Appendix-C16.3-5

動的円錐貫入(DCP)試験

Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh

DYNAMIC CONE PENETRATION (DCP) TEST REPORT

June 2013

Client:

Roads and Highways (RHD), Ministry of Communications

&

Japan International Cooperation Agency (JICA)

Through Tokyo Electric Power Services Co., Ltd.

Survey and report prepared by:

SURVEY 2000

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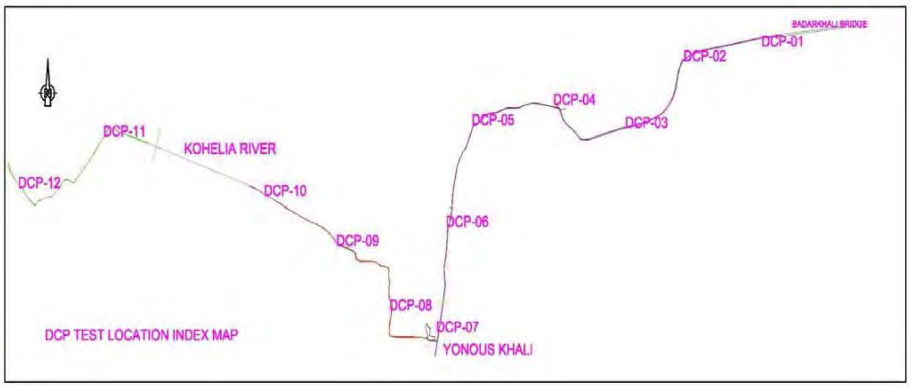
1.0 背景

SURVEY2000 は、バングラデシュ国コックスバザール地域を対象にして、国際協力機構（JICA）が実施した「チッタゴン地域石炭火力発電所建設プロジェクト」に係るアクセス道路コンポーネントのための動的円錐貫入(DCP)試験を実施し、その結果を報告書にとりまとめた。

1.1 調査場所



プロジェクトサイトは、バ国の Chittagong 市から 90km 離れた場所に位置し、コックスバザール管区、Mosheskhai Upasilla に属し、ベンガル湾に面している。
プロジェクトサイトの地理位置は下記の通り。
北緯：21° 42′ 34″
東経：91° 53′ 50″
また計画されているアクセス道路の地理位置は下記の通り。
北緯：21° 42′ 11″ ～21° 42′ 34″
東経：91° 54′ 07″ ～91° 54′ 54″

1.2 試験場所

UTM グリッドゾーン 46 の下の位置

sl	test point	easting	northing	remarks
1	DCP-01	390754mE	2401723mN	Badarkhai to Yonuskhali road
2	DCP-02	390298mE	2401620mN	
3	DCP-03	389961mE	2401311mN	
4	DCP-04	389540mE	2401404mN	
5	DCP-05	389079mE	2401315mN	
6	DCP-06	388929mE	2400849mN	
7	DCP-07	388873mE	2400358mN	
8	DCP-08	388599mE	2400459mN	
9	DCP-09	388290mE	2400760mN	
10	DCP-10	387869mE	2400994mN	
11	DCP-11	386933mE	2401270mN	On embankment Rangakhali side
12	DCP-12	386439mE	2401031mN	
13	DCP-13	393505mE	2414255mN	Near Pekua intersection
14	DCP-14	396605mE	2409592mN	Between Pekua-Eidmoni
15	DCp-15	393505mE	2414255mN	Near Eidmoni Intersection
1	Sample PIT-01	387960mE	2400943mN	
2	Sample PIT-02	387222mE	2401220mN	
3	Sample PIT-03	386466mE	2400999mN	

2.0 業務範囲

既存道路材料に関する実験室試験及び DCP 試験

	Item	Unit	Quantity	Remark
1-1.	Trial pit sampling, observation	No.	3	
1-2.	Laboratory Test from Existing Road for embankment, subgrade, subbase, base material samples			
	(a) Liquid Limit (LL)	No.	3	AASHTO T88-00
	(b) Plastic Limit (PL)	No.	3	AASHTO T89-02
	(c) Moisture Density Relations	No.	3	AASHTO T90-00
	(d) Specific Gravity	No.	3	AASHTO T99-01
	(e) Particle Size Analysis	No.	3	AASHTO T100
	(f) CBR test	No.	3	AASHTO T193-99
2-1.	Portable DCP Test on site	No.	15	

3.0 使用機器等

i) 動的円錐貫入器：8 kg ハンマー、60° 先端

ii) データ処理ソフト：UK DCP 2.2

6.0 試験作業写真

SURVEY2000

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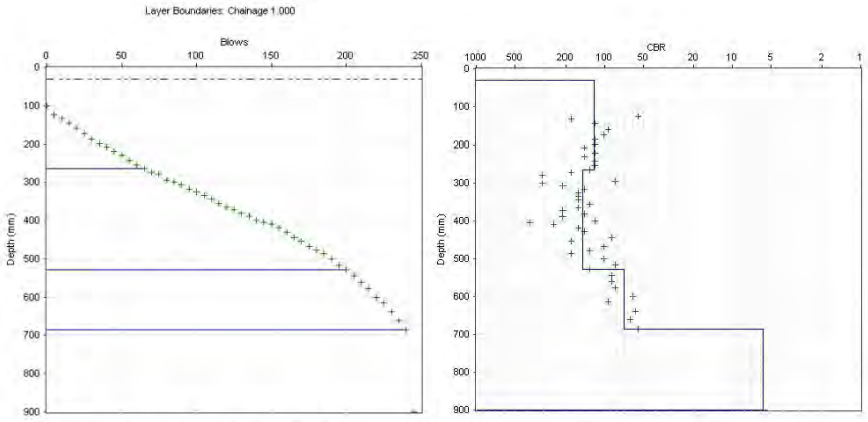
4.0 試験データ及び解析

UK DCP V3.1

DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point No: DCP-01		Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	30
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	22/05/2013	Strength Coeff.:	



Layer Boundaries Chart　　CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	2.37	121	235	265	Base	0.14	1.32	1.32	1.32
2	1.95	149	263	528	Sub-Base	0.12	1.19	1.19	1.22
3	3.95	71	158	686	Subgrade	--	--	--	--
4	42.80	6	214	900	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.47	0.47	0.47
Base	1.32	1.32	1.32
Sub-Base	1.19	1.19	1.22
Subgrade	--	0.74	0.65
Pavement Strength	2.98	3.72	3.66

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

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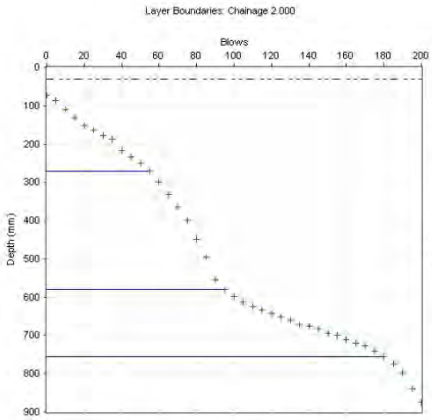
Report Date: 19-Jun-2013　　Page 1 of 15

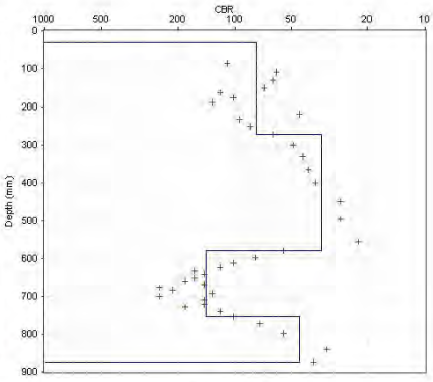
DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 02	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	30
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	22/05/2013	Strength Coeff.:	



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	3.65	77	242	272	Base	0.13	1.22	1.22	1.22
2	7.70	35	308	580	Sub-Base	0.10	1.25	1.25	1.25
3	2.05	142	174	754	Subgrade	--	--	--	--
4	6.00	45	120	874	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.47	0.47	0.47
Base	1.22	1.22	1.22
Sub-Base	1.25	1.25	1.25
Subgrade	--	2.05	1.68
Pavement Strength	2.94	4.99	4.62

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

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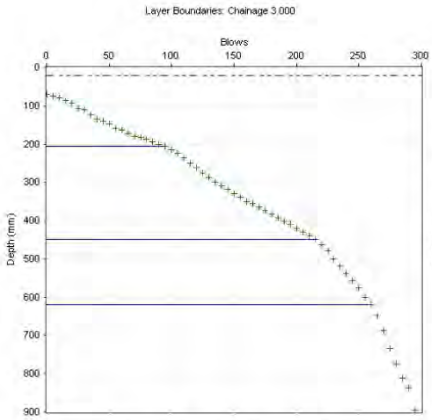
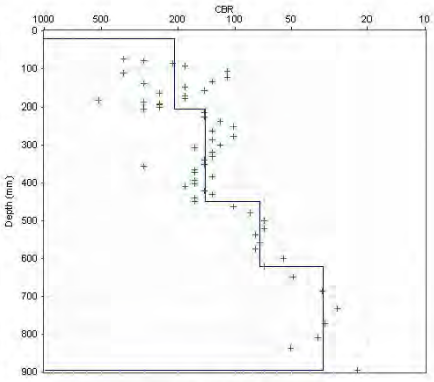
DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 03	**Surface Type:**	Hot Mixed Asphalt
Direction:		Thickness (mm):	20
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	22/05/2013	Strength Coeff.:	



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	1.42	208	185	205	Base	0.14	1.05	1.05	1.05
2	2.03	143	244	449	Sub-Base	0.12	1.11	1.11	1.14
3	3.80	74	171	620	Subgrade	--	--	--	--
4	7.86	34	275	895	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	**SN**	**SNC**	**SNP**
Surface	0.31	0.31	0.31
Base	1.05	1.05	1.05
Sub-Base	1.11	1.11	1.14
Subgrade	--	1.95	1.79
Pavement Strength	2.47	4.42	4.29

CBR Relationship:

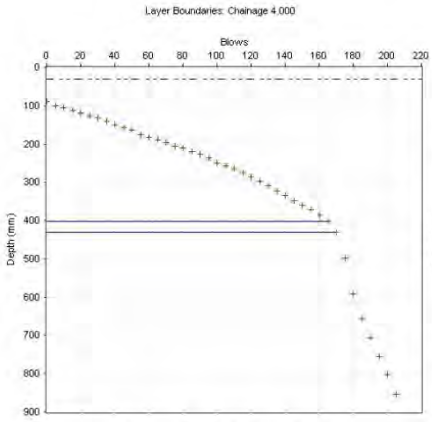
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

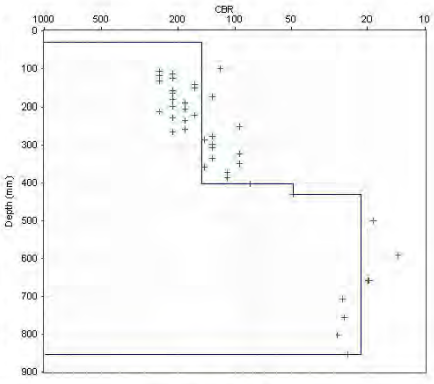
DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 04	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	30
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	26/05/2013	Strength Coeff.:	



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	1.95	149	372	402	Base	0.14	2.11	2.11	2.11
2	5.60	49	28	430	Sub-Base	0.11	0.12	0.12	0.12
3	12.11	22	424	854	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.47	0.47	0.47
Base	2.11	2.11	2.11
Sub-Base	0.12	0.12	0.12
Subgrade	--	1.74	1.84
Pavement Strength	2.70	4.44	4.54

CBR Relationship:

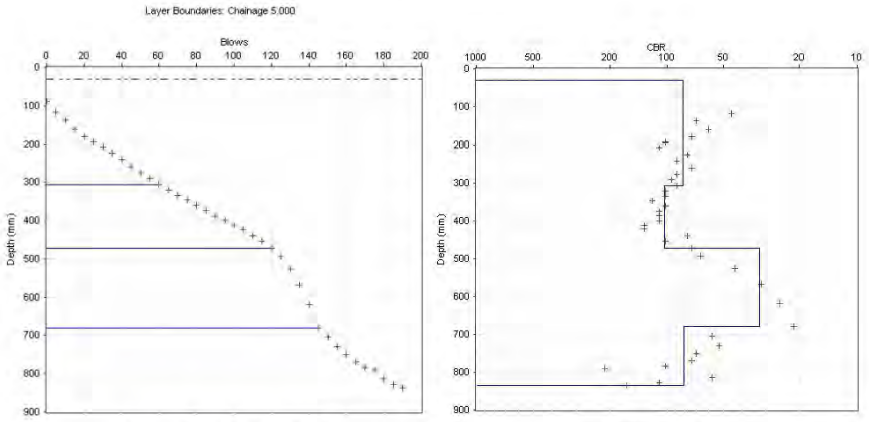
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 05	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	30
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	26/05/2013	Strength Coeff.:	



Layer Boundaries Chart　　CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	3.44	82	277	307	Base	0.13	1.43	1.43	1.43
2	2.77	103	166	473	Sub-Base	0.12	0.75	0.75	0.80
3	8.28	32	207	680	Subgrade	--	--	--	--
4	3.47	81	156	836	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.47	0.47	0.47
Base	1.43	1.43	1.43
Sub-Base	0.75	0.75	0.80
Subgrade	--	1.93	1.97
Pavement Strength	2.65	4.58	4.67

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

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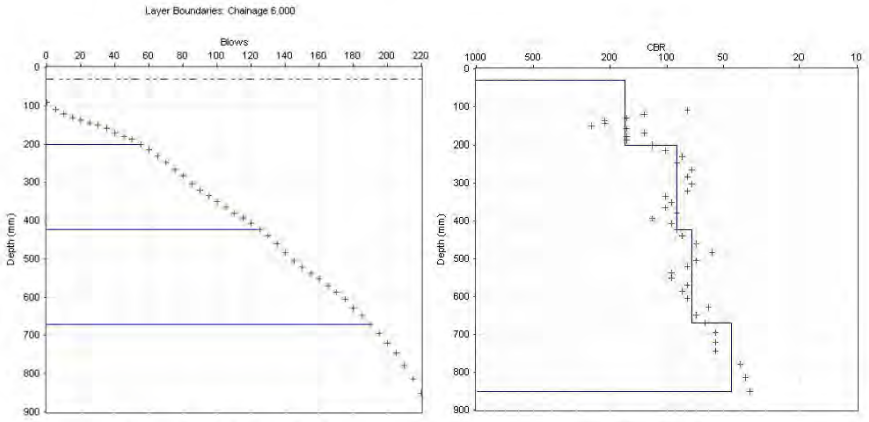
UK DCP V3.1

DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 06	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	30
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	26/05/2013	Strength Coeff.:	



Layer Boundaries Chart　　CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	1.76	167	170	200	Base	0.14	0.96	0.96	0.96
2	3.19	89	223	423	Sub-Base	0.11	1.01	1.01	1.05
3	3.80	74	247	670	Subgrade	--	--	--	--
4	6.00	45	180	850	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.47	0.47	0.47
Base	0.96	0.96	0.96
Sub-Base	1.01	1.01	1.05
Subgrade	--	2.05	1.94
Pavement Strength	2.44	4.49	4.42

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

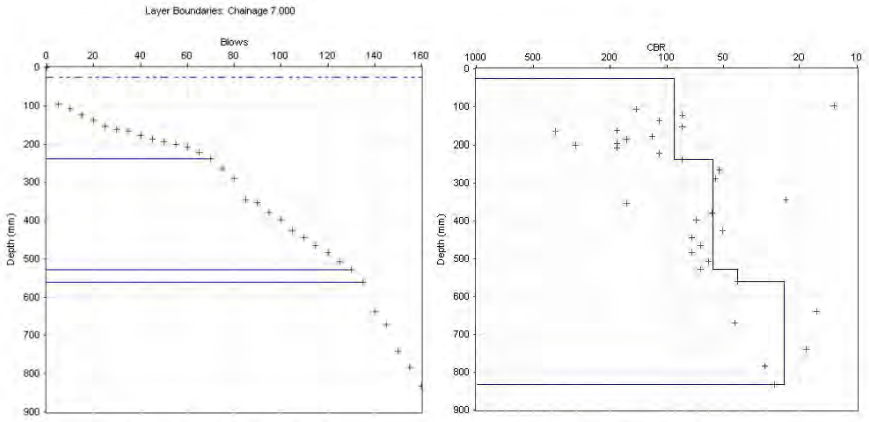
Report produced by .....

UK DCP V3.1

DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 07	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	25
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	20/05/2013	Strength Coeff.:	



Layer Boundaries Chart　　CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	3.10	91	213	238	Base	0.14	1.14	1.14	1.14
2	4.83	57	290	528	Sub-Base	0.11	1.27	1.27	1.28
3	6.40	42	32	560	Subgrade	--	--	--	--
4	10.92	24	273	833	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.39	0.39	0.39
Base	1.14	1.14	1.14
Sub-Base	1.27	1.27	1.28
Subgrade	--	1.80	1.52
Pavement Strength	2.80	4.60	4.33

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

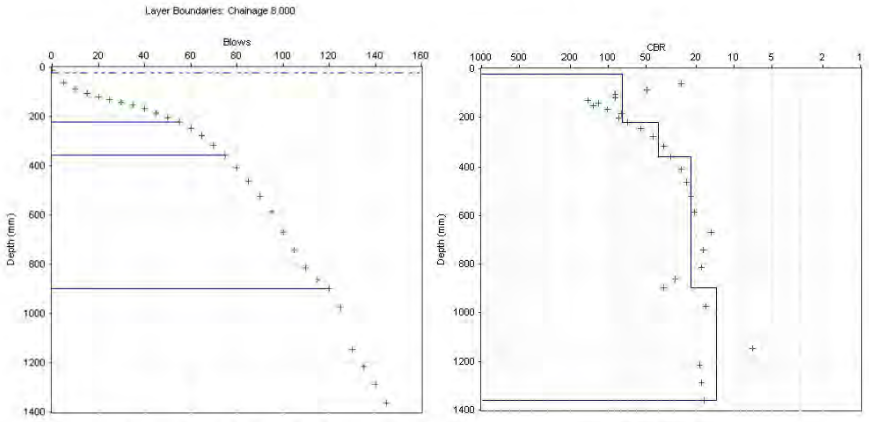
Report produced by .....

UK DCP V3.1

DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 08	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	20
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	20/05/2013	Strength Coeff.:	



Layer Boundaries Chart　　CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	3.62	77	202	222	Base	0.13	1.02	1.02	1.02
2	6.75	40	135	357	Sub-Base	0.11	0.56	0.56	0.60
3	12.00	22	540	897	Subgrade	--	--	--	--
4	18.60	14	465	1362	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.31	0.31	0.31
Base	1.02	1.02	1.02
Sub-Base	0.56	0.56	0.60
Subgrade	--	1.46	1.55
Pavement Strength	1.89	3.35	3.48

CBR Relationship:

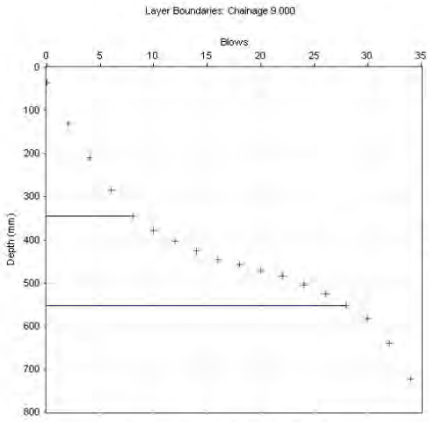
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

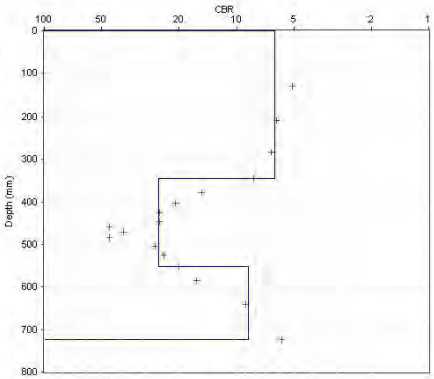
DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	**DCP- 09**	**Surface Type:**	**Hot Mixed Asphalt**
Direction:		Thickness (mm):	0
Location/Offset:	Carriageway	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	100	Surface Moisture:	Dry
Test Date:	20/05/2013	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	38.75	6	345	345	Base	0.02	0.24	0.24	0.24
2	10.35	26	207	552	Sub-Base	0.10	0.78	0.78	0.82
3	28.67	9	172	724	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	**SN**	**SNC**	**SNP**
Surface	--	--	--
Base	0.24	0.24	0.24
Sub-Base	0.78	0.78	0.82
Subgrade	--	1.12	1.08
Pavement Strength	1.02	2.14	2.14

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

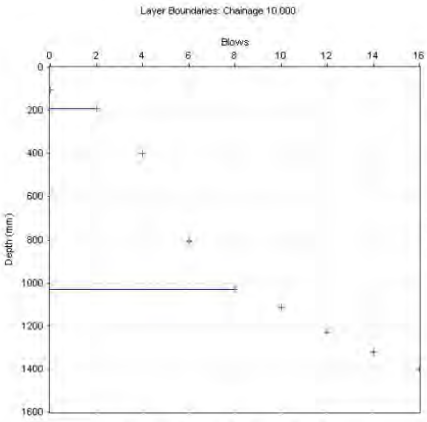
Report produced by .....

UK DCP V3.1

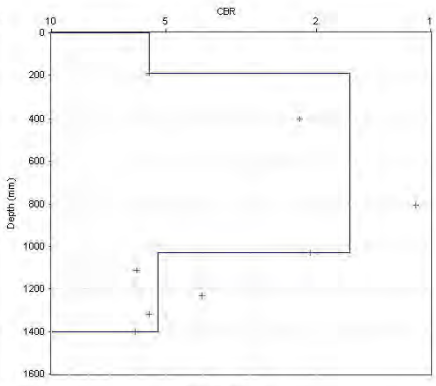
DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 10	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	0
Location/Offset:	Carriageway	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	87	Surface Moisture:	Moderate
Test Date:	20/05/2013	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	44.00	6	191	191	Base	0.02	0.12	0.12	0.12
2	140.00	2	840	1031	Sub-Base	0.00	0.00	0.00	0.00
3	46.25	5	370	1401	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	--	--	--
Base	0.12	0.12	0.12
Sub-Base	0.00	0.00	0.00
Subgrade	--	0.66	0.18
Pavement Strength	0.12	0.78	0.30

CBR Relationship:

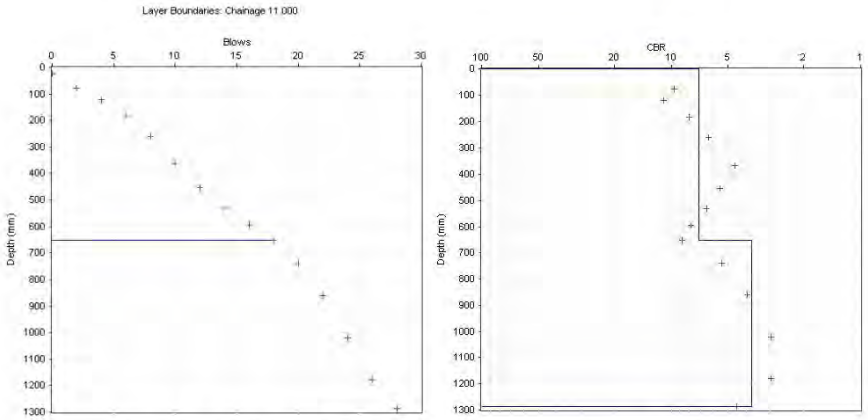
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 11	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	0
Location/Offset:	Carriageway	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	100	Surface Moisture:	Moderate
Test Date:	23/05/2013	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart　　CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	34.78	7	650	650	Base	0.02	0.50	0.50	0.50
2	63.60	4	636	1286	Sub-Base	0.02	0.40	0.40	0.32

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	--	--	--
Base	0.50	0.50	0.50
Sub-Base	0.40	0.40	0.32
Subgrade	--	--	--
Pavement Strength	0.90	0.90	0.82

CBR Relationship:

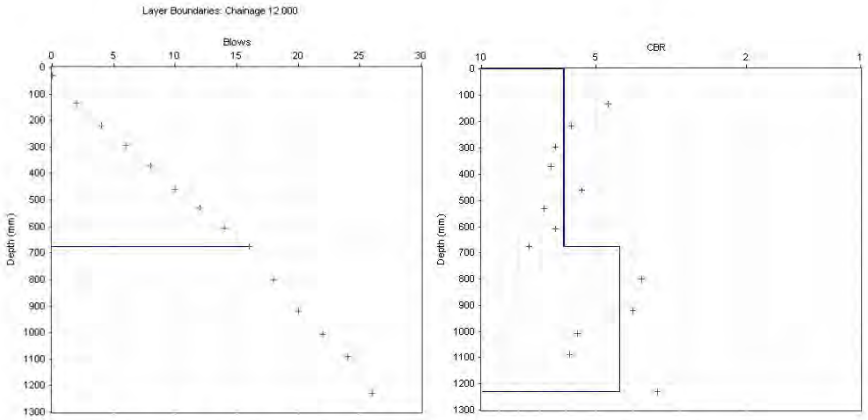
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 12	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	0
Location/Offset:	Carriageway	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	100	Surface Moisture:	Moderate
Test Date:	23/05/2013	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart　　CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	40.25	6	674	674	Base	0.02	0.45	0.45	0.45
2	55.40	4	554	1228	Sub-Base	0.02	0.53	0.53	0.45

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	--	--	--
Base	0.45	0.45	0.45
Sub-Base	0.53	0.53	0.45
Subgrade	--	--	--
Pavement Strength	0.98	0.98	0.90

CBR Relationship:

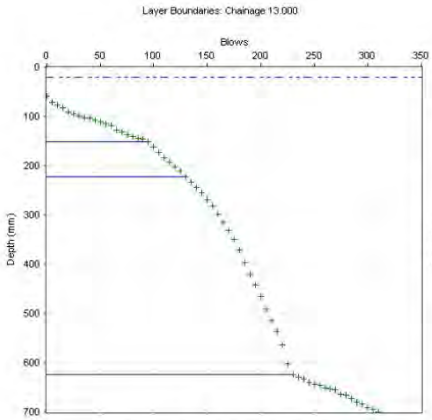
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

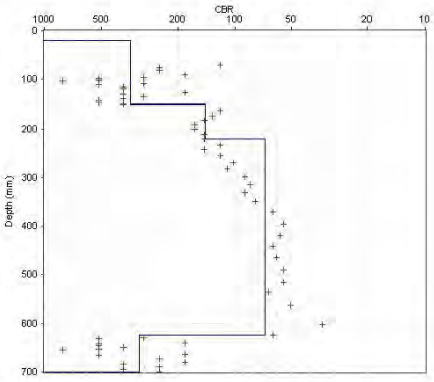
DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 13	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	20
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	23/05/2013	Strength Coeff.:	



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	0.86	352	130	150	Base	0.14	0.74	0.74	0.74
2	2.03	143	71	221	Sub-Base	0.12	0.32	0.32	0.34
3	4.03	69	403	624	Subgrade	--	--	--	--
4	0.95	319	76	700	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.31	0.31	0.31
Base	0.74	0.74	0.74
Sub-Base	0.32	0.32	0.34
Subgrade	--	2.08	2.26
Pavement Strength	1.37	3.45	3.65

CBR Relationship:

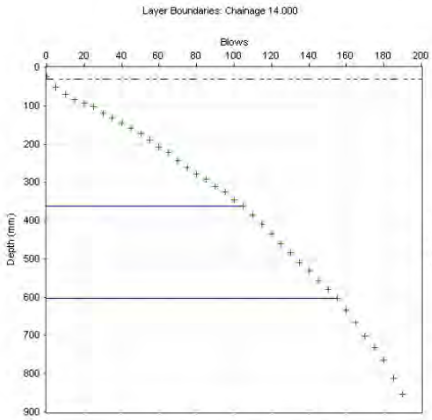
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

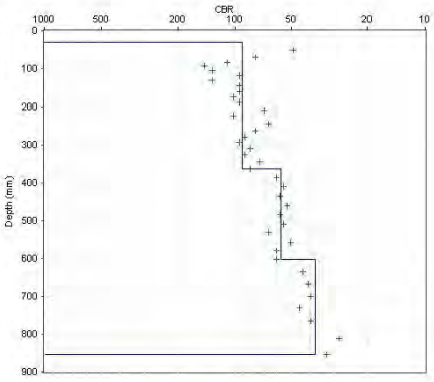
DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 14	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	30
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	24/05/2013	Strength Coeff.:	



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	3.10	91	332	362	Base	0.14	1.77	1.77	1.77
2	4.82	57	241	603	Sub-Base	0.11	1.06	1.06	1.09
3	7.14	38	250	853	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.47	0.47	0.47
Base	1.77	1.77	1.77
Sub-Base	1.06	1.06	1.09
Subgrade	--	1.99	1.83
Pavement Strength	3.30	5.29	5.16

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

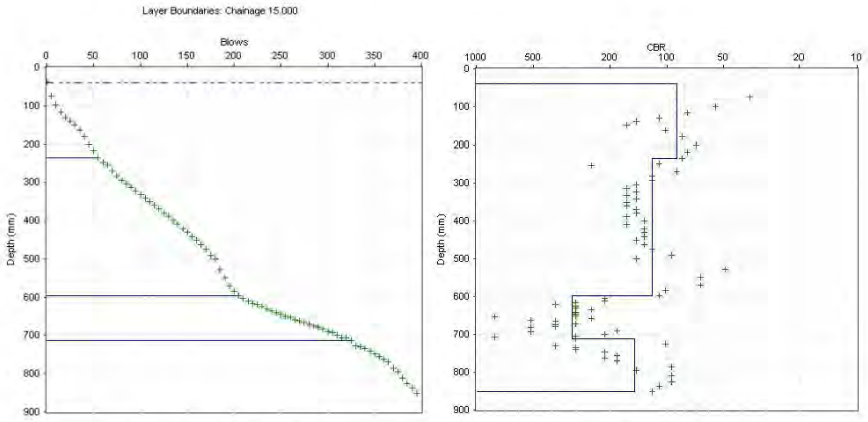
Report produced by .....

UK DCP V3.1

DCP 層強度解析レポート

Project Name: DCP_ACCESS ROAD

Point no:	DCP- 15	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	40
Location/Offset:	Carriageway	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	24/05/2013	Strength Coeff.:	



Layer Boundaries Chart　　CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)	Position	Strength Coefficient	SN	SNC	SNP
1	3.20	88	195	235	Base	0.13	1.03	1.03	1.03
2	2.41	119	362	597	Sub-Base	0.12	1.65	1.65	1.59
3	0.96	316	115	712	Subgrade	--	--	--	--
4	1.97	147	138	850	Subgrade	--	--	--	--

Pavement Strength

	Layer Contribution		
Layer	SN	SNC	SNP
Surface	0.63	0.63	0.63
Base	1.03	1.03	1.03
Sub-Base	1.65	1.65	1.59
Subgrade	--	2.08	1.54
Pavement Strength	3.31	5.39	4.79

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

Report Date: 19-Jun-2013　　Page 15 of 15

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貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-01
Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 22/05/2013

Thickness (mm): 30
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff:

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	200	0.00	26	5	125	471	1.40
2	5	5	225	5.00	27	5	130	481	2.00
3	5	10	233	1.60	28	5	135	489	1.40
4	5	15	245	2.40	29	5	140	500	2.40
5	5	20	260	3.00	30	5	145	504	0.80
6	5	25	274	2.80	31	5	150	510	1.20
7	5	30	286	2.40	32	5	155	519	1.80
8	5	35	298	2.40	33	5	160	529	2.00
9	5	40	308	2.00	34	5	165	545	3.20
10	5	45	320	2.40	35	5	170	553	1.60
11	5	50	330	2.00	36	5	175	567	2.80
12	5	55	342	2.40	37	5	180	578	2.20
13	5	60	354	2.40	38	5	185	586	1.60
14	5	65	365	2.20	39	5	190	600	2.80
15	5	70	373	1.60	40	5	195	617	3.40
16	5	75	378	1.00	41	5	200	628	2.20
17	5	80	395	3.40	42	5	205	644	3.20
18	5	85	400	1.00	43	5	210	660	3.20
19	5	90	407	1.40	44	5	215	677	3.40
20	5	95	417	2.00	45	5	220	700	4.60
21	5	100	426	1.80	46	5	225	715	3.00
22	5	105	435	1.80	47	5	230	739	4.80
23	5	110	444	1.80	48	5	235	761	4.40
24	5	115	455	2.20	49	5	240	786	5.00
25	5	120	464	1.80	50	5	245	1000	42.80

UK DCP V3.1

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-02
Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 22/05/2013

Thickness (mm): 30
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff:

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	173	0.00	26	5	125	752	1.80
2	5	5	186	2.60	27	5	130	760	1.60
3	5	10	209	4.60	28	5	135	770	2.00
4	5	15	231	4.40	29	5	140	776	1.20
5	5	20	251	4.00	30	5	145	783	1.40
6	5	25	263	2.40	31	5	150	794	2.20
7	5	30	277	2.80	32	5	155	800	1.20
8	5	35	288	2.20	33	5	160	810	2.00
9	5	40	318	6.00	34	5	165	820	2.00
10	5	45	333	3.00	35	5	170	828	1.60
11	5	50	350	3.40	36	5	175	840	2.40
12	5	55	372	4.40	37	5	180	854	2.80
13	5	60	400	5.60	38	5	185	873	3.80
14	5	65	431	6.20	39	5	190	898	5.00
15	5	70	464	6.60	40	5	195	939	8.20
16	5	75	500	7.20	41	5	200	974	7.00
17	5	80	548	9.60					
18	5	85	596	9.60					
19	5	90	655	11.80					
20	5	95	680	5.00					
21	5	100	698	3.60					
22	5	105	712	2.80					
23	5	110	724	2.40					
24	5	115	733	1.80					
25	5	120	743	2.00					

UK DCP V3.1

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-03
Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 22/05/2013

Thickness (mm): 20
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff.

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	170	0.00	26	5	125	376	2.80
2	5	5	174	0.80	27	5	130	387	2.20
3	5	10	179	1.00	28	5	135	399	2.40
4	5	15	186	1.40	29	5	140	408	1.80
5	5	20	194	1.60	30	5	145	419	2.20
6	5	25	207	2.60	31	5	150	430	2.20
7	5	30	211	0.80	32	5	155	440	2.00
8	5	35	224	2.60	33	5	160	450	2.00
9	5	40	235	2.20	34	5	165	455	1.00
10	5	45	240	1.00	35	5	170	464	1.80
11	5	50	248	1.60	36	5	175	473	1.80
12	5	55	258	2.00	37	5	180	484	2.20
13	5	60	264	1.20	38	5	185	493	1.80
14	5	65	272	1.60	39	5	190	502	1.80
15	5	70	280	1.60	40	5	195	510	1.60
16	5	75	283	0.60	41	5	200	520	2.00
17	5	80	288	1.00	42	5	205	531	2.20
18	5	85	294	1.20	43	5	210	540	1.80
19	5	90	300	1.20	44	5	215	549	1.80
20	5	95	305	1.00	45	5	220	563	2.80
21	5	100	315	2.00	46	5	225	580	3.40
22	5	105	325	2.00	47	5	230	600	4.00
23	5	110	337	2.40	48	5	235	620	4.00
24	5	115	351	2.80	49	5	240	638	3.60
25	5	120	362	2.20	50	5	245	657	3.80
51	5	250	675	3.60					
52	5	255	700	5.00					
53	5	260	720	4.00					
54	5	265	748	5.60					
55	5	270	787	7.80					
56	5	275	833	9.20					
57	5	280	873	8.00					
58	5	285	910	7.40					
59	5	290	937	5.40					
60	5	295	995	11.60					

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-04
Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 26/05/2013

Thickness (mm): 30
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff:

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	188	0.00	26	5	125	397	2.20
2	5	5	200	2.40	27	5	130	408	2.20
3	5	10	206	1.20	28	5	135	423	3.00
4	5	15	213	1.40	29	5	140	434	2.20
5	5	20	219	1.20	30	5	145	449	3.00
6	5	25	226	1.40	31	5	150	459	2.00
7	5	30	232	1.20	32	5	155	472	2.60
8	5	35	241	1.80	33	5	160	485	2.60
9	5	40	250	1.80	34	5	165	502	3.40
10	5	45	257	1.40	35	5	170	530	5.60
11	5	50	264	1.40	36	5	175	599	13.80
12	5	55	275	2.20	37	5	180	691	18.40
13	5	60	282	1.40	38	5	185	757	13.20
14	5	65	290	1.60	39	5	190	806	9.80
15	5	70	297	1.40	40	5	195	856	10.00
16	5	75	305	1.60	41	5	200	902	9.20
17	5	80	311	1.20	42	5	205	954	10.40
18	5	85	320	1.80					
19	5	90	327	1.40					
20	5	95	335	1.60					
21	5	100	350	3.00					
22	5	105	358	1.60					
23	5	110	365	1.40					
24	5	115	376	2.20					
25	5	120	386	2.00					

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貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-05
Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 26/05/2013

Thickness (mm): 30
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff:

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	188	0.00	26	5	125	594	4.20
2	5	5	218	6.00	27	5	130	625	6.20
3	5	10	238	4.00	28	5	135	667	8.40
4	5	15	261	4.60	29	5	140	719	10.40
5	5	20	280	3.80	30	5	145	780	12.20
6	5	25	294	2.80	31	5	150	804	4.80
7	5	30	307	2.60	32	5	155	830	5.20
8	5	35	325	3.60	33	5	160	850	4.00
9	5	40	341	3.20	34	5	165	869	3.80
10	5	45	360	3.80	35	5	170	883	2.80
11	5	50	376	3.20	36	5	175	890	1.40
12	5	55	391	3.00	37	5	180	914	4.80
13	5	60	407	3.20	38	5	185	927	2.60
14	5	65	421	2.80	39	5	190	936	1.80
15	5	70	435	2.80					
16	5	75	447	2.40					
17	5	80	461	2.80					
18	5	85	474	2.60					
19	5	90	487	2.60					
20	5	95	500	2.60					
21	5	100	511	2.20					
22	5	105	522	2.20					
23	5	110	540	3.60					
24	5	115	554	2.80					
25	5	120	573	3.80					

UK DCP V3.1

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-06
Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 26/05/2013

Thickness (mm): 30
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff:

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	192	0.00	26	5	125	523	3.20
2	5	5	210	3.60	27	5	130	540	3.40
3	5	10	221	2.20	28	5	135	560	4.00
4	5	15	230	1.80	29	5	140	584	4.80
5	5	20	237	1.40	30	5	145	604	4.00
6	5	25	244	1.40	31	5	150	622	3.60
7	5	30	250	1.20	32	5	155	637	3.00
8	5	35	259	1.80	33	5	160	652	3.00
9	5	40	270	2.20	34	5	165	670	3.60
10	5	45	279	1.80	35	5	170	687	3.40
11	5	50	288	1.80	36	5	175	705	3.60
12	5	55	300	2.40	37	5	180	728	4.60
13	5	60	314	2.80	38	5	185	748	4.00
14	5	65	331	3.40	39	5	190	770	4.40
15	5	70	347	3.20	40	5	195	795	5.00
16	5	75	366	3.80	41	5	200	820	5.00
17	5	80	384	3.60	42	5	205	845	5.00
18	5	85	403	3.80	43	5	210	878	6.60
19	5	90	421	3.60	44	5	215	913	7.00
20	5	95	435	2.80	45	5	220	950	7.40
21	5	100	450	3.00					
22	5	105	464	2.80					
23	5	110	480	3.20					
24	5	115	492	2.40					
25	5	120	507	3.00					

UK DCP V3.1

貫入データレポート

Project Name: DCP_ACCESS ROAD

Chainage (km):	7.000	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	25
Location/Offset:	Carriageway	Strength Coeff:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	100	Thickness (mm):	
Test Date:	20/05/2013	Strength Coeff:	

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	100	0.00	26	5	125	607	4.60
2	5	5	197	19.40	27	5	130	628	4.20
3	5	10	207	2.00	28	5	135	660	6.40
4	5	15	224	3.40	29	5	140	739	15.80
5	5	20	237	2.60	30	5	145	770	6.20
6	5	25	254	3.40	31	5	150	840	14.00
7	5	30	262	1.60	32	5	155	884	8.80
8	5	35	266	0.80	33	5	160	933	9.80
9	5	40	278	2.40					
10	5	45	287	1.80					
11	5	50	295	1.60					
12	5	55	300	1.00					
13	5	60	308	1.60					
14	5	65	321	2.60					
15	5	70	339	3.40					
16	5	75	364	5.20					
17	5	80	389	5.00					
18	5	85	445	11.20					
19	5	90	454	1.80					
20	5	95	478	4.80					
21	5	100	498	4.00					
22	5	105	525	5.40					
23	5	110	544	3.80					
24	5	115	565	4.20					
25	5	120	584	3.80					

UK DCP V3.1

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-08
Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 20/05/2013

Thickness (mm): 20
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff.

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	110	0.00	26	5	125	1074	15.40
2	5	5	160	10.00	27	5	130	1247	34.60
3	5	10	188	5.60	28	5	135	1316	13.80
4	5	15	204	3.20	29	5	140	1387	14.20
5	5	20	220	3.20	30	5	145	1482	15.00
6	5	25	230	2.00					
7	5	30	242	2.40					
8	5	35	253	2.20					
9	5	40	267	2.80					
10	5	45	285	3.60					
11	5	50	302	3.40					
12	5	55	322	4.00					
13	5	60	347	5.00					
14	5	65	378	6.20					
15	5	70	415	7.40					
16	5	75	457	8.40					
17	5	80	507	10.00					
18	5	85	562	11.00					
19	5	90	622	12.00					
20	5	95	685	12.60					
21	5	100	769	16.80					
22	5	105	843	14.80					
23	5	110	915	14.40					
24	5	115	960	9.00					
25	5	120	997	7.40					

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-09

Direction:		Thickness (mm):	0
Location/Offset:	Carriageway	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	100	Surface Moisture:	Dry
Test Date:	20/05/2013	Moisture adjustment factor:	Not adjusted

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	135	0.00					
2	2	2	230	47.50					
3	2	4	309	39.50					
4	2	6	384	37.50					
5	2	8	445	30.50					
6	2	10	479	17.00					
7	2	12	504	12.50					
8	2	14	525	10.50					
9	2	16	546	10.50					
10	2	18	558	6.00					
11	2	20	572	7.00					
12	2	22	584	6.00					
13	2	24	604	10.00					
14	2	26	626	11.00					
15	2	28	652	13.00					
16	2	30	684	16.00					
17	2	32	740	28.00					
18	2	34	824	42.00					

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-10

Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 87
Test Date: 20/05/2013

Thickness (mm): 0
Base Type:
Thickness (mm):
Surface Moisture: Moderate
Moisture adjustment factor: Not adjusted

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	190	0.00					
2	2	2	278	44.00					
3	2	4	487	104.50					
4	2	6	895	204.00					
5	2	8	1118	111.50					
6	2	10	1200	41.00					
7	2	12	1319	59.50					
8	2	14	1407	44.00					
9	2	16	1488	40.50					

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-11

Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 23/05/2013

Thickness (mm): 0
Base Type:
Thickness (mm):
Surface Moisture: Moderate
Moisture adjustment factor: Not adjusted

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	124	0.00					
2	2	2	176	26.00					
3	2	4	222	23.00					
4	2	6	284	31.00					
5	2	8	361	38.50					
6	2	10	466	52.50					
7	2	12	554	44.00					
8	2	14	630	38.00					
9	2	16	693	31.50					
10	2	18	750	28.50					
11	2	20	840	45.00					
12	2	22	961	60.50					
13	2	24	1120	79.50					
14	2	26	1279	79.50					
15	2	28	1386	53.50					

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-12

Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 23/05/2013

Thickness (mm): 0
Base Type:
Thickness (mm):
Surface Moisture: Moderate
Moisture adjustment factor: Not adjusted

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	130	0.00					
2	2	2	234	52.00					
3	2	4	318	42.00					
4	2	6	395	38.50					
5	2	8	470	37.50					
6	2	10	559	44.50					
7	2	12	631	36.00					
8	2	14	708	38.50					
9	2	16	774	33.00					
10	2	18	900	63.00					
11	2	20	1020	60.00					
12	2	22	1107	43.50					
13	2	24	1190	41.50					
14	2	26	1328	69.00					

UK DCP V3.1

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-13

Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 23/05/2013

Thickness (mm): 20
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff:

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	158	0.00	26	5	125	311	2.00
2	5	5	170	2.40	27	5	130	321	2.00
3	5	10	176	1.20	28	5	135	333	2.40
4	5	15	182	1.20	29	5	140	343	2.00
5	5	20	190	1.60	30	5	145	355	2.40
6	5	25	195	1.00	31	5	150	369	2.80
7	5	30	198	0.60	32	5	155	382	2.60
8	5	35	201	0.60	33	5	160	398	3.20
9	5	40	203	0.40	34	5	165	415	3.40
10	5	45	208	1.00	35	5	170	431	3.20
11	5	50	211	0.60	36	5	175	449	3.60
12	5	55	215	0.80	37	5	180	471	4.40
13	5	60	219	0.80	38	5	185	496	5.00
14	5	65	227	1.60	39	5	190	520	4.80
15	5	70	231	0.80	40	5	195	542	4.40
16	5	75	236	1.00	41	5	200	586	4.60
17	5	80	240	0.80	42	5	205	590	5.00
18	5	85	243	0.60	43	5	210	615	5.00
19	5	90	246	0.60	44	5	215	636	4.20
20	5	95	250	0.80	45	5	220	663	5.40
21	5	100	262	2.40	46	5	225	702	7.80
22	5	105	273	2.20	47	5	230	724	4.40
23	5	110	283	2.00	48	5	235	729	1.00
24	5	115	292	1.80	49	5	240	732	0.60
25	5	120	301	1.80	50	5	245	740	1.60
51	5	250	743	0.60					
52	5	255	746	0.60					
53	5	260	750	0.80					
54	5	265	753	0.60					
55	5	270	755	0.40					
56	5	275	763	1.60					
57	5	280	766	0.60					
58	5	285	772	1.20					
59	5	290	780	1.60					
60	5	295	784	0.80					
61	5	300	790	1.20					
62	5	305	794	0.80					
63	5	310	800	1.20					

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-14

Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 24/05/2013

Thickness (mm): 30
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff:

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	124	0.00	26	5	125	560	5.20
2	5	5	152	5.60	27	5	130	584	4.80
3	5	10	170	3.60	28	5	135	609	5.00
4	5	15	183	2.60	29	5	140	630	4.20
5	5	20	193	2.00	30	5	145	657	5.40
6	5	25	204	2.20	31	5	150	680	4.60
7	5	30	219	3.00	32	5	155	703	4.60
8	5	35	230	2.20	33	5	160	734	6.20
9	5	40	245	3.00	34	5	165	767	6.60
10	5	45	260	3.00	35	5	170	801	6.80
11	5	50	274	2.80	36	5	175	831	6.00
12	5	55	289	3.00	37	5	180	885	6.80
13	5	60	309	4.00	38	5	185	912	9.40
14	5	65	323	2.80	39	5	190	953	8.20
15	5	70	344	4.20					
16	5	75	362	3.60					
17	5	80	378	3.20					
18	5	85	393	3.00					
19	5	90	410	3.40					
20	5	95	426	3.20					
21	5	100	445	3.80					
22	5	105	462	3.40					
23	5	110	485	4.60					
24	5	115	510	5.00					
25	5	120	534	4.80					

UK DCP V3.1

貫入データレポート

Project Name: DCP_ACCESS ROAD

POINT: DCP-15

Direction:
Location/Offset: Carriageway
Cone Angle: 60 degrees
Zero Error (mm): 100
Test Date: 24/05/2013

Thickness (mm): 40
Strength Coeff: 0.40
Base Type:
Thickness (mm):
Strength Coeff:

No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)	No.	Blows	Cumulative Blows	Penetration Depth (mm)	Penetration Rate (mm/blow)
1	0	0	137	0.00	26	5	125	480	2.00
2	5	5	174	7.40	27	5	130	489	1.80
3	5	10	199	5.00	28	5	135	500	2.20
4	5	15	217	3.60	29	5	140	509	1.80
5	5	20	230	2.60	30	5	145	520	2.20
6	5	25	240	2.00	31	5	150	531	2.20
7	5	30	249	1.80	32	5	155	542	2.20
8	5	35	263	2.80	33	5	160	552	2.00
9	5	40	280	3.40	34	5	165	563	2.20
10	5	45	300	4.00	35	5	170	575	2.40
11	5	50	318	3.60	36	5	175	590	3.00
12	5	55	335	3.40	37	5	180	600	2.00
13	5	60	348	2.60	38	5	185	628	5.60
14	5	65	354	1.20	39	5	190	649	4.20
15	5	70	370	3.20	40	5	195	670	4.20
16	5	75	382	2.40	41	5	200	684	2.80
17	5	80	394	2.40	42	5	205	697	2.60
18	5	85	404	2.00	43	5	210	704	1.40
19	5	90	413	1.80	44	5	215	711	1.40
20	5	95	423	2.00	45	5	220	716	1.00
21	5	100	432	1.80	46	5	225	720	0.80
22	5	105	442	2.00	47	5	230	725	1.00
23	5	110	451	1.80	48	5	235	730	1.00
24	5	115	460	1.80	49	5	240	736	1.20
25	5	120	470	2.00	50	5	245	741	1.00
51	5	250	746	1.00	76	5	375	895	2.00
52	5	255	751	1.00	77	5	380	910	3.00
53	5	260	753	0.40	78	5	385	925	3.00
54	5	265	759	1.20	79	5	390	938	2.60
55	5	270	762	0.60	80	5	395	950	2.40
56	5	275	766	0.80					
57	5	280	771	1.00					
58	5	285	775	0.80					
59	5	290	779	0.80					
60	5	295	782	0.60					
61	5	300	790	1.60					
62	5	305	793	0.60					
63	5	310	800	1.40					
64	5	315	805	1.00					
65	5	320	807	0.40					
66	5	325	812	1.00					
67	5	330	826	2.80					
68	5	335	830	0.80					
69	5	340	835	1.00					
70	5	345	840	1.00					
71	5	350	847	1.40					
72	5	355	855	1.60					
73	5	360	862	1.40					
74	5	365	870	1.60					
75	5	370	885	3.00					

試験まとめレポート

UK DCP V3.1

Project Name: DCP_ACCESS ROAD

Test Details					Upper Layers			Test Layers			Pavement Strength	
No.	Test Date	DCP TEST NO	Location	Offset (m)	Surface Type	Surface Moisture	Base Type	Base Thickness (mm)	Sub-base Thickness (mm)	Subgrade CBR (%)	SN	SNP
1	5/22/2013	1.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	235	263	6	2.98	3.66
2	5/22/2013	2.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	242	306	45	2.94	4.62
3	5/22/2013	3.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	185	244	34	2.47	4.29
4	5/26/2013	4.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	372	28	22	2.70	4.54
5	5/26/2013	5.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	277	166	32	2.65	4.67
6	5/26/2013	6.050	Carriageway	--	Hot Mixed Asphalt	n/a	--	170	223	45	2.44	4.42
7	5/26/2013	7.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	213	290	24	2.60	4.33
8	5/26/2013	8.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	202	135	14	1.89	3.48
9	5/26/2013	9.000	Carriageway	--	Unpaved	0.51 (Dry)	--	345	207	9	1.02	2.14
10	5/26/2013	10.000	Carriageway	--	Unpaved	0.71 (Moderate)	--	191	840	5	0.12	0.30
11	5/23/2013	11.000	Carriageway	--	Unpaved	0.71 (Moderate)	--	650	836	--	0.90	0.82
12	5/23/2013	12.000	Carriageway	--	Unpaved	0.71 (Moderate)	--	674	554	--	0.98	0.90
13	5/23/2013	13.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	130	71	50	1.37	3.86
14	5/24/2013	14.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	332	241	38	3.30	5.16
15	5/24/2013	15.000	Carriageway	--	Hot Mixed Asphalt	n/a	--	195	362	50	3.31	4.79

Report Date: 1th-Jun-2013

5.0 実験室試験（物理的性質）結果

SURVEY 2000

比重計による粒度解析

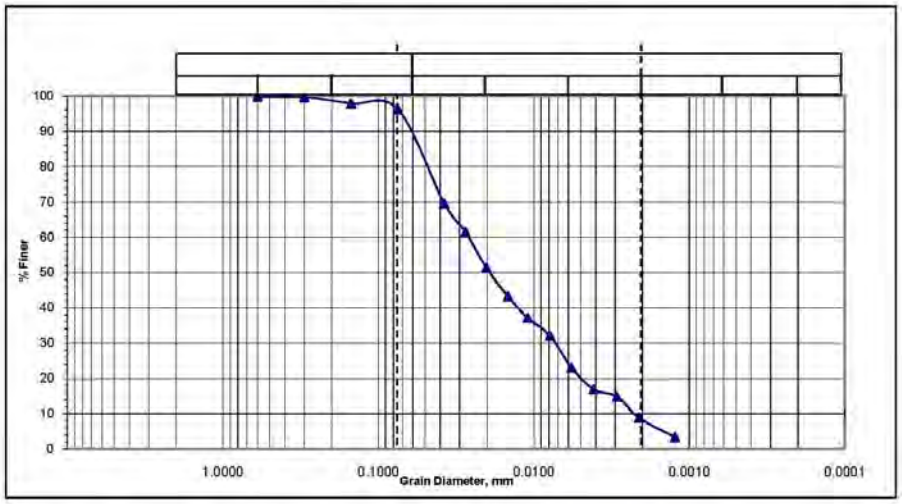
Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 01 Sample No. : D1 Sampled Date : 21/05/2013

Depth (m) : 1.5 Test Date : 10/6/2013

Graphical Representation:



Mean Diameter, D_{50} = 0.02 mm

Silt-Factor, f = 1.76xsqrt(D_{50}) = 0.25

% Particles (from the grain -size analysis graph).

Sand (0.075mm size) =4%, Silt (0.005mm size) & Clay (0.001mm size) =88% & 8%

Tested by : Azharul,

SURVEY 2000

比重計による粒度解析

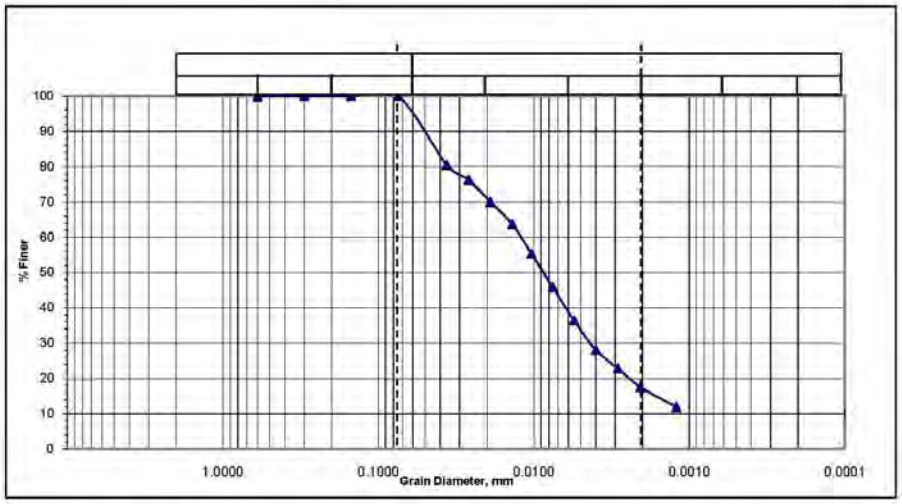
Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 02 Sample No. : D1 Sampled Date : 23/05/2013

Depth (m) : 1.0 Test Date : 10/6/2013

Graphical Representation:



Mean Diameter, D_{50} = 0.009 mm

Silt-Factor, f = 1.76xsqrt(D_{50}) = 0.17

% Particles (from the grain -size analysis graph).

Sand (0.075mm size) =0%, Silt (0.005mm size) & Clay (0.001mm size) =82% & 18%

Tested by : Azharul,

SURVEY 2000

比重計による粒度解析

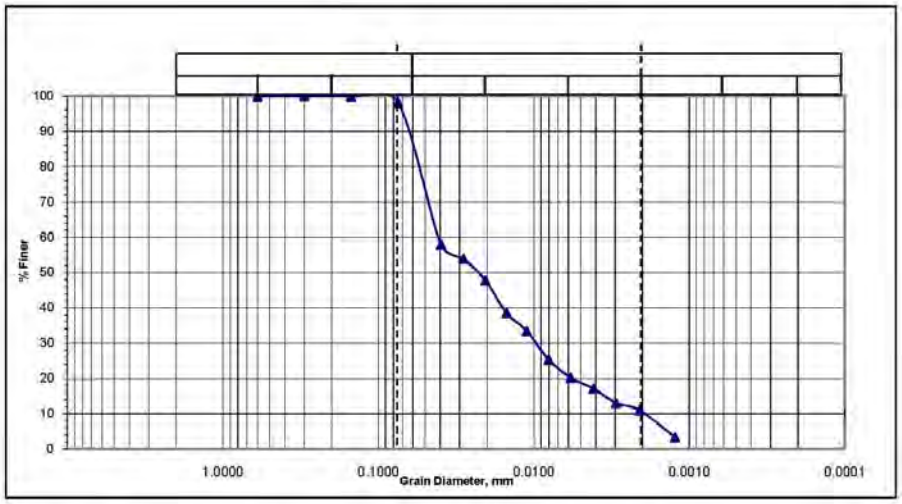
Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 03 Sample No. : D1 Sampled Date : 25/05/2013

Depth (m) : 1.2 Test Date : 10/6/2013

Graphical Representation:



Mean Diameter, D_{50} = 0.022 mm

Silt-Factor, f = 1.76xsqrt(D_{50}) = 0.26

% Particles (from the grain -size analysis graph).

Sand (0.075mm size) =2%, Silt (0.005mm size) & Clay (0.001mm size) =88% & 10%

Tested by : Azharul,

SURVEY 2000

湿度－密度（圧縮）試験

（ASTM D 698）

Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 01

Sample Type : Grey Clayey SILT　　Sample No : D1

Sample Date : 21/05/2013　　Depth(m) : 1.50

Test Date : 13/06/2013　　Test Type : Modified proctor (AASHTO T-180)

TEST DATA

Water Content Determination :

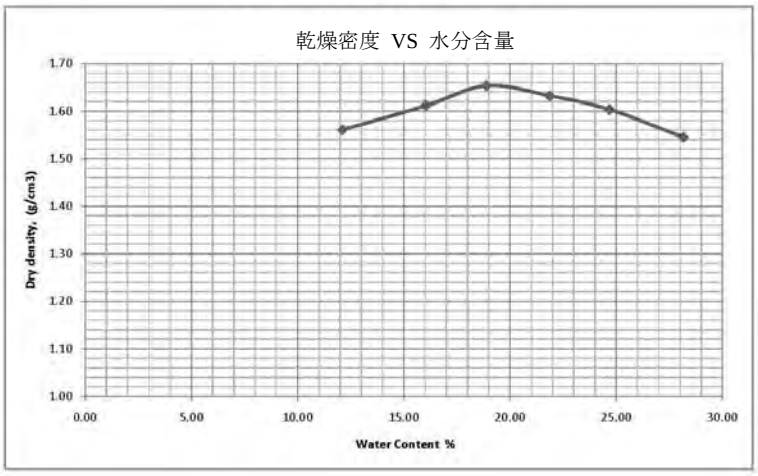
Moisture Can No.	C5	C10	15	14	30	29
Wt. of Can + Wet Specimen (A) gm	80.0	107.54	100.0	130.50	112.50	106.52
Wt. of Can + Dry Specimen (B) gm	75.0	98.2	87.68	110.34	95.14	90.17
Wt. of Water (A - B) gm	5.00	9.34	12.32	20.16	17.36	16.35
Wt. of Can (C) gm	33.70	39.95	22.41	18.15	24.82	25.01
Wt. of Dry Specimen (B - C) gm	41.30	58.25	65.27	92.19	70.32	65.16
Moisture Content W = (A - B / B - C) x 100 %	12.11	16.03	18.88	21.87	24.69	25.16

Density Determination :

Mold Volume =2085cm^3

Sample No.	1	2	3	4	5	6
Actual Water Content %	12.11	16.03	18.88	21.87	24.69	25.16
Mold + Wet Soil (A) gm	6400	6850	6850	6900	6920	6880
Mold Weight (B) gm	2752	2752	2752	2752	2752	2752
Weight of Wet soil (A-B) gm	3648	3898	4098	4148	4168	4128
Wet density, pw, (g/cm^3)	1.75	1.87	1.97	1.99	2.00	1.98
Dry density, pd, (g/cm^3)	1.56	1.61	1.65	1.63	1.60	1.54

Tested by : Azharul.



Optimum Moisture Content = 19.0%
Maximum Dry Density = 1.65 gm/cm^3

Tested by : Azhar

Checked by : Mahabub

SURVEY 2000

湿度－密度（圧縮）試験

（ASTM D 698）

Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 02

Sample Type : Grey Clayey SILT　　Sample No : D1

Sample Date : 23/05/2013　　Depth(m) : 1.00

Test Date : 14/06/2013　　Test Type : Modified proctor (AASHTO T-180)

TEST DATA

Water Content Determination :

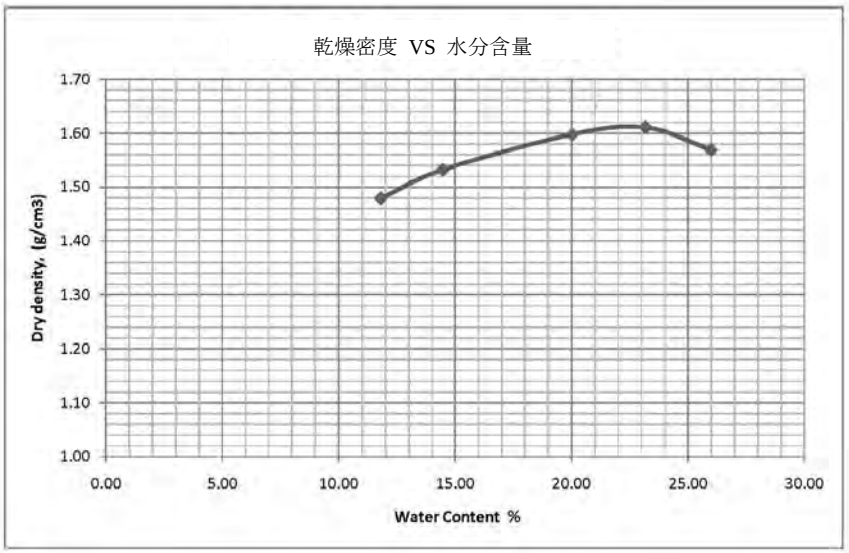
Moisture Can No.	30	14	0	C8	C2
Wt. of Can + Wet Specimen (A) gm	100.83	81.05	91.49	100.12	92.35
Wt. of Can + Dry Specimen (B) gm	92.8	73.10	80.04	88.45	80.18
Wt. of Water (A - B) gm	8.03	7.95	11.45	11.67	12.17
Wt. of Can (C) gm	24.82	18.15	22.81	38.06	33.34
Wt. of Dry Specimen (B - C) gm	67.98	54.95	57.23	50.39	46.84
Moisture Content W = (A - B / B - C) x 100 %	11.81	14.47	20.01	23.16	25.98

Density Determination :

Mold Volume =2085 cm^3

Sample No.	1	2	3	4	5
Actual Water Content %	11.81	14.47	20.01	23.16	25.98
Mold + Wet Soil (A) gm	6200	6408	6750	6888	6874
Mold Weight (B) gm	2752	2752	2752	2752	2752
Weight of Wet soil (A-B) gm	3448	3656	3998	4136	4122
Wet density, ρw, (g/cm^3)	1.65	1.75	1.92	1.98	1.98
Dry density, ρd, (g/cm^3)	1.48	1.53	1.60	1.61	1.57

Tested by : Azharul.



Optimum Moisture Content = 23.0%
Maximum Dry Density = 1.61 gm/cm^3

Tested by : Azhar

Checked by : Mahabub

SURVEY 2000

湿度－密度（圧縮）試験

（ASTM D 698）

Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 03

Sample Type : Brownish Grey Clayey SILT Sample No : D1

Sample Date : 25/05/2013 Depth(m) : 1.20

Test Date : 16/06/2013 Test Type : Modified proctor (AASHTO T-180)

TEST DATA

Water Content Determination :

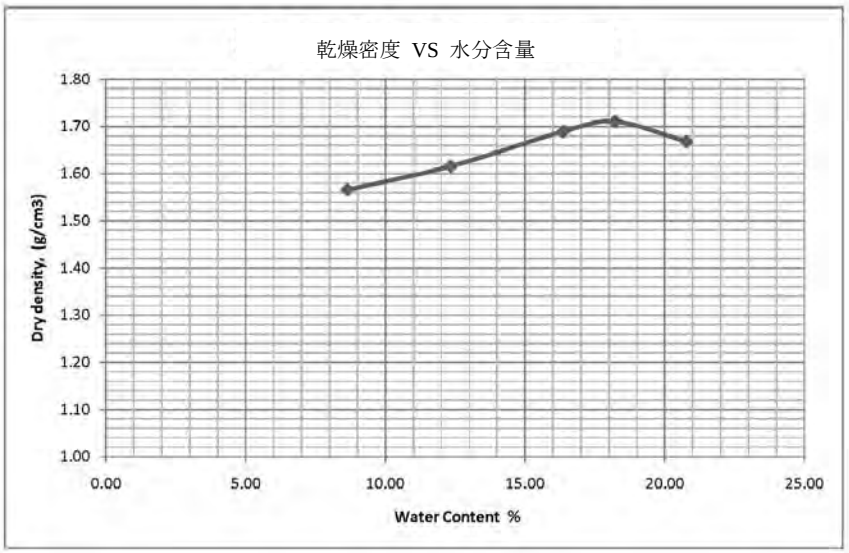
Moisture Can No.	12	29	C-1	C-5	15
Wt. of Can + Wet Specimen (A) gm	77.11	103.38	92.27	109.63	116.05
Wt. of Can + Dry Specimen (B) gm	72.7	94.78	85.02	97.92	99.94
Wt. of Water (A - B) gm	4.41	8.60	7.25	11.71	16.11
Wt. of Can (C) gm	21.64	25.10	40.68	33.70	22.41
Wt. of Dry Specimen (B - C) gm	51.06	69.68	44.34	64.22	77.53
Moisture Content W = (A - B / B - C) x 100 %	8.64	12.34	16.35	18.23	20.78

Density Determination :

Mold Volume =2085 cm^3

Sample No.	1	2	3	4	5
Actual Water Content %	8.64	12.34	16.35	18.23	20.78
Mold + Wet Soil (A) gm	6298	6536	6850	6968	6952
Mold Weight (B) gm	2752	2752	2752	2752	2752
Weight of Wet soil (A-B) gm	3546	3784	4098	4216	4200
Wet density, ρw, (g/cm^3)	1.70	1.81	1.97	2.02	2.01
Dry density, ρd, (g/cm^3)	1.57	1.62	1.69	1.71	1.67

Tested by : Azharul



Optimum Moisture Content = 18.0%
Maximum Dry Density = 1.71 gm/cm^3

Tested by : Azhar

Checked by : Mahabub

SURVEY 2000
Road #21,House#74,Block-B
Banani,Dhaka 1213,Bangladesh.
Tele/fax:8818386,01711323266.
Email: survey @bdonline.com

土壌アッテルベリ制限値の
実験室試験結果
(ASTM 指定：D4818)

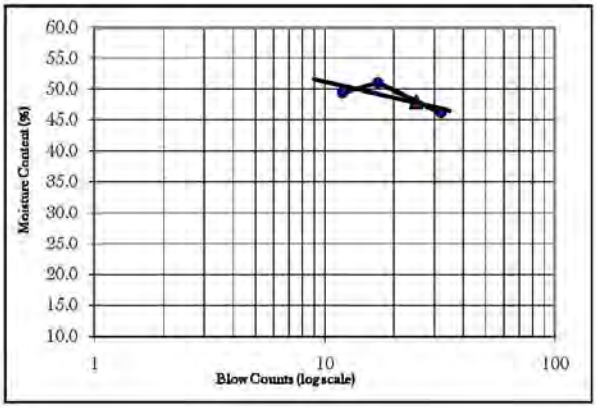
Client : BETS
Project Location : Matarbari, Cox's Bazar
Sample Information: Grey Clayey SILT
Sample Date: 21/05/2013
Test Date: 04/06/2013

Boring Number	Pit 01
Sample Number	D1
Depth of Sample(m)	1.5

Determination of Liquid Limit			
Cup Number	95	92	104
Weight of Cup (g)	12.79	12.92	12.72
Weight of Wet Soil and Cup (g)	32.08	38.93	42.18
Weight of Dry Soil and Cup (g)	25.7	30.14	32.87
Moisure Content (%)	49.4	51.0	46.2
Blow Counts	12	17	32

Determination of Plastic Limit		
Cup Number	96	9
Weight of Cup (g)	12.38	12.84
Weight of Wet Soil and Cup (g)	28.36	34.25
Weight of Dry Soil and Cup (g)	25.36	30.29
Moisure Content (%)	23.1	22.7

Compilation of Test Results



Liquid Limit	48
Plastic Limit	23
Plasticity Index	25

Tested by : Azhrul

SURVEY 2000
Road #21,House#74,Block-B
Banani,Dhaka 1213,Bangladesh.
Tele/fax:8818386,01711323266.
Email: survey @bdonline.com

土壌アッテルベリ制限値の
実験室試験結果
(ASTM 指定：D4818)

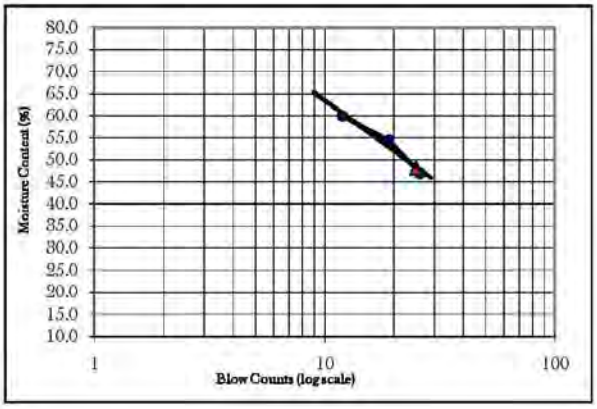
Client : BETS
Project Location : Matarbari, Cox's Bazar
Sample Information: Grey Clayey SILT
Sample Date: 23/05/2013
Test Date: 04/06/2013

Boring Number	Pit 02
Sample Number	D1
Depth of Sample(m)	1

Determination of Liquid Limit			
Cup Number	97	4	53
Weight of Cup (g)	12.87	13.36	13.03
Weight of Wet Soil and Cup (g)	37.22	42.76	40.67
Weight of Dry Soil and Cup (g)	28.1	32.4	31.85
Moisure Content (%)	59.9	54.4	46.9
Blow Counts	12	19	26

Determination of Plastic Limit		
Cup Number	88	7
Weight of Cup (g)	12.47	11.15
Weight of Wet Soil and Cup (g)	30.77	28.51
Weight of Dry Soil and Cup (g)	27.25	24.8
Moisure Content (%)	23.8	27.2

Compilation of Test Results



Liquid Limit	48
Plastic Limit	25
Plasticity Index	23

Tested by : Azhrul

SURVEY 2000
Road #21,House#74,Block-B
Banani,Dhaka 1213,Bangladesh.
Tele/fax:8818386,01711323266.
Email: survey @bdonline.com

土壌アッテルベリ制限値の
実験室試験結果
(ASTM 指定：D4818)

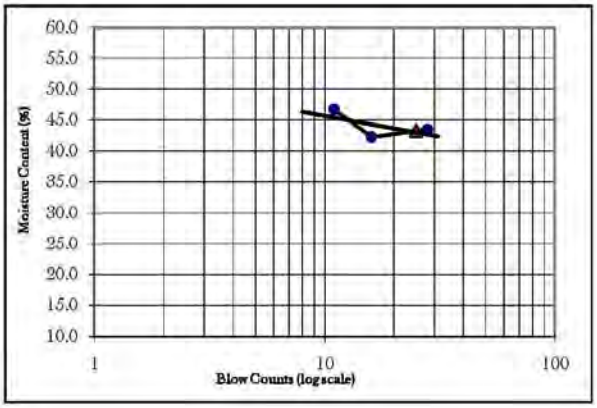
Client : BETS
Project Location : Matarbari, Cox's Bazar
Sample Information: Brownish Grey Clayey SILT
Sample Date: 25/05/2013
Test Date: 04/06/2013

Boring Number	Pit 03
Sample Number	D1
Depth of Sample(m)	1.2

Determination of Liquid Limit			
Cup Number	3	L3	L12
Weight of Cup (g)	15.39	23.36	25.86
Weight of Wet Soil and Cup (g)	42.87	46.94	52.42
Weight of Dry Soil and Cup (g)	34.12	39.94	44.37
Moisure Content (%)	46.7	42.2	43.5
Blow Counts	11	16	28

Determination of Plastic Limit		
Cup Number	100	101
Weight of Cup (g)	12.67	12.75
Weight of Wet Soil and Cup (g)	38.9	38.98
Weight of Dry Soil and Cup (g)	34.111	34.1
Moisure Content (%)	22.3	22.9

Compilation of Test Results



Liquid Limit	43
Plastic Limit	23
Plasticity Index	21

Tested by : Azhrul

SURVEY 2000

ASTM D-854 による土壌比重

Client : BETS

Scheme : Access road unit Proposed Coal fired Power plant | Location : Matarbari, Cox's Bazar

Pit No : 01 | Sample No. : D-1 | Sampled by & Date : 21/05/2013

Laboratory Register No. | Test Date : 30/05/2013

Pycnometer Type :Volumetric Flask/Stoppered Bottle Capacity : 50mL | Air Removal By : Boiling

Description of soil : Grey Clayey SILT | Test Specimen :

Nature of Specimen : Oven-Dry Sample

Soaking Period : Soaked overnight (since oven-dry specimen is used)

TEST DATA :

TEST/TRIAL NO.		1		
PYCNOMETER NO.		P4		
Wt. of Soil (oven dry weight), W_o in gm		10.00		
Observed Temperature, T_x in deg.Centigrade		32		
Wt.of Pycnometer + water, Wa (at T_x) in gm (from Calibration Data of Pycnometer)		80.42		
Wt.of Pycnometer + water+soil, W_b (at T_x) in gm		86.58		
Specific Gravity, G (at T_x) = $W_o/(W_o+W_a-W_b)$		2.60		
Variation of Specific Gravity Values & Average	Ratio : 2.71/2.63 >or = 1.02			
(According to some specification average value	Ratio : 2.73/2.71 < or = 1.02			
shall be calculated only if (Largest value of Gs)/		0.000		
Smalliest value of Gs)< or = 1.02)	Avg. Gs (at T_x)	2.60		
Density of Water at T_x deg.Cent., in gm/cc		0.9951		
Density of Water at 20 deg.Cent., in gm/cc		0.9982		
Specific Gravity, G (at 20 deg.Cent.) = (Density of Water at T_x/Density of Water at 20 deg.cent.) x G (at T_x)		2.60		

Tested by : S. Alam, Laboratory specialist

Comments of the Laboratory Incharge :

Signed by : M. Islam

SURVEY 2000

ASTM D-854 による土壌比重

Client : BETS

Scheme : Access road unit Proposed Coal fired Power plant | Location : Matarbari, Cox's Bazar

Pit No : 02 | Sample No. : D-1 | Sampled by & Date : 23/05/2013

Laboratory Register No. | Test Date : 30/05/2013

Pycnometer Type :Volumetric Flask/Stoppered Bottle Capacity : 50mL | Air Removal By : Boiling

Description of soil : Grey Clayey SILT | Test Specimen :

Nature of Specimen : Oven-Dry Sample

Soaking Period : Soaked overnight (since oven-dry specimen is used)

TEST DATA :

TEST/TRIAL NO.		1		
PYCNOMETER NO.		8		
Wt. of Soil (oven dry weight), W_o in gm		10.00		
Observed Temperature, T_x in deg.Centigrade		32		
Wt.of Pycnometer + water, Wa (at T_x) in gm (from Calibration Data of Pycnometer)		80.84		
Wt.of Pycnometer + water+soil, W_b (at T_x) in gm		86.79		
Specific Gravity, G (at T_x) = $W_o/(W_o+W_a-W_b)$		2.47		
Variation of Specific Gravity Values & Average	Ratio : 2.71/2.63 >or = 1.02			
(According to some specification average value	Ratio : 2.73/2.71 < or = 1.02			
shall be calculated only if (Largest value of Gs)/		0.000		
Smalliest value of Gs)< or = 1.02)	Avg. Gs (at T_x)	2.47		
Density of Water at T_x deg.Cent., in gm/cc		0.9951		
Density of Water at 20 deg.Cent., in gm/cc		0.9982		
Specific Gravity, G (at 20 deg.Cent.) = (Density of Water at T_x/Density of Water at 20 deg.cent.) x G (at T_x)		2.46		

Tested by : S. Alam, Laboratory specialist

Comments of the Laboratory Incharge :

Signed by : M. Islam

SURVEY 2000

ASTM D-854 による土壌比重

Client : BETS

Scheme : Access road unit Proposed Coal fired Power plant | Location : Matarbari, Cox's Bazar

Pit No : 03 | Sample No. : D-1 | Sampled by & Date : 25/05/2013

Laboratory Register No. | Test Date : 30/05/2013

Pycnometer Type :Volumetric Flask/Stoppered Bottle Capacity : 50mL | Air Removal By : Boiling

Description of soil : Brownish Grey Clayey SILT | Test Specimen :

Nature of Specimen : Oven-Dry Sample

Soaking Period : Soaked overnight (since oven-dry specimen is used)

TEST DATA :

TEST/TRIAL NO.		1		
PYCNOMETER NO.		3		
Wt. of Soil (oven dry weight), W_o in gm		10.00		
Observed Temperature, T_x in deg.Centigrade		32		
Wt.of Pycnometer + water, Wa (at T_x) in gm (from Calibration Data of Pycnometer)		79.06		
Wt.of Pycnometer + water+soil, W_b (at T_x) in gm		85.16		
Specific Gravity, G (at T_x) = $W_o/(W_o+W_a-W_b)$		2.56		
Variation of Specific Gravity Values & Average	Ratio : 2.71/2.63 >or = 1.02			
(According to some specification average value shall be calculated only if (Largest value of Gs)/	Ratio : 2.73/2.71 < or = 1.02	0.000		
Smalliest value of Gs)< or = 1.02)	Avg. Gs (at T_x)	2.56		
Density of Water at T_x deg.Cent., in gm/cc		0.9951		
Density of Water at 20 deg.Cent., in gm/cc		0.9982		
Specific Gravity, G (at 20 deg.Cent.) = (Density of Water at T_x/Density of Water at 20 deg.cent.) x G (at T_x)		2.56		

Tested by : S. Alam, Laboratory specialist

Comments of the Laboratory Incharge :

Signed by : M. Islam

Client : BETS

SURVEY 2000

Trial Pit No. : 01

Method of Boring : Manual

Depth of Pit (m) : 1.5m

Existing Ground Level : 0.0m

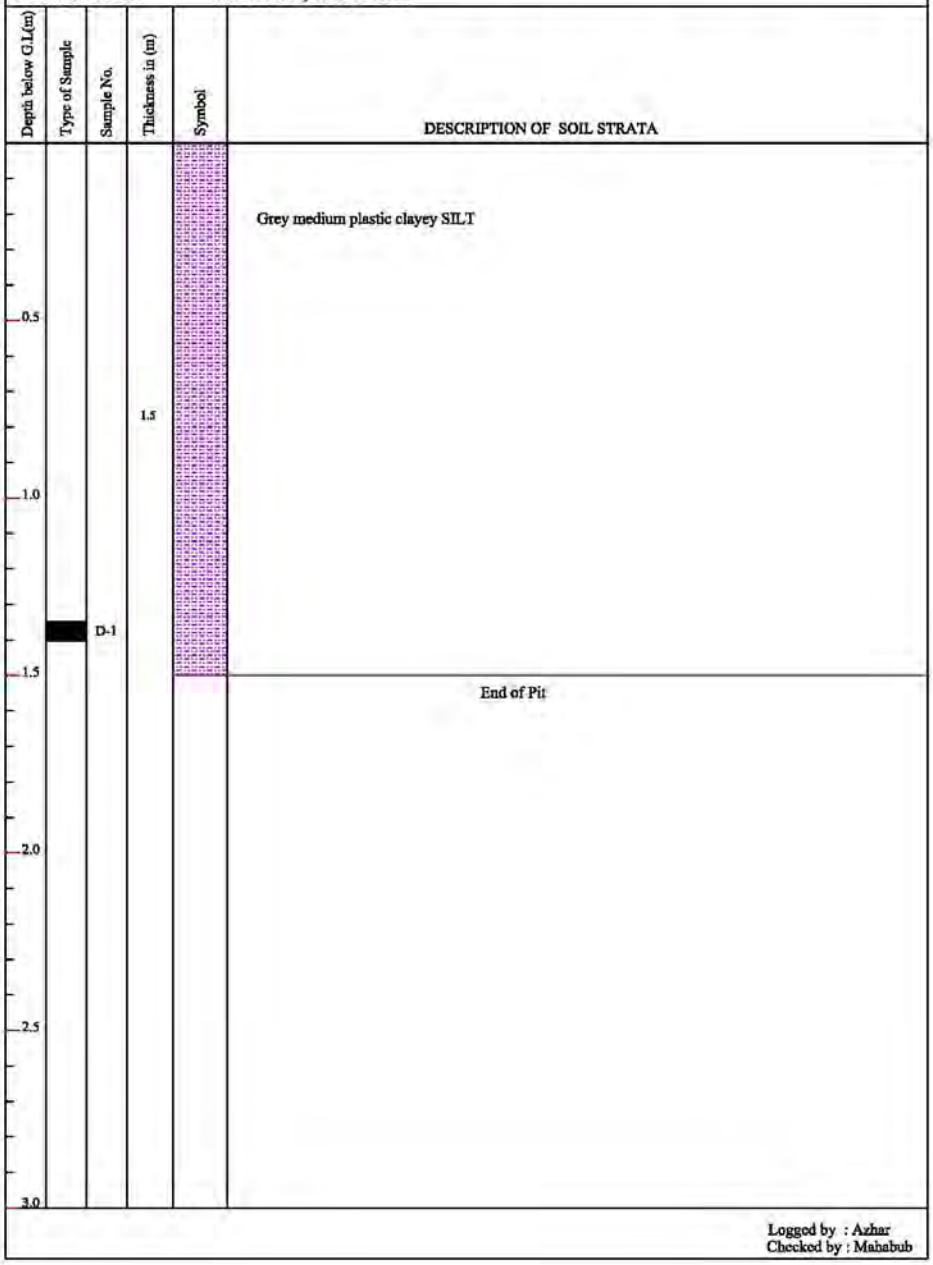
Date Started : 21-05-2013

Date Completed : 21-05-2013

Legend : SAND SILT CLAY

Coordinates :387960, 2400943. Chainage :Ch 4+445km

Location of Pit : Matarbari, Cox's Bazar



Logged by : Azhar

Checked by : Mahabub

Client : BETS

SURVEY 2000

Trial Pit No. : 02

Method of Boring : Manual

Depth of Pit (m) : 1.5m

Existing Ground Level : 0.0m

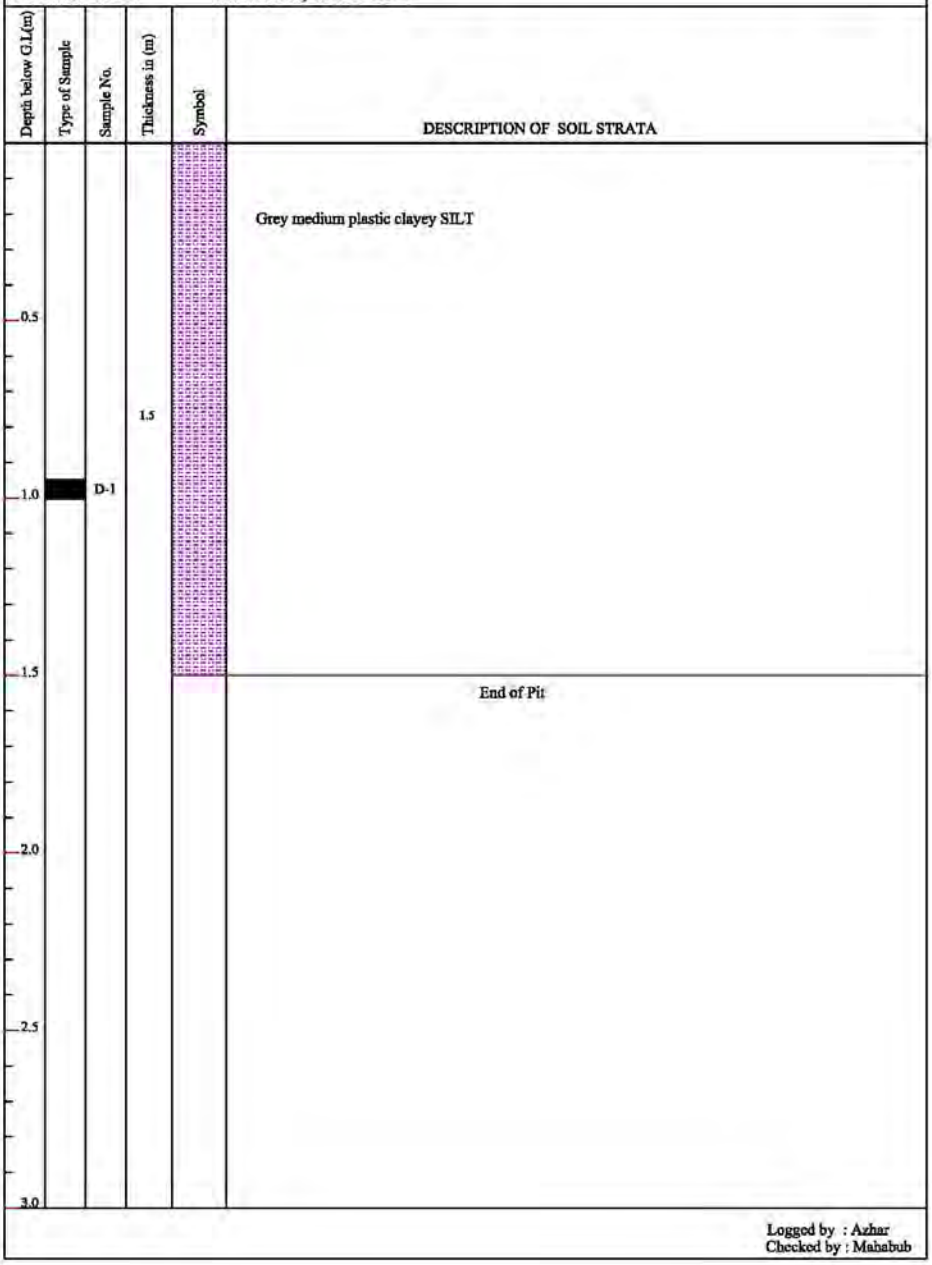
Date Started : 23-05-2013

Date Completed : 23-05-2013

Legend : SAND SILT CLAY

Coordinates :387222, 2401220. Chainage :Ch 5+235km

Location of Pit : Matarbari, Cox's Bazar



Logged by : Azhar
Checked by : Mahabub

Client : BETS

SURVEY 2000

Trial Pit No. : 03

Method of Boring : Manual

Depth of Pit (m) : 1.5m

Existing Ground Level : 0.0m

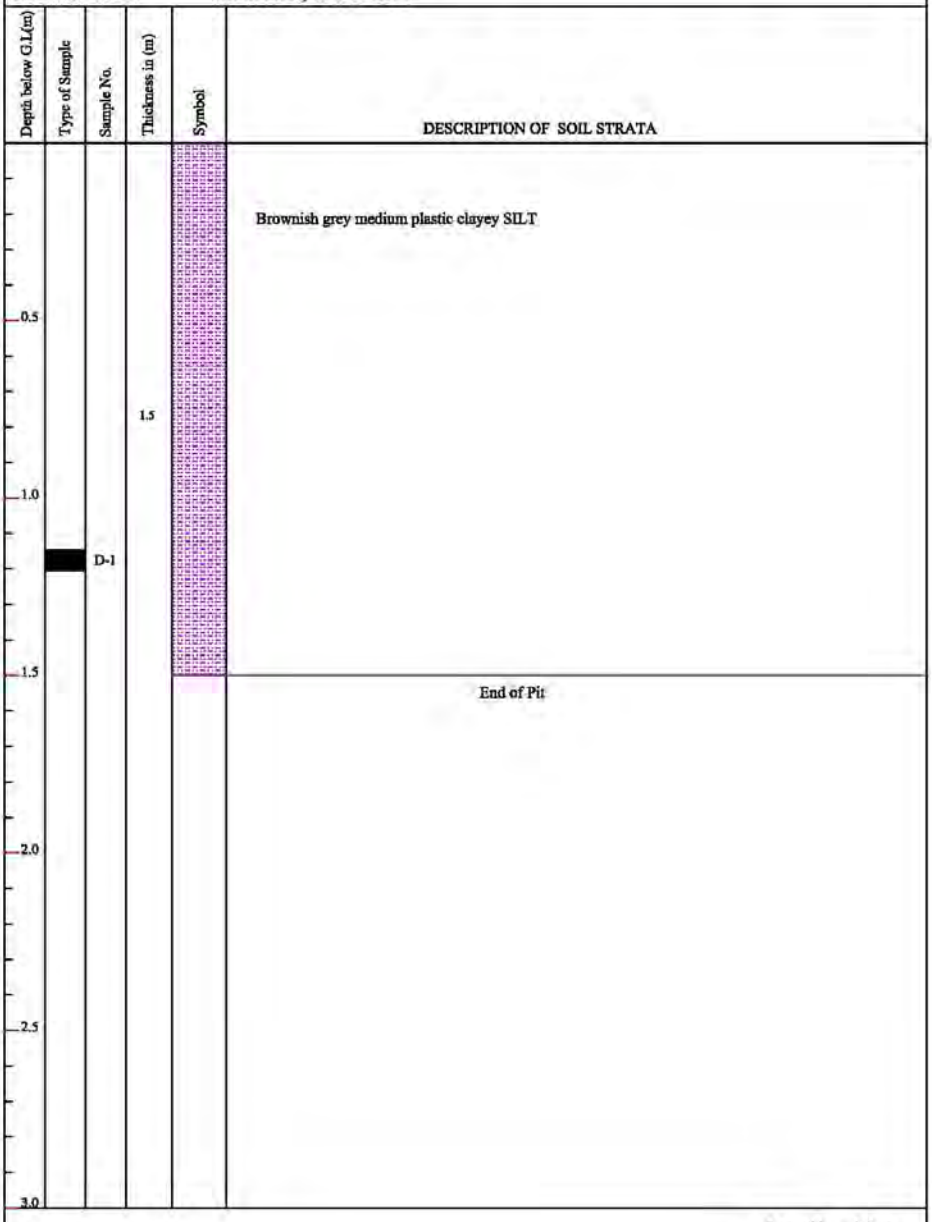
Date Started : 25-05-2013

Date Completed : 25-05-2013

Legend : SAND SILT CLAY

Coordinates :386466, 2400999. Chainage :Ch 6+205km

Location of Pit : Matarbari, Cox's Bazar



Logged by : Azhar
Checked by : Mahabub

SURVEY 2000

MDD 及び OMC の判断のためのプロクター密度試験

（ASTM D 698）

Client : BETS

Project Location : Matarbari, Cox's bazar

Pit No. : 01

Sample Type : Grey clayey SILT　　Sample No : D1

Sample Date : 21/05/2013　　Depth(m) : 1.50

Test Date : 13/06/2013　　Test Type : Modified proctor (AASHTO T-180)

TEST DATA

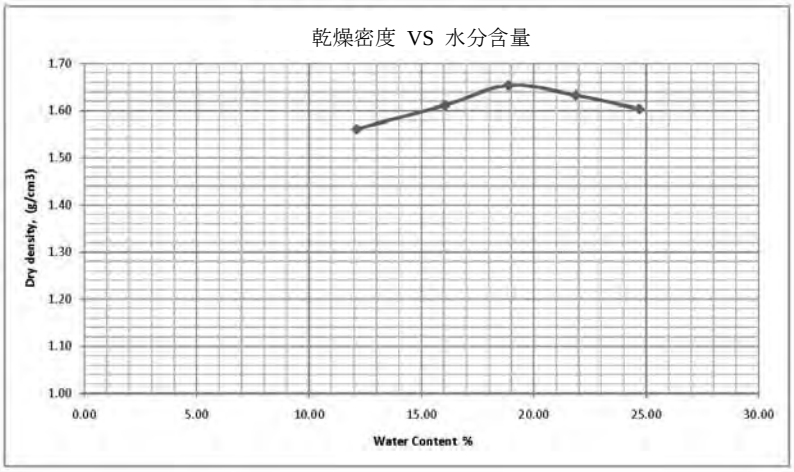
Water Content Determination :

Moisture Can No.	C5	C10	15	14	30	29
Wt. of Can + Wet Specimen (A) gm	80.0	107.54	100.0	130.50	112.50	106.52
Wt. of Can + Dry Specimen (B) gm	75.0	98.2	87.68	110.34	95.14	90.17
Wt. of Water (A - B) gm	5.00	9.34	12.32	20.16	17.36	16.35
Wt. of Can (C) gm	33.70	39.95	22.41	18.15	24.82	25.01
Wt. of Dry Specimen (B - C) gm	41.30	58.25	65.27	92.19	70.32	65.16
Moisture Content W = (A - B / B - C) x 100 %	12.11	16.03	18.88	21.87	24.69	25.16

Density Determination :

Mold Volume =2085cm^3

Sample No.	1	2	3	4	5	6
Actual Water Content %	12.11	16.03	18.88	21.87	24.69	25.16
Mold + Wet Soil (A) gm	6400	6850	6850	6900	6920	6880
Mold Weight (B) gm	2752	2752	2752	2752	2752	2752
Weight of Wet soil (A-B) gm	3648	3898	4098	4148	4168	4128
Wet density, pw, (g/cm^3)	1.75	1.87	1.97	1.99	2.00	1.98
Dry density, pd, (g/cm^3)	1.56	1.61	1.65	1.63	1.60	1.54



Optimum Moisture Content = 19.0%
Maximum Dry Density = 1.65 gm/cm^3

Tested by : Azhar

Checked by : Mahabub

SURVEY 2000

カリフォルニア支持力比率（CBR）試験
(AASHTO T 193)

Client : BETS

Project Location : Matarbari, Cox's bazar

Pit No. : 01

Sample Type : Grey clayey SILT Sample No : D1

Sample Date : 21/05/2013 Depth(m) : 1.50

Test Date : 23/06/2013 CBR Test Type : AASHTO T 193

Description of test specimen : Specimen is 100% passing through 4.75 mm sieve

Type of Test : Three point CBR (Specimen is compacted at OMC % in different density)

Soaking Condition : Soaked 4 days

Water Content Determination :

Moisture Can No.	C1		59		57
Wt. of Can + Wet Specimen (A) gm	111.46		134.41		108.89
Wt. of Can + Dry Specimen (B) gm	103.0		120.4		95.5
Wt. of Water (A - B) gm	8.46		14.01		13.39
Wt. of Can (C) gm	40.68		28.68		23.72
Wt. of Dry Specimen (B - C) gm	62.32		91.72		71.78
Moisture Content W = (A - B / B - C) x 100 %	13.58		15.27		18.65
Optimum Moisture content (OMC)= 19%					

Density Determination :

Mold Volume =2122cm^3

Mold No.	1	2	3
Blows applied in each of layer (5 Layers, 4.5kg rammer)	10	30	65
Actual Water Content %	13.58	15.27	18.65
Mold + Wet Soil (A) gm	7832	7820	8452
Mold Weight (B) gm	4256	3910	4214
Weight of Wet soil (A-B) gm	3576	3910	4238
Wet density, ρw, (g/cm^3)	1.69	1.84	2.00
Dry density, ρd, (g/cm^3)	1.48	1.60	1.68
Compaction (%)	90	97	101
(MDD and Type of Proctor Density test), MDD=	1.65 gm/cm^3	Method -A, AASHTO T-180(Modified)	

SWELL DATA

	Time	Date	Elapsed Time	Mold No-1 Reading	Swell (%)	Mold No-2 Reading	Swell (%)	Mold No-3 Reading	Swell (%)
Submerged	1:06 PM	22-6-2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final reading	1:06 PM	23-6-2013	24 hrs.	10.66	9.11	10.65	9.10	10.65	9.10

Load Cell No: PR-40-20465 Maximum Capacity : 40 kN

Load Determination :

Area of penetration Plunger, A = 0.001962 m^2 Date of penetration : 01.04.2013

CBR ' LOAD-PENETRATION" DATA

Penetration Reading		Proving Ring Reading and Stress								
		Mold No.-1			Mold No.-2			Mold No.-3		
		Reading	Load	Stress	Reading	Load	Stress	Reading	Load	Stress
in	(mm)		kN	kPa		kN	kPa		kN	kPa
0.000	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.025	0.64	0.00	0.87	444.44	0.50	0.93	474.77	1.00	0.99	505.10
0.050	1.27	0.50	0.93	474.77	1.00	0.99	505.10	1.50	1.05	535.42
0.075	1.91	1.25	1.02	520.26	1.50	1.05	535.42	2.00	1.11	565.75
0.100	2.54	1.50	1.05	535.42	2.00	1.11	565.75	2.50	1.17	596.08
0.125	3.18	1.50	1.05	535.42	2.50	1.17	596.08	3.50	1.29	656.73
0.150	3.81	2.50	1.17	596.08	3.00	1.23	626.40	4.00	1.35	687.05
0.175	4.45	2.50	1.17	596.08	3.25	1.26	641.56	5.00	1.47	747.71
0.200	5.08	3.00	1.23	626.40	4.00	1.35	687.05	6.00	1.59	808.36
0.225	5.72	3.50	1.29	656.73	4.50	1.41	717.38	7.00	1.71	869.01
0.250	6.35	4.50	1.41	717.38	5.00	1.47	747.71	7.50	1.78	899.34
0.275	6.99	5.00	1.47	747.71	6.00	1.59	808.36	8.00	1.82	929.66
0.300	7.62	5.00	1.47	747.71	7.00	1.71	869.01	9.00	1.94	990.32
0.325	8.25	5.00	1.47	747.71	8.00	1.82	929.66	10.00	2.06	1050.97
0.350	8.89	5.00	1.47	747.71	8.00	1.82	929.66	11.00	2.18	1111.62
0.400	10.16	5.00	1.47	747.71	8.00	1.82	929.66	12.00	2.30	1172.27

CBR CALCULATION (From the graph of above data, as shown in next page)

CBR Calculation								
	a) Stress at 2.54 mm =	535 kPa	a) Stress at 2.54 mm =	565 kPa	a) Stress at 2.54 mm =	596 kPa		
	Ratio (in %) =	7	Ratio (in %) =	8	Ratio (in %) =	8		
	b) Stress at 5.08 mm =	630 kPa	b) Stress at 5.08 mm =	687 kPa	b) Stress at 5.08 mm =	808 kPa		
	Ratio (in %) =	6	Ratio (in %) =	7	Ratio (in %) =	8		
	CBR =	6 %	CBR =	7 %	CBR =	8 %		
	At Dry-Density (kg/m^3)	1480	At Dry-Density (kg/m^3)	1600	At Dry-Density (kg/m^3)	1680		
	(% of Compaction)	90	(% of Compaction)	97	(% of Compaction)	101		
Remark (if any)								

CBR AT PARTICULAR COMPACTION FROM ' Dry-density versus CBR' GRAPH (Applicable for 3 points CBR only)

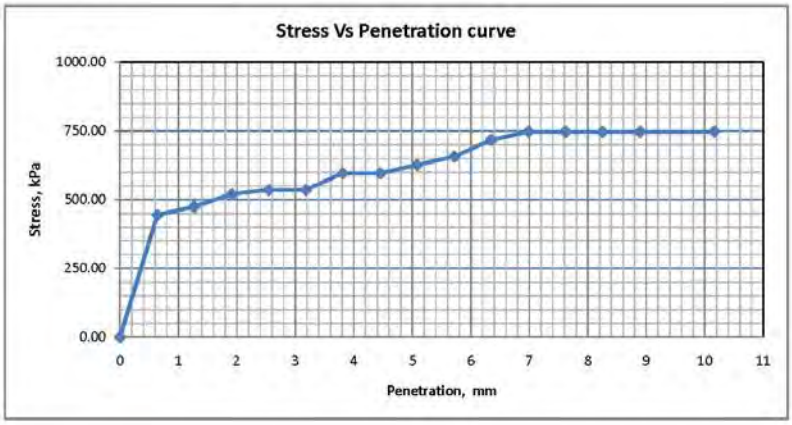
CBR at particular	At 100% Compaction (or 1650 kg/m^3 Dry-Density); the soaked CBR = 8 %
Degree of Compaction	(MDD = 1650 kg/m^3, Modified Proctor Test)

Tested by : Azhar

Checked by : Mahabub

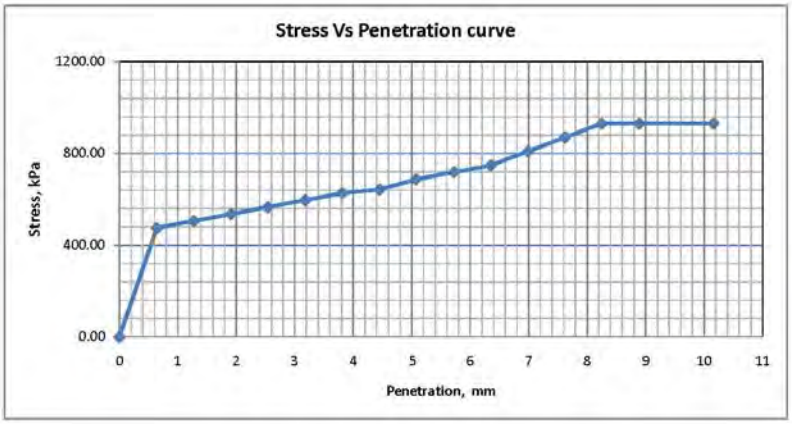
CBR 圧力貫入曲線

Mold No.-1　　Dry Density=1480 kg/m^3 or 90% Compaction



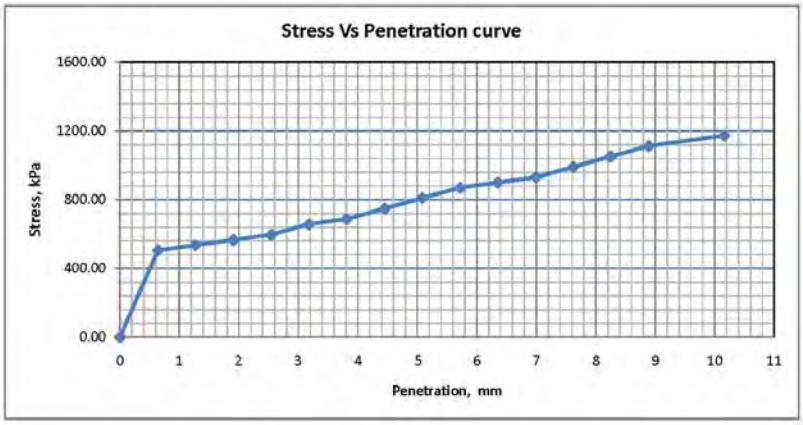
CBR 圧力貫入曲線

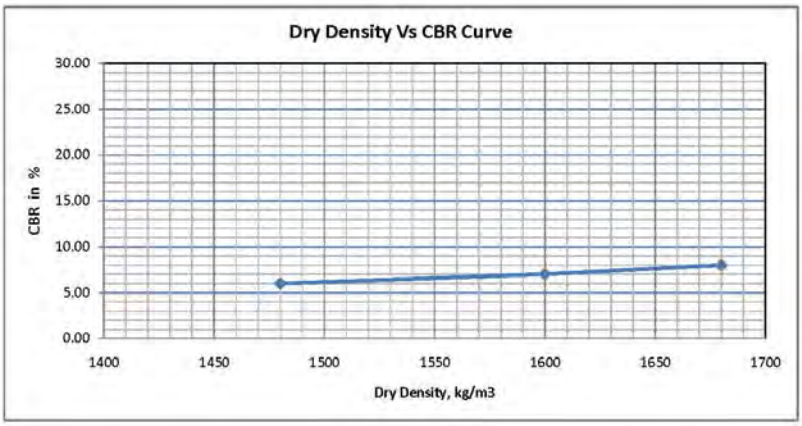
Mold No.-2　　Dry Density=1600 kg/m^3 or 97 % Compaction



CBR 圧力貫入曲線

Mold No.-3 Dry Density=1680 kg/m^3 or 101 % Compaction





Tested by : Azhar

Checked by : Mahabub

SURVEY 2000

MDD 及び OMC の判断のためのプロクター密度試験

（ASTM D 698）

Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 02

Sample Type : Grey clayey SILT　　Sample No : D1

Sample Date : 04/02/2013　　Depth(m) : 1.00

Test Date : 29/06/2013　　Test Type : Modified proctor (AASHTO T-180)

TEST DATA

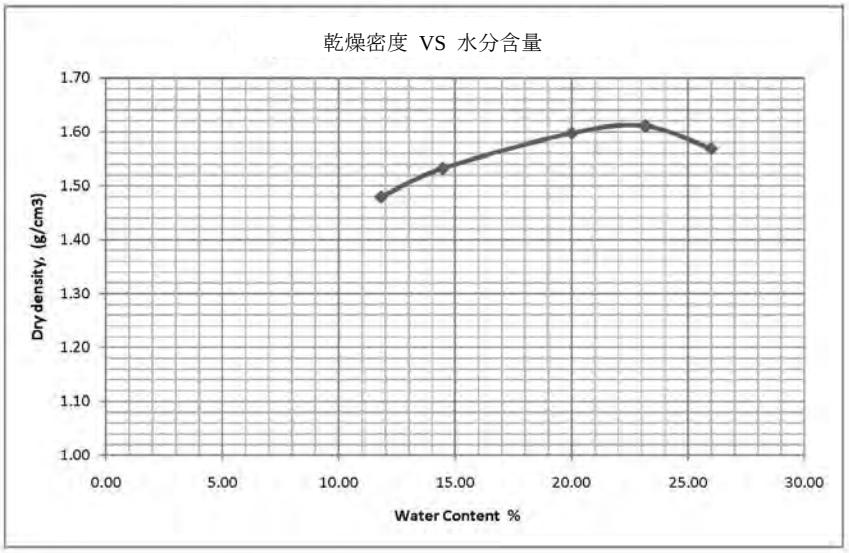
Water Content Determination :

Moisture Can No.	30	14	0	C8	C2
Wt. of Can + Wet Specimen (A) gm	100.83	81.05	91.49	100.12	92.35
Wt. of Can + Dry Specimen (B) gm	92.8	73.10	80.04	88.45	80.18
Wt. of Water (A - B) gm	8.03	7.95	11.45	11.67	12.17
Wt. of Can (C) gm	24.82	18.15	22.81	38.06	33.34
Wt. of Dry Specimen (B - C) gm	67.98	54.95	57.23	50.39	46.84
Moisture Content W = (A - B / B - C) x 100 %	11.81	14.47	20.01	23.16	25.98

Density Determination :

Mold Volume =2085cm^3

Sample No.	1	2	3	4	5
Actual Water Content %	11.81	14.47	20.01	23.16	25.98
Mold + Wet Soil (A) gm	6200	6408	6750	6888	6874
Mold Weight (B) gm	2752	2752	2752	2752	2752
Weight of Wet soil (A-B) gm	3448	3656	3998	4136	4122
Wet density, ρw, (g/cm^3)	1.65	1.75	1.92	1.98	1.98
Dry density, ρd, (g/cm^3)	1.48	1.53	1.60	1.61	1.57



Optimum Moisture Content = 23.0%
Maximum Dry Density = 1.61 gm/cm^3

Tested by : Azhar

Checked by : Mahabub

SURVEY 2000

カリフォルニア支持力比率（CBR）試験
(AASHTO T 193)

Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 02

Sample Type : Grey clayey SILT — Sample No : D1

Sample Date : 04/02/2013 — Depth(m) : 1.00

Test Date : 29/06/2013 — CBR Test Type : AASHTO T 193

Description of test specimen : Specimen is 100% passing through 4.75 mm sieve

Type of Test : Three point CBR (Specimen is compacted at OMC % in different density)

Soaking Condition : Soaked 4 days

Water Content Determination :

Moisture Can No.	C3		57		C4
Wt. of Can + Wet Specimen (A) gm	111.61		117.10		120.0
Wt. of Can + Dry Specimen (B) gm	98.37		101.22		106.33
Wt. of Water (A - B) gm	13.24		15.88		13.67
Wt. of Can (C) gm	32.72		25.38		39.91
Wt. of Dry Specimen (B - C) gm	65.65		75.84		66.42
Moisture Content W = (A - B / B - C) x 100 %	20.17		20.94		20.58
Optimum Moisture content (OMC)= 23%					

Density Determination :

Mold Volume =2122cm^3

Mold No.	1	2	3
Blows applied in each of layer (5 Layers, 4.5kg rammer)	10	30	65
Actual Water Content %	20.17	20.94	20.58
Mold + Wet Soil (A) gm	7844	8350	8390
Mold Weight (B) gm	3910	4256	4214
Weight of Wet soil (A-B) gm	3934	4094	4176
Wet density, ρw, (g/cm^3)	1.85	1.93	1.97
Dry density, ρd, (g/cm^3)	1.54	1.60	1.63
Compaction (%)	95	99	101
(MDD and Type of Proctor Density test), MDD=	1.61 gm/cm^3	Method -A, AASHTO T-180(Modified)	

SWELL DATA

	Time	Date	Elapsed Time	Mold No-1 Reading	Swell (%)	Mold No-2 Reading	Swell (%)	Mold No-3 Reading	Swell (%)
Submerged	4:30 PM	29-06-2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final reading	4:30 PM	30-06-2013	24 hrs.	3.55	3.03	12.57	10.74	2.45	2.09

Load Cell No: PR-40-20465 Maximum Capacity : 40 kN

Load Determination :

Area of penetration Plunger, A = 0.001962 m^2 Date of penetration : 01.04.2013

CBR ' LOAD-PENETRATION" DATA

Penetration Reading		Proving Ring Reading and Stress								
		Mold No.-1			Mold No.-2			Mold No.-3		
		Reading	Load kN	Stress kPa	Reading	Load kN	Stress kPa	Reading	Load kN	Stress kPa
in	(mm)									
0.000	0	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00
0.025	0.64	0.0	0.87	444.44	1.0	0.99	505.10	1.0	0.99	505.10
0.050	1.27	1.0	0.99	505.10	2.0	1.11	565.75	2.0	1.11	565.75
0.075	1.91	1.5	1.05	535.42	2.5	1.17	596.08	4.0	1.35	687.05
0.100	2.54	2.0	1.11	565.75	3.5	1.29	656.73	5.0	1.47	747.71
0.125	3.18	3.0	1.23	626.40	5.0	1.47	747.71	7.0	1.71	869.01
0.150	3.81	3.0	1.23	626.40	7.0	1.71	869.01	8.5	1.88	959.99
0.175	4.45	3.5	1.29	656.73	8.0	1.82	929.66	11.0	2.18	1111.62
0.200	5.08	4.0	1.35	687.05	8.5	1.88	959.99	12.0	2.30	1172.27
0.225	5.72	4.0	1.35	687.05	9.0	1.94	990.32	14.0	2.54	1293.58
0.250	6.35	4.5	1.41	717.38	9.0	1.94	990.32	15.0	2.66	1354.23
0.275	6.99	4.5	1.41	717.38	10.0	2.06	1050.97	16.0	2.78	1414.88
0.300	7.62	5.0	1.47	747.71	11.0	2.18	1111.62	18.0	3.01	1536.19
0.325	8.25	5.0	1.47	747.71	11.0	2.18	1111.62	20.0	3.25	1657.49
0.350	8.89	5.0	1.47	747.71	12.0	2.30	1172.27	20.0	3.25	1657.49
0.400	10.16	5.0	1.47	747.71	12.0	2.30	1172.27	20.0	3.25	1657.49

CBR CALCULATION (From the graph of above data, as shown in next page)

CBR Calculation								
	a) Stress at 2.54 mm =	565 kPa	a) Stress at 2.54 mm =	656 kPa	a) Stress at 2.54 mm =	720 kPa		
	Ratio (in %) =	8	Ratio (in %) =	9	Ratio (in %) =	10		
	b) Stress at 5.08 mm =	687 kPa	b) Stress at 5.08 mm =	960 kPa	b) Stress at 5.08 mm =	1100 kPa		
	Ratio (in %) =	7	Ratio (in %) =	9	Ratio (in %) =	10		
	CBR =	7 %	CBR =	9 %	CBR =	10 %		
	At Dry-Density (kg/m^3)	1540	At Dry-Density (kg/m^3)	1600	At Dry-Density (kg/m^3)	1630		
	(% of Compaction)	95	(% of Compaction)	99	(% of Compaction)	101		
Remark (if any)								

CBR AT PARTICULAR COMPACTION FROM ' Dry-density versus CBR' GRAPH (Applicable for 3 points CBR only)

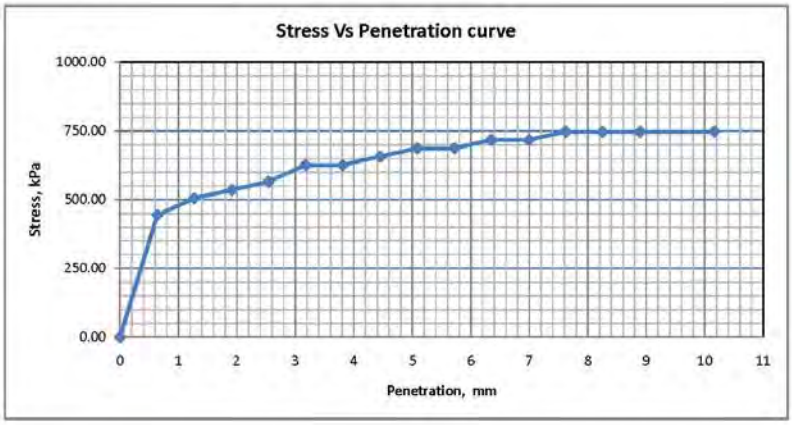
CBR at particular	At 100% Compaction (or 1610 kg/m^3 Dry-Density); the soaked CBR = 9 %
Degree of Compaction	(MDD = 1610 kg/m^3, Modified Proctor Test)

Tested by : Azhar

Checked by : Mahabub

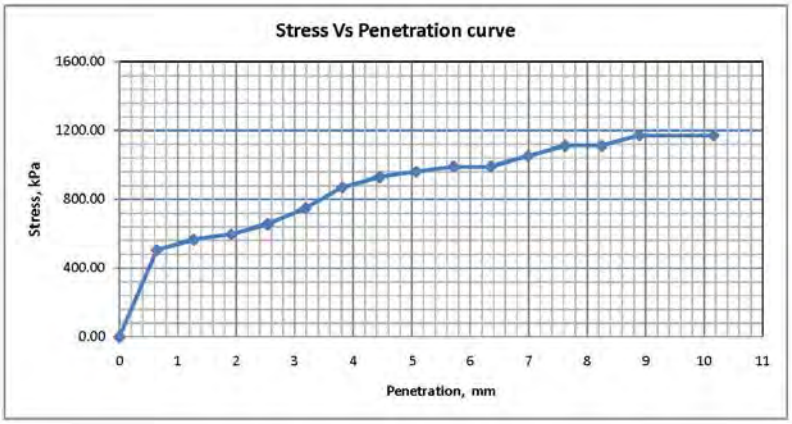
CBR 圧力貫入曲線

Mold No.-1　　Dry Density=1540 kg/m^3 or 95% Compaction



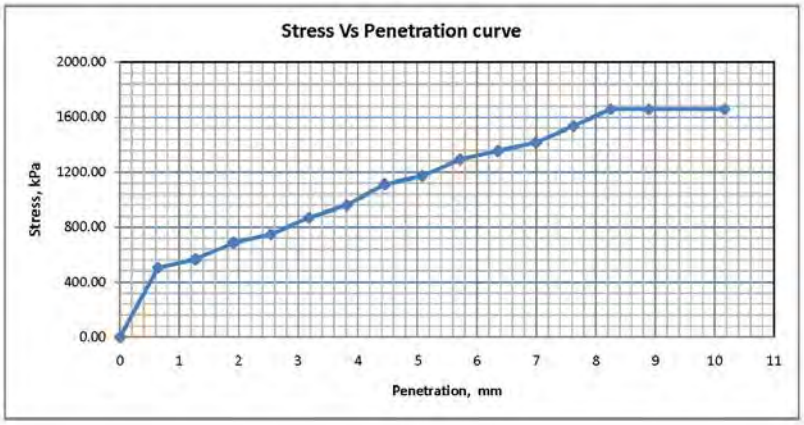
CBR 圧力貫入曲線

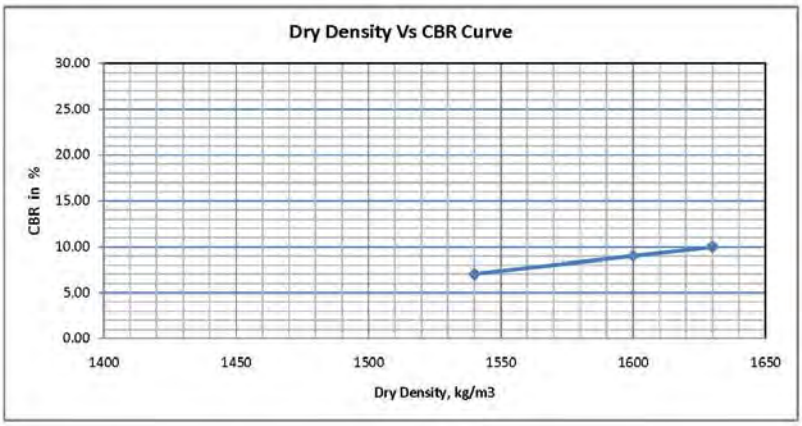
Mold No.-2　　Dry Density=1600 kg/m^3 or 99 % Compaction



CBR 圧力貫入曲線

Mold No.-3 Dry Density=1630 kg/m^3 or 101 % Compaction





Tested by : Azhar

Checked by : Mahabub

SURVEY 2000

MDD 及び OMC の判断のためのプロクター密度試験
（ASTM D 698）

Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 03

Sample Type : Brownish grey clayey SILT Sample No : D1

Sample Date : 25/05/2013 Depth(m) : 1.20

Test Date : 16/06/2013 Test Type : Modified proctor (AASHTO T-180)

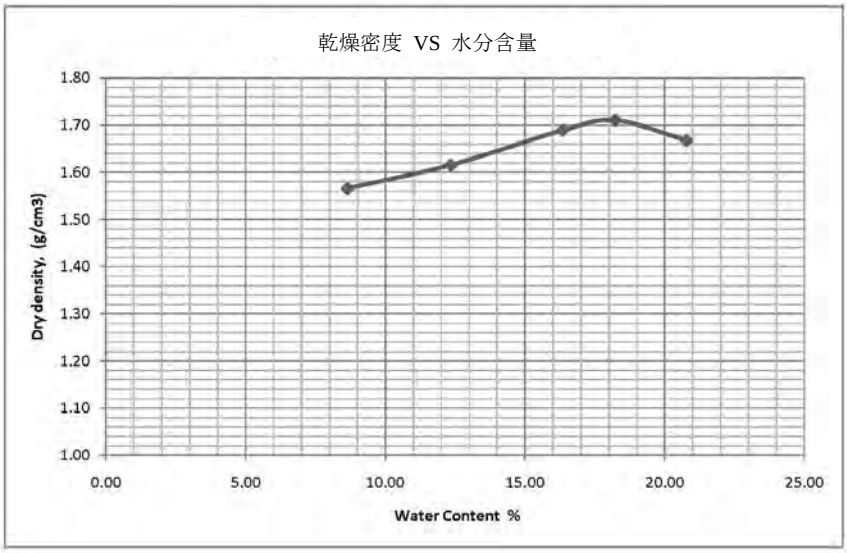
TEST DATA

Water Content Determination :

Moisture Can No.	12	29	C-1	C-5	15
Wt. of Can + Wet Specimen (A) gm	77.11	103.38	92.27	109.63	116.05
Wt. of Can + Dry Specimen (B) gm	72.7	94.78	85.02	97.92	99.94
Wt. of Water (A - B) gm	4.41	8.60	7.25	11.71	16.11
Wt. of Can (C) gm	21.64	25.10	40.68	33.70	22.41
Wt. of Dry Specimen (B - C) gm	51.06	69.68	44.34	64.22	77.53
Moisture Content W = (A - B / B - C) x 100 %	8.64	12.34	16.35	18.23	20.78

Density Determination :
Mold Volume =2085cm^3

Sample No.	1	2	3	4	5
Actual Water Content %	8.64	12.34	16.35	18.23	20.78
Mold + Wet Soil (A) gm	6298	6536	6850	6968	6952
Mold Weight (B) gm	2752	2752	2752	2752	2752
Weight of Wet soil (A-B) gm	3546	3784	4098	4216	4200
Wet density, ρw, (g/cm^3)	1.70	1.81	1.97	2.02	2.01
Dry density, ρd, (g/cm^3)	1.57	1.62	1.69	1.71	1.67



Optimum Moisture Content = 18.0%
Maximum Dry Density = 1.71 gm/cm^3

Tested by : Azhar

Checked by : Mahabub

SURVEY 2000

カリフォルニア支持力比率（CBR）試験
(AASHTO T 193)

Client : BETS

Project Location : Matarbari, Cox's Bazar

Pit No. : 03

Sample Type : Brownish grey clayey SILT Sample No : D1

Sample Date : 25/05//2013 Depth(m) : 1.20

Test Date : 03/07/2013 CBR Test Type : AASHTO T 193

Description of test specimen : Specimen is 100% passing through 4.75 mm sieve

Type of Test : Three point CBR (Specimen is compacted at OMC % in different density)

Soaking Condition : Soaked 4 days

Water Content Determination :

Moisture Can No.	C2		C7		C10
Wt. of Can + Wet Specimen (A) gm	129.82		105.25		141.7
Wt. of Can + Dry Specimen (B) gm	113.78		94.97		125.58
Wt. of Water (A - B) gm	16.04		10.28		16.12
Wt. of Can (C) gm	33.34		40.42		39.95
Wt. of Dry Specimen (B - C) gm	80.44		54.55		85.63
Moisture Content W = (A - B / B - C) x 100 %	19.94		18.85		18.83
Optimum Moisture content (OMC)= 18%					

Density Determination :

Mold Volume =2122cm^3

Mold No.	1	2	3
Blows applied in each of layer (5 Layers, 4.5kg rammer)	10	30	65
Actual Water Content %	19.94	18.85	18.83
Mold + Wet Soil (A) gm	8096	8460	8556
Mold Weight (B) gm	3910	4214	4256
Weight of Wet soil (A-B) gm	4186	4246	4300
Wet density, ρw, (g/cm^3)	1.97	2.00	2.03
Dry density, ρd, (g/cm^3)	1.64	1.68	1.71
Compaction (%)	95	98	100
(MDD and Type of Proctor Density test), MDD=	1.71 gm/cm^3	Method -A, AASHTO T-180(Modified)	

SWELL DATA

	Time	Date	Elapsed Time	Mold No-1 Reading	Swell (%)	Mold No-2 Reading	Swell (%)	Mold No-3 Reading	Swell (%)
Submerged	4:50 PM	3/7/2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final reading	4:50 PM	4/7/2013	24 hrs.	1.22	1.04	1.42	1.21	1.36	1.16

Load Cell No: PR-40-20465 Maximum Capacity : 40 kN

Load Determination :

Area of penetration Plunger, A = 0.001962 m^2 Date of penetration : 01.04.2013

CBR ' LOAD-PENETRATION" DATA

Penetration Reading		Proving Ring Reading and Stress								
		Mold No.-1			Mold No.-2			Mold No.-3		
		Reading	Load	Stress	Reading	Load	Stress	Reading	Load	Stress
in	(mm)		kN	kPa		kN	kPa		kN	kPa
0.000	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.025	0.64	0.50	0.93	474.77	0.50	0.93	474.77	1.00	0.99	505.10
0.050	1.27	1.00	0.99	505.10	1.00	0.99	505.10	1.50	1.05	535.42
0.075	1.91	1.50	1.05	535.42	1.50	1.05	535.42	2.00	1.11	565.75
0.100	2.54	1.75	1.08	550.59	2.00	1.11	565.75	2.50	1.17	596.08
0.125	3.18	2.50	1.17	596.08	2.00	1.11	565.75	3.50	1.29	656.73
0.150	3.81	3.00	1.23	626.40	2.50	1.17	596.08	4.50	1.41	717.38
0.175	4.45	3.00	1.23	626.40	3.00	1.23	626.40	5.00	1.47	747.71
0.200	5.08	4.00	1.35	687.05	4.00	1.35	687.05	5.50	1.53	778.03
0.225	5.72	4.00	1.35	687.05	5.00	1.47	747.71	7.00	1.71	869.01
0.250	6.35	4.00	1.35	687.05	5.00	1.47	747.71	7.50	1.78	899.34
0.275	6.99	4.50	1.41	717.38	6.00	1.59	808.36	8.00	1.82	929.66
0.300	7.62	5.50	1.53	778.03	6.50	1.65	838.69	9.00	1.94	990.32
0.325	8.25	5.50	1.53	778.03	7.00	1.71	869.01	10.00	2.06	1050.97
0.350	8.89	5.50	1.53	778.03	7.00	1.71	869.01	11.00	2.18	1111.62
0.400	10.16	5.50	1.53	778.03	7.00	1.71	869.01	11.00	2.18	1111.62

CBR CALCULATION (From the graph of above data, as shown in next page)

CBR Calculation	a) Stress at 2.54 mm =	540 kPa	a) Stress at 2.54 mm =	565 kPa	a) Stress at 2.54 mm =	580 kPa
	Ratio (in %) =	7	Ratio (in %) =	8	Ratio (in %) =	8
	b) Stress at 5.08 mm =	700 kPa	b) Stress at 5.08 mm =	687 kPa	b) Stress at 5.08 mm =	800 kPa
	Ratio (in %) =	6	Ratio (in %) =	7	Ratio (in %) =	8
	CBR =	6 %	CBR =	7 %	CBR =	8 %
	At Dry-Density (kg/m^3)	1640	At Dry-Density (kg/m^3)	1680	At Dry-Density (kg/m^3)	1710
	(% of Compaction)	95	(% of Compaction)	98	(% of Compaction)	100
Remark (if any)						

CBR AT PARTICULAR COMPACTION FROM ' Dry-density versus CBR' GRAPH (Applicable for 3 points CBR only)

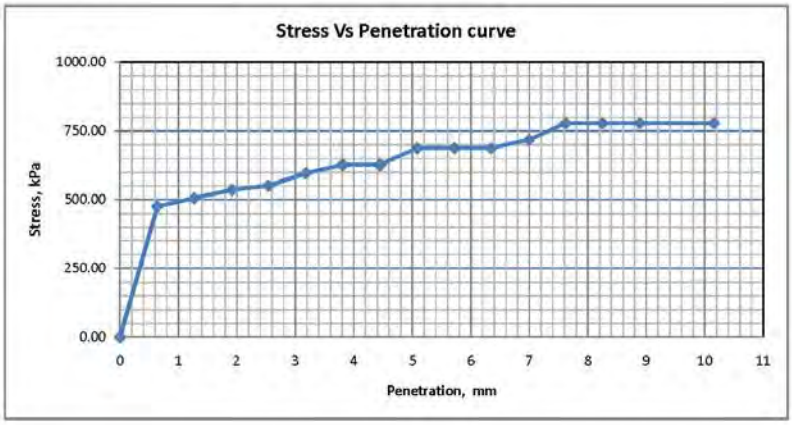
CBR at particular	At 100% Compaction (or 1710 kg/m^3 Dry-Density); the soaked CBR = 8 %
Degree of Compaction	(MDD = 1710 kg/m^3, Modified Proctor Test)

Tested by : Azhar

Checked by : Mahabub

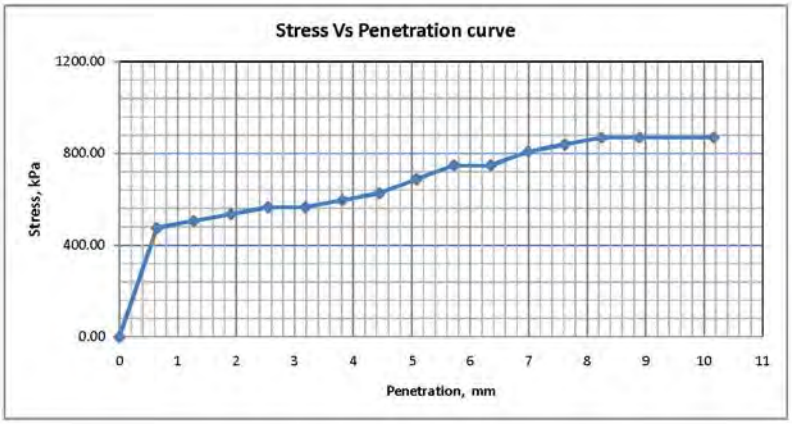
CBR 圧力貫入曲線

Mold No.-1　　Dry Density=1640 kg/m^3 or 95% Compaction



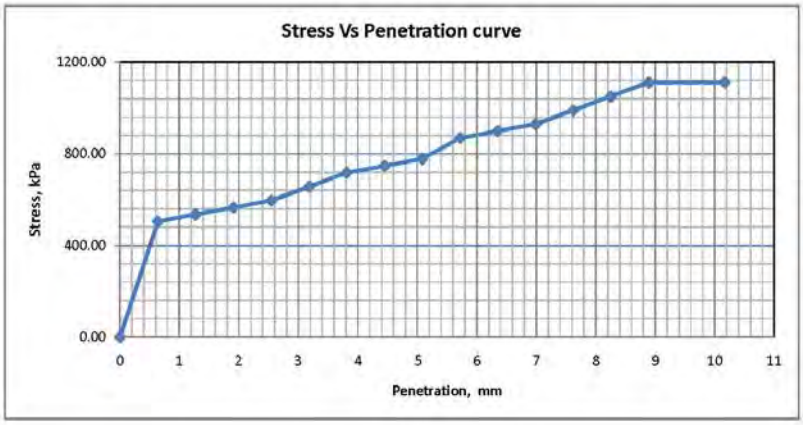
CBR 圧力貫入曲線

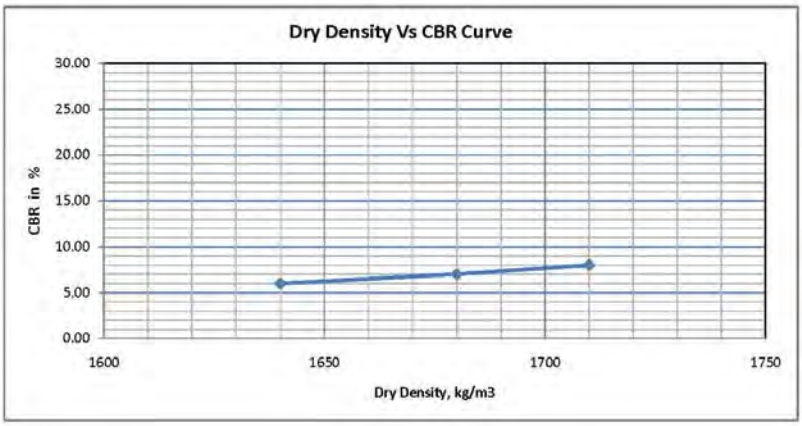
Mold No.-2　　Dry Density=1680 kg/m^3 or 98 % Compaction



CBR 圧力貫入曲線

Mold No.-3 Dry Density=1710 kg/m^3 or 100 % Compaction





Tested by : Azhar

Checked by : Mahabub

SURVEY 2000

SUMMARY OF LABORATORY TEST RESULTS			
Pit No.	Pit_01	Pit_02	Pit_3
Sample No.	D1	D1	D1
Depth in Meter	1.5	1.0	1.2
Atterberg Limits : Liquid Limit (LL) (%)	48	48	43
Plastic Limit (PL) (%)	23	25	23
Plasticity Index (PI) (%)	25	23	21
Grain Size Analysis : Sand (%)	4	0	2
Silt (%)	88	82	88
Clay (%)	8	18	10
D_{50}(mm)	0.02	0.009	0.022
Silt Factor :	0.25	0.17	0.26
Proctor Test : OMC (%)	19	23	18
MDD (gm/cc)	1.65	1.61	1.71
CBR in (%)	8	9	8

Appendix-C16.3-6

水文・地形解析

D.　水文、地形

チッタゴン石炭火力発電所へのアクセス道路上にある Kohelia 川を渡る橋建設に関する水文、地形について、解析を行った。

D1.　はじめに

チッタゴン石炭火力発電所への提案されたアクセス道路のルートでは、Cox's Bazar District Maheshkhali Upazila で Kohelia 川を渡る新しい橋の建設が必要となる。約 640m の橋は幅約 578m の河道を横断する。バングラデシュ水開発委員会（BWDB）の文書では、Kohelia 川は Matarbari チャネルと呼ばれている。提案された発電所は、Maheshkhali Upazila の Matarbari Union 及び Dholghata Union の中にある BWDB 沿岸洪水防災干拓地 No-70 内に位置する。干拓地の北側及び東側が Kohelia 川に囲まれ、西側及び南側にはそれぞれ Kutubdia チャネル及び Bengal 湾がある。提案された東側から干拓地 No-70 内に位置する発電所までのアクセス道路は Kohelia 川を横断し、BWDB 堤防上に一定距離続く。Kohelia 川橋は Kohelia 川東岸の Nayaghata Jetty サイトからスタートする。橋は既存の河道を横切った後、約 62m の干潟を横断する。

Kohelia 川、提案された橋サイト、アクセス道路、及び発電所サイトの一部の位置関係を下図に示す。

図：提案された Kohelia 川橋サイトの概要

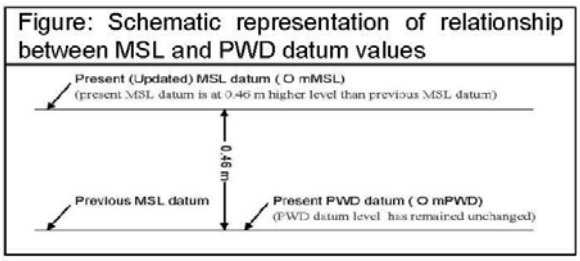
提案された橋の建設に関わる Kohelia 川の水文及び地形の詳細は次の章に述べる。実

用上、全ての解析は公共事業部（PWD）の値の下で行われた。速やかな参考のため、公共事業部（PWD）値と平均海面（MSL）値との関係は、下記で、概要を説明する。

公共事業部（PWD）値と平均海面（MSL）値との関係

最初に公共事業部（PWD）の値は、平均海面（MSL）の値をもとに修正される。従って、MSL 値は引き上げられるが、PWD 値は変わらない。概要は下図に示す。

図：公共事業部（PWD）値と平均海面（MSL）値との関係の概要



MSL 値が引き上げられたため、公共事業部（PWD）値と平均海面（MSL）値との数学関係は、mPWD =mMSL + 0.46　となる。

D2　提案された Kohelia 川橋の設計のための水文学解析

水文解析の目的は、橋の詳細設計に係る水力工学パラメーターを決定することである。前に述べた理由により、今回の解析は Kohelia 川橋に限定する。必要となる水力工学設計パラメーターは次の通り。

（１） 設計高水位（DHWL）
（２） 設計定水位（DLWL）
（３） 設計流量
（４） 水路開放度
（５） 予測洗い流し深度
（６） ナビゲーションクリアランス

なお、現地調査等で次の情報が収集された。
－Kohelia 川は活発な潮河川である。提案された橋全長約 640m の中、約 578m が主要河道の上に、約 62m が西側の干潟上を横断する。
－橋の東側の平均地盤高は 2.157 mPWD。

－橋の西側の干潟の平均地盤高は 2.587 mPWD。
－満水位時の川岸の基準レベル（RL）は 2.157 mPWD。
－満水位時の川の横断面積は 1050 m2。
－橋サイト付近にある BWDB 水位計観測所（Shaflapur of Maheshkhali)で観測された最高水位は 4.36 mPWD。
－上記観測所（Shaflapur of Maheshkhali)で観測された最低水位は（－）2.17 mPWD。
－水中地形測量時に観測された最低河床レベルは（－）3.87 mPWD。
－BIWTA 潮位表 2013 によると、Cox's バザール付近の朔望平均満潮面（MHWS）は：
3.785 mCD = 3.785－(4.836－3.931) mPWD = 2.88 mPWD
－BIWTA 潮位表 2013 によると、Cox's バザール付近の朔望平均低潮面（MHWS）は：
0.205 mCD = 0.205－(4.836－3.931) mPWD = (－)0.700 mPWD
－BWDB 干拓地 No-70 の建設期間（1962－65 年）の最高洪水位は 3.96 mPWD と想定された。（出典：Halcrow　et. al; BWDB Systems Rehabilitation Project，Feasibility Report，Polder - 70 Sub-project; June 1994）。
－BWDB 干拓地 No-70 の保護工事設計時の 2009 年 6 月 30 日の最高水位は 4.00 mPWD と想定された。
－設計高水位以上の想定ナビゲーションクリアランスは 8m。
－水平クリアランスは 30.48m。

1 設計高水位（DHWL）

RHD は、道路マスタープランプロジェクト（RMPP）の下で、1992 年全域内の橋梁設計を目的とした総合的水力工学解析を行った。RMPP 研究報告書（Vol-V、水文学）は、大河川の直接冠水をさらされる地域での道路橋梁建設のために 50 年間洪水発生頻度の解析を推奨した。本研究はさらに、活発的な潮地域で道路を設計する際、通常の高潮位の利用を推奨した。設計高水位（DHWL）の修正は下記のさまざまな基準を考慮する。

－潮位
－長期間の最高水位
－BWDB が考慮した高洪水水位（HFL）：（a）干拓地 No-70 の建設時、（b）干拓地 No-70 の防災工事時。
－サイクロン高潮レベル
－海面上昇

1.1　潮位

Kohelia 川は活発な潮河川であり、その片端がベンガル湾に直接に繋がり、もう

一つの片端が Kutubdia 河道を通る。バングラデシュの沿岸の潮は、インド洋に発生してから 2 海底谷、すなわち「Swatch of No Ground」と「ビルマ海溝」を通じて、ベンガル湾に入る。ベンガル湾の潮は、主に半日潮で、12 時間 25 分間続く。ベンガル湾の通常の高潮位は、朔望平均満潮面（MHWS）である。 MHWS は大潮の時期（多くの場合 19 年）の期間の平均に到達する最も高い潮位である。この潮位は、一般的に最高水準点であると考えられている。 MHWS は、海図基準面（CD）の上または下に m で表される。 CD は、すべての海図深さが関係している垂直基準面である。この基準面は、水位がほとんどそれを下回らないほど低い面である。

近くのバングラデシュ内陸水上交通局（BIWTA）の Cox’s Bazar 観測所で観測された MHWS 値は 3.785m　CD である（BIWTA Tide Talbe-2013）。Cox’s Bazar での BIWTA ベンチマーク（BM）の高さはそれぞれの CD 値および PWD 値が 4.836m と 3.931m であることに留意する必要がある。。

従って、MHWS 値は：3.785 － (4.836－3.931) mPWD = 2.880 mPWD

1.2　長期間の最高水位

最も近い水位観測所は Maheshkhali Upazila の Shaflapur に位置する BWDB 水位観測所である。水位観測所の詳細は次の通り。

観測所名称：Maheshkhali Upazila の Shaflapur　BWDB 水位計観測所

観測所 ID：　SW 200

観測所位置：緯度 21.6479、経度 91.98

BWDB 水文局が維持管理している水位観測所のアーカイブから 1971 年～2012 年のデータを入手した。その中から毎年最大水位及び最小水位を抽出した。本リストを作成する際、欠損データ及び混乱データは除かれた。観測された Maheshkhali Upazila の Shaflapur の毎年最大水位及び最小水位は下表の通り。

表：Maheshkhali Upazila の Shaflapur の BWDB 水位計観測所の毎年最大水位及び最小水位（期間：1971 年～2012 年、出典：BWDB 水文局）

Serial	Year	Yearly maximum WL(mPWD)	Maximum recorded WL during the period (mPWD)	Yearly minimum WL(mPWD)	Minimum recorded WL during the period(mPWD)
1	1971	3.23		(-) 1.68	

Serial	Year	Yearly maximum WL(mPWD)	Maximum recorded WL during the period (mPWD)	Yearly minimum WL(mPWD)	Minimum recorded WL during the period(mPWD)
2	1972	3.05		(-) 1.77	
3	1973	3.17		(-) 1.80	
4	1974	3.75		(-) 1.74	
5	1975	2.74		(-) 1.68	
6	1976	3.16		(-) 0.39	
7	1977	3.35		(-) 1.67	
8	1978	2.59		(-) 1.68	
9	1983	4.21		(-) 1.91	
10	1984	3.65		(-) 1.55	
11	1985	4.36	**4.36**	(-) 1.20	
12	1986	3.60		(-) 1.20	
13	1987	4.20		(-) 1.50	
14	1988	4.20		(-) 1.50	
15	1989	4.20		(-) 1.86	
16	1990	3.76		(-) 1.86	
17	1991	3.13		(-) 2.17	**(-) 2.17**
18	1992	3.33		(-) 2.10	
19	1993	3.56		(-) 1.88	
20	1994	3.16		(-) 1.64	
21	1995	3.74		(-) 1.55	
22	1996	3.88		(-) 1.35	
23	1997	3.75		(-) 1.40	
24	1998	3.20		(-) 1.30	
25	2004	3.45		(-) 1.60	
27	2005	3.70		(-) 1.80	
28	2006	2.80		(-) 1.70	
29	2007	*		(-) 1.80	
30	2008	3.84		*	
31	2009	3.98		*	
32	2010	3.95		*	
33	2011	3.88		*	
34	2012	3.97		*	

Note:*indicates confusing data

1971 年から 2012 年の間の水位観測ステーション SW 200 の最高記録水位は 4.36 mPWD である。

1.3 最高洪水水位（HFL）頻度解析

利用可能な Maheshkhali の Shaflapur 地点の BWDB 水位観測所のデータを基づき、Gumbels EV-1 手法を用いて、最高洪水水位（HFL）頻度解析を行った。ピーク時の水位は次の通り。

1: 10 年間: 4.29 mPWD

1: 20 年間: 4.59 mPWD

1: 25 年間: 4.68 mPWD

1: 50 年間: 4.98 mPWD

Halcrow らは、BWDB システム修復プロジェクトの中、干拓地 No-70 のサブプロ

ジェクトの F/S 調査時、Cox's バザール付近の Bakkhali 川の BWDB データを利用して頻度解析を行った。彼らが計算したピーク時の水位は次の通り。

1:20 年間: 3.63 mPWD

1:50 年間 3.74 mPWD

なお、Halcrow らは、報告書の中、下記に示す該当地域のサイクロン防災プロジェクトーII の頻度解析結果を引用した。

1:20 year: 4.24 mPWD

1:50 year: 4.60 mPWD

1.4 BWDB が考慮した高洪水水位（HFL）：（a）干拓地 No-70 の建設時、（b）干拓地 No-70 の防災工事時

（a） 干拓地 No-70 の建設時の BWDB が考慮した高洪水水位

干拓地 No-70 は「沿岸プロジェクト（CEP-1)」の下で、1962 年から 1965 年までに建設された。干拓地は 25.76 ㎞の海上堤防及び 8.04 ㎞の陸上堤防をもつ。海上堤防及び陸上堤防の設計最高水位は、それぞれ 5.49 mPWD [3.96 m (HFL) +1.53 m (乾舷)] 及び 4.88 mPWD [3.96m (HFL)+0.92m (乾舷)]であった。それ以降、堤防は多数の潮や暴風雨に耐えており、越流は全くなかった。

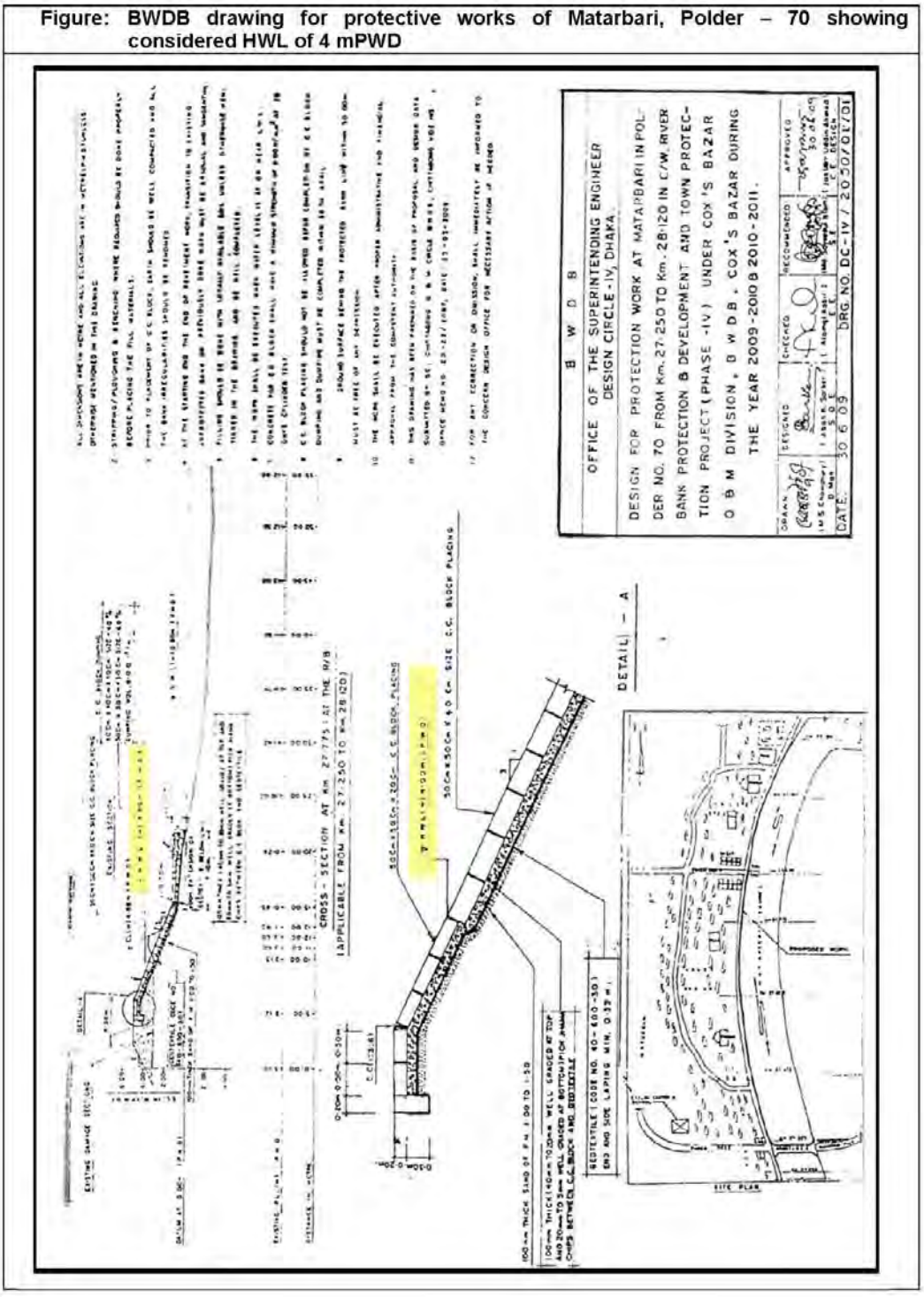
（b） 干拓地 No-70 の防災工事時の BWDB が考慮した高洪水水位

「BWDB Design Circle - IV，Dhaka BWD」の中、Cox's Bazar O&M 課が 2009～2010 年及び 2010～2011 年に実施した「河川堤防防災と開発及び町防災プロジェクト（フェーズーIV）」における干拓地 No-70 の Matarbari の Km 27.250 ～ Km 28.120 区間の防災工事の設計が述べられた。防災工事の設計最高水位は 4.00 mPWD だった（次のページの図面を参照）。

上記の要因を踏まえた干拓地 No-70 堤防建設及び防災工事時に設計された最高水位（HWL）は 4.00 mPWD だった。

図 : BWBD 干拓地 No-70 の Matarbari 区間の堤防建設及び防災工事時に設計された最高水位（HWL）（4.00 mPWD）

Figure: BWDB drawing for protective works of Matarbari, Polder – 70 showing considered HWL of 4 mPWD



1.5　サイクロン高潮潮位

サイクロン高潮がさまざまな天候／環境パラメーターの複合効果に起因している。パラメーターには、あまりにも多くの変数があり、各変数が自然の中で非常に敏感である。天気予報では、世界で最も強力なコンピュータを使用しているが、信頼できる段階までまだ至ってない。パラメーターに非常に多くの変数が存在するため、納得できる程度までのサイクロンおよび／またはサイクロン高潮の予測はまだ実現されてない。

バングラデシュ沿岸に発生した高潮の高さデータに関しては、1960 年から現在までバングラデシュ気象局（BMD）が収集していた。最近、バングラデシュの沿岸に大型サイクロンがなかったため、BMD は報告書で 1960～2011 の期間のデータを扱っている。報告書の最後のエントリは 2009 年 2 月 25 日に発生したサイクロン AILA と記されている。BMD のリストは下表のとおりである。

表：1960～2011 年バングラデシュで高潮を発生した主要なサイクロン
（出典：バングラデシュ気象局）

Date of landfall	Landfall area	Max. wind speed (Kph)	Surge height
11.10.1960	Chittagong	160	6.0 m
31.10.1960	Chittagong	193	6.6 m
09.05.1961	Chittagong	160	5.0 m
30.05.1961	Chittagong (Near Feni)	160	2.0 - 4.55 m
28.05.1963	Chittagong- Cox's Bazar	200	6.0 m
11.05.1965	Chittagong-Barisal Coast	160	3.7 m
05. 1l. l965	Chittagong	160	6-7.62 m
15.12.1965	Cox's Bazar	210	2.4 - 3.6 m
23.09.1966	Noakhali coast	139	6 - 6.67 m
1.11.1966	Chittagong		6-6.7 m
07.12.1966	Cox's Bazar	81	-
08.11.1967	Khulna (Sundarban)	111	-
23.10.1967	Cox's Bazar	107	
23.10.1970	Bangladesh- WestBengal coast	163	4.7 m
12.11.1970	Chittagong	224	3 - 10 m
8.05.1971	Chittagong	81	2.4 - 4.24 m
29.09.1971	Sundarban coast	97 - 113	0.61 m
6.11.1971	Chittagong- Noakhali coast	--	-
18.1l.l973	Chittagong	102	-
30.05.1974	Patuakhali	74 - 83	-
28.11.1974	Chittagong -Cox's Bazar coast	163	3.0 - 5.1 m
10.12.1981	Khulna	120	2.12-4.55 m
15.10.1983	Chittagong	93	-
09.11.1983	Chittagong -Cox's Bazar coast	136	1.5 m
24.05.1985	Chittagong	154	4.55 m
29.11.1988	Khulna coast	160	4.4 m
18.12.1990	Cox's Bazar coast	115	2.13 m
29.04.1991	Chittagong	225	6 - 7.6 m
31.05.1991	Noakhali coast	83	2.5 m
02.05.1994	Cox's Bazar-Teknaf Coast	200 - 250	3.64 - 4.85 m
25.11.1995	South of Cox's Bazar	55	3.05 m
26.10.1996	Sundarban coast	70	1.5 - 2.0 m
19.05.1997	Sitakundu	232	4.55 m
27.09.1997	Sitakundu	150	3.03-4.55 m
20.05.1998	Chittagong coast near Sitakundu	173	0.911m
28.10.2000	Sundarban coast	50-60	1.22 m
12.11.2002	Sundarban coast near Raimangal River	65-85	2.13 m
19.05.2004	Cox's Bazar &Akyab coast	65-90	1.223 m
15.05.2007(**AKASH**)	Ctg-Cox's Bazar coast near ctg	83	-
15.11.2007(**SIDR**)	Khulna-Barisal coast near Patharghata	223	6.10 m
26.10.2008(**Rashmi**)	Khulna-Barisal coast near Patharghata		2.13 m
17.04.2009(**BIJLI**)	Ctg-Cox's Bazar coast near Chittagong	90	-
25.05.2009(**AILA**)	West Bengal-Khulna (Bangladesh) coast near Sagar Island of India	92	2.44m

リスト中、最も高い高潮は、1970 年 11 月 12 日に記録された 3～10m である。3～10m の変動幅は、推測／推定要因が入ることを表す。リスト中、2 番目に高い高

潮は 1965 年の 6～7.62m である。ここでも予測因子の存在が明らかである。多かれ少なかれ、他のデータについても当てはまる。

頻度解析に基づいて、高潮の高さの予測がいくつか実施された。なお、頻度解析の方法が統計的分析に基づいた経験的なものであることは留意すべきである。これらは、水位又は流出の長期的な影響を予測することが仮定されている。水位や流出の変動はいくつかの変数に制限される。前述したように、高潮の高さは、多くの変数の影響を受ける。高潮の高さの解析はどのように水位や流出に類似することはまだわかってない。しかし、学術的関心から、バングラデシュ沿岸の高潮に関する頻度解析の結果のいくつかを以下に示す。

－BMD データを基づき、Gumbel　EV-1 手法を用いた頻度解析

年間の極端値は下記の表に示す通り。

Year	Extreme Surge Height (m)
1960	6.6
1961	5.0
1963	6.0
l965	7.62
1966	6.7
1970	10
1971	4.24
1974	5.1
1981	4.55
1983	1.5
1985	4.55
1988	4.4
1990	2.13
1991	7.6
1994	4.85
1995	3.05
1996	2.0
1997	4.55
1998	0.911
2000	1.22
2002	2.13
2004	1.223
2007	6.10
2008	2.13
2009	2.44

一方で、Gumbel 手法では下記の発生頻度と高潮潮位の関係を示す。

Frequency Analyses of Bangladesh Coast Cyclone Storm Surges									
Recurrence interval in years	1:2	1:5	1:10	1:20	1:25	1:50	1:100	1:200	1:1000
Water level in mPWD	3.91	6.38	8.01	9.58	10.08	11.62	13.14	14.65	18.17

－サイクロン防災プロジェクト（CPP）－II の頻度解析

サイクロン防災プロジェクト-II は、その最終的なプロジェクト準備報告書

Appendix-C で、次の頻度解析によるサイクロン高潮潮位を示した。（参考：Halcrow　et. al; BWDB Systems Rehabilitation Project; Feasibility Report – Polder 70 Sub-project; June 1994)

Peak water levels (mPwd) on frequency analyses of storm surges for Polder - 70						
Frequency in years	1:5	1:10	1:20	1:40	1:50	1:100
Water levels in m(PWD)	4.31	4.92	5.53	6.03	6.23	6.75

ー水モデリング研究所（IWM）の解析

水モデリング研究所（IWM）は、日本の株式会社パシフィックコンサルタンツインターナショナルとの共同研究により、Cox's Bazar 付近の Sonadia 島の 100 年間の高潮が約 5.5m MSL (5.96 mPWD)だと報告した。（IWM: Coastal and Hydraulic Study for Deep Sea Port,　Final Report; November　2008）

上記各種解析の比較

上記の解析結果が一様ではないことは明らかである。100 年に 1 回の頻度の高潮高さに関して、BMD データ、CPP-II データ、IWM データはそれぞれ 13.14 m、6.75 m、5.96 m の値を出している。

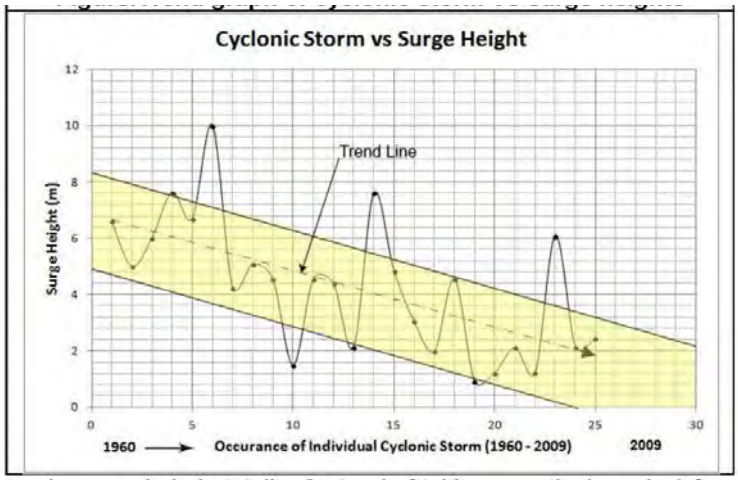
BMD の高潮高さデータ（エントリーごとに高めの値を取っている）は、降順でリストされた。そこに平均値集団の考えがあった。しかし、このデータセットから平均値集団の確認は不可能だった。データは次のようにリストされた。

10m; 7.62 m; 7.6 m; 6.7 m; 6.6 m; 6.1 m; 6.00 m; 5.1 m; 5.0 m; 4.85 m; 4.55 m; 4.55 m; 4.55 m; 4.4 m; 4.24 m; 3.05 m; 2.44 m; 2.13 m; 2.13 m; 2.13 m; 2.00 m; 1.5 m; 1.223 m; 1.22 m; 0.911 m。

傾向を把握するため、期間中に発生した高潮高さを下図に描いた。この図が示したように、いくつかのデータを除き、高潮高さは包絡線にうまくフィットしている。この包絡線は下降傾向を示す。これは、地球温暖化に伴い、高潮の高さが増加するという一般的な予測に反するものである。

前述の事実から、設計高水位を修正する際には、特定の値を取るのではなく、全体的に過去のサイクロン高潮高さ記録を評価することを推奨する。

図：サイクロン VS 高潮高さのトレンド



1.6　気候変動に起因する海面上昇

地球温暖化による気候変動の大きな影響は、「海面上昇（SLR）」になることは、現在、認められている事実である。多くの論文は、バングラデシュの水分野での地球温暖化の影響の可能性に関して、定性的または広域的に論述する。SRL の影響を明確にまたは定量的に言及する研究論文は極めて少ない。

バングラデシュ国水資源計画機構（WARPO）は、政府間気候変動パネル（IPCC）の第三次評価報告書（TAR）の勧告及び NAPA（国家適応行動計画）のシナリオに基づいき、バングラデシュの沿岸域に SLR の影響の詳細な評価を行った（WARPO: Impact Assessment of Climate Zone of Bangladesh, 2005）。気候変動の潜在的影響によりプロジェクト年の 2030 年、2050 年及び 2100 年の海面上昇が 14cm、32cm、88cm になるだろうと予測された。

世界銀行は、「Bangladesh: Climate Change and Sustainable Development Report No. 21140 BO，Ohaka; 2000」という報告書で、バングラデシュ沿岸の海面上昇が 2030 年、2050 年、2100 年までそれぞれ 10 cm、25 cm、1 m だと予測した。IPCC の予測した 2100 年の海面上昇幅 18～59cm の数値に比べると、世界銀行の数値は悲観的である。

以上さまざまな側面から見ると、WARPO が考えた 2050 年の海面上昇値 32cm が、今回の道路橋梁建設時に考慮できる合理的な値と考えられる。

1.7　水路開放度

最大洪水の時にも氾濫が発生しないように、橋の設計は、十分な水路を持たせる必要がある。氾濫は予期せぬ洗掘を発生する橋梁のアウトフランキングや高速流出を引き起こす危険性を持つ。いずれの場合、橋梁構造の安定性が危険にさらされる。

Lacey の公式によると、必要となる正味水路は Ws = 4.75 Q である。ここで、Ws は 必要となる水路開放度（m）、Q は設計流量（m3/sec）である。設計流量を 7289 m3/sec に設定すると、必要となる正味水路は次になる。

Ws = 4.75Q = 4.753745 m = 290.68 m

現在河川の水路幅は 578 m で、提案された橋梁長さ（高架橋も含む）は 640 m である。水路開放度の視点から見ると、提案された橋梁長さは安全上問題がない。

2　設計低水位（DLWL）

設計低水位は次の 2 つの観点から確定される。

i)　朔望平均低水位 (MLWS)

ii) 最低観測水位

3　朔望平均低水位 (MLWS)

朔望平均低水位 (MLWS)は、大潮が一定期間（通常 19 年間）に達した最低水位を指す。通常これは低水位マークと考えられる。付近にある Cox's バザール観測所での MLWS 値は 0.205m CD（BIWTA Tide Table 2013）である。mPWD に変換すると、0.205－(4.836－3.931) mPWD=(-) 0.700 mPWD になる。

4　最低観測水位

前述の表によると、Maheshkhali の Shaflapur にある BWDB 水位計観測所 SW 200 での最低観測水位は (-)2.17 mPWD である。

5　推奨「設計高水位」

上記の結果をまとめると、次の通りである。

i)　朔望平均高水位(MHWS): 2.880 mPWD

ii)　高観測水位: 4.36 mPWD

iii)　開拓地 No-70 の最高洪水水位: 4.00 m PWD

iv)　最高洪水水位の頻度解析

Analysis	1:20 year flood frequency	1:50 year flood frequency
Analysis of Shaflapur BWDB data	4.59 mPWD	4.98 mPWD
Halcrow's analysis using Cox's Bazar BWDB data	3.63 mPWD	3.74 mPWD
CPP-II's analysis	4.24 m PWD	4.60 m PWD

v)　海面上昇効果：2050 年に 32cm

vi)　ナビゲーションクリアランス：設計高水位より 5m 以上

前述の事実によって、Kohelia 橋の設計に関しては、推奨「設計高水位（DHWL）」は 4 mPWD で、推奨水位は 4.00 mPWD である。2050 年の 3cm の海面上昇の影響や過去に観測されたサイクロン高潮の高さを考慮すると、推奨ナビゲーションクリアランスは 5m になる。

6　推奨「設計低水位（DLWL）」

Kohelia 橋の設計に関しては、推奨「設計低水位（DLWL）」は(-)0.700　mPWD になる。

7　設計流量

Kohelia 川の流量に関する歴史的データや情報は存在しない。式 Q = A v を用いて流量を算出する。ここで、Q は流量（m3/sec）、A は断面積（m2）、v は流速（m/sec）である。断面積および流速の情報は必要となる。

流量は間接的に推計できる。つまり、（i）悪条件で定義されたチャンネルの有理式、あるいは（ii）定義されたチャンネルの斜面面積法。有理式 Q = ciA は流域流出のピーク流量を算出する。ここで、Q はピーク流量、c は有理式流出係数、i は降雨強度、A は流域面積である。一方で、斜面面積式は Manning の式を用いて流速を算出する。Manning の式 $v = (1/n)R^{2/3}S^{1/2}$ である。ここで、v は流速、n は粗度係数、R は水力半径、S は河川傾斜度である。バングラデシュの南地域の河川流域境界が正確に定められない。河川は並行したり、交差したりする。従って、間接的な手法の斜面面積法は流出算出に適している。

今回の特例で、IWM 研究で得られた付近の Kutubdia チェンネルの観測流速を利用する。IWM が観測した最大平均流速は 1.7 m/sec だった（lWM; Hydraulic Modeling Study for Rehabilitation of Affected Seven High Risk Coastal Polders; Final Report; November 2004）。これと同じように、以下の計算では流速 1.7 m/sec を使う。

図：メインチャンネルおよび干潟に渡る橋梁設置場所

設計洪水水位が 4.00 mPWD で、平均低水位が 2.157 mPWD であるため、水位が 2.157 mPWD を超えると、河川水が西側の干潟を氾濫する。累積地表流幅が 62m を仮定する。付図はメインチャンネルおよび干潟に渡る橋梁の設置場所を示す。

流量式、計測した断面積および観測した流速を下に、下表に示すメインチャンネルの流量、地表流幅および設計流量を算出する。

設計流量は 3745m3/sec である。

	Level (mPWD)	Area (m^2)	v(m/sec)	Q=A*v(m^3/sec)
Main channel flow	4.00	2115.25	1.7	3596
Over-land flow	4.00	87.61	1.7	149
Design Discharge				3745

8　予想洗掘深さ

橋梁およびその関連防災工事は、構造体を不安定にさせないよう、川岸や河床の洗掘がよく考慮されるように設計される。洗掘には、川岸洗掘および／または河床洗掘があげられる。洗掘深さは、数学と物理モデリング（あった場合）および実験式を用いて推定する。

川岸洗掘は、渦や局所的な乱流によって引き起こされる川岸の浸食を指し、河川の一部または長距離に広がる。川岸洗掘はチャンネルの配置に密接に関係し、また、川岸の構造材料の材質に依存する。水路の狭窄が流速を急激に加速させるため、川岸洗掘（狭窄洗掘）を引き起こす。提案された橋には、環境への配慮およびナビゲーションの高さの要件をクリアすることから、高架橋を設ける。川岸の材料には、粘土材料がかなり含まれる。橋梁がチャネル方向に対して垂直に配置されるため、水路の狭窄は存在しない。このように川岸洗掘は全く予想されて

いない。

河床洗掘は河床の下方浸食および／または局所的洗掘を引き起こす。一般的な河床の下方浸食は、流路内の長期的な水文および地形の変化によって引き起こされる。また、局所的河床洗掘は、流路障害によって引き起こされる。3 種類の河床洗掘は次の通り。

(i) 一般洗掘

(ii) 狭窄洗掘。今回の特例では、狭窄洗掘の危険が存在したい（前述説明した）

(iii) 局所洗掘

8.1 メインチャンネル内洗掘

一般洗掘

メインチャンネル内の一般洗掘に関しては、Lacey 氏の式で正常洗掘（d）を算出する。

$d = 0.473\ (Q / fs)^{1/3}$

ここで、

d = 設計高水位（DHWL）以下の正常洗掘深さ（m）

Q = 流量（cumec）

fs = シルト率 $= 1.76\sqrt{}$平均粒径（mm）（D50） $= 1.76 \quad \sqrt{}0.08 = 0.5$

よって、$d = 0.473\ (3596 / 0.5)^{1/3} = 9.13$ m （設計洪水水位以下）

狭窄洗掘

水路狭窄が存在しないため、狭窄洗掘の発生は予想されてない。

局所洗掘

くいの下の局所洗掘は次の一般式で算出する。

i) 2.25 x くい直径（水深は 5m 以上）

ii) 1.5 x くい直径（水深は 5m 以下）

局所洗掘算出は他の実験式・実験手法もある。実験式・実験手法は実験的で、サイトに特化したものである。これらは、水深、流速、攻撃角度、桟橋サイズと構造に依存する。計算結果は式および手法によってばらつきがある。

Indian Road Congress (1998, 2000)は、さまざまな局所洗掘式の実験結果を考慮した上、正常洗掘深さを倍にして、最大河床洗掘（一般洗掘＋局所洗掘）を算出することをお勧めした。

$dmax = 2\ d$

T. R. Jagadeesh と M. A. Jayaram は、著書「Design of Bridge Structure (Prentice Hall, India)の中、橋台の下での洗掘深さを計算するために 1.5 d の使用、また桟橋の下での洗掘の深さを計算するために 2 d の使用を示唆している。

そこで、メインチャンネル内の予想洗掘深さは下記の通り。

i) メインチャンネル内の桟橋の下

= 2 d 設計洪水水位以下 = 2 x 9.13 m = 18.26 m

ii) 東側の橋台の下 (例えば、Nayaghata Jetty 側の橋台)

= 1.5 d 設計洪水水位以下 = 1.5 x 9.13 m = 13.70 m

8.2 氾濫原内の洗掘

一般洗掘

氾濫原内の一般洗掘に関しては、Lacey 氏の式で正常洗掘（d）を算出する。

$d_{fp} = 0.473 (Q_{fp}/ fs)^{1/3}$

ここで、

d_{fp} = 設計高水位（DHWL）以下の正常洗掘深さ（m）

Q_{fp} = 氾濫原流量（cumec）

fs = シルト率 = 1.76√平均粒径（mm）（D50） = 1.76 √0.08 = 0.5

よって、$d_{fp} = 0.473 (149 / 0.5)^{1/3} = 3.16$ m （設計洪水水位以下）

局所洗掘

くいの下の局所洗掘は次の一般式で算出する。

－2.25 x くい直径（水深は 5m 以上）

－1.5 x くい直径（水深は 5m 以下）

氾濫原内の最大水深が 5m 未満なので、くいの下の局所洗掘深さは、

= 1.5 x 1.2 (くい直径を 1.2 m に仮定) = 1.80 m

そこで、氾濫原内の予想洗掘深さは下記の通り。

i) 氾濫原内の桟橋の下

(a) 条件： $2 d_{fp} = 2 x 3.16 = 6.32$ m（設計洪水水位以下）

(b) 条件：d_{fp} + くいの局所洗掘 = 3.16 + 2.25 = 5.41m（設計洪水水位以下）

(c) 従って、氾濫原内の桟橋の下の洗掘深さは 6.32 m（設計洪水水位以下）と推測される

ii) 西側の橋台の下 (例えば、西側干潟の橋台)

= 1.5 d_{fp} 設計洪水水位以下 = 1.5 x 3.16 m = 4.74 m

8.3 予想選択深さと水位

メインチャンネル

i) メインチャンネル内の桟橋の下 = 18.26 m（設計高水位以下、例えば、(-)14.26 mPWD）

ii) 東側橋台の下 = 13.70 m （設計高水位以下、例えば、(-) 9.70 mPWD）

氾濫原

iii) 氾濫原内の桟橋の下 = 6.32 m（設計高水位以下、例えば、(-)2.32 mPWD）

iv) 西側橋台の下 = 4.74 m（設計高水位以下、例えば、(-)0.74 mPWD）

9 ナビゲーションクリアランス

必要となるナビゲーション高さに関しては、バングラデシュ内陸水上交通局は次のような規定を出している。(出典: Bridge Design Standards for Roads and Highways Department; Government of the People's Republic of Bangladesh , Ministry of Communications, Roads and Railways Division; January 2004)

Sl.	Classification of waterways	Minimum vertical clearance (m)	Minimum horizontal clearance (m)
1	Class-I	18.30	76.22
2	Class-II	12.20	76.22
3	Class-III	7.62	30.48
4	Class-IV	5.00	20.00

バングラデシュ人民共和国道路と高速道路部の設計マニュアルでは、BIWTA に分類されていない水路に関しては、漁船、ボート、トロール漁船、burg などの通行に地元の要求を考慮すべきだと定めている。

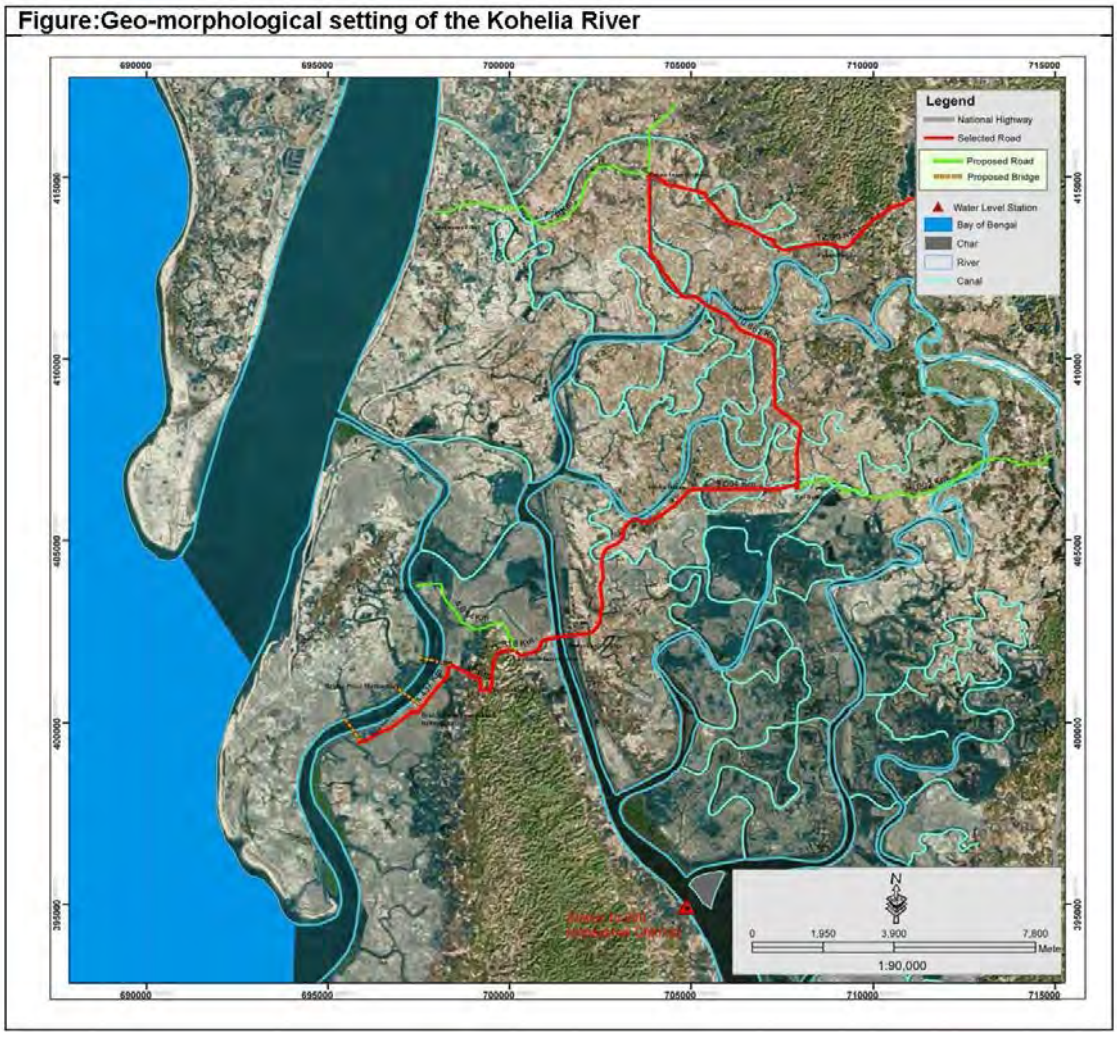
提案された橋梁は、未分類ルートであるため、絶対最少垂直クリアランスは設計高水位より 1.5m を超えなければならない。一方で、提案された橋梁の上流（北方約 2km）に LGED Matarbari 橋がある。この橋の内のりスパンは 20m 未満であるが、それに近い。この橋のアーチ内面レベルは１２．４８mPWD である。従って、設計高水位によるナビゲーションクリアランスは 8.12 m (12.48 mPWD – 4.36 mPWD)になる。提案された橋の近くで Matarbari 橋の存在は論理的に明確な内のりスパンとナビゲーションの高さの制限条件を提供する。

地上の実際条件および発電所運転、アクセス道路建設後の将来発生の交通量を考慮すると、橋梁の 1 スパンは最小 20m 水平クリアランスと最低 5m 垂直クリアランスを持つことを推奨する。

D3　地形学および Kohelia 川の岸線変動

Cox’s Bazar 地区 Maheshkhali Upazilla 内の Kohelia 川は潮川である。BWDB 文書では、通常 Matarbari 河道と呼ばれている。川の北端が Kutubdia チャンネルを介して、ベンガル湾に繋がり、南端が直接ベンガル湾に繋がる。川の主要部分は、南北方向に合わせている。北側は、西へ移動し、Kutubdia 河道に合流する。川の北側に、Ujantia Khal は北から川に合流し、Koriardia Khal は北東側から川に合流する。干拓地 No-70 の内側から、長さ 1.76m の Donarghona Khal は南側から北に流れ、Kohelia 川に流れていく。 1.86km の Morakhali Khal、8.29km の Rangakhali Khal および 4.06km の Tiakhali Khal は西側から川に流れていく。なお、干拓地 No-70 は北側と東側に Kohelia 川に囲まれる。Kutubdia 河道およびベンガル湾はそれぞれ干拓地の西側と南側に位置している。1.84km の Kankadi Khal は Kutubdia 河道に流れていく。下の図は、Kohelia 川の地形条件を示す。

図：Kohelia 川の地形条件

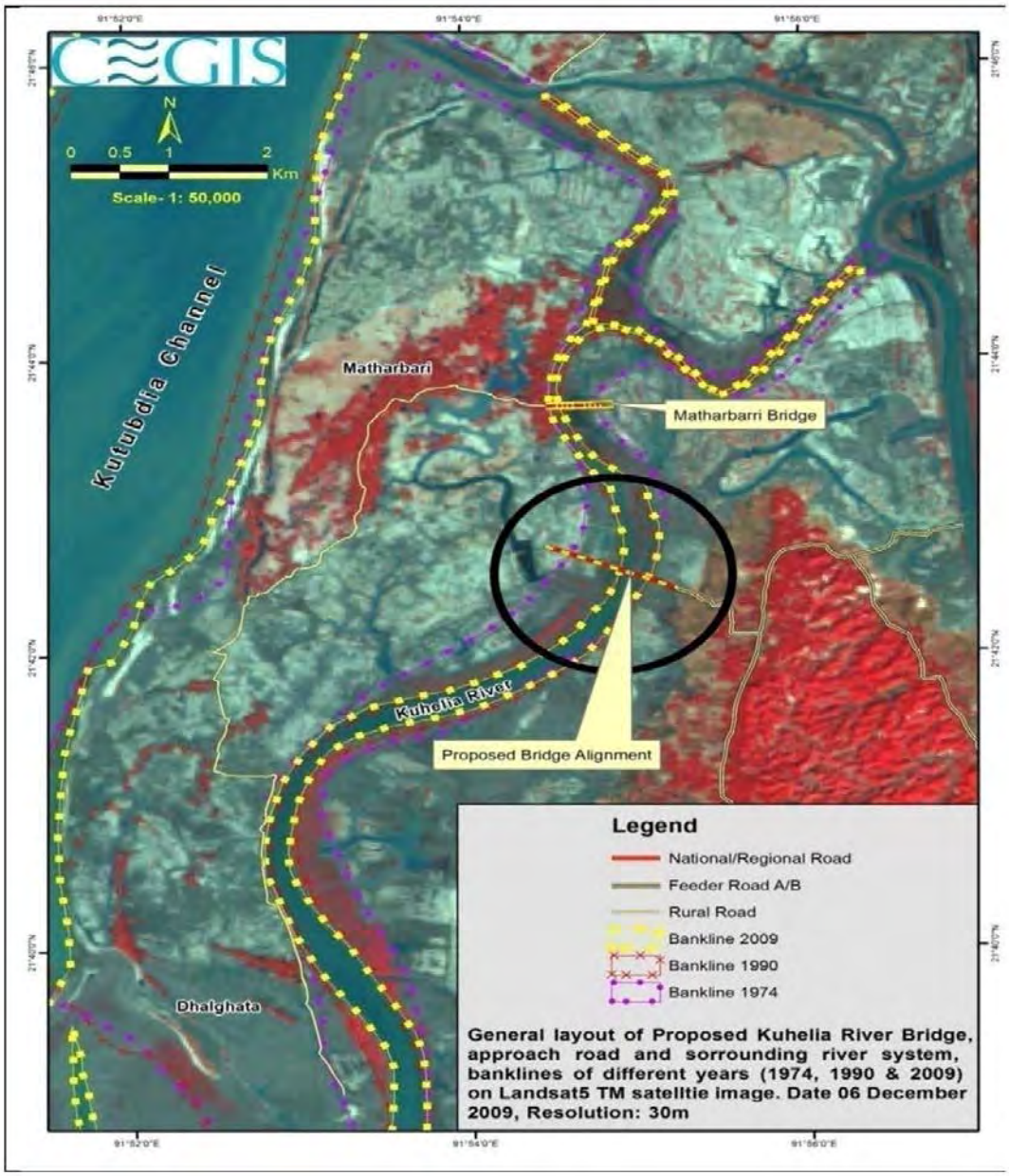


提案された「Nayaghata Jetty」に位置する橋梁サイトの河川幅は約 365m である。幅 220.25m の LGED の Matarbari 橋が提案された橋の場所から（北に）約 2km の距離に位置している。

1 川岸線変動解析

Kohelia 川の川岸線変動解析は、Center for Environment and Geographic Information Services (CEGIS)でアーカイブされた衛星画像を用いて行った、CEGIS の支援と協力を得て、画像処理および川岸線変動解析を行った。CEGIS アーカイブの中、最初の画像として 1974 年の画像は選ばれた。2009 年の画像は現在の川の状況を示す。中間画像として 1990 年の画像はランダムで選ばれた。下記の画像は異なる年の提案された橋周辺の川岸線を示す。画像の中、Matarbari の LGED 橋の場所も示されている。

図：Kohelia 川の川岸線の長期変動



解析に使われた画像の詳細は下表の通り。

Details of the images used in the analyses are as follows:

Name	Path	Row	Acquisition Date	Image Type	Remarks
Landsat5 TM	136	45	06 December 2009	Multispectral 30 m resolution	
Landsat5 TM	136	45	31 December 1990	Multispectral 30 m resolution	
Landsat5 MSS	146	45	10 January 1974	Multispectral 80 m resolution	

画像はまず地上コントロール点（GCP）を用いて地理校正を行い、地理座標系 Bangladesh Transverse Mercator (BTM)に投影された。画像は互いに登録された。画像は 30 m x 30 m のピクセルサイズにリサンプルされた。そして、岸線が判読され、抽出さ

れた。1970 年と 1990 年の川岸線は 2009 年の画像に重ね合わせた。

画像上で、「Nayaghata Jetty」の提案された橋の場所が容易に判読できた。なお、橋の場所は下記の過去の座標記録から判読できた。

1)「Nayaghata Jetty」側：北緯 21° 42′ 33.28″、東経 91° 54′ 53.77″

2) 干潟西端：北緯 21° 42′ 41.80″、東経 91° 54′ 31.23″

異なる年の間、橋梁周辺の川岸線の位置は次のように変化があった。

東　岸

Image	X- Coordinate	Y- Coordinate	Observations on bank line shifting
Image of 1974	698350.574	401572.049	No appreciable movement of bank lines
Image of 1990	698350.574	401572.049	
Image of 2009	698350.574	401572.049	

西　岸

Image	X- Coordinate	Y- Coordinate	Observations on bank line shifting
Image of 1974	697556.240	401874.296	Bank line has been found to move eastward for a distance of about 500 m by accretion during the period 1974 – 1990; and after that no appreciable movement of bank lines could be seen for the period 1990 - 2009
Image of 1990	698065.813	401684.455	
Image of 2009	698065.813	401684.455	

水文地形学評価および川岸線変動から、下記のことが分かった。

a) 25 年以上の観測期間（1974～2009 年）において、東岸は安定状態を保った。

b) 1974～1990 年、西岸に約 500m の堆積が発生した（マングローブ林の減少に起因するかもしれない）。その後の 19 年間（1990～2009 年）、新たな堆積や浸食は起きなかった。

上記の事実と解析を基に、橋梁サイトの Kohelia 川の両側の岸は現在安定期を通過していることが明らかである。仮に外部からの攪乱がなければ、現在の安定状態は将来数年間にわたり継続すると予想できる。

D4 Kohelia 川橋梁設計に関する結論と提言

提案された Kohelia 川橋梁サイト地域の現在の水文環境、地形環境に関するレビューおよび解析を踏まえ、次の通り結論と提言をまとめる。

- 設計高水位：4.00 mPWD
- 設計低水位：(-) 0.700 mPWD
- 橋梁サイトの Kohelia 川幅：578 m
- チャンネルの航行部分の橋梁アーチレベル：9.00 mPWD より高い
- チャンネルの航行部分の最少橋梁スパン：20 m
- 予想洗掘レベル：

－観測最低河床レベルは(-)3.87 mPWD
－メインチャンネル内の橋梁桟橋の予想最大洗掘レベルは(-)14 .26 mPWD に達す
－氾濫原内の橋梁桟橋の予想最大洗掘レベルは(-)2.32 mPWD に達す
－メインチャンネル内の東側の橋台の予想最大洗掘レベルは(-) 9.70 mPWD に達す
－氾濫原内の西側の橋台の予想最大洗掘レベルは(-)0.74 mPWD に達す

提案された橋梁サイト地域の川岸線は水文学的地形学的に安定状態と保っているため、大きな浸食や堆積の発生は予想されない。正常な波浸食および橋梁建設にともなう川の流れへの攪乱による予想浸食を防ぐため、河川訓練および護岸工事を推奨する。

Appendix-C16.3-7

Drawings

People's Republic of Bangladesh
Ministry of Power, Energy and Mineral Resources

Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh

Access Road
【DESIGN DRAWINGS】

September 2013

Japan International Cooperation Agency

Tokyo Electric Power Services Co., LTD
Tokyo Electric Power Co., LTD

Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh
Access Road
DESIGN DRAWINGS
September 2013

No	ITEM	DWG NO.
	List of Drawings	
1	Route Map (Existing Road)	RM-1
	Route Map (New Road)	RM-1
2	Road Plan (New Road)	PLAN/DWG-01 of 10
3	Road Plan (Existing Road)	PLAN/DWG-01 of 04
4	New Bridge	BRDG/GEN/DWG-01-02, BRDG/S_LP/DWG-03, BRDG/D-40/DWG-04-05, JICA/BRDG/D40/DWG-06, JICA/BRDG/G40/DWG-07, JICA/BRDG/CAB/DWG-08, JICA/BRDG/END/DWG-09, JICA/BRDG/REINF./DWG-10, JICA/BRDG/X_GIR/DWG-11, JICA/BRDG/PIER/DWG-12-13, JICA/BRDG/PILE/DWG-14, JICA/BRDG/ABUT/DWG-15-17, JICA/BRDG/B.PAD/DWG-18, JICA/BRDG/E.JOINT/DWG-19-20, JICA/BRDG/PROT./DWG-21
5	Road Longitudinal Profile	PS/CFPP/S2K-003, 01 of 19
6	Cross Section Index Map	PLAN-DWG-01 of 07
7	Design Cross Section	CS/DWG-01 of 54
8	Culvert and Road Ancillary Structures	CULV-01/DWG-01 of 06, C.WAY/DWG-01, IRRI-DR/DWG-01, SG/DWG-01 of 02, SDR/DWG-01 of 04, BRDG/GEN/DWG-01, BRDG/S_LP/DWG-02, BRDG/P_ELV/DWG-03, BRDG/DECK/DWG-04-05, BRDG/G1/DWG-06-08, BRDG/P1/DWG-09, BRDG/P2/DWG-10, BRDG/P3/DWG-11-12
9	Drainage Route Map	PLAN/DWG-01 of 21
10	Typical Cross Section	RDS/DWG-01 of 09, RS/DWG-01 of 01

ROUTE MAPS

Route Map

N

0 1,600 3,200 6,400 Meters

1:50,000

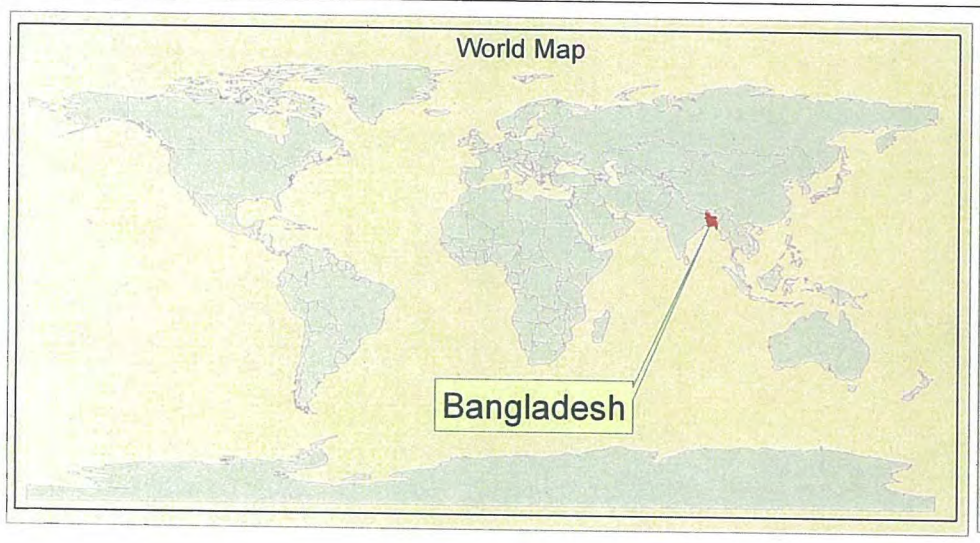
690000 700000 710000

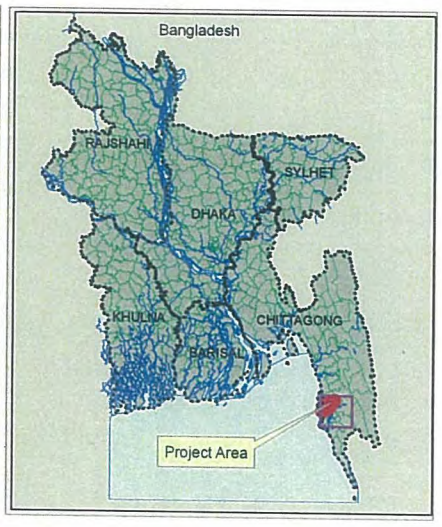
420000 410000 400000

Uttar Dhurung
Chhanua
Dakshin Dhurung
Lemsikhali
Rajakhali
Harbang
Bara Bakia
Aziznagar
Kaiyarbil
KUTUBDIA
Baraghop
Pekua
Baraitali
Kaiarbil
Bheola Manik Char
Kakhara
Magnama
Lakhyarchar
CHAKARIA
Ali Akbar Deil
Paschim Bara Bheola
Fasiakhali
Chiringa
Matarbari
Kohelia River
Badarkhali
Power Plant
Yunuskhali Bazar
Purba Barabheola
Fasyakhali
Dulahazara
Fasyakhali
Kalarmarchhara
Dhalghata
Saflapur
Khuntakhali
Baishari
Hoanak

690000 700000 710000

World Map





Legend

- District HQ
- Thana HQ
- Boundary Wall
- Existing RHD Road
- New Road
- National Highway
- Regoinal Road
- Feeder Road A
- Feeder Road B
- Rural Road
- unionbd91
- Division Boundary
- District Boundary
- char
- River
- River

Roads and Highways Department (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on chittagong Area Coal Fared Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)	DRAWING TITLE : ROUTE MAP	SCALE : 1:50,000	DATE : AUGUST, 2013	DRAWING NO. RM-1

Route Map

N

0 320 640 1,280 Meters

1:10,000

Magnama

Matarbari

Kohelia River

Power Plant

Yunuskhali Bazar

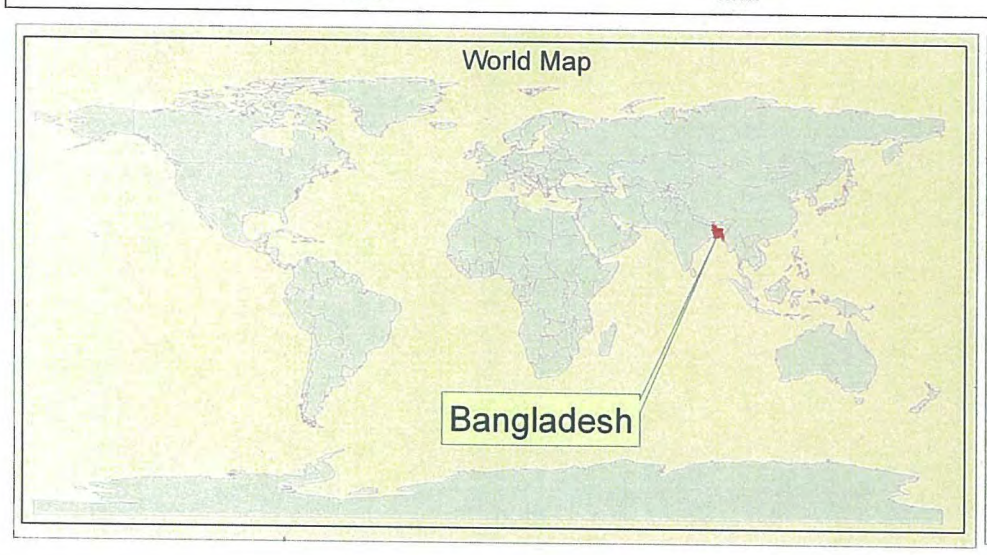
Kalarmarchhara

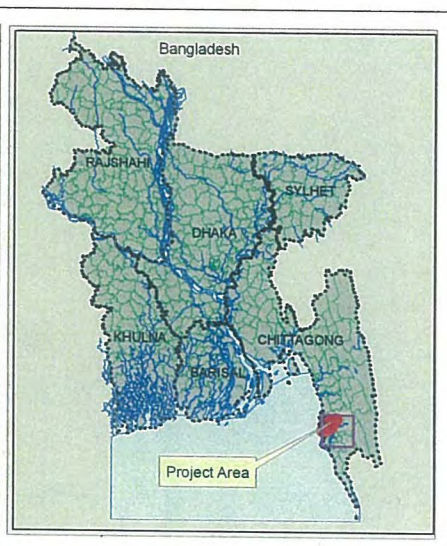
Saflapur

Dhalghata

696000 697000 698000 699000 700000

404000 403000 402000 401000 400000 399000





Legend

- District HQ
- Thana HQ
- Boundary Wall
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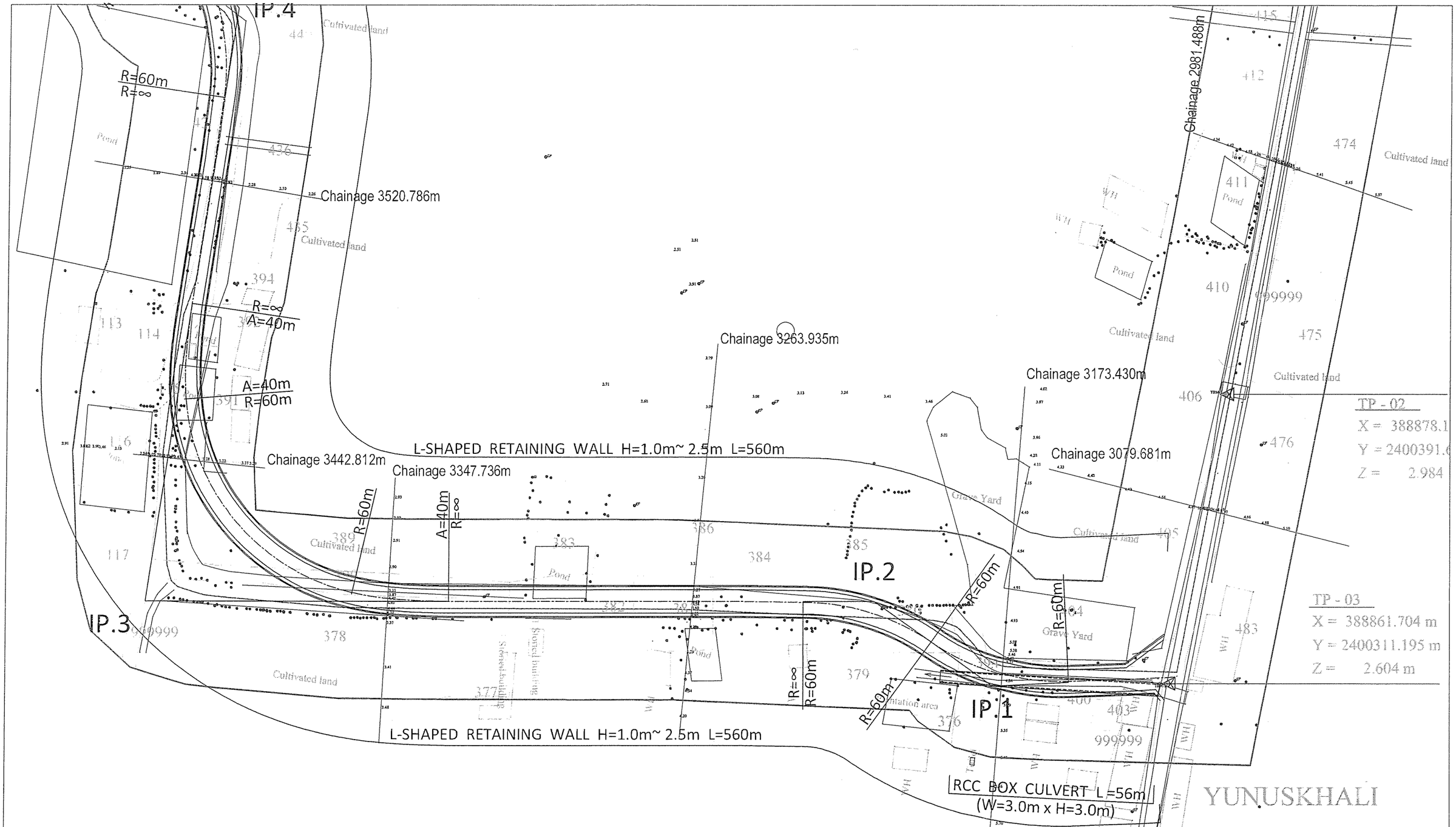
ROAD PLAN (NEW ROAD)



REV.	DESCRIPTION	DATE

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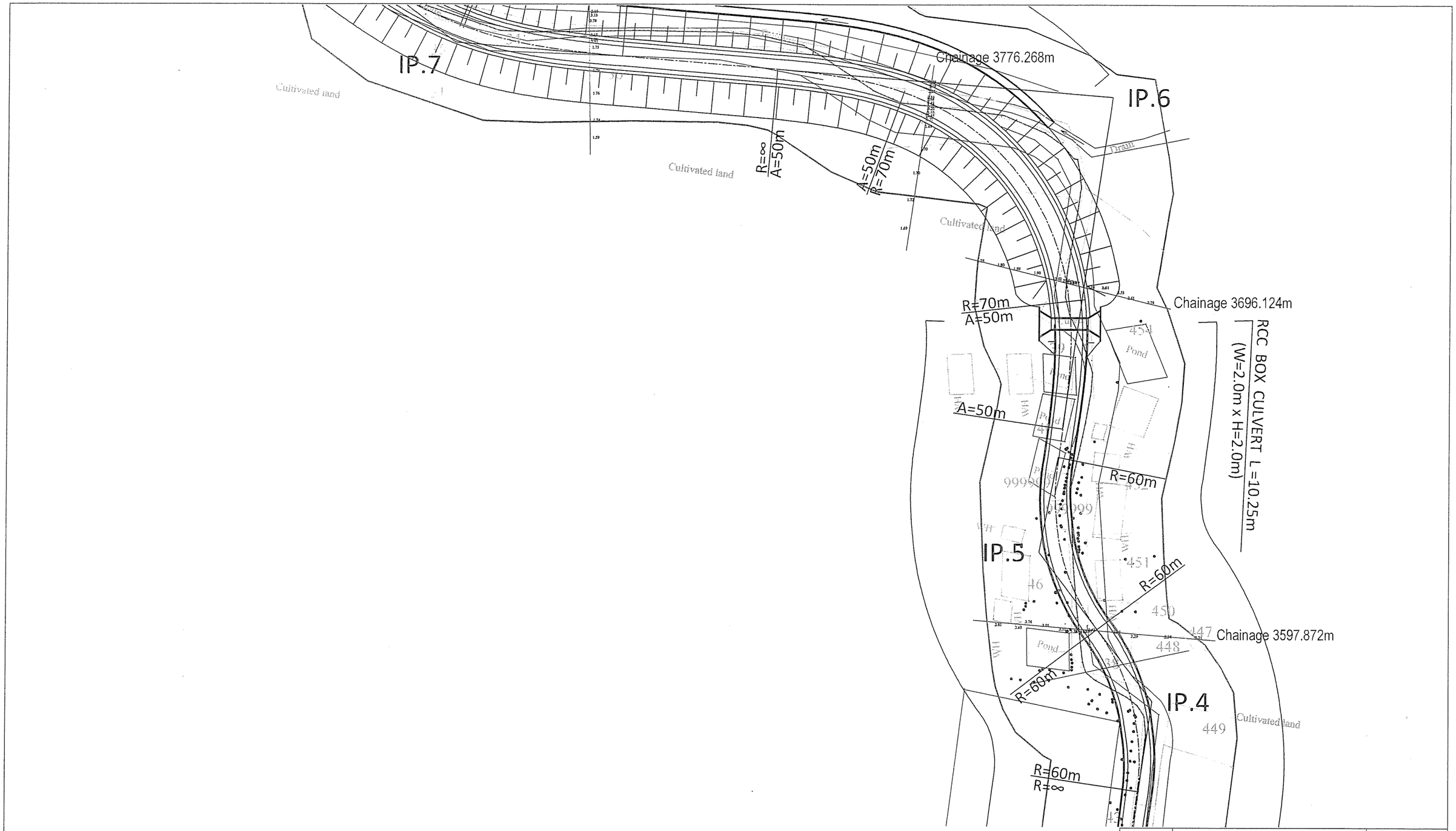

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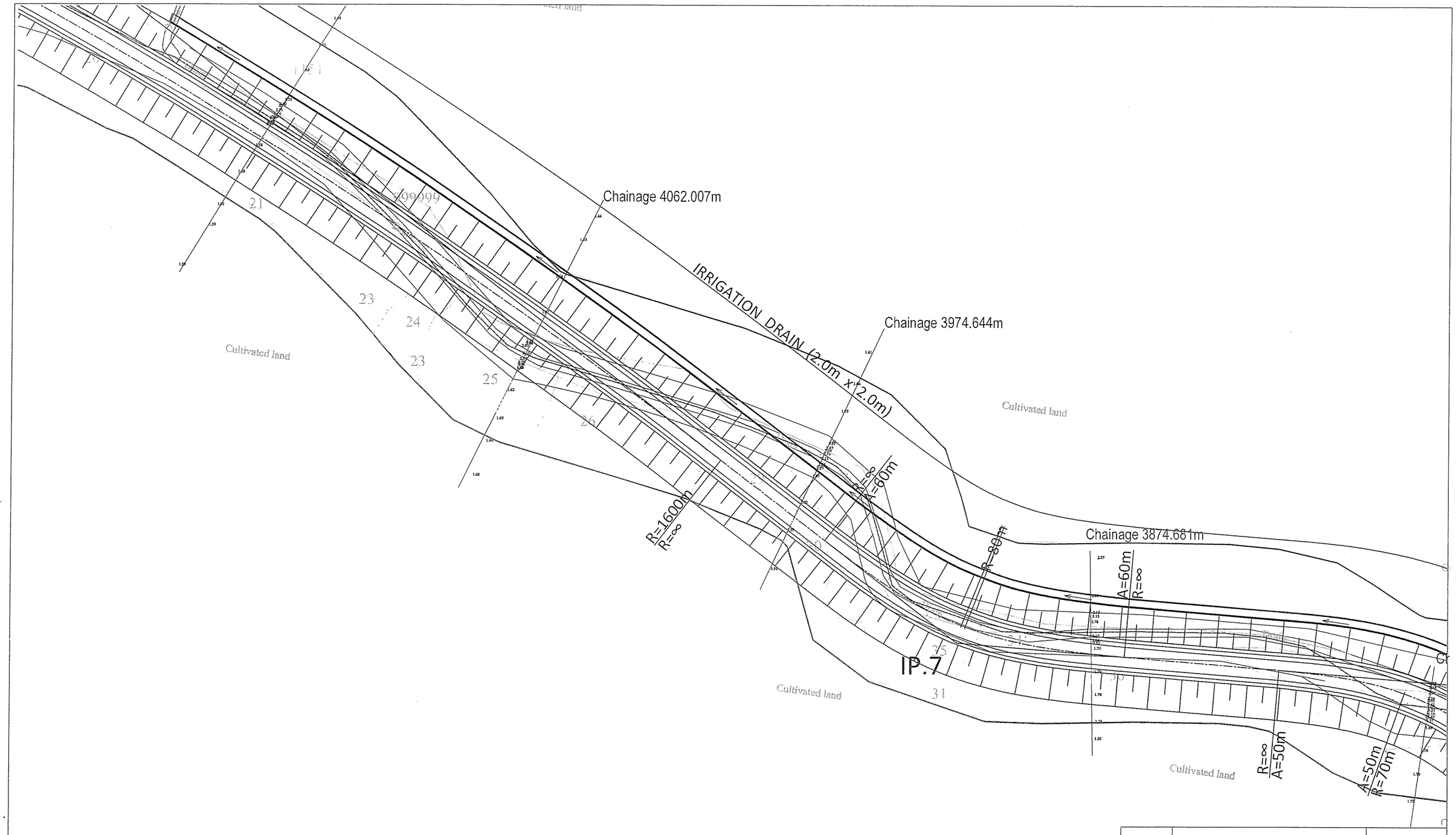

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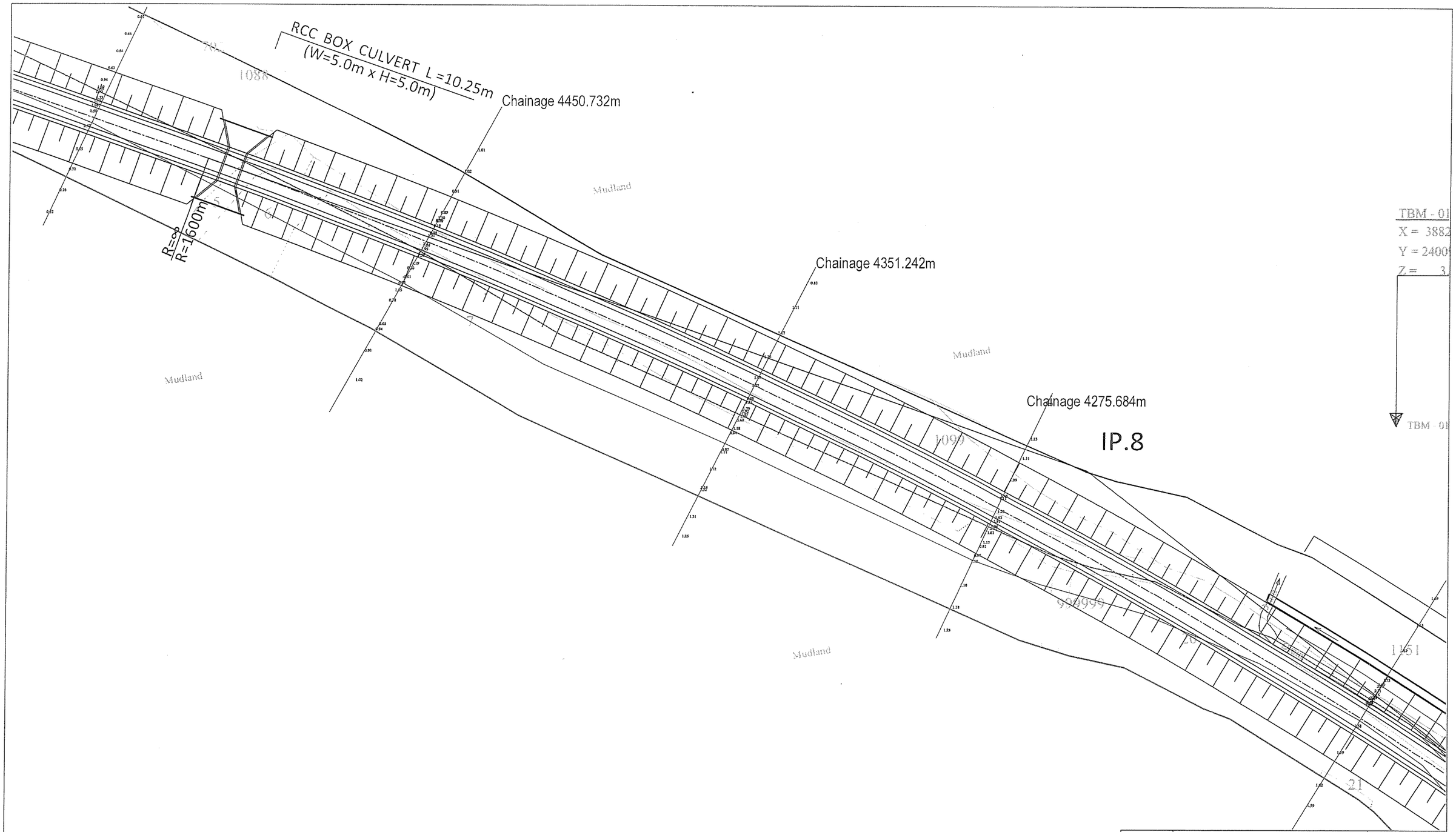

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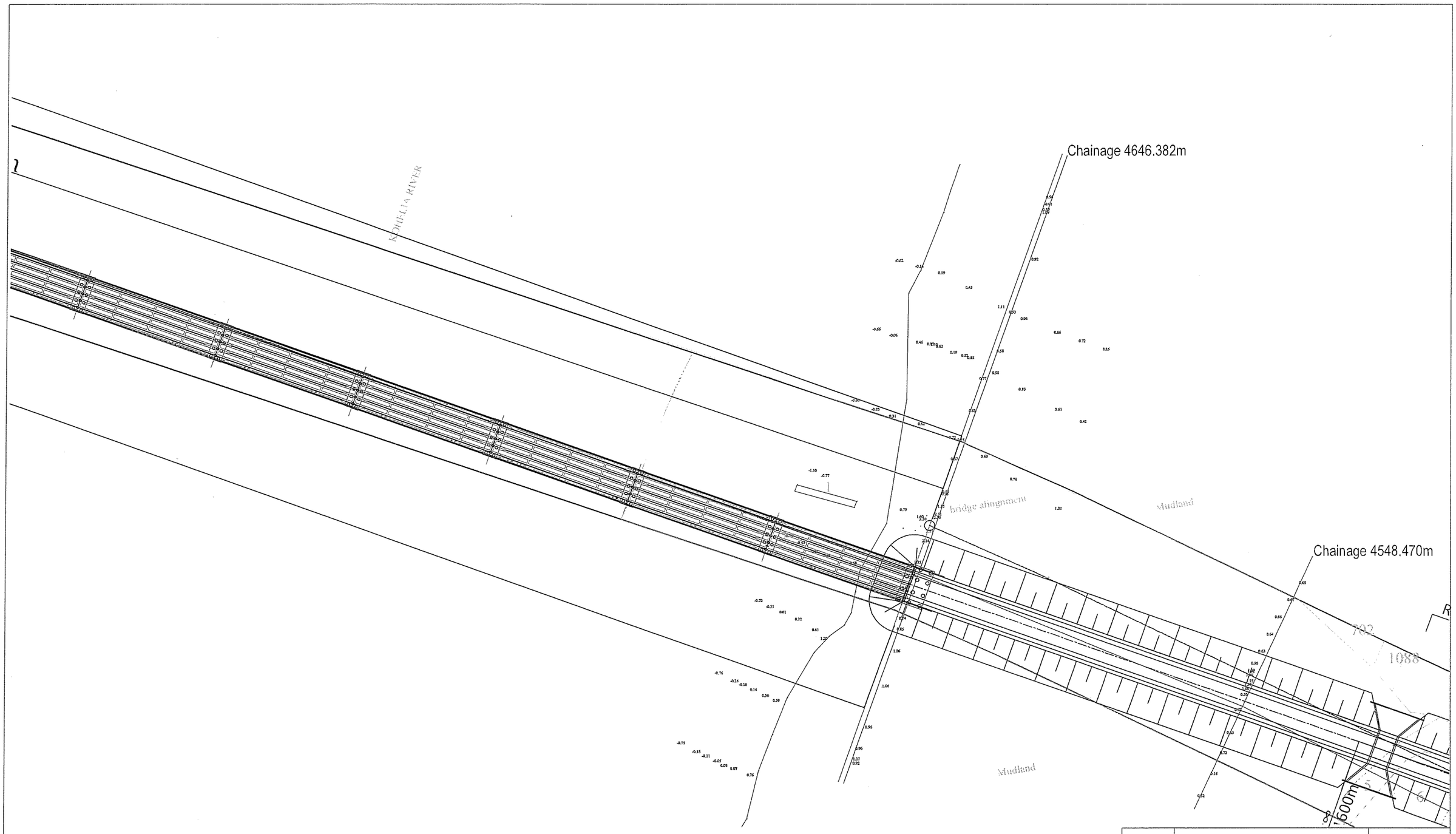

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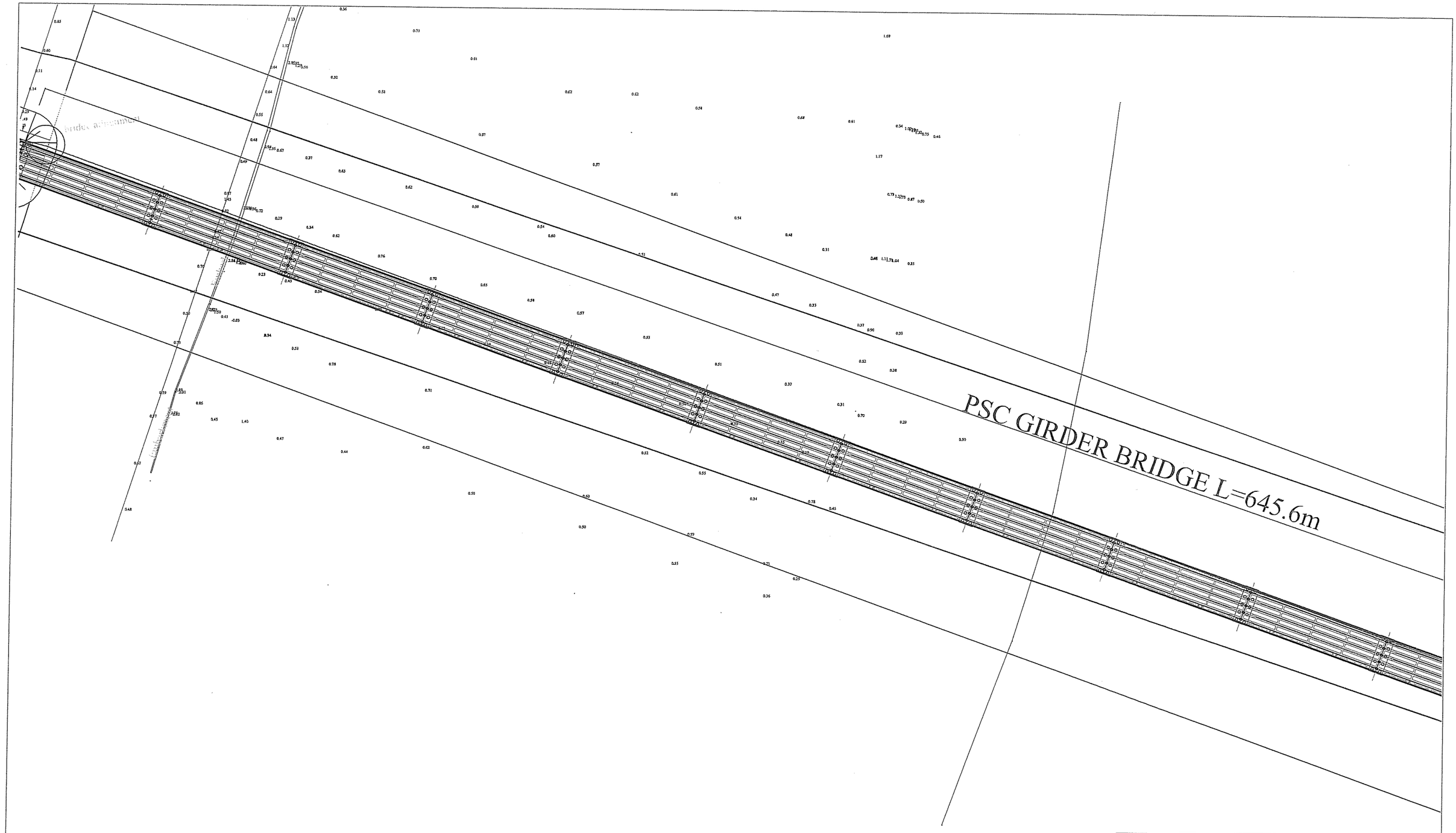

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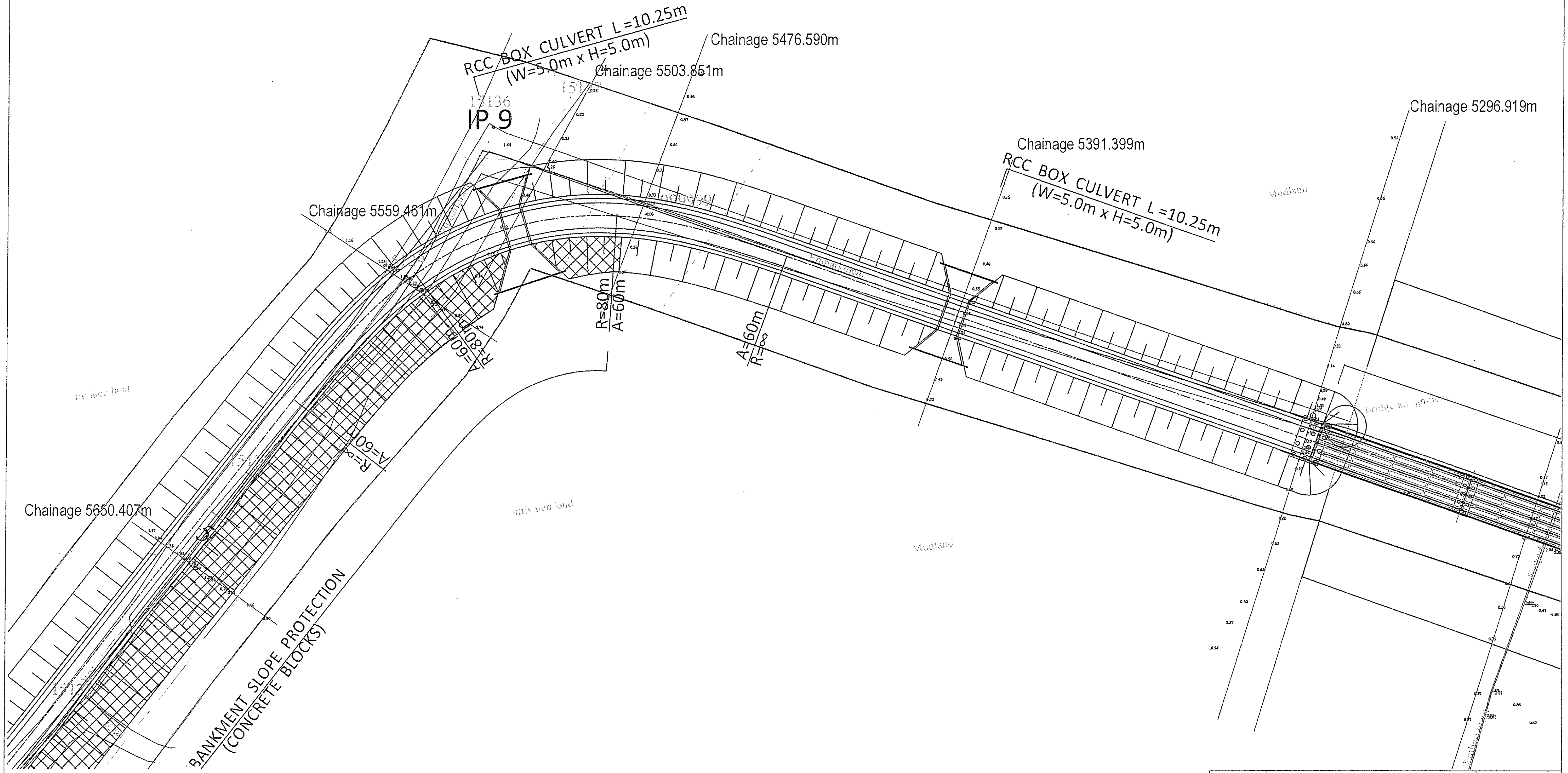

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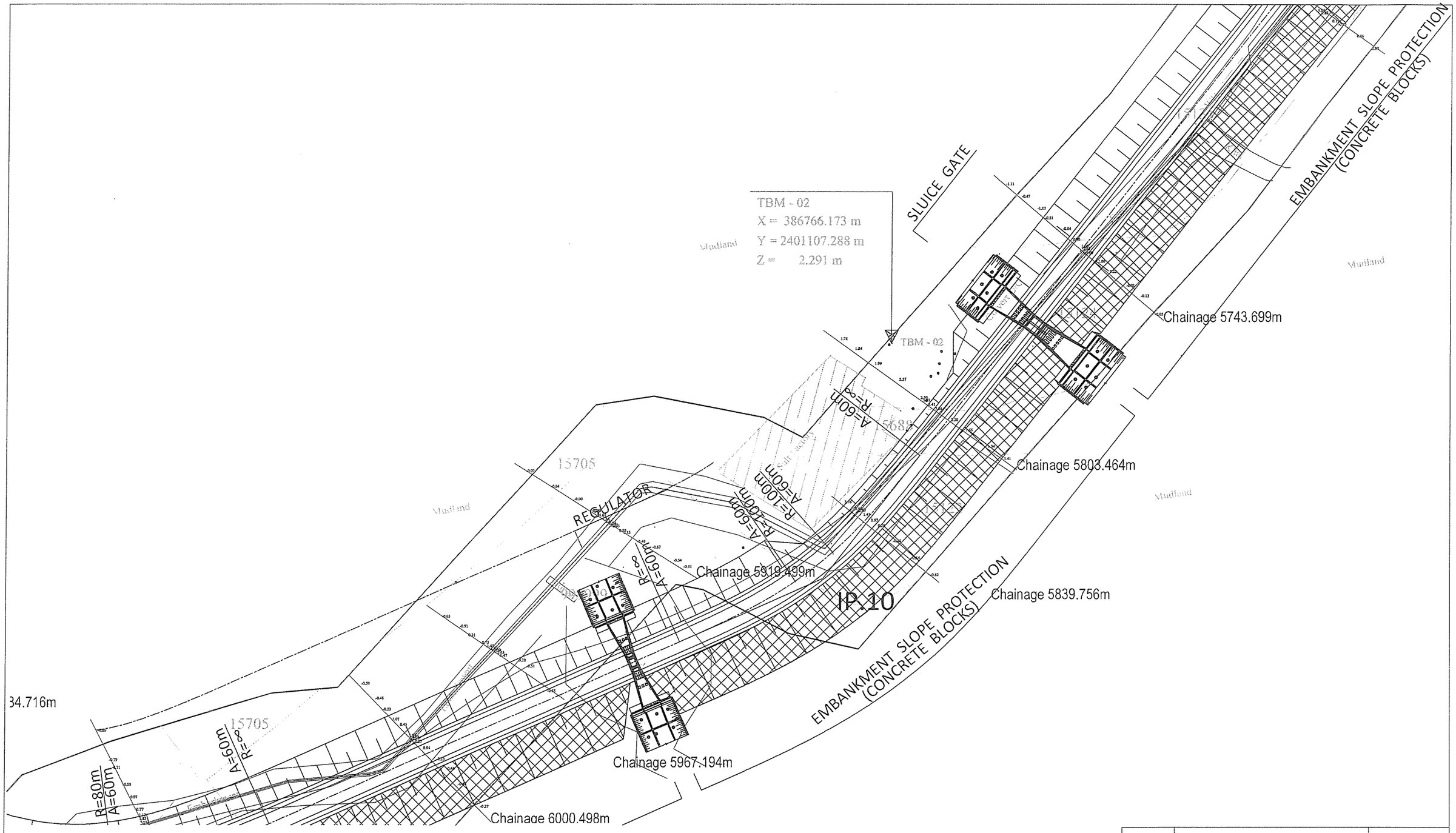
	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Roads and Highways Department (RHD) Ministry of Communications	Preparatory Survey on chittagong Area Coal Fared Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)	ROAD PLAN VIEW BADARKHALI TO POWER PLANT SITE	SCALE : 1:1000	AUGUST, 2013	PLAN/DWG- 06 of 10



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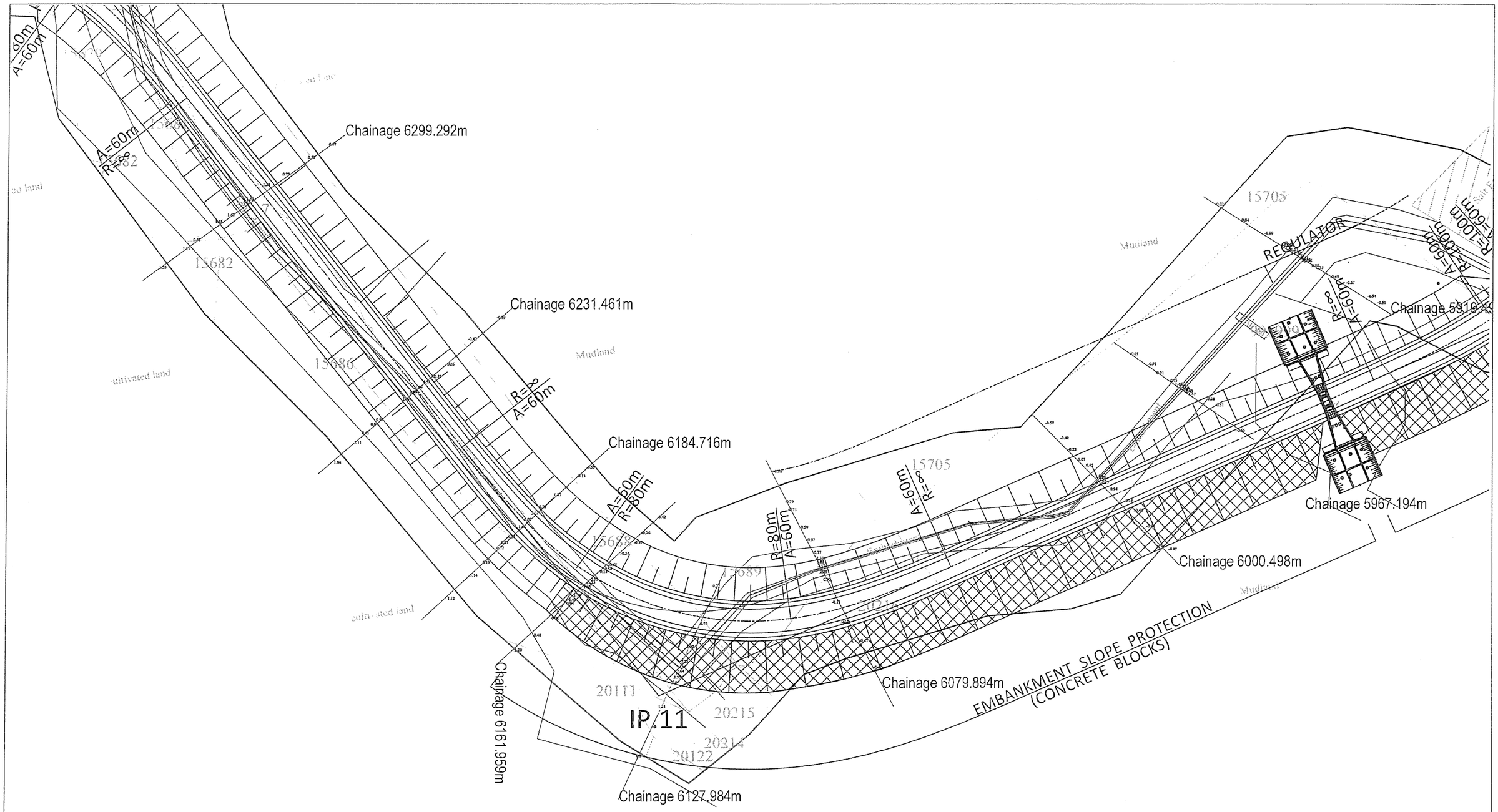

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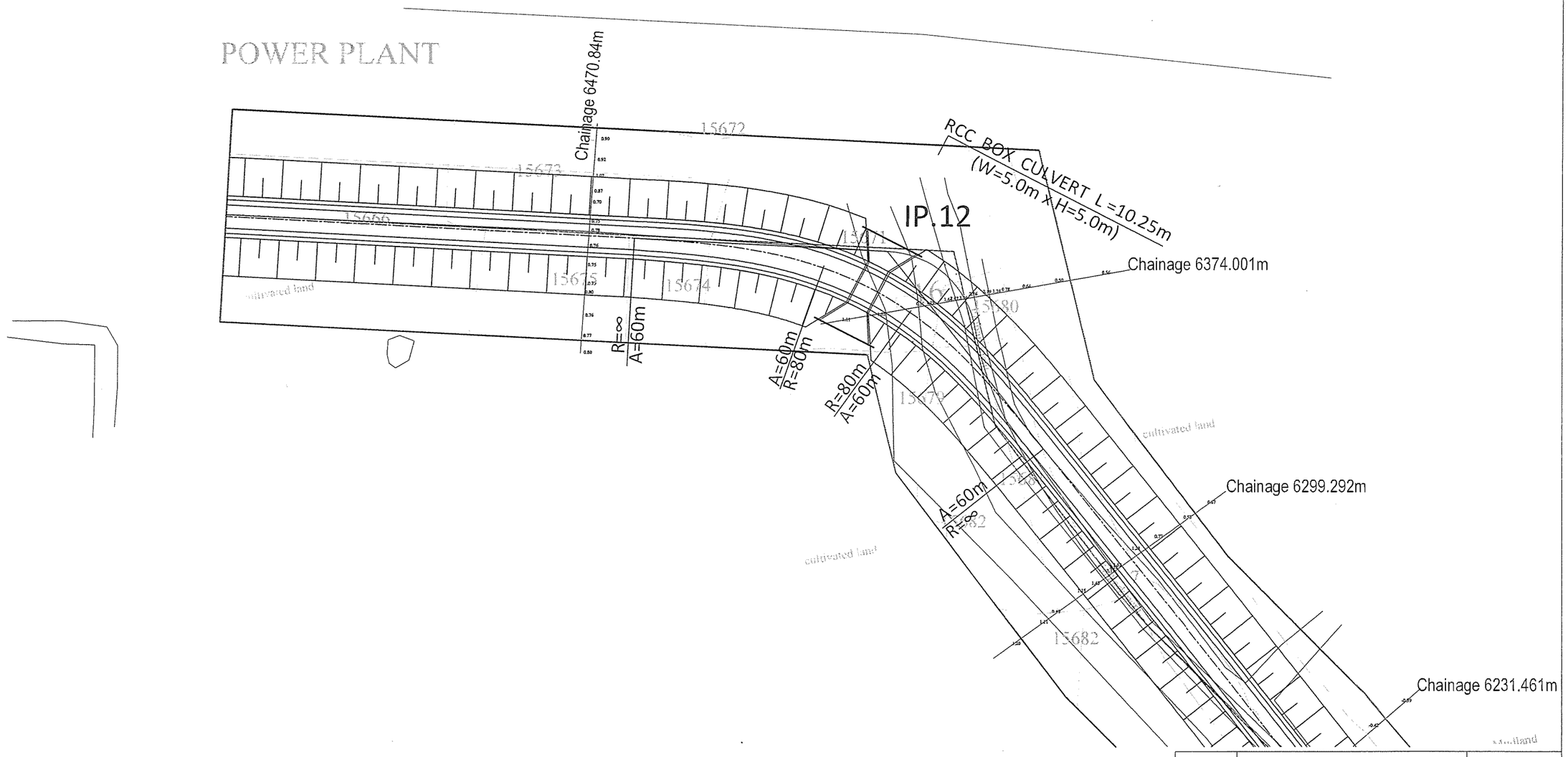

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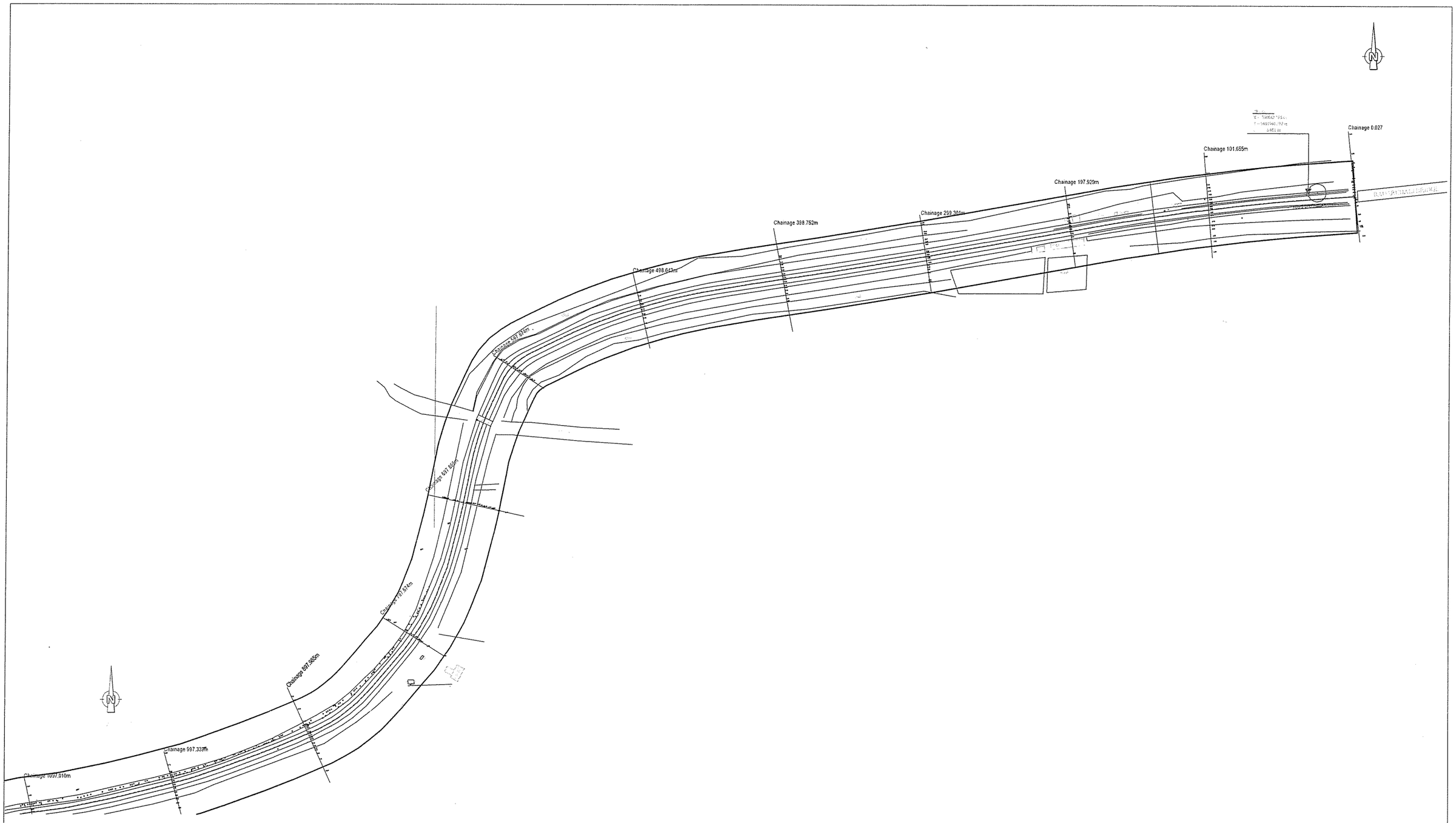
Roads and Highways Department (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on chittagong Area Coal Fared Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)	DRAWING TITLE : ROAD PLAN VIEW BADARKHALI TO POWER PLANT SITE	SCALE : SCALE : 1:1000	DATE : AUGUST, 2013	DRAWING NO. PLAN/DWG- 09 of 10

ROAD PLAN (EXISTING ROAD)



REV.	DESCRIPTION	DATE

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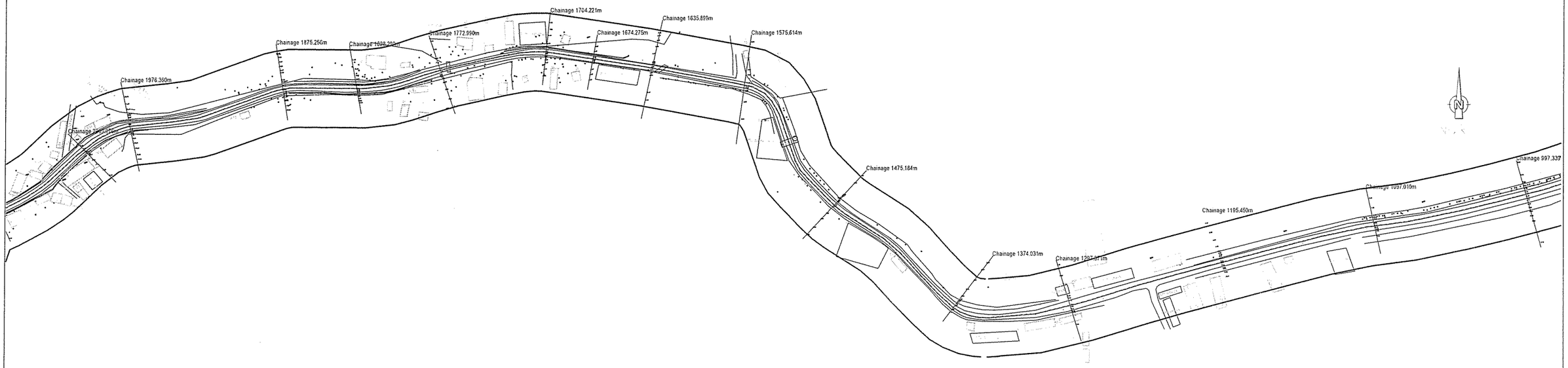

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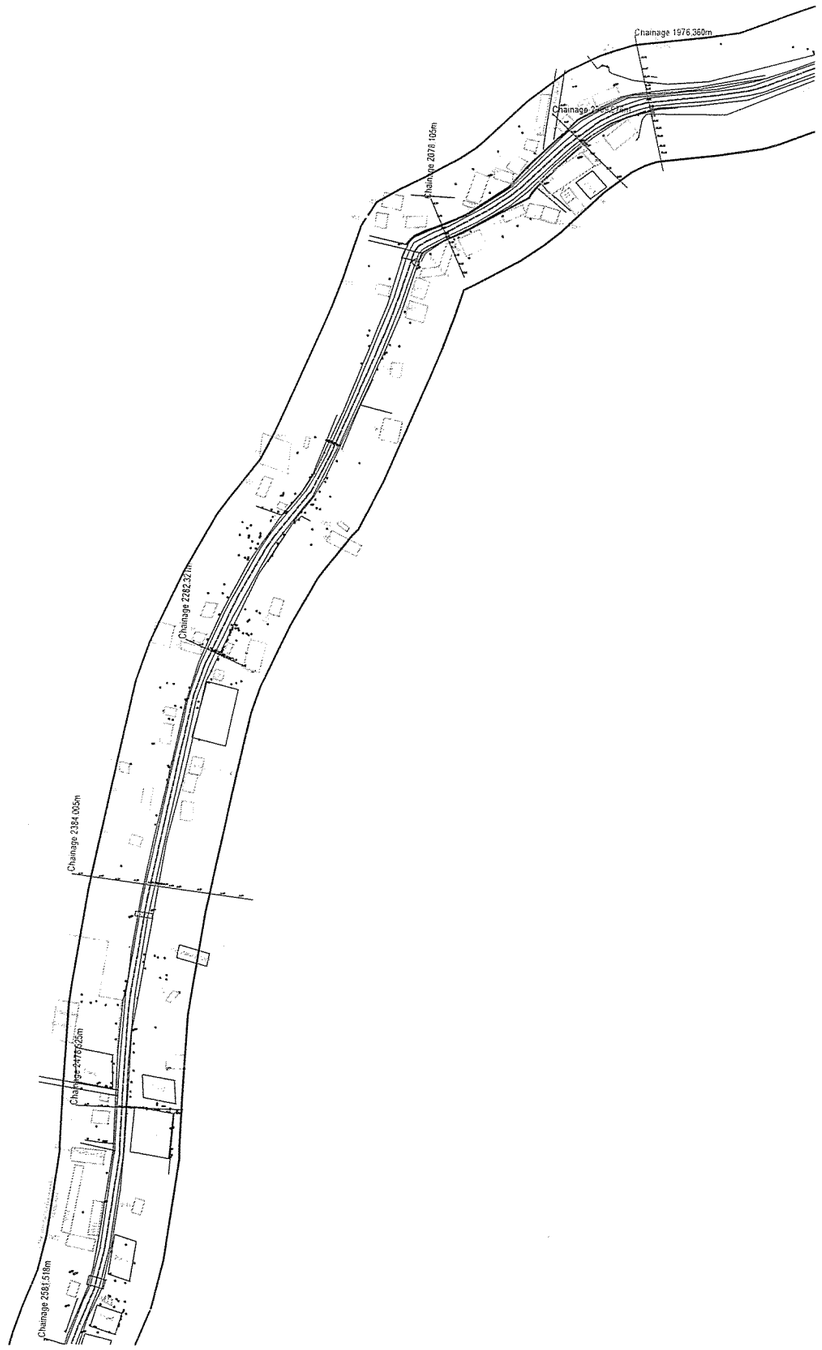

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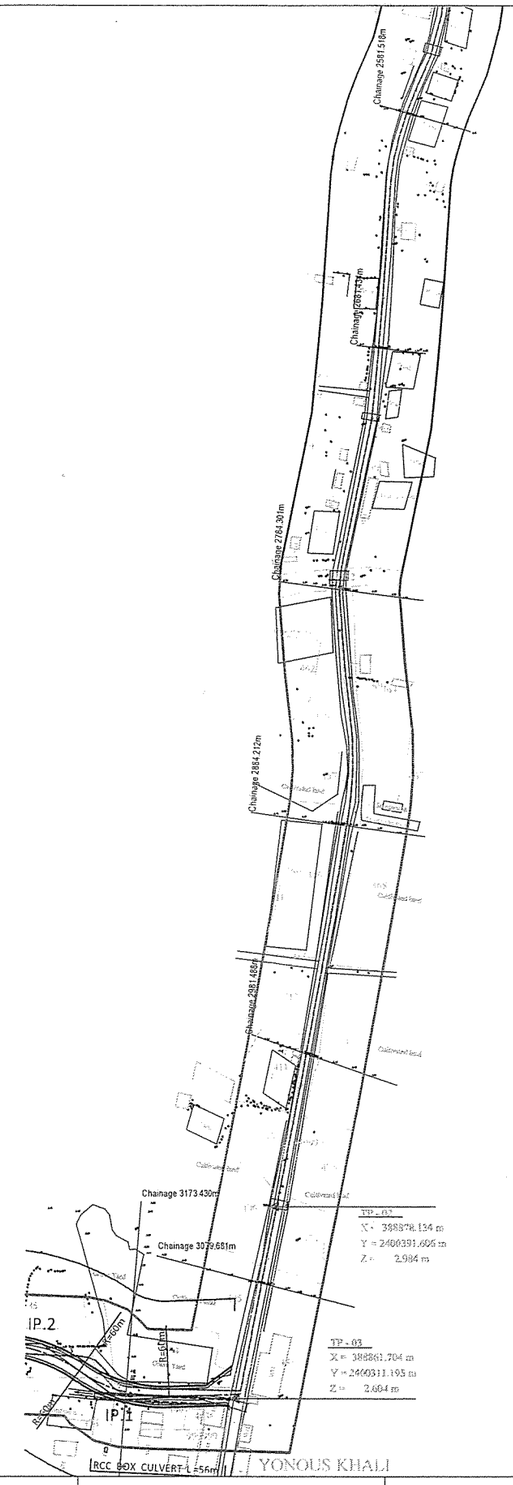

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NEW BRIDGE

GENERAL NOTES FOR RC CONSTRUCTION

1. CONCRETE

a) FOR PILE CAP, ABUTMENT, APPROACH SLAB, WING WALL, RETURN WALL , CULVERTS BASE SLAB, TOP SLAB, VERTICAL WALLS AND APRONS ETC.
- −28 DAYS STANDARD CYLINDER CRUSHING STRENGTH : fc'=30 N/mm²
- −CONCRETE MIX PROPORTION SHALL BE DECIDED BY MIX DESIGN IN ACCORDANCE WITH SPECIFICATION.

b) FOR DIAPHRAGM, PIER COLUMN, PIER CAP ETC.
- −28 DAYS STANDARD CYLINDER CRUSHING STRENGTH : fc'=30 N/mm²
- −CONCRETE MIX PROPORTION SHALL BE DECIDED BY MIX DESIGN IN ACCORDANCE WITH SPECIFICATION.

c) FOR DECK SLAB, KERBS, RAILINGS, FOOTPATH & BEARING PEDSTALS
- −28 DAYS STANDARD CYLINDER CRUSHING STRENGTH : fc'=35 N/mm²

d) FOR BORED PILES
- −28 DAYS STANDARD CYLINDER CRUSHING STRENGTH : fc'=30 N/mm²

2. REINFORCEMENT

a) TYPE:
DEFORMED BILLET MILD STEEL BARS IN ACCORDANCE WITH ASTM DESIGNATION : A615M−87 OR EQUIVALENT.

b) STRENGTH :
MINIMUM YIELD STRENGTH 415 N/mm² (60000 psi) FOR HYS DEFORMED BAR (Y)

c) SPLICES IN REINFORCEMENT :
- −SPLICES IN REINFORCEMENT IF NECESSARY SHALL BE MADE ONLY AS AUTHORISED BY THE ENGINEER.
- −SPLICES IN REINFORCEMENT AT POINT OF MAXIMUM STRESS IN SLABS, BEAMS, GIRDERS SHALL NOT BE PERMITTED.
- −LAP LENGTH FOR HYS DEFORMED BAR UNLESS OTHERWISE SHOWN WILL BE:

FOR TENSION BAR : − 40 x DIAMETER OF BAR
FOR COMPRESSION BAR: − 30 x DIAMETER OF BAR

d) LAPS SHALL BE STAGGERED AND NOT MORE THAN 50% OF THE HYS DEFORMED BARS AND 25% OF PLAIN BARS SHALL BE LAPPED AT ANY SECTION.

e) TYPE OF REINFORCEMENT IN RC BRIDGE AND PSC BRIDGE SHALL BE PROVIDED AS SHOWN IN DRAWING AND DETAILS.

f) BAR BENDING SCHEDULE GIVEN HEREWITH ARE PROVISIONAL AND CONTRACTOR SHALL PREPARE ACTUAL BAR BENDING SCHEDULE APROVED BY THE ENGINEER BEFOR BAR CUTTING.

3. CLEAR COVER TO MAIN REINFORCEMENT

a)
RAIL POST	= 25mm ALL FACES
RAIL BAR	= 20mm ALL FACES
KERB, POST BASE	= 25mm ALL FACES

b) DECK SLAB

TOP BARS	= 50mm
BOTTOM BARS	= 40mm
EDGES	= 40mm

c) GIRDERS AND DIAPHRAGMS

TOP BARS	= 50mm
BOTTOM BARS	= 50mm
SIDES	= 40mm

d) PIER COLUMN = 75mm (ALL FACES)

e) PIER CAP = 50mm (ALL FACES)

f) ABUTMENT AND WING WALLS = 75mm (ALL FACES)

g) PILE AND PILE CAP = 75mm (ALL FACES)

4. CONSTRUCTION JOINTS IN ADDITION TO THE PLACES SHOWN IN THE DRAWING IF REQUIRED SHALL BE PROVIDED AS PER DIRECTION OF THE ENGINEER−IN−CHARGE

5. GUIDE TO REINFORCEMENT ABBREVIATIONS:

EXAMPLE 1 : A1−Y20−100 INDICATES AS FOLLOWS:
- A1 : BAR MARK '1' IN ABUTMENT
- Y20 : GRADE−60 DEFORMED BAR 20mm DIA
- 100 : C/C BAR SPACING IN mm

EXAMPLE 2 : A3−10−Y20 INDICATES AS FOLLOWS:
- A3 : BAR MARK '3' IN ABUTMENT
- 10 : NO. OF BARS=10
- Y20: GRADE−60 DEFORMED BAR 20mm DIA

6. BEFORE CONSTRUCTION OF FOUNDATION A DETAILED SUBSOIL INVESTIGATION MUST BE CARRIED OUT IN ORDER TO VERIFY THE LENGTH OF PILE AND ITS GEOTECHNICAL CAPACITY AGAINST THE SERVICE LOAD SHOWN ON THE GENERAL ARRANGEMENT DRAWING.

7. EXPANSION JOINTS SHALL HAVE TO CATER FOR A TOTAL MOVEMENT AS INDICATED IN RESPECTIVE DRAWING IT MUST BE PROVIDED OVER THE FULL WIDTH OF DECK AND FOLLOW THE PROFILE INCLUDING KERB AND FOOTPATH.

8. CONCRETE WEARING COORSE OF 50mm THICKNESS SHALL BE PROVIDED AS PER SPECIFICATIONS.

9. FILTER MATERIAL SHALL BE BRICK AGGREGATES AS PER TECHNICAL SPECIFICATIONS AND SHALL BE WELL PACKED TO A THICKNESS NOT LESS THAN 450mm WITH SMALLER SIZE TOWARDS THE SOIL AND BIGGER SIZE TOWARDS THE WALL AND PROVIDED OVER THE ENTIRE SURFACE BEHIND ABUTMENT, WING OR RETURN WALLS TO THE FULL HEIGHT.

10. BACK FILL MATERIAL BEHIND ABUTMENT AND WINGWALLS SHALL BE OF SUITABLE GRANULAR SOIL AS PER TECHNICAL SPECIFICATIONS. MATERIAL FOR BACK FILL SHALL BE APPROVED BY THE ENGINEER IN CHARGE.

11. ABUTMENT DIRT WALL OF PSC BRIDGES SHALL BE CAST ONLY AFTER THE COMPLETION OF ALL PRESTRESSING OPERATIONS

REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE :	SCALE :	DATE : / DRAWING NO.
			GENERAL NOTES OF RCC WORK	Scale : N.T.S.	02 July' 2013 / BRDG/GEN/DWG−01

GENERAL REQUIREMENTS FOR PSC GIRDER

A. MATERIAL STRENGTH

01. CONCRETE SHALL HAVE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH OF STANDARD CYLINDER OR CUBE 15 cm) AT 28 DAYS, ARE AS FOLLOWS:
    a) STANDARAD CYLINDER CRUSHING STRENGTH, f'c = 40 N/mm^2
    b) STANDARD CUBE CRUSHING STRENGTH, fcu = 46 N/mm^2
02. REINFORCING STEEL SHALL CONFORM TO ASTM A615–87 GRADE 60 DEFORMED BARS (MARKED 'Y') HAVING MINIMUM YEILD STRENGTH Fy = 415 N/mm^2.
03. PRESTRESSING STEEL SHALL BE OF 15.24mm DIA. 7 PLY UNCOATED LOW RELAXATION STRAND CONFORMING TO AASHTO–M203 OR EQUIVALENT HAVING THE FOLLOWING STRENGTH:
    (a) MINIMUM ULTIMATE TENSILE STRENGTH (UTS) f's = 1861 N/mm^2
    (b) MINIMUM YIELD STRENGTH f'y =1581 N/mm^2

03. PRESTRESSING CABLE SHALL BE CONSISTS OF 19 NOS.15.24mm DIA. STRAND (19T13) IN A SHEATHING/DUCT

B. PRESTRESSING ACCESSORIES

01. THE DETAILS OF ANCHORAGES, DUCTS, CABLE SPACINGS AND END BLOCK REINFORCEMENT SHOWN ON THE DRAWINGS ARE BASED ON FREYSSINET 19T13 MULTI–STRAND ANCHORAGE SYSTEM.
02. THE SHEATHING/DUCTS FOR THE 19T13 PRESTRESSING CABLES SHALL BE FORMED FROM 95mm INTERNAL DIA. (ID) CORRUGATED STEEL SHEATHS OF BRIGHT METAL STRIP HAVING MINIMUM THICKNESS 0.40mm. THE OUTSIDE DIA. (OD) OF THE SHEATH SHOULD BE ABOUT 6mm LARGER THAN THE ID. THE CONNECTING SLEEVES FOR SHEATH SHOULD HAVE A DIAMETER ABOUT 3.1mm GREATER.
03. FOLLOWING PROPERTIES HAVE BEEN CONSIDERED IN THE DESIGN
    AREA OF STRAND = 98.7 mm^2
    AREA OF CABLE = 1875 mm^2
    MODULLES OF ELASTICITY OF STRAND = $2x10^5$ (N/mm^2)
    AVERAGE SLIP = 6mm
    JACKING FORCE IN EACH CABLE = 2615 KN.

C. WORKMANSHIP DETAILING

01. AFTER SATISFACTORY COMPLETION OF TENSIONING THE CABLES SHALL GROUTED AS PER STANDARED SPECIFICATION. BESIDES THE GROUT HOLES AT STRESSING END ONE GROUT VENT MAY ALSO BE PROVIDED AT LOWEST POINT OF EACH CABLE, IF REQUIRED BY THE ENGINEER.
02. EXTRA LENGTH OF CABLE REQUIRED FOR FIXING FREYSSINET JACK IS 750mm. HOWEVER FOR OTHER ANCHORAGE SYSTEM GRIP LENGTH SHALL BE VERIFIED AT SITE.
03. THE CABLE MUST BE PLACED STRAIGHT AND CO–AXIAL WITH THE ANCHORAGE FOR A DISTANCE OF AT LEAST 400mm.
04. THE PROFILE OF LONGITUDINAL PRESTRESSING DUCTS SHALL BE MAINTAINED BY PROVIDING 10mm DIA. U–SHAPED MS WELDED SADDLES ATTACHED TO ONE BRANCH OF THE STIRRUPS @ 1000mm C/C APPROX.
05. NON–PRESTRESSED REINFORCEMENT IS TO BE ADJUSTED TO THE SATISFACTION OF THE EINGINNER, IF OBSTRUCTON TO CABLE DUCT OCCURS.

D. CLEAR COVER TO PRESTRESSING AND REINFORCING STEEL

01. MINIMUM CLEAR COVER TO REINFORCING STEEL SHALL BE 40mm.

E. PRESTRESSING AND GROUTING OPERATION

01. THE PRESTRESSING FORCE IN EACH CABLE AT ANCHORAGE DURING STRESSING PRIOR TO LOCK OFF (JACKING FORCE) SHALL BE 2615KN.
02. EACH CABLE SHALL BE SIMULTENOUSLY STRESSED FROM BOTH END OF PC GIRDER BY USING FREYSSINET/OR EUIVALENT MULTISTRAND JACK.
03. NO. OF STAGES, STRESSING SEQUENCE OF THE CABLES AND CONCRETE STRENGTH f'ci AT DIFFERENT STAGE OF STRESSING SHALL BE AS SHOWN ON RESPECTIVE SHEET OF THE DRAWING SERIES OF THE PC GIRDER.
04. THE APPLIED PRESTRESSING FORCES ON THE CABLES SHALL BE MEASURED ON THE RECENTLY JACKS ACCOMPANIED BY ELONGATION MEASUREMENT IN PRESENCE OF THE ENGINEER OR HIS DESIGNATED REPRESENTATIVE. PROPER RECORDS OF THE ABOVE SHALL BE MAINTAINED.
05. ALL DUCTS SHALL BE GROUTED FOLLOWING STRANDARD SPECIFICATION AFTER SATISFACTORY COMPLETION OF THE STRESSING OPERATIONS AND APPROVAL OF THE ENGINEER.
06. FOR ALL STRESSING AND GROUTING OPERATIONS, THE PROCEDURE GIVEN IN THE GUIDE FOR FREYSSINET OR EQUIVALENT METHODS SHALL BE USED.

F. INSTALLATION DETAILS

01. THE PC GIRDERS SHALL BE MOVED AT LEAST AFTER COMPLETION OF THE 1ST STAGE STRESSING OF THE CABLES AND GROUTING OF THE CABLE DUCTS ONLY.
02. THE PC GIRDERS SHALL BE LIFTED BY PROIVIDING SUPPORTS IN THE VICINITY OF THE CENTER LINE OF BEARINGS ONLY.
03. LATERAL SUPPORTS TO THE PRECAST PC GIRDER SHALL BE PROVIDED DURING MOVEMENT OPERATION OF THE SAME AND CONCRETING OF THE CAST–IN–SITU DECK.
04. TIME DIFFERENCE BETWEEN GIRDER CONCRETE & DECK CONCRETE SHALL NOT BE MORE THAN 2 MONTHS.

G. MISCELLANEOUS

01. THE SURFACE OF THE TOP FLANGE OF THE PC GIRDER SHALL BE INTENTIONALLY ROUGHENED EXPOSING ABOUT 6mm OR 1/4TH HEIGHT OF THE COARSE AGGREGATE BREAKING THEM TO DEVELOP COMPOSITE ACTION BETWEEN THE PC GIRDER CAST–IN–SITU DECK CONCRETE.
02. PRECAMBER TO THE GIRDER SHALL BE PROVIDED AT THE GIRDER SOFFIT BEFORE CASTING OF GIRDER
03. ALL LAP LENGTHS SHALL BE PROVIDED AT LEAST 40 x BAR DIA. AND SHALL BE STAGGERED BY +/– 50% UNLESS OTHERWISE SHOWN.

H. SPECIAL NOTE FOR PRESTRESSING

01. (i) IF THE CALCULATED ELONGATION IS REACHED BEFORE THE CALCULATED GUAGE PRESSURE IS OBTAINED, CONTINUE TENTIONING TILL ATTAINING THE CALCULATED GAUGE PRESSURE,PROVIDED THE ELONGATION DOES NOT EXCEED 1.05 TIMES THE CALCULATED ELONGATION. IF THIS ELONGATION IS ACHIEVED BEFORE THE CALCULATED GUAGE PRESSURE IS ATTAINED, STOP STRESSING AND INFORM THE ENGINEER.

(ii) IF THE CALCULATED ELONGATION HAS NOT BEEN REACHED CONTINUE TENSIONING BY INTERVALS OF 5 Kg/Sq.CM UNTIL THE CALCULATED ELONGATION IS REACHED PROVIDED THE GAUGE PRESSURE DOES NOT EXCEED 1.05 TIMES THE CALCULATED GUAGE PRESSURE.

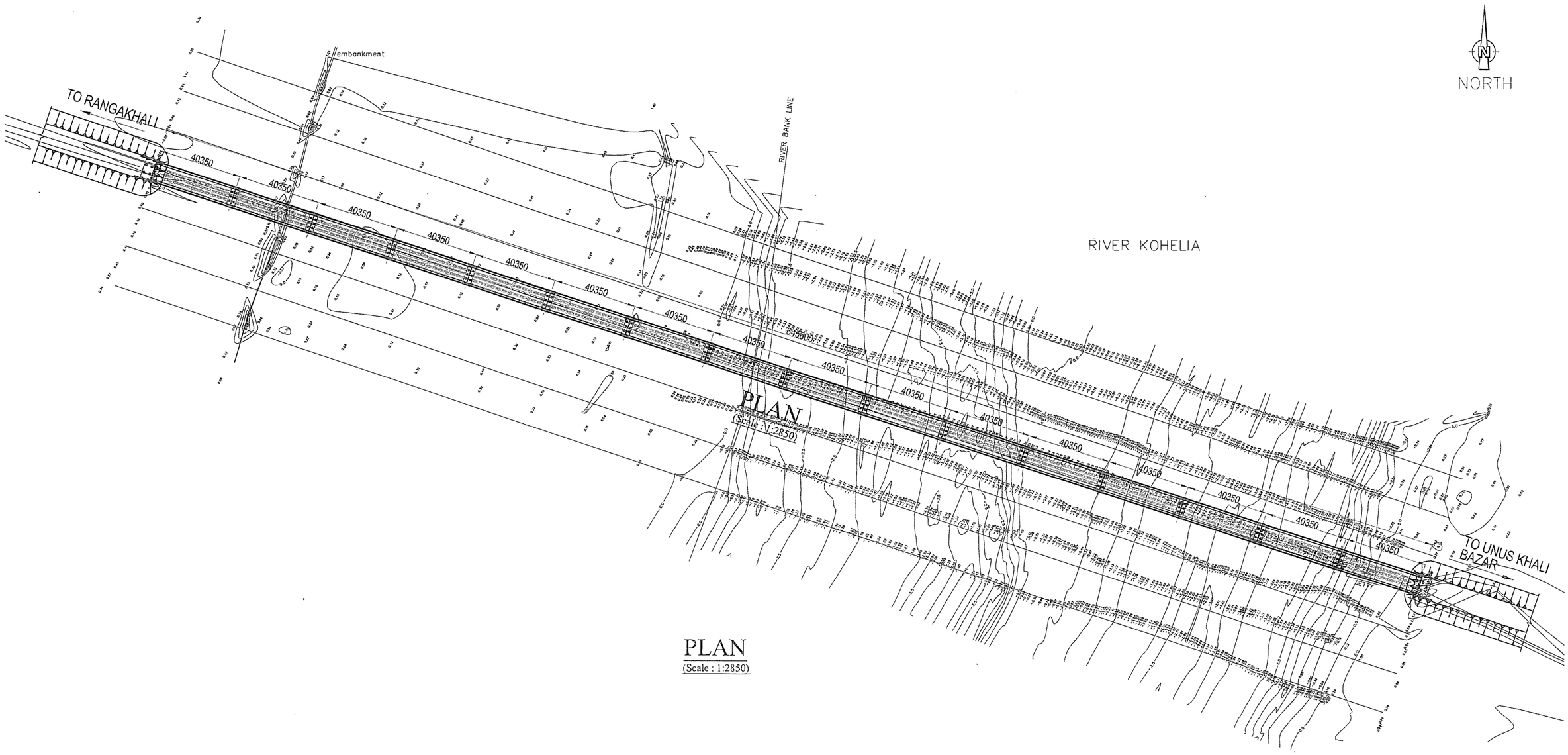
(iii) IF THE ELONGATION AT 1.05 TIMES THE CALCULATED GAUGE PRESSURE IS LESS THAN 0.95 TIMES THE CALCULATED ELONGATION, THE FOLLOWING MEASURES MUST BE TAKEN, IN SUCCESSION,TO DEFINE THE CAUSE OF THIS LACK OF ELONGATION.

- RECALIBRATE THE PRESSURE GUAGE
- CHECK THE CORRECT FUNCTIONING OF THE JACK. PUMP AND LEADS.
- DE–TENSION THE CABLE, SLIDE IT IN ITS DUCT TO CHECK THAT IT IS NOT BLOCKED BY MORTAR WHICH HAS ENTERED THROUGH HOLES IN THE SHEATH. RE–TENSION THE CABLE IF FREE. IF THE REQUIRED ELONGATION IS NOT OBTAINED. FURTHER FINISHING OPERATIONS SUCH AS CUTTING OR SEALING SHOULD NOT BE UNDERTAKEN WITHOUT THE APPROVAL OF THE ENGINEER.

02. ELONGATION SHOWN IN THE DRAWINGS SHALL BE CORRECTED FOR THR ACTUAL 'A' AND 'E' VALUE OF WIRES OBTAINED FROM THE MANUFACTURER .
    CORRECTED ELONGATION = ELONGATION SHOWN IN THE DRAWINGS x A.E/A1.E1
    A, E ARE THE DESIGN AREA AND MODULUS OF ELASTICITY OF WIRES.
    A1,E1 ARE ACTUAL AREA AND MODULUS OF ELASTICITY OF WIRES.

REV.	DESCRIPTION	DATE

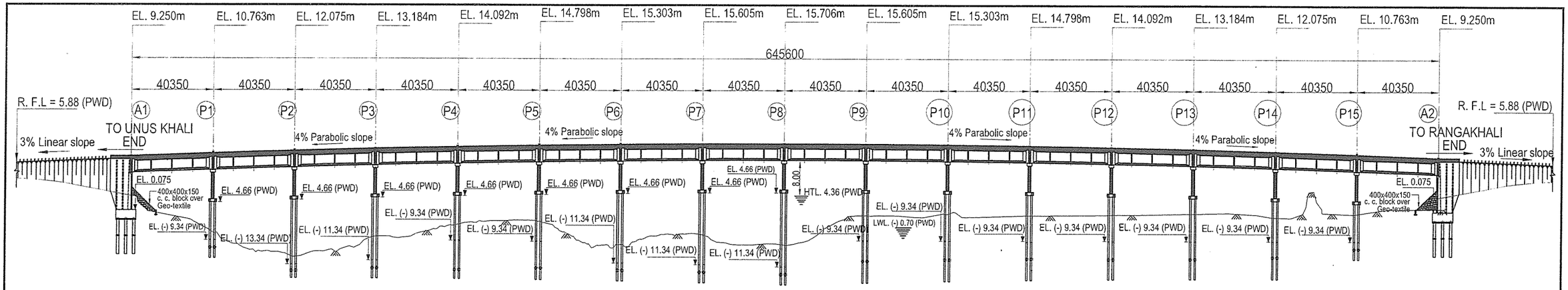
ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	GENERAL NOTES FOR PSC WORK	Scale : N.T.S.	02 July' 2013	BRDG/GEN/DWG–02



PLAN
(Scale : 1:2850)

REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE : LAYOUT PLAN OF 640.0m LONG PSC GIRDER BRIDGE OVER KOHELIA RIVER, COX'S BAZAR.	SCALE : Scale : As above	DATE : 02 July' 2013	DRAWING NO. BRDG/S_LP/DWG-03

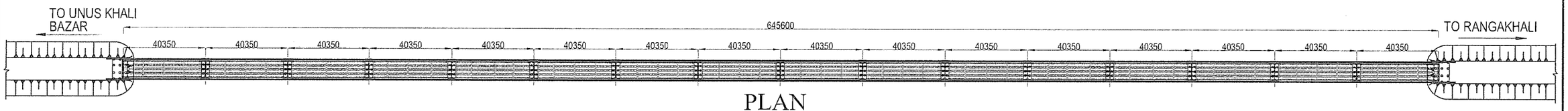


GENERAL ELEVATION

(Scale : 1:2000)

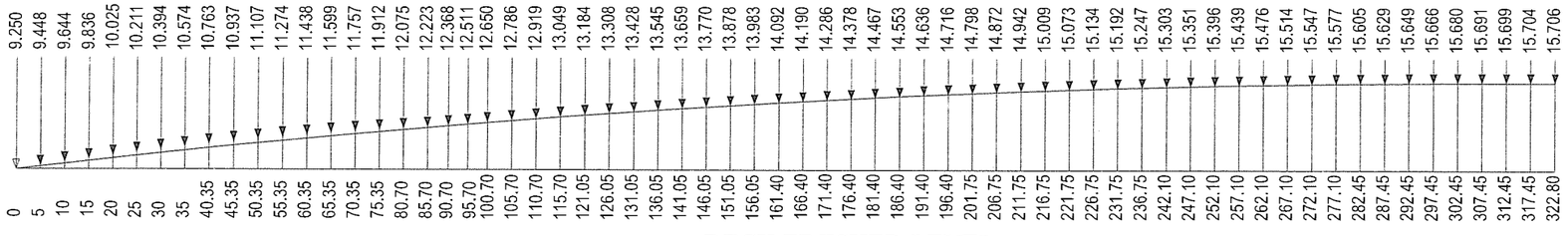
EXIST. RL (m)	2.150 1.250 0.570 0.380 0.190 0.000 -0.270 -0.830 -1.380 -2.130 -2.550 -2.900 -3.170 -3.360 -3.400 -3.500 -3.870 -3.710 -3.370 -3.320 -3.170 -3.030 -2.900 -2.390 -1.880 -1.830 -1.920 -1.910 -1.690 -1.370 -1.090 -0.890 -0.710 -0.470 -0.460 -0.350 -0.230 -0.270 -0.220 -0.230 -0.250 -0.480 -0.940 -1.450 -2.070 -2.470 -2.770 -2.680 -2.640 -2.860 -2.300 -1.910 -1.760 -1.590 -1.640 -1.550 -1.540 -1.790 -2.370 -2.490 -2.650 -2.640 -2.570 -2.510 -2.560 -2.640 -2.420 -2.210 -1.510 -0.790 -0.270 0.230 0.290 0.270 0.290 0.270 0.170 0.110 0.230 0.420 0.550 0.100 0.130 0.150 0.190 0.230 0.260 0.300 0.310 0.310 0.320 0.320 0.330 0.340 0.350 0.360 0.380 0.390 0.390 0.400 0.420 0.450 0.460 0.480 0.500 0.510 0.540 0.560 0.530 0.470 0.420 0.260 0.140 0.110 0.270 1.200 1.750 0.560 0.540 0.490 0.500 0.640 0.790 0.940 0.970 0.980 0.980 0.980 0.980 1.000
DISTANCE (m)	0.00 5.00 10.00 15.00 20.00 25.00 30.00 35.00 40.00 45.00 50.00 55.00 60.00 65.00 70.00 75.00 80.00 85.00 90.00 95.00 100.00 105.00 110.00 115.00 120.00 125.00 130.00 135.00 140.00 145.00 150.00 155.00 160.00 165.00 170.00 175.00 180.00 185.00 190.00 195.00 200.00 205.00 210.00 215.00 220.00 225.00 230.00 235.00 240.00 245.00 250.00 255.00 260.00 265.00 270.00 275.00 280.00 285.00 290.00 295.00 300.00 305.00 310.00 315.00 320.00 325.00 330.00 335.00 340.00 345.00 350.00 355.00 360.00 365.00 370.00 375.00 380.00 385.00 390.00 395.00 400.00 405.00 410.00 415.00 420.00 425.00 430.00 435.00 440.00 445.00 450.00 455.00 460.00 465.00 470.00 475.00 480.00 485.00 490.00 495.00 500.00 505.00 510.00 515.00 520.00 525.00 530.00 535.00 540.00 545.00 550.00 555.00 560.00 565.00 570.00 575.00 580.00 585.00 590.00 595.00 600.00 605.00 610.00 615.00 620.00 625.00 630.00 635.00 640.00 645.00

SECTION AT BRIDGE CENTER LINE



PLAN

(Scale : 1:2850)



DECK FINISHED LEVEL

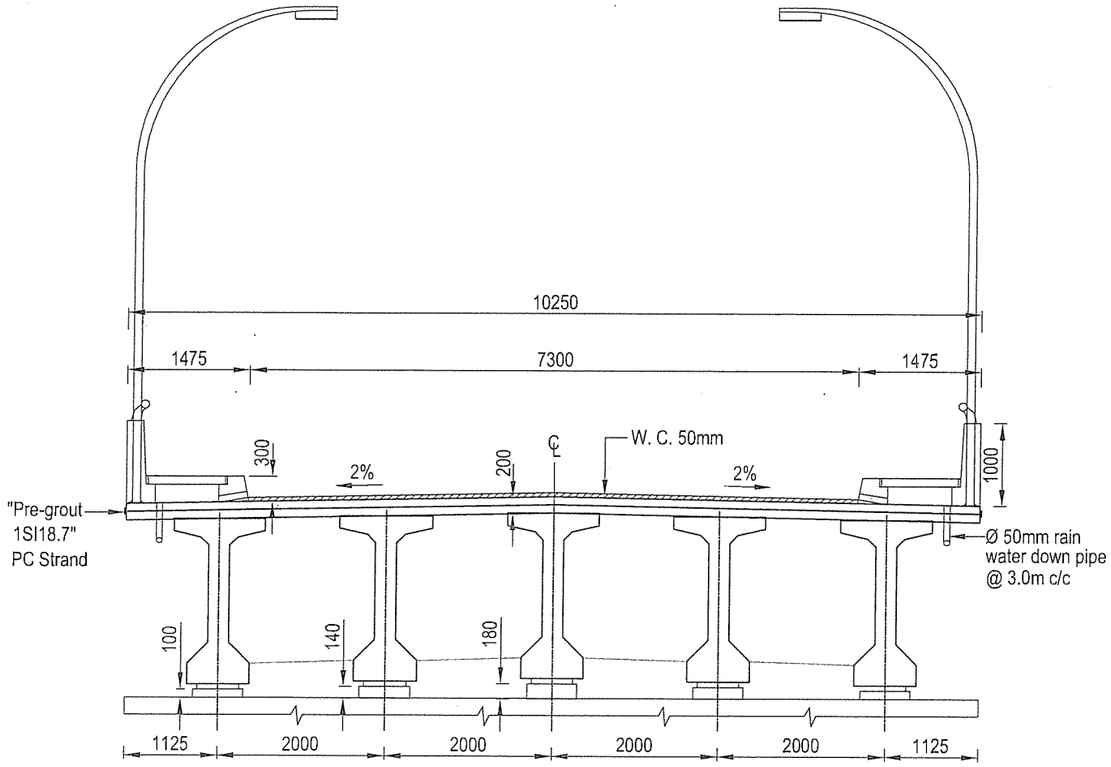
(Scale : 1:500)

Note :

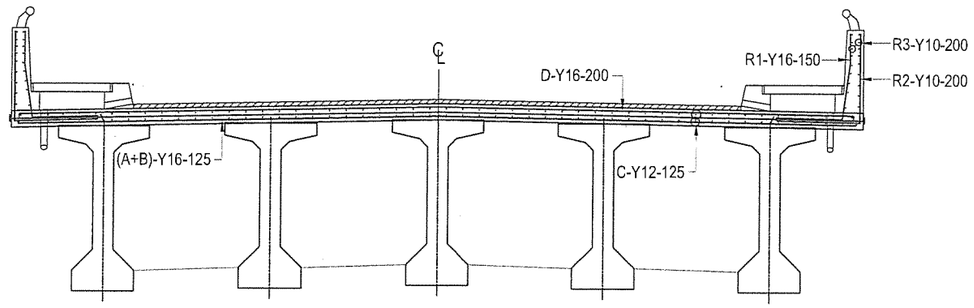
1. All dimensions are in mm unless otherwise specified.
2. In the Bridge 4% Parabolic Slope and in the Approach 3% Linear slope is used.

REV.	DESCRIPTION	DATE

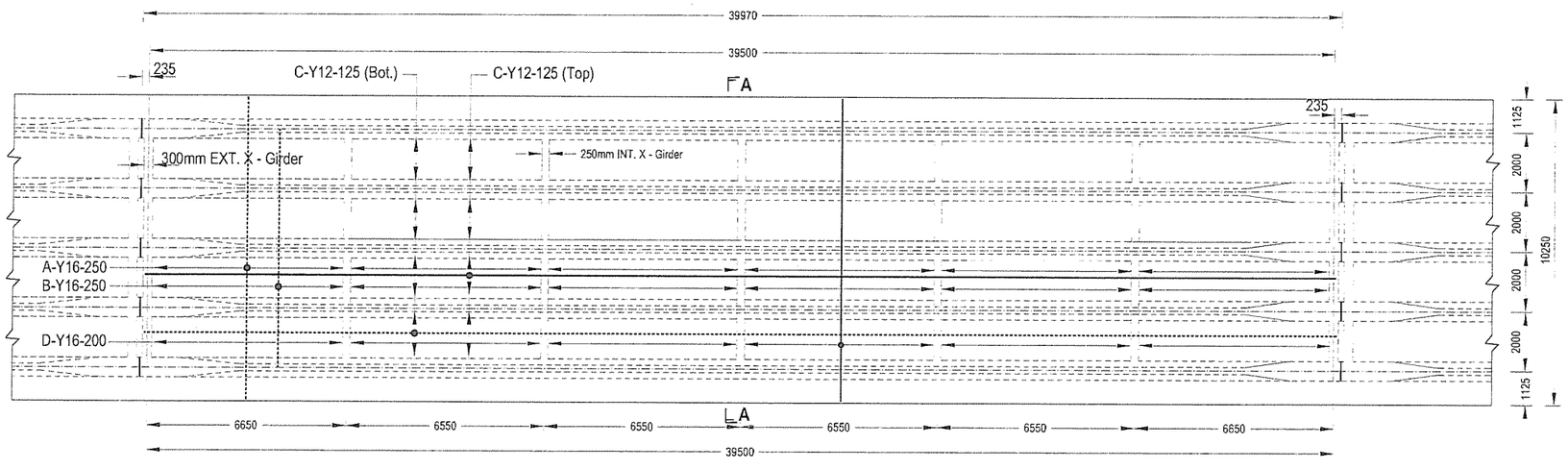
ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLAN AND SECTIONAL ELEVATION OF 640.0m LONG PSC CONCRETE GIRDER BRIDGE OVER KOHELIA RIVER	Scale : As above	02 July' 2013	BRDG/D-40/DWG-04



DECK SECTION (CONCRETE)



DECK SECTION (REINFORCEMENT)



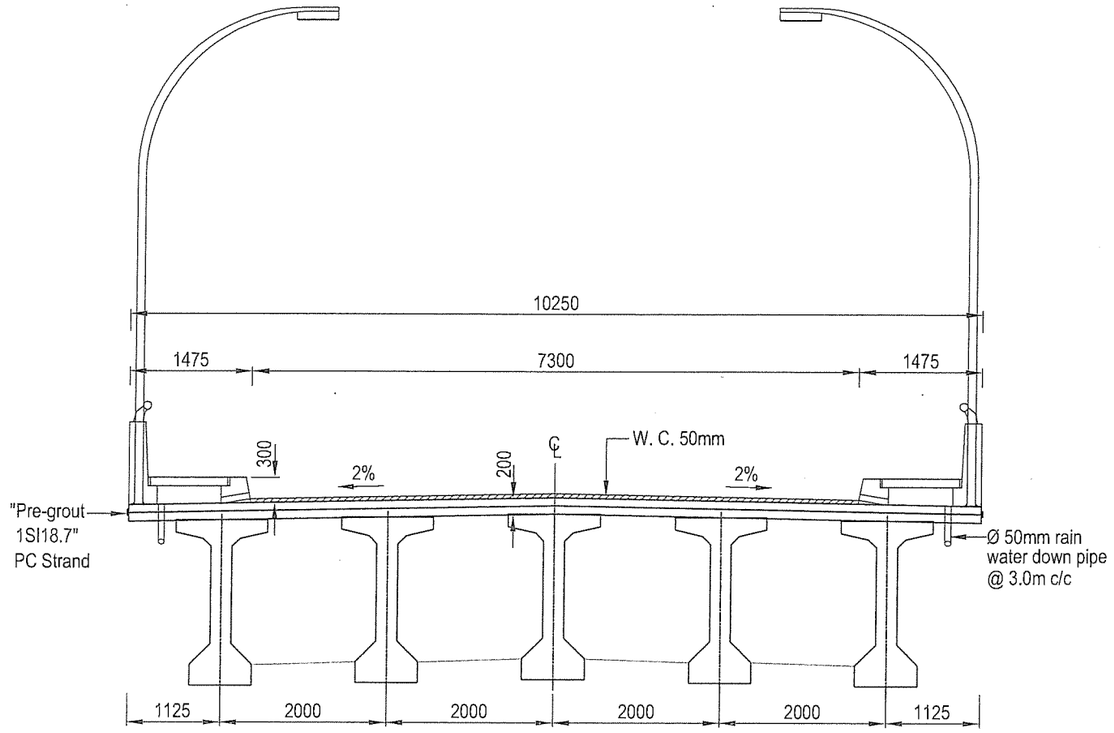
PLAN OF DECK SECTION (REINF.)
(Scale : 1:150)

Note :

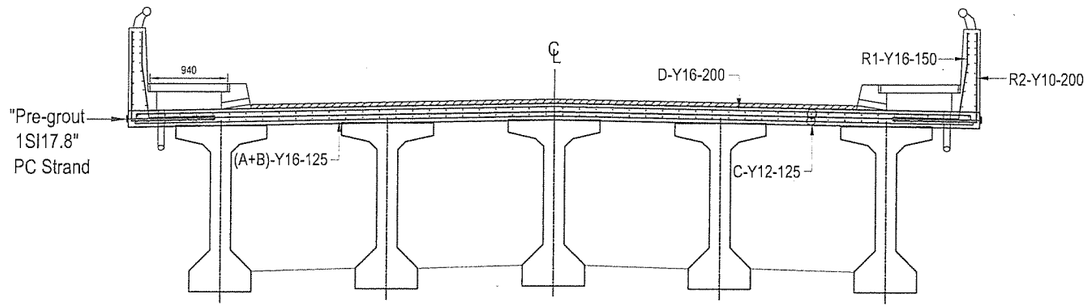
1. Expansion joint in slab to be provided at every three span interval.
2. Tranverse Pre-stressing Strand ("pre-grout 1SI18.70") to be provided at 500mm c/c along the deck slab.

REV.	DESCRIPTION	DATE

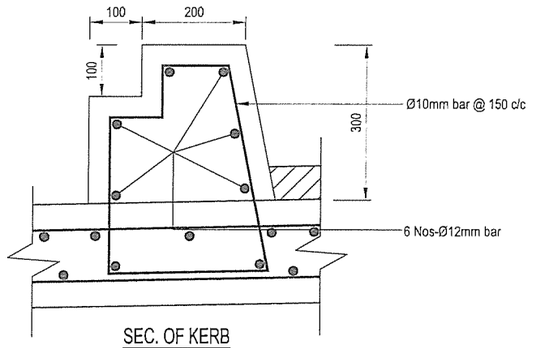
ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE : TYPICAL SECTION OF DECK SLAB FOR 640.0m LONG PSC GIRDER BRIDGE OVER KOHELIA RIVER SCALE : Scale : As above DATE : 02 July' 2013 DRAWING NO. BRDG/D-40/DWG-05



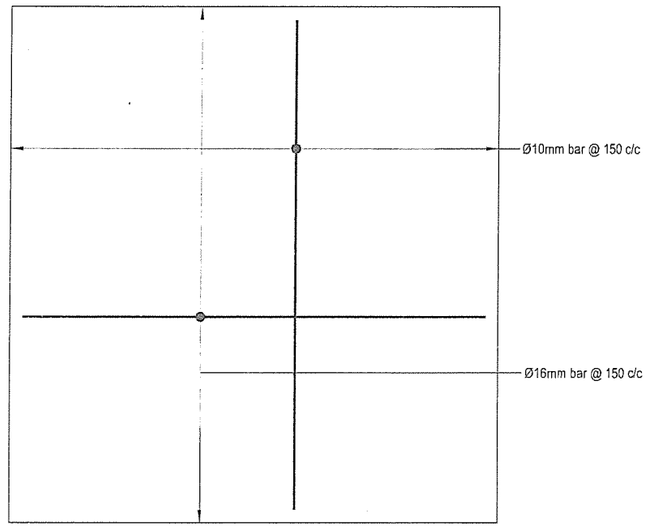
DECK SECTION (CONCRETE)



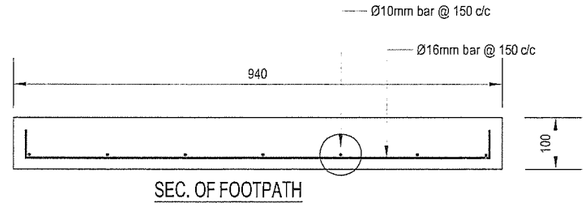
DECK SECTION (REINFORCEMENT)



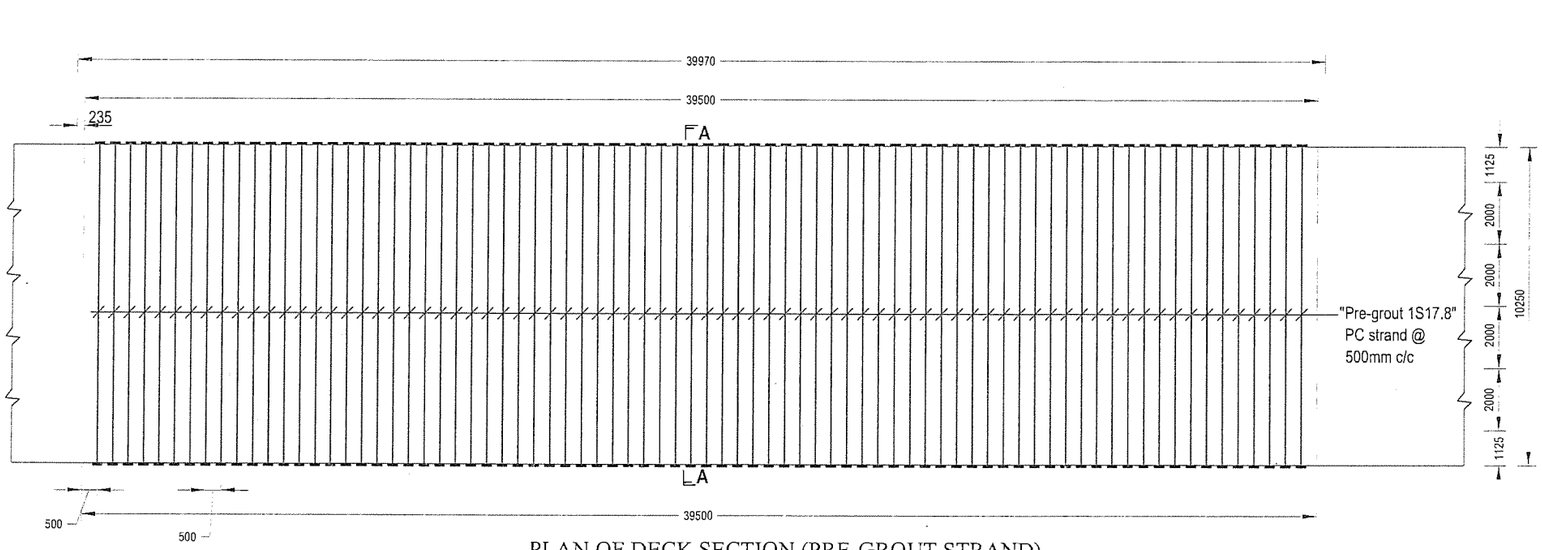
SEC. OF KERB



PLAN OF FOOTPATH



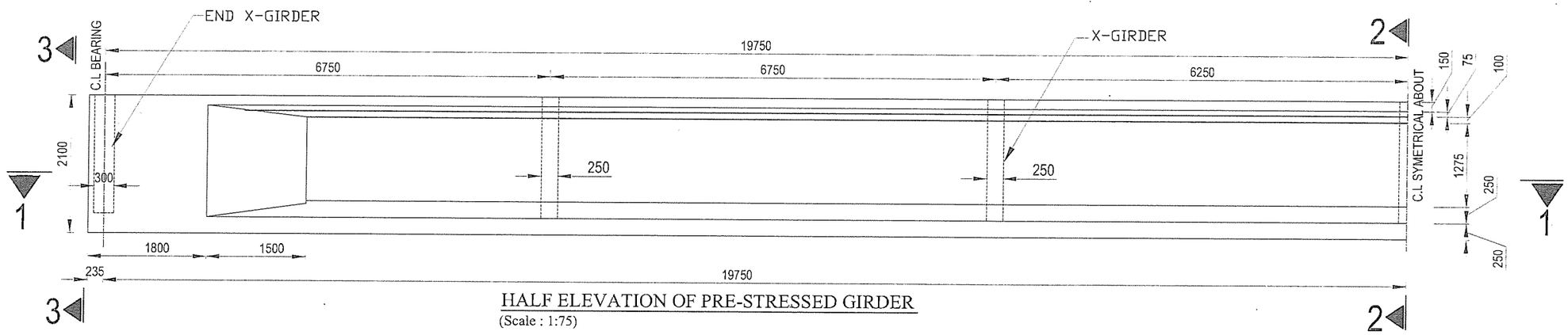
SEC. OF FOOTPATH



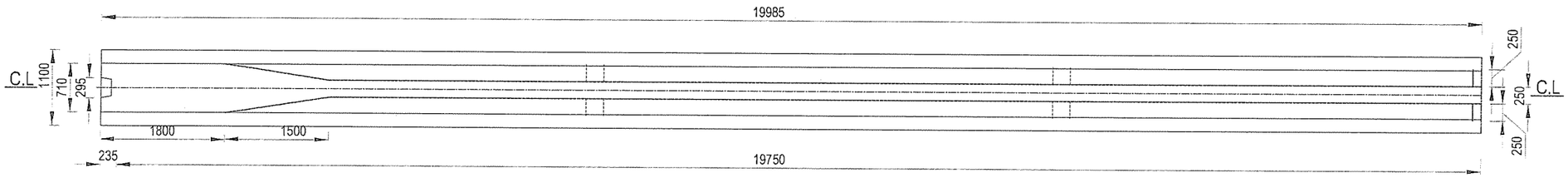
PLAN OF DECK SECTION (PRE-GROUT STRAND)
(Scale : 1:150)

REV.	DESCRIPTION	DATE

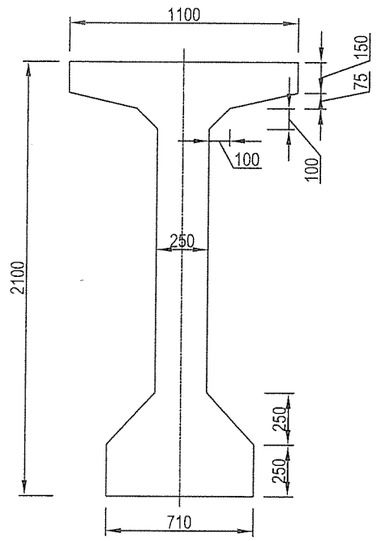
ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLACING OF PRE-GROUT STRAND IN THE DECK SLAB	Scale : As above	02 July' 2013	JICA/BRDG/D40/DWG-06



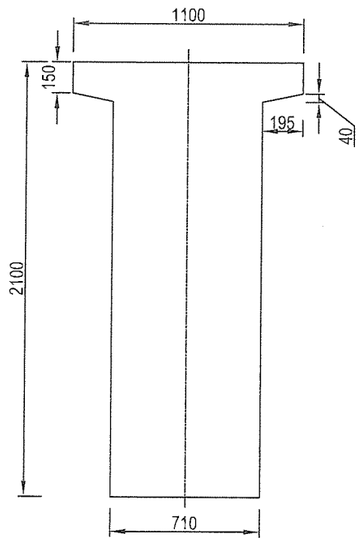
HALF ELEVATION OF PRE-STRESSED GIRDER
(Scale : 1:75)



TOP VIEW OF PRE-STRESSED GIRDER (SEC. 1-1)
(Scale : 1:75)



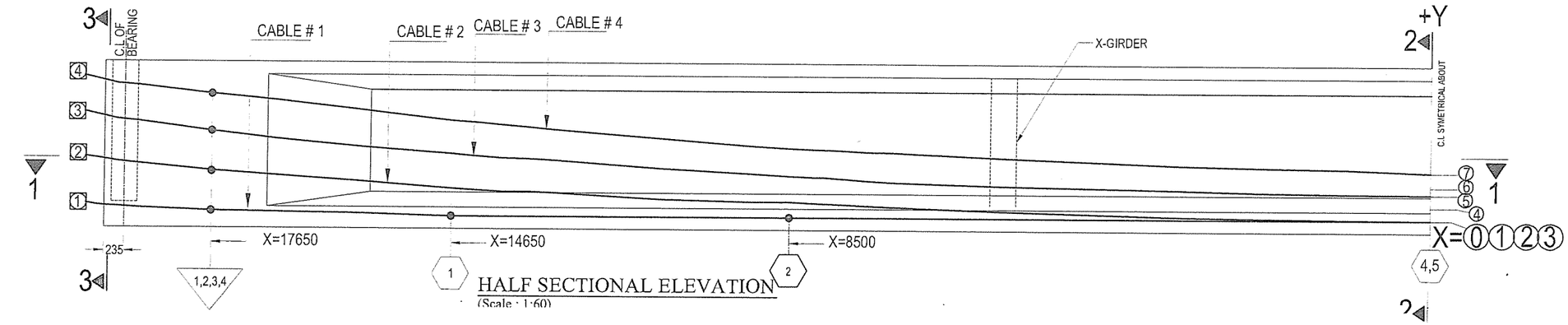
SEC. 2-2



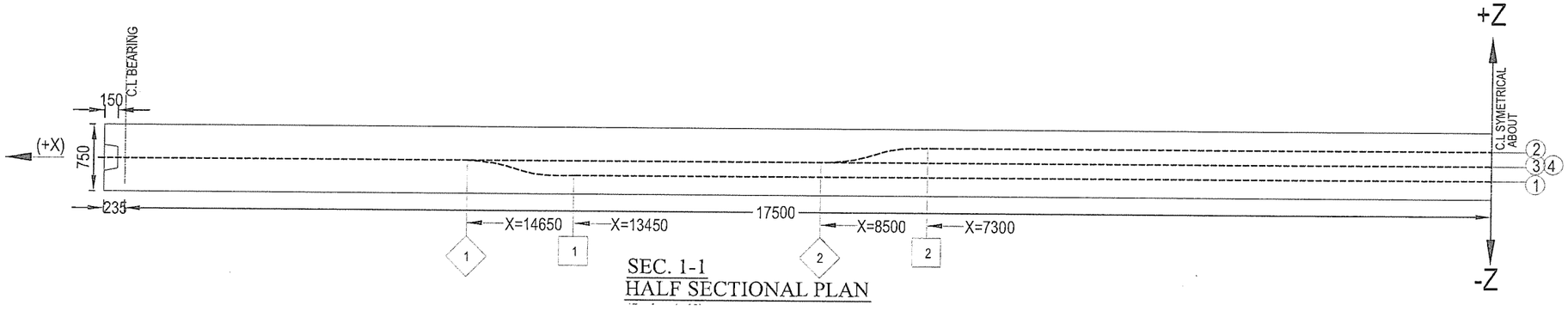
SEC. 3-3
(Scale : 1:30)

REV.	DESCRIPTION	DATE

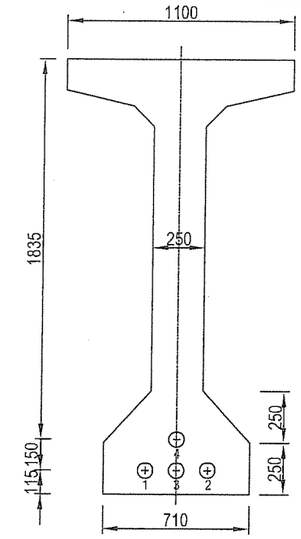
ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DETAILS OF 40.32m LONG PSC GIRDER BRIDGE OVER KOHELIA RIVER AT COX'S BAZAR.	Scale : As above	02 July' 2013	JICA/BRDG/G40/DWG-07



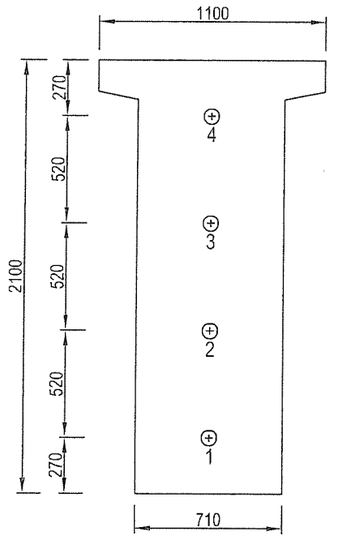
HALF SECTIONAL ELEVATION
(Scale : 1:60)



SEC. 1-1
HALF SECTIONAL PLAN



MID SECTION



END SECTION
(Scale : 1:30)

Cable No.	ORDINATE AT DISTANCE X FROM CENTER																																		Extension at each jacking end	Emergence angle
	20001		18500		17500		16500		15500		14650		13450		12250		10550		10250		9000		8000		6500		7300		6100		6000		5500		5000		3000		2000		1000		0			
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z		
1	270		220		193		169		150		115		115		115		115		115		115		115		115		115		115		115		115		115		115		115		115		139.60	0.89
2	790		625		526		442		365		308		240		187		136		131		116		116		115		115		115		115		115		115		115		115		115		140.01	3.86
3	1310		1137		1030		928		833		756		655		563		447		429		357		306		331		274		226		223		205		190		142		127		116		115		140.91	6.78
4	1830		1604		1463		1330		1205		1105		973		852		700		676		582		515		546		473		411		406		383		363		300		281		269		255		141.86	8.82
1		0		0		0		0		0		0		-75.0		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150		-150			
2		0		0		0		0		0				0		0		0		0		0		0		0		75		150		150		150		150		150		150		150			

LEGEND

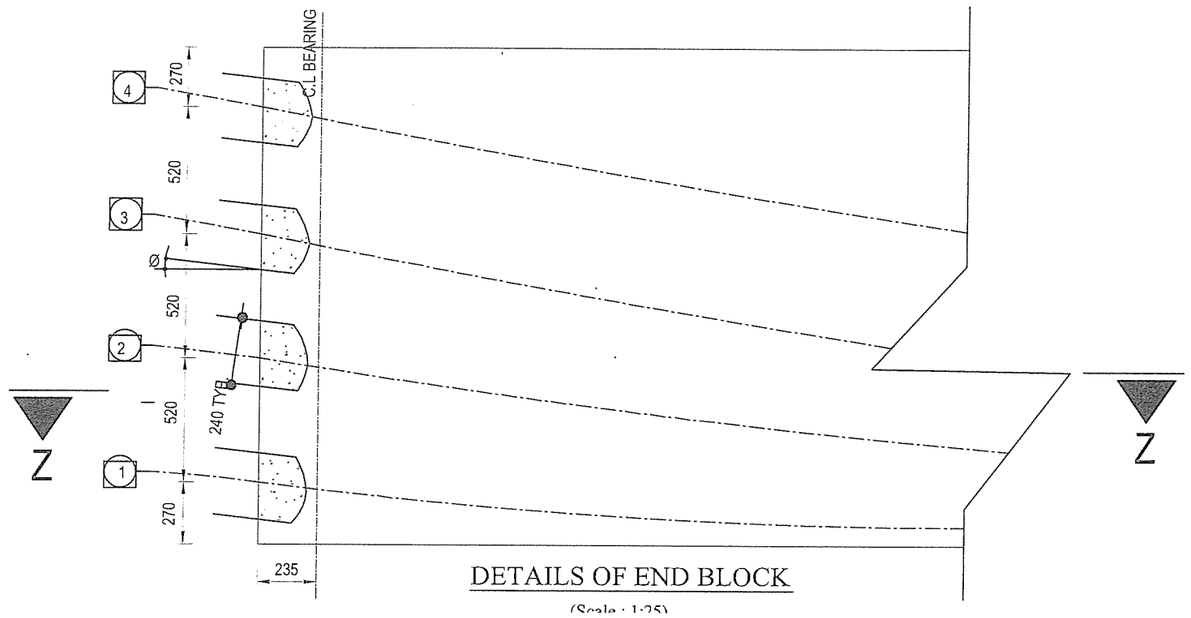
- INDICATES START OF CURVE IN ELEVATION
- INDICATES END OF CURVE IN ELEVATION
- INDICATES START OF CURVE IN PLAN
- INDICATES END OF CURVE IN PLAN
- INDICATES END OF CABLE
- INDICATES CABLE NUMBER

Note :

1. All dimensions are in mm unless otherwise mentioned.
2. Type of girder shall be of Pre-cast Post-tensioned Pre-stressed Concrete.
3. Both Exterior and Interior girder shall be of same type, size & cable pos

REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DETAILS OF CABLE PROFILE FOR PSC GIRDER	Scale : As above	02 July' 2013	JICA/BRDG/CAB/DWG-08



DETAILS OF END BLOCK

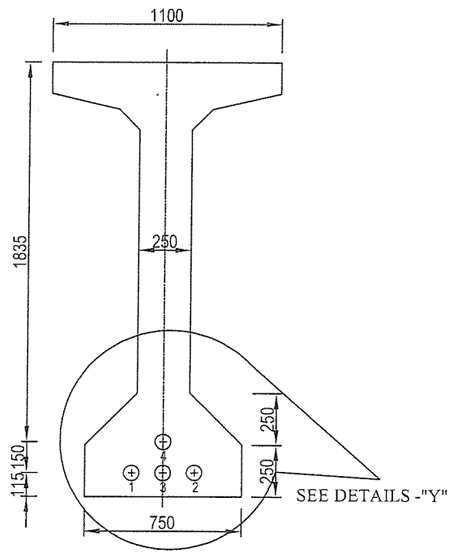
(Scale : 1:25)

NOTES :

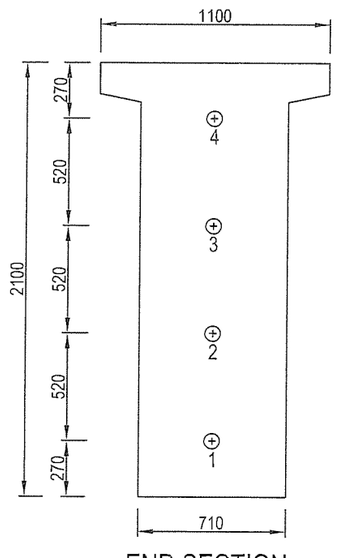
1. EACH CABLE SHALL BE STRESSED SIMULTANEOUSLY FROM BOTH ENDS. THE JACKING FORCE IN EACH CABLE SHALL BE 2615 kN TO BE IMPERTED SIMULTANEOUSLY AT BOTH ENDS.
2. THE SEQUENCE OF STRESSING OF PRESTRESSING CABLES SHALL BE AS FOLLOWS.
   STAGE 1 : 3, 1, 2 & 4
3. STAGE 1 STRESSING OF CABLE SHALL BE DONE AFTER 10 DAYS OR CONCRETE STRENGTH NOT LESS THAN 30N/mm2 WHICHEVER IS LATER.
4. CONSTRUCTION SEQUENCE

DAYS (AFTER CASTING OF GIRDER)	DAYS
10	STRESSING OF STAGE 1 CABLES
AFTER 21	SHIFTING OF FINAL POSITION, CASTING OF DECK SLAB INSTALLATION OF EXPANSION JOINTS CASTING/ LAYING OF FOOTPATH, KERBS, WEARING COURSE AND RAILINGS

   AFTER STAGE 1 STREEING GIRDER CAN BE SHIFTED.
5. FOR ANCHORAGE DERAILS REFER DRG.
6. THE EXTENSION SHOWN IN THE TABLE IS FOR THE PORTION OF CABLES LYING BETWEEN MID SPAN AND GRIPPING POINT OF THE JACK.
   THE GRIPPING POINT IS ASSUMED AT 750mm FROM THE FACE OF THE RECESS.
7. EACH CABLES CONSISTS OF 19 NOS. 12.7mm (19T13) STRANDS.
8. CONTRUCTOR SHALL BE SUBMITTED PROCESS OF STRESSING WITH ELONGATION AND CAMBER OF BEAM DECK TO EACH CABLE STRESSING TO THE ENGINEER IN-CHARGE FOR APPROVAL BEFOR 30 DAYS OF BEAM CASTING.

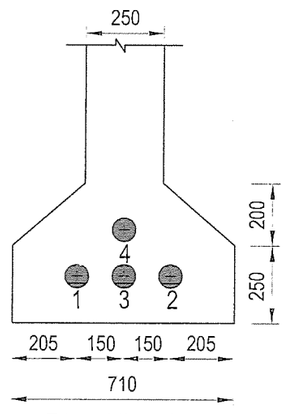


MID SECTION



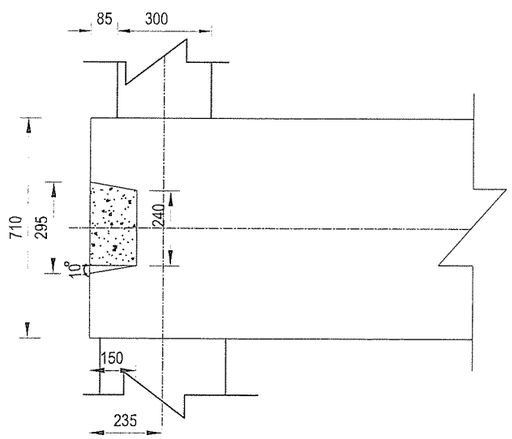
END SECTION

(Scale : 1:30)



DETAIL Y

(Scale : 1:20)

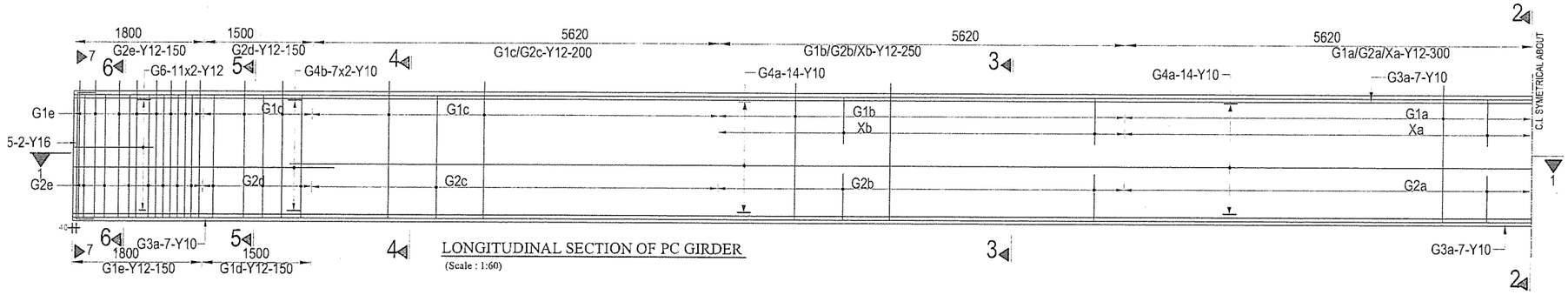


SECTION Z-Z

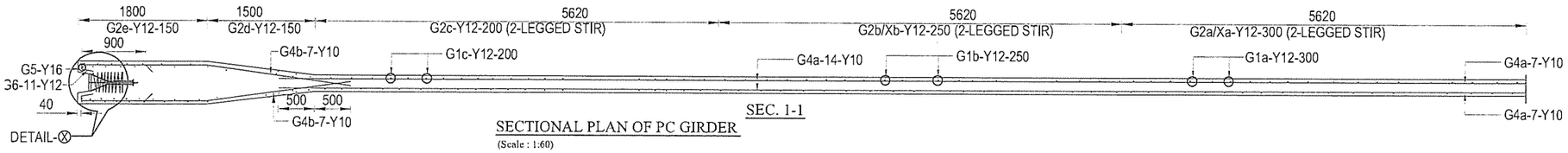
(Scale : 1:20)

REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DETAILS OF END SECTION OF PSC GIRDER	Scale : As above	02 July' 2013	JICA/BRDG/END/DWG-09

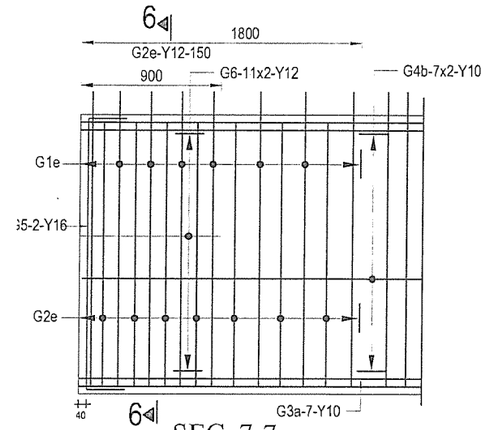


LONGITUDINAL SECTION OF PC GIRDER
(Scale : 1:60)

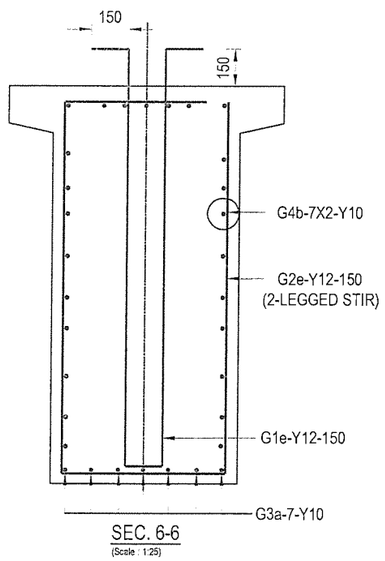


SECTIONAL PLAN OF PC GIRDER
(Scale : 1:60)

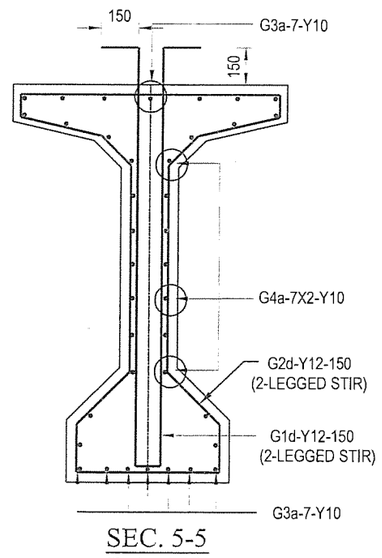
SEC. 1-1



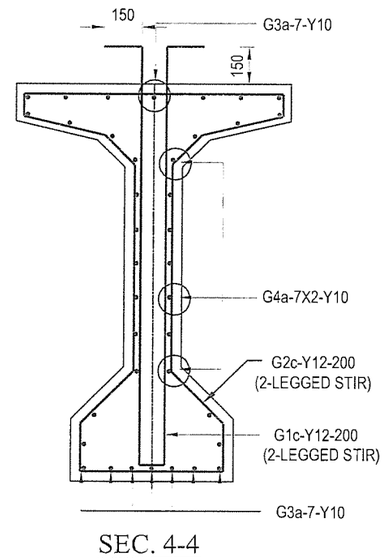
SEC. 7-7



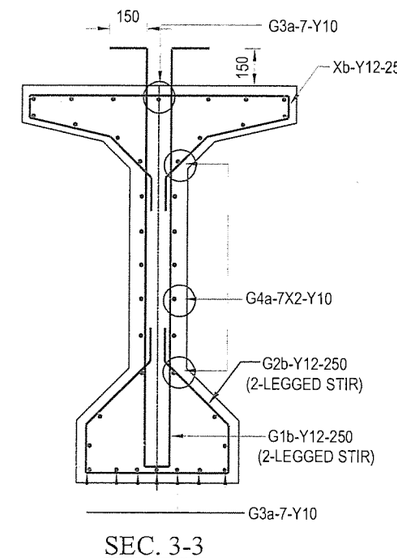
SEC. 6-6
(Scale : 1:25)



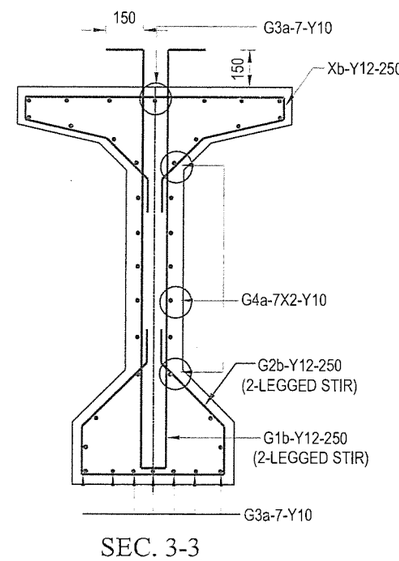
SEC. 5-5
(Scale : 1:25)



SEC. 4-4
(Scale : 1:25)



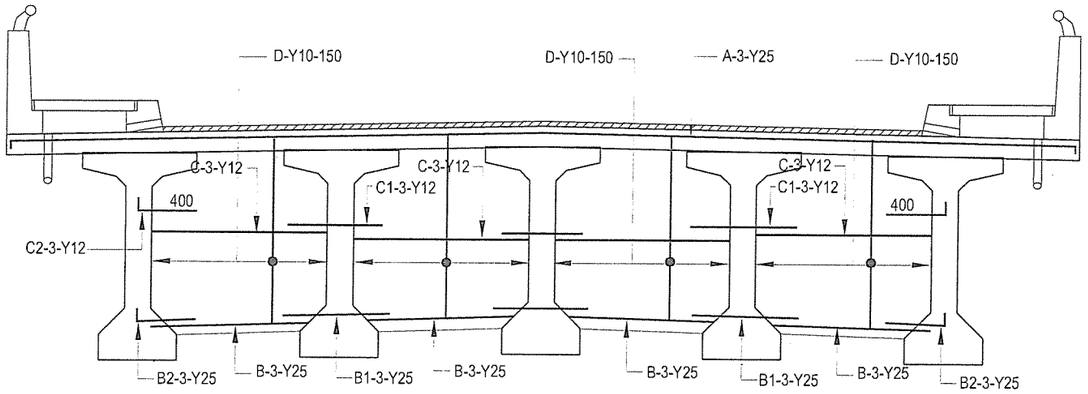
SEC. 3-3
(Scale : 1:25)



SEC. 3-3
(Scale : 1:25)

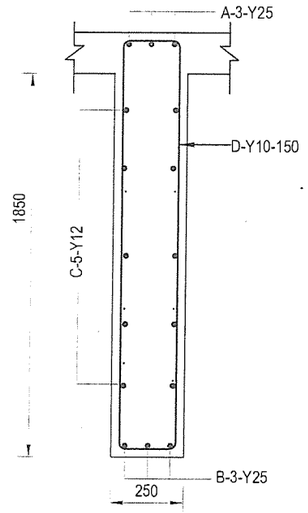
REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	NON-PRESTRESSED REINFORCEMENT DETAILS	Scale : As above	02 July' 2013	JICA/BRDG/REINF./DWG-10

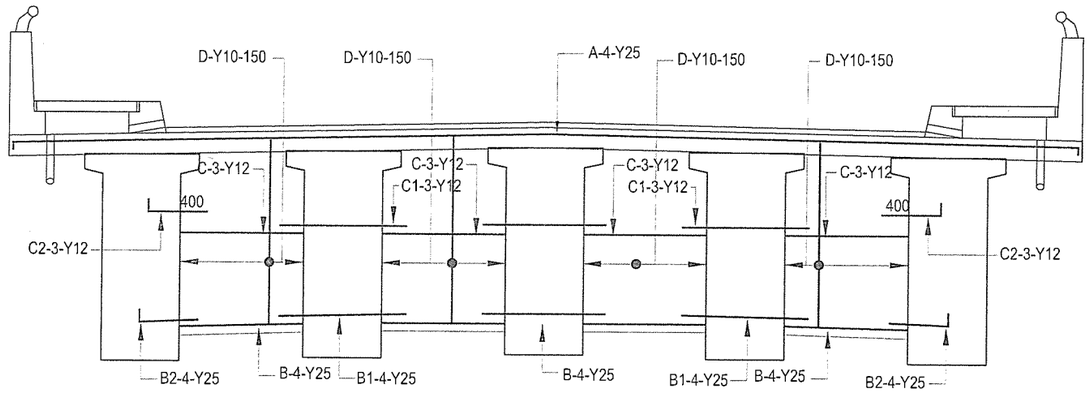


REINF. DETAILS OF MID X-GIRDER

(Scale : 1:60)

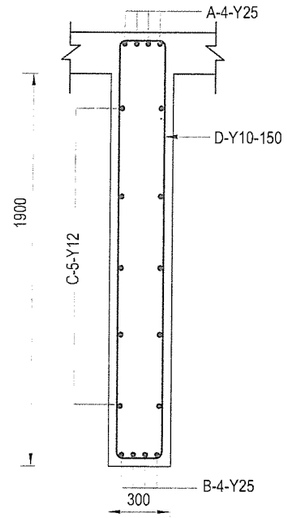


SEC. B-B (INTERIOR X-GIRDER)



REINF. DETAILS OF END X-GIRDER

(Scale : 1:60)



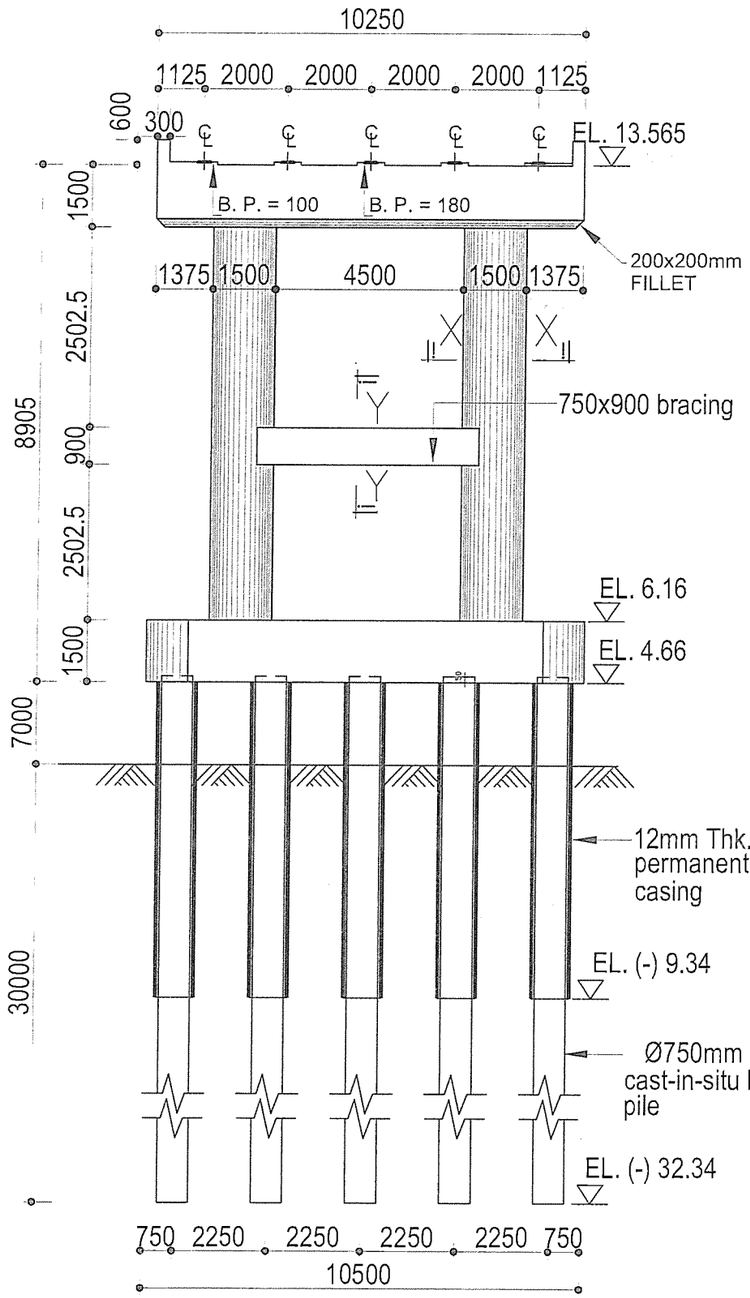
SEC. A-A (END X-GIRDER)

(Scale : 1:30)

SHAPE CODE	01	01A	02	02A	02B	03	04	05	06
SHAPE OF BARS	a	b a	b a	c b a	b a	a b	b a	b c a	a c b

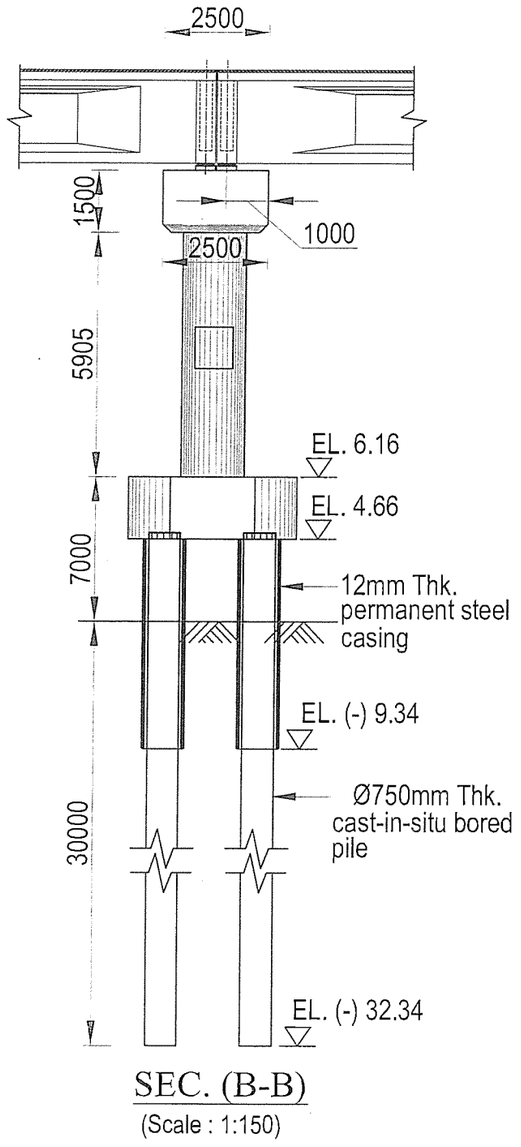
REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	X-GIRDER DETAILS	Scale : As above	02 July' 2013	JICA/BRDG/X_GIR/DWG-11



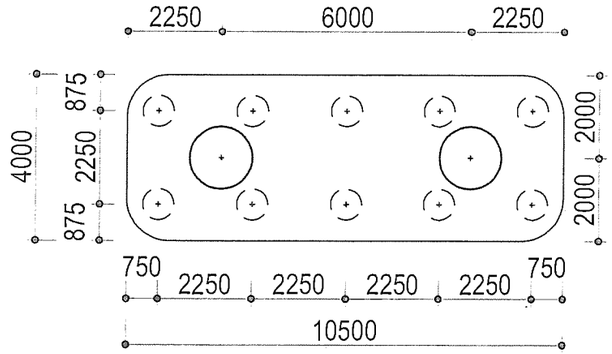
SECTIONAL ELEVATION OF PIER (A-A)

(Scale : 1:150)



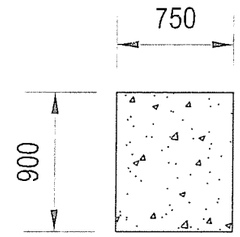
SEC. (B-B)

(Scale : 1:150)



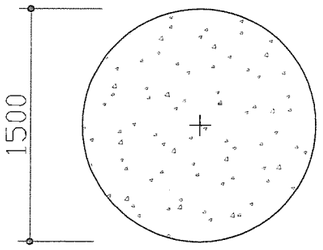
PILE LAYOUT PLAN

(Scale : 1:150)



SEC. Y-Y

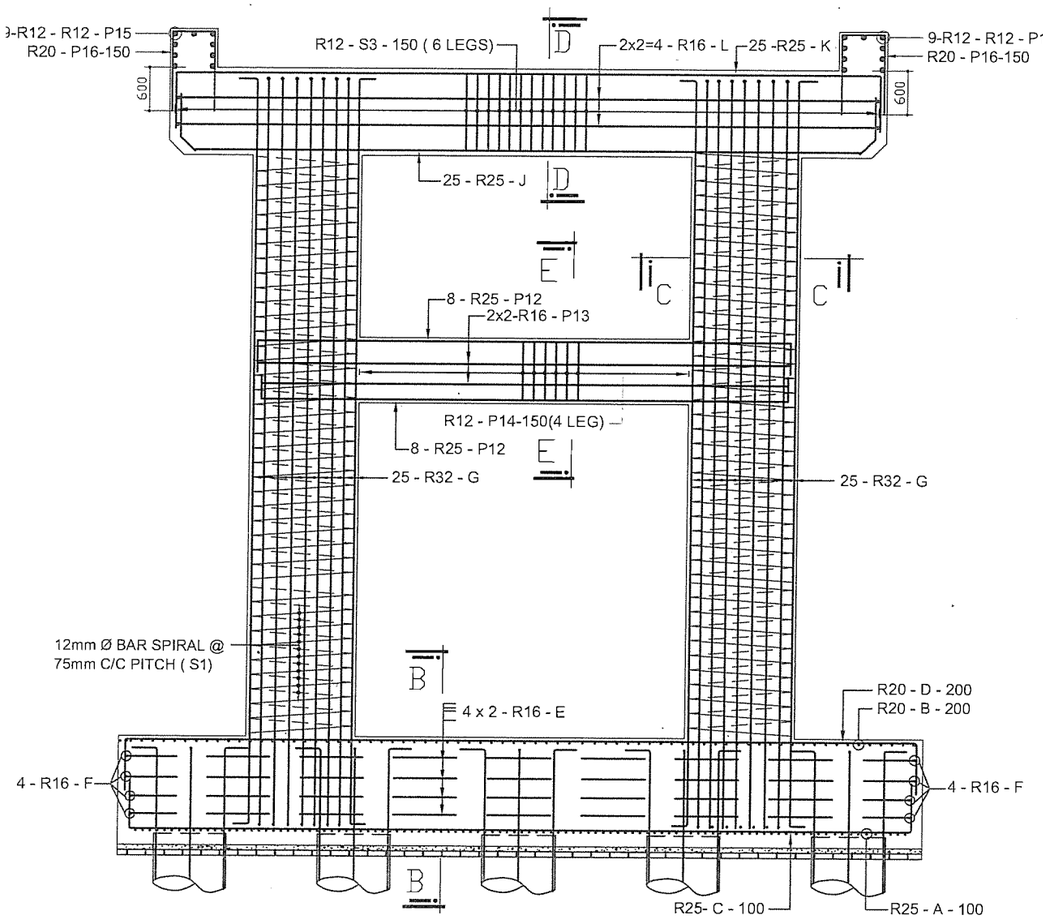
(Scale : 1:40)



SEC. X-X

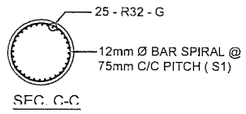
REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).		CONCRETE OUTLINE OF PIER-P8 (TYPICAL)	Scale : As above	02 July' 2013	JICA/BRDG/PIER/DWG-12

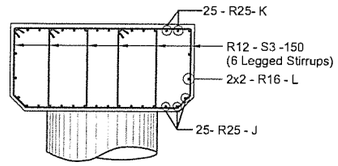


REINFORCEMENT ELEVATION OF PIER

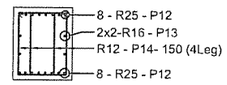
SECTION A - A



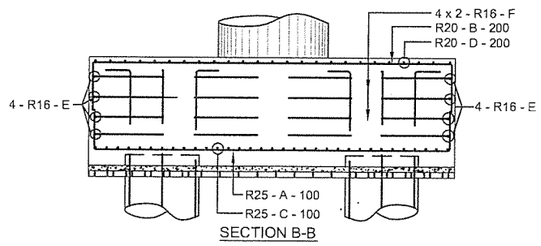
SEC. C-C



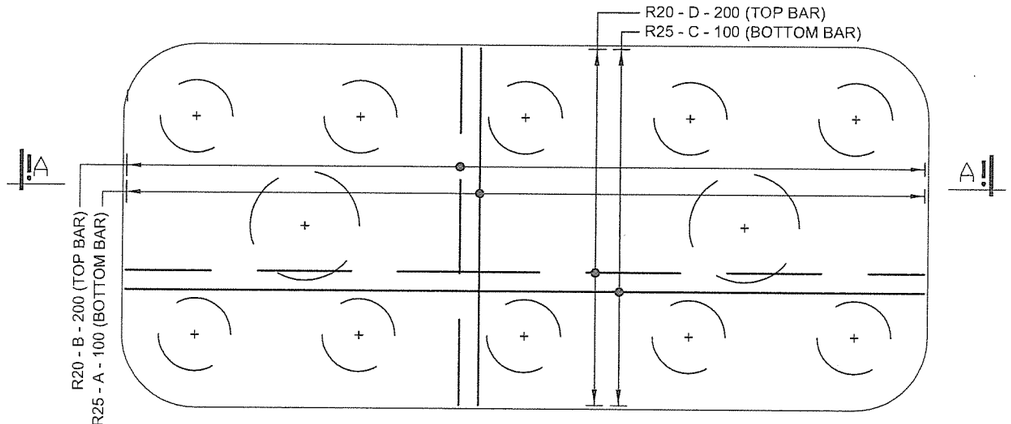
SEC. D-D



SEC. E - E



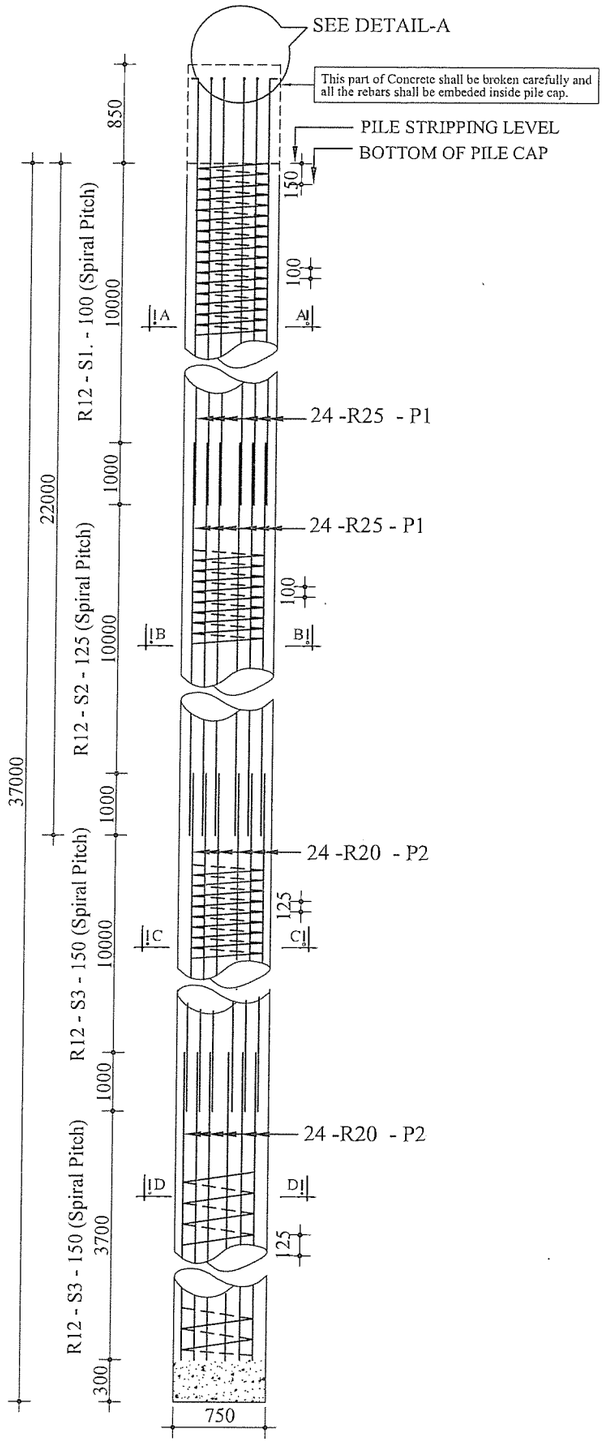
SECTION B-B



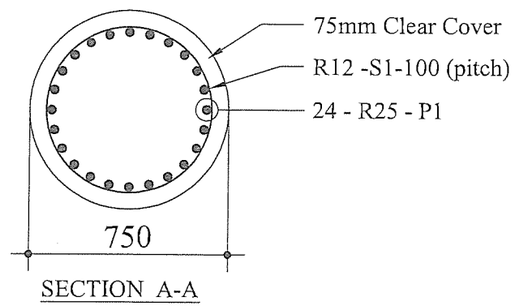
REINFORCEMENT PLAN OF PILE CAP

REV.	DESCRIPTION	DATE

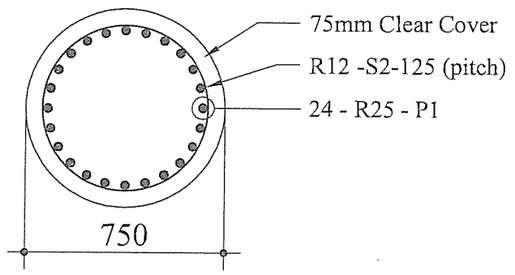
ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).		REINFORCEMENT DETAILS OF PIER (TYPICAL)	Scale : As above	02 July' 2013	JICA/BRDG/PIER/DWG-13



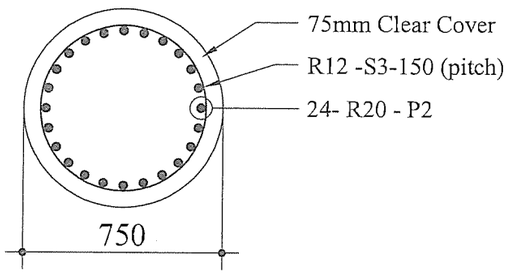
REINF. DETAILS OF PIER PILE
CAST-IN-SITU PILE DETAILS



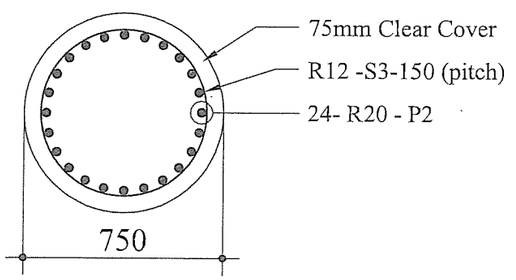
SECTION A-A



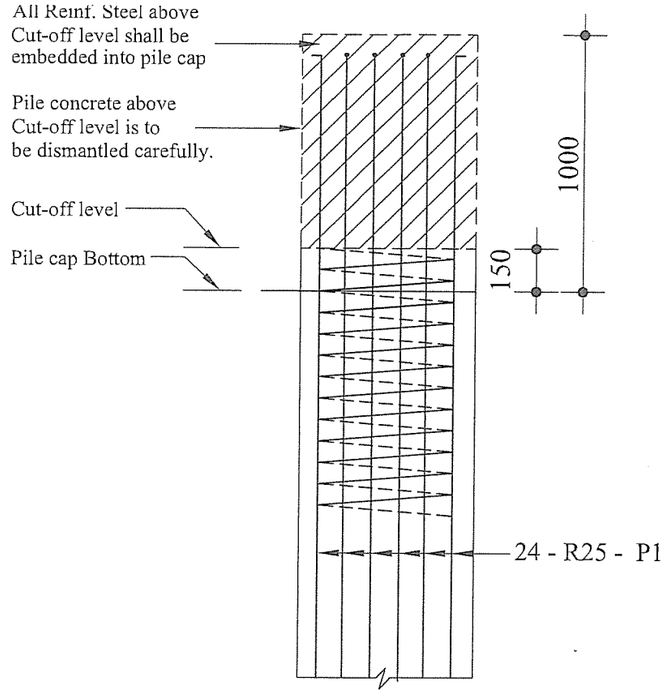
SECTION B-B



SECTION C-C



SECTION D-D



DETAIL-A

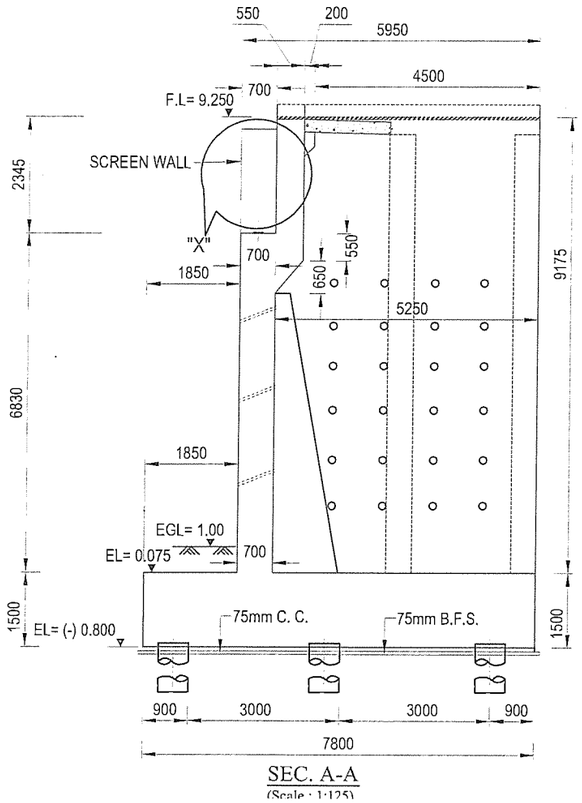
NOTES:

Cast-in-situ Pile:

1. All dimensions are in millimeters unless otherwise mentioned .
2. 28 days cylinder crushing strength of concrete f'c= 25 N/mm^2 (3500 psi)
3. Yield strength of M.S deformed reinforcement bar fy = 413 N/mm^2 (60000 psi)
4. Clear Cover to main reinforcement bar is to be 75mm. unless otherwise mentioned.
5. When concreting at the top of Pile one batch of concrete must be over flown to ensure fresh concrete at Pile head.
6. The spiral reinforcement should preferably be tack welded to the main Reinforceing bars.
7. The lapping portion of main reinforcement shall be joint welded .
8. Design load of Pile under service load condition is 210 M. T for Pier Pile.
9. Test load shall be 420M. T. on service Pile.
10. Pile capacity is to be confirmed by static pile load test.
11. Boring to done by Rotary drilling method.

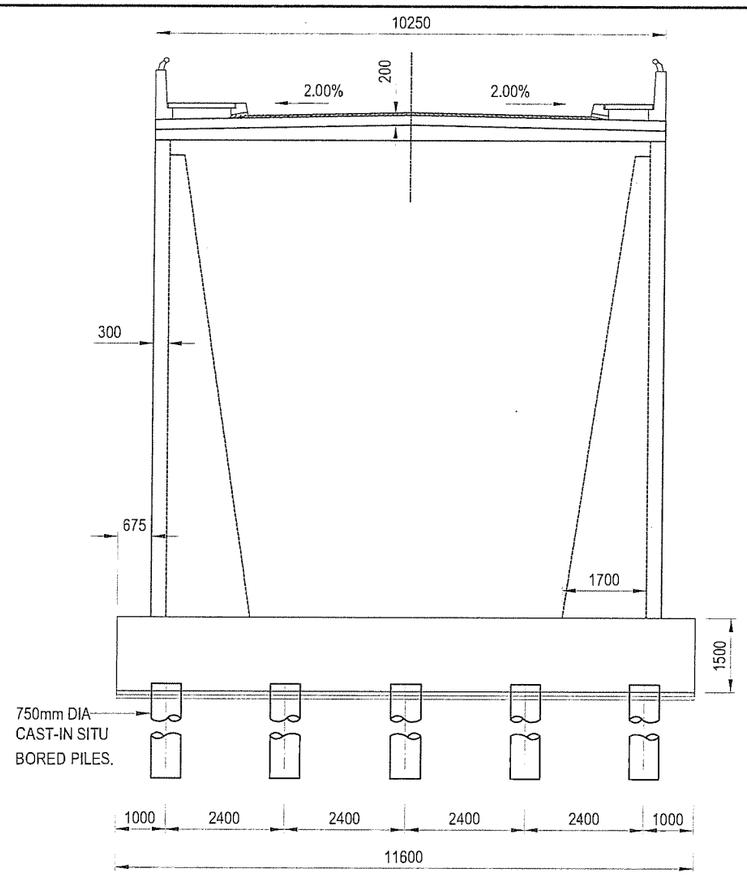
REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE : REINFORCEMENT DETAILS OF PIER PILE (TYPICAL) Scale : As above 02 July' 2013 DRAWING NO. JICA/BRDG/PILE/DWG-14

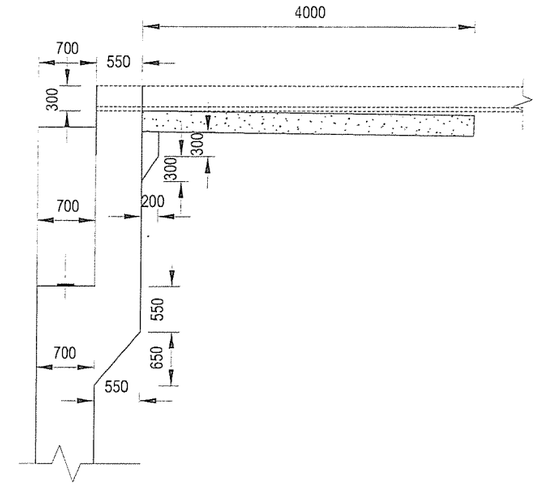


SEC. A-A

(Scale : 1:125)

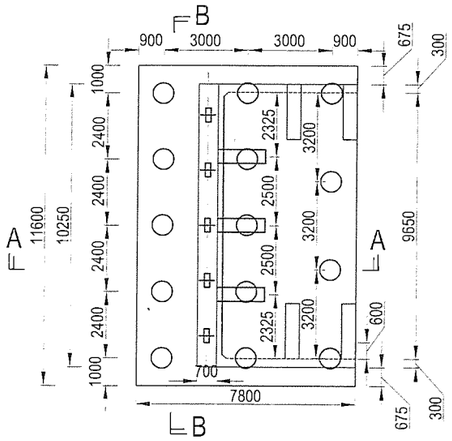


SECTIONAL ELEVATION B-B

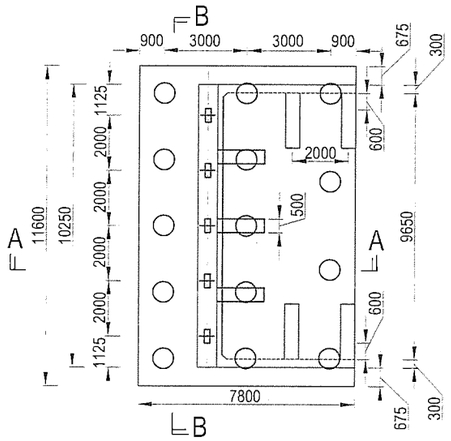


DETAILS "X"

(Scale : 1:75)



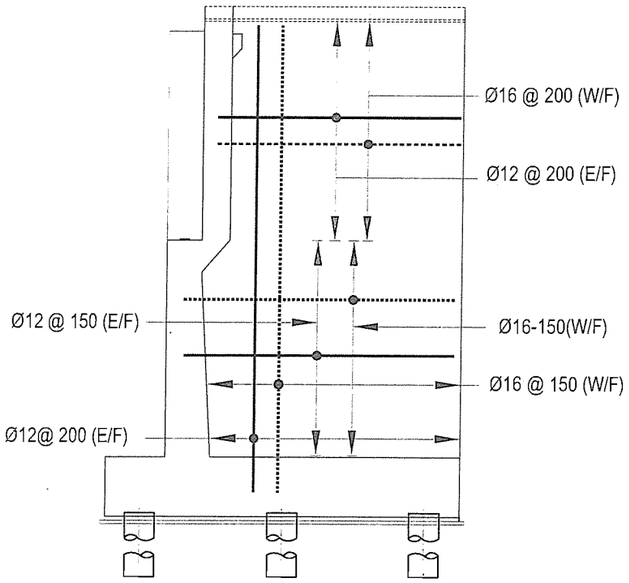
PILE CAP & PILE LAYOUT PLAN



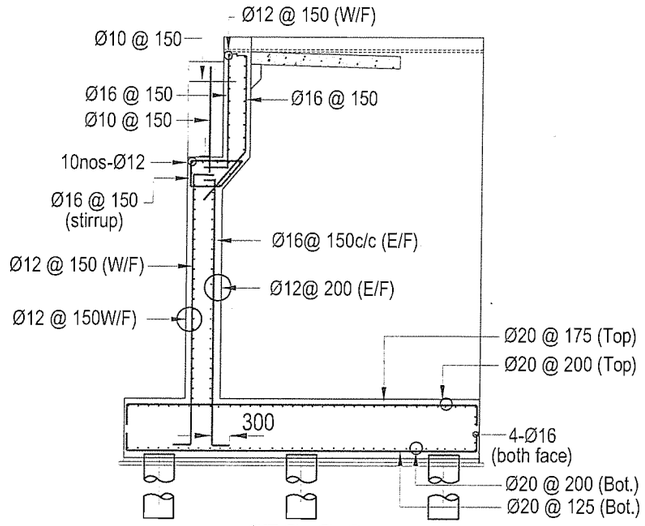
PLAN OF ABUTMENT & BEARING PAD ARRANGEMENT

REV.	DESCRIPTION	DATE

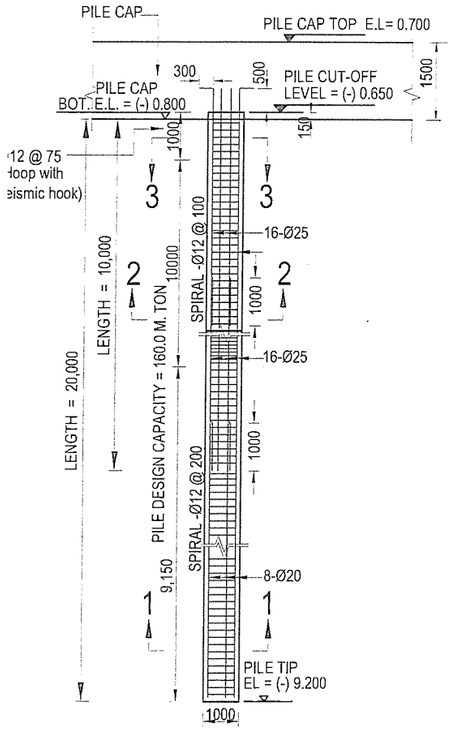
ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE : CONCRETE OUT LINE OF ABUTMENT (A1 & A2) Scale : As above 02 July' 2013 DRAWING NO. JICA/BRDG/ABUT/DWG-15



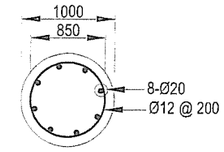
ELEV. SHOWING REINF.
DETAILS OF RETURN WALL
(Scale : N.T.S)



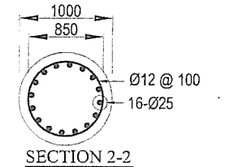
SEC. C-C
(Scale : 1:125)



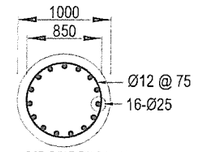
SECTIONAL ELEVATION
OF ABUTMENT PILE
(Scale : 1:130)



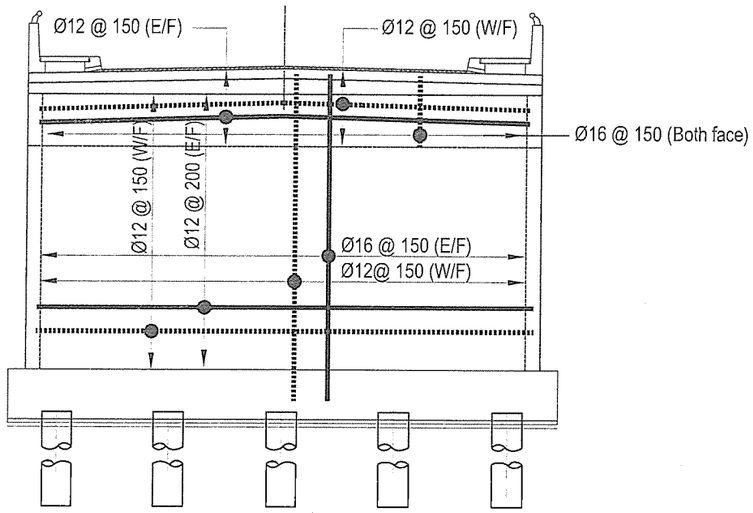
SECTION 1-1
(Scale : 1:50)



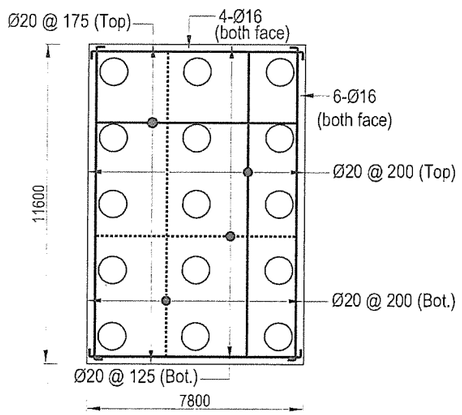
SECTION 2-2
(Scale : 1:50)



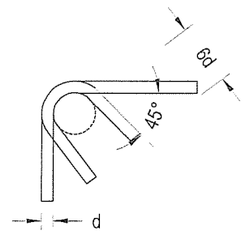
SECTION 3-3
(Scale : 1:50)



SECTIONAL ELEVATION B-B
(Scale : 1:125)



PLAN SHOWING REINF.
DETAILS OF PILE CAP
(Scale : 1:225)



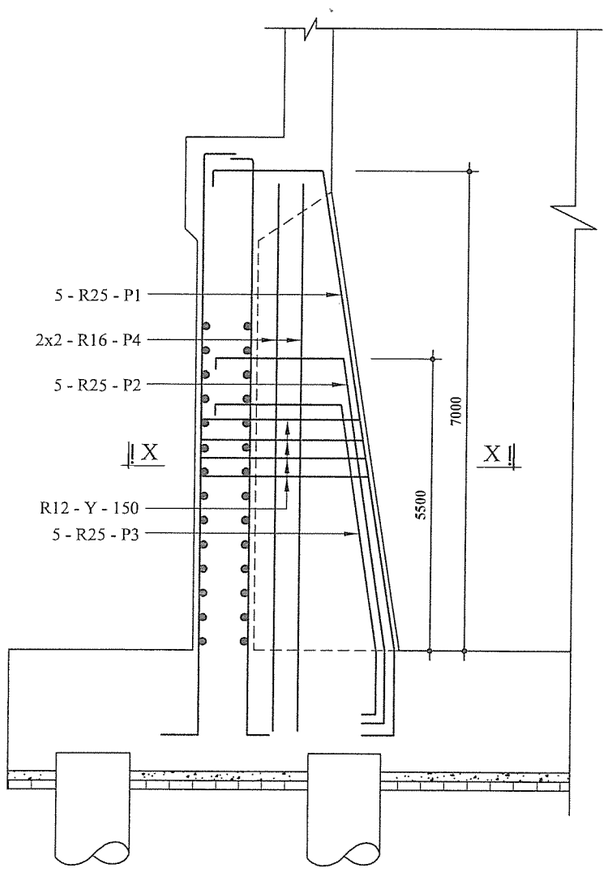
SEISMIC HOOK
(Scale : 1:30)

Legend :

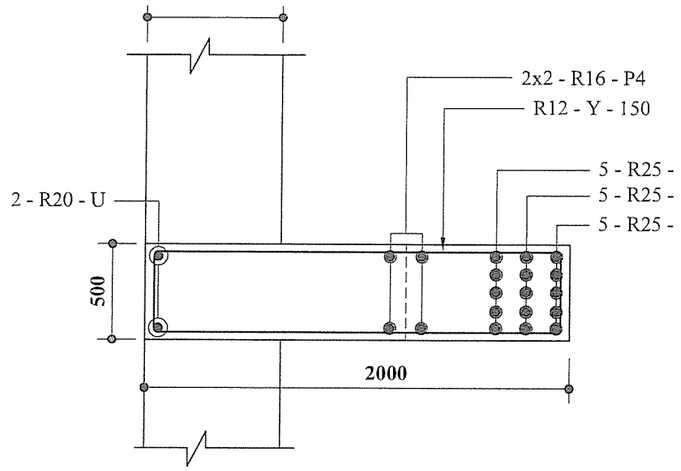
E/F : Earth face
W/F : Water face

REV.	DESCRIPTION	DATE

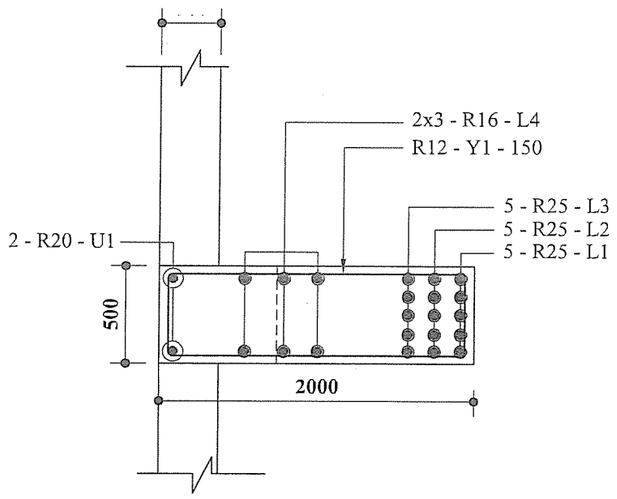
ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE : REINF. DETAILS OF ABUTMENT (A1 & A2) Scale : As above 02 July' 2013 CONTRACT NO DRAWING NO. JICA/BRDG/ABUT/DWG–16



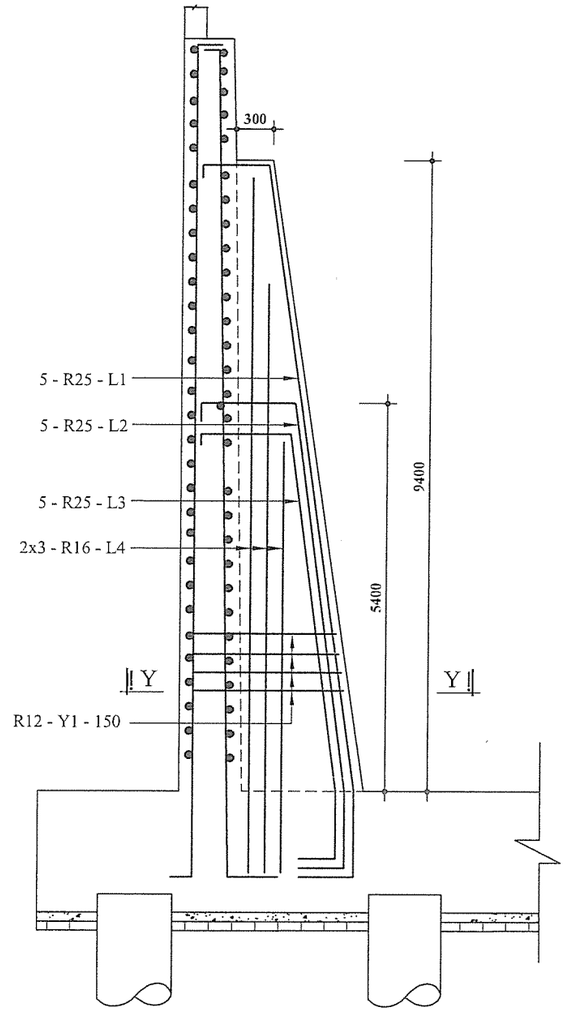
REINF. DETAILS OF ABUTMENT COUNTERFORT (C2)



SECTION X -X (C2)



SECTION Y -Y (C1)



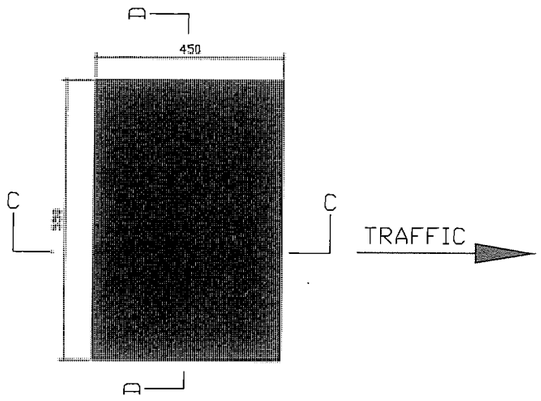
REINF. DETAILS OF WINGWALL COUNTERFORT (C1)

NOTES:

1. Clear cover to main reinforcement bar is to be 50mm. unless otherwise mentioned.
2. 28 days cylinder strength of concrete: f 'c = 25.0N/mm (3600 psi)
3. Yield strength of mild steel deformed bar fy = 413N/mm (60000psi)
4. EF = Earth Face
   WF = Water Face

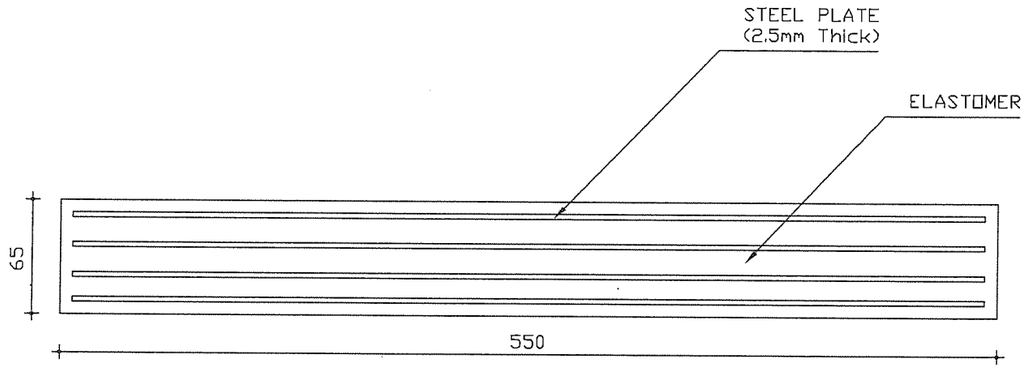
REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE : REINF. DETAILS OF COUNTERFORT (FOR ABUT. A1 & A2)	DRAWING NO. Scale : As above 02 July' 2013 JICA/BRDG/ABUT/DWG-17



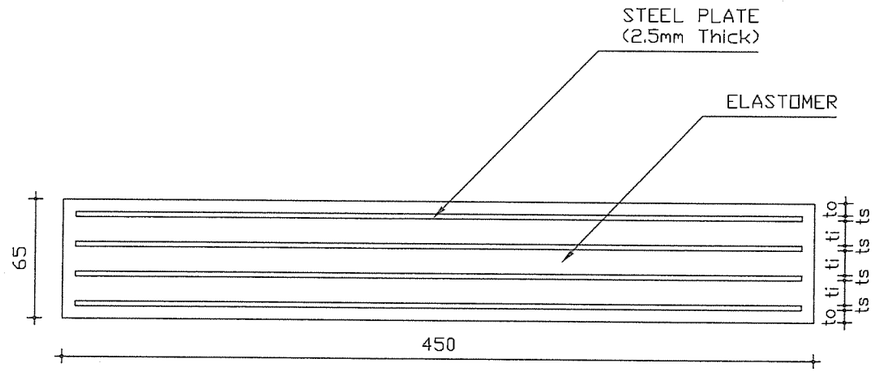
PLAN-BEARING

Scale: 1:20



SECTION D-D

Scale: 1:10



SECTION C-C

Scale: 1:10

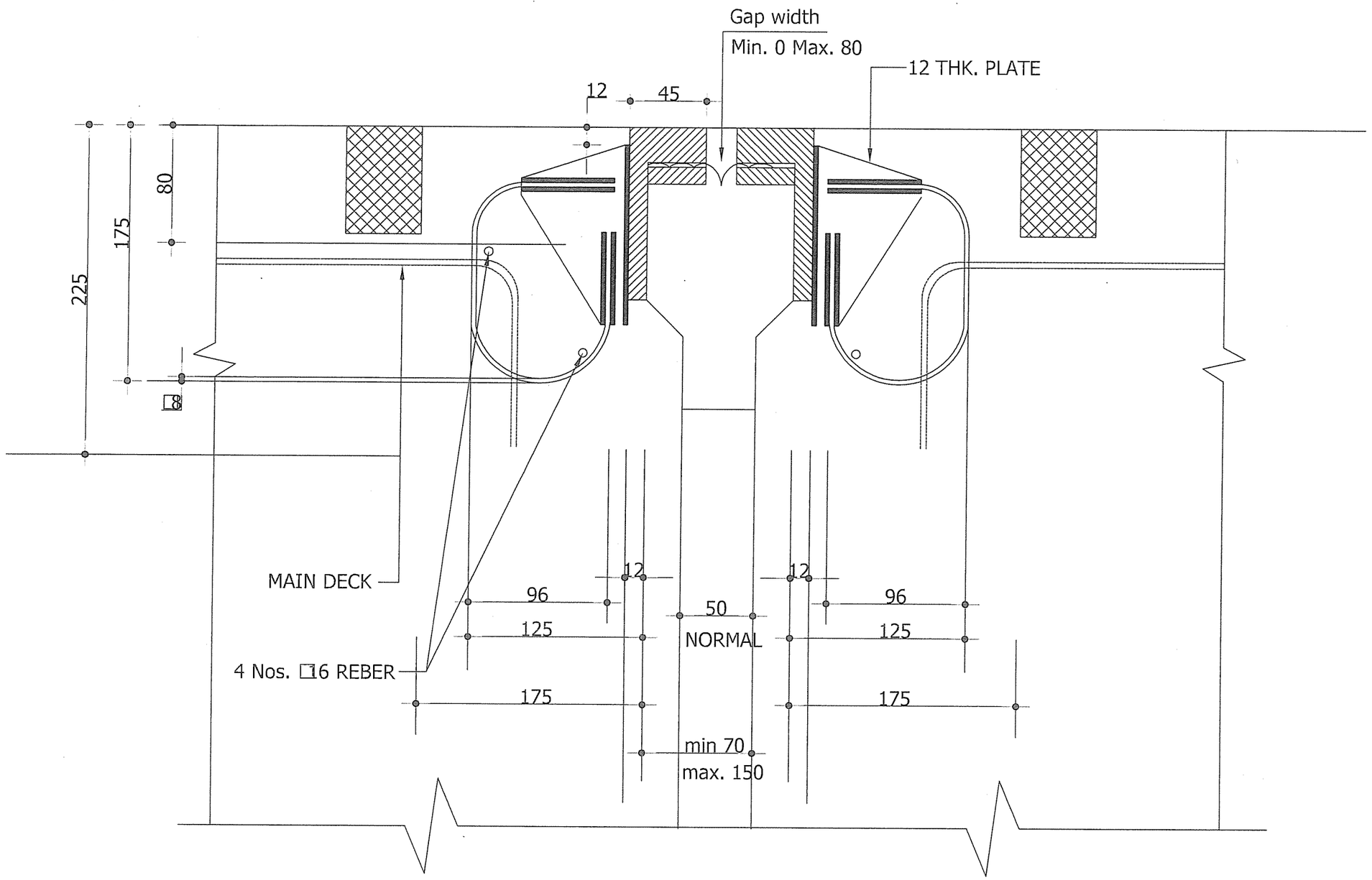
1. EMBEDDED STEEL PLATE SHALL CONFORM TO AASHTO DESIGNATION: M183/M183M-90
   (ASTM DESIGNATION: A 36/A 36M-88d) WITH MINIMUM fy=250 N/mm2.
2. SHORE 'A' HARDNESS OF ELASTOMER SHALL CONFORM TO MINIMUM 60.
3. SHEAR MODULUS OF ELASTOMER AT 73 DEG. F SHALL BE MINIMUM 0.9 N/mm2
4. COMPRESSION SET 35% (MAX)
5. TEST TO BE DONE FOR 115 M. TON LOAD
6. TENSILE STRENGTH 2250 PSI OR 15.5 N/mm2
7. ELONGATION AT BREAK 35%
8. ALL TEST OF BEARING SHALL BE DONE AS PER AASTO M251-92.

1. Thickness of exterior layer of elastomer, t0=6.5mm
2. Thickness of interior layer of elastomer, ti=14mm
3. Thickness of steel plate, ts=2.5mm
4. Total thickness of bearing= 4x2.5+14x3+2x6.5=65mm

REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE : DETAILS OF ELASTOMERIC BEARING PAD

		DRAWING NO.
Scale : As above	02 July' 2013	JICA/BRDG/B.PAD/DWG-18

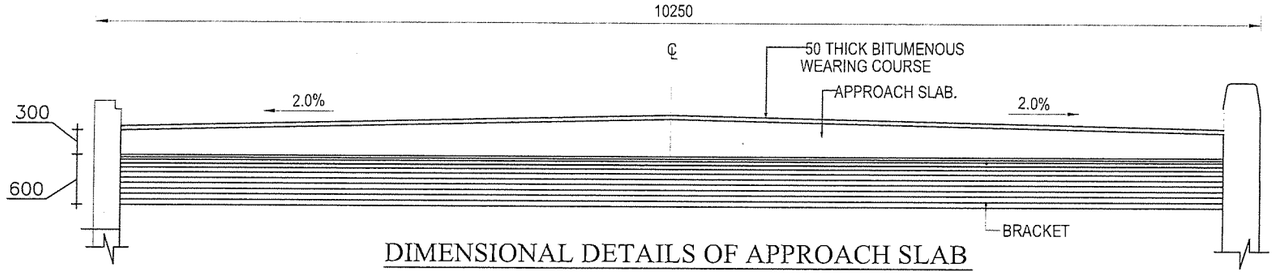


SEC. OF EXPANTION JOINT

(Scale : 1:3)

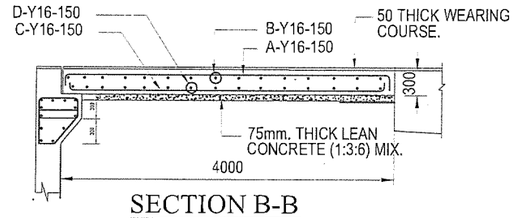
REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE : DETAILS OF EXPANSION JOINT Scale : As above 02 July' 2013 DRAWING NO. JICA/BRDG/E.JOINT/DWG-19



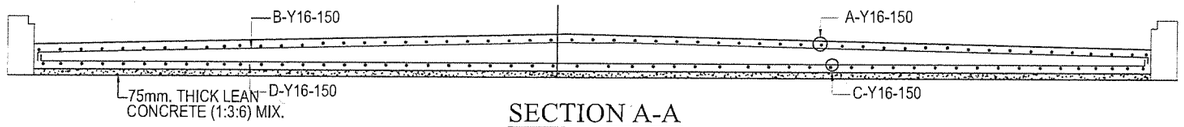
DIMENSIONAL DETAILS OF APPROACH SLAB

(Scale : 1:75)



SECTION B-B

(Scale : 1:75)

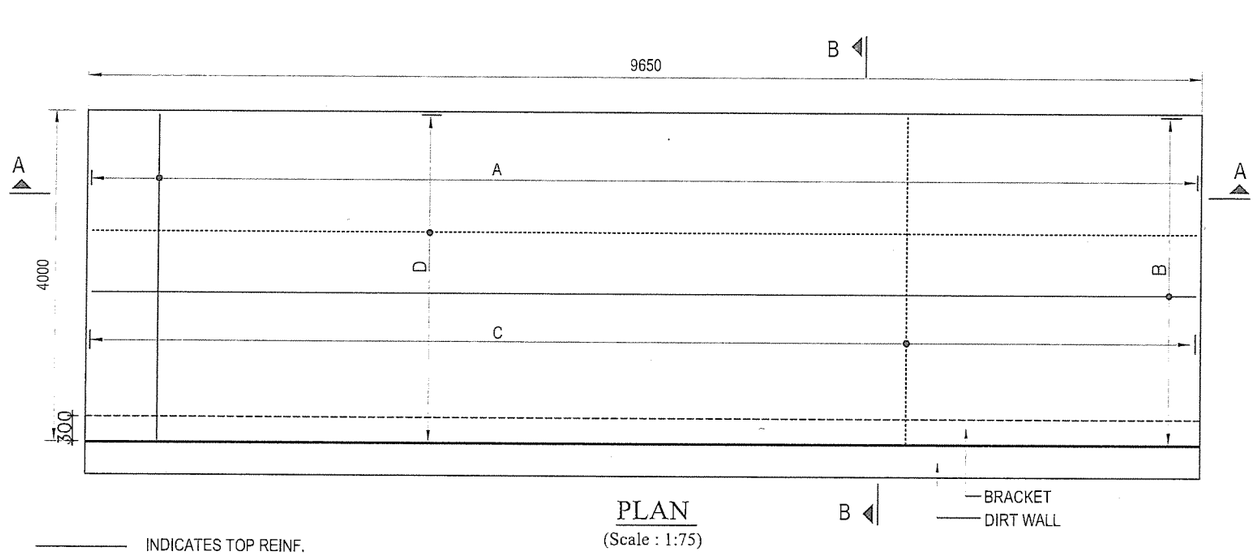


SECTION A-A

(Scale : 1:75)

BAR BENDING SCHEDULE OFAPPROACH SLAB (EACH)

TYPE OF BAR	SYM. OF MARK	DIA OF BAR	SHAPE CODE	SPACE OF BAR	BENDING DIMENSION (mm) a	b	c	d	LENGTH OF BAR	NO OF BAR	TOTAL LENGTH (m)	WT. OF STEEL (Kg)	SHAPE CODE	BAR SHAPE
GRADE-60 DEFORMED BAR	A	16	38	150	3900	75	75		4050	64	259.20	409.18	38	a b c
	B	16	99	150	9550	75	75		9700	27	261.90	413.28		
	C	16	38	150	3900	75	75		4050	64	259.20	409.18	38	a b c
	D	16	38	150	9550	75	75		9700	27	261.90	413.28		
TOTAL = 1644.92														



PLAN

(Scale : 1:75)

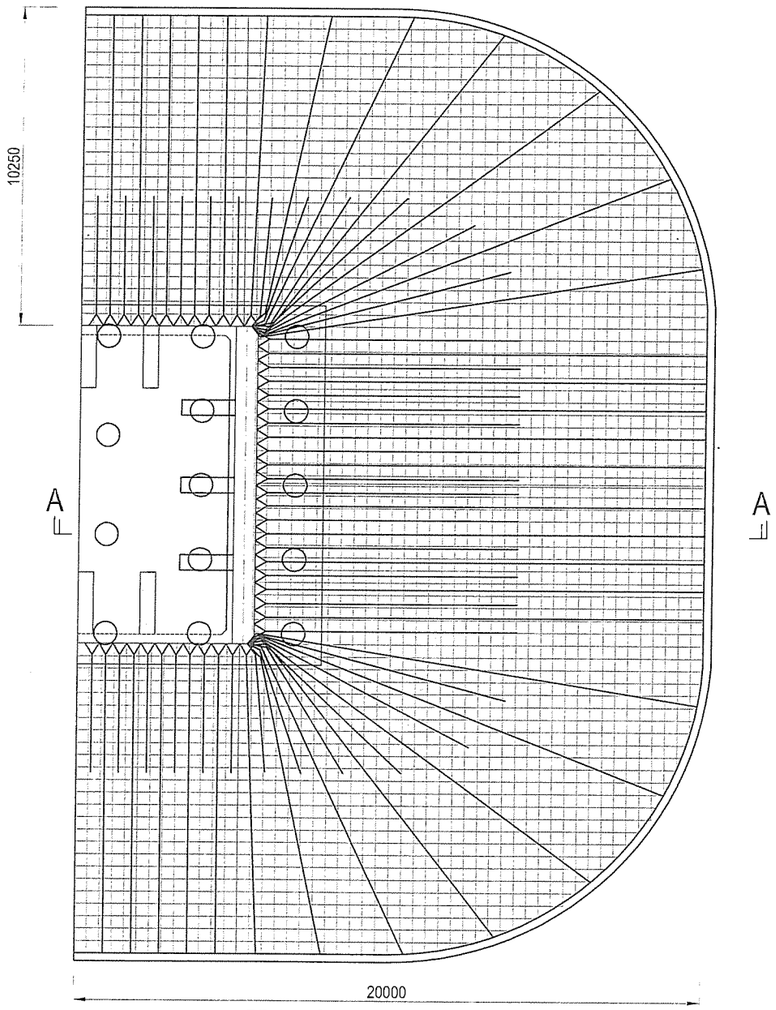
SYMB. OF BAR	SHAPE	SYMB. OF BAR	SHAPE
38	150 a 150	85	286, 72, 200
60	a, b	99	68, 142, c
70	a, b, c, d		

NOTES :

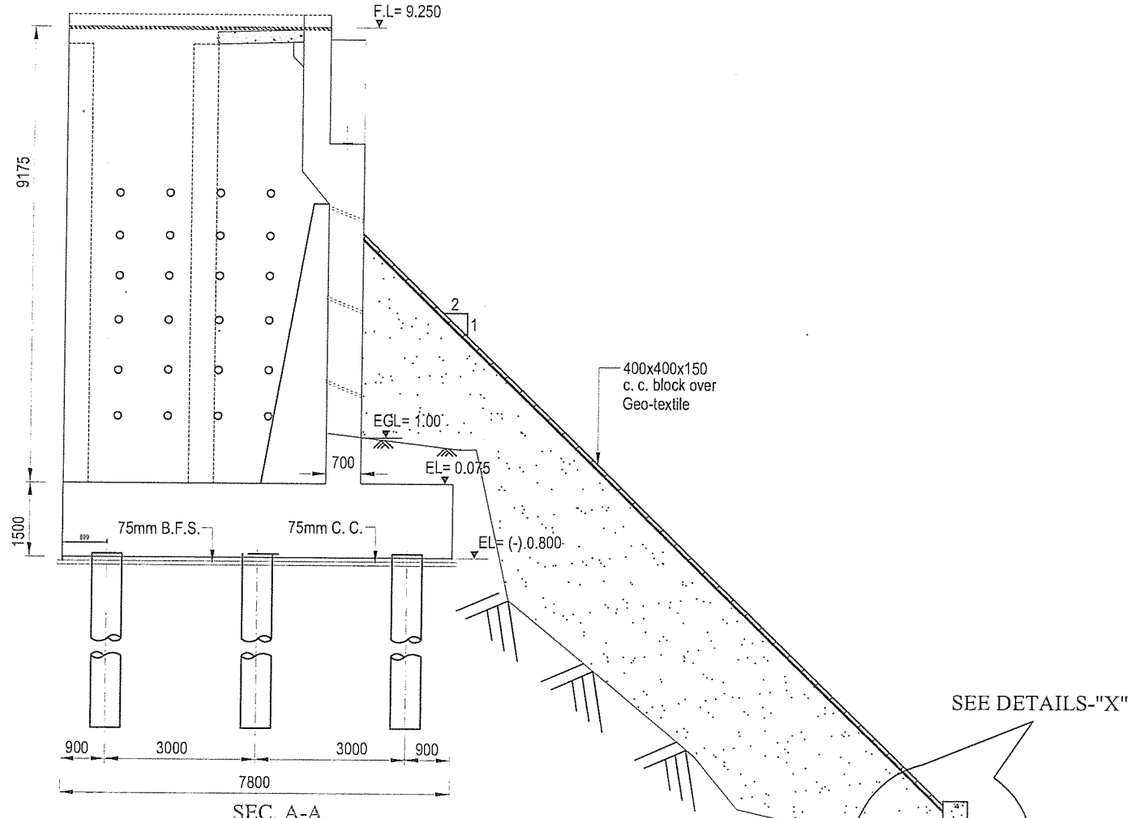
1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
2. DIMENSIONS SHOWN IN THE BAR BENDING SCHEDULE SHALL BE VERIFIED AT SITE.
3. CONCRETE COVER FOR APPROACH SLAB & BRACKET = 50mm

REV.	DESCRIPTION	DATE

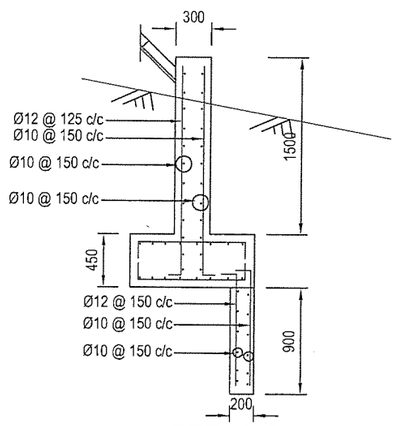
ROADS AND HIGHWAYS DEPARTMENT (RHD) Ministry of Communications	NAME OF THE PROJECT : Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DRAWING TITLE : DETAILS OF EXPANSION JOINT Scale : As above 02 July' 2013 DRAWING NO. JICA/BRDG/E.JOINT/DWG-20



PLAN OF SLOPE PROTECTION
(Scale : 1:200)



SEC. A-A
(Scale : 1:125)



DETAILS-"X"

REV.	DESCRIPTION	DATE

ROADS AND HIGHWAYS DEPARTMENT (RHD)	NAME OF THE PROJECT :		DRAWING TITLE :	SCALE :	DATE :	DRAWING NO.
Ministry of Communications	Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh (JICA Study).	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DETAILS OF PROTECTION WORK ON BOTH ABUTMENT	Scale : As above	02 July' 2013	BRDG/PROT./DWG-21