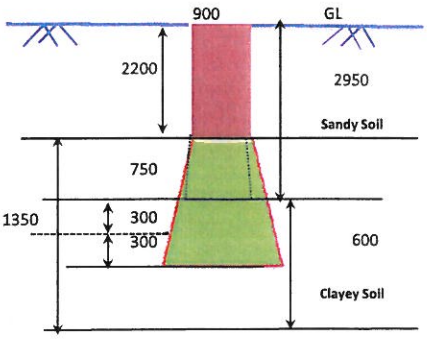
Sample Calculation

Safe Bearing Capacity & Safe Bearing Pressure of Well Foundation

Refer - 6403, 8009(part-I)

Location :- BH-1(A2),Yamuna River.

Diameter of Well **(B)**	=	900 cm
Depth of Well **(d_f)**	=	2200 cm
Depth of scour from ground level	=	1141.1 cm
Effective depth of Well	=	1058.9 cm
Founding Strata	=	Fine Sand with Gravel
D / B	=	1.18



(All dimensions are in cm)

The Following parameters are utilised in Calculation

N = **25**

Angle of Shearing Resistance of Soil **(Φ)** = 35° (Resricted) (Ref : Fig. No-1 ,Pg -11, IS : 6403-1981)

Saturated unit weight of foundation soil **(γ_{sat})** = 0.002 Kg/Cm^3

Submerged unit weight of foundation soil **(γ')** = 0.001 Kg/Cm^3

(A) Safe Bearing Capacity

Bearing Capacity Factor,

N_q = 33.30

N_γ = 48.03

(Ref : Clause no. 5.3.1.1 , IS : 6403-1981)

Shape Factors,

S_q = 1.20

S_γ = 0.60

(Ref : Clause no. 5.1.2.1 , IS : 6403-1981)

Depth Factor ,

$d_q = d_\gamma$ = $1+0.1(D_f/B)x\sqrt{N\Phi}$

= 1.23

Where, $\sqrt{N\Phi} = \tan(\prod/4)+\Phi/2$

(Ref : Clause no. 5.1.2.2 , IS : 6403-1981)

Correction factor for water table **(W')** = 0.5 (Assuming water table at the EGL)

Net Ultimate Bearing Capacity **(q_d)** = $q(N_q-1)s_q d_q i_q + 0.5BYN_\gamma s_\gamma d_\gamma i_\gamma W'$

= 66.22 kg/cm^2 (Ref :Clause no. 5.3.1.1,IS : 6403-1981)

Factor of Safety **(FOS)** = 2.50

Safe Bearing Capacity **(q_{safe})** = q_d /FOS

= 26.487 kg/cm^2

= 264.87 t / m^2

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B **Safe Bearing Pressure**

* Load is dispersed in soil as per 2v : 1h Principle
* The zone of Soil within a depth of 1.5xdia of well is assumed to the involved in setlement

For Sandy Soil Stratum :

N ava of the layer = 25

Assuming Structural Load applied **(q)** = 1 kg/cm^2

Pressure Increment **(p)** at top-layer of sandy layer involved in settlement = 1.00 kg/cm^2

Settlement $(S_i) = pB\,I\,(1 - \mu 2) / E$

Where, (Ref : Clause no - 9.2.3.2 , IS : 8009 (Part -1) - 1976)

Influence factor **(I)** = 0.85

Poisson's Ratio **(μ)** = 0.30 (Ref:Table no-1.16.2,Foundation Design Manual, N. V. Nayak)

Modulus of Elasticity **(E)** = **1200(N+6)**

= 37200 kp_a

= 372 kg/cm^2 (Ref : Bowles, J.E., Foundation Analysis & Design,McGraw-Hill , New York,2002)

Settlement (S_i) = 1.871371 cm

For Clayey Soil Stratum :

Initial Void Ratio at mid-height of layer (e_0) = 0.51

Compression index (C_c) = $0.3(e_0 - 0.27)$ (Ref:Clause no-9.2.2.2 IS: 8009 (Part -1)-1976)

= 0.07

Initial effective Pressure at mid-height of layer (P_0) = 2.1089 kg/cm^2

Assuming Structural Load applied **(q)** = 1 kg/cm^2

Area of the top layer where load applied in cm^2 = 636172.5124

Area of the middle layer where load applied in cm^2 = 2986476.516

Pressure Increment (Δ_p) in kg/cm^2 = 0.213017751

Thickness of soil layer involved (H_t) = 600 cm

$$\text{Settlement } (S_{oed}) = \frac{H_t}{1 + e_0} C_c \log_{10}\left(\frac{P_0 + \Delta_p}{P_0}\right)$$ (Ref:Clause no-9.2.2.2 IS: 8009 (Part -1)-1976)

= 1.196 cm

Depth factor & λ :

D / √LB	=	0.85	
√LB / D	=	1.18	(Ref : Fig no - 12 , IS : 8009 (Part -1) - 1976)
L / B	=	1.00	
Depth Factor	=	0.753	
λ	=	0.70	(Ref : Table no - 1, IS : 8009 (Part -1) - 1976)
Rigidity Factor	=	0.80	

Settlement for 1kg / cm^2 = $((S_{oed} \times \lambda) + S_i) \times$ **Depth Factor x Rigidity Factor**

= 1.63 cm

16.3 mm Settlement caused due to = 1.00 kg / cm^2 = 10.00 t / m^2

Hence,

50 mm Settlement caused due to = 3.06 kg / cm^3 = 30.65 t / m^2

75 mm Settlement caused due to = 4.60 kg / cm^3 = 45.97 t / m^2

C **Allowable Bearing Pressure**

Safe Bearing Capacity (q_{safe})	=	264.87 t / m^2
Safe Bearing Pressure for 50mm Settlement	=	30.65 t / m^2
Safe Bearing Pressure for 75mm Settlement	=	45.97 t / m^2

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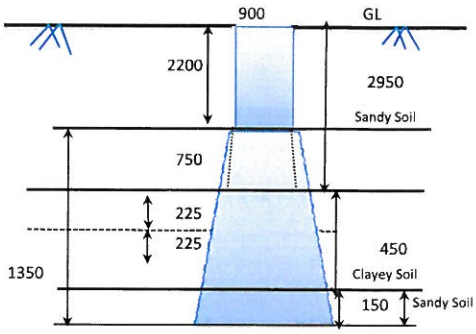
Sample Calculation

Safe Bearing Capacity & Safe Bearing Pressure of Well Foundation

Loaction :-Yamuna River -BH-4(A1)

Diameter of Well **(B)**	=	900	cm
Depth of Well **(d_f)**	=	2200	cm
Depth of scour from ground level	=	1273.4	cm
Effective depth of Well	=	926.6	cm
D / B	=	1.029556	cm
Founding Strata	=	Fine Sand with gravel	
N corrected	=	25	



Angle of Shearing Resistance of Soil **(Φ)** = 35° (Ref : Fig. No-1 ,Pg -11, IS : 6403-1981)

Saturated unit weight of foundation soil **(γ_{sat})** = 0.002 Kg/Cm^3

Submerged unit weight of foundation soil **(γ')** = 0.001 Kg/Cm^3

(A) Safe Bearing Capacity

Bearing Capacity Factor,

N_q = 33.30 (Ref : Clause no. 5.3.1.1 , IS : 6403-1981)

N_γ = 48.03

Shape Factors,

S_q = 1.20 } (Ref : Clause no. 5.1.2.1 , IS : 6403-1981)

S_γ = 0.60

Depth Factor ,

Where, √NΦ = tan(∏/4)+Φ/2

$d_q = d_\gamma$ = 1+0.1(D_f/B)x√NΦ } (Ref : Clause no. 5.1.2.2 , IS : 6403-1981)

= 1.20

Correction factor for water table **(W')** = 0.5 (Assuming water table at the EGL)

Net Ultimate Bearing Capacity **(q_d)** = **$cNc\ Sc\ dci_c + q(N_q-1)s_q d_q i_q + 0.5BYN_\gamma s_\gamma d_\gamma i_\gamma W'$**

= 74.65 kg/cm^2 } (Ref :Clause no. 5.3.1.1,IS : 6403-1981)

Factor of Safety **(FOS)** = 2.50

Safe Bearing Capacity **(q_{safe})** = **q_d /FOS**

= 29.86 kg/cm^2

= 298.61 t / m^2

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B **Safe Bearing Pressure**

* It is assumed that soil layer of thickness 1.5m (1.5xB) below the footing takes part in settlement process.
* Load is dispersed in soil as per 2v : 1h Principle

For Sandy Soil Stratum (1) :

N ava of the layer = 25

Assuming Structural Load applied **(q)** = 1 kg/cm^2

Pressure Increment **(p)** at top-layer of sandy layer involved in settlement = 1.00 kg/cm^2

L / B = 2.44

Settlement **$(S_i 1) = pB\,I\,(1-\mu 2)\,/\,E$** (Ref : Clause no - 9.2.3.2 , IS : 8009 (Part -1) - 1976)

Where,

Influence factor **(I)** = 0.85

Poisson's Ratio **(μ)** = 0.30 (Ref:Table no-1.16.2,Foundation Design Manual, N. V. Nayak)

Modulus of Elasticity **(E)** = **1200(N+6)**

= 37200 kp_a

= 372 kg/cm^2 (Ref : Bowles, J.E., Foundation Analysis & Design,McGraw-Hill , New York,2002)

Settlement **(S_{i1})** = 1.871370968 cm

For Clayey Soil Stratum :

Initial Void Ratio at mid-height of layer **(e_0)** = 0.51

Compression index **(C_c)** = $0.3(e_0 - 0.27)$ (Ref:Clause no-9.2.2.2 IS: 8009 (Part -1)-1976)

= 0.07

Initial effective Pressure at mid-height of layer **(P_0)** = 1.90 kg/cm^2

Assuming Structural Load applied **(q)** = 1 kg/cm^2

Area of the top layer where load applied in cm^2 = 636172.5124

Area of the middle layer where load applied in cm^2 = 2761165.418

Pressure Increment **(Δ_p)** in kg/cm^2 = 0.2304

Thickness of soil layer involved **(H_t)** = 450 cm

Settlement **(S_{oed})** = $\frac{H_t}{1+e_0}\, C_c \log_{10}\left(\frac{P_0+\Delta_p}{P_0}\right)$ (Ref:Clause no-9.2.2.2 IS: 8009 (Part -1)-1976)

= 1.07 cm

For Sandy Soil Stratum (2) :

N ava of the layer = 25

Assuming Structural Load applied **(q)** = 1 kg/cm^2

Area of the top layer of foundation = 636172.51 cm^2

Area of top layer of sandy strata = 3463605.9 cm^2

Foundation Pressure **(p)** = = 0.184 kg/cm^2

L / B = 1.00

Settlement **$(S_i 2) = pB\,I\,(1-\mu 2)\,/\,E$** (Ref : Clause no - 9.2.3.2 , IS : 8009 (Part -1) - 1976)

Where,

Influence factor **(I)** = 0.85

Poisson's Ratio **(μ)** = 0.30 (Ref:Table no-1.16.2,Foundation Design Manual, N. V. Nayak)

Modulus of Elasticity **(E)** = **1200(N+6)**

= 37200 kp_a

= 372 kg/cm^2 (Ref : Bowles, J.E., Foundation Analysis & Design,McGraw-Hill , New York,2002)

Settlement **(S_{i2})** = 0.343721198 cm

Depth factor & λ :

D / √LB = 1.03

√LB / D = 0.97

L / B = 1.00

Depth Factor = 0.72 (Ref : Fig no - 12 , IS : 8009 (Part -1) - 1976)

λ = 0.70 (Ref : Table no - 1, IS : 8009 (Part -1) - 1976)

Rigidity Factor = 0.80

Settlement for 1kg / cm^2 = **$((S_{oed} \times \lambda) + S_{i\,1} + S_{i\,2}) \times$ Depth Factor x Rigidity Factor**

= 1.71 cm

17.1 mm Settlement caused due to = 1.00 kg / cm^2 = 10.00 t / m^2

Hence ,

50 mm Settlement caused due to = 2.93 = 29.32 t / m^2

75 mm Settlement caused due to = 4.40 kg / cm^2 = 43.97 t / m^2

C **Allowable Bearing Pressure**

Safe Bearing Capacity (q_{safe}) = 298.61 t / m^2

Safe Bearing Pressure for 50mm Settlement = 29.32 t / m^2

Safe Bearing Pressure for 75mm Settlement = 43.97 t / m^2

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WELL FOUNDATION

Refer - IS code 6403, 8009(part-I)

Location :- Yamuna River_BH-5(P6)

Diameter of Well **(B)**	=	900 cm	9	m
Depth of Well **(d_f)**	=	3200 cm	32	m
Depth of scour from ground level	=	2010.5 cm	20.105	m
Effective depth of Well	=	1189.5 cm	11.895	m

Founding Stratum = Silty Clay

D / B = 1.32166667

Shear Criteria

N = **N>50**

C = **2.00** kg/ cm^2

(Ref: Page no-30, Foundation Design Manual, Narayan V. Nayak)

Saturated unit weight of foundation soil **(γ_{sat})** = 0.002 Kg/Cm^3

Submerged unit weight of foundation soil **(γ')** = 0.001 Kg/Cm^3

Bearing Capacity Factor,

N_c = 5.14 (Ref : Clause no. 5.3.1.1 , IS : 6403-1981)

Shape Factor,

S_c = 1.30 (Ref : Clause no. 5.1.2.1 , IS : 6403-1981)

Depth Factor ,

d_c = 1.26 (Ref : Clause no. 5.1.2.1 , IS : 6403-1981)

Net Ultimate Bearing Capacity **(q_d)** = **cNc Sc dc** = 16.90 kg/cm^2

(Ref : Clause no. 5.1.2.1 IS : 6403-1981)

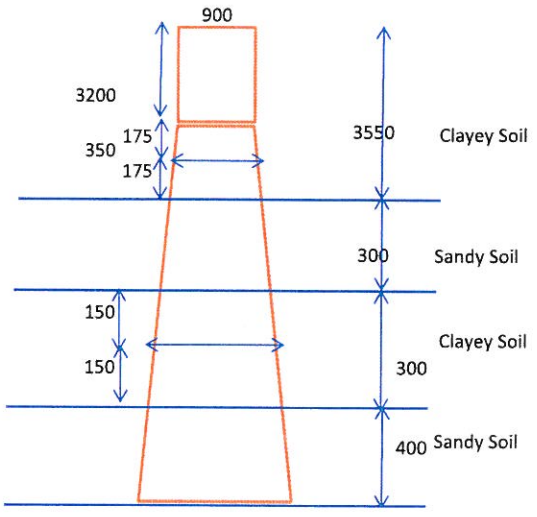
Factor of Safety **(FOS)** = 2.50

Net Safe Bearing Capacity(**q_{safe}**) = **q_d /FOS**

= 6.759 kg/cm^2

= 67.59 t / m^2

Safe Bearing Pressure



4721

For Clayey Soil Stratum :

From lab test,

Initial Void Ratio at mid-height of layer (e_0) = 0.51

Compression Index (C_c) = **0.3 (e_0 - 0.27)**

= 0.07

Assumptions :

- Load is dispersed in soil as per 2v : 1h Principle
- The zone of Soil within a depth of 1.5xdia of well is assumed to the involved in setlement

Initial effective Pressure at mid-height of layer (P_0) in kg/cm^2 = 1.365

Assuming Load applied (**q**) in kg/cm^2 = 1

Area of the top layer where load applied in cm^2 = 636172.5124

Area of the middle layer where load applied in cm^2 = 907625.7526

Pressure Increment (Δ_p) in kg/cm^2 = 0.7009

$$\frac{H_t}{1+e_0} = 231.79$$

$$\log_{10}\left(\frac{P_0+\Delta_p}{P_0}\right) = 0.180$$

$$\text{Settlement } (S_{oed}1) = \frac{H_t}{1+e_0} C_c \log_{10}\left(\frac{P_0+\Delta_p}{P_0}\right)$$

= 3.00 cm

For Sandy Soil Stratum :

N avareage of the sandy soil layer = 25

Assumptions :

- Load is dispersed in soil as per 2v : 1h Principle
- The zone of Soil within a depth of 1.5xwidth of footing is considered for settlement

Assuming Load applied (**q**) = 1 kg/cm^2

Area of the top layer of foundation = 636172.5124

Area of top layer of sandy strata = 1227184.63 cm^2

Foundation Pressure (**p**) = 0.52 kg/cm^2

Settlement $(S_i) = pB\,I\,(1-\mu 2)\,/\,E$ (Ref : Clause no - 9.2.3.2 , IS : 8009 (Part -1) - 1976)

Where, Influence factor (**I**) = 0.85

Poisson's Ratio (μ) = 0.30 (Ref:Table no-1.16.2,Foundation Design Manual, Narayan V. Nayak)

Modulus of Elasticity(**E**) = **1200(N+6)** (Ref : Bowles, J.E. 2002, Foundation Analysis & Design, McGraw-Hill,New York with Permission)

= 37200 kp_a

= 372 kg/cm^2

Settlement (S_i1) = 0.9701 cm

For Clayey Soil Stratum :

Initial effective Pressure at mid-height of layer (P_0) in kg/cm^2 = 1.99

Assuming Load applied (**q**) in kg/cm^2 = 1

Area of the top layer where load applied in cm^2 = 636172.5124

Area of the middle layer where load applied in cm^2 = 2269800.692

Pressure Increment (Δ_p) in kg/cm^2 = 0.28

$$\frac{H_t}{1+e_0} = 198.68$$

$$\log_{10}\left(\frac{P_0+\Delta_p}{P_0}\right) = 0.057$$

$$\text{Settlement } (S_{oed}2) = \frac{H_t}{1+e_0} C_c \log_{10}\left(\frac{P_0+\Delta_p}{P_0}\right)$$

= 0.82 cm

4722

For Sandy Soil Stratum :

N avareage of the sandy soil layer = 25

Assumptions :

- Load is dispersed in soil as per 2v : 1h Principle
- The zone of Soil within a depth of 1.5xwidth of footing is considered for settlement

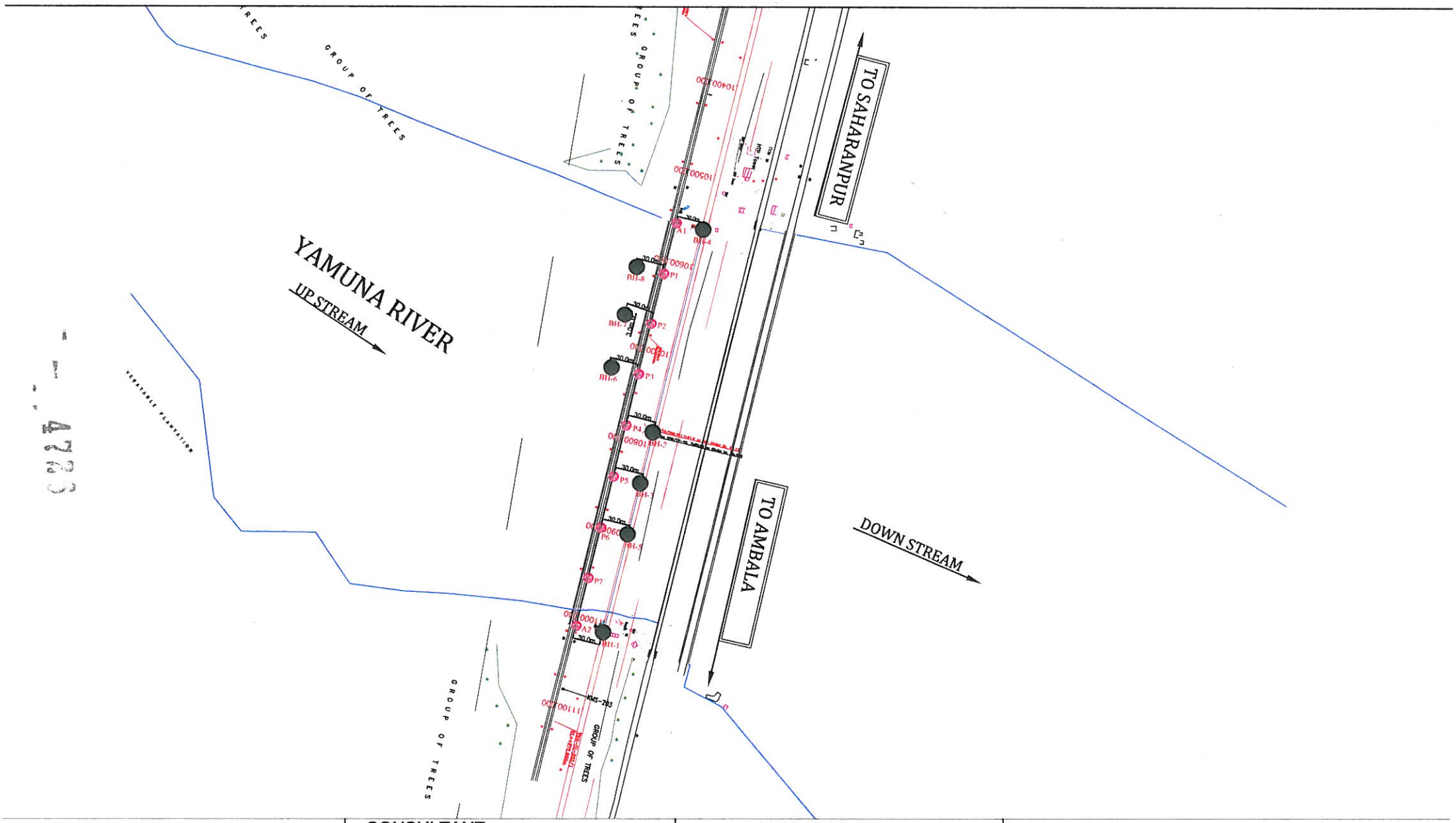
Assuming Load applied **(q)** =	1	kg/cm^2	
Area of the top layer of foundation =	636172.5124		
Area of top layer of sandy strata =	2688025.214	cm^2	
Foundation Pressure **(p)** =	0.24	kg/cm^2	
Settlement **(S_i) = pB I (1 - μ2) / E**			(Ref : Clause no - 9.2.3.2 , IS : 8009 (Part -1) - 1976)
Where, Influence factor **(I)** =	0.85		
Poisson's Ratio **(μ)** =	0.30		(Ref:Table no-1.16.2,Foundation Design Manual, Narayan V. Nayak)
Modulus of Elasticity **(E)** =	**1200(N+6)**		(Ref : Bowles, J.E. 2002, Foundation Analysis & Design, McGraw-Hill,New York with Permission)
=	37200	kp_a	
=	372	kg/cm^2	
Settlement **(S_i2)** = 0.4429 cm			
D / √ LB =	1.32		(Ref : Fig no - 12 , IS : 8009 (Part -1) - 1976)
√LB / D =	0.76		
L / B =	1.00		
Depth Factor =	0.668		
Rigitidity Factor =	0.80		
λ =	0.70		
($S_{oed}1+S_{oed}2)λ+ S_{i1}+Si_2$) =	4.09	cm	
Settlement for 1kg / cm^2 =	**((Soed1+Soed2)λ+ Si) x Depth Factor x Rigidity Factor**		
=	2.19 cm		
21.9 mm Settlement at =	1.00 kg/cm^2	=	10.00 t/m^2
1 mm Settlement at =	0.05 kg/cm^2	=	0.46 t/m^2
50 mm Settlement at =	2.29 kg/cm^2	=	22.88 t/m^2
75 mm Settlement at =	3.43 kg/cm^2	=	34.32 t/m^2
Net Safe Bearing Capacity (q_{safe}) =	67.586 t/m^2		
Safe Bearing Pressure for 50mm settlement =	22.880 t/m^2		
Safe Bearing Pressure for 75mm settlement =	34.319 t/m^2		

Bridge at Km (10+786)

① Borelocation Plan
② River cross-section 1 km both in U/S and D/S side.
③ Catchment area marking in Toposheet
④ Discharge Calculations
⑤ Silt factor Calculations

BOREHOLE LOCATION PLAN

4735



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डेडीकेटेड फ्रेट कोरीडोर

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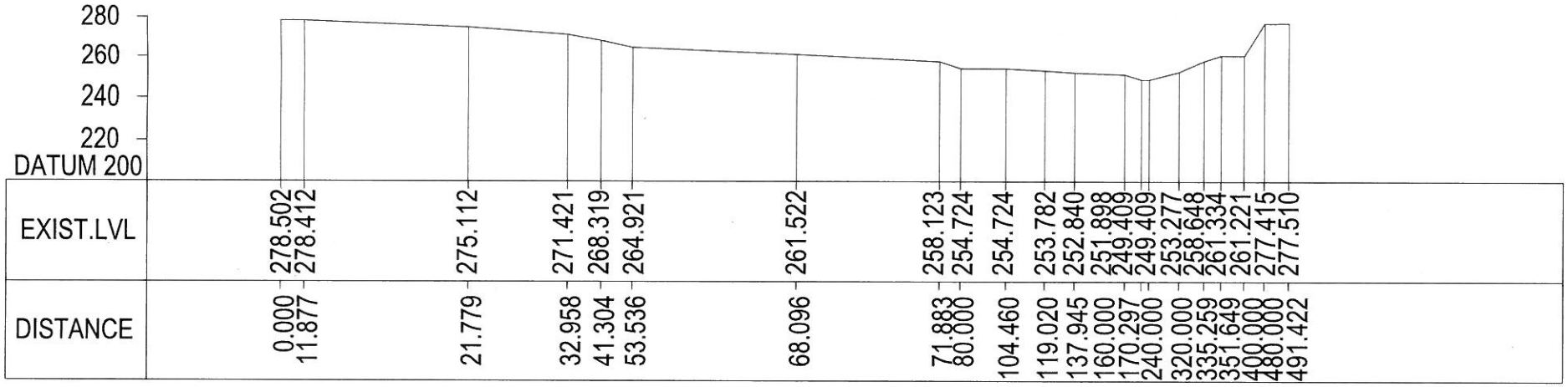
PROJECT:-
GEOTECHNICAL INVESTIGATION FOR 3 NOS IMPORTANT BRIDGES

LOACTION PLAN ALONG YAMUNA RIVER

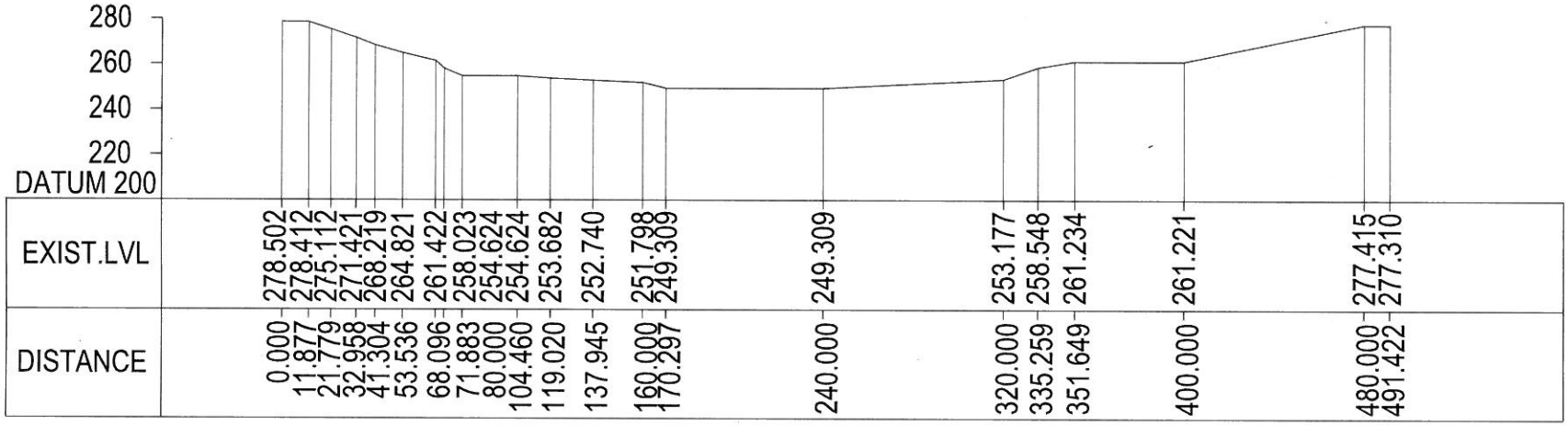
DRG NO.	ATCPL/DFCC/TR/LP-03	DRN BY:-I.B	CHKD BY:-JKR
DATE	JUNE-2013	SCALE	AS SHOWN

YAMUNA RIVER PROFILE AT-PROP:-10+786 SPAN SIZE :-
7 X 61.0M on 1 KM SURVEY BOTH IN U/S & D/S

4727



CROSS SECTION - 1



CROSS SECTION - 2

DATE	DESCRIPTION	CHKD.	APPRD.
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TITLE:-
CROSS SECTION OF YAMUNA RIVER
AT PROP.CH:-10+786.761
SPAN SIZE:-
7 x 61.0m OPEN WEB GIRDER

SCALE :	AS SHOWN	SIGNATURE
DATE :	JULY-2013	
PREP.BY	GM	
DESG.BY		
CHKD. BY	NNA	
Appvd By:		

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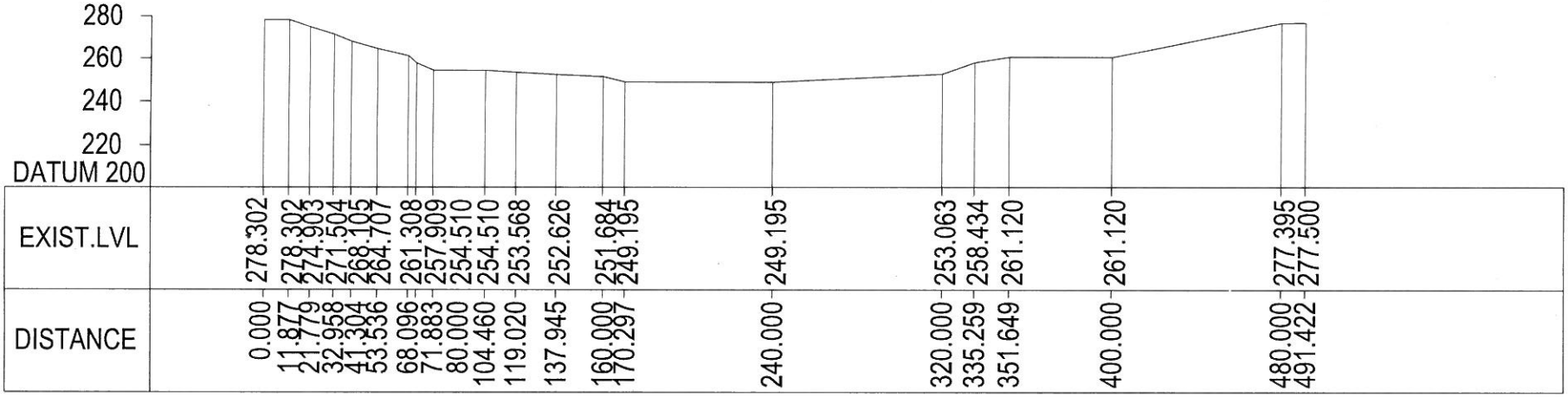

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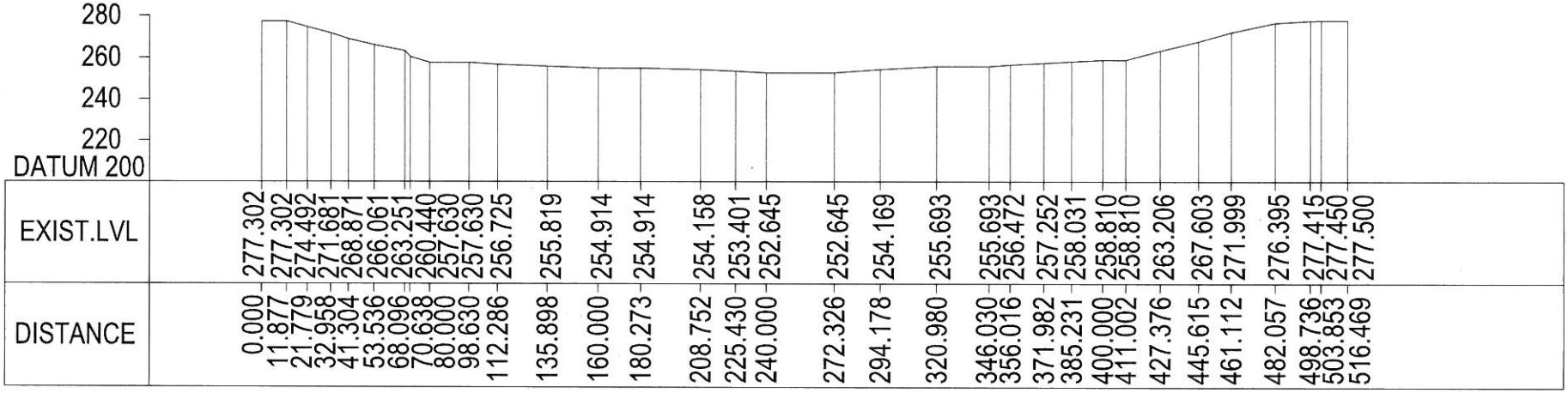

CROSS SECTION - 4

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	REVISIONS		

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A[illegible]
Telefax: 0171-2612412

TITLE:-
CROSS SECTION OF YAMUNA RIVER
AT PROP.CH:-10+786.761
SPAN SIZE:-
[illegible] OF [illegible] GIRDER

SCALE :	AS SHOWN	SIGNATURE
DATE :	JULY-2013	
PREP.BY	GM	
DESG.BY		
CHKD. BY	NA	
Appvd By:		

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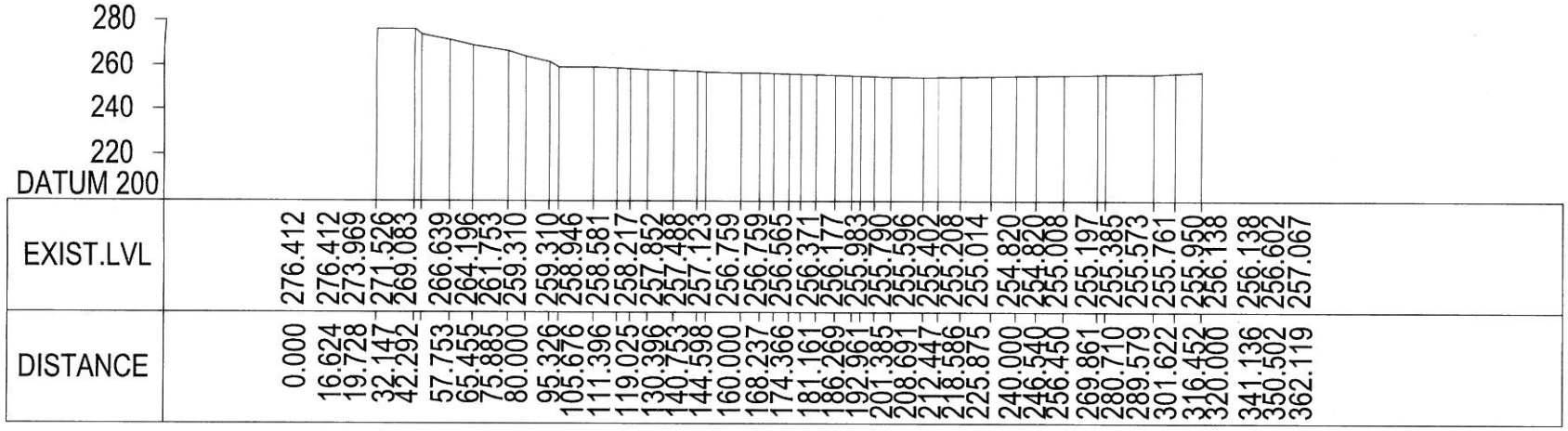
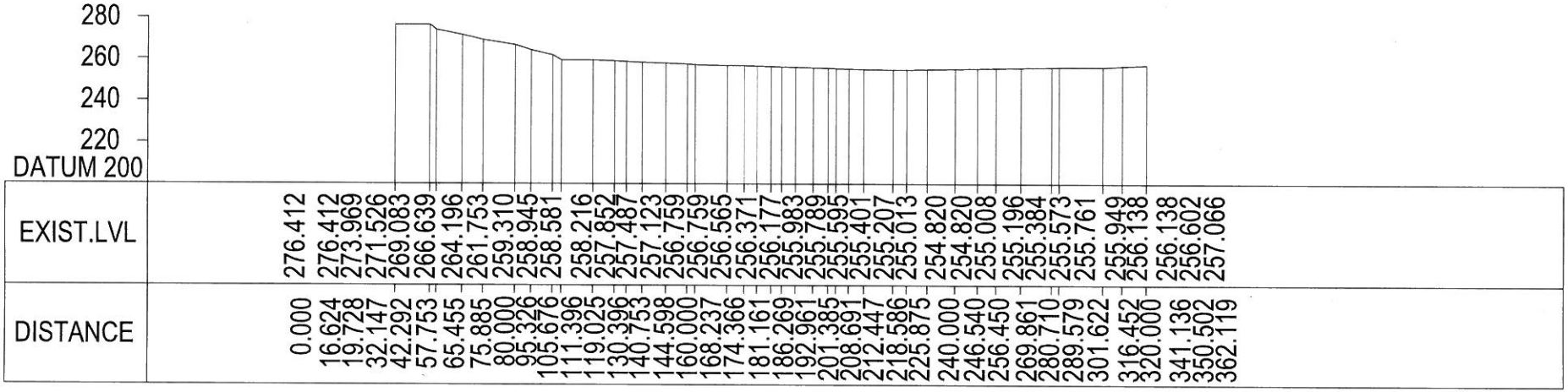


CROSS SECTION - 5



CROSS SECTION - 6

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	REVISIONS		

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(A Govt. of India Enterprise)
Old Railway colony (Near Anand Market)
Ambala Cantt-133001
Telefax: 0171-2612412

TITLE:-
CROSS SECTION OF YAMUNA RIVER
AT PROP.CH:-10+786.761
SPAN SIZE:-
7 x 61.0m OPEN WEB GIRDER

SCALE :	AS SHOWN	SIGNATURE
DATE :	JULY-2013	
PREP.BY	GM	
DESG.BY		
CHKD. BY	NNA	
Appvd By:		

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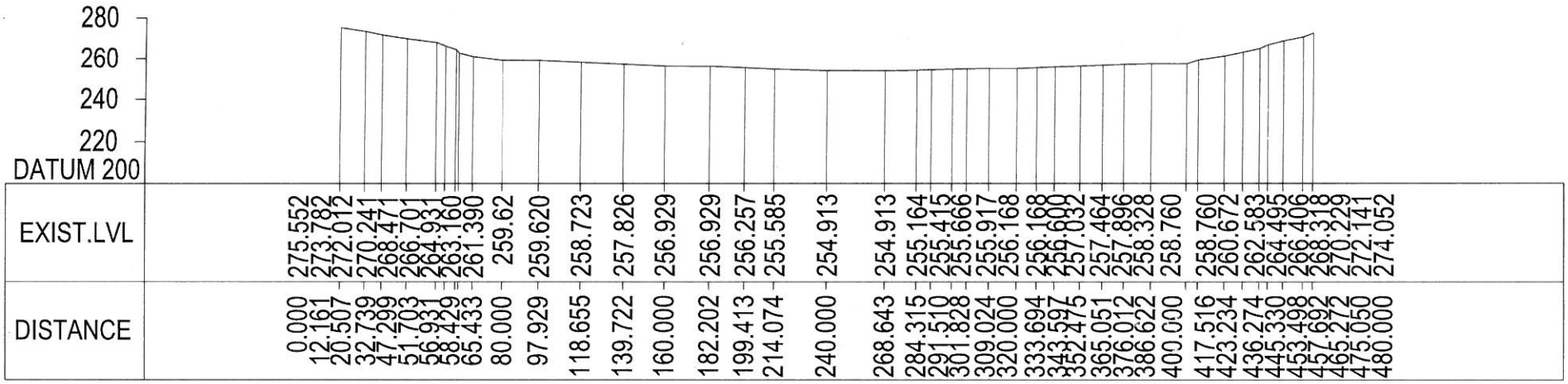
REV. 1



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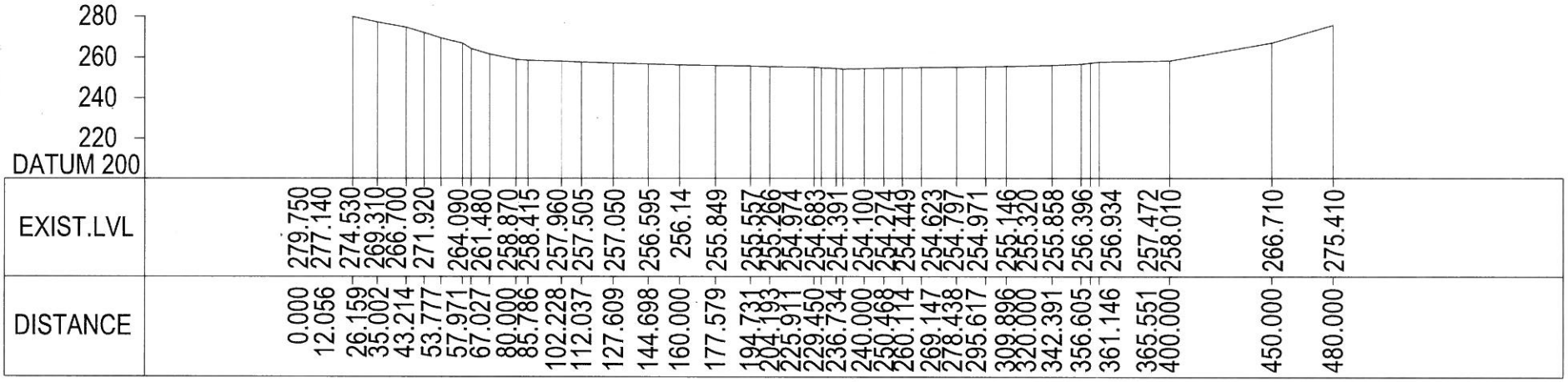


CROSS SECTION - 8

4234

DATE	DESCRIPTION	CHKD.	APPRD.
	REVISIONS		

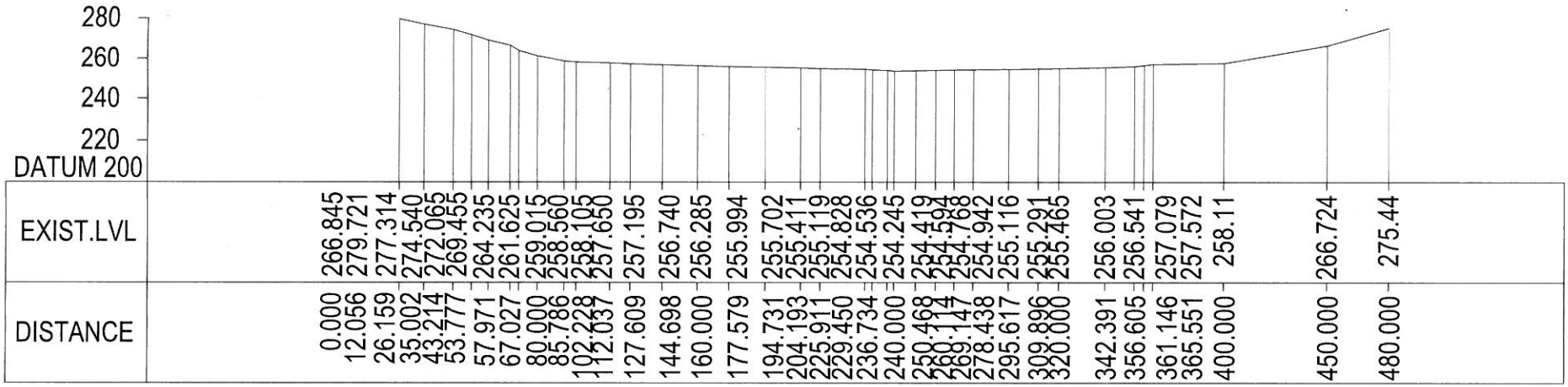
CLIENT:- DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED
(A Govt. of India Enterprise)
Old Railway colony (Near Anand Market)
Ambala Cantt 133001
Telefax: 0171-2612412

TITLE:-
CROSS SECTION OF YAMUNA RIVER
AT PROP.CH:-10+786.761
SPAN SIZE:-
61 .0 W GI ER

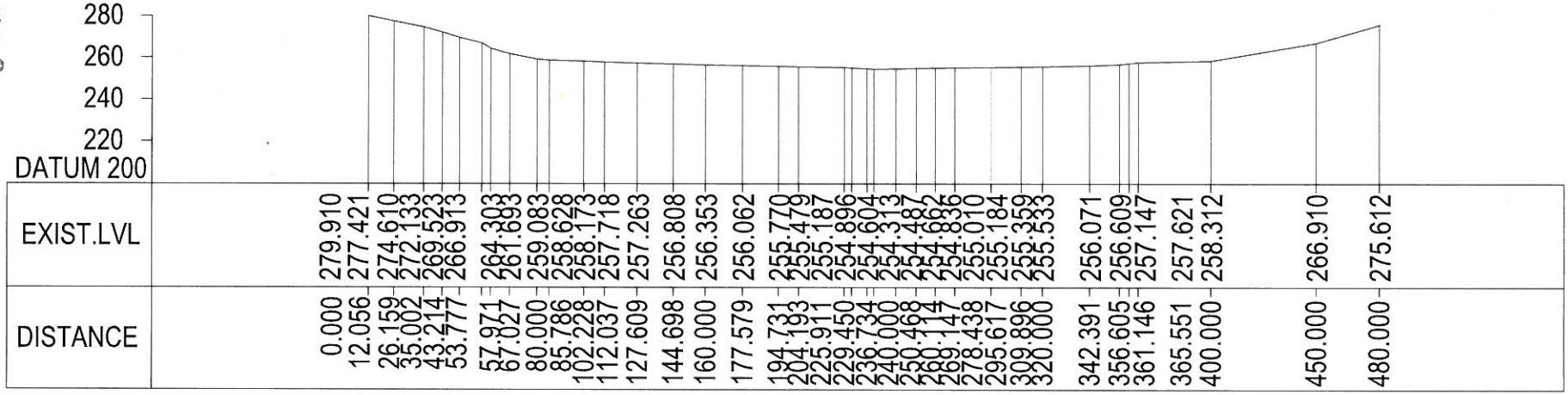
SCALE :	AS SHOWN	SIGNATURE
DATE :	JULY-2013	
PREP.BY	GM	
DESG.BY		
CHKD BY	NA	
Appvd By:		

ARKITECHNO
ARKITECHNO Consultants (India) Pvt.Ltd
ISO 9001-2008 Certified Company
Plot No# N3/91,IRC Village,Nayapalli
Bhubaneswar-751015,Odisha
Web:www.arkitechno.com

DRAWING NO.
ATCPL/DFCC/2013/BR/68/CS



CROSS SECTION - 9



CROSS SECTION - 10

4733

DATE	DESCRIPTION	CHKD.	APPRD.
	REVISIONS		

CLIENT:- DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED
(A Govt. of India Enterprise)
Old Railway colony (Near Anand Market)
Ambala Cantt-133001
Telefax: 0171-2612412

TITLE:-
CROSS SECTION OF YAMUNA RIVER
AT PROP.CH:-10+786.761
SPAN SIZE:-
7 x 61.0m OPEN WEB GIRDER

SCALE :	AS SHOWN	SIGNATURE
DATE :	JULY-2013	
PREP.BY	GM	
DESG.BY		
CHKD. BY	NNA	
Appvd By:		

ARKITECHNO
ARKITECHNO Consultants (India) Pvt.Ltd
ISO 9001-2008 Certified Company
Plot No# N3/91,IRC Village,Nayapalli
Bhubaneswar-751015,Odisha
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DRAWING NO.
ATCPL/DFCC/2013/BR/68/CS

REV. 1

CATCHMENT AREA MARKING IN TOPOSHEET

YAMUNA RIVER
CHAINAGE - 10+786
TOPO SHEET NO. = 53F/6 , 53F/7 , 53F/10 , 53F/11 , 53F/14 , 53F/15 , H43L8 , H43L12
CATCHMENT AREA (A) = 4110 Sq km.
LENGTH OF LONGEST STREAM (L) = 96.00 KM
ELEVATION OF SOURCE POINT = 1885
ELEVATION OF BRIDGE POINT = 269
HEIGHT DIFFERENCE BETWEEN SOURCE POINT TO BRIDGE POINT (H) = 1616

DISCHARGE CALCULATIONS

Discharge Calculations :-
Hydrology & Hydraullic calculations @ 10+786

1.0 Discharge Calculations as per Empirical Formula (Dickens) :

Details of the Bridge :

Chainage = 10+786 km

Preparation of Catchment Area Plan:

A catchment plan showing the river/stream , contours and spot levels was prepared for determining the physiographic parameters as follow:

Physiographic Parameters:

Catchment Area (M) = 4110.000 sq km

Discharge Calculations :

Discharge $Q = CM^{3/4}$, As per Dickens Formula

Where
Q = The Peak run-off in cum/sec
C = 14
M = 4110.0 Sq.km

$\therefore Q = 14 \times 4110.0^{3/4}$
$= \mathbf{7186.367}$ **cu.m/sec**

2.0 Discharge Calculations as per Rational Formula :

$Q = 0.028\ P.f.A.Ic$

Where Q = Maximum run-off in cu.m / sec

A = Area of catchment in hectares = 411000.0 From Topo Sheet

P = Percentage coefficient of runoff for the catchment characteristics
= 0.6

f = fraction depending on the catchment area from f curve
= 0.62

Ic = Critical Intensity of rainfall in cm per hour

$= Io \left(\frac{2}{tc + 1} \right)$ Io = one hour rainfall

Where $Io = \frac{F}{2} \left(1 + \frac{1}{T} \right)$ = 7.30 cm/hr

F = Precipitation of the storm in cm = 7.3 cm

T = Duration in hours = 1 hrs

tc = Concentration time of Catchment in hours

$= 0.870 \left(\frac{L^3}{H} \right)^{0.385}$ = 9.858 hrs

From Topo Sheet
L = The distance from the critical point to the culvert in km. = 96.000

H = The fall in level from the critical point to the bridge in metre. = 1616.0

$\therefore Q = A.Io.\lambda$

$I = \frac{0.056\ f.P}{tc + 1} = \frac{0.056 \times 0.62 \times 0.6}{9.858 + 1} = 0.00191857$

$Q = 411000 \times 7.3 \times 0.002 =$ **5756.286 cu.m/sec**

4736

Discharge Calculations - SUH :-

Discharge calculation by Synthetic Unitgraph Method

1 Design data

Catchment Area	(A)	=	4110	sqkm
Length of Longest Stream	(L)	=	96	km
Length of Longest Stream from cg to site	(L_c)	=	48	km
Unit Duration of Unitgraph	(t)	=	1.0	hr

2 Computation of Equivalent Stream Slope (S)

Sl. No.	Reduced distance	Reduced levels	L_i	D_i	$D_{i-1} + D_i$	$L_i(D_{i-1}+ D_i)$
	(kms)	(m)	(kms)	(m)	(m)	(mxkm)
1	2	3	4	5	6	7
1	0.000	262.012	0		-	-
2	0.110	262.001	0.110	-0.011	-	0.00
3	0.230	261.976	0.120	-0.036	-0.047	-0.01
4	0.330	261.945	0.100	-0.067	-0.103	-0.01
5	0.390	261.924	0.060	-0.088	-0.155	-0.01
6	0.510	261.913	0.120	-0.099	-0.187	-0.02
7	0.580	262.056	0.070	0.044	-0.055	0.00
8	0.710	262.032	0.130	0.02	0.064	0.01
9	0.830	261.911	0.120	-0.101	-0.081	-0.01
10	0.950	261.888	0.120	-0.124	-0.225	-0.03
11	1.100	261.776	0.150	-0.236	-0.36	-0.05
12	1.240	261.728	0.140	-0.284	-0.52	-0.07
13	1.350	261.709	0.110	-0.3035	-0.5875	-0.06
14	1.450	261.664	0.100	-0.3485	-0.652	-0.07
15	1.520	261.520	0.070	-0.4925	-0.841	-0.06
			1.520			**-0.3954**

Slope (S) = $\Sigma \frac{Li(D_{i-1}+D_i)}{L^2}$ = **0.1712** m/km

3 Determination of Synthetic Unitgraph Parameters:-

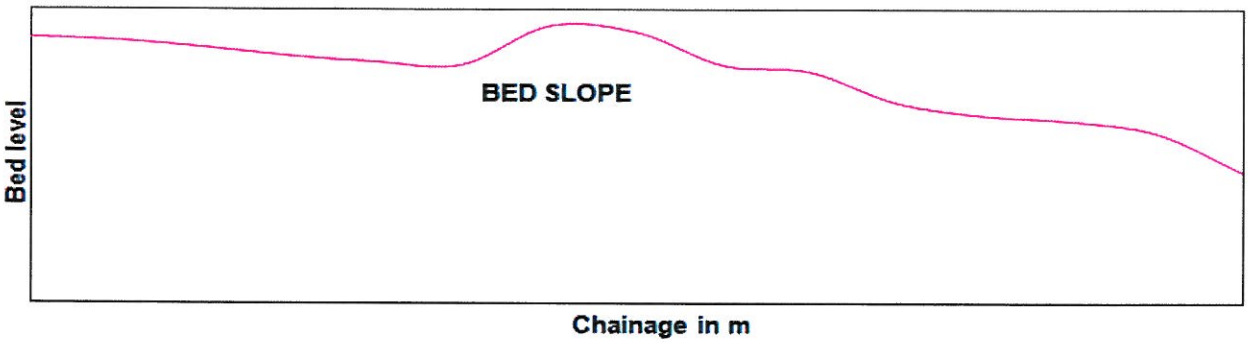
Time fromcenter of unit rain fall to Unit hydrograph in hr.	tp	=	$0.433[L/\sqrt{s}]^{0.704}$
		=	77.38 hr
Peak discharge of unit hydrograph in cumecs / Sq. Km	q_p	=	$1.161 \times (tp)^{-0.635}$
		=	0.073 cumecs / Sq. Km
Width of unit hydrograph at 50% of Max discharge ordinate	W_{50}	=	$2.284(q_p)^{-1.0}$
		=	31.13 hr
Width of unit hydrograph at 75% of Max discharge ordinate	W_{75}	=	$1.331(q_p)^{-0.991}$
		=	17.72 hr
Width of rising side of unit hydrograph at 50% of Max discharge ordinate =			$0.827 \times (qp)^{-1.023}$
	W_{R50}	=	11.97 hr
Width of rising side of unit hydrograph at 75% of Max discharge ordinate =			$0.561 \times (qp)^{-1.037}$
	W_{R50}	=	8.421 hr
Base width of Unit hydrograph	T_B	=	$8.375 \times (tp)^{0.512}$
		=	77.62 hr
Time from the start of rise to the peak of unit hydrograph	T_M	=	$t_p + t_r / 2$
		=	77.88 hr
Peak discharge of unit hydrograph	Qp	=	q_p X A
		=	301.6 cumecs

Slope of River bed calculations :-

Bed Slope / Longitudinal Slope of River Bed :

S. No.	length	LBL
1	0	262.012
2	110	262.001
3	230	261.976
4	330	261.945
5	390	261.924
6	510	261.913
7	580	262.056
8	710	262.032
9	830	261.911
10	950	261.888
11	1100	261.776
12	1240	261.728
13	1350	261.709
14	1450	261.664
15	1520	261.52

Bed slope = -0.00027 - ve sign indicate Down Ward Slope



Discharge Calculations as per Area-velocity Method :-

At Upstream Site(500 m from Bridge center)

Q = A x V

Where

A = Cross Sectional Area

V = Velocity, calculated from Manning's formula

$= \frac{1}{n} \times R^{2/3} \times S^{1/2}$

R = Hydraulic Mean depth = A / P

P = Wetted Perimeter

S = Bed Slope, measured over a long reach

n = Coefficient of rugosity (from code)

Chainage 10+786 :

H.F.L = 271.445 m L.B.L = 254.095 m

Bed slope S = 0.00027 Spread length = 480.000 m

Rugosity coefficient, n = 0.055

S.No.	H.F.L	offset (M)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	2	3	4	5	6	7	8	9
							(6 x 7)	sqrt{7*7+ (h1-h2)^2}
1	271.445	0.00	279.75	0.000	0.000	0.000	0.000	0.000
2	271.445	80.00	258.87	12.575	6.287	80.000	503.000	80.982
3	271.445	160.00	256.14	15.301	13.938	80.000	1115.027	80.046
4	271.445	240.00	254.10	17.350	16.325	80.000	1306.027	80.026
5	271.445	320.00	255.32	16.122	16.736	80.000	1338.880	80.009
6	271.445	400.00	258.01	13.435	14.778	80.000	1182.267	80.045
7	271.445	480.00	275.41	0.000	6.717	80.000	537.387	81.120
		AVG. B.L =	262.515					

Total (Cross sectional Area, A) = **5982.587** sq. m

Wetted Perimeter, P in m = **482.230**

Hydraulic Radius, R = A / P = = **12.406 m**

Velocity, V = $1/n * R^{2/3}. S^{1/2}$ = **1.601 m/sec**

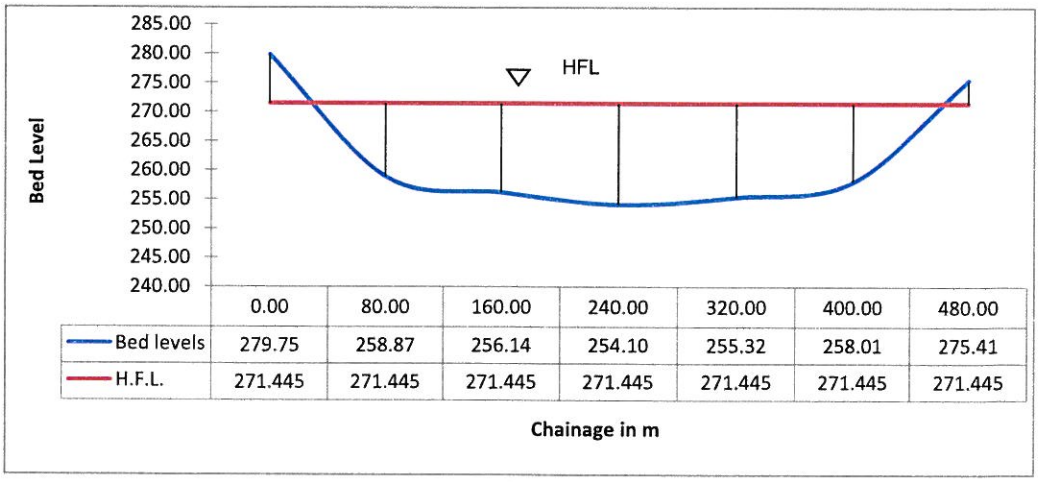
Discharge, Q = A*V = 9578.516 cumecs

Say **9579.00** cumecs

Linear water way = **480.000** m

Abbreviations

H.F.L. - High Flood Level
D.O.F. - Depth Of Flow
A.D.O.F. - Average Depth Of Flow
W.P. - Wetted Perimeter
L.B.L. - Lowest Bed Level



Discharge Calculations as per Area-velocity Method :-

At Upstream Site(100 m from Bridge center)

Q = A x V

Where A = Cross Sectional Area

V = Velocity, calculated from Manning's formula

$= \frac{1}{n} \times R^{2/3} \times S^{1/2}$

R = Hydraulic Mean depth = A / P

P = Wetted Perimeter

S = Bed Slope, measured over a long reach

n = Coefficient of rugosity (from code)

Chainage 10+786 :

H.F.L = 271.445 m L.B.L = 254.913 m

Bed slope S = 0.00027 Spread length = 480.000 m

Rugosity coefficient, n = 0.050

S.No.	H.F.L	offset (M)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	2	3	4	5	6	7	8	9
							(6 x 7)	sqrt{7*7+ (h1-h2)^2}
1	271.445	0.00	275.552	0.000	0.000	0.000	0.000	0.000
2	271.445	80.00	259.620	11.825	5.912	80.000	473.000	80.869
3	271.445	160.00	256.929	14.516	13.171	80.000	1053.647	80.045
4	271.445	240.00	254.913	16.533	15.524	80.000	1241.947	80.025
5	271.445	320.00	256.168	15.278	15.905	80.000	1272.400	80.010
6	271.445	400.00	258.760	12.685	13.981	80.000	1118.487	80.042
7	271.445	480.00	274.052	0.000	6.342	80.000	507.387	80.999
		AVG. B.L =	262.285					

Total (Cross sectional Area, A) = **5666.867** sq. m

Wetted Perimeter, P in m = **481.991**

Hydraulic Radius, R = A / P = = **11.757 m**

Velocity, V = $1/n * R^{2/3}. S^{1/2}$ = **1.699 m/sec**

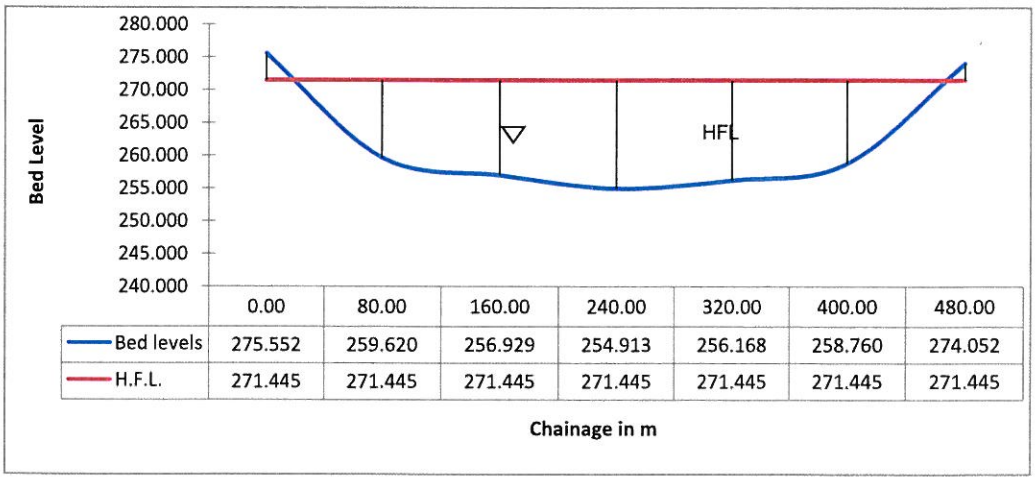
Discharge, Q = A*V = 9629.214 cumecs

Say **9630.00** cumecs

Linear water way = **480.000** m

Abbreviations

- **H.F.L.** - High Flood Level
- **D.O.F.** - Depth Of Flow
- **A.D.O.F.** - Average Depth Of Flow
- **W.P.** - Wetted Perimeter
- **L.B.L.** - Lowest Bed Level



4741

Discharge Calculations as per Area-velocity Method :- *At Bridge Site*

Q = A x V

Where A = Cross Sectional Area

V = Velocity, calculated from Manning's formula

$= \frac{1}{n} \times R^{2/3} \times S^{1/2}$

R = Hydraulic Mean depth = A / P

P = Wetted Perimeter

S = Bed Slope, measured over a long reach

n = Coefficient of rugosity (from code)

Chainage 10+786 :

H.F.L = 271.445 m L.B.L = 254.820 m

Bed slope S = 0.00027 Spread length = 480.000 m

Rugosity coefficient, n = 0.050

S.No.	H.F.L	offset (M)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	2	3	4	5	6	7	8	9
							(6 x 7)	sqrt{7*7+ (h1-h2)^2}
1	271.445	0.00	276.412	0.000	0.000	0.000	0.000	0.000
2	271.445	80.00	259.310	12.135	6.068	80.000	485.400	80.915
3	271.445	160.00	256.759	14.686	13.410	80.000	1072.827	80.041
4	271.445	240.00	254.820	16.625	15.655	80.000	1252.427	80.024
5	271.445	320.00	256.138	15.307	15.966	80.000	1277.280	80.011
6	271.445	400.00	258.460	12.985	14.146	80.000	1131.667	80.034
7	271.445	480.00	275.415	0.000	6.492	80.000	519.387	81.047
		AVG. B.L =	262.474					

Total (Cross sectional Area, A) = **5738.987** sq. m

Wetted Perimeter, P in m = **482.071**

Hydraulic Radius, R = A / P = = **11.905 m**

Velocity, V = $1/n * R^{2/3} . S^{1/2}$ = **1.713 m/sec**

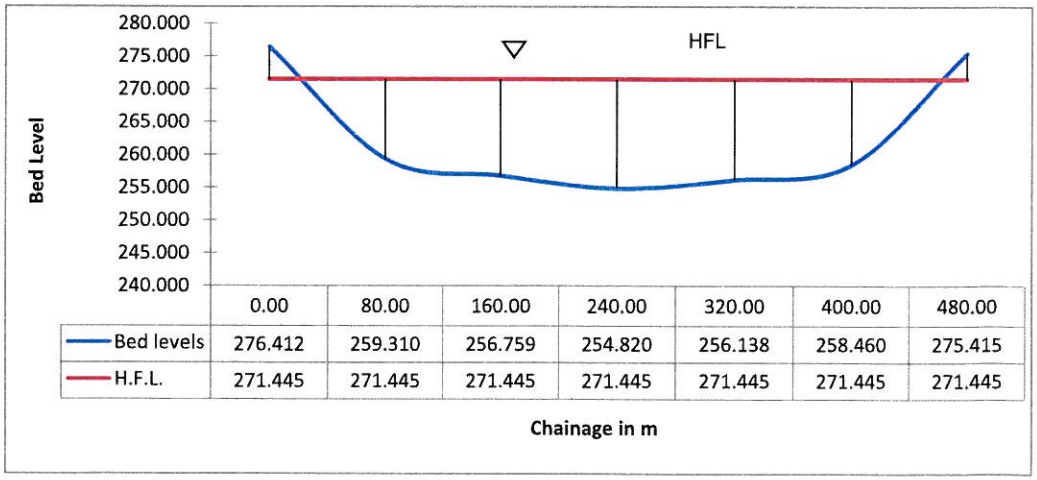
Discharge, Q = A*V = 9833.242 cumecs

Say **9834.00** cumecs

Linear water way = **480.000** m

Abbreviations

H.F.L. - High Flood Level
D.O.F. - Depth Of Flow
A.D.O.F. - Average Depth Of Flow
W.P. - Wetted Perimeter
L.B.L. - Lowest Bed Level



4742

Discharge Calculations as per Area-velocity Method :-

At Down stream Site
(100 m from Bridge center)

Q = A x V

Where
A = Cross Sectional Area
V = Velocity, calculated from Manning's formula
= $\frac{1}{n} \times R^{2/3} \times S^{1/2}$
R = Hydraulic Mean depth = A / P
P = Wetted Perimeter
S = Bed Slope, measured over a long reach
n = Coefficient of rugosity (from code)

Chainage 10+786 :

H.F.L = 271.445 m L.B.L = 252.645 m

Bed slope S = 0.00027 Spread length = 480.000 m

Rugosity coefficient, n = 0.050

S.No.	H.F.L	offset (M)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	2	3	4	5	6	7	8	9
							(6 x 7)	sqrt{7*7+ (h1-h2)^2}
1	271.445	0.00	277.302	0.000	0.000	0.000	0.000	0.000
2	271.445	80.00	257.630	13.815	6.908	80.000	552.600	81.184
3	271.445	160.00	254.914	16.531	15.173	80.000	1213.827	80.046
4	271.445	240.00	252.645	18.800	17.665	80.000	1413.227	80.032
5	271.445	320.00	255.693	15.752	17.276	80.000	1382.080	80.058
6	271.445	400.00	258.810	12.635	14.193	80.000	1135.467	80.061
7	271.445	480.00	276.395	0.000	6.317	80.000	505.387	80.992
		AVG. B.L =	261.913					

Total (Cross sectional Area, A) = **6202.587** sq. m
Wetted Perimeter, P in m = **482.373**

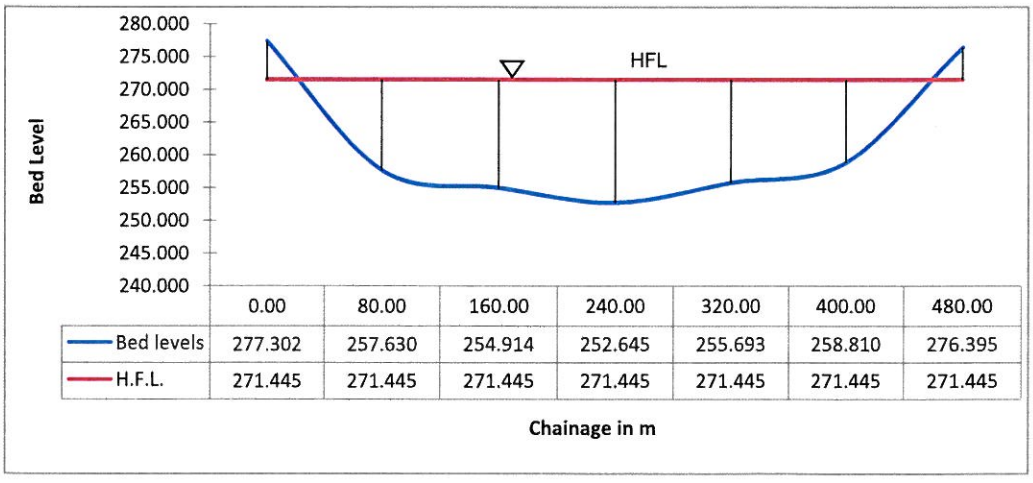
Hydraulic Radius, R = A / P = = **12.858 m**

Velocity, V = $1/n * R^{2/3} . S^{1/2}$ = **1.804 m/sec**

Discharge, Q = A*V = 11187.803 cumecs
Say **11188.00** cumecs

Linear water way = **480.000** m

Abbreviations
H.F.L. - High Flood Level
D.O.F. - Depth Of Flow
A.D.O.F. - Average Depth Of Flow
W.P. - Wetted Perimeter
L.B.L. - Lowest Bed Level



4713

Discharge Calculations as per Area-velocity Method :-

At Down stream Site
(500 m from Bridge center)

Q = A x V

Where
A = Cross Sectional Area
V = Velocity, calculated from Manning's formula
= $\frac{1}{n} \times R^{2/3} \times S^{1/2}$
R = Hydraulic Mean depth = A / P
P = Wetted Perimeter
S = Bed Slope, measured over a long reach
n = Coefficient of rugosity (from code)

Chainage 10+786 :

H.F.L = 271.445 m L.B.L = 249.195 m

Bed slope S = 0.00027 Spread length = 480.000 m

Rugosity coefficient, n = 0.050

S.No.	H.F.L	offset (M)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	2	3	4	5	6	7	8	9
							(6 x 7)	sqrt{7*7+ (h1-h2)^2}
1	271.445	0.00	278.302	0.000	0.000	0.000	0.000	0.000
2	271.445	80.00	254.510	16.935	8.468	80.000	677.400	81.773
3	271.445	160.00	251.684	19.761	18.348	80.000	1467.827	80.050
4	271.445	240.00	249.195	22.250	21.005	80.000	1680.427	80.039
5	271.445	320.00	253.063	18.382	20.316	80.000	1625.280	80.093
6	271.445	400.00	261.120	10.325	14.353	80.000	1148.267	80.405
7	271.445	480.00	277.395	0.000	5.162	80.000	412.987	80.663
		AVG. B.L =	260.753					

Total (Cross sectional Area, A) = **7012.187** sq. m
Wetted Perimeter, P in m = **483.023**

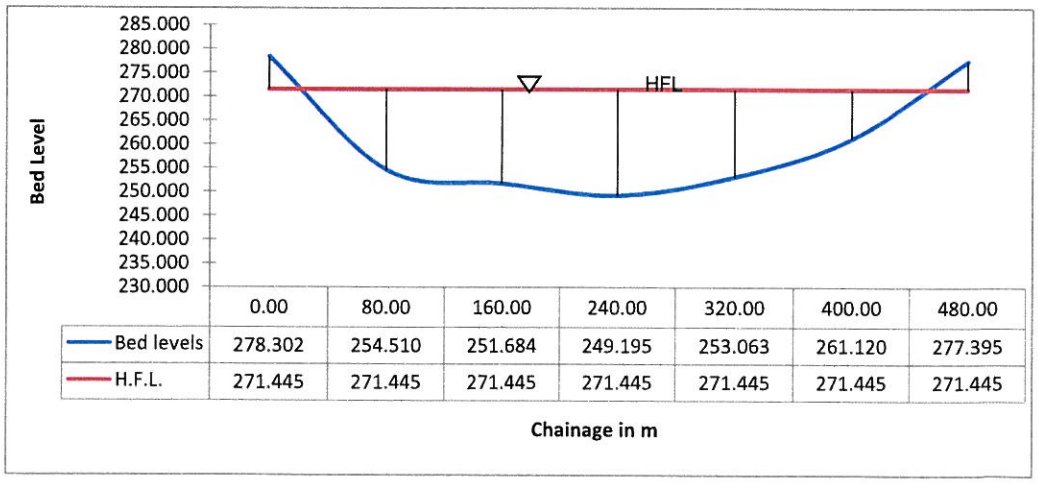
Hydraulic Radius, R = A / P = = **14.517 m**

Velocity, V = $1/n * R^{2/3}. S^{1/2}$ = **1.956 m/sec**

Discharge, Q = A*V = 13713.734 cumecs
Say **13714.00** cumecs

Linear water way = **480.000** m

Abbreviations
H.F.L. - High Flood Level
D.O.F. - Depth Of Flow
A.D.O.F. - Average Depth Of Flow
W.P. - Wetted Perimeter
L.B.L. - Lowest Bed Level



4744

Design Discharge :-

Design discharge :

Formula	Discharge from catchment	Units
Emperical formula	7186.37	Cumecs
Rational Formula	5756.29	Cumecs
A-V method (at SOC)	13714.00	Cumecs

Max. discharge = 13714.00 Cumecs

Second Highest = 7186.37 Cumecs

As per Cl.6.2 of IRC SP:13,

1.5 x 7186.37 = 10779.55 Cumecs

Hence Design discharge = **10779.55 Cumecs**

Design discharge for foundation design :

As per Indian Rail Standard Code

Catchment area (in km^2)		Increase over design discharge in percent
0 -	500	30 %
500 -	5000	30 - 20
5000 -	25000	20 - 10
>25000		10 %

Design discharge for foundation = 1.2 x 10779.55

12936.00 Cumecs

Linear water way & Afflux :-

1 **Linear Water Way:**

Design discharge	=	13714.00 m^3/s	(As calculated)
Velocity of river	=	1.96 m/s	
HFL	=	271.445 m	
Bed level	=	254.820 m	
Depth of water	=	16.63 m	
Assumed Afflux	=	0.05 m	
Velocity of approach	=	1.954 m/s	
Head due to velocity of approach (V^2 / 2g)	=	0.195 m	
Total head	=	0.246 m	
Velocity through vent (2gh)	=	2.20 m/s	
Velocity allowable	=	2.20 m/s	
Linear water way required	=	375.78 m	
Proposed vent way 07 x 61	=	427.00 m	O.K

2 **Check for Afflux**

As per Cl. 2.2.7 of Pocket Book for Bridge Engineers published by Indian Road Congress, New Delhi

By Molesworth formula

Afflux = $\left[\frac{V^2}{17.89}+0.015\right]\times\left[\left(\frac{Au}{Ae}\right)^2-1\right]$

Velocity, V	=	1.96 m/sec	
Unobstructed area, Au	=	5738.987 m^2	
Effective vent area, Ae	=	7098.88 m^2	
Afflux	=	0.000 m	< Assumed afflux
		Hence OK	

3 **Design of Formation Level**

Vertical clearance (V_c) required = 0.90 m

Bottom of deck level to be provided = 272.396 m

4 **Scour Depth Calculations :**

$d_{sm} = 1.34\ (D_b^2 / K_{sf})^{1/3}$ As per cl.703.2 of IRC 78 - 2000

where, D_b = the discharge in cumecs per metre width.
K_{sf} = silt factor

$D_b = \frac{12936.0}{427.0} = 30.30$ cumecs/m

K_{sf} = 0.71 (From Dr. Ghuman and Gupta Geotech Consultants, Chandigarh)

d_{sm} = 1.34 x (30.295^2 / 0.71)^(1/3) = **14.597** m below HFL

Max. depth of scour for Piers = $2 \times d_{sm}$ = 29.19 m below HFL

Max. depth of scour for Abutment = $1.27 \times d_{sm}$ = 18.54 m below HFL

Scour level for Abutments = 252.91 m

Scour level for Piers = 242.25 m

4746

SILT FACTOR CALCULATION

YAMUNA RIVER			
Bore Hole No	**Depth (m)**	**Sub-Starta**	**Silt Factor**
BH-1(A2)	1.5	Fine Sand	2.26
BH-2(P4)	1.5	Fine Sand	2.15
BH-3(P5)	1.5	Fine Sand	2.24
BH-4(A1)	1.5	Fine Sand	2.28
BH-5(P6)	1.5	Fine Sand	2.19
BH-6(P3)	1.5	Fine Sand	2.19
BH-7(P2)	1.5	Fine Sand	2.22
BH-8(P1)	1.5	Silty Sand	2.22

Appendix -III

(Laboratory Test Results)

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GRAIN SIZE ANALYSIS OF SOIL WITH SILT FACTOR

(AS PER IS 2720, P- 4 & IRC 5)

Client:	DFCC		
Project Name	G.I For 3nos Important Bridges		
Type of Sample	SPT	Date of Testing :	24.10.12
Location	BH-1(Yamuna River-Ambala)	Sampled by :	T. K. Das
Depth	1.5m	Tested by :	K.C Sahoo

Weight of oven dried sample before washing (gm) :- 100

Weight of oven dried sample after washing (gm) :- 83.28

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %	Average size of Particle in mm	Column 3 X Column 6
1	2	3	4	5	6	7
4.75	0.00	0.00	0.00	100.00	2.38	0.00
2.00	36.37	36.37	36.37	63.63	3.38	122.75
0.425	31.76	31.76	68.13	31.87	1.21	38.51
0.075	14.430	14.43	82.56	17.44	0.25	3.61
Pan	0.72	17.44	100.00	0.00	0.0375	0.65
Wash Loss	16.720					
Total	100					

Gravel Content (%)= 0.00 **Sand Content (%) 82.56** **Silt and clay % 17.44**

Weighted mean dia of Particle (d_{sm}) = 1.66 **Silt Factor 1.76 X sqrt (d_{sm}) = 2.26**

Remarks :-

Lab Manager Checked By

4750

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	1.5m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 82.57

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.00	0.00	0.00	100.00
2.00	36.37	36.37	36.37	63.63
0.425	31.76	31.76	68.13	31.87
0.075	14.44	14.44	82.57	17.43
Total	100.00			

Gravel Content (%)= **0.00**

Sand Content (%) = 82.57 **Silt and clay %** 17.43

Remarks :-

4751

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	3.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 91.03

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.00	0.00	0.00	100.00
2.00	40.93	40.93	40.93	59.07
0.425	34.68	34.68	75.61	24.39
0.075	15.42	15.42	91.03	8.97
Total	100.00			

Gravel Content (%)= **0.00**

Sand Content (%) = 91.03 **Silt and clay %** 8.97

Remarks :-

4752

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	4.5m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 89.24

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.00	0.00	0.00	100.00
2.00	39.10	39.10	39.10	60.90
0.425	34.36	34.36	73.46	26.54
0.075	15.79	15.79	89.25	10.75
Total	100.00			

Gravel Content (%)= **0.00**

Sand Content (%) = 89.25 **Silt and clay %** 10.75

Remarks :-

4753

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	6.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 85.38

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.00	0.00	0.00	100.00
2.00	38.82	38.82	38.82	61.18
0.425	33.94	33.94	72.76	27.24
0.075	12.63	12.63	85.39	14.61
Total	100.00			

Gravel Content (%)= **0.00**

Sand Content (%) = 85.39 **Silt and clay %** 14.61

Remarks :-

4754

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	10.5m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 88.84

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.00	0.00	0.00	100.00
2.00	38.02	38.02	38.02	61.98
0.425	35.37	35.37	73.39	26.61
0.075	15.45	15.45	88.84	11.16
Total	100.00			

Gravel Content (%)= **0.00**

Sand Content (%) = 88.84 **Silt and clay %** 11.16

Remarks :-

4755

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	13.5m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 86.53

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	9.19	9.19	9.19	90.81
2.00	34.85	34.85	44.04	55.96
0.425	30.13	30.13	74.17	25.83
0.075	12.36	12.36	86.53	13.47
Total	100.00			

Gravel Content (%)= **9.19**

Sand Content (%) = 77.34 **Silt and clay %** 13.47

Remarks :-

4756

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	16.5m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 87.56

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	8.94	8.94	8.94	91.06
2.00	34.33	34.33	43.27	56.73
0.425	30.97	30.97	74.24	25.76
0.075	13.32	13.32	87.56	12.44
Total	100.00			

Gravel Content (%)= **8.94**

Sand Content (%) = 78.62 **Silt and clay %** 12.44

Remarks :-

4757

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	18.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 86.18

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.00	0.00	0.00	100.00
2.00	37.24	37.24	37.24	62.76
0.425	33.58	33.58	70.82	29.18
0.075	15.37	15.37	86.19	13.81
Total	100.00			

Gravel Content (%)= **0.00**

Sand Content (%) = 86.19 **Silt and clay %** 13.81

Remarks :-

4758

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	21.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 87.06

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.00	0.00	0.00	100.00
2.00	37.94	37.94	37.94	62.06
0.425	34.88	34.88	72.82	27.18
0.075	14.24	14.24	87.06	12.94
Total	100.00			

Gravel Content (%)= **0.00**

Sand Content (%) = 87.06 **Silt and clay %** 12.94

Remarks :-

4759

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	22.5m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 86.70

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	9.87	9.87	9.87	90.13
2.00	34.15	34.15	44.02	55.98
0.425	30.71	30.71	74.73	25.27
0.075	11.97	11.97	86.70	13.30
Total	100.00			

Gravel Content (%)= **9.87**

Sand Content (%) = 76.83 **Silt and clay %** 13.30

Remarks :-

4760

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	27.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 87.19

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	10.65	10.65	10.65	89.35
2.00	33.97	33.97	44.62	55.38
0.425	30.51	30.51	75.13	24.87
0.075	12.06	12.06	87.19	12.81
Total	100.00			

Gravel Content (%)= **10.65**

Sand Content (%) = 76.54 **Silt and clay %** 12.81

Remarks :-

4761

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	30.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 30.25

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	17.82	17.82	17.82	82.18
2.00	5.87	5.87	23.69	76.31
0.425	4.81	4.81	28.50	71.50
0.075	1.75	1.75	30.25	69.75
Total	100.00			

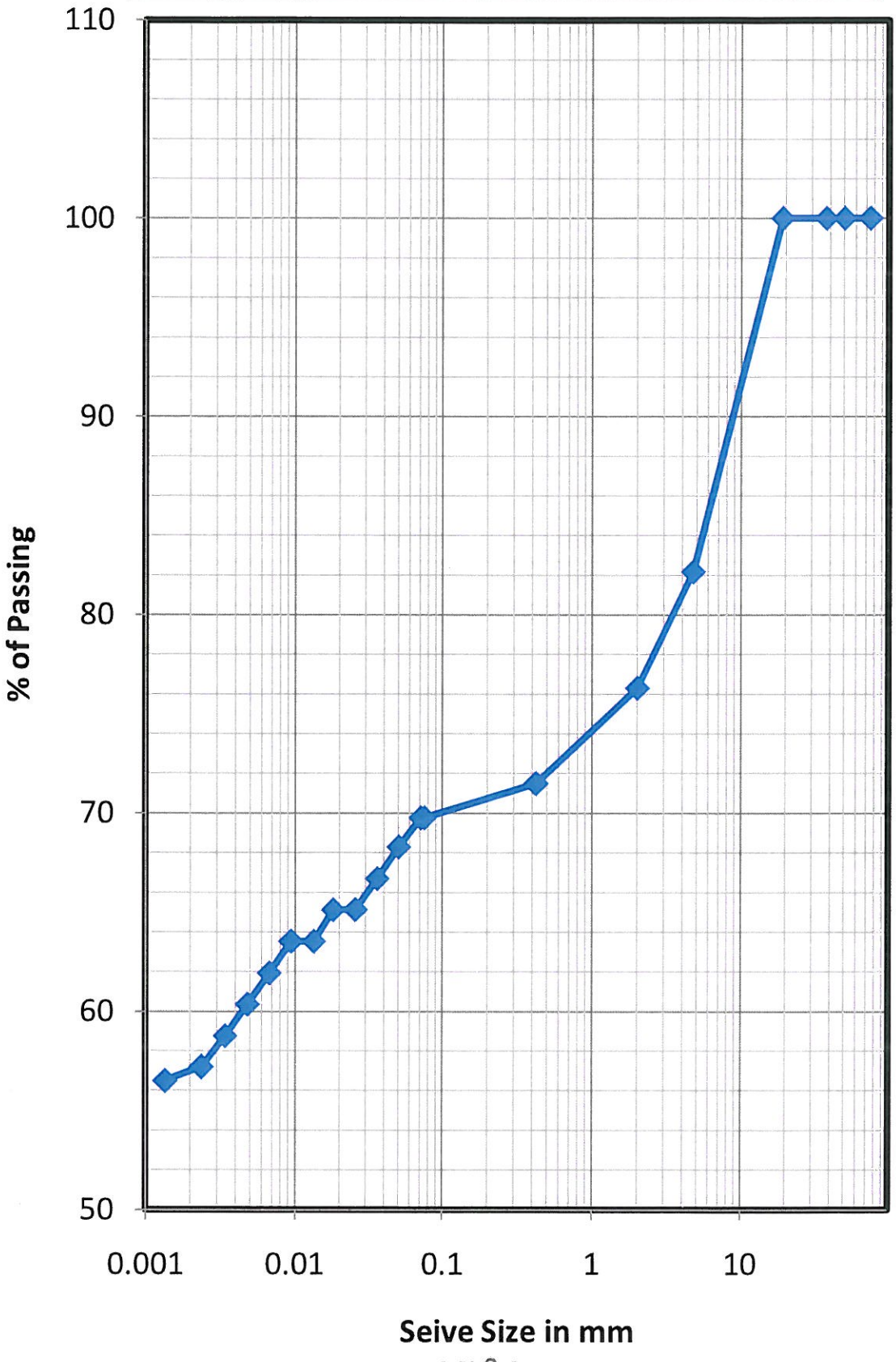
Gravel Content (%)= **17.82**

Sand Content (%) = 12.43 **Silt and clay %** 69.75

Remarks :-

4762

Grain Size Distribution Curve
BH-1,D-30.0m



4763

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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	36.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 31.38

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	18.57	18.57	18.57	81.43
2.00	6.36	6.36	24.93	75.07
0.425	4.63	4.63	29.56	70.44
0.075	1.82	1.82	31.38	68.62
Total	100.00			

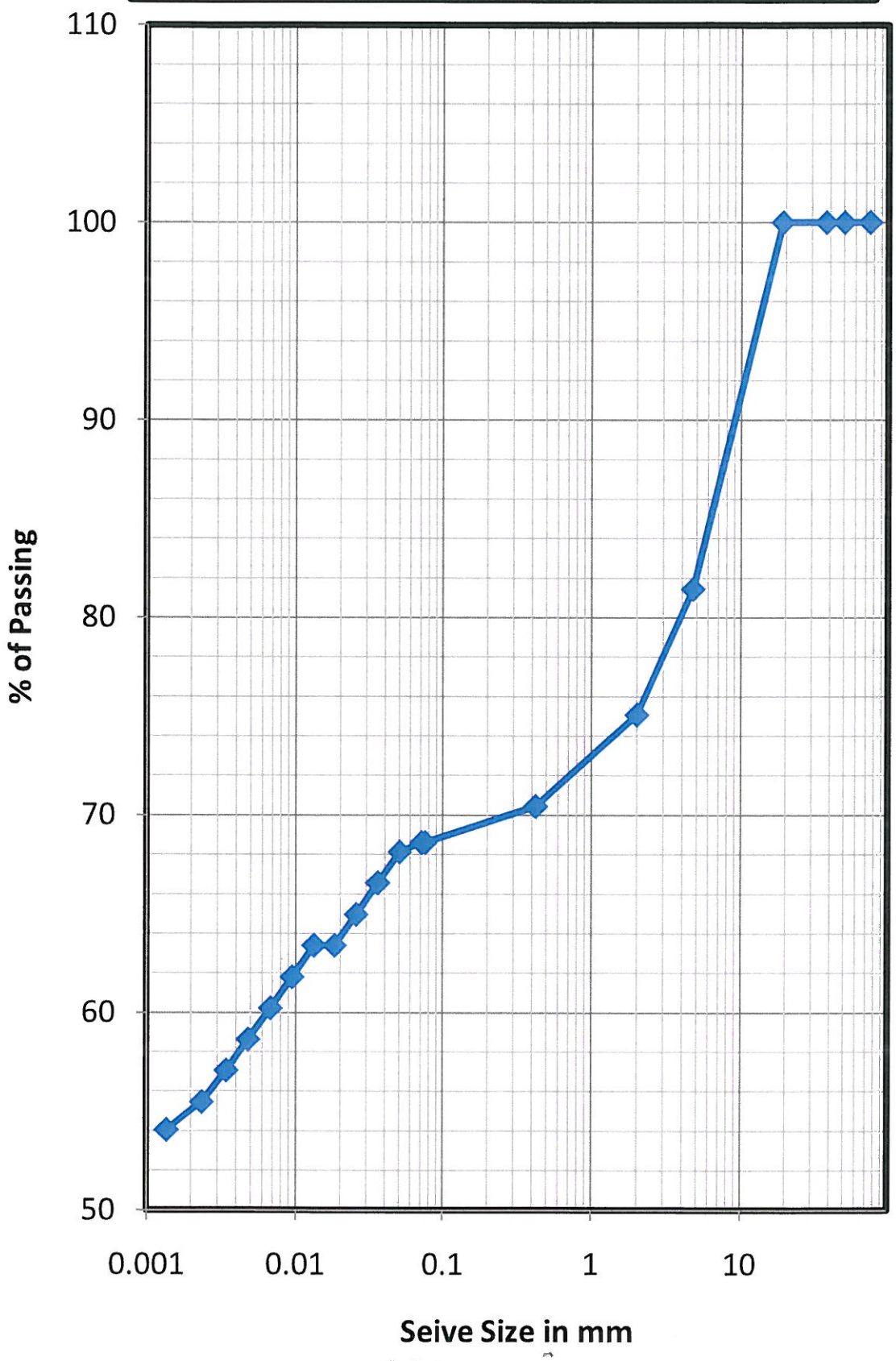
Gravel Content (%)= **18.57**

Sand Content (%) = 12.81 **Silt and clay %** 68.62

Remarks :-

4764

Grain Size Distribution Curve
BH-1,D-36.0m



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GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	37.5m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 1.64

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.56	0.56	0.56	99.44
2.00	0.59	0.59	1.15	98.85
0.425	0.34	0.34	1.49	98.51
0.075	0.15	0.15	1.64	98.36
Total	100.00			

Gravel Content (%)= **0.56**

Sand Content (%) = 1.08 **Silt and clay %** 98.36

Remarks :-

4766

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N 3/91, IRC Village, Bhubaneswar

GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	39.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 89.23

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	10.94	10.94	10.94	89.06
2.00	35.62	35.62	46.56	53.44
0.425	30.28	30.28	76.84	23.16
0.075	12.39	12.39	89.23	10.77
Total	100.00			

Gravel Content (%)= **10.94**

Sand Content (%) = 78.29 **Silt and clay %** 10.77

Remarks :-

4767

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N 3/91, IRC Village, Bhubaneswar

GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	40.5m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 86.94

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	10.41	10.41	10.41	89.59
2.00	35.14	35.14	45.55	54.45
0.425	29.24	29.24	74.79	25.21
0.075	12.15	12.15	86.94	13.06
Total	100.00			

Gravel Content (%)= **10.41**

Sand Content (%) = 76.53 **Silt and clay %** 13.06

Remarks :-

4763

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N 3/91, IRC Village, Bhubaneswar

GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	43.5m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 84.30

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.00	0.00	0.00	100.00
2.00	37.57	37.57	37.57	62.43
0.425	33.25	33.25	70.82	29.18
0.075	13.48	13.48	84.30	15.70
Total	100.00			

Gravel Content (%)= **0.00**

Sand Content (%) = 84.30 **Silt and clay %** 15.70

Remarks :-

4769

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N 3/91, IRC Village, Bhubaneswar

GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	45.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 84.52

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	0.00	0.00	0.00	100.00
2.00	36.81	36.81	36.81	63.19
0.425	32.06	32.06	68.87	31.13
0.075	15.64	15.64	84.51	15.49
Total	100.00			

Gravel Content (%)= **0.00**

Sand Content (%) = 84.51 **Silt and clay %** 15.49

Remarks :-

4770

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N 3/91, IRC Village, Bhubaneswar

GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	48.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 87.90

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	11.42	11.42	11.42	88.58
2.00	33.65	33.65	45.07	54.93
0.425	30.12	30.12	75.19	24.81
0.075	12.71	12.71	87.90	12.10
Total	100.00			

Gravel Content (%)= **11.42**

Sand Content (%) = 76.48 **Silt and clay %** 12.10

Remarks :-

4771

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N 3/91, IRC Village, Bhubaneswar

GRAIN SIZE ANALYSIS OF SOIL AS PER IS 2720 (P- 4)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date of Testing	:	24.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T. K. Das
Depth	:	50.0m	Tested by	:	K.C .Sahoo

Weight of oven dried sample before washing (gm) :- 100.00

Weight of oven dried sample after washing (gm) :- 88.21

Sieve Size mm	Individual Weight Retained in gm.	Individual Wt. Retained In %	Cummulative Wt Retained In %	Cummulative Wt Passing In %
75	0	0.00	0.00	100.00
50	0	0.00	0.00	100.00
37.5	0	0.00	0.00	100.00
19	0	0.00	0.00	100.00
4.75	10.86	10.86	10.86	89.14
2.00	34.05	34.05	44.91	55.09
0.425	29.94	29.94	74.85	25.15
0.075	13.36	13.36	88.21	11.79
Total	100.00			

Gravel Content (%)= **10.86**

Sand Content (%) = 77.35 **Silt and clay %** 11.79

Remarks :-

4772

ARKI TECHNO CONSULTANTS (INDIA) PVT LTD

N 3/91, IRC Village, Bhubaneswar

GRAIN SIZE ANALYSIS OF SOIL - HYDROMETER METHOD

Client : DFCC

Project Name : G.I For 3 Nos. Important Bridges

Type of Sample : SPT

Location : BH-1(Yamuna River- Ambala)

Sampled by : T.K.Das

Depth : 30.0m

Date of Testing : 25.10.12

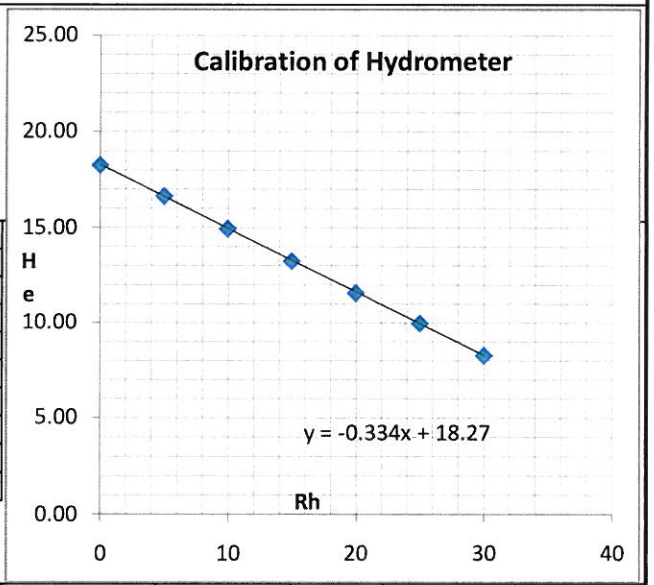
Tested by : D.Mohanty

(I)	Percentage of 75 micron passing (from sieve analysis)		69.75
(II)	Mass of dry soil passing 2mm sieve taken (gm)		50
(III)	Mass of dry soil retained on 75micron sieve (gm)		15.1
(IV)	Mass of dry soil passing 75 micron Wh (gm)		34.9
(V)	Specific gravity of soil grains, Gs		2.7
(VI)	Top Meniscus reading on hydrometer stem		2.0
(VII)	Bottom meniscus reading on hydrometer stem		2.5
(VIII)	Meniscuss correction, Cm = + [(VII) - (VI)]		0.5
a	Hydrometer No	1	
	Volume of Hydrometer V (cm3)	50	
	Height of bulb (h) in cm	16.5	
b	Sedimentation Jar No	1	
	Cross sectional area of jar (A) in cm2	35.714	

CALIBRATION OF HYDROMETER

(Rh)	H (cm)	He (cm)
30	0.7	8.25
25	2.4	9.95
20	4.0	11.55
15	5.7	13.25
10	7.4	14.95
5	9.1	16.65
0	10.7	18.25
-5	12.4	19.95

Rh = hydrometer Reading
H = height corresponding to Rh
He = Effective height = H + 0.5*(h -V/A)



Time	Elapsed Time (min)	Hydrometer Reading (Rh)	Temperature (o C)	Composite Correction +/- C	Effective depth h (cm)	Rc1 = Rh + Cm	Sqrt (h/t)	Viscosity (gm/cm2)	Factor M	Particle 'C' (cm) (8) x (10)	Rc2 = Rh + C (3) + (5)	Factor N	% Finner w.r.t Wd F (12) x (13)	% Finner w.r.t total mass (14) x (I)/100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.30	0.5	23.96	29	-2.0	10.27	24.46	0.585	0.000008341	0.012132344	0.00709782	21.96	4.554	100.00	69.75
	1	23.50	29	-2.0	10.42	24.00	0.417	0.000008341	0.012132344	0.00505619	21.50	4.554	97.91	68.29
	2	23.00	29	-2.0	10.59	23.50	0.297	0.000008341	0.012132344	0.00360380	21.00	4.554	95.64	66.71
	4	22.50	29	-2.0	10.76	23.00	0.212	0.000008341	0.012132344	0.00256829	20.50	4.554	93.36	65.12
	8	22.50	29	-2.0	10.76	23.00	0.150	0.000008341	0.012132344	0.00181606	20.50	4.554	93.36	65.12
	15	22.00	29	-2.0	10.92	22.50	0.110	0.000008341	0.012132344	0.00133652	20.00	4.554	91.08	63.53
	30	22.00	29	-2.0	10.92	22.50	0.078	0.000008341	0.012132344	0.00094506	20.00	4.554	91.08	63.53
	60	21.50	29	-2.0	11.09	22.00	0.056	0.000008341	0.012132344	0.00067335	19.50	4.554	88.80	61.94
	120	21.00	29	-2.0	11.26	21.50	0.040	0.000008341	0.012132344	0.00047970	19.00	4.554	86.53	60.35
	240	20.50	29	-2.0	11.42	21.00	0.028	0.000008341	0.012132344	0.00034171	18.50	4.554	84.25	58.76
	480	20.00	32	-2.0	11.59	20.50	0.020	0.000007821	0.011748049	0.00023567	18.00	4.554	81.97	57.18
	1440	19.78	32	-2.0	11.66	20.28	0.012	0.000007821	0.011748049	0.000136489	17.78	4.554	80.99	56.49

ARKI TECHNO CONSULTANTS (INDIA) PVT LTD

N 3/91, IRC Village, Bhubaneswar

GRAIN SIZE ANALYSIS OF SOIL - HYDROMETER METHOD

Client : DFCC

Project Name : G.I For 3 Nos. Important Bridges

Type of Sample : SPT

Location : BH-1(Yamuna River- Ambala)

Sampled by : T.K.Das

Depth : 36.0m

Date of Testing : 25.10.12

Tested by : D.Mohanty

(I)	Percentage of 75 micron passing (from sieve analysis)		68.62
(II)	Mass of dry soil passing 2mm sieve taken (gm)		50
(III)	Mass of dry soil retained on 75micron sieve (gm)		15.7
(IV)	Mass of dry soil passing 75 micron Wh (gm)		34.3
(V)	Specific gravity of soil grains, Gs		2.71
(VI)	Top Meniscus reading on hydrometer stem		2.0
(VII)	Bottom meniscus reading on hydrometer stem		2.5
(VIII)	Meniscuss correction, Cm = + [(VII) - (VI)]		0.5
a	Hydrometer No	1	
	Volume of Hydrometer V (cm3)	50	
	Height of bulb (h) in cm	16.5	
b	Sedimentation Jar No	1	
	Cross sectional area of jar (A) in cm2	35.714	

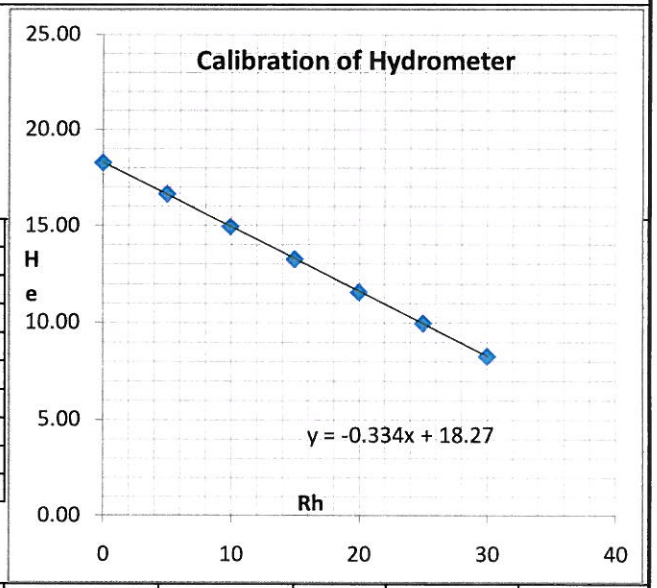
CALIBRATION OF HYDROMETER

(Rh)	H (cm)	He (cm)
30	0.7	8.25
25	2.4	9.95
20	4.0	11.55
15	5.7	13.25
10	7.4	14.95
5	9.1	16.65
0	10.7	18.25
-5	12.4	19.95

Rh = hydrometer Reading

H = height corresponding to Rh

He = Effective height = H + 0.5*(h -V/A)



Time	Elapsed Time (min)	Hydrometer Reading (Rh)	Temperature (o C)	Composite Correction +/- C	Effective depth h (cm)	Rc1 = Rh + Cm	Sqrt (h/t)	Viscosity (gm/cm2)	Factor M	Particle 'C' (cm) (8) x (10)	Rc2 = Rh + C (3) + (5)	Factor N	% Finner w.r.t Wd F (12) x (13)	% Finner w.r.t total mass (14) x (I)/100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.30	0.5	23.65	29	-2.0	10.37	24.15	0.588	0.000008341	0.012096818	0.00711250	21.65	4.619	100.00	68.62
	1	23.50	29	-2.0	10.42	24.00	0.417	0.000008341	0.012096818	0.00504139	21.50	4.619	99.31	68.15
	2	23.00	29	-2.0	10.59	23.50	0.297	0.000008341	0.012096818	0.00359325	21.00	4.619	97.00	66.56
	4	22.50	29	-2.0	10.76	23.00	0.212	0.000008341	0.012096818	0.00256077	20.50	4.619	94.69	64.98
	8	22.00	29	-2.0	10.92	22.50	0.151	0.000008341	0.012096818	0.00182474	20.00	4.619	92.38	63.39
	15	22.00	29	-2.0	10.92	22.50	0.110	0.000008341	0.012096818	0.00133260	20.00	4.619	92.38	63.39
	30	21.50	29	-2.0	11.09	22.00	0.078	0.000008341	0.012096818	0.00094947	19.50	4.619	90.07	61.81
	60	21.00	29	-2.0	11.26	21.50	0.056	0.000008341	0.012096818	0.00067641	19.00	4.619	87.76	60.22
	120	20.50	29	-2.0	11.42	21.00	0.040	0.000008341	0.012096818	0.00048183	18.50	4.619	85.45	58.64
	240	20.00	29	-2.0	11.59	20.50	0.028	0.000008341	0.012096818	0.00034319	18.00	4.619	83.14	57.05
	480	19.50	32	-2.0	11.76	20.00	0.020	0.000007821	0.011713648	0.00023667	17.50	4.619	80.83	55.47
	1440	19.05	32	-2.0	11.91	19.55	0.012	0.000007821	0.011713648	0.000137513	17.05	4.619	78.75	54.04

ARKI TECHNO CONSULTANTS (INDIA) PVT LTD

N 3/91, IRC Village, Bhubaneswar

GRAIN SIZE ANALYSIS OF SOIL - HYDROMETER METHOD

Client : DFCC

Project Name : G.I For 3 Nos. Important Bridges

Depth : 37.5m

Type of Sample : SPT

Date of Testing : 25.10.12

Location : BH-1(Yamuna River- Ambala)

Tested by : D.Mohanty

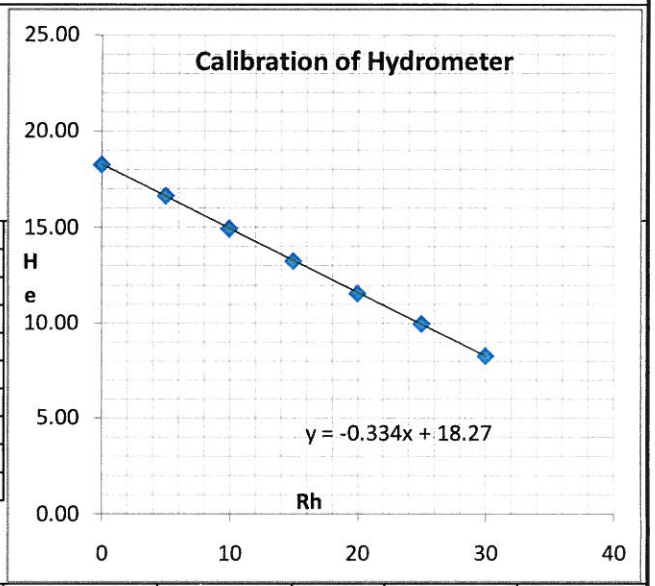
Sampled by : T.K.Das

(I)	Percentage of 75 micron passing (from sieve analysis)		98.36
(II)	Mass of dry soil passing 2mm sieve taken (gm)		50
(III)	Mass of dry soil retained on 75micron sieve (gm)		0.8
(IV)	Mass of dry soil passing 75 micron Wh (gm)		49.2
(V)	Specific gravity of soil grains, Gs		2.67
(VI)	Top Meniscus reading on hydrometer stem		2.0
(VII)	Bottom meniscus reading on hydrometer stem		2.5
(VIII)	Meniscuss correction, Cm = + [(VII) - (VI)]		0.5
a	Hydrometer No	1	
	Volume of Hydrometer V (cm3)	50	
	Height of bulb (h) in cm	16.5	
b	Sedimentation Jar No	1	
	Cross sectional area of jar (A) in cm2	35.714	

CALIBRATION OF HYDROMETER

(Rh)	H (cm)	He (cm)
30	0.7	8.25
25	2.4	9.95
20	4.0	11.55
15	5.7	13.25
10	7.4	14.95
5	9.1	16.65
0	10.7	18.25
-5	12.4	19.95

Rh = hydrometer Reading
H = height corresponding to Rh
He = Effective height = H + 0.5*(h -V/A)



Time	Elapsed Time (min)	Hydrometer Reading (Rh)	Temperature (o C)	Composite Correction +/- C	Effective depth h (cm)	Rc1 = Rh + Cm	Sqrt (h/t)	Viscosity (gm/cm2)	Factor M	Particle 'C' (cm) (8) x (10)	Rc2 = Rh + C (3) + (5)	Factor N	% Finner w.r.t Wd F (12) x (13)	% Finner w.r.t total mass (14) x (I)/100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.30	0.5	29.67	29	-2.0	8.36	30.17	0.528	0.000008341	0.012240833	0.00646188	27.67	3.251	89.95	88.48
	1	29.50	29	-2.0	8.42	30.00	0.375	0.000008341	0.012240833	0.00458473	27.50	3.251	89.40	87.93
	2	29.00	29	-2.0	8.58	29.50	0.267	0.000008341	0.012240833	0.00327390	27.00	3.251	87.77	86.34
	4	29.00	29	-2.0	8.58	29.50	0.189	0.000008341	0.012240833	0.00231500	27.00	3.251	87.77	86.34
	8	28.50	29	-2.0	8.75	29.00	0.135	0.000008341	0.012240833	0.00165280	26.50	3.251	86.15	84.74
	15	28.50	29	-2.0	8.75	29.00	0.099	0.000008341	0.012240833	0.00120703	26.50	3.251	86.15	84.74
	30	28.00	29	-2.0	8.92	28.50	0.070	0.000008341	0.012240833	0.00086161	26.00	3.251	84.52	83.14
	60	28.00	29	-2.0	8.92	28.50	0.050	0.000008341	0.012240833	0.00060925	26.00	3.251	84.52	83.14
	120	27.50	29	-2.0	9.09	28.00	0.036	0.000008341	0.012240833	0.00043482	25.50	3.251	82.90	81.54
	240	27.50	29	-2.0	9.09	28.00	0.025	0.000008341	0.012240833	0.00030746	25.50	3.251	82.90	81.54
	480	27.00	32	-2.0	9.25	27.50	0.018	0.000007821	0.011853101	0.00021245	25.00	3.251	81.27	79.94
	1440	26.84	32	-2.0	9.31	27.34	0.010	0.000007821	0.011853101	0.000123017	24.84	3.251	80.74	79.42

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ARKITECHNO CONSULTANTS (INDIA) PVT. LTD.

N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

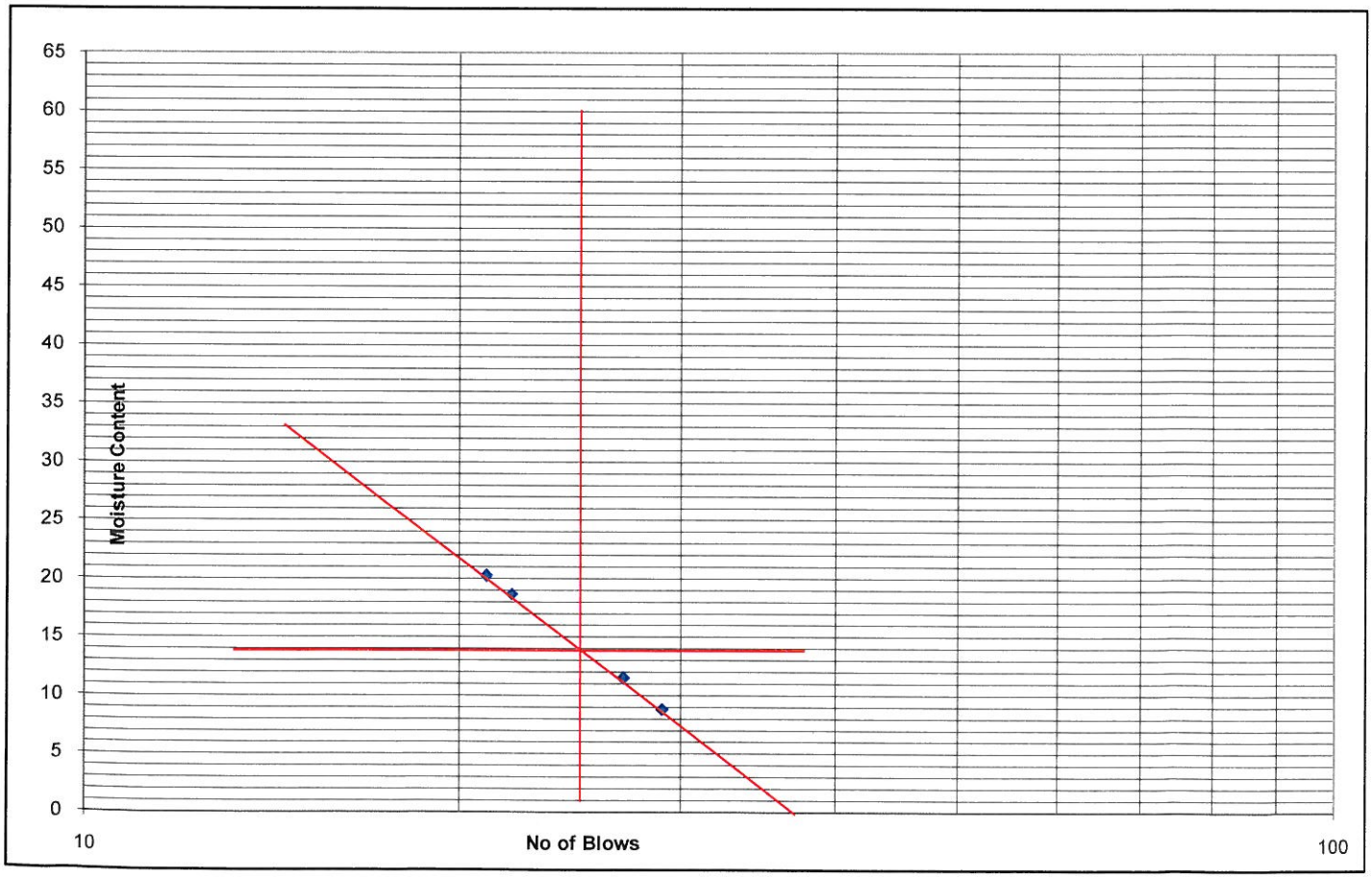
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	1.5m	Tested by	:	D.Mohanty

Number of Blows	29	27	22	21	Plastic Limit	
Container No.	C11	C12	C17	C18	NP	
Container Weight (gm) (W1)	31.85	36.97	30.76	32.24		
Container + Wt. of wet soil (gm) (W2)	82.22	94.46	96.10	98.39		
Wt of Container + Wt. of oven dry soil (gm) (W3)	78.13	88.52	85.82	87.26		
Wt. Of water (gm) (W2-W1)-(W3-W1)	4.09	5.93	10.28	11.13		
Wt. of oven dry soil (gm) (W3-W1)	46.28	51.55	55.06	55.02		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**8.84**	**11.51**	**18.68**	**20.23**		

Result Summary

Liquid Limit (WL)	14	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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ARKITECHNO

N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

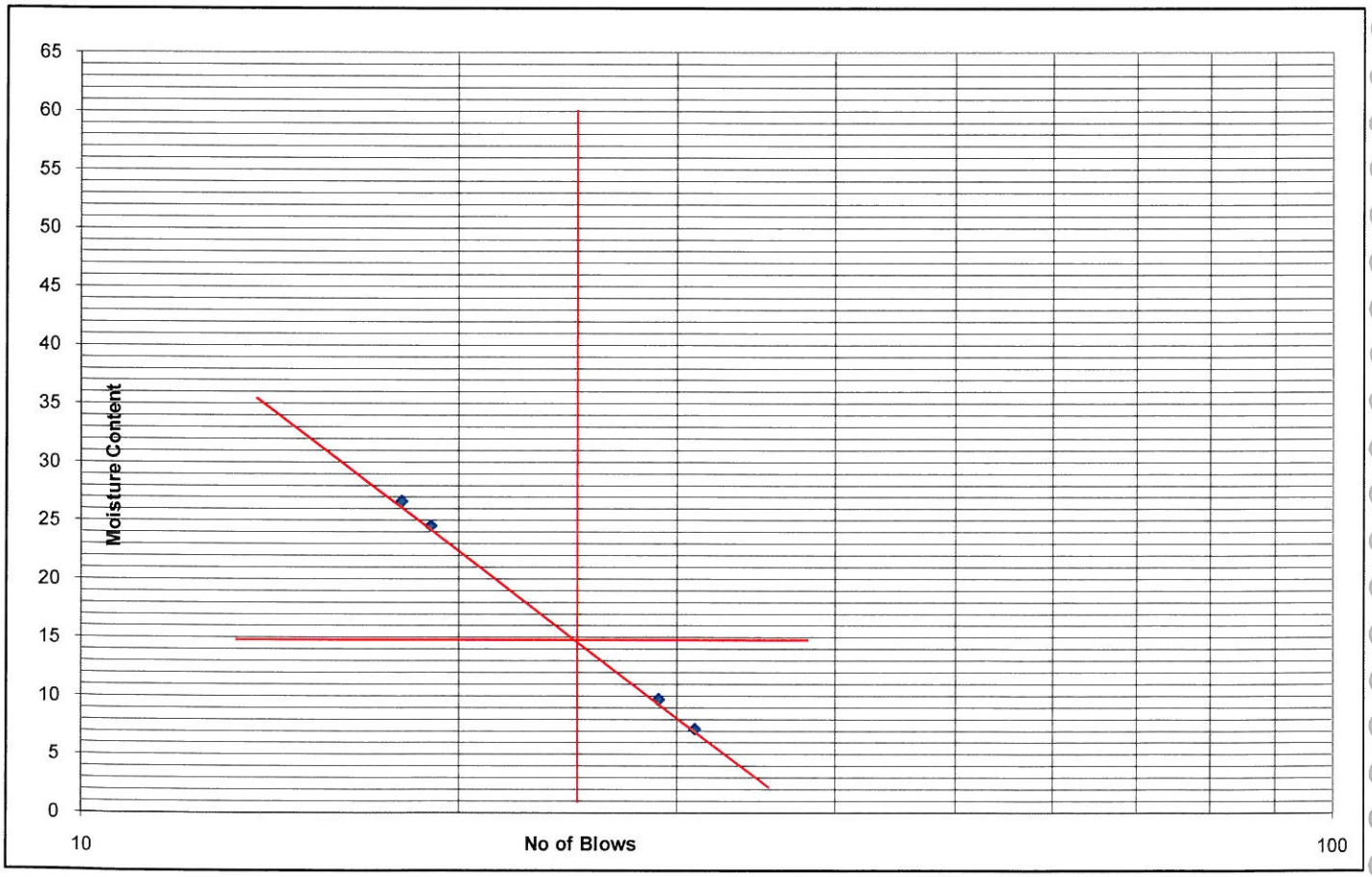
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	3.0m	Tested by	:	D.Mohanty

Number of Blows	31	29	19	18	Plastic Limit	
Container No.	C7	C8	C9	C10		
Container Weight (gm) (W1)	32.58	37.21	33.14	35.42		
Container + Wt. of wet soil (gm) (W2)	81.10	93.94	98.91	101.05		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.84	88.92	85.94	87.25		
Wt. Of water (gm) (W2-W1)-(W3-W1)	3.26	5.03	12.96	13.80		
Wt. of oven dry soil (gm) (W3-W1)	45.26	51.71	52.80	51.83		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**7.21**	**9.72**	**24.55**	**26.62**		

Result Summary

Liquid Limit (WL)	15	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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ARKITECHNO

N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

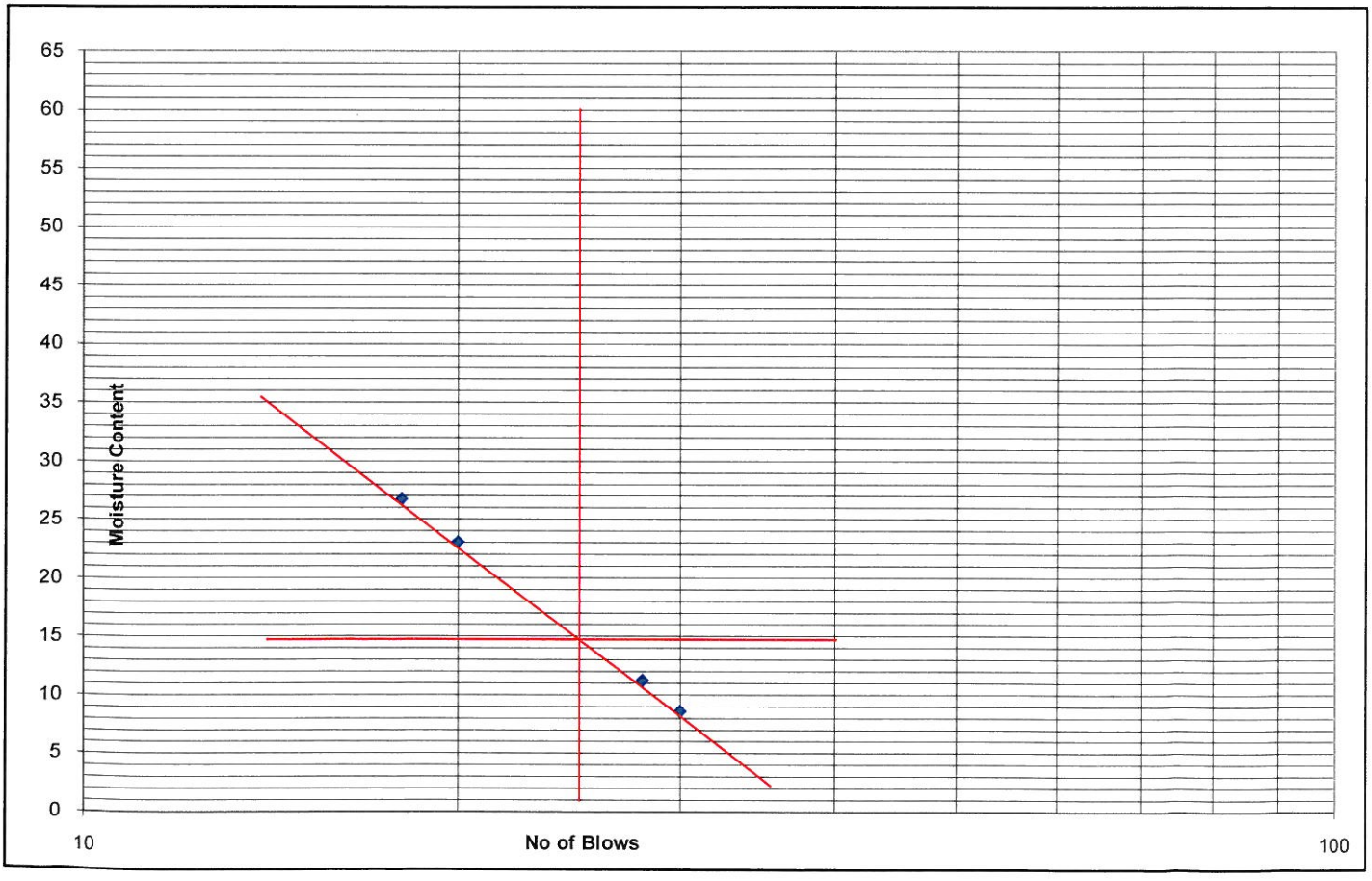
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	4.5m	Tested by	:	D.Mohanty

Number of Blows	30	28	20	18	Plastic Limit	
Container No.	C15	C16	C17	C18	NP	
Container Weight (gm) (W1)	33.14	32.28	30.76	32.24		
Container + Wt. of wet soil (gm) (W2)	81.51	95.31	98.60	101.85		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.68	88.94	85.88	87.17		
Wt. Of water (gm) (W2-W1)-(W3-W1)	3.83	6.37	12.71	14.68		
Wt. of oven dry soil (gm) (W3-W1)	44.54	56.66	55.12	54.93		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**8.59**	**11.24**	**23.06**	**26.73**		

Result Summary

Liquid Limit (WL)	15	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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ARKITECHNO

N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

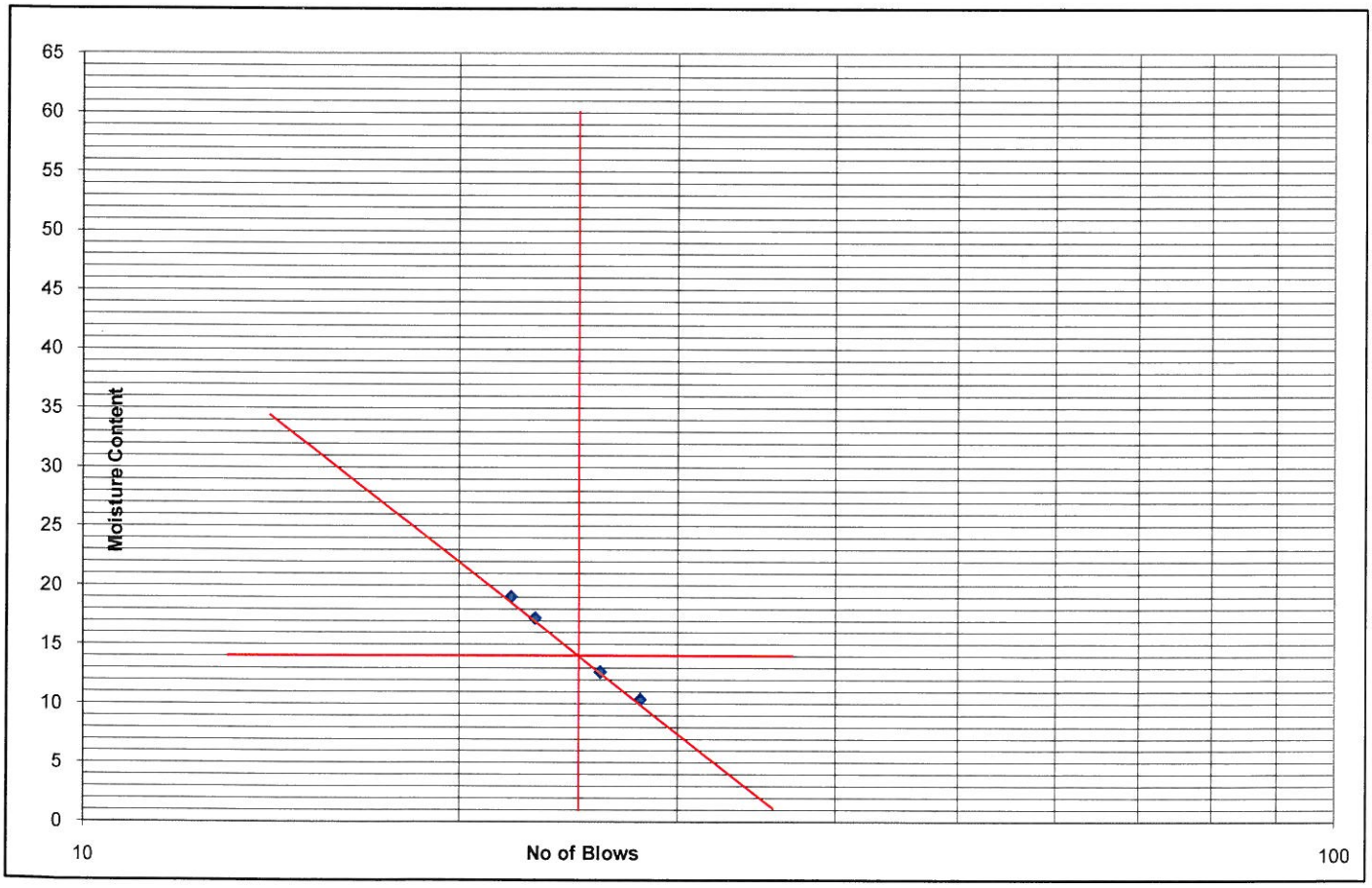
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	6.0m	Tested by	:	D.Mohanty

Number of Blows	28	26	23	22	Plastic Limit	
Container No.	C29	C30	C25	C26	NP	
Container Weight (gm) (W1)	34.86	30.76	35.83	33.36		
Container + Wt. of wet soil (gm) (W2)	81.92	96.35	94.36	97.54		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.51	88.97	85.75	87.29		
Wt. Of water (gm) (W2-W1)-(W3-W1)	4.41	7.38	8.60	10.26		
Wt. of oven dry soil (gm) (W3-W1)	42.65	58.21	49.92	53.93		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**10.35**	**12.68**	**17.23**	**19.02**		

Result Summary

Liquid Limit (WL)	14	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

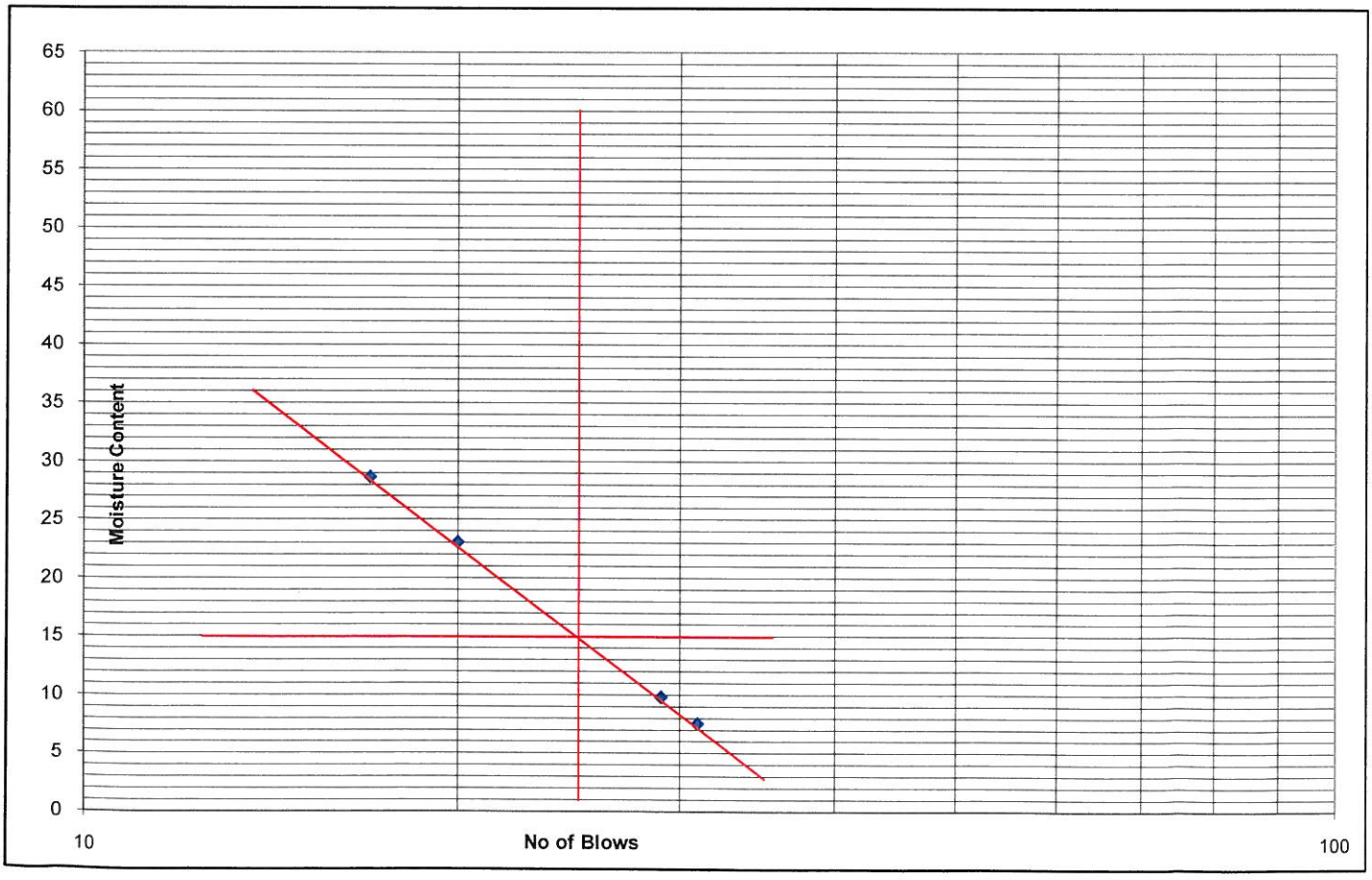
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	10.5m	Tested by	:	D.Mohanty

Number of Blows	31	29	20	17	Plastic Limit	
Container No.	C13	C14	C15	C16	NP	
Container Weight (gm) (W1)	39.64	36.34	33.14	32.28		
Container + Wt. of wet soil (gm) (W2)	80.81	94.82	98.09	103.47		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.93	89.59	85.92	87.62		
Wt. Of water (gm) (W2-W1)-(W3-W1)	2.88	5.23	12.17	15.84		
Wt. of oven dry soil (gm) (W3-W1)	38.29	53.25	52.78	55.34		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**7.53**	**9.82**	**23.05**	**28.63**		

Result Summary

Liquid Limit (WL)	15	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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ARKITECHNO

N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

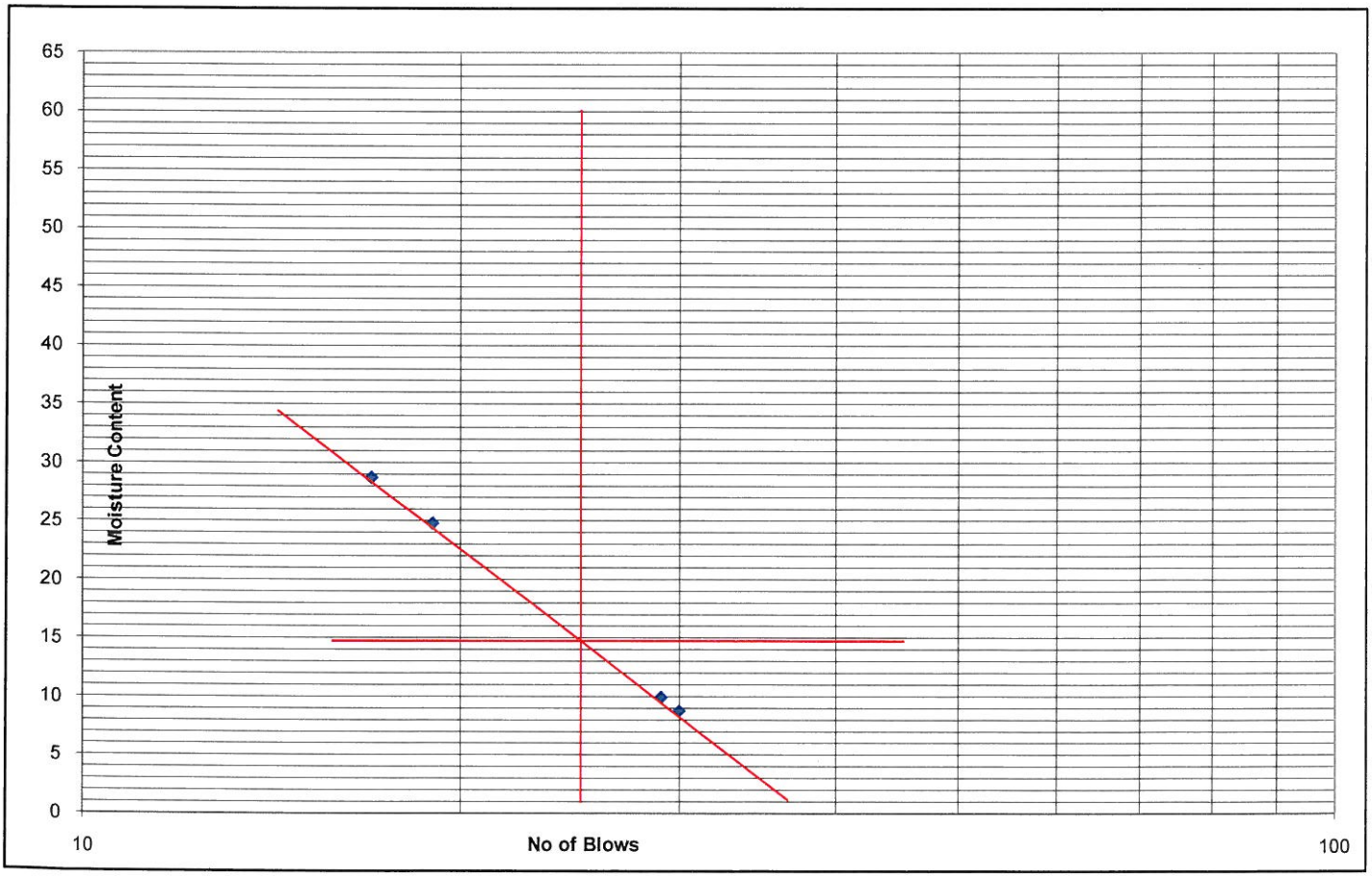
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	13.5m	Tested by	:	D.Mohanty

Number of Blows	30	29	19	17	Plastic Limit	
Container No.	C1	C2	C3	C4	NP	
Container Weight (gm) (W1)	33.6	34.2	36.7	32.65		
Container + Wt. of wet soil (gm) (W2)	81.54	94.95	98.27	103.15		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.67	89.47	86.04	87.44		
Wt. Of water (gm) (W2-W1)-(W3-W1)	3.87	5.48	12.23	15.72		
Wt. of oven dry soil (gm) (W3-W1)	44.07	55.27	49.34	54.79		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**8.79**	**9.91**	**24.79**	**28.69**		

Result Summary

Liquid Limit (WL)	15	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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ARKITECHNO

N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

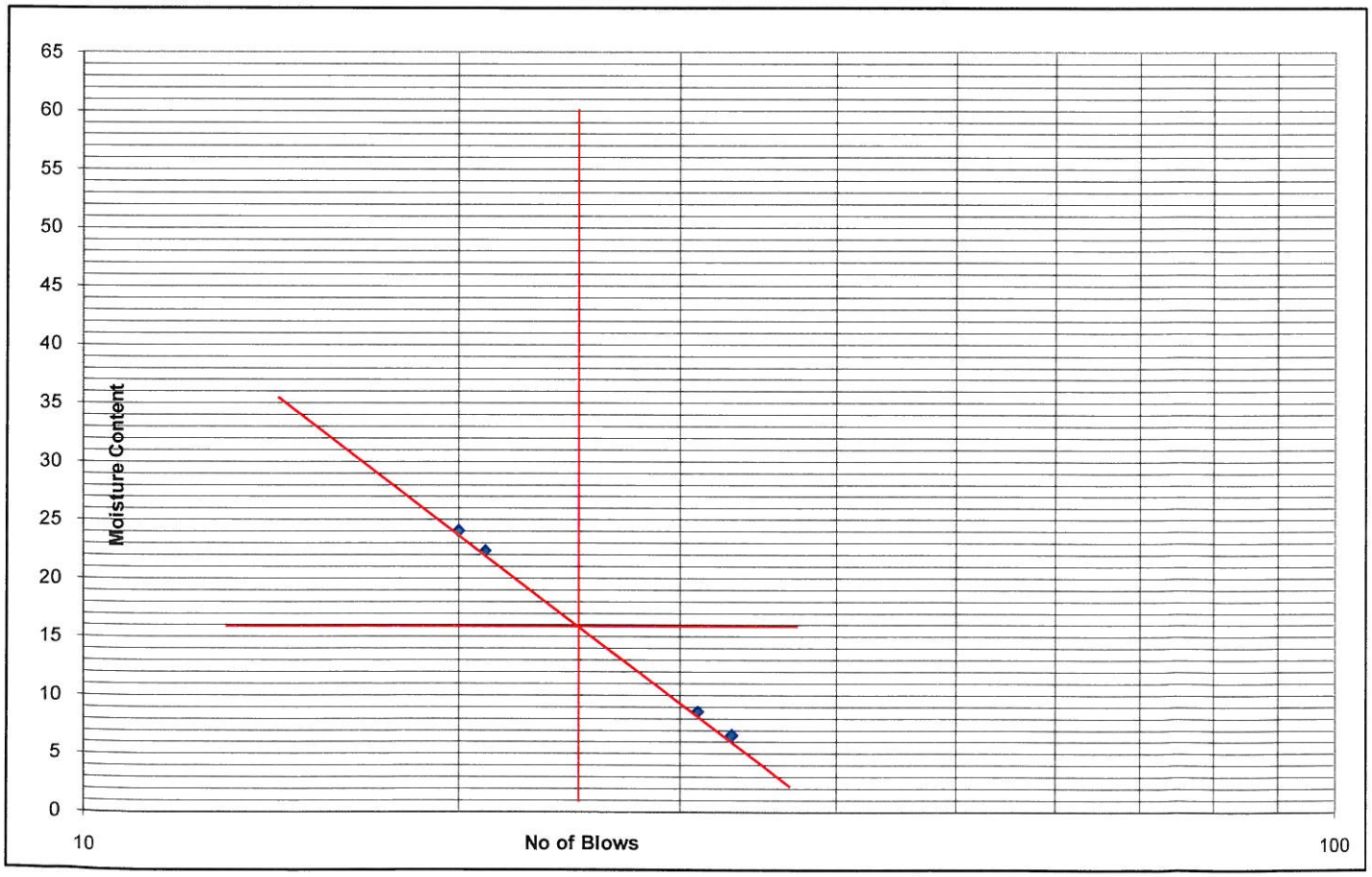
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	16.5m	Tested by	:	D.Mohanty

Number of Blows	33	31	21	20	Plastic Limit	
Container No.	C19	C20	C37	C38	NP	
Container Weight (gm) (W1)	30.48	35.24	38.52	37.22		
Container + Wt. of wet soil (gm) (W2)	80.64	94.15	97.08	99.66		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.54	89.48	86.37	87.55		
Wt. Of water (gm) (W2-W1)-(W3-W1)	3.10	4.68	10.71	12.10		
Wt. of oven dry soil (gm) (W3-W1)	47.06	54.24	47.85	50.33		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**6.58**	**8.62**	**22.37**	**24.05**		

Result Summary

Liquid Limit (WL)	16	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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ARKITECHNO

N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

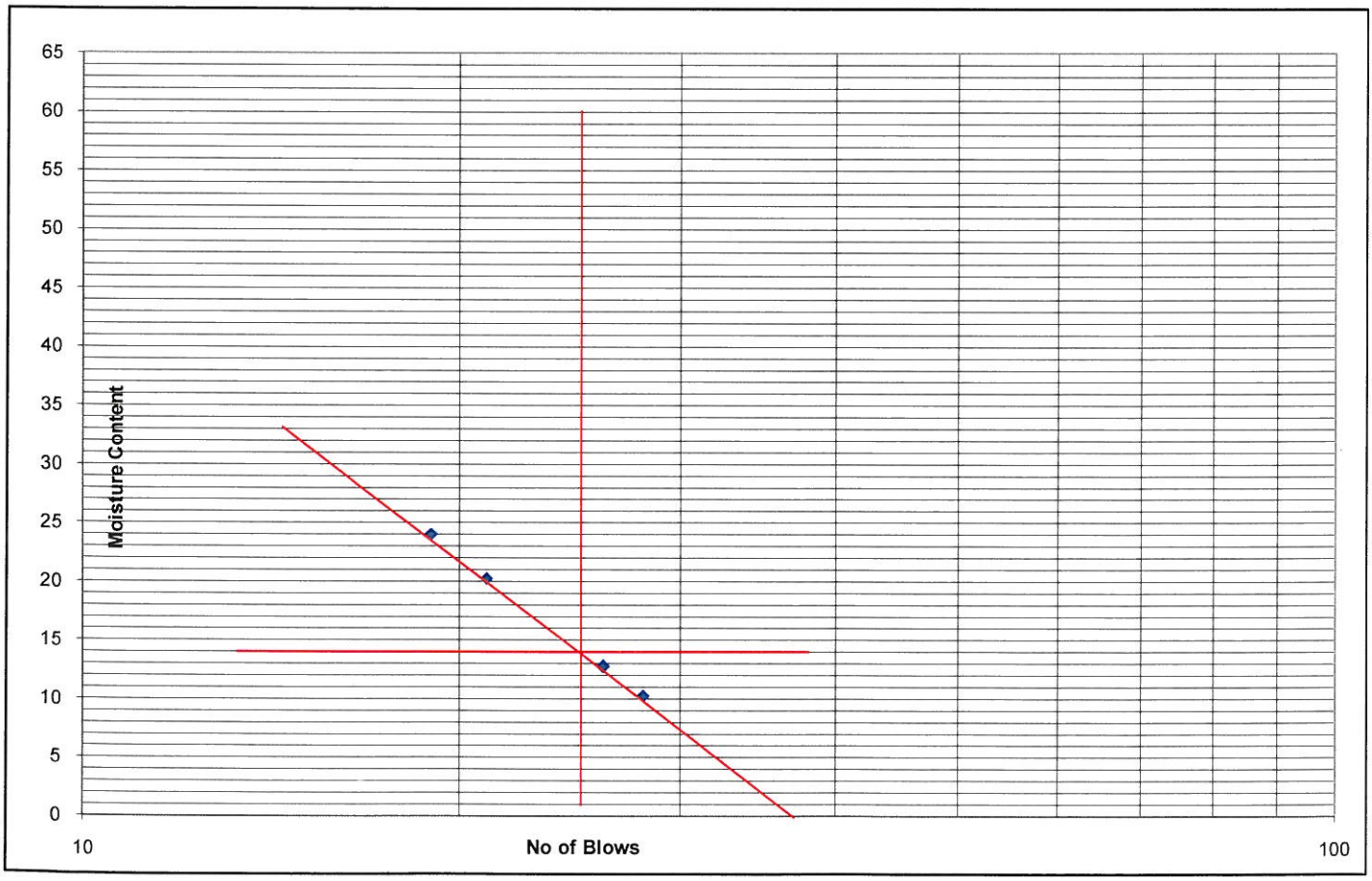
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	18.0m	Tested by	:	D.Mohanty

Number of Blows	28	26	21	19	Plastic Limit	
Container No.	C41	C42	C27	C28	NP	
Container Weight (gm) (W1)	37.6	35.55	31.2	39.42		
Container + Wt. of wet soil (gm) (W2)	81.50	96.27	97.57	99.26		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.41	89.39	86.38	87.67		
Wt. Of water (gm) (W2-W1)-(W3-W1)	4.08	6.89	11.19	11.59		
Wt. of oven dry soil (gm) (W3-W1)	39.81	53.84	55.18	48.25		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**10.26**	**12.79**	**20.27**	**24.01**		

Result Summary

Liquid Limit (WL)	14	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

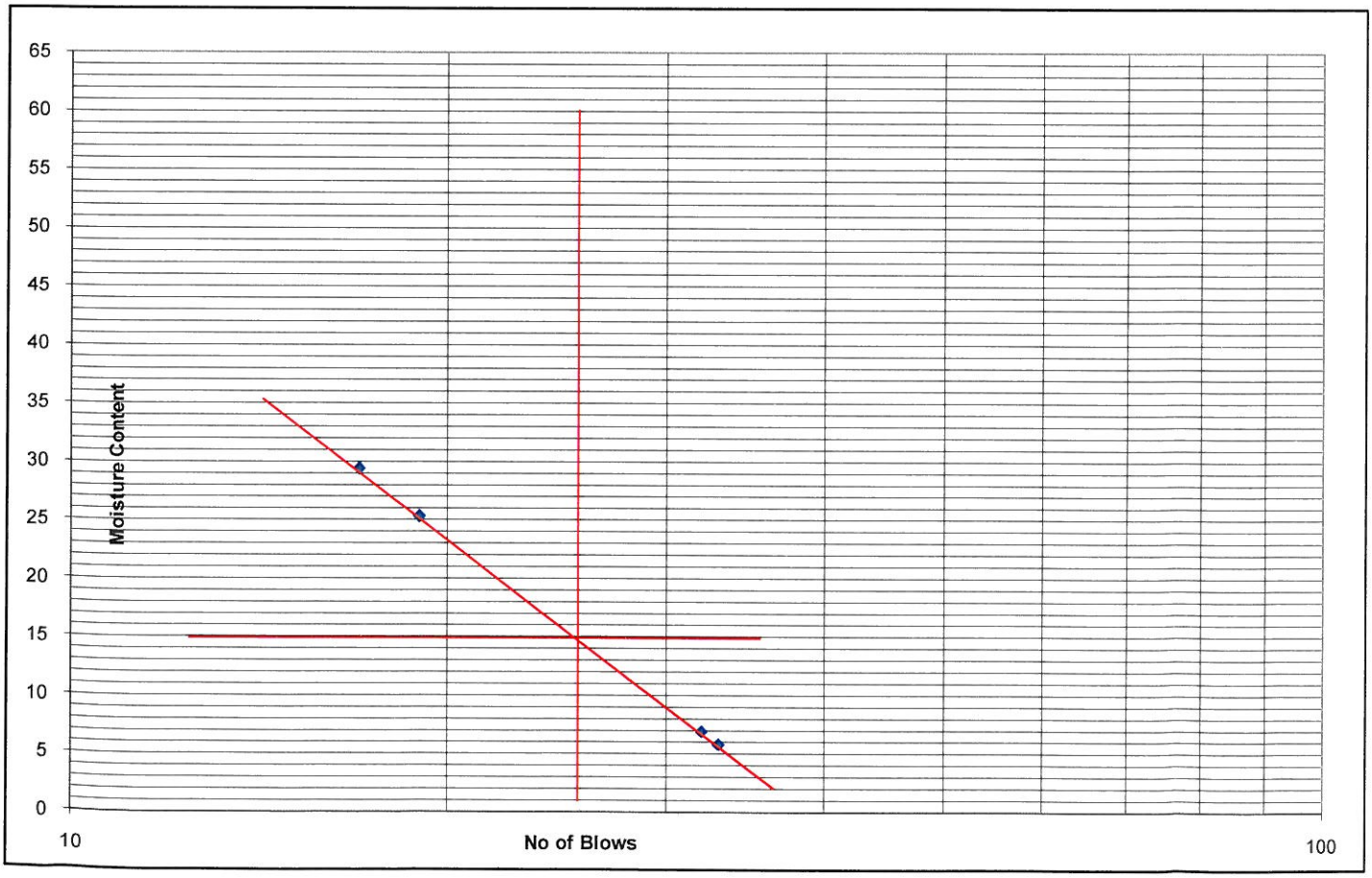
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	21.0m	Tested by	:	D.Mohanty

Number of Blows	33	32	19	17	Plastic Limit	
Container No.	C5	C6	C21	C22	NP	
Container Weight (gm) (W1)	31.26	30.12	37.88	34.61		
Container + Wt. of wet soil (gm) (W2)	79.97	92.89	97.94	103.22		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.29	88.82	85.81	87.65		
Wt. Of water (gm) (W2-W1)-(W3-W1)	2.68	4.07	12.13	15.58		
Wt. of oven dry soil (gm) (W3-W1)	46.03	58.70	47.93	53.04		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**5.82**	**6.93**	**25.30**	**29.37**		

Result Summary

Liquid Limit (WL)	15	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

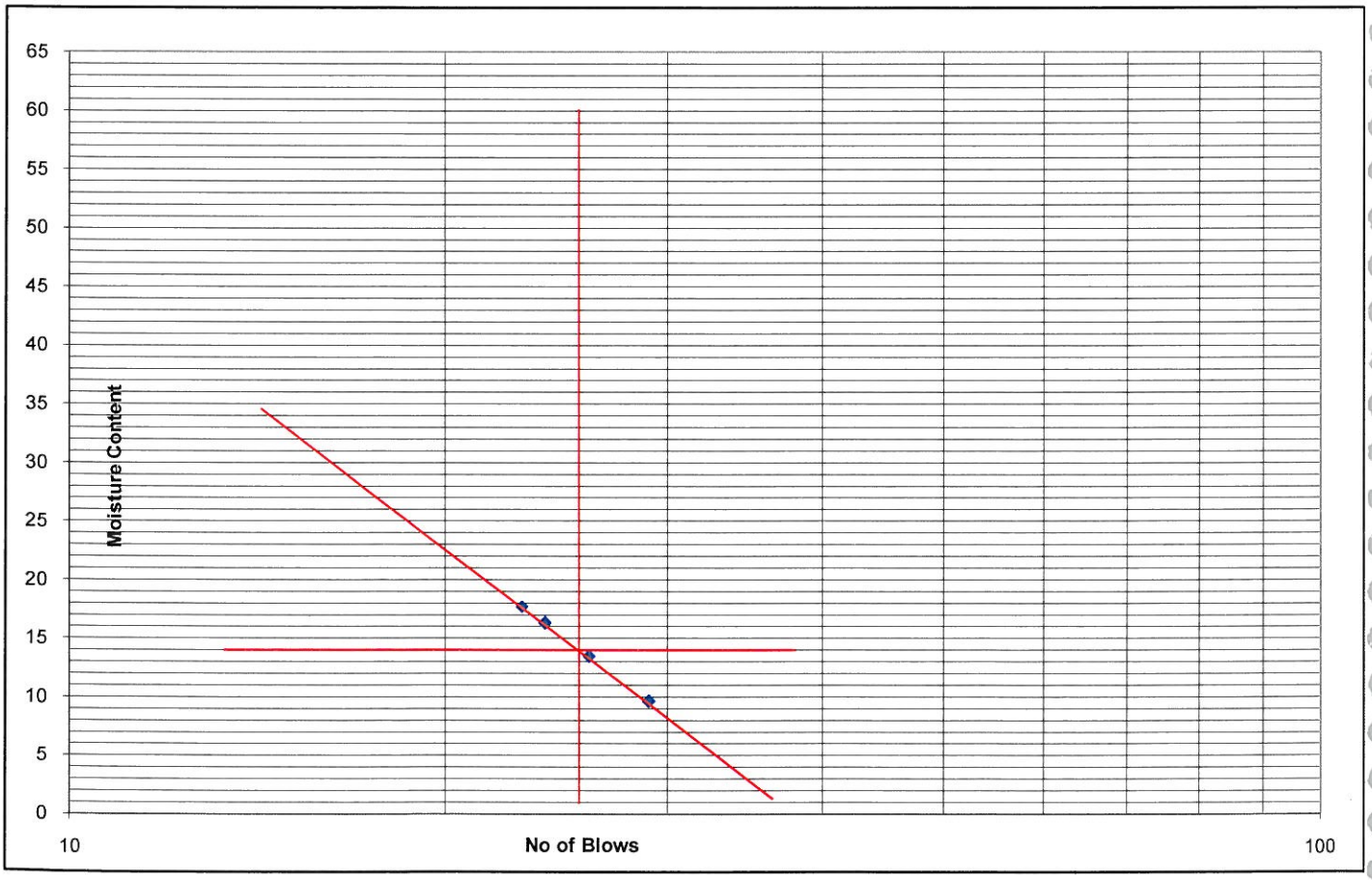
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	25.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	22.5m	Tested by	:	D.Mohanty

Number of Blows	29	26	24	23	Plastic Limit	
Container No.	C35	C36	C39	C40	NP	
Container Weight (gm) (W1)	37.73	30.99	39.43	30.5		
Container + Wt. of wet soil (gm) (W2)	81.71	96.75	93.97	97.66		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.83	88.95	86.32	87.55		
Wt. Of water (gm) (W2-W1)-(W3-W1)	3.87	7.80	7.65	10.11		
Wt. of oven dry soil (gm) (W3-W1)	40.10	57.96	46.89	57.05		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**9.66**	**13.46**	**16.32**	**17.73**		

Result Summary

Liquid Limit (WL)	14	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

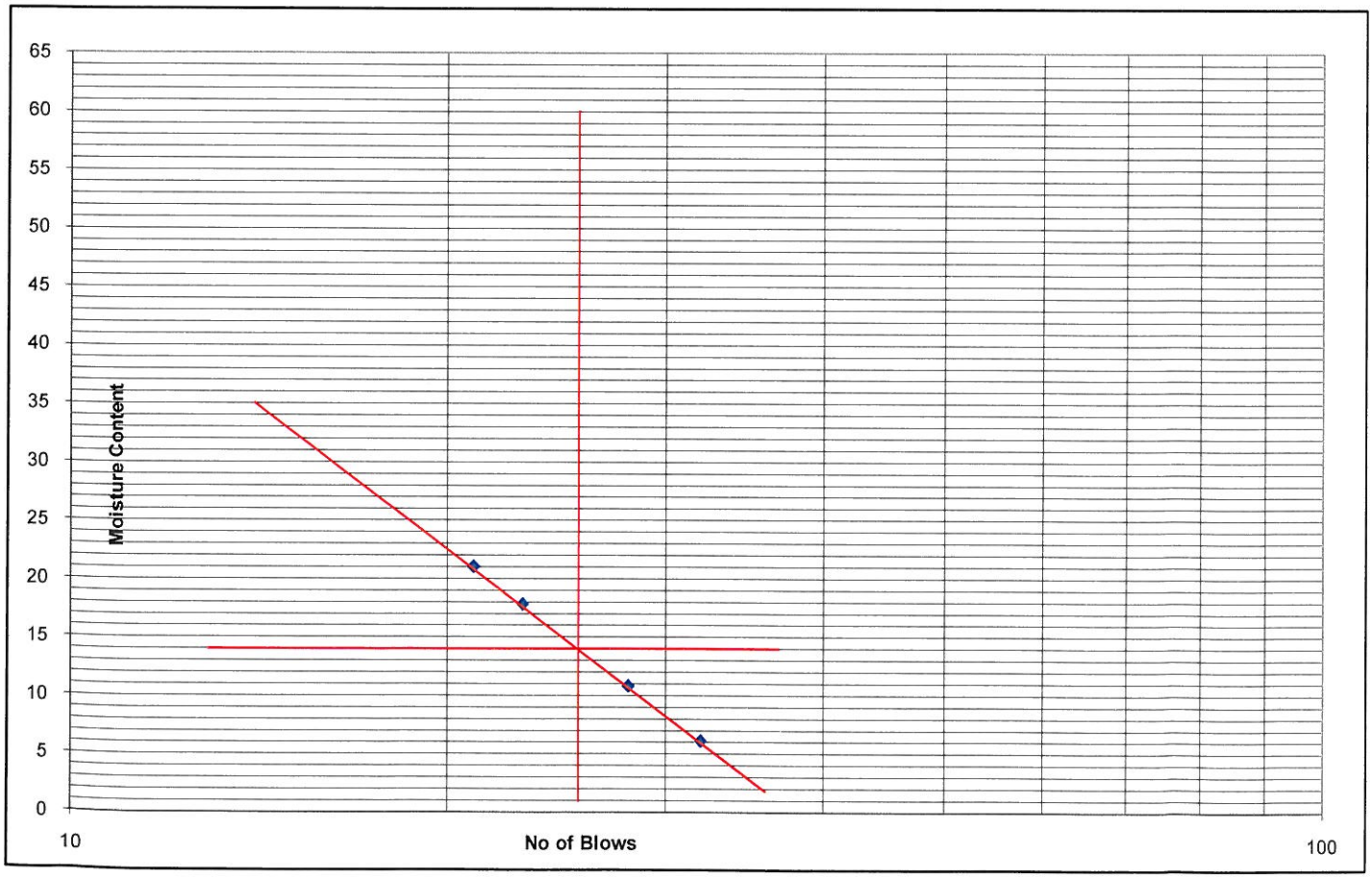
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	26.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	27.0m	Tested by	:	D.Mohanty

Number of Blows	32	28	23	21	Plastic Limit	
Container No.	C31	C32	C33	C34	NP	
Container Weight (gm) (W1)	30.8	38.08	32.47	31.56		
Container + Wt. of wet soil (gm) (W2)	80.80	94.79	96.66	99.30		
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.91	89.25	86.96	87.53		
Wt. Of water (gm) (W2-W1)-(W3-W1)	2.89	5.54	9.69	11.77		
Wt. of oven dry soil (gm) (W3-W1)	47.11	51.17	54.49	55.97		
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**6.13**	**10.83**	**17.79**	**21.03**		

Result Summary

Liquid Limit (WL)	14	%
Plastic Limit (Wp)	_	%
Plasticity Index (Ip)	_	%



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ARKITECHNO

N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

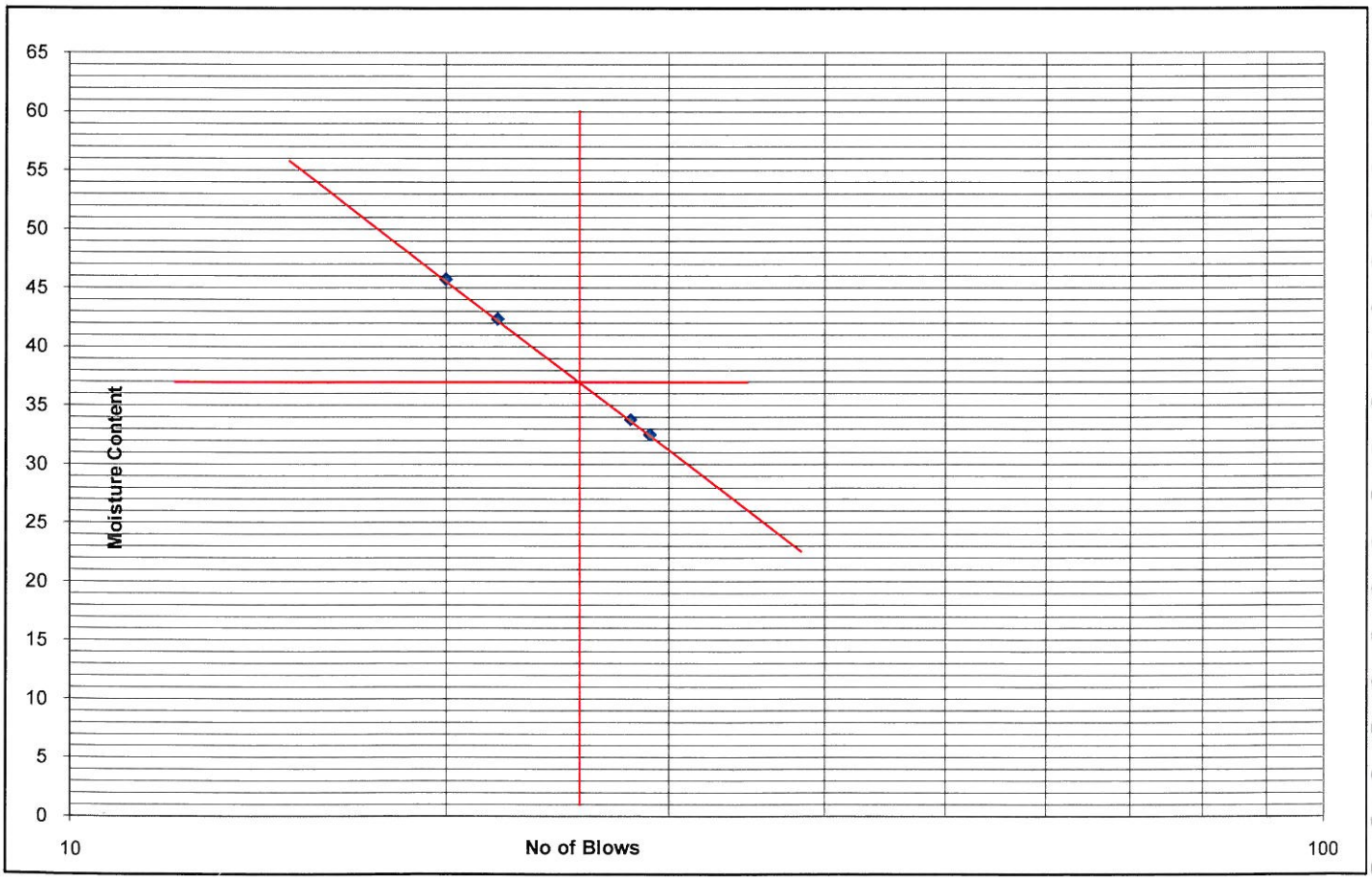
IS : 2720 (Part -5)

Client	:	DFCC			
Project Name	:	G.I For 3 Nos. Important Bridges			
Type of Sample	:	SPT	Date Of Testing	:	26.10.12
Location	:	BH-1(Yamuna River-Ambala)	Sampled by	:	T.K.Das
Depth	:	30.0m	Tested by	:	D.Mohanty

Number of Blows	29	28	22	20	Plastic Limit	
Container No.	A37	A38	A39	A40	A41	A42
Container Weight (gm) (W1)	30.18	33.67	35.48	31.39	32.16	35.55
Container + Wt. of wet soil (gm) (W2)	93.48	108.30	107.28	113.18	97.65	96.98
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.95	89.45	85.92	87.52	88.16	88.52
Wt. Of water (gm) (W2-W1)-(W3-W1)	15.53	18.85	21.36	25.66	9.49	8.46
Wt. of oven dry soil (gm) (W3-W1)	47.77	55.78	50.44	56.13	56.00	52.97
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**32.51**	**33.79**	**42.34**	**45.71**	**16.95**	**15.98**

Result Summary

Liquid Limit (WL)	37	%
Plastic Limit (Wp)	16	%
Plasticity Index (Ip)	21	%



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N 3/91, IRC Village, Bhubaneswar

DETERMINATION OF LIQUID LIMIT AND PLASTIC LIMIT

IS : 2720 (Part -5)

Client : DFCC

Project Name : G.I For 3 Nos. Important Bridges

Type of Sample : SPT

Location : BH-1(Yamuna River-Ambala)

Depth : 36.0m

Date Of Testing : 26.10.12

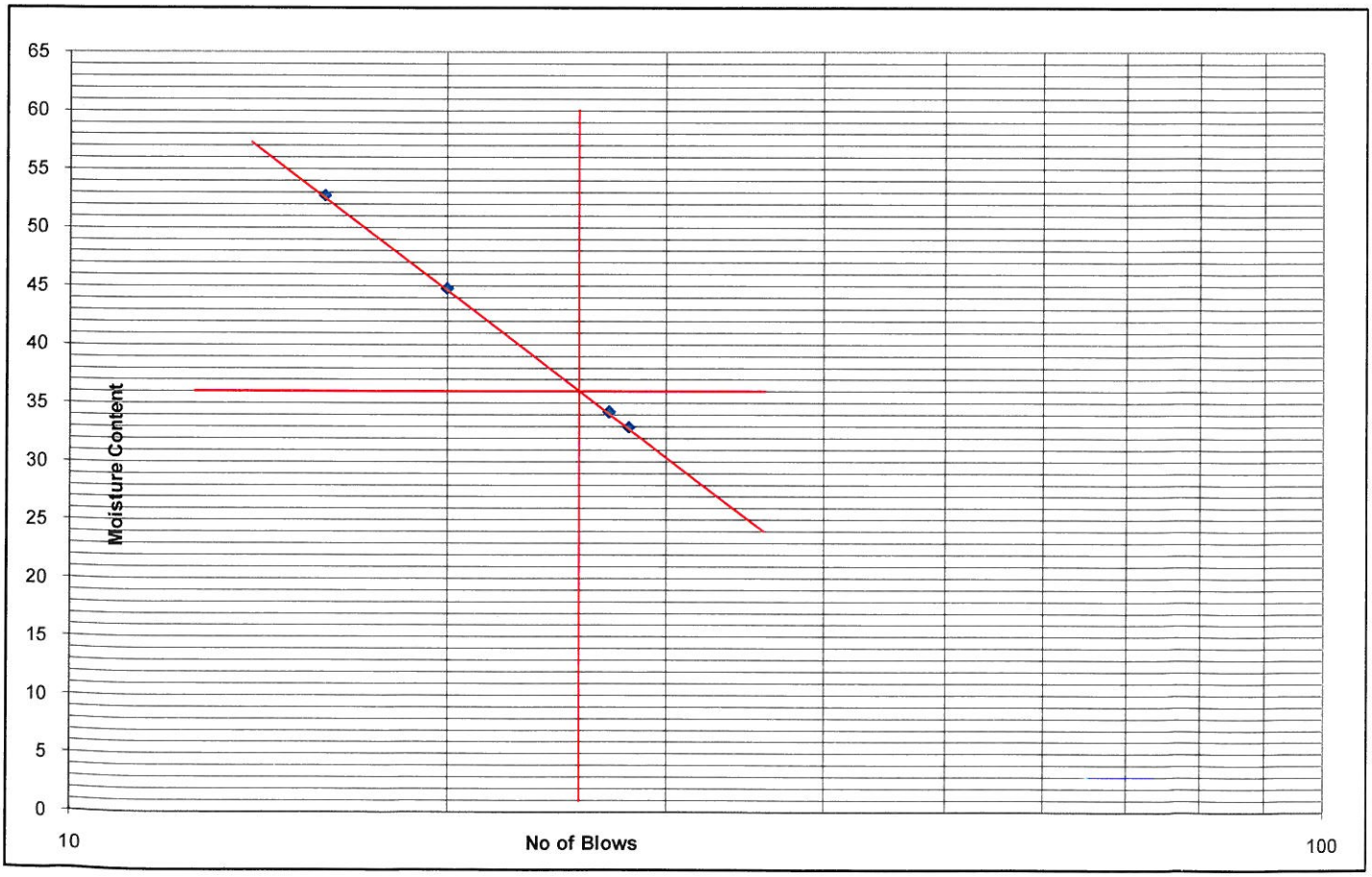
Sampled by : T.K.Das

Tested by : D.Mohanty

Number of Blows	28	27	20	16	Plastic Limit	
Container No.	A31	A32	A33	A34	A35	A36
Container Weight (gm) (W1)	35.64	34.29	32.47	31.56	30.22	33.47
Container + Wt. of wet soil (gm) (W2)	91.59	108.39	109.54	117.01	97.53	97.07
Wt of Container + Wt. of oven dry soil (gm) (W3)	77.73	89.49	85.70	87.51	88.74	88.84
Wt. Of water (gm) (W2-W1)-(W3-W1)	13.87	18.90	23.84	29.50	8.79	8.23
Wt. of oven dry soil (gm) (W3-W1)	42.09	55.20	53.23	55.95	58.52	55.37
Moisture Content (%)= [(W2-W1)-(W3-W1)]/(W3-W1) X 100	**32.95**	**34.23**	**44.79**	**52.73**	**15.02**	**14.86**

Result Summary

Liquid Limit (WL)	36	%
Plastic Limit (Wp)	15	%
Plasticity Index (Ip)	21	%



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