVIEWED BY:

LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIV., B.O.D.

RECOMMENDING APPROVAL:

DANTE B. POTANTE
DIRECTOR IV, B.O.D.

RAULO Q. ASIS
UNDERSECRETARY FOR TECHNICAL SERVICES

APPROVED BY:

ROGELIO C. SINCSON
SECRETARY

Department of Public Works and Highways
Office of the Secretary



WIN6R01229

SET NO.

STD
RVTMNT

SHEET NO.

3
3

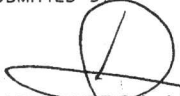


Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
Bonifacio Drive, Port Area, Manila

STANDARD DETAILS OF GATES


- a. FLAP GATE
- b. SLIDE GATE

SUBMITTED BY:


LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIV., B.O.D.


RECOMMENDING APPROVAL:

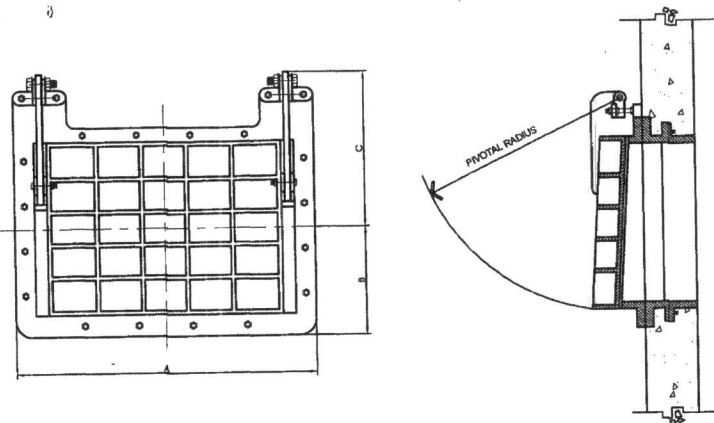

DANTE B. POTANTE
DIRECTOR IV, B.O.D.


RAUL C. ASIS
UNDERSECRETARY
FOR TECHNICAL SERVICES

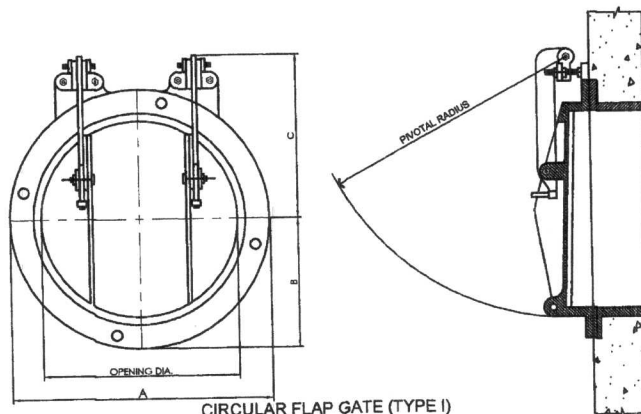
APPROVED BY:


ROGELIO L. SINGSON
SECRETARY

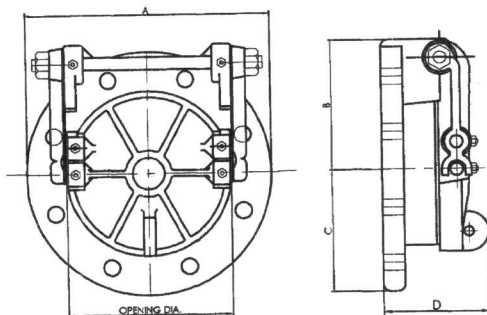
Department of Public Works and Highways
Office of the Secretary

WIN6R01230



RECTANGULAR STEEL FLAP GATE

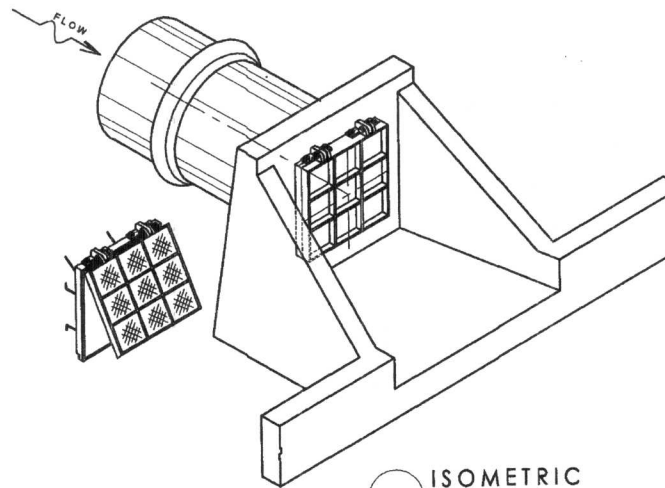


CIRCULAR FLAP GATE (TYPE I)

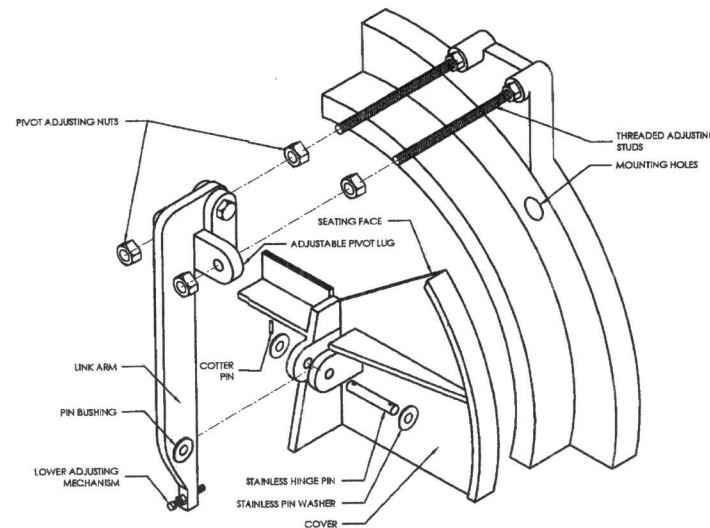


CIRCULAR FLAP GATE (TYPE II)

CIRCULAR STEEL FLAP GATE



ISOMETRIC



SECTION DETAIL



Department of Public Works and Highways
Office of the Secretary



WIN6R01230

RECTANGULAR FLAP GATE

WIDTH (mm)	DIMENSION (mm)			PIVOTAL RAD. (mm)
	A	B	B	
300 X 300	450	225	281.25	456.25
450 X 450	625	312.5	393.75	625
600 X 600	800	375	481.25	781.25
750 X 450	925	312.5	393.75	825
750 X 750	1012.5	488.75	643.75	1006.25
900 X 600	1,100	400	525	781.25
900 X 900	1100	550	687.5	1131.25
1050 X 750	1300	481.25	581.25	966.25
1050 X 1050	1300	625	800	1331.25
1200 X 800	1400	400	475	731.25
1200 X 900	1400	550	681.25	1182.5
1200 X 1200	1450	725	943.75	1543.75
1350 X 900	1575	562.5	887.5	1187.5
1350 X 1350	1600	875	993.75	1699
1500 X 750	1700	475	608.25	893.75
1500 X 900	1750	575	725	1200
1500 X 1200	1750	725	943.75	1543.75
1500 X 1500	1750	875	1143.75	1875
1650 X 1050	1900	650	818.75	1337.5
1650 X 1650	1900	950	1300	2125
1800 X 1200	2050	725	943.75	1543.75
1800 X 1500	2050	875	1143.75	1893.75
1800 X 1800	2050	1025	1368.75	2282.5
2100 X 1500	2350	875	1150	1893.75
2100 X 2100	2350	1175	1556.25	2800
2400 X 1500	2700	900	1150	1900
2400 X 2100	2700	1200	1582.5	2600
2400 X 2400	2700	1350	1725	2925
2700 X 2700	3000	1500	1900	3450
3000 X 3000	3300	1500	2025	3725

CIRCULAR FLAP GATE (TYPE I)

OPENING DIA. (mm)	DIMENSION (mm)			PIVOTAL RAD. (mm)
	A	B	B	
300	475	237.5	256.25	418.75
350	525	262.5	312.5	468.75
375	566.25	281.25	312.5	507.75
400	587.5	293.75	325	531.25
450	618.75	312.5	293.75	625
500	687.5	343.75	406.25	656.25
525	700	350	412.5	684.5
600	800	400	481.25	781.25
675	850	425	531.25	887.5
750	968.75	487.5	581.25	962.5
900	1150	575	687.5	1125
1050	1325	650	812.5	1325
1200	1487.5	743.75	943.75	1543.75
1350	1658.25	831.25	993.75	1681.25
1500	1825	912.5	1150	1900
1650	2000	1000	1250	2075
1800	2150	1081.25	1356.25	2250
1950	2337.5	1168.75	1456.25	2425
2100	2500	1250	1556.25	2606.25
2250	2650	1337.5	1637.5	2781.25
2400	2850	1275	1725	2931.25

CIRCULAR FLAP GATE (TYPE II)

OPENING DIA. (mm)	A	B	C	D
750	1840	920	920	770
1000	2160	1470	1080	600
1500	2800	1490	1400	1180
2000	3390	1680	1680	750
3000	4080	2050	2030	1000

NOTES:

1. HYDRO FLAP GATES ARE MADE OF CAST IRON OR DUCTILE IRON. A SMALL DIFFERENTIAL PRESSURE AT THE BACK OF THE GATE CAUSES IT TO OPEN AUTOMATICALLY TO ALLOW DISCHARGE THROUGH LEVEES, SEWER LINES OR DRAINAGE CONDUITS. WHEN WATER ON THE FACE SIDE OF THE GATE RISES ABOVE WATER ON THE BACK SIDE, THE GATE CLOSES AUTOMATICALLY TO PREVENT THE BACK FLOW.

A) SEAT (FRAMES)

A SEAT FRAME IS A ONE PIECE CASTING. THE SEATING FACE IS CAST AND MACHINED AT AN ANGLE OFF VERTICAL SO THAT THE HINGED COVER HAS A HORIZONTAL FORCE COMPONENT TO COMPLETELY SEAT THE GATE BY GRAVITY. CORROSION RESISTANT SEATING FACES ARE PNEUMATICALLY IMPACTED INTO DOVETAIL GROOVES FOR HEAVY GATES WHEN RUBBER SEATS ARE SPECIFIED THE GUMDROP CROSS-SECTION RUBBER SEAL IS LOCKED INTO A DEEP DOVETAIL GROOVE ON SEAT.

B) FLAPS (COVER)

FLAPS ARE IRON CASTINGS OF REINFORCED FLAT PLATE DESIGN. REINFORCING RIBS BOTH HORIZONTAL AND VERTICAL ARE CAST INTEGRALLY ALONG WITH BOSSES FOR THE HINGE.

C) DOUBLE-HINGE ACTION

FOR PROPER SEATING OF A FLAP GATE, DOUBLE ACTION IS NECESSARY. THE MAIN HINGE ACTION ON ANY FLAP GATE IS ABOUT ITS UPPER PIVOT POINTS. HOWEVER FLEXIBILITY IS REQUIRED AT THE BOTTOM PIVOT POINTS TO ALLOW SEATING OF THE FLAP AGAINST THE SEAT.

2. TO MAKE THE GATE MORE SELF-CLEANING IT SHOULD BE MOUNTED 30cm TO 45cm ABOVE THE SEAT IN FRONT OF THE GATE.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:

- SECTION DETAILS OF FABRICATED RECTANGULAR & CIRCULAR FLAP GATE
- SIZES OF FAB. RECTANGULAR & CIRCULAR FLAP GATE
- GENERAL NOTES

SHEET TITLE:

TYPICAL STANDARD DRAWING
OF STEEL FLAP GATE

PREPARED BY:

DESIGN: TEODORO M. GERALDE

DRAWN: R. R. RONDA

CHECKED: MARCELINO A. CARLOTA II

DATE:

SIGNATURE

TEODORO M. GERALDE

REVIEWED BY:

LEONARDO L. LINGAN

CHIEF, WATER PROJECTS DIV. B.O.D.

RECOMMENDING APPROVAL:

DANTE B. POTANJE

DIRECTOR IN CHARGE

APPROVED BY:

RUGELIO L. SINESON

UNDERSECRETARY FOR TECHNICAL SERVICES

SET NO.

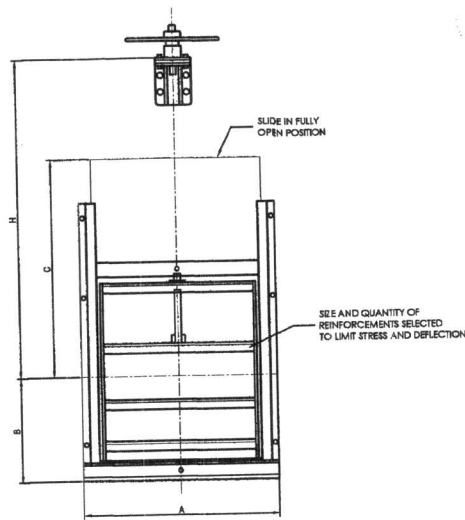
STD

FLAPGATE

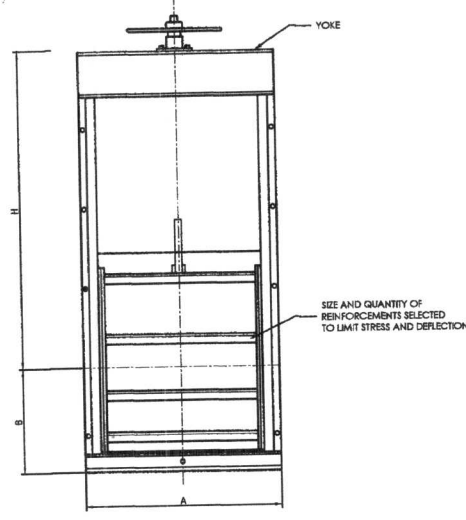
SHEET NO.

1

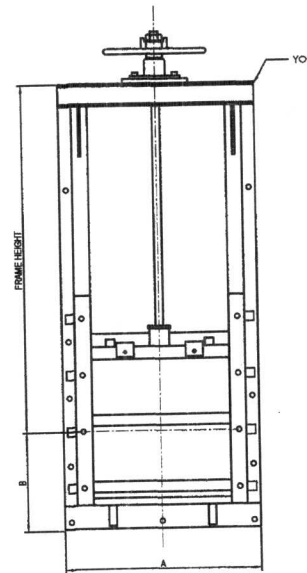
2



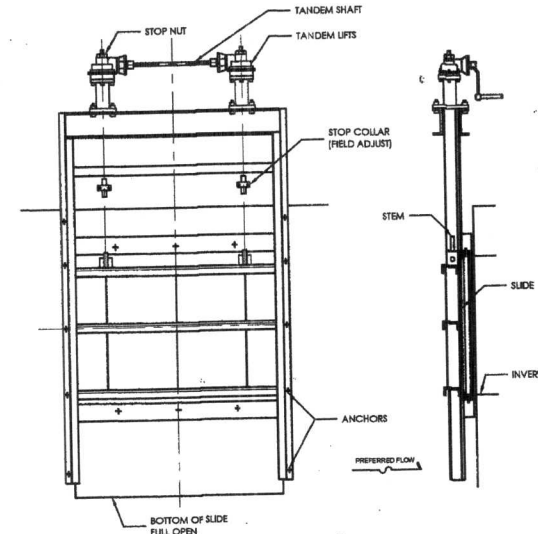
FABRICATED SLIDE GATE (NOT SELF-CONTAINED)



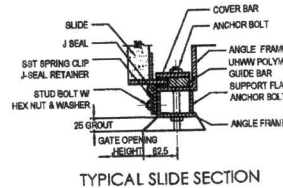
FABRICATED SLIDE GATE (SELF-CONTAINED)



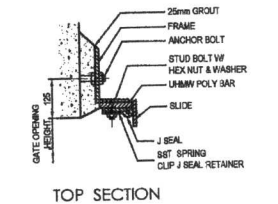
FABRICATED HEAVY DUTY STAINLESS STEEL SLIDE GATE



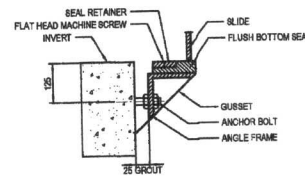
WEIR GATE - DOWNWARD OPENING (SELF CONTAINED)



TYPICAL SLIDE SECTION



TOP SECTION



FLUSH - BOTTOM SECTION

FABRICATED SLIDE GATES

WIDTH (mm) X HEIGHT (mm)	CARBON STEEL & GALVANIZED		STAINLESS		ALUMINUM		ALL MAT'L'S	RECOMMENDED	"H" DIST.	
	A (mm)	B (mm)	A (mm)	B (mm)	A (mm)	B (mm)	(mm)	STEM DIA. (mm)	LIFT DIA. (mm)	NOT BKT CONTAINED (mm)
300 X 300	500	250	500	250	500	250	31.25	250	750	900
300 X 300	500	400	500	400	500	400	31.25	250	1200	1050
450 X 450	650	325	650	325	650	325	31.25	250	975	800
450 X 800	850	400	850	400	850	400	31.25	250	1200	1050
450 X 750	850	475	850	475	850	475	31.25	250	1425	1350
800 X 450	800	325	800	325	800	325	31.25	250	975	900
800 X 600	800	400	800	400	800	400	31.25	350	1200	1050
800 X 750	800	475	800	475	800	475	31.25	350	1425	1350
800 X 900	800	550	800	550	800	550	31.25	600	1650	1500
800 X 1200	800	700	800	700	800	700	31.25	600	2100	1800
750 X 600	950	400	950	400	950	400	31.25	600	1200	1050
750 X 750	950	475	950	475	950	475	31.25	600	1425	1350
750 X 900	950	550	950	550	950	550	31.25	600	1650	1500
750 X 1050	950	625	950	625	950	625	31.25	600	1875	1800
750 X 1200	950	700	950	700	950	700	31.25	600	2100	1950
800 X 600	1100	400	1100	400	1100	400	31.25	600	1200	1050
800 X 750	1100	475	1100	475	1100	475	31.25	600	1425	1350
800 X 900	1100	550	1100	550	1100	550	31.25	600	1650	1500
800 X 1050	1100	625	1100	625	1100	625	31.25	600	1875	1800
800 X 1200	1100	700	1100	700	1100	700	31.25	600	2100	1950
900 X 1500	1100	850	1100	850	1100	850	31.25	600	2400	2100
1050 X 750	1250	475	1250	475	1250	475	31.25	600	1650	1500
1050 X 900	1250	550	1250	550	1250	550	31.25	600	1875	1800
1050 X 1050	1250	625	1250	625	1250	625	31.25	600	2100	1950
1050 X 1200	1250	700	1250	700	1250	700	31.25	600	2325	2250
1050 X 1500	1250	850	1250	850	1250	850	31.25	600	2650	2550
1200 X 750	1400	475	1400	475	1400	475	31.25	600	1650	1500
1200 X 900	1400	550	1400	550	1400	550	31.25	600	1875	1800
1200 X 1050	1400	625	1400	625	1400	625	31.25	600	2100	1950
1200 X 1200	1400	700	1400	700	1400	700	31.25	600	2325	2250
1200 X 1500	1400	850	1400	850	1400	850	31.25	600	2650	2550
1200 X 1800	1400	1000	1400	1000	1400	1000	31.25	600	3000	2850
1325 X 1325	1550	775	1550	775	1550	775	31.25	600	1875	1800
1500 X 900	1700	550	1700	550	1700	550	31.25	600	2100	1950
1500 X 1050	1700	625	1700	625	1700	625	31.25	600	2325	2250
1500 X 1200	1700	700	1700	700	1700	700	31.25	600	2550	2400
1500 X 1500	1700	850	1700	850	1700	850	31.25	600	3000	2850
1500 X 1800	1700	1000	1700	1000	1700	1000	31.25	600	3300	3150
1800 X 1050	2000	625	2000	625	2000	625	31.25	600	2100	1950
1800 X 1200	2000	700	2000	700	2000	700	31.25	600	2325	2250
1800 X 1500	2000	850	2000	850	2000	850	31.25	600	2650	2550
1800 X 1800	2000	1000	2000	1000	2000	1000	31.25	600	3000	2850

Department of Public Works and Highways
Office of the Secretary



WIN6R01230



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:	SHEET TITLE:
DETAILS OF FABRICATED SLIDE GATE	TYPICAL STANDARD DRAWING OF FABRICATED SLIDE GATE

PREPARED BY:	DATE:	SIGNATURE:	REVIEWED BY:
DESIGN: TEODORO M. CERALDE			
DRAWN: R. B. RONDA			
CHECKED: MARCELANO A. CARLOTA II			

RECOMMENDING APPROVAL:	APPROVED BY:
DANTE B. POTANTE	ROSELIO SINGSON
DIRECTOR IV, B.O.D.	SECRETARY

SET NO.	SHEET NO.
STD	2
SLD/GATE	2




Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
Bonifacio Drive, Port Area, Manila

STANDARD DETAILS OF PILE HURDLES

SUBMITTED BY:


LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIV. B.O.D.

RECOMMENDING APPROVAL:


DANTE B. POTANTE
DIRECTOR IV, B.O.D.

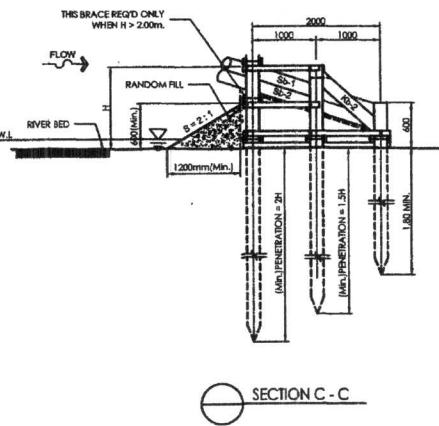
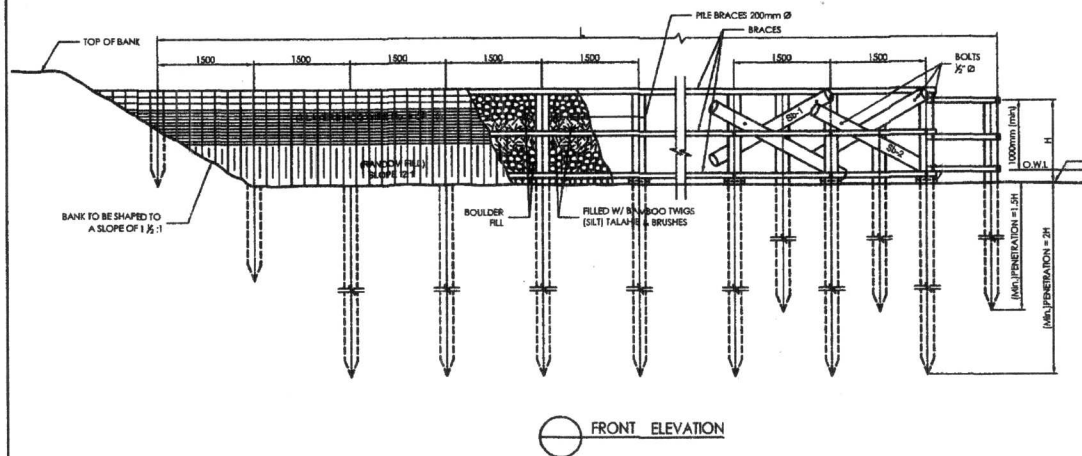
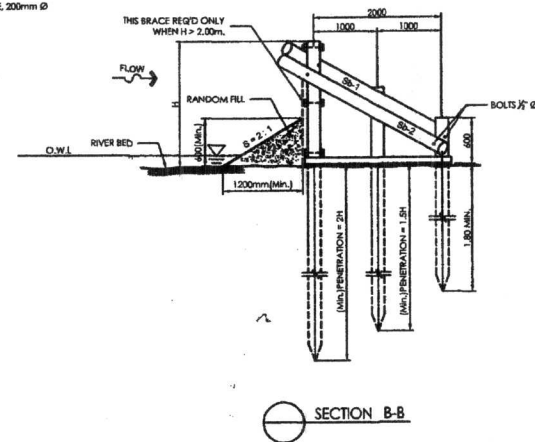
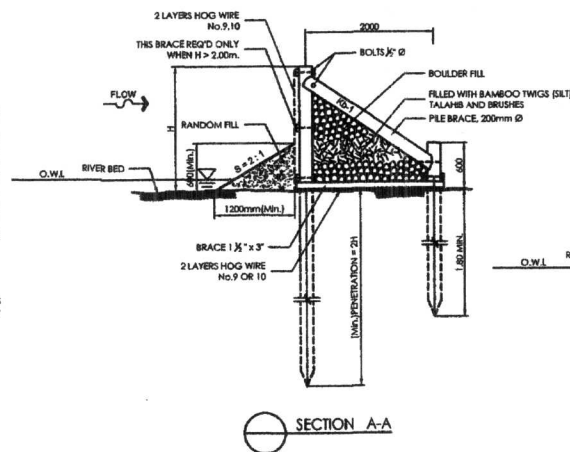
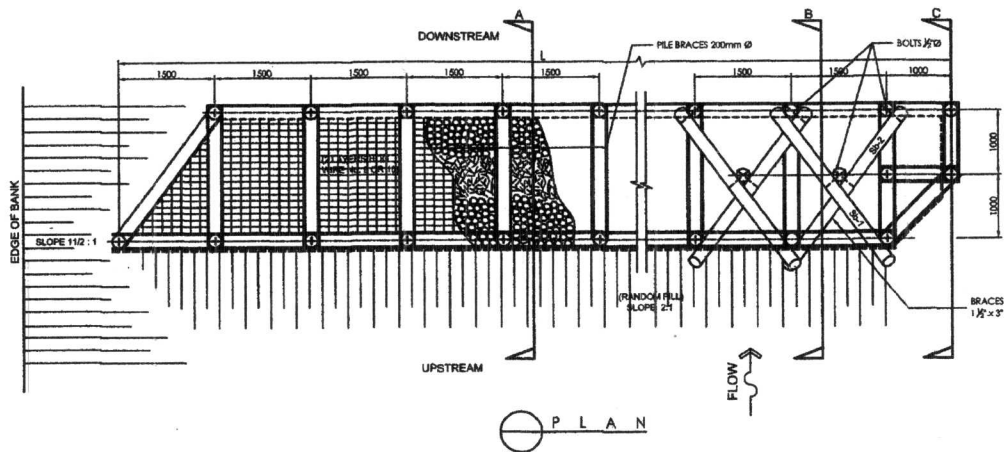

RAUL C. ASIS
UNDERSECRETARY
FOR TECHNICAL SERVICES

APPROVED BY:


ROGELIO L. SINGSON
SECRETARY

Department of Public Works and Highways
Office of the Secretary

WIN6R01231



- NOTES:
1. ALL PILES SHALL BE AT LEAST 200mm IN DIAMETER.
 2. ALL BOLTS SHALL BE 18" IN DIAMETER WITH NUTS AND WASHERS.
 3. LENGTH L OF HURDLES SHALL RANGE FROM 10 TO 15 PERCENT OF THE WIDTH OF THE RIVER OR CHANNEL BUT NOT TO EXCEED 100m.
 4. TOP OF HURDLES SHALL BE AT LEAST 1.0m ABOVE THE NORMAL OR ORDINARY WATER LEVEL.
 5. SECTION MODULUS FOR STEEL SHEET PILE HURDLES SHALL BE BASED ON THE RESULT OF DESIGN ANALYSIS AND CALCULATIONS.

TIMBER PILE HURDLES
SCALE 1:400

Department of Public Works and Highways
Office of the Secretary

WIN6R01231



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:

-DETAIL OF TIMBER PILE HURDLES

SHEET TITLE:

STANDARD PILE HURDLES

PREPARED BY:

DESIGN: TEODORO M. CERALES

DRAWN: R. L. RONA

CHECKED: MARCELO A. CARLOTA III

DATE:

1/24/16

SIGNATURE:

LEONARDO L. LINGAN

DIRECTOR N. J. J.

CHIEF, WATER PROJECTS DIV. B.O.D.

REVIEWED BY:

DANTE B. POTANTE

DIRECTOR N. J. J.

CHIEF, WATER PROJECTS DIV. B.O.D.

RECOMMENDING APPROVAL:

RAUL C. ASIS

UNDERSECRETARY

FOR TECHNICAL SERVICES

APPROVED BY:

ROGELIO L. SINGSON

SECRETARY

SET NO.

STD

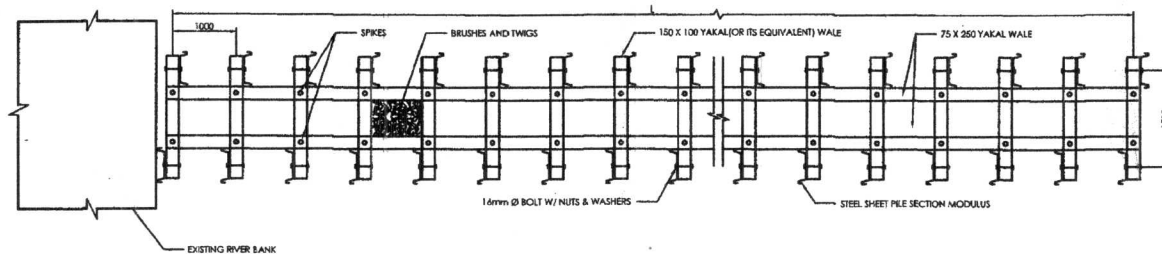
PLHRL

1

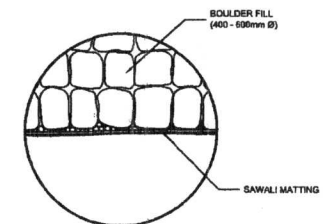
SHEET NO.

1

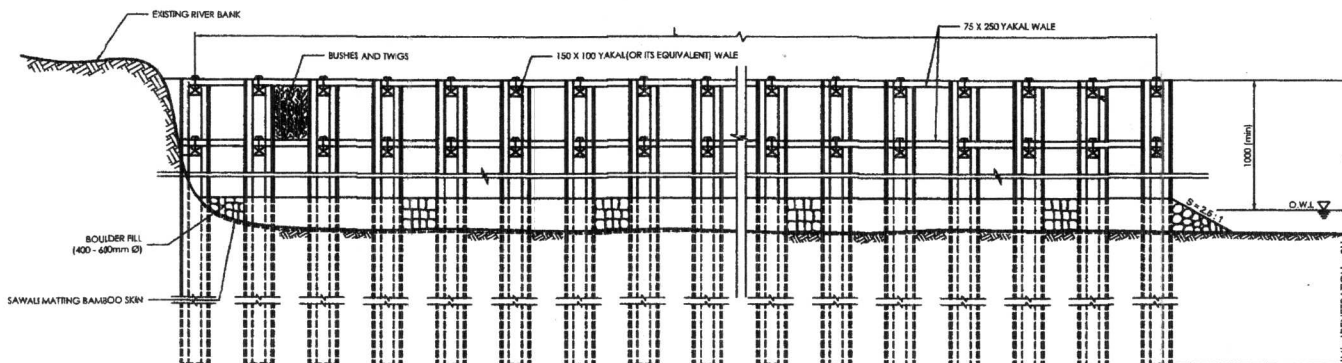
2



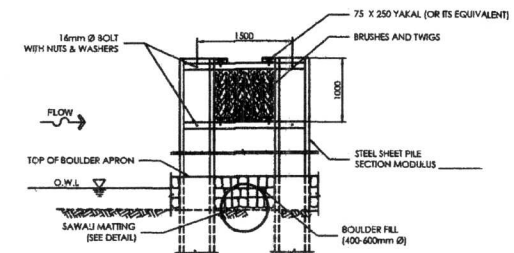
PLAN



DETAIL OF SAWALI MATTING



FRONT ELEVATION



CROSS SECTION

STEEL SHEET PILE HURDLES
SCALE 1:500

Department of Public Works and Highways
Office of the Secretary
WIN6R01231



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:

-DETAIL OF STEEL SHEET
PILE HURDLES

SHEET TITLE:

STANDARD PILE HURDLES

PREPARED BY:

DESIGN: TECOCRO M. GERALDE

DRAWN: R. R. RONDIA

CHECKED: MARCELANO A. CARLOTA

DATE:

1/24/16

SIGNATURE

REVIEWED BY:

LEONARDO L. LINGAN

CHIEF, WATER PROJECTS DIV. B.O.D.

RECOMMENDING APPROVAL:

DANTE B. POTANTE

DIRECTOR W. B.O.

APPROVED BY:

RAUL C. ASIS

UNDERSECRETARY
FOR TECHNICAL SERVICES

APPROVED BY:

ROGELIO L. SINGSON

SECRETARY

SET NO.

STD

PLNRD.

SHEET NO.

2

2

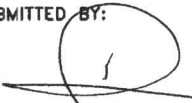


Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
Bonifacio Drive, Port Area, Manila

STANDARD BIO - ENGINEERING FOR SLOPE PROTECTION APPLICATION

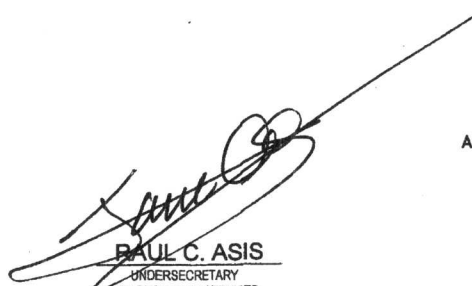
- a. COCONET, INTERLOCKING BLOCKS WITH VETIVER GRASS
- b. COCONET WITH VETIVER GRASS
- c. COCONET, COCOLOGS / FASCINE WITH VETIVER GRASS

SUBMITTED BY:


LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIV., B.O.D.

RECOMMENDING APPROVAL:


DANTE B. POTANTE
DIRECTOR IV, B.O.D.


PAUL C. ASIS
UNDERSECRETARY
FOR TECHNICAL SERVICES

APPROVED BY:

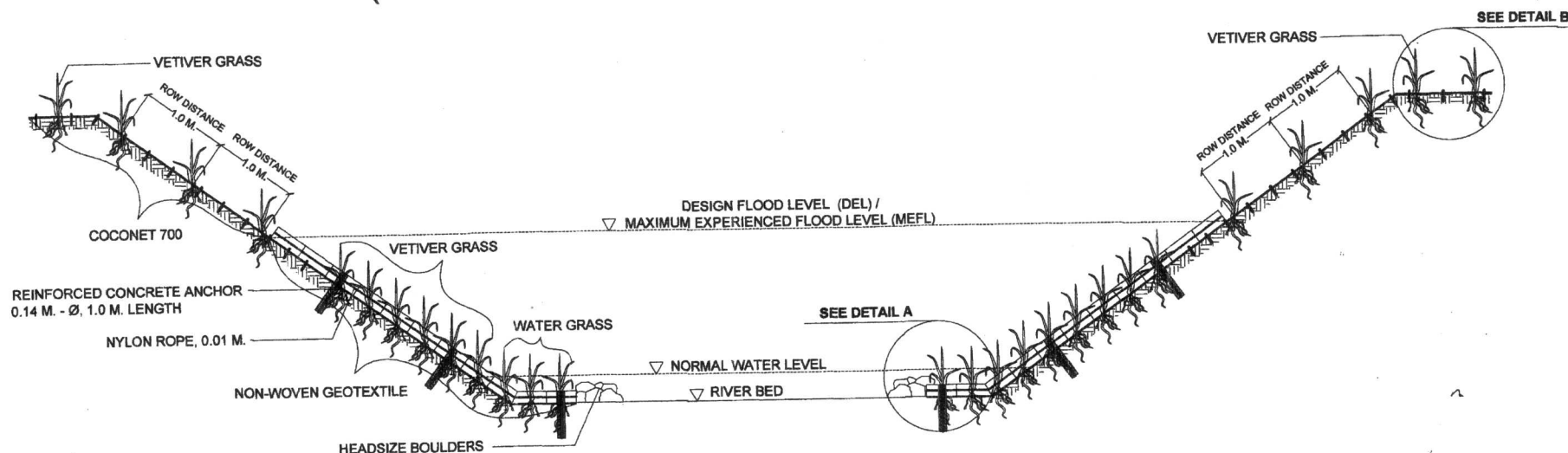

ROGELIO L. SINGSON
SECRETARY

Department of Public Works and Highways
Office of the Secretary

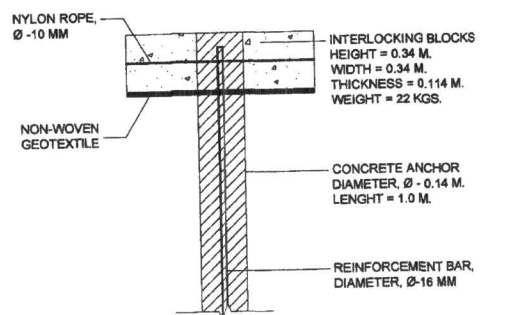
WIN6R01232

BIO- ENGINEERING FOR RIVER BANK SLOPE PROTECTION APPLICATION

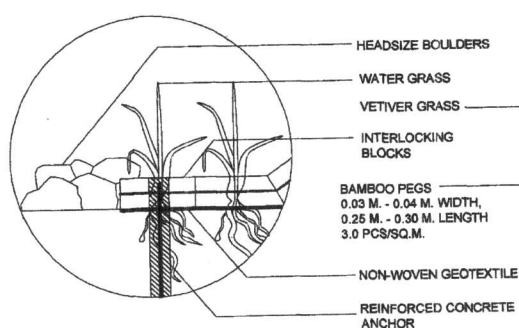
(COCONET, INTERLOCKING BLOCKS WITH VETIVER GRASS)



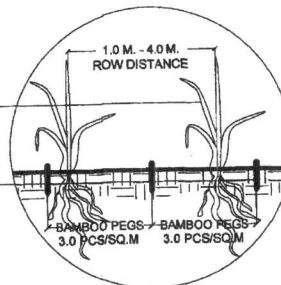
TYPICAL CROSS SECTION
SCALE: NOT TO SCALE



REINFORCED CONCRETE ANCHOR
SCALE: NTS:



DETAIL A
SCALE: NTS:



DETAIL B
SCALE: NTS:

GENERAL NOTES :

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
2. VETIVER GRASS HEDGEROW SHALL BE PLANTED ON THE SLOPES AT 0.10 M. TO 0.15 M. PLANT INTERVAL AND THE ROW DISTANCE SHALL BE 1.0 M - 4.0 M. APART.
3. INTERLOCKING BLOCKS CAN BE USED WITH NON-WOVEN GEOTEXTILE TO PROTECT AGAINST SOIL EROSION.
4. COCONET 700 IS USUALLY USED FOR RIVER BANK PROTECTION. IT CAN ALSO BE USED FOR INTERMITTENT HIGH VELOCITY AND HIGH WATER VOLUME DURING HEAVY RAINS.
5. COCONET SHALL BE LAID LOOSELY, NOT STRETCHED ON THE GROUND. DIRECT CONTACT WITH THE SOIL SHALL BE MAINTAINED AT ALL TIMES.
6. BACKFILL SHALL BE IN ACCORDANCE WITH THE APPROVED PLAN AND SHALL CONFORM TO THE REQUIREMENTS OF EMBANKMENT.
7. BAMBOO PEGS SHALL BE USED TO ANCHOR THE NETS INTO THE GROUND. USE 3 PCS OF BAMBOO PEGS PER SQUARE METER.
8. WATER GRASS ARE PLANTED AT EACH HOLE OF THE INTERLOCKING BLOCKS SUBMERGED UNDER NORMAL WATER LEVEL.
9. INTERLOCKING BLOCKS ARE USUALLY USED IN STREAM BANKS WITH VELOCITIES WHICH MAY EXCEED 3.0 M/SEC.
10. HEAD SIZE BOULDERS ARE PLACED AT THE TOP OF THE INTERLOCKING BLOCKS

Department of Public Works and Highways
Office of the Secretary

WIN6R01232



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
SONFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:

TYPICAL CROSS SECTION
REINFORCED CONCRETE ANCHOR
DETAIL A, DETAIL B
GENERAL NOTES

SHEET TITLE:

BIO- ENGINEERING FOR RIVER BANK
SLOPE PROTECTION APPLICATION
(COCONET, INTERLOCKING BLOCKS
WITH VETIVER GRASS)

PREPARED BY:

DESIGN: CATHARINE KAY G. DUQUE
ENGINEER

DRAWN: R. R. RONDA
DRAFTSMAN

CHECKED: MARTINIANO M. DE LA CRUZ, JR.
SUPERVISOR

DATE:

SIGNATURE

LEONARDO L. LINGAN

CHIEF, WATER PROJECTS DIV., B.O.D.

REVIEWED BY:

DANTE B. POTANTE

DIRECTOR IV, B.O.D.

RECOMMENDING APPROVAL:

RAUL O. ABIS

UNDERSECRETARY
WATER TECHNICAL SERVICES

REVIEWED BY:

REGELIO L. SINGSON

SECRETARY

STD

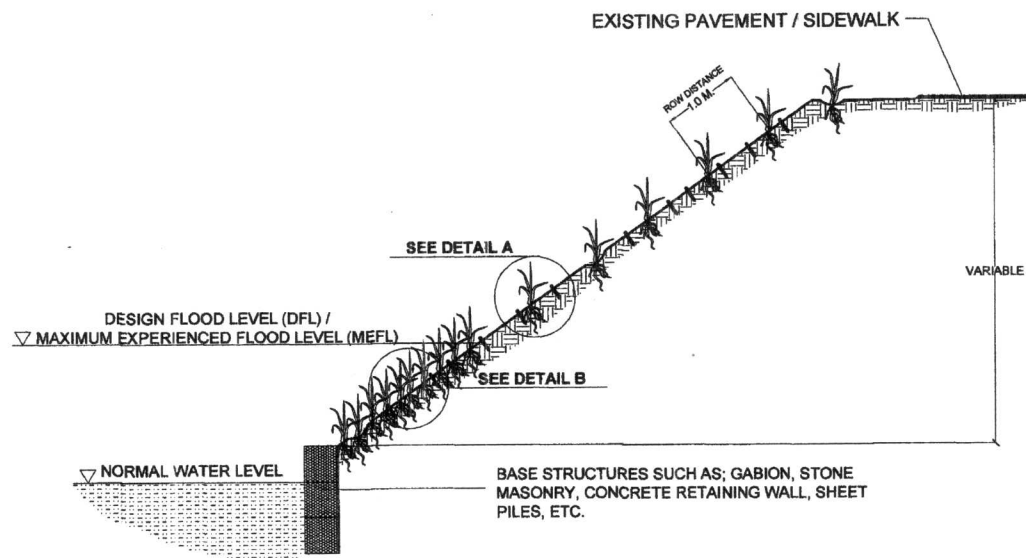
SWALL

1

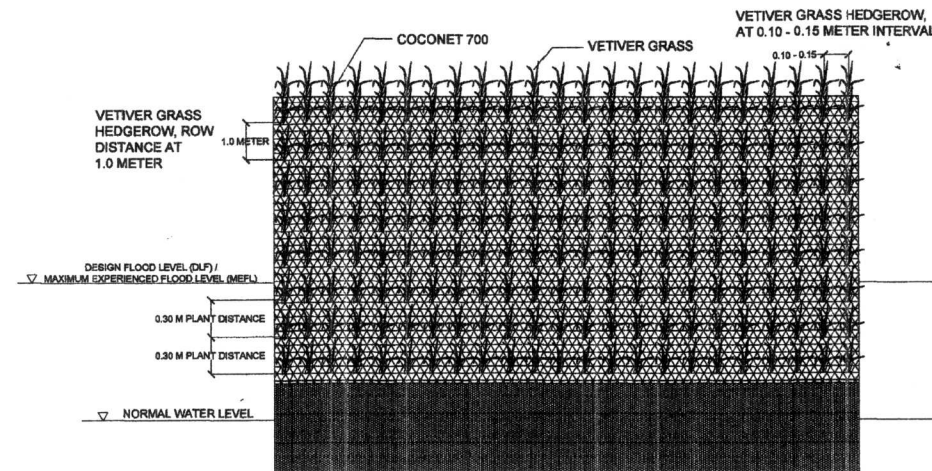
3

BIO- ENGINEERING FOR RIVER BANK SLOPE PROTECTION APPLICATION

(COCONET WITH VETIVER GRASS)



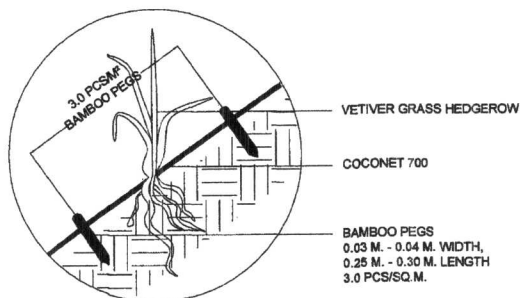
TYPICAL CROSS SECTION
SCALE: NOT TO SCALE



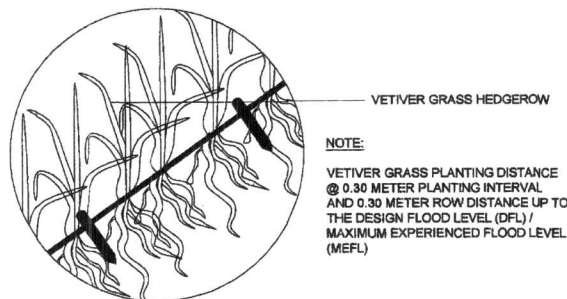
ELEVATION
SCALE: NTS:

GENERAL NOTES :

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
2. VETIVER GRASS HEDGEROW SHALL BE PLANTED ON THE SLOPES AT 0.10 M. TO 0.15 M. PLANT INTERVAL AND THE ROW DISTANCE SHALL BE 0.30 M. APART UP TO THE DFL/MEFL AND 1.0 M. - 4.0 M. APART ON SLOPES ABOVE THE DFL/MEFL.
3. COCONET 700 IS USUALLY USED FOR RIVER BANK PROTECTION. IT CAN ALSO BE USED FOR INTERMITTENT HIGH VELOCITY AND HIGH WATER VOLUME DURING HEAVY RAINS.
4. FOR CUT SECTION MAXIMUM HEIGHT IS 7.0 METERS WITH A SLOPE OF LESS THAN OR EQUAL TO 1:1 OR 45 DEGREES.
5. FOR EMBANKMENT/FILL SECTION MAXIMUM HEIGHT IS 3.0 METERS WITH A SLOPE OF LESS THAN OR EQUAL TO 1.5:1.
6. COCONET SHALL BE LAID LOOSELY, NOT STRETCHED ON THE GROUND. DIRECT CONTACT WITH THE SOIL SHALL BE MAINTAINED AT ALL TIMES.
7. BACKFILL SHALL BE IN ACCORDANCE WITH THE APPROVED PLAN AND SHALL CONFORM TO THE REQUIREMENTS OF EMBANKMENT.
8. BAMBOO PEGS SHALL BE USED TO ANCHOR THE NETS INTO THE GROUND. USE 3.0 PCS OF BAMBOO PEGS PER SQUARE METER.
9. MUST HAVE AT LEAST 0.025 M (ONE INCH) OF SOIL FOR PLANTS TO GROW.
10. USE BASE STRUCTURES SUCH AS; GABION, STONE MASONRY, CONCRETE RETAINING WALL, ETC.



DETAIL A
SCALE: NTS:



DETAIL B
SCALE: NTS:



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:
- SECTION DETAIL OF WAVE DEFLECTOR
- DETAIL OF DRAINAGE DITCH
- TYPICAL SECTION
- DETAIL OF ANCHORAGE TO ARMOUR ROCK

SHEET TITLE:
BIO- ENGINEERING FOR RIVER BANK
SLOPE PROTECTION APPLICATION
(COCONET WITH VETIVER GRASS)

PREPARED BY:
DESIGN: CATHARINE KAY G. DUQUE
ENGINEER
DRAWN: R. R. RONDA
CHECKED: MARTIN AND M. DE LA CRUZ, JR.
SUPERVISOR

DATE:
SIGNATURE:
REVIEWED BY:

LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIV., B.O.D.

RECOMMENDING APPROVAL:
DANTE B. POTANTE
DIRECTOR, B.O.D.

PAUL C. ASIS
UNDERSECRETARY
FOR TECHNICAL AFFAIRS

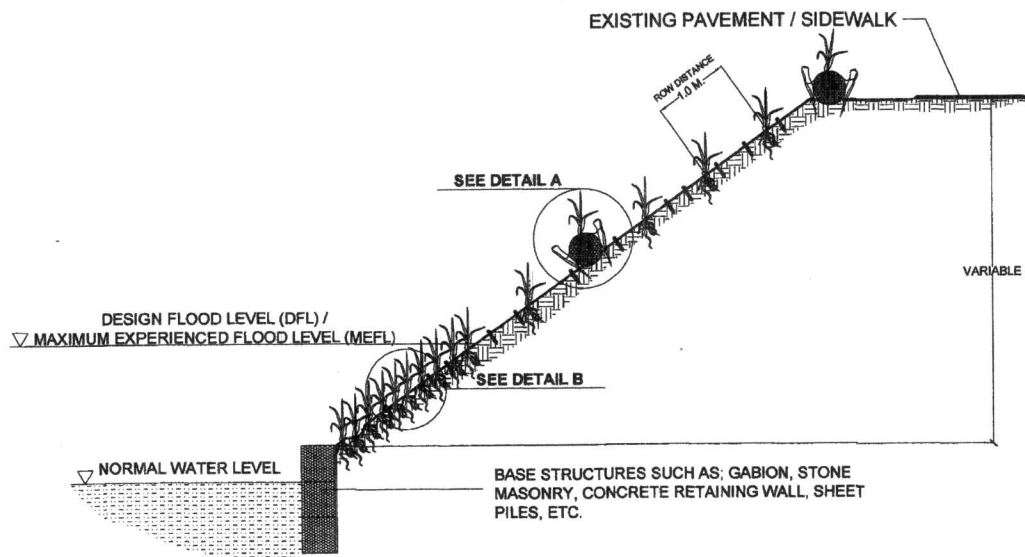
APPROVED BY:
ROGELIO L. SINGSON
SECRETARY

WIN6R01232

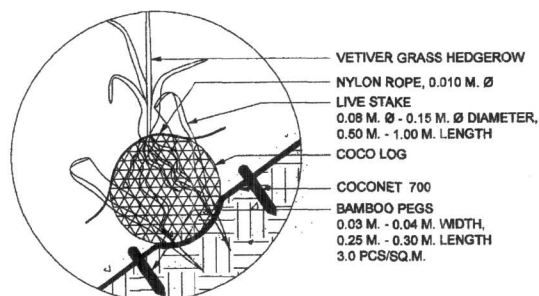
SET NO. 2
SHEET NO. 3

BIO- ENGINEERING FOR RIVER BANK SLOPE PROTECTION APPLICATION

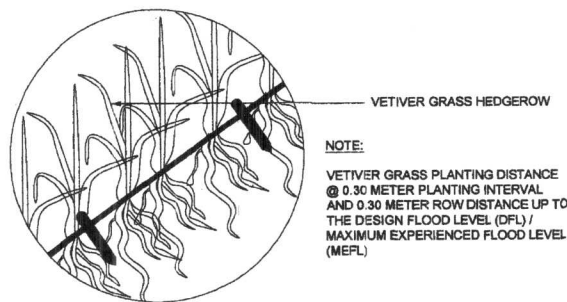
(COCONET, COCOLOGS / FASCINE WITH VETIVER GRASS)



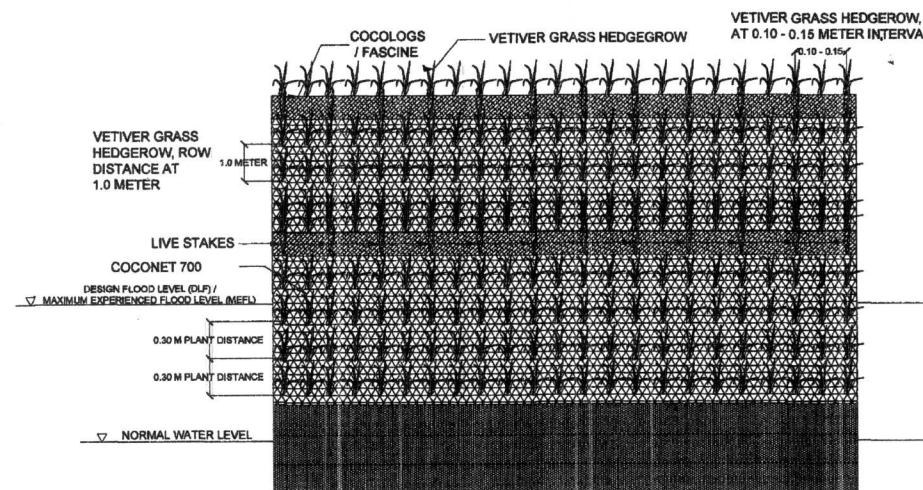
TYPICAL CROSS SECTION
SCALE: NOT TO SCALE



DETAIL A
SCALE: NTS:



DETAIL B
SCALE: NTS:



ELEVATION
SCALE: NTS:

GENERAL NOTES :

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
2. VETIVER GRASS HEDGEROW SHALL BE PLANTED ON THE SLOPES AT 0.10 M. TO 0.15 M. PLANT INTERVAL AND THE ROW DISTANCE SHALL BE 0.30 M. APART UP TO THE DFL/MEFL AND 1.0 M. - 4.0 M. APART ON SLOPES ABOVE THE DFL/MEFL.
3. COCONET 700 IS USUALLY USED FOR RIVER BANK PROTECTION. IT CAN ALSO BE USED FOR INTERMITTENT HIGH VELOCITY AND HIGH WATER VOLUME DURING HEAVY RAINS.
4. FOR CUT SECTION MAXIMUM HEIGHT IS 7.0 METERS, SLOPE IS 1:1.
5. FOR EMBANKMENT/FILL SECTION MAXIMUM HEIGHT IS 3.0 METERS, SLOPE IS 1.5:1.
6. COCONET SHALL BE LAID LOOSELY, NOT STRETCHED ON THE GROUND. DIRECT CONTACT WITH THE SOIL SHALL BE MAINTAINED AT ALL TIMES.
7. BACKFILL SHALL BE IN ACCORDANCE WITH THE APPROVED PLAN AND SHALL CONFORM TO THE REQUIREMENTS OF ITEM 104 - EMBANKMENT.
8. BAMBOO PEGS SHALL BE USED TO ANCHOR THE NETS INTO THE GROUND. USE 3 PCS OF BAMBOO PEGS PER SQUARE METER.
9. COCOLOGS/FASCINES SHALL BE INSTALLED IF THERE IS NO EXISTING VERTICAL AND HORIZONTAL DRAIN. COCOLOGS/FASCINES SHALL BE INSTALLED AT THE SLOPE AT EVERY 8.0 M. SPACING PLANTED WITH VETIVER GRASS.
10. LIVE STAKES SHALL BE USED TO ANCHOR THE COCOLOGS/FASCINE TO THE GROUND AND ADD TO THE STABILITY OF THE SLOPE. IT SHALL BE PLACED ON BOTH UPHILL AND DOWNHILL SIDES OF THE LOGS AND MUST BE SPACED AT 1.0 METER APART.
11. NYLON ROPES ARE USED TO TIE THE LOGS TO THE LIVE STAKES TO ADD STABILITY.
12. USE BASE STRUCTURES SUCH AS: GABION, STONE MASONRY, CONCRETE RETAINING WALL, ETC.

STEEPNESS OF SLOPE	COCONET	COCOLOG	VERTICAL DISTANCE OF COCOLOGS
3 : 1	400	100	8.0 METERS
2 : 1	400	100	8.0 METERS
1.5 : 1	400	200	8.0 METERS
1 : 1	700	200	8.0 METERS
0.5 : 1	900	200	4.0 METERS

TYPE OF SLOPE	VEGETATION	HORIZONTAL INTERVAL	VERTICAL INTERVAL
EMBANKMENT	VETIVER GRASS	0.15 M	4.0 M
CUT	GRASS COVER	DEPENDS OF DESIRED DENSITY	

NATURE OF SURFACE	ANCHORING MATERIALS	SUCCESS OF VEGETATION
SOFT SOIL	BAMBOO PEGS	DEPENDS ON PLANT SPECIE
HARD SURFACE	STEEL BARS	

WIN6R01232



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:
- SECTION DETAIL OF WAVE DEFLECTOR
- DETAIL OF DRAINAGE DITCH
- TYPICAL SECTION
- DETAIL OF ANCHORAGE TO ARMOUR ROCK

SHEET TITLE:
BIO- ENGINEERING FOR RIVER BANK SLOPE PROTECTION APPLICATION
(COCONET, COCOLOGS / FASCINE WITH VETIVER GRASS)

PREPARED BY:
DESIGN: CATHARINE EAY O. DUQUE
DRAWN: R. R. RONDA
CHECKED: MARTINIANO M. DE LA CRUZ, JR.

DATE:

SIGNATURE

REVIEWED BY:

LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIV. B.O.D.

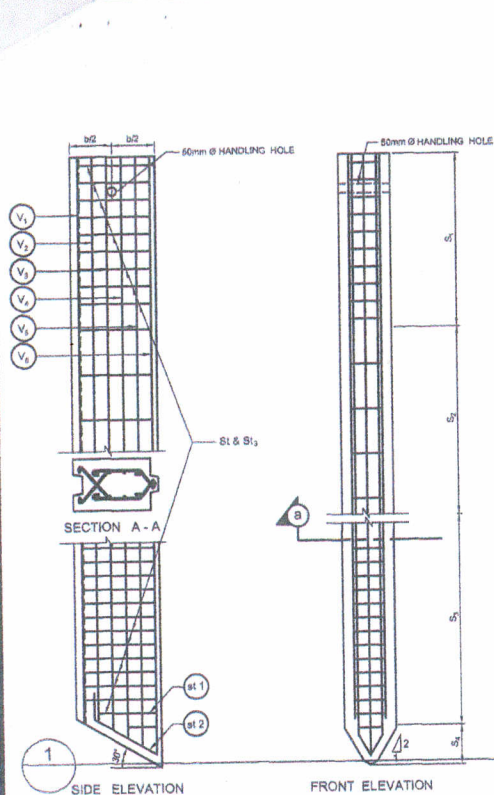
RECOMMENDING APPROVAL:

DANTE B. POTANTE
DIRECTOR IV, B.O.D.

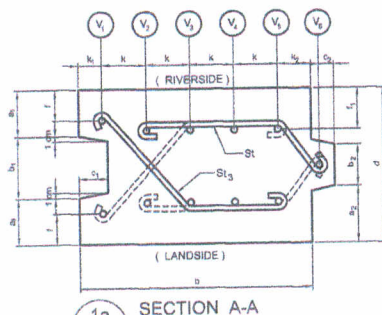
ROSEL C. ASIS
UNDERSECRETARY
FOR TECHNICAL AFFAIRS

APPROVED BY:
ROGELIO B. SINGSON
SECRETARY

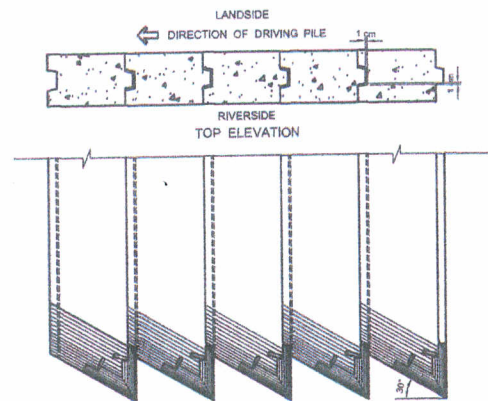
SET NO. 3
SHEET NO. 3



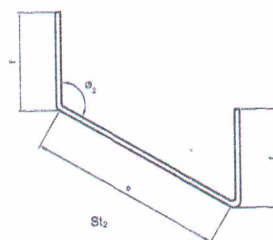
R. C. PILES SHOWING REINFORCING BARS



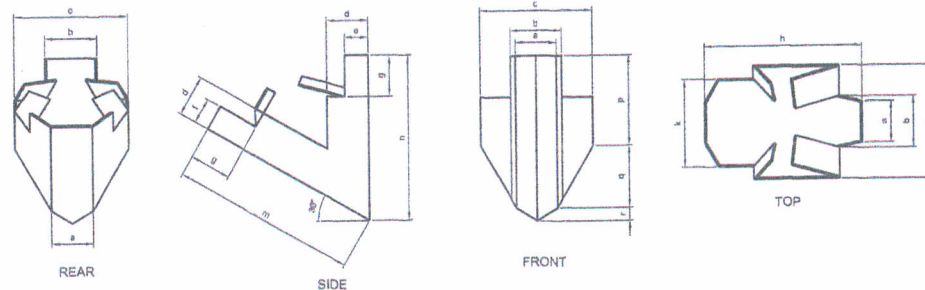
1a SECTION A-A



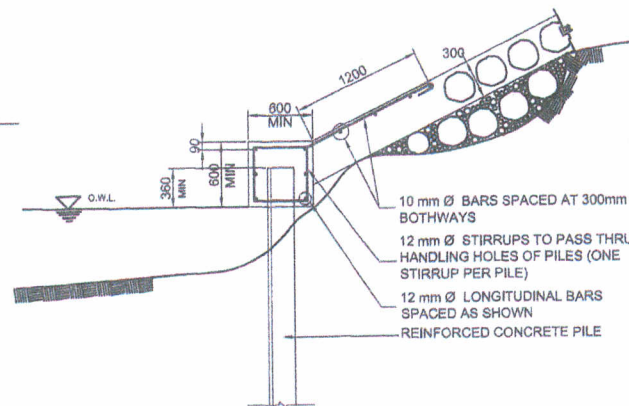
2 ERECTION DIAGRAM



3 DETAIL OF STIRRUPS



4 DETAIL OF STEEL SHOE PLATE (3mm THICK)



5 PILE CAP DETAIL

GENERAL NOTES :

- CLASS "A" (FOR PILE CAP) AND CLASS "C" (FOR REINFORCED CONCRETE PILE) CONCRETE SHALL HAVE MINIMUM STRENGTHS OF 20.70 MPa.
- ALL REINFORCING BARS SHALL CONFORM TO ASTM A618/A618M. USE MINIMUM GRADE 40, $f_y = 276$ MPa FOR BARS WITH OR LESS THAN 12 MM DIAMETER, AND USE MINIMUM 60, $f_y = 414$ MPa, FOR BARS WITH OR GREATER THAN 16 MM DIAMETER.
- ADD 0.5 KLO OF DIATOMACEOUS SILICA (CELITE OR THE LIKE) AS AN ADMIXTURE FOR BAG OF CEMENT. USE WATER JET IF NECESSARY IN DRIVING PILES.
- THESE PILES ARE DESIGNED WITH A RESISTING MOMENT OF 68.60, 113.80, 176.50 KLO-NEWTON-METERS PER METER OF WALL FOR 6 M, 7.5 M, AND 9 M, PILES RESPECTIVELY.
- MINIMUM PENETRATION BELOW CHANNEL BED TO BE 4.01 M, 4.42 M, AND 5.11 M, FOR 6 M, 7.5 M, AND 9 M, PILES RESPECTIVELY.
- CONCRETE VIBRATOR SHALL BE USED IN THE CASTING OF THESE PILES, TO PRODUCE A DENSE AND HIGH COMPRESSIVE STRENGTH CONCRETE. THE ASSUMED STRESSER ARE FOR CONCRETE COMPRESSION: 1,666 POUNDS PER SQUARE INCH AND FOR STEEL IN TENSION: 18,000 POUNDS PER SQUARE INCH.
- DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
- FIGURES SHALL GOVERN OVER SCALED DIMENSIONS IN CASE OF DISCREPANCIES.
- IT SHOULD BE NOTED THAT THE REINFORCEMENTS OF THE RIVERSIDE AND LANDSIDE OF THE PILES ARE NOT THE SAME. EXTREME CARE SHOULD BE EXERCISED IN DRIVING THE PILES. EACH SIDE OF THE PILE CAST SHOULD BE MARKED "W" FOR THE WATERSIDE AND "L" FOR THE LANDSIDE AS THE CASE MAYBE NEAR THE BUTT END. MARKER SHOULD BE ATTACHED TO THE FORM.

LENGTH OF MAIN REINFORCEMENT							
LENGTH OF PILE	SIZE OF BARS	LANDSIDE	RIVERSIDE	V ₁ (m)	V ₂ (m)	V ₃ (m)	V ₄ (m)
6.00 M.	20mm Ø	12mm Ø	12mm Ø	5.77	6.82	6.87	6.92
7.50 M.	25mm Ø	12mm Ø	12mm Ø	7.27	7.32	7.37	7.43
9.00 M.	25mm Ø	12mm Ø	12mm Ø	8.76	8.79	8.86	8.91

NOTES:

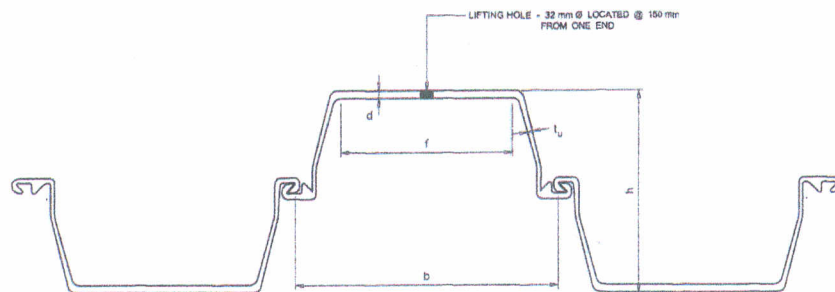
- FOR 6.10 M. AND 7.62 M. PILES, USE 5 (FIVE) PAIRS OF MAIN REINFORCING BARS.
- FOR 9.15 M. PILES, USE 5 (FIVE) PAIRS OF MAIN REINFORCING BARS.

SIZE, NUMBER, AND SPACING OF STIRRUPS							
LENGTH OF PILE	SIZE OF STIRRUPS	LENGTH	NO. OF STIRRUPS	LENGTH	NO. OF STIRRUPS	LENGTH	NO. OF STIRRUPS
6.00 M.	10mm Ø	1.0 M	11 pos @ 10 o.c.	3.04 M	14 pos @ 20 o.c.	1.23 M	15 pos @ 15 o.c.
7.50 M.	10mm Ø	1.0 M	11 pos @ 10 o.c.	6.0 M	25 pos @ 20 o.c.	1.36 M	21 pos @ 15 o.c.
9.00 M.	10mm Ø	1.0 M	11 pos @ 10 o.c.	6.02 M	16 pos @ 34 o.c.	1.36 M	17 pos @ 15 o.c.

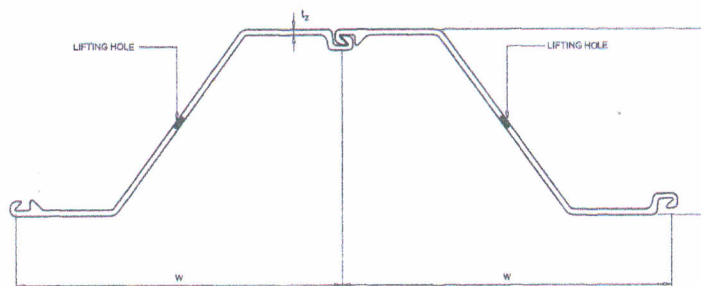
STIRRUP BAR BENDING SCHEDULE															
LENGTH OF PILE	SIZE OF STIRRUPS	a (cm)	b (cm)	c (cm)	d (cm)	e (cm)	f (cm)	g (cm)	h (cm)	i (cm)	j (cm)	k (cm)	l (cm)	m (cm)	n (cm)
6.00 M.	10mm Ø	28.8	12	23.5	17	41	20	17	10	130	122	140	142		
7.50 M.	10mm Ø	28.5	13	27.5	19	46	23	19	12	120	126	160	139		
9.00 M.	10mm Ø	39	14	27.5	29	56	25	19	13	107	123	131	137		

DATA ON THE TYPICAL CROSS-SECTION													
LENGTH OF PILE	CROSS SECTION a x b (cm)	a ₁ (cm)	b ₁ (cm)	a ₂ (cm)	b ₂ (cm)	a ₃ (cm)	b ₃ (cm)	a ₄ (cm)	b ₄ (cm)	a ₅ (cm)	b ₅ (cm)	a ₆ (cm)	b ₆ (cm)
6.00 M.	30 x 45	9	12	11	8	6.5	4.5	6.5	5.5	4.5	3.0	6.0	6.0
7.50 M.	35 x 50	10	15	12	11	6.5	4.5	7.5	6.0	4.5	3.0	6.5	6.5
9.00 M.	42 x 60	13	16	16	12	9.5	5.0	7.5	7.0	6.0	4.0	7.5	9.5

DATA ON STEEL SHOE PLATE													
LENGTH OF PILE	a (cm)	b (cm)	c (cm)	d (cm)	e (cm)	f (cm)	g (cm)	h (cm)	i (cm)	j (cm)	k (cm)	l (cm)	m (cm)
6.00 M.	6	10	22	8	4.5	5	6	31.0	17	36	32	18	12
7.50 M.	11	15	22	10	4.5	6	11	34.0	19	40	30	22	14
9.00 M.	12	14	26	10	8.0	6	12	43.6	20	48	42	24	15



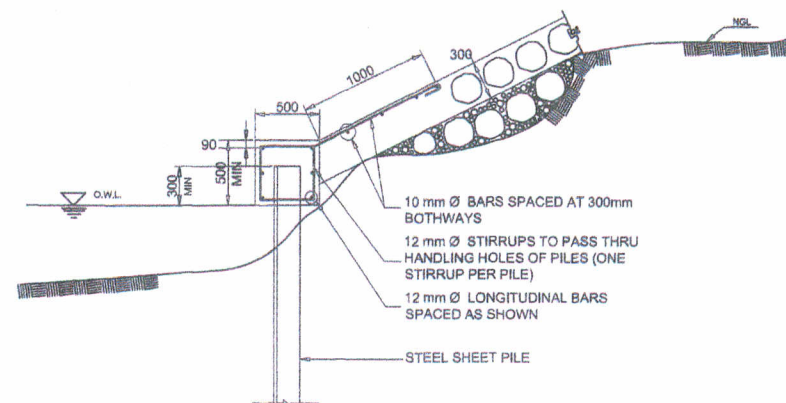
U-TYPE STEEL SHEET PILES



Z-TYPE STEEL SHEET PILES

LEGEND:

d = WEB THICKNESS
f = NOMINAL
b = WIDTH
h = DEPTH
t_u = FLANGE THICKNESS
t_z = THICKNESS
w = NOMINAL WIDTH



PILE CAP DETAIL

(should indicate the ff):
L, Length (m)
Wt, Weight (kg/m)
Sx, Section Modulus (cm³/m)
fy, grade of steel adopted

GENERAL NOTES :

1. CLASS "A" CONCRETE SHALL BE USED WITH A MINIMUM COMPRESSIVE STRENGTH OF 20.70 MPa.
2. ALL REINFORCING BARS SHALL HAVE A MINIMUM GRADE OF 40 (fy = 276 MPa).
3. ALLOWABLE STRESS FOR STEEL SHEET PILE SHALL BE 1800 kg/cm²
4. THE CENTER OF LIFTING HOLE SHALL BE LOCATED AT DISTANCE OF 150mm FROM END OF EACH PILE, DIAMETER OF LIFTING HOLES SHALL BE 32mm.
5. ONE MAN BOULDERS (300-400mm DIA.) SHALL BE USED FOR THE BOULDER NEAR THE TOE OF THE FILL. ALL VOIDS BETWEEN BOULDERS SHALL BE FILLED WITH SAND AND GRAVEL AND SUFFICIENTLY WATERED TO SECURE COMPACTION.
6. DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
7. FIGURES SHALL GOVERN OVER SCALED DIMENSIONS IN CASE OF DISCREPANCIES.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET CONTENTS:

- TYPES OF STEEL SHEET PILE
- DETAIL OF PILE CAP
- GENERAL NOTES

SHEET TITLE:

TYPES OF STANDARD DETAILS OF
STEEL SHEET PILE FOR
a. U-TYPE STEEL SHEET PILES
b. Z-TYPE STEEL SHEET PILES

PREPARED BY:

DESIGN: MARTINIANO M. DELACRUZ JR.
DRAWN: JAN CHRISTOPHER A. TUAATCH
CHECKED: MARCELLANO A. CARLOS

DATE:

SIGNATURE

REVIEWED BY:

LEONARDO L. LINGAN
CHIEF, WATER PROJECTS DIVISION

RECOMMENDING APPROVAL:

DANTE B. POTANTE
DIRECTOR

APPROVED BY:

GILBERTO S. REYES
ASSISTANT SECRETARY
FOR TECHNICAL SERVICES

APPROVED BY:

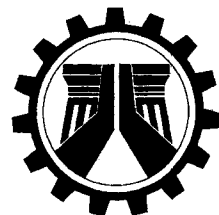
RAUL M. ASIS
UNDERSECRETARY
FOR TECHNICAL SERVICES

SET NO.

STD
STL/ST

SHEET NO.

1
1



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

STANDARD EARTHDIKE/LEVEE

GENERAL NOTES

I. DESIGN CRITERIA AND SPECIFICATIONS

1. DPWH DESIGN GUIDELINES, CRITERIA & STANDARDS (DGCS), 2015 EDITION
2. DPWH STANDARD SPECIFICATIONS, VOLUME 2, 2013 EDITION

II. DESIGN CONDITIONS

1. HEIGHT AND CREST WIDTH OF DIKE

- a) THE HEIGHT OF DIKE IS DETERMINED FROM THE DESIGN FLOOD LEVEL ELEVATION PLUS AN ADDITIONAL FREEBOARD ALLOWANCE DEPENDING ON THE DESIGN DISCHARGE AS SHOWN IN THE FOLLOWING TABLE:

DESIGN FLOOD DISCHARGE Q (m ³ /sec)	FREEBOARD (m)
LESS THAN 200	0.8
200 LESS THAN 500	0.8
500 AND LESS THAN 2,000	1.0
2,000 AND LESS THAN 5,000	1.2
5,000 AND LESS THAN 10,000	1.5
10,000 AND OVER	2.0

- b) THE TOP/CREST WIDTH OF THE DIKE SHALL BE BASED ON THE DESIGN FLOOD DISCHARGE AND SHALL NOT BE LESS THAN VALUES GIVEN IN THE FOLLOWING TABLE:

DESIGN/FLOOD DISCHARGE Q (m ³ /sec)	CREST WIDTH (m)
LESS THAN 500	3
500 LESS THAN 2,000	4
2,000 AND LESS THAN 5,000	5
5,000 AND LESS THAN 10,000	6
10,000 AND OVER	7

2. SIDE SLOPE (V:H)

- a) 1:2 FOR EMBANKMENT < 6.0m IN HEIGHT (LOW EMBANKMENT)
- b) 1:3 FOR EMBANKMENT > 6.0m IN HEIGHT (HIGH EMBANKMENT)
- c) 1:4 FOR EMBANKMENT CONSISTING OF SAND AND SHALL BE PROTECTED BY PROVIDING A TOTAL COVER OF 300mm THICK OF A GOOD SOIL AND SODDING

3. BERM

- a) RIVER SIDE: FOR HEIGHT > 6.0m, PROVIDE BERM AT EVERY 3.0m TO 5.0m WITH A WIDTH OF 1.0m (MIN.)
- b) LAND SIDE: FOR HEIGHT > 4.0m, PROVIDE BERM AT EVERY 2.0m TO 3.0m WITH A WIDTH OF 1.0m (MIN.)

4. HYDRAULIC DESIGN DATA

- a) DRAINAGE AREA, (D.A) = ___ km²
- b) DISCHARGE, (Q) = ___ m³/sec
- c) VELOCITY, (V) = ___ m/sec

III. MATERIAL AND CONSTRUCTION REQUIREMENTS

1. EMBANKMENT


EMBANKMENT SHALL CONTAIN NO MUCK, PEAT, SOD, ROOTS OR OTHER DELETERIOUS MATTER.

EMBANKMENT OF EARTH MATERIAL SHALL BE PLACED IN HORIZONTAL LAYERS NOT EXCEEDING 200mm LOOSE MEASUREMENT AND SHALL BE COMPACTED AS SPECIFIED BEFORE THE NEXT LAYER IS PLACED. THE MATERIALS PLACED IN ALL EMBANKMENT LAYERS AND THE MATERIAL SCARIFIED TO THE DESIGNATED DEPTH BELOW SUBGRADE IN CUT SECTIONS SHALL BE COMPACTED UNTIL A UNIFORM DENSITY OF NOT LESS THAN 95 MASS PERCENT OF THE MAXIMUM DRY DENSITY IS ATTAINED AT A MOISTURE CONTENT DETERMINED BY THE ENGINEER TO BE SUITABLE FOR SUCH DENSITY.

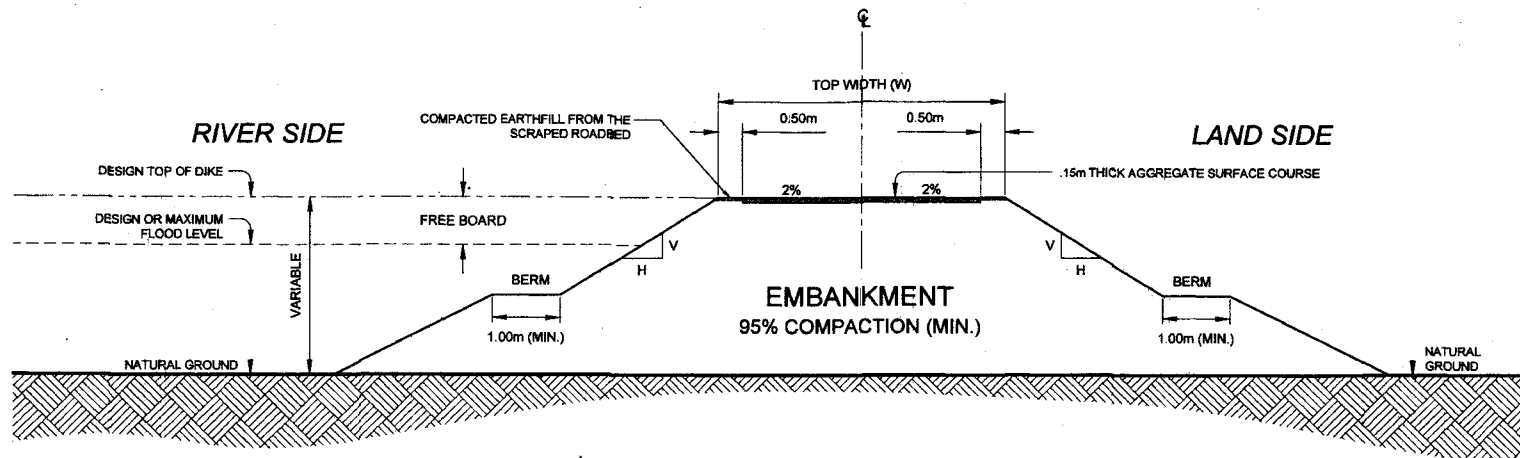
2. AGGREGATE SURFACE COURSE

THE AGGREGATE SHALL CONSIST OF HARD, DURABLE PARTICLES OR FRAGMENTS OF STONE OR GRAVEL AND SAND OR OTHER FINE MINERAL PARTICLES FREE FROM VEGETABLE MATTER AND LUMPS OR BALLS OF CLAY AND OF SUCH NATURE THAT IT CAN BE COMPACTED READILY TO FORM A FIRM, STABLE LAYER.

WHERE THE REQUIRED THICKNESS IS 150mm OR LESS, THE MATERIAL MAY BE SPREAD AND COMPACTED IN ONE LAYER. WHERE THE REQUIRED THICKNESS IS MORE THAN 150mm, THE AGGREGATE SUBBASE SHALL BE SPREAD AND COMPACTED IN TWO OR MORE LAYERS OF APPROXIMATELY EQUAL THICKNESS, AND THE MAXIMUM COMPACTED THICKNESS OF ANY LAYER SHALL NOT EXCEED 150mm. ALL SUBSEQUENT LAYERS SHALL BE SPREAD AND COMPACTED IN A SIMILAR MANNER.

 REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS BUREAU OF DESIGN WATER PROJECTS DIVISION BONIFACIO DRIVE, PORT AREA, MANILA	SHEET TITLE:	SHEET CONTENTS:	DESIGNED:	SUBMITTED:	RECOMMENDING APPROVAL:	APPROVED:	SET NO.	SHT. NO.
	STANDARD EARTHDIKE/LEVEE	GENERAL NOTES	DESIGNED: TEOCORO M. CERALDE DRAWN: MARK JOVEN S. OLIVENTINO CHECKED: TERESA E. DAQUIRO	SUBMITTED: EDUARDO L. LINGAN Chief, Water Projects Division Bureau of Design	RECOMMENDING APPROVAL: LIA S. DEL PINADO, CHIEF Office in Charge Bureau of Design	APPROVED: GILBERTO S. BAYES Chief, Water Projects Division Bureau of Design	STD	1 2

SEP 28 2018



NOTE:

REQUIRED DESIGN ANALYSES (HYDROLOGY, HYDRAULIC, SCOUR, SETTLEMENT, SEEPAGE, SLOPE STABILITY AND OVERALL STABILITY ANALYSES) SHALL BE CONDUCTED.



TYPICAL SECTION OF EARTHDIKE/LEEVE

SCALE:

1:50 mts.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:

STANDARD EARTHDIKE/LEEVE

SHEET CONTENTS

TYPICAL SECTION

DESIGNED: *TEODORO M. CERALDE*

DRAWN: *MARK J. B. TOLENTINO*

CHECKED: *TERESE E. DAPARO*

SUBMITTED:

LEONARDO C. LUNGAN
Chief, Water Projects Division
Bureau of Design

RECOMMENDING APPROVAL:

LEA N. DELFINADO, CEBU
Officer-in-Charge
Bureau of Design

APPROVED:

GILBERTO S. REYES
Officer-in-Charge, Office of Infrastructure
and Public Transportation
Department of Public Works and Highways

SET NO.

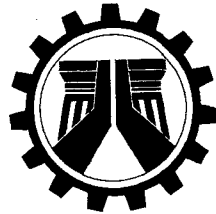
STD

SHT. NO.

2

2

SEP 20 2010



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

STANDARD DRAINAGE CULVERT WITH FLAP GATE

GENERAL NOTES

I. DESIGN CRITERIA AND SPECIFICATIONS

1. DPWH DESIGN GUIDELINES, CRITERIA & STANDARDS (DGCS), VOLUME 3, 2015 EDITION
2. DPWH STANDARD SPECIFICATIONS, VOLUME 2, 2013 EDITION

II. DESIGN CONDITIONS

1. BACKFLOW CONTROL STRUCTURES OUTLET FLOW CONTROLS INCLUDE STRUCTURES SUCH AS TIDAL FLAPS, FLOOD GATES AND DUCK BILLED VALVES. THESE STRUCTURES CONTROL THE BACKFLOW OF WATER FROM THE RECEIVING WATER BODY INTO EITHER THE CULVERT OR PIPE. THEY MAY BE INCORPORATED FOR A VARIETY OF REASONS, INCLUDING:
 - a. TO PREVENT TIDAL BACKFLOW INTO A CULVERT OR PIPE NETWORK
 - b. TO PREVENT FLOODWATERS FROM A RIVER OR CREEK FROM BACKWATERING THROUGH A PIPE NETWORK OR CULVERT, PARTICULARLY UNDER A LEVEE OR DIKE
 - c. TO PROVIDE WATER QUALITY CONTROLS BETWEEN TWO AREAS
2. THESE STRUCTURES INTRODUCE ADDITIONAL HEAD LOSSES. REFERENCE SHOULD BE MADE TO THE APPROPRIATE MANUFACTURER GUIDELINES. MAINTENANCE OF THESE STRUCTURES IS ALSO CRITICAL FOR THEIR PERFORMANCE.

III. MATERIAL AND CONSTRUCTION REQUIREMENTS

1. THE FLAP GATE SHALL BE OBTAINED FROM AN APPROVED MANUFACTURER AND THE CONTRACTOR SHALL SUBMIT FULL DRAWINGS AND DETAILS OF THE PROPOSED FLAP GATE TO THE ENGINEER FOR APPROVAL AT LEAST 28 DAYS BEFORE COMMENCING INSTALLATION OF ANY FLAP GATE.

THE FLAP GATES AND FRAMES SHALL HAVE THE FOLLOWING FEATURES:

- a. DUAL HINGE ARMS, EACH WITH DUAL PIVOT POINTS.
- b. STOPS TO PREVENT THE FLAP FROM OVERTURNING.
- c. DISTANCE BETWEEN HINGE ARMS APPROXIMATELY EQUAL TO CLEAR OPENING WIDTH.
- d. FIFTY TO SEVENTY CHLOROPRENE SEALS OF DUROMETER HARDNESS.
- e. STAINLESS STEEL HINGE PINS IN DOUBLE SHEAR.
- f. FRAME AND COVER, EITHER AN ULTRAVIOLET STABILIZED FIBER REINFORCED PLASTIC (FRP) OR ALUMINUM ALLOY 5083, AS APPROPRIATE TO THE FLAP GATE BODY MATERIAL.

THE FLAP GATE SHALL BE IN ACCORDANCE WITH THE DETAILS SHOWN IN THE FOLLOWING TABLE EXCEPT OTHERWISE INDICATED IN THE PLANS OR AS DIRECTED BY THE ENGINEER.

LOCATION	MATERIAL	SHAPE	SIZE
DRAINAGE OUTLETS	FRP	CIRCULAR	300mm dia.
	FRP	CIRCULAR	750mm dia.
	FRP	CIRCULAR	900mm dia.
SLUICE STRUCTURE	ALUMINUM	RECTANGULAR	2000mm X 2000mm
	ALUMINUM	RECTANGULAR	1700mm X 1700mm

2. FLAP GATES SHALL HAVE ONE (1) STANDARD MATERIAL COMBINATION AS LISTED IN THE FOLLOWING TABLE:

DESCRIPTION	STANDARD MATERIAL	REFERENCE STANDARD
SEAT AND COVER	CAST IRON, CLASS B	ASTM A126 - STANDARD SPECIFICATION FOR GRAY IRON CASTINGS FOR VALVES, FLANGES, AND PIPE FITTINGS
SEATING FACES	SILICON BRONZE, ALLOY 851	ASTM B98 - STANDARD SPECIFICATION FOR COPPER SILICON ALLOY ROD, BAR AND SHAPES
PIVOT LUGS LINKS	DUCTILE IRON, GRADE 80-55-06	ASTM A538 - STANDARD SPECIFICATION FOR DUCTILE IRON CASTINGS
BUSHINGS	BRONZE, ALLOY 932	ASTM B594 - STANDARD SPECIFICATION FOR COPPER ALLOY SAND CASTINGS FOR GENERAL APPLICATION
FASTENERS	STAINLESS STEEL, ALLOY GROUP 2, TYPE 316	ASTM F593 - STANDARD SPECIFICATION FOR STAINLESS STEEL BOLTS HEX CAP SCREWS, AND STUDS

3. FIBER REINFORCED PLASTIC (FRP) SHALL CONFORM TO THE REQUIREMENTS OF THE FOLLOWING ASTM STANDARDS:

DESIGNATION	DESCRIPTION
ASTM D638	STANDARD TEST METHOD FOR TENSILE PROPERTIES OF PLASTICS
ASTM D3039M	STANDARD TEST METHOD FOR TENSILE PROPERTIES OF POLYMER MATRIX COMPOSITE MATERIALS
ASTM D790	STANDARD TEST METHODS FOR FLEXURAL PROPERTIES OF UNREINFORCED AND REINFORCED PLASTICS AND ELECTRICAL INSULATING MATERIALS
ASTM D695	STANDARD TEST METHOD FOR COMPRESSIVE PROPERTIES OF RIGID PLASTICS
ASTM D570	STANDARD TEST METHOD FOR WATER ABSORPTION OF PLASTICS
ASTM D1435	STANDARD PRACTICE FOR OUTDOOR WEATHERING OF PLASTICS

4. ALUMINUM ALLOY 5083
ALUMINUM ALLOY 5083 USED IN FLAP GATES SHALL CONFORM TO ASTM B209M, STANDARD SPECIFICATION FOR ALUMINUM AND ALUMINUM-ALLOY SHEET AND PLATE

5. INSTALLATION OF FLAP GATES
THE GATE SHALL BE ANCHORED TO THE DRAINAGE STRUCTURE END WALL OR TO THE SLUICE STRUCTURE WALL WITH STAINLESS STEEL ANCHOR BOLTS.

THE CONTRACTOR SHALL ENSURE THAT THE ANCHOR HOLES ARE ACCURATELY LOCATED AND SHALL CHECK THE HOLE SPACING BY "DRY FITTING" THE GATE FRAME BEFORE ATTEMPTING TO MOUNT THE GATE BODY ON THE WALL.

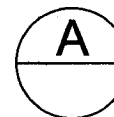
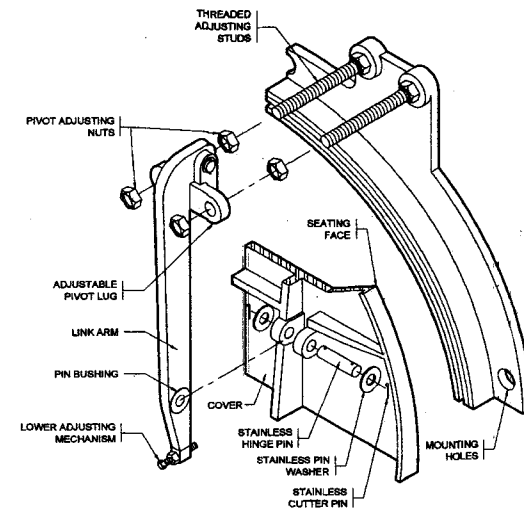
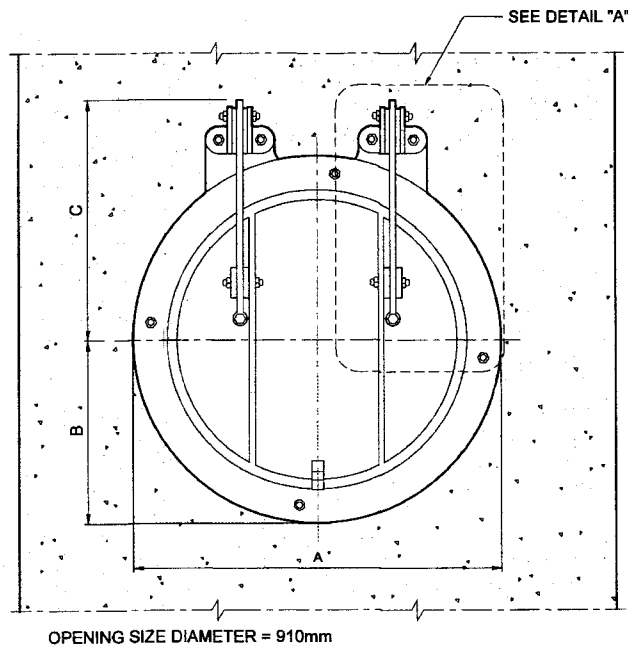
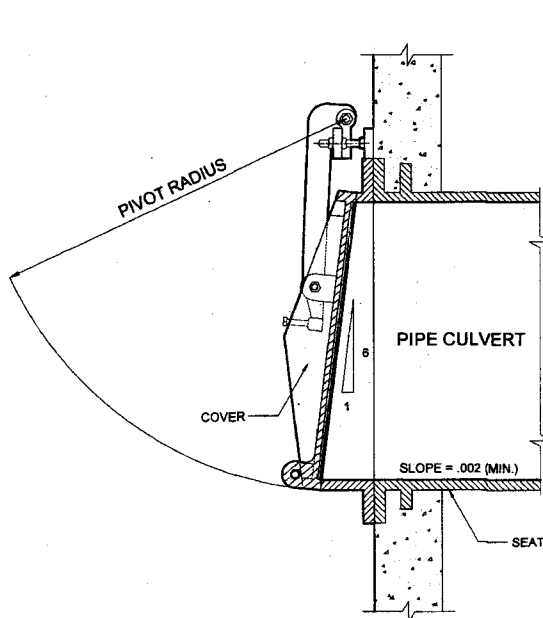
WHERE A FLAP GATE IS TO BE INSTALLED FOR A CIRCULAR CULVERT PIPE, THE GATE SHALL BE SIZED TO ALLOW ATTACHMENT OF THE GATE FRAME TO THE CULVERT END WALL WITHOUT THE ANCHORING BOLTS DAMAGING THE PIPE CULVERT WALL.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

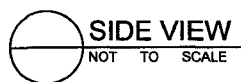
SHEET TITLE:	SHEET CONTENTS	DESIGNED:	SUBMITTED:	RECOMMENDING APPROVAL:	APPROVED:	SET NO.	SHT. NO.
STANDARD DRAINAGE CULVERT WITH FLAP GATE	GENERAL NOTES	MA. JENIE S. VELASCO DESIGNED	LEONARDO L. LINGAN Chief, Water Projects Division Bureau of Design	LEA N. DELFIRADO, CES, IV Assistant Chief Bureau of Design	GILBERTO S. RETES Assistant Chief Bureau of Design	STD	1 3

SEP 24 2018



**DETAILS OF ADJUSTABLE
TOP PIVOT AND LINK ASSEMBLY**

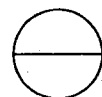
NOT TO SCALE



SIDE VIEW
NOT TO SCALE



FRONT VIEW
NOT TO SCALE



TYPICAL DETAILS OF PIPE CULVERT WITH FLAP GATE

SCALE AS SHOWN

OPENING SIZE DIA.(mm.)	DIMENSION (mm.)			PIVOT RADIUS (mm.)
	A	B	C	
910	1170	584	700	1158.00
1067	1346	673	826	1359
1219	1511	758	959	1568
1372	1683	845	1010	1708
1524	1854	927	1168	1930
1676	2032	1016	1270	2108
1829	2197	1099	1378	2298
1981	2375	1187	1480	2484
2134	2540	1270	1581	2648
2286	2706	1353	1684	2826
2438	2877	1438	1784	2978
2743	3175	1588	1908	3296



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:

STANDARD DRAINAGE CULVERT
WITH FLAP GATE

SHEET CONTENTS

TYPICAL DETAILS OF PIPE CULVERT
WITH FLAP GATE

DESIGNED:

MA. TERESA VELARCO

DRAWN:

MARK JOYENS TOLENTINO

CHECKED:

TESSE E. DABURO

SUBMITTED:

LEONARDO L. LINGAN
Chief, Water Projects Division
Bureau of Design

RECOMMENDING APPROVAL:

LEONARDO L. LINGAN
Chief, Water Projects Division
Bureau of Design
SEP 27 2018

APPROVED:

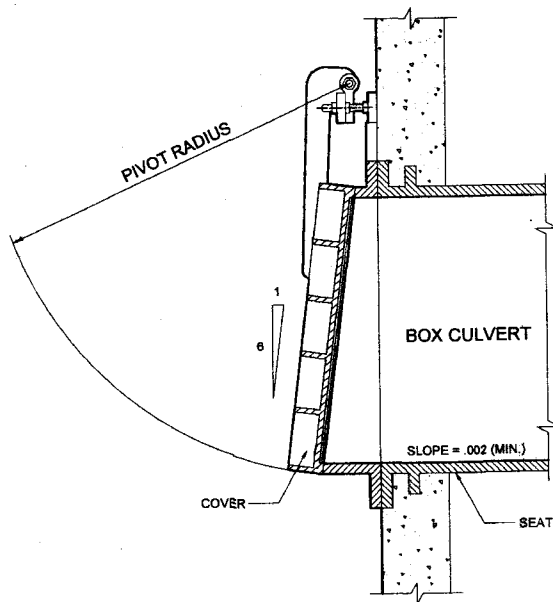
GILBERTO S. BAYES
Chief, Water Projects Division
Bureau of Design

SET NO.

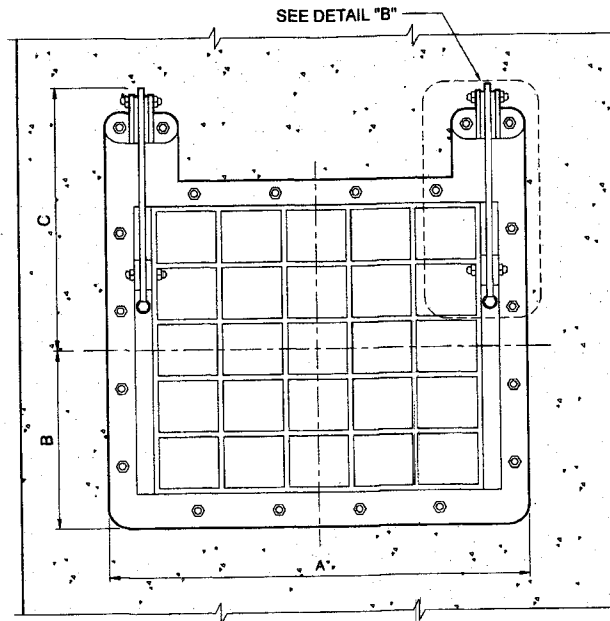
STD

SHT. NO.

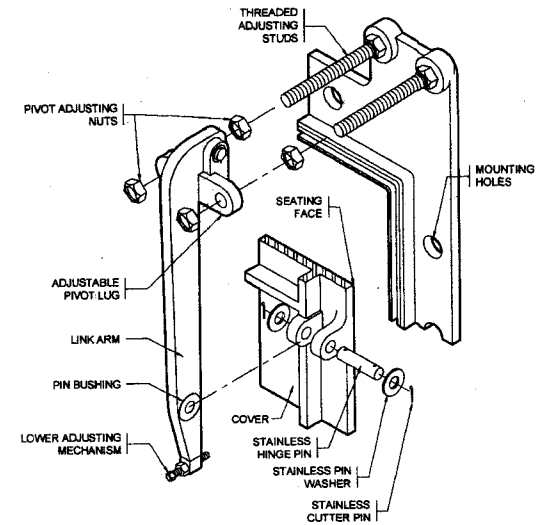
2
3



SIDE VIEW
NOT TO SCALE



FRONT VIEW
NOT TO SCALE



B DETAILS OF ADJUSTABLE
TOP PIVOT AND LINK ASSEMBLY
NOT TO SCALE

OPENING (mm.)	DIMENSION (mm.)			PIVOT RADIUS (mm.)
	A	B	C	
1000X1000	1300	825	812.50	1331.25
1250X1250	1600	900	993.75	1668.75
1500X1250	1750	725	943.75	1543.75
1500X1500	1750	875	1143.75	1883.75
1500X1000	1900	650	818.75	1337.50
1250X1200	2050	725	943.75	1543.75
1800X1500	2050	875	1143.75	1893.75
1800X1600	2050	1025	1388.75	2282.50
1800X1800	2350	875	1150.00	1993.75
2150X1500	2350	1175	1596.25	2600.00
2100X2100	2700	900	1150.00	1900.00
2400X1500	2700	1200	1562.50	2600.00
2400X2100	2700	1350	1725.00	2925.00
2400X2400	2700	1500	1900.00	3450.00
2750X2750	3000	1500	2025.00	3725.00
3000X3000	3300	1500	2025.00	3725.00

TYPICAL DETAILS OF BOX CULVERT WITH FLAP GATE
SCALE AS SHOWN



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:

STANDARD DRAINAGE CULVERT
WITH FLAP GATE

SHEET CONTENTS

TYPICAL DETAILS OF BOX CULVERT
WITH FLAP GATE

DESIGNED:

MARK S. VELASCO

DRAWN:

MARK S. TOLENTINO

CHECKED:

TERESA E. MAGURO

SUBMITTED:

LEONARDO L. LINGAN
Chief, Water Projects Division
Bureau of Design

RECOMMENDED APPROVAL:

LEA N. BELFERRADO, 9850
Chief of Office, Office of Engineering
Bureau of Design

APPROVED:

GILBERTO S. REYES
Chief of Office, Office of Engineering
Bureau of Design

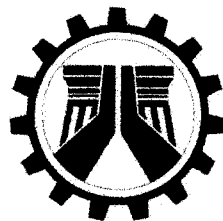
SET NO.

STD

SHT. NO.

3

SEP 21 2018



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN, WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

STANDARD PLAN OF 2M TO 6M GRAVITY WALL

GENERAL NOTES

I. DESIGN CRITERIA AND SPECIFICATIONS

1. DPWH DESIGN GUIDELINES, CRITERIA & STANDARDS (DGCS), 2015 EDITION
2. DPWH STANDARD SPECIFICATIONS, VOLUME 2, 2013 EDITION

II. DESIGN CONDITIONS

1. SURCHARGE = 25 t/m OR 24.47 kN/m²
2. FREEBOARD = 600 mm (minimum)
3. SOIL PROPERTIES :
 - a) UNIT WT. OF SOIL = 19 kN/m³
 - b) ANGLE OF REPOSE = 30°
5. HYDRAULIC DESIGN DATA
 - a) DRAINAGE AREA, (DA) = ____ km²
 - b) DISCHARGE, (Q) = ____ m³/sec.
 - c) VELOCITY, (V) = ____ m/sec.

III. MATERIAL AND CONSTRUCTION REQUIREMENTS

1. STONES
 - a) THE STONES SHALL BE CLEAN, HARD AND DURABLE AND SHALL BE SUBJECT TO THE ENGINEER'S APPROVAL. ADOBE STONE SHALL NOT BE USED UNLESS OTHERWISE SPECIFIED.
 - b) STONES SHALL HAVE A THICKNESS OF NOT LESS THAN 150 mm, AND WIDTHS OF NOT LESS THAN ONE AND ONE-HALF TIMES THEIR RESPECTIVE THICKNESS, AND LENGTHS OF NOT LESS THAN ONE AND ONE-HALF TIMES THEIR RESPECTIVE WIDTHS.
2. THE FOUNDATION BED SHALL BE EXCAVATED TO THE LINES AND GRADES AS SHOWN IN THE PLANS AS DIRECTED BY THE ENGINEER AND SHALL BE THOROUGHLY COMPACTED IN ACCORDANCE WITH ITEM 140.3.3 OF DPWH STANDARD SPECIFICATIONS.

3. MORTAR

THE MORTAR FOR THE MASONRY SHALL BE COMPOSED OF ONE PART OF PORTLAND CEMENT AND TWO PARTS OF FINE AGGREGATE BY VOLUME AND SUFFICIENT WATER TO MAKE THE MORTAR OF SUCH CONSISTENCY THAT IT CAN BE HANDLED EASILY AND SPREAD WITH A TROWEL.

4. PLACING OF STONES

WHEN THE MASONRY IS TO BE PLACED ON A PREPARED FOUNDATION BED, THE BED SHALL BE FIRM AND NORMAL TO, OR IN STEPS NORMAL TO THE FACE OF THE WALL, AND SHALL HAVE BEEN APPROVED BY THE ENGINEER BEFORE ANY STONE IS PLACED.

CARE SHALL BE TAKEN TO PREVENT THE BUNCHING OF SMALL STONE OR STONES OF THE SAME SIZE. LARGE STONES SHALL BE USED IN THE CORNER.

THE STONES SHALL BE LAID WITH THEIR LONGEST FACES HORIZONTAL IN FULL BEDS OF MORTAR, AND THE JOINTS SHALL BE FLUSHED WITH MORTAR.

THE EXPOSED FACES OF INDIVIDUAL STONES SHALL BE PARALLEL TO THE FACES OF THE WALLS IN WHICH THE STONES ARE SET.


THE STONES SHALL BE HANDLED SO AS NOT TO JAR OR DISPLACE THE STONES ALREADY SET. SUITABLE EQUIPMENT SHALL BE PROVIDED FOR SETTING STONES LARGER THAN THOSE THAT CAN BE HANDLED BY TWO MEN. THE ROLLING OR TURNING OF STONES ON THE WALL WILL NOT BE PERMITTED. IF A STONE IS LOOSENED AFTER THE MORTAR HAS TAKEN INITIAL SET, IT SHALL BE REMOVED, THE MORTAR CLEANED OFF, AND THE STONE RELAID WITH FRESH MORTAR.

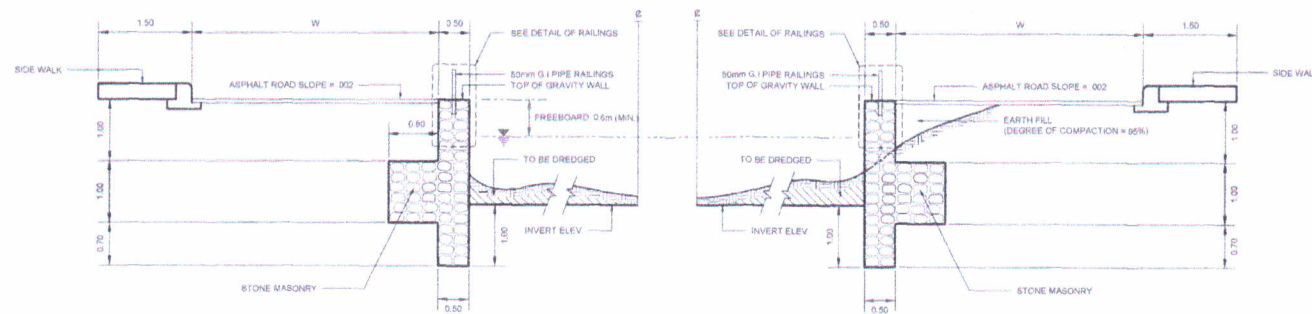
5. BED AND JOINTS

BEDS FOR FACE STONES MAY VARY FROM 20 mm TO 50 mm IN THICKNESS. THEY SHALL NOT EXTEND IN AN UNBROKEN LINE THROUGH MORE THAN 5 STONES. JOINTS MAY VARY FROM 20 mm TO 50 mm IN THICKNESS. THEY SHALL NOT EXTEND IN UNBROKEN LINE THROUGH MORE THAN TWO STONES. THEY MAY BE AT ANGLES WITH THE THE VERTICAL FROM 0° TO 45°. FACE STONE SHALL BOND AT LEAST 150 mm LONGITUDINALLY AND 50 mm VERTICALLY AT NO PLACE SHALL CORNERS OF FOUR STONES BE ADJACENT AT EACH OTHER.

CROSS BEDS FOR VERTICAL FACED WALL SHALL BE LEVEL, AND FOR BATTERED WALLS MAY VARY FROM LEVEL TO NORMAL TO THE BATTER LINE OF THE FACE OF THE WALL.

6. ROADWAY AND SIDEWALK SURFACES MUST BE MADE TO CONFORM WITH THE NEW STANDARD SECTION FOR ESTERO CHANNEL IMPROVEMENT.

 REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS BUREAU OF DESIGN WATER PROJECTS DIVISION BONIFACIO DRIVE, PORT AREA, MANILA	SHEET TITLE	SHEET CONTENTS	PREPARED	SUBMITTED	RECOMMENDING APPROVAL	APPROVED	SET NO.	SHT. NO.
	STANDARD PLAN OF 2M TO 6M GRAVITY WALL	GENERAL NOTES	TEODORO M. SERRALDE					
			MARK J. VALENTINO	LEONARDO L. LINGAN	ARSTARCO M. DORON	EMERSON S. SAGIN	STD	1
			RESERVOIR	Chief, Water Projects Division Bureau of Design	Chief, Water Projects Division Bureau of Design	Chief, Water Projects Division Bureau of Design	Chief, Water Projects Division Bureau of Design	5



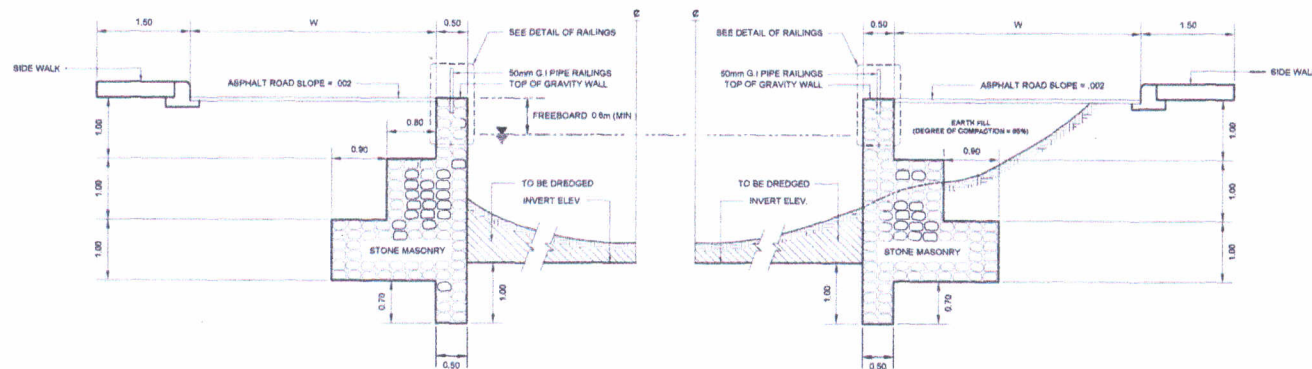
2M GRAVITY WALL

(MAXIMUM UPLIFT PRESSURE AT TOE 21.55 kN/m²)



SCALE:

1:40M



3M GRAVITY WALL

(MAXIMUM UPLIFT PRESSURE AT TOE 31.36 kN/m²)



SCALE:

1:40M

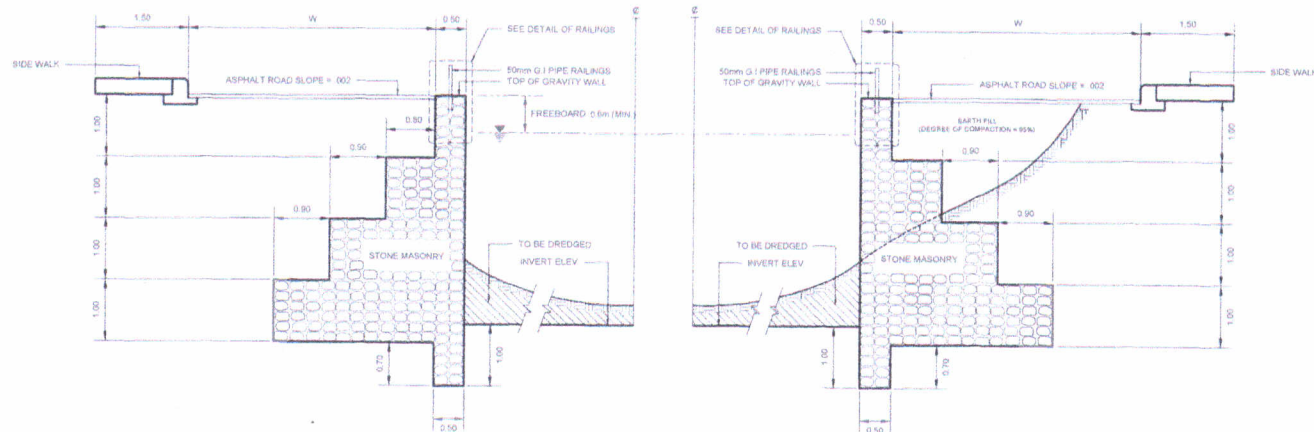
NOTE:

THE REQUIRED DESIGN ANALYSES (HYDROLOGY, HYDRAULIC, SCOUR, SLOPE STABILITY AND OVERALL STABILITY ANALYSES) SHALL BE CONDUCTED.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE	SHEET CONTENTS	PREPARED	SUBMITTED	RECOMMENDING APPROVAL	APPROVED	SET NO.	SHT NO.
STANDARD PLAN OF 2M TO 6M GRAVITY WALL	2M & 3M GRAVITY WALL	TEODORO M. CERALDE	LEONARDO L. LINGAN	ARISTARCO M. DOROS	EMIL K. SADAIN	STD	2
		MARK J. CRISTOLINO	Chief, Water Projects Division	Chief, Water Projects Division	Chief, Water Projects Division		5
		TESSE E. CAGURO	Chief, Water Projects Division	Chief, Water Projects Division	Chief, Water Projects Division		

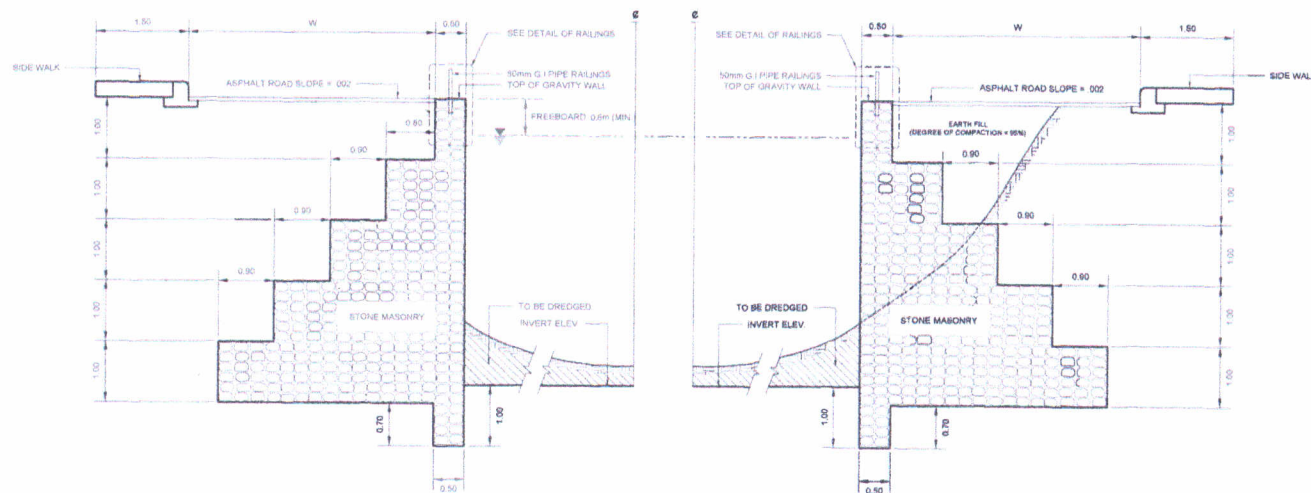


4M GRAVITY WALL

(MAXIMUM UPLIFT PRESSURE AT TOE 41.18 kN/m²)

SCALE:

1:40M



5M GRAVITY WALL

(MAXIMUM UPLIFT PRESSURE AT TOE 47.88 kN/m²)

SCALE:

1:40M

NOTE:

THE REQUIRED DESIGN ANALYSES (HYDROLOGY, HYDRAULIC, SCOUR, SLOPE STABILITY AND OVERALL STABILITY ANALYSES) SHALL BE CONDUCTED.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE

STANDARD PLAN OF 2M TO 6M
GRAVITY WALL

SHEET CONTENTS

4M & 5M GRAVITY WALL

PREPARED

TEODORO M. CERALDE

DRAWN

MARK J. SOLER

CHECKED

YESSIE E. LARIBUR

SUBMITTED

LEONARDO L. LINGAN

Chief, Water Projects Division
Bureau of Design

RECOMMENDING APPROVAL

ARISTARCO M. DORCA

Chief, Water Projects Division
Bureau of Design

APPROVED

EMIL K. SAGIN

Undersecretary for Urban Operations
and Technical Services

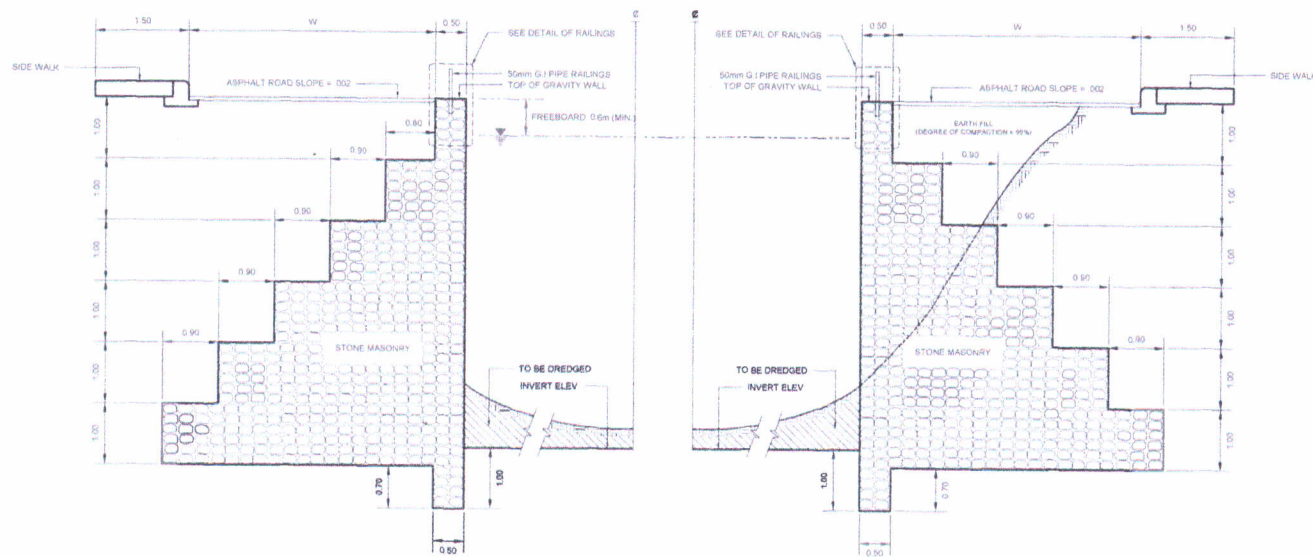
SET NO.

STD

SHT. NO.

3

5



6M GRAVITY WALL

(MAXIMUM UPLIFT PRESSURE AT TOE 156.57 kN/m²)

SCALE:

1:40M

NOTE:

THE REQUIRED DESIGN ANALYSES (HYDROLOGY, HYDRAULIC, SCOUR, SLOPE STABILITY AND OVERALL STABILITY ANALYSES) SHALL BE CONDUCTED.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:

STANDARD PLAN OF 2M TO 6M
GRAVITY WALL

SHEET CONTENTS

6M GRAVITY WALL

PREPARED:

TEODORO M. CERALDE

DRAWN:

MARK JOHN B. GLENTINO

CHECKED:

TESSE S. GARCIA

SUBMITTED:

LEONARDO L. LINGAN

Chief, Water Projects Division
Bureau of Design

RECOMMENDING APPROVAL:

ARISTARCO M. DORON

Officer in Charge
Bureau of Design

APPROVED:

EMIL K. SAGAN

Undersecretary for Land Operations
and Technology Services

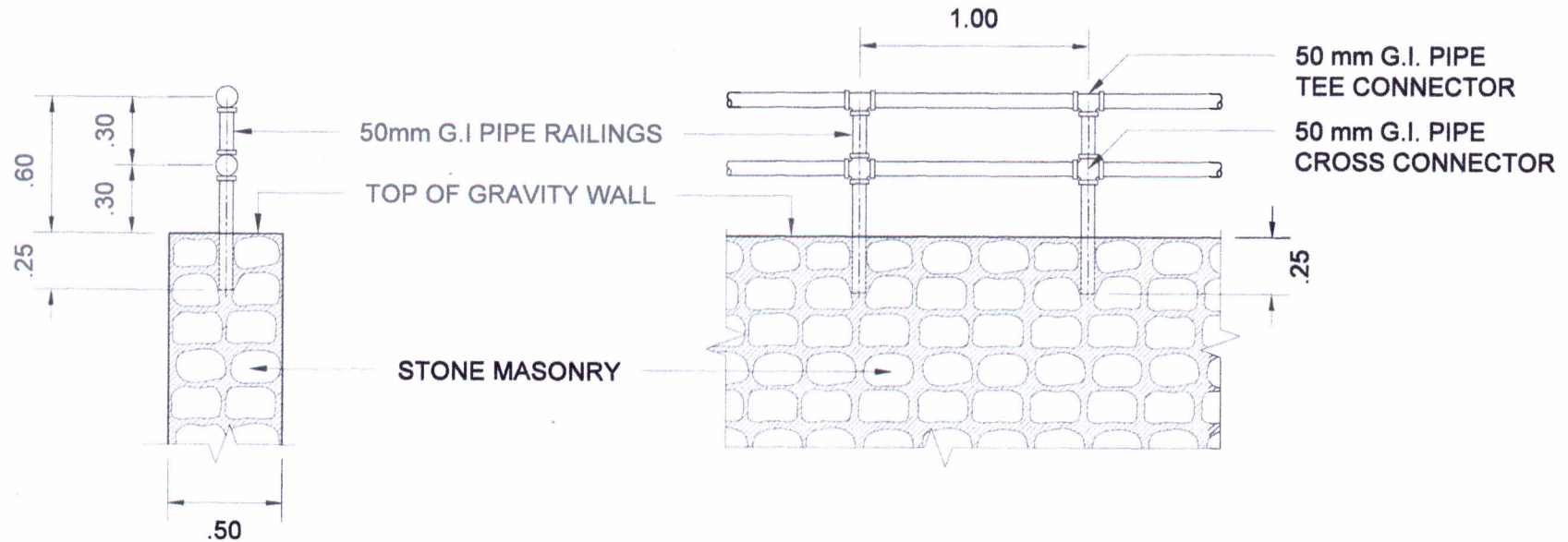
SET NO.

STD

SHT. NO.

4

5



DETAIL OF RAILINGS

SCALE:

1:16M



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
WATER PROJECTS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:

STANDARD PLAN OF 2M TO 6M
GRAVITY WALL

SHEET CONTENTS

DETAILS OF RAILINGS

PREPARED

TEODORO M. CERALDE

DRAWN

MARK J. CLEMENTINO

CHECKED

ESSIE E. DARGO

SUBMITTED

LEONARDO L. LINGAN

Chief, Water Projects Division
Bureau of Design

RECOMMENDING APPROVAL:

ARISTARCO M. DORON

Officer in Charge
Bureau of Design

APPROVED

EMIL K. SADAN

Under Secretary for Operations
and Technical Services

SET NO.

SHT. NO.

STD

5
5