Submitted sir,

Sub: RWS&S-TDWSP- Chillapalligutta 20KL GLBR in Sirpur T Mandal–Komarambheem Asifabad Segment-Adilabad District-Designs -Approval-Reg.

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Kindly puruse the Designs of the following 20KL GLBR at Madharamgutta(V) ,Sirpur T (M), submitted by the Executive Engineer TDWSP Asifabad Division ,Adilabad district for approval.

1. 20 KL GLBR.

The Executive Engineer TDWSP Asifabad Division has submitted Structural Designs & Drawings of 20KL GLBR based on the field conditions and as per the estimate provisions , the structural designs & drawings for the above structure is verified and submitted for approval.

The following design parameters were considered:

- Capacity : 20KL
- Net SBC of Soil : 10.0 t/sqm
- Grade of concrete & Steel : M 30 & Fe 500
- Dia of GLBR Inner to Inner : 4.10m
- Sidewall Height : 2.0mts
- Sidewall Thickness:200mm
- Top Slab thickness: 200 mm
- Raft Slab thickness: 200mm

As per the above parameters the structural design and drawings of the GLBR is verified, duly following IS codes, IS: 456-1000, SP:16, 34, IS:3370 and IS 1893-1002 (seismic codes).The sizes and steel proposed in the designs and drawings of all components are safe and sufficient.

The additional points noted after checking the designs are:

- Detailed Estimate of the Structure with these specifications has to be prepared and compared with the provision made in sanctioned estimate. Such that deviation if any is within authorized limits. If any deviations noticed, the Estimate should be submitted for obtaining approval from the Competent Authority.

Subject to approval a draft memo addressed to the EE, TDWSP Asifabad Division , for communicating approved Structure is put up for kind perusal and approval.

AEE (Designs)	DEE (Designs)	Superintending Engineer,
TDWSP,Nirmal Circle	TDWSP,Nirmal Circle	TDWSP,Nirmal Circle

GOVERNMENT OF TELANGANA
TELANGANA DRINKIMG WATER SUPPLY PROJECT
Rural Water Supply & Sanitation Department

TELANGANA WATER GRID

L&T Construction - Water, Smart World & Communication
CHENNAI

CLIENT:	CONSULTANT :
RURAL WATER SUPPLY AND SANITATION DEPARTMENT (WATER GRID), TELUNGANA.	WAPCOS LIMITED

PROJECT :	PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT
SUPPLIER / CONTRACTOR:	L&T Construction, Water, Smart World and Communication

JOB Ref. No. : LE150883

	NAME	SIGN	DATE
DSGN			
CHKD			
APPD			

TITLE :

DESIGN OF GLBR- 20KL CAPACITY BEJJUR AT BEJJUR MANDAL

DOC./DRG. No.

LE150883-C-WS-RW-DC-1464

SIZE: A4

REV.: A

RELEASED FOR

☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

DESIGN CALCULATION

PROJECT TITLE

PROVIDING DRINKING WATER TO HABITATIONS
IN KOMARAMBHEEM ASIFABAD SEGMENT
IN ADILABAD DISTRICT (30 MLD WTP)

UNIT

20 KL GLBR

DCI NO: - LE150883-C-WS-RW-DC-1542

PRINCIPAL CLIENT

RURAL WATER SUPPLY
AND
SANITATION DEPARTMENT,
TELANGANA

CONTRACTOR

L&T CONSTRUCTION
WATER & EFFLUENT TREATMENT SBG

DESIGN OF GLBR

BASIC DATA

Diameter = 4.1 m
Water depth = 1.7 m
Free board = 0.3 m

CAPACITY CHECK

Required capacity = 20 KL

Capacity of section

Clear diameter = 4.1 – 2 x plaster thickness
= 4.1 – 2 x 0.012
= 4.076 m

Water depth = 1.70 m

Volume = (pi * d x d ./ 4) x H
= (Pi* 4.076 x 4.076 / 4) * 1.7 = 22.18 m^3 (including dead storage)

Volume-Dead storage = 22.18 – 1.95 = 20.23 m^3

Net volume = 20.23 m^3 > 20 m^3 hence O.K.

ELEMENT:
Inside tank: (1) Cylindrical wall
(2) Top Slab

SBC – 10 t/m^2

GROUND WATER TABLE: NO GWT

Tank type : Ground storage resrvoir				
Tank Geomtry : Circular with slab				
20 KL GLBR				
Basic data				
	General			
No	Description	Notation	Value	Unit
(A)	Unit weight			
	Unit weight of concrete	Uwc	25.0	kN/m3
	Unit weight of water	Uww	10.00	kN/m3
	Unit weight of plaster	Uwp	21.0	kN/m3
	Unit weigth of IPS	Uips	21.0	kN/m3
	Unit weight of soil	Uws	18.0	kN/m3
(B)	Material			
	Grade of concrete of container	Fck	30	N/mm2
	Grade of Steel	Fy	500	N/mm2
	Mass & Wt relation factor	g	9.81	
(C)	Loading			
	Finishing load on top slab	Fl	1.00	kN/m2
	Live load on top slab	Ll	1.50	kN/m2
	Other			
(D)	Plaster thickness	Pt	20	mm
	Bottom IPS thickness	Bips	20	mm
	Free board	Fb	300	mm
(E)	Capacity			
	Required volumn of water	Vw	20	m3
		Vwl	20000	liter
(F)	Geometry data			
	Height between Bottom slab & FSl	Hw	1.7	m
	Depth below ground	Dbgl	0.6	m
	Water depth	Wd	1.7	
	Diameter of tank required	Diar	3.91	m
	Diameter of tank provide	Diat	4.1	m
	Actual capcity of tank	Tcap	22.009	m3
		Tcapl	22009	liter
(G)	RCC geometry data			
	Bottom slab thickness	Thkbs	200	mm
	Top Slab thickness	Thkts	150	mm
	Wall thickness	Thkw	175	mm
	Progection of bottom slab	Prjbs	300	mm
	Projection of PCC	prjpcc	100	mm
	Thickness of PCC	Thkpcc	100	mm
(H)	Earthquake data			
	Zone	Eqzone	2	
	Soil type (1,2,3)	typesoil	2	
	soft soil : Soil type 1			
	Medium soil : Soil type 2			
	Hard soil : soil type 3			
	Importance Factor	Impfac	1.5	

Tank Geomtry : Circular with slab				
20KL GLBR				
Mass & Weight Calculation				
	RCC			
(A)	Bottom slab			
	Out to out dia of bottom slab	Bso	5.05	m
	Thickness of bottom slab in m	thkbsm	0.20	m
	Volume of bottom slab	Vbs	4.01	m3
	Weight of bottom slab	wtbs	100.15	kN
	Mass of bottom slab	Mbs	10209	kg
(B)	Side wall			
	C/C wall dia	Wdiacc	4.28	m
	Total height of wall	Wht	2.00	m
	Thickness of wall in meter	thkwm	0.18	m
	Volume of side wall	Vw	4.70	m3
	Weight of side wall	Ww	117.52	kN
	Mass of side	Mw	11979	kg
(C)	Top slab			
	Out to out dia of top slab	Tso	4.45	m
	Thickness of top slab in m	thktsm	0.150	m
	Surface area of top slab		15.55	
	Volume of top slab	VTs	2.33	m3
	Weight of top slab	wtts	58.32	kN
	Mass of top slab	Mts	5945	kg
(D)	bottom IPS			
	Area of Bottom IPS	Arips	13.20	m2
	Weight of bottom IPS	Wips	5.55	kN
	Mass of bottom IPS	Mips	565	kg
(E)	Plaster			
	Area of Plaster on wall	Arpsw	25.76	m2
	Weight of plaster on wall	Wpsw	10.82	kN
	Mass of plaster on wall	Mpsw	1103	kg
	Area of Plaster top slab	Arpsts	13.20	m2
	Weight of plaster on top slab	Wpsts	5.55	kN
	Mass of plaster on top slab	Mpsts	565	kg
(F)	Finishing load			
	Area of Finishing load	Arfl	15.55285	m2
	Weight of finishing load	Wfl	15.55285	kN
	Mass of finishing load	Mfl	1585.407	kg
(H)	Water			
	Weight of water up to FSL	Wwfsl	220.09	kN
	Mass of water upto FSL	Mwfsl	22435	kg
	Weight of water in free board	Wwfb	38.84	kN
	Mass of water in free board	Mwfb	3959	kg
	Total weight of water	Tww	258.92	kN
	Total mass of water	Tmw	26394	kg
	Total mass		58346	kg
	Total wt		572	kN

Tank Geomtry : Circular with slab				
20KL GLBR				
Parameter of spring mass Model				
(A)	H/D calculation			
	Height of tank including Freeboard	H	2	m
	Inside Diameter of tank	D	4.1	m
	H/D ratio - Ra	Ra	0.488	
	D/H ratio Rb	Rb	2.05	
(B)	Mass calculation			
	Total mass of water	M	26394	kg
	Calculation of Impulsive mass			
	mi/m = tanh (0.866d/h)			
	0.866 d/h			
	Mi/m - Ratio Rd	Rd	0.5318	
		Mi	14037	kg
	Calculation of Convective mass			
	mc/m = 0.23 * tanh (3.68h/d)			
	h/d			
	Mc/m - Ratio Re	Re	0.446	
		Mc	11776	kg
	Total mass of water	Tm	25814	
(C)	Calculation of Height Hi & Hc			
	for hydrodynamic pressure on			
	tank wall only			
	For H/D < 0.75 , hi = 0.375			
	For H/D > 0.75			
	hi/h = 0.5 - 0.09375/ (h/d) -Ratio Rf	Rf	0.375	
		hia	0.750	m
	hc/h = 1-cosh(3.68 h/d)-1	Rg	0.602	
	3.68 h/d sinh(3.68 h/d)	Hca	1.203	m
(D)	Calculation of Height Hi* & Hc*			
	Hi for hydrodynamic pressure on			
	tank wall and base slab			
	For H/D < 1.33			
	hi*/h = 0.866d/h * - 0.125			
	2 tanh (0.866 d/h)			
	For H/D > 1.33			
	hi*/h =0.45	Rh	0.815	
		hib	1.630	m
	hc*/h = 1-cosh(3.68 h/d)-2.01	Ri	0.794	
	3.68 h/d sinh(3.68 h/d)	Hcb	1.588	m
(E)	Calculation of spring stiffness			
	kc = 0.836*mg/h*tanh^2(3.68 h/d)	Kc	96918	

Tank Geomtry : Circular with slab				
20KL GLBR				
Time Period				
(A)	Ci			
	Coefficient for Calculation of			
	Time period in Impulsive mode time			
	$Ci = \frac{1}{(h/d)^{0.5}*(0.46-0.3*h/d+0.067(h/d)^2)}$	Ci	4.344	
(B)	Cc			
	Coefficient for Calculation of			
	Time period in Convective mode time			
	$Cc = \frac{2 * pi}{(3.68*\tanh(3.68h/d))^{0.5}}$	Cc	3.367	
(C)	Time period in Impulsive mode			
	Ti = Ci * H* (mdwt)^0.5 /(tw/D)^0.5(E)^0.5			
	mass density of water	mdwt	1019.368	kg/m3
		Ti	0.008	second
(D)	Time period in Convective mode			
	Tc = Cc * (D/g)^0.5	Tc	2.177	second

Tank Geomtry : Circular with slab				
20KL GLBR				
Horizontal seismic coefficient				
(A)	Zone factor Z			
	Earthquake zone	2		
	Zone Factor : Z	Z	0.1	
	Imporatnce factor	I	1.5	
	Soil type	st	2	
(B)	Response reduction factor			
	Response reduction factor for ground	Grfac	2	
	supported tank			
	Response reduction factor for under	Ugrfac	4	
	grounf tank			
	Response factor for partial under ground			
	Tank above ground		1.30	m
	Tank below ground		0.60	
	Total heigth of tank		2.00	
	Ratio for partial burried	Rpb	0.300	
	Partial R	Prfac	2.600	
(C)	Calculation for Sa/g : for impulsive mode			
	Time Period Ti		0.0081	second
	Sa/g : For Soft soil	saga	2.5	
	Sa/g : For Medium soil	sagb	2.5	
	Sa/g : For hard soil	sagc	2.5	
		sag	2.5	
(D)	Seismic coeficient for implusive mode			
	Ahi = Z / 2 * I /R * Sa/g	Ahi	0.072115	
(E)	Calculation for Sa/g : for convective			
	Time Period Tc		2.18	second
	Sa/g : For Soft soil	saga1	0.767	
	Sa/g : For Medium soil	sagb1	0.625	
	Sa/g : For hard soil	sagc1	0.459	
	Sag for 0.5 % damping = sag * 1.75	sag1	1.09	
(F)	Seismic coeficient for implusive mode			
	Ahc = Z / 2 * I /R * Sa/g	Ahc	0.032	
(G)	Calculation of base shear due to			
	implusive mode			
	Vi = Ahi * (Mass of tank + Mass of water in impulsive mode) x G			
		Vi	24.91	kN
(H)	Calculation of base shear due to			
	convective mode			
	Vc = Ahc * (Mass of water in convective mode) x G			

Tank Geomtry : Circular with slab				
20KL GLBR				
Horizontal seismic coefficient				
		Vc	3.64	kN
(I)	Total base shear			
	V = (Vi^2+ Vc^2)^ 0.5	V	25	
(J)	Moment at bottom of wall			
	Impulsive mode			
	Mombti : Ahi*(mi*hi+Mw*hw+Mt*ht)* G			kn-m
	Impusive mass of water	14037	0.75	10528
	Mass of wall	11979	1.00	11979
	Mass of plaster	1103	1.00	1103
	Mass of top slab	5945	2.08	12336
	Mass of topslab finishing	1585	2.15	3409
				39355
	Moment = Afi * (Sigma M * H) * G	mombti	27.8	
	Center of gravity of slab			
	=slab thickness /2		0.075	
(K)	Moment at bottom of wall			
	Convective mode			
	Mombti : Ahc*(mc*hc)* G	mombtc	4.38	kn-m
(L)	Total bending moment			
	momto			
	= ((mombti^2+mombtc^2))^0.5	Momto	28.19	kn-m

Tank Geomtry : Circular with slab				
20KL GLBR				
Horizontal seismic coefficient				
(M)	Over turning moment			
	Impusive mode			
	ahi*(mi*(hi*+thkbs)+mw(hw+thkbs)			
	+mt(hw+thkbs+thkts/2)+mb*thkbs/2			
	Item	mass	distance	
	Impusive mass of water	14037	1.83	25692
	Mass of wall	11979	1.20	14375
	Mass of plaster	1103	1.20	1324
	Mass of top slab	5945	2.28	13526
	Mass of topslab finishing	1585	2.35	3726
	Mass of bottom slab	10209	0.10	1021
	Mass of Bottom Ips	565	0.20	113
				59775.581
	Moment = Afi * (Sigma M * H)* G	momovei	42.29	kn-m
(N)	Over turning moment			
	Convective mode			
	moment = Ahc*Mc*(hc*+thkbs)G	momovec	6.51	
	Total Moment of overturining	Momovrto	42.79	
	P/A	preaa	28.58	
	M/z	Prebb	3.38	
	P/a+m/z	Pmax	31.96	< SBC O.K
	Pa/-m/z	Pmin	25.19	> 0 O/K
(P)	Sloshing Wave Height			
	Wavh = Ahc * R * D/2	Wavh	0.168	
(Q)	Anchore Requriment			
	h/d ratio	0.4878		
	1/ahi	13.8667		
	h/d < 1/ahi	No anchorage required		

100 kN/m²

Tank Geomtry : Circular with slab		
20KL GLBR		
Hydrodynamic Pressure		
A	Impulsive hydrodynamic pressure at base of wall	Piw
B	Impulsive hydrodynamic pressure at base slab	Pib
C	Convective hydrodynamic pressure at base of wall	Pcw
D	Impulsive hydrodynamic pressure at base of wall	Pcb
E	Pressure due to wall inertia	Pww
F	Pressure due vertical excitation	Pv

A	Impulsive hydrodynamic pressure at base of wall

Pressure on wall due to impulsive load					
Piw = Qiw * (y) * ahi * ro * G * h * Cos phi					
for maximum value angle phi = 0, cos phi = 1					
Qiw = 0.866 * (1-(y/h)^2*tanh(0.866D/h)					
Table					
Diameter of Tank =		4.10	m		
Total Height of tank =		2.00	m		
D/h		2.05	ratio		
tanh(0.866D/h) = (A)		0.944			
Ahi *ro * G * h * Cos phi = C)		1415			

No	y/h	Y	(1-(y/h)^2	Qiw = 0.866* A * B	Piw
			(B)		kn/m2
1	0	0.00	1	0.818	1.2
2	0.1	0.20	0.99	0.809	1.1
3	0.2	0.40	0.96	0.785	1.1
4	0.3	0.60	0.91	0.744	1.1
5	0.4	0.80	0.84	0.687	1.0
6	0.5	1.00	0.75	0.613	0.9
7	0.6	1.20	0.64	0.523	0.7
8	0.7	1.40	0.51	0.417	0.6
9	0.8	1.60	0.36	0.294	0.4
10	0.9	1.80	0.19	0.155	0.2
11	1	2.00	0	0.000	0.0
Pressure on wall due to impulsive load at Y = 0				1.2	

Tank Geomtry : Circular with slab					
20KL GLBR					
Hydrodynamic Pressure					
B	Impulsive hydrodynamic pressure at base slab				
Pressure on slab due to impulsive load					
Pib = 0.866 x ahi * ro* g * h * sinh(1.732 x/h)/cosh(0.866*l'/h)					
y = 0 at base slab					
at center x = D/2 =		2.050			
L' =		2.050			
sinh(1.732*x/h)		2.866			
cosh(0.866*l'/h)		1.421			
Pib		2.472	kn/m2		
C	Convective hydrodynamic pressure at base of wall				
Pressure on wall due to convective mode					
Pcw = Qcw(y)(Ahc)*ro* G*D*(1-1/3cos ph^2)*cos ph					
Qcw = 0.5625 * cosh(3.674 y/d)/(cosh 3.674 h/d)					
for maximum value angle phi = 0, cos phi = 1					
cosh(3.674*H/d) : (A)		3.0846043			
Ahc *ro * G * D *(1-1/3cosph^2) Cos phi = C)		846			

No	y/d	Y	cosh(3.674*y/d) (B)	Qcw = 0.5625*A / B	Pi
					kn/m2
1	0	0.00	1.000	0.182	0.154
2	0.1	0.41	1.068	0.195	0.165
3	0.2	0.82	1.282	0.234	0.198
4	0.3	1.23	1.671	0.305	0.258
5	0.4	1.64	2.289	0.417	0.353
6	0.5	2.05	3.218	0.587	0.496
7	0.6	2.46	4.588	0.837	0.708
8	0.7	2.87	6.583	1.200	1.015
9	0.8	3.28	9.477	1.728	1.462
10	0.9	3.69	13.664	2.492	2.107
11	1	4.10	19.717	3.596	3.041
Pressure on wall due to convective load at Y = 0				Pcw	0.15

Tank Geomtry : Circular with slab					
20KL GLBR					
Hydrodynamic Pressure					
D	Convective hydrodynamic pressure at base of slab				
Pressure on slab due to convective mode					
	ahc	0.0315403			
Pcb = Qcb*ahc* ro* g * D					
Ahc *ro * G * D		1269			
Qcb = 1.125(x/D-4/3(x/d)^3)sech(3.674h/d)					
x = d /2					
	h	2.00			
	d	4.10			
	x	2.05			
	x/d	0.5			
	cosh(3.675h/d)	3.0846043			
	sech(3.674 h/d)	0.3241907			
qcb		0.1215715			
Pcb		0.1542234	kn/m2		
Final summary					
1	Impulsive hydrodynamic pressure at base of wall		Piw	1.157	kn/m2
2	Impulsive hydrodynamic pressure at base slab		Pib	2.472	kn/m2
3	Convective hydrodynamic pressure at base of wall		Pcw	0.154	kn/m2
4	Impulsive hydrodynamic pressure at base of wall		Pcb	0.154	kn/m2
E	Pressure due to wall inertia				
Pww = ahi*t*rom* G					
Ahi	hor. Seismic coef. In impls	0.0721154			
t	wall thickness	0.175	m		
rom*G	mass density* G	25	kn/m3		
Pww			Pww	0.315505	kn/m2

Tank Geomtry : Circular with slab					
20KL GLBR					
Hydrodynamic Pressure					
F	Pressure due vertical excitation				
Pv = av * (ro * g * h * (1-y/h)					
av = 2/3 * (Z /2 * I/R * Sa/g)					
z	zone factor		0.1		
I	Importance factor		1.5		
R	response factor		2.600		
sa/g	acceleration		2.5		
			Av	0.048	
for y = 0 at base level					
ro*g* h*(1-y/h)		19.62			
			Pv	0.943269	kn/m2
F	Maximum hydrodynamic pressure				
Pmax	=((Piw+Pww)^2+Pcw^2+pv^2)^0.5				
			Pmax	1.755	kn/m2
Pmax is about		8.7772065	%	< 33.33 %	
Maximum hydraudyanmic froce in normal condition				20.00	kn/m2
As hydraudyanmic force < 33 % it will not govern in design					

20KL GLBR				FORMULA
PROJECT: PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)	GLBR AT	CLIENT		
	Different village	RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA		
STRUCTURE	DESIGN CALCULATION FOR SUMP	DATE	REV	
		14/03/2016	0	

DESIGN CALCULATION

DATA

General Data				
Required Capacity of GLBR	Sumpcap	**20.000**	m3	As per tender Specification
Location				
Hydraulic Features				
Ground Level	GL	**0.00**	m	
Dead Storage	Ds	**0.15**	m	
Free Board	FB	**0.30**	m	
Basic Shape :		Circular with flat slab		
Material Data				
unit weight of concrete	uwc	**25.000**	kN/m3	
unit weight of water	uww	**10.000**	kN/m3	
unit weight of plaster	uwp	**21.000**	kN/m3	
load Data				
live load at roof slab	llf	**1.500**	kN/m2	
Finish load	Fl	**1.000**	kN/m2	
Geometry Data				
Diameter	Dia	**4.10**	m	
Depth of tank above GL		**1.40**		
Depth of tank below GL		**0.60**		
Water depth : With Dead storage	Wd	**1.70**	m	
Top Slab thickness	Tsthk	**0.150**	m	

Bottom slab thickness	Bsthk	**0.200**	m		
plaster thickness	pt	**0.012**	m		

Permissible stress (As per IS 456 & IS 3370)

Concrete				
Concrete grade -FCK	**fck**	30	N/mm2	
per. stress in con. for direct comp	fckc	8.0	N/mm2	
per. stress in con in com.due to bending	fckbc	10.0	N/mm2	
per. stress in con. for direct tension	fckt	1.5	N/mm2	
per. stress in con. In ten due to bending	fcktb	2.0	N/mm2	
modulus of elasticity for container	em	2.74E+04	N/mm2	=5000*(fck)^0.5*100
Reinforcement	fy	500	N/mm2	
per. Ten. str.- steel tension due to bending	fyc	130	N/mm2	
per. Ten. str.- steel tension due to direct ten	fyuc	130	N/mm2	
Modular ratio	md	9.33		
Dimension for minimum steel	Dmin	15.0	m	
Mass & Wt relation factor	g	9.810		

[A] CAPACITY OF CONTAINER

Volume Calculation

Water Depth with Dead Storage	Wdd	1.700			
Inside Diameter		4.100			
Clear Inside Diamater without plaster	Diac	4.076			
total volume	**vt**	**22.18**	m3		
dead storage	vdd	1.96	m3		
net volume	vn	20.23	m3 >	20.000	OK

[B] TOP SLAB DESIGN

Concrete grade	Fck	30	N/mm2	
Steel	Fy	500	N/mm2	
Clear cover	Cv	45	mm	
Slab Diameter	Lx	4.100	m	
Slab type	St	1	Simply supported	

Width	B		1000	mm
Depth	D		150	mm
Maximum Bar dia	Db		10	mm
Density of concrete	Wd		25	kN/m3
Loading				
Live load	Ll		1.5	kN/m2
Finishing load	Fl		1	kN/m2
CALCULATION				
Calculation of loading				
Self wt (Dead load)	Dl		3.75	kN/m2
Total Load	Tl		6.25	kN/m2
Effective depth	De		100	mm
Bending Moment	Bm		3.283	kN-m
Modular ratio			9.33	
K		k	0.42	
j = 1-k/3		j	0.9	
Ast			293.4	mm2
Provide : 10 dia - 200 c/c				

[C] CYLINDRICAL WALL

inner diameter	cyid	4.100	m
top thickness	cytt	~~0.175~~ 0.20	m
bottom thickness	cybt	~~0.175~~ 0.20	m
Water depth	cyh	**1.700**	m
coefficient of constant height	cyc	**0.000**	
free board		0.300	m

height of wall fir design	cyhh	2.000	m
increment in thickness	cyith	0.000	m

Hoop Force ; Wall free at Top and hinge at bottom condition
F = coe x H x D / 2
F= Hoop force

H = Height of water above that section
D = Diameter of wall at that section

Ration H^2/DT 5.575
Enter Value for Auto serach **8.000**

h

hoop force

	sr. no	depth from top in meter	thickness at section	coeiffient	hoop force in wall = Coe. X rad * height * unit wt of liquid	area of steel required = force / 1300 in cm2	actual tensile stress in concrete = force/(thk*width+m*ast)	Minimum Area of steel in mm2 on each face	
		m	mm		kN	mm2			
	1	0.200	0.175	0.010	0.4	3	0.002	210	
Minimun % steel as per IS 3370-2009	2	0.400	0.175	0.108	4.4	34	0.024	210	
	3	0.600	0.175	0.228	9.4	72	0.052	210	
Maximum Dimension	4	0.800	0.175	0.349	14.3	110	0.079	210	
4.100	5	1.000	0.175	0.466	19.1	147	0.105	210	
Permissible dimension for 0.24 % steel	6	1.200	0.175	0.564	23.1	178	0.127	210	
15.000	7	1.400	0.175	0.630	25.8	199	0.142	210	
Minimum Steel	8	1.600	0.175	0.627	25.7	198	0.142	210	
0.240	9	1.800	0.175	0.528	21.7	167	0.119	210	
	10	2.000	0.175	0.313	12.8	99	0.071	210	

	sr. no	area of steel requd	dia of bar	bar spacing	area of steel prod				
	1	210.000	**10**	**200**	785				
	2	210.000	**10**	**200**	785				
	3	210.000	**10**	**200**	785				
	4	210.000	**10**	**200**	785				
	5	210.000	**10**	**200**	785				
	6	210.000	**10**	**200**	785				
	7	210.000	**10**	**200**	785				
	8	210.000	**10**	**200**	785				
	9	210.000	**10**	**200**	785				
	10	210.000	**10**	**200**	785				

weight of wall					
straight part	cyspw	99.9	kN		=PI()*(cyid+cytt)*cyh*cytt*uwc
tapered part	cytpw	0.0	kN		=PI()*(cyid+cytt+(cybt-cytt)/3)*cyh*(1-cyc)*(cybt-cytt)/2*uwc
plaster	cyppw	6.5	kN		=(cyid-pt)*PI()*pt*(trdd+cyh+mrdd/2-cyxa)*uwp
total weight	tlcy	106.4	kN		=cyspw+cytpw+cyppw

Maximum moment in wall

	sr. no	depth from top in meter	thickness at section	coeiffient	moment in wall = Coe. X height^3 * unit wt of liquid	effective depth	Aera of steel required	Minimum Area of steel in mm2
		m	m		kN-m	m		
	1	0.200	0.175	0.00014	0.011	0.120	1	210
Minimun % steel as per IS 3370-2009	2	0.400	0.175	0.00051	0.041	0.120	3	210
	3	0.600	0.175	0.00114	0.091	0.120	6	210
Maximum Dimension	4	0.800	0.175	0.00233	0.186	0.120	13	210
#REF!	5	1.000	0.175	0.00380	0.304	0.120	22	210
Permissible dimension for 0.24 % steel	6	1.200	0.175	0.00515	0.412	0.120	29	210
15.000	7	1.400	0.175	0.00544	0.435	0.120	31	210
Minimum Steel	8	1.600	0.175	0.00286	0.229	0.120	16	210
#REF!	9	1.800	0.175	-0.00482	-0.386	0.120	-27	210
	10	2.000	0.175	-0.02019	-1.615	0.120	-115	210

	sr. no	area of steel requd	dia of bar	bar spacing	area of steel prod	distance
	1	210.000	10	200	393	0.200
	2	210.000	10	200	393	0.400
	3	210.000	10	200	393	0.600
	4	210.000	10	200	393	0.800
	5	210.000	10	200	393	1.000
	6	210.000	10	200	393	1.200
	7	210.000	10	200	393	1.400
	8	210.000	10	200	393	1.600
	9	210.000	10	200	393	1.800
	10	210.000	10	200	393	2.000

Vertical steel			
as compression only,I provide min r/f	0.240	%	
area of steel required total on both face	4.200	cm2	

FOUNDATION DESIGN

WALL FOOTING DESIGN

PROJECT : P16_02_Adilabad W.S.S — JOB : P16_02

UNIT : 20KL GLBR

WALL TYPE 1 — **W1**

BASIC DATA

Density of water	denwt	**10**	kN/m3		fyuc	130	N/mm2
Density of soil	denso	**18**	kN/m3		fyucb	130	N/mm2
Density of concrete	decon	**25**	kN/m3		fckbc	10.0	N/mm2
Angle of Repose	Phi	**30**	degree		fckt	1.5	N/mm2
Safe bearing capacity of soil	Sbc	**150.0**	kN/m2	modular ratio	m	9.33	
Concrete grade	Fck	**30**	N/mm2		K	0.42	
Steel grade	Fy	**500**	N/mm2		j	0.86	
Depth below GI	Dbg	**0.60**	m				
Water depth	wtd	**1.70**	m				
free board	fb	**0.30**	m				
Wall above Ground		**1.40**	m				
Clear cover	Cv	**50**	mm				
Maximum size of bar dia	Db	**12**	mm				
Water depth with free board	Wd	**2.00**	m				
minimum % steel	pt	**0.24**	%				
Moment							
Due to Water	Mtw	**1.65**	kN-m	(From Analysis Result)			
Due to soil if any	Mts	**0.40**	kN-m				
Wt from top dome/slab/column/wall	Slabwt	**6.40**	kN-m				

Wall geometry (Figure 1)

Straight portion	lb	**2.000**	m
Tapered portion	lc	**0.000**	m
	tb	**0.175**	m
	td	**0.175**	m
Footing geometry			
Toe projection	ht	**0.300**	m
Heel straight projection	hh1	**0.450**	m
Heel tapered projection	hh2	**0.000**	m
Heel portion for soil stability	hh3	**0.450**	m
Thickness at toe (free end)	tta	**0.200**	m
Thickness at toe (fwall face)	ttb	**0.200**	m
Thickness at heel (wall end)	tha	**0.200**	m
Thickness at heel (freel face)	thb	**0.200**	m
Total Height of Wall	Tlw	2.000	m
Total length of wall footing	wf	0.925	m

CASE 1 : TANK FULL CONDITION WITH NO SOIL OUTSIDE

Total load & Moment calculation
Taking moment @ toe

Component		Wt kN W	Lever Arm m Dist	Moment kN-m W * dist
Wall Straight portion	W1	8.75	0.39	3.39
Wall Tapered portion	W2	0.00	0.30	0.00

Walkway/slab	P		6.40	0.39	2.48
Footing					
Footing : toe	W3		1.50	0.15	0.23
Footing center	W4		0.88	0.39	0.34
Footing : heel (straight)	W5		2.25	0.70	1.58
Footing : heel (tapered)	W6		0.00	0.93	0.00
Water	W7		9.00	0.70	6.30
Total downward load			28.78		14.31

Total restoring moment @ toe	TRM	14.3	kN-m
Total over turning moment		1.7	kN-m
F.S.against over turning		8.7	
Check for over turning	Hense o.k		
Total moment due to vertical load	Tmv	14.3	kN-m
Total moment due to horizontal load	Tmh	1.7	kN-m
Total vertical load	TPv	28.8	kn
Net Moment	Tmn	12.7	kN-m
M/p	E	0.44	m
Ecc	Ecc	0.023	m
b/6	Aec	0.15	m
Net moment From ECC	Mdg	0.649	

Property of footing

Width of footing		1.00	m
Depth of footing		0.93	m
Footing Area	Fare	0.93	m2
Modulus of section	Fz	0.14	m3

Pressure distribution			
Pressure due to direct load =P/A	prea	31.11	kN/m2
Pressure due to moment =M/Z	Preb	4.55	kN/m2
Pressure			
Maximum pressure - P/A + M/Z	Pmax	35.66	kN/m2
Minimum pressure - P/A + M/Z	Pmin	26.56	kN/m2
Check for SBC			
Maximum pressure < SBC	OK		
Minimum presure > 0	OK		
Pressure difference	9.099		
Pressure difference / m	9.836		

Pressure at outer Wall face - A	preow	32.71	kN/m2
Pressure at inner Wall face B	preiw	30.99	kN/m2
Pressure at point C	preiw1	26.56	kN/m2

Design of Toe - At Point A

Moment at face of outer wall

Due to rectangle diagram	Mreco	1.47	kN-m
	Mtrio	0.09	kN-m
Total moment due to upward pressure		1.56	kN-m
Net moment at A from Toe side	Toem	1.56	kN-m
Thickness at toe		200	mm
Effective depth	Deftoe	144	mm
Ast required =		97	mm2
Check for minimum steel			
top		240	mm2
bottom		0	mm2
Design Steel			
Main steel - Top		240	mm2
Main steel - bottom		97	mm2
Distribution steel - top		240	mm2
Distribution steel - bottom		0	mm2
Design of heel : At point B & C			
Design at point B			
Due to rectangle diagram (upward)	Mreci	2.7	kN-m
	Mtrii	0.1	kN-m
Total Upward moment		2.8	kN-m
Due to water (down ward)		2.0	kN-m
Net downward moment at B from heel side	heelm	0.8	kN-m
Thickness Provided		200	mm
	defheel	144	mm
Ast required =		50	mm2
Check for minimum steel - straight portion			
top		240	mm2
bottom		0	mm2
Design Steel			
Main steel - Top		240	mm2
Main steel - bottom		0	mm2
Distribution steel - top		240	mm2
Distribution steel -bottom		0	mm2
Design at point C			
Due to rectangle diagram (upward)	Mreci	0.00	kN-m
	Mtrii	0.00	kN-m
Total Upward moment		0.00	kN-m
Due to water (down ward)		0.00	kN-m
Net downward moment at B from heel side	heelm	0.00	kN-m
Thickness Provided		200	mm
	defheel	144	mm
Ast required =		0	mm2
Check for minimum steel - tapered portion			
Avrage thickness	thav	0.20	m
top		240	mm2
bottom		0	mm2
Design Steel			
Main steel - Top		240	mm2
Main steel - bottom		0	mm2
Distribution steel - top		240	mm2
Distribution steel -bottom		0	mm2

SUMMARY									
Pressure Check									
1>	P/A + M/Z	35.7	<	150	OK				
2>	P/A - M/Z	26.6	>	0	OK				
Reinforcement									
	AstR							Astp	
Toe			dia	spc	+	dia	spc		
Top - main	240		10	200		0	0	393	OK
Bottom main	97		10	200		0	0	393	OK
Top - Dist	240		10	200		0	0	393	OK
Bottom - Dist	0		10	200		0	0	393	OK
Heel Straight portion									
Top - main	240		10	200		0	0	393	OK
Bottom main	0		10	200		0	0	393	OK
Top - Dist	240		10	200		0	0	393	OK
Bottom - Dist	0		10	200		0	0	393	OK
Heel tapered portion									
Top - main	240		10	200		0	0	393	OK
Bottom main	0		10	200		0	0	393	OK
Top - Dist	240		10	200		0	0	393	OK
Bottom - Dist	0		10	200		0	0	393	OK

CASE 2 : TANK EMPTY CONDITION WITH SOIL OUTSIDE					
Total load & Moment calculation					
Taking moment @ toe					
Component			Wt kN W	Lever Arm m Dist	Moment kN-m W * dist
Wall Straight portion		W1	8.75	0.54	4.70
Wall Tapered portion		W2	0.00	0.63	0.00
Walkway/slab		P	6.40	0.54	3.44
Footing					
Footing : toe		W3	1.50	0.78	1.16
Footing center		W4	0.88	0.54	0.47
Footing : heel		W5	2.25	0.23	0.51
Soil on toe		W6	3.24	0.78	2.51
Total downward load			**23.02**		**12.79**
Total restoring moment @ heel		TRMs	12.8	kN-m	
Total over turning moment due to soil			0.4	kN-m	
F.S.against over turning			32.0		
Check for over turning		Hense o.k			

Total moment due to vertical load	Tmv1	12.8	kN-m	
Total moment due to horizontal load	Tmh1	0.4	kN-m	
Total vertical load	TPv1	23.0	kn	
Net Moment	Tmn1	12.4	kN-m	
M/p	E1	0.54	m	
Ecc	Ecc1	-0.076	m	
b/6	Aec1	0.15	m	
Net moment From ECC	Mdg1	-1.7488		
Property of footing				
Width of footing		1.00	m	
Depth of footing		0.93	m	
Footing Area	Fare1	0.93	m2	
Modulus of section	Fz1	0.14	m3	
Pressure distribution				
Pressure due to direct load =P/A	prea1	24.88	kN/m2	
Pressure due to moment =M/Z	Preb1	-12.3	kN/m2	
Pressure				
Maximum pressure - P/A + M/Z	Pmax1	12.62	kN/m2	
Minimum pressure - P/A + M/Z	Pmin1	37.14	kN/m2	
Check for SBC				
Maximum pressure < SBC		OK		
Minimum presure > 0		OK		
Pressure difference		-24.53	kN/m2	
Pressure difference / m		-26.51	kN/m2	
Pressure at outer Wall face - A	preow1	29.19	kN/m2	
Pressure at inner Wall face B	preiw1	24.55	kN/m2	

Design of Toe - At Point A			
Moment at face of outer wall			
Due to rectangle diagram	Mreco1	1.67	kn-m
Due to triabgular diagram	Mtrio1	-0.12	kn-m
Total moment due to upward pressure		1.55	kn-m
Total downward moment due to soil		0.49	kn-m
Net moment at A from Toe side	Toem1	-1.07	kn-m
Thickness at toe		200	mm
Effective depth	Deftoe1	144	mm
Ast required =		-66.17	mm2
Check for minimum steel			
top		240	mm2
bottom		0	mm2
Design Steel			
Main steel - Top		240	mm2
Main steel - bottom		0	mm2
Distribution steel - top		240	mm2
Distribution steel - bottom		0	mm2

Design of heel : At point B			
Design at point B			
Due to rectangle diagram (upward)	Mreci1	2.49	kn-m
	Mtrii1	-0.81	kn-m
Total Upward moment	heelm1	1.68	kn-m
Net downward moment at B from heel side		200	mm
Thickness Provided	defheel1	144	mm
Steel required at bottom		104	mm2
Ast required =			
Check for minimum steel - straight portion			
top		240	mm2

bottom	0	mm2
Design Steel		
Main steel - Top	240	mm2
Main steel - bottom	104	mm2
Distribution steel - top	240	mm2
Distribution steel -bottom	0	mm2

SUMMARY

Pressure Check

1>	P/A + M/Z	12.6	<	150.0	OK
2>	P/A - M/Z	37.1	>	0	OK

Reinforcement

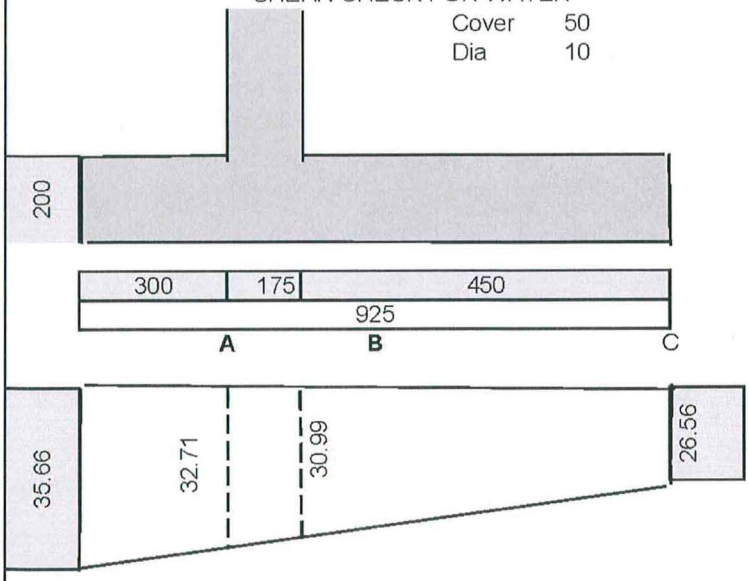
	AstR						Astp	
Toe		dia	spc	+	dia	spc		
Top - main	240	10	200				393	OK
Bottom main	0	10	200		0	0	393	OK
Top - Dist	240	10	200		0	0	393	OK
Bottom - Dist	0	10	200		0	0	393	OK
Heel Straight portion								
Top - main	240	10	200		0	0	393	OK
Bottom main	104	10	200		0	0	393	OK
Top - Dist	240	10	200		0	0	393	OK
Bottom - Dist	0	10	200		0	0	393	OK

Base slab design-

Base slab thickness = 0.20 m
Steel required = 0.24 * 0.200*10000/2 = 240 mm2
Steel provided = 10 # 200 c/c = 393 mm2

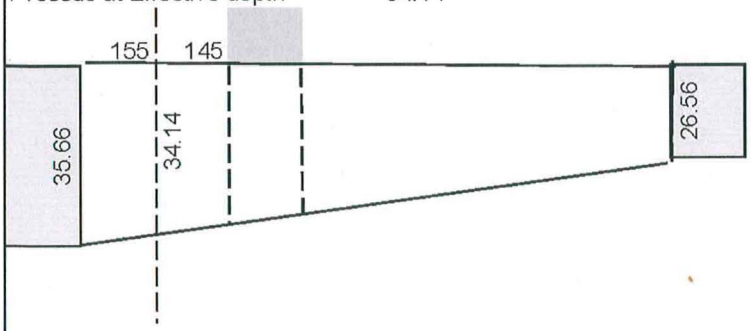
SHEAR CHECK FOR WATER

Cover 50
Dia 10



Total Width	925 mm	
Difference in pressure	9.10	kN/m2
Pressure Difference / m	9.838	kN/m2
Pressure at outer face of wall	32.71	kN/m2
Pressure at inner face of wall	30.99	kN/m2
Shear t be check at effective depth	D	
Effective depth	145	mm

Pressue at Effective depth 34.14



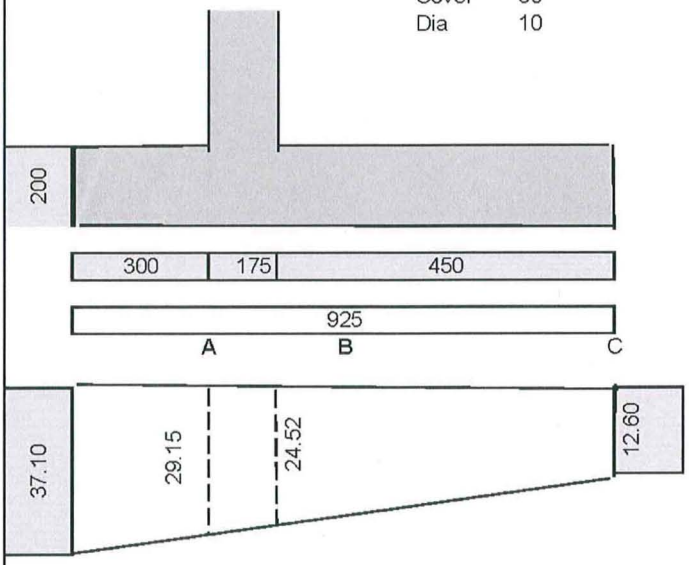
Total shear

Avg presure	=	34.9	
Shear	=	5.409	kN
effevtive depth		145	mm
Shear stress	=	0.037	N/mm2

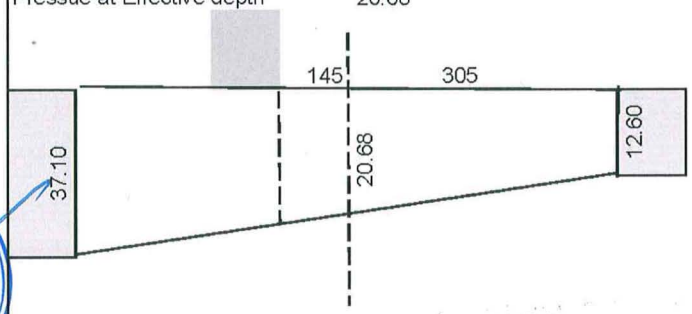
SHEAR CHECK FOR SOIL

Cover 50

Dia 10



Total Width	925	mm
Difference in pressure	24.50	kN/m2
Pressure Difference / m	26.49	kN/m2
Pressure at outer face of wall	29.15	kN/m2
Pressure at inner face of wall	24.52	kN/m2
Shear t be check at effective depth	D	
Effective depth	145	mm
Pressue at Effective depth	20.68	



Total shear

Avg presure = 16.64

Shear = 5.075 kN

effevtive depth 145 mm

Shear stress = 0.035 N/mm2

APPROVED

SE, NIRMAL

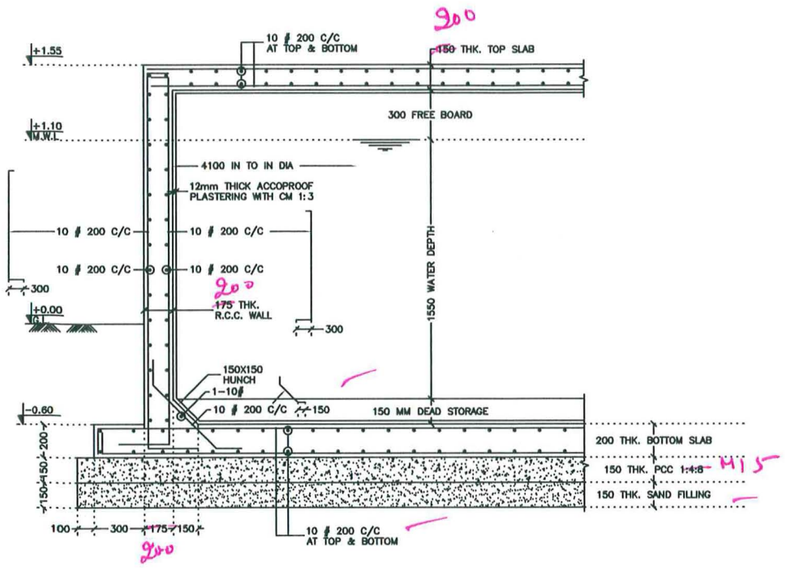
"Designs Vetted"

M/s. S.K. Associates HYD-8

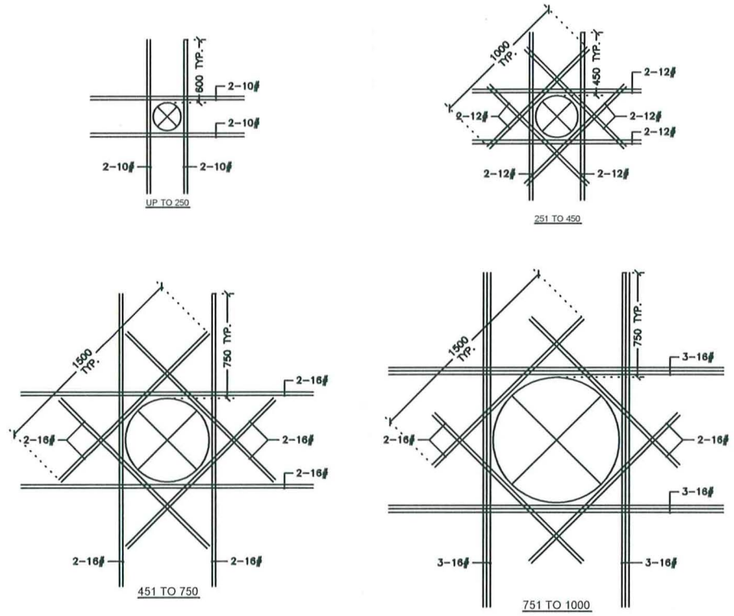
Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

Executive Engineer
TDWSP Asifabad



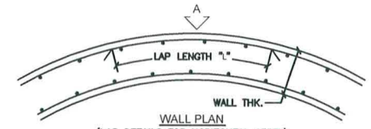
SECTION : A - A



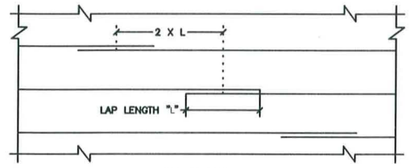
TYPICAL DETAIL FOR EXTRA STEEL BAR AT CUT-OUT

SCHEDULE OF PIPE	
INLET PIPE SIZE	-
OUTLET PIPE SIZE	-
OVER FLOW PIPE SIZE	-

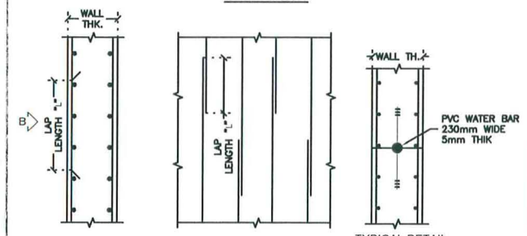
LAP LENGTH SECHDULE	
DIA OF BAR	LAP LENGTH "L" IN mm
8	368
10	460
12	552
16	736
20	920
25	1150



WALL PLAN
(LAP DETAILS FOR HORIZONTAL STEEL)
(LAP SHALL BE STAGGERED AS PER ELEVATION – C)
(FOR WALL HORIZONTAL STEEL LAP LENGTH : 2 x L)



ELEVATION : A



WALL SECTION
LAP DETAILS FOR VERTICAL STEEL
(LAP SHALL BE STAGGERED AS PER ELEVATION – B)

ELEVATION : B

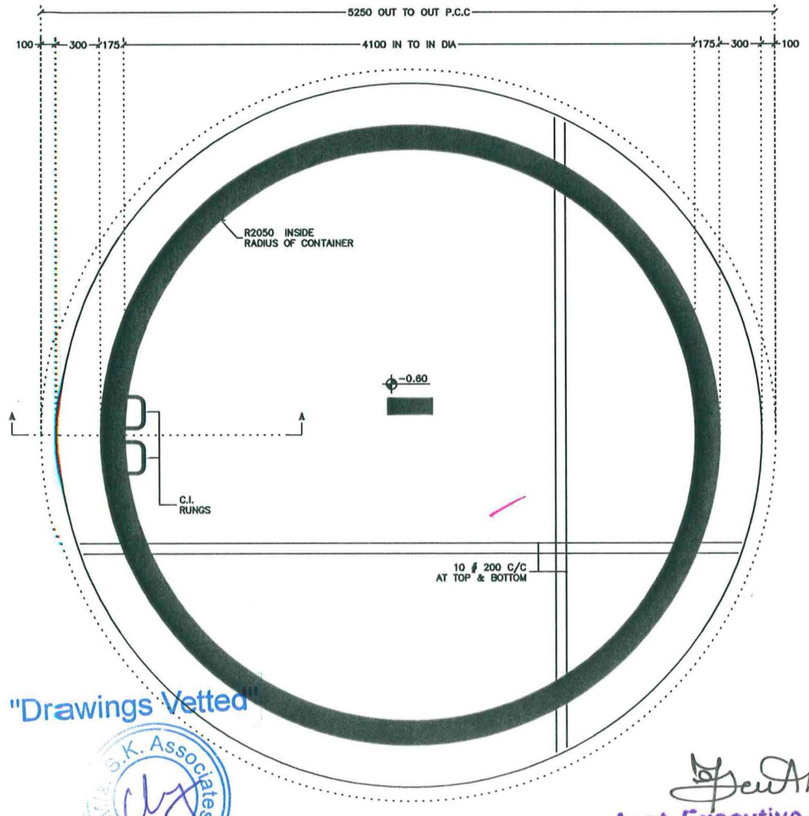
TYPICAL DETAIL OF WATER BAR

NOTES :

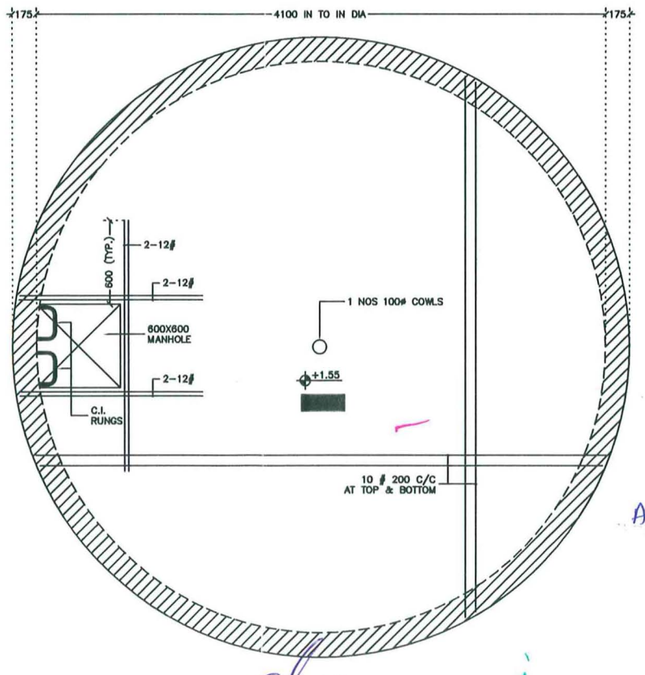
1 ALL DIMENSION ARE IN MM AND LEVELS ARE IN METER.
2 ALL CONCRETE MIX M:30 WITH MAXIMUM FREE WATER CEMENT RATIO OF 0.45 AND MAXIMUM CEMENT CONTENT OF 400kg/m3 FOR WATER RETAINING STRUCTURE
3 ALL CONCRETE SHALL BE MACHINE MIXED AND MACHINE VIBRATED
4 ϕ – INDICATE HYSD–TMT BAR FE–500 GRADE 1 COMFORMING TO I.S 1786–LATEST REVISION
5 CLEAR COVER TO WATER RETAINING STRUCTURE
(A) BOTTOM SLAB : 50mm
(b) WALL WATER FACE : 45mm & SOIL FACE : 30mm
(c) TOP SLAB : 45mm
6 FOUNDATION SHALL REST ON IN–SITU SOIL AND IT SHALL NOT BE ON FILLING MATERIAL I.e. MADE UP SOIL OR HIGHLY COMPRESSIBLE SOIL
7 BACK FILLING SHALL BE DONE IN WELL COMPACTED AND WELL WATER LAYER NOT EXCEEDING 150mm IN DEPTH
8 SBC CONSIDERED IN DESIGN IS 15 T/M2 & NO GROUND WATER TABLE.
9 INLET & OVERFLOW PIPE SHALL BE DECIDED AS PER SITE CONDITION
10 LOCATION & LEVELS OF INLET,OUTLET & OVERFLOW PIPE SHALL BE VERIFY WITH ENGINEER INCHARGE BEFORE EXECUTION

NAME OF VILLAGE

BEJJUR	BUGGAGUDAUMRI	CHILLAPALLIGUTTA	GOPALRAOPETGUTTA	GOPERALAMBHADITHA



FOUNDATION PLAN



TOP PLAN

"Drawings Vetted"
M.K. Associates

APPROVED
30/4/16
SE, NIRMAL

Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

Executive Engineer
TDWSP Asifabad

LARSEN & TOUBRO LIMITED Construction - Chennai

WAPCOS LIMITED Hyderabad

REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	22/03/16	RPS	PMD	RMM	–

REVISIONS

L&T Construction
Water, Smart World & Communication.

CLIENT : RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA.
CONSULTANT : -

PROJECT : PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT

SUPPLIER / CONTRACTOR : L&T Construction Water & Effluent Treatment SBG

JOB No. : LE150883

	NAME	SIGN	DATE
DSGN	RPS		22-03-16
DRWN	PMD		22-03-16
CHKD	RMM		22-03-16
APPD	–		22-03-16

TITLE : 20KL CAPACITY GLBR AT DIFFERENT VILLAGE (STRUCTURAL DETAILS)

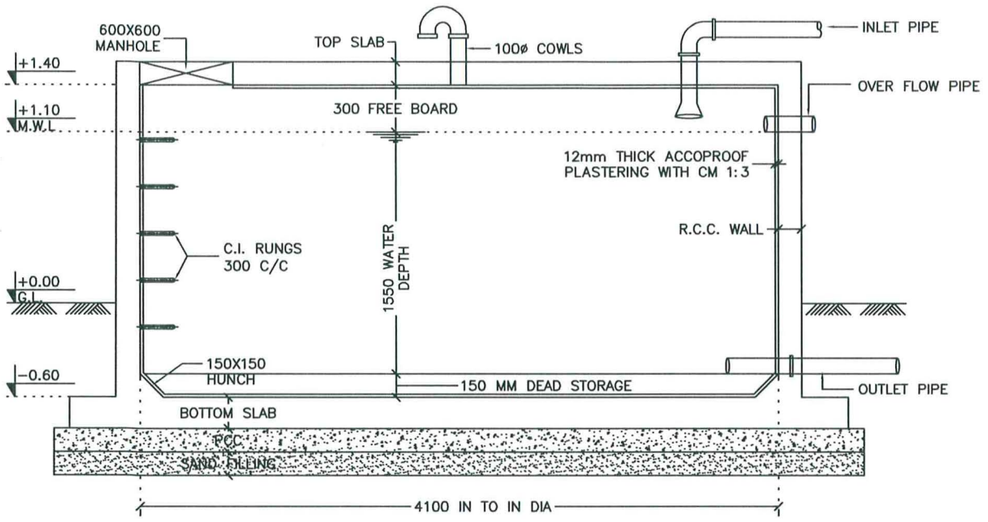
SCALE 1: 30,25

PROJECTION

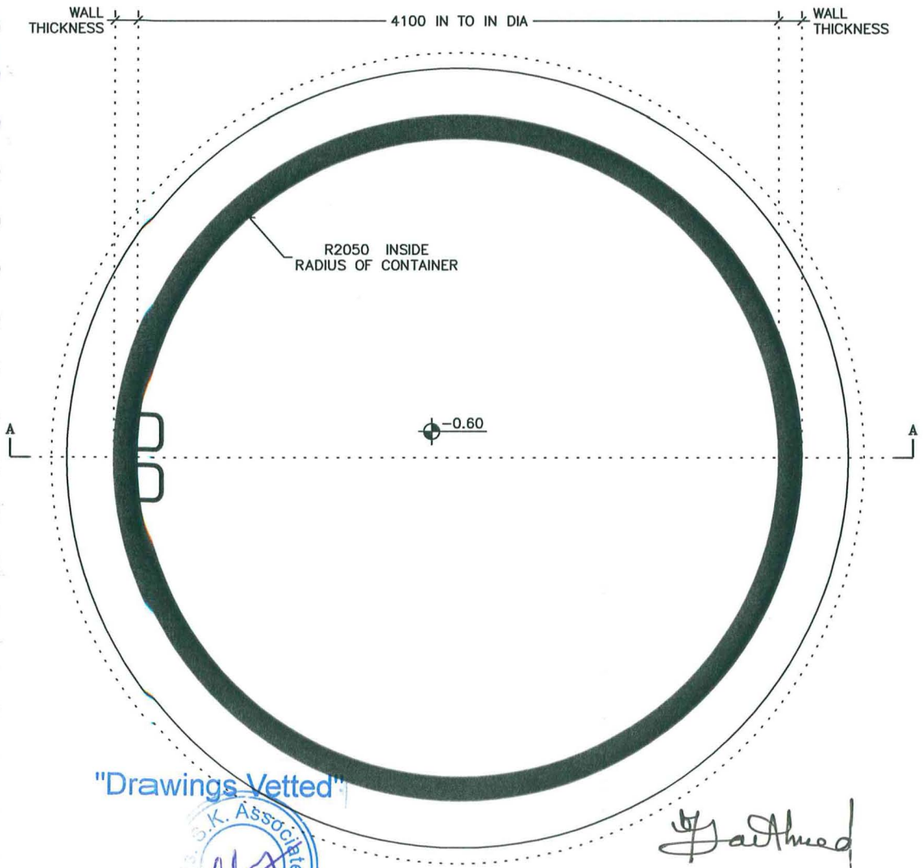
DRAWING No. LE150883-C-WS-RW-RC-1544 | SIZE A2 | REV. A

COMP. DATA : P18-02_65-02-01 | SHEET 1 OF 1

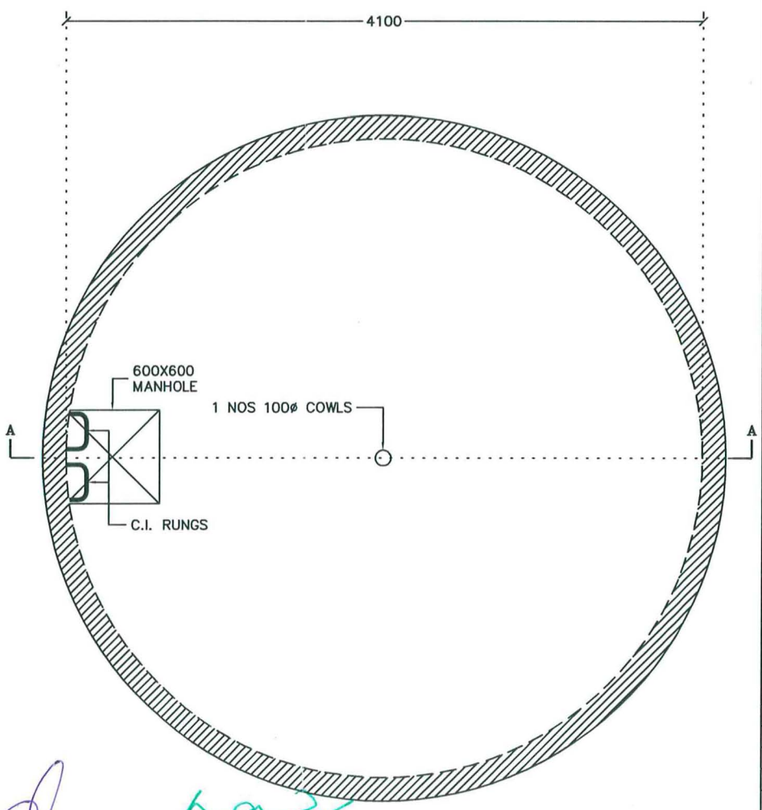
RELEASED FOR ☐ PRELIMINARY ☐ TENDER ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION



SECTION : A - A



BOTTOM PLAN



TOP PLAN

SCHEDULE OF PIPE	
INLET PIPE SIZE	–
OUTLET PIPE SIZE	–
OVER FLOW PIPE SIZE	–

NAME OF VILLAGE				
BEJJUR	BUGGAGUDAUMRI	CHILLAPALLIGUTTA	GOPALRAOPETGUTTA	GOPERALAMBHADITHA

NOTES :

<1> ALL DIMENSION ARE IN MM AND LEVELS ARE IN METER.

<2> LOCATION & LEVELS OF INLET,OUTLET & OVERFLOW PIPE SHALL BE VARIFIED WITH ENGINEER INCHARGE BEFORE EXECUTION

APPROVED
21/6/16
SE, NIRMAL

"Drawings Vetted"
K. Associates
HYD-8

REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	21/03/16	–	DGP	RMM	–

REVISIONS

L&T Construction
Water, Smart World & Communication.

CLIENT : RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA.	CONSULTANT : -

PROJECT : PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT

SUPPLIER / CONTRACTOR : L&T Construction
Water & Effluent Treatment SBG

JOB No. : LE150883

	NAME	SIGN	DATE
DSGN	HMP		21-03-16
DRWN	DGP		21-03-16
CHKD	RMM		21-03-16
APPD	–		21-03-16

TITLE :
20KL CAPACITY GLBR
AT DIFFERENT VILLAGE
(GENERAL ARRANGEMENT DRAWING)

SCALE 1:40

PROJECTION

DRAWING No. LE150883-C-WS-RW-GA-1541
COMP. DATA : P16-02_65-01-01
SHEET 1 OF 1

SIZE A3 | REV. A

RELEASED FOR ☐ PRELIMINARY ☐ TENDER ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

GEOTECHNICAL INVESTIGATION REPORT

TELANGANA DRINKING WATER SUPPLY PROJECT

KOMARAM BHEEM - ASIFABAD- SEGMENT 22

ASIFABAD , ADILABAD DISTRICT

20 KL GLBR BEJJUR AT BEJJUR (M)

***CONTRACTOR* :**

M/s. LARSEN& TOUBRO LIMITED,L&T CONSTRUCTION,

WATER & EFFLUENT TREATMENT SBG, CHENNAI

Drilling By:

M/s. ANJI DRILLING & GROUTING WORKS

Report Prepared by

DR. D. BABU RAO,

M.E.(IIT,Roorkee), Ph.D.(USA), MIGS

MCH Panellist No. 2490 /TP/2000-2

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TELANGANA DRINKING WATER SUPPLY PROJECT

20 KLGLBR AT BEJJUR, BEJJUR (M) IN ADILABAD DT.

1. INTRODUCTION

M/s. L &T Construction, Water & Effluent Treatment is proposing to construct 20 KL GLBR at BEJJUR, BEJJUR (M) .The work is taken up under Segment 22 , Komaram Bheem Project , TDWSP, in Adilabad Dt.

The present Report presents the results of (1) Bore hole.

M/S Anji Drilling & Grouting works; Anantapur has carried out the drilling of bore holes, collection of soil and rock samples and conduct of Standard Penetration Tests at different levels in the respective bore holes at the proposed site.

Analysis of borehole data , Laboratory tests and geotechnical investigation report have been made by Prof. D Babu Rao, ME (IIT,R) , Ph.D. (USA), MIGS, Empanelled Consulting Geo technical Engineer &,Director, Geo technologies, Former Professor of Civil Engineering, Osmania University.

2. SCOPE OF WORK

The following is the scope of work of M/s. Anji Drilling and Grouting Works:

- Drilling Borehole at (1) location for 20 KL GLBR at BEJJUR in Adilabad Dt.
- Conducting SPT at regular intervals, where feasible
- Collection of undisturbed / disturbed samples from the Bore holes
- Preparation of Technical Report recommending suitable foundations and safe bearing capacity

Dr. D. BABU RAO
M.E., Ph.D.(USA)
Consulting Geotechnical Engineer

Following is the scope of work of Prof. D Babu Rao ,

Testing of soil samples in the Laboratory

Preparation of Technical Report

3. SUB SOIL INVESTIGATION

The sub soil investigation was carried out to determine:

Nature of sub stratum and engineering properties of sub strata which may affect the mode of construction of the proposed work.

FIELD INVESTIGATION PROCEDURE:

The following technique is adopted for sub soil investigations.

a) **BORINGS:**Rotary Drilling was done using TC / Diamond bits. The size of the casing used was 125 to 75 mm, yielding samples of NX size.

TC bits were employed for the overburden, and Impregnated Diamond Core bits were used for rock formation.

Drilling was performed on 10-15 Jan ,2016.

The following relevant data was recorded during Rotary drilling operations.

- Nature of strata
- Details of samples
- Core Recovery (CR)
- Rock Quality Designation (RQD)

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GEO TECH BABU RAO

b) STANDARD PENETRATION TEST (SPT):

SPT split spoon sampler of standard dimensions was driven into the soil from the borehole bottom using 63.5 kg hammer with a fall of 75 cm height. The SPT weight was lifted to the specified height and allowed to fall freely on the anvil with the use of cat-head winch with one to one and half turn of the drum. Blow counts for the penetration of every 15 cm were recorded and the 'N' value is reported as the blow counts for 30 cm penetration of the sampler excluding the first 15 cm penetration as seating drive.

When the number of blows exceeded 50 to penetrate the first or second 15 cm length of the sampler, the SPT 'N' is regarded as more than 100 as described in IS 2131 - 1981. The test is terminated in such case and a record of the penetration of the sampler under 50 blows is made. SPT refusal is recorded when there is no penetration of the sampler at any stage and also when a rebound of the sounding system is recorded. These tests were conducted at close intervals of 1.0m so that a continuous SPT 'N' profile is available.

Disturbed soil collected in the SPT sampler was preserved in polythene covers and transported to the laboratory. Additional polythene cover was used to prevent the loss of moisture during the transit period.

c) DEPTH OF BORING: The depth of the Bore hole was as follows:

BH No	Drilled depth
1	5 m

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Consulting Geotechnical Engi

d) LOG OF BORE HOLE:

All the results obtained from the field operations are presented in Log of Bore hole in Fig. 1 .

4. LABORATORY TESTING:

The laboratory tests are conducted in the laboratory of Geotechnolgies, Hyderabad, an ISO- 9000 approved Laboratory.

Sandstone (sedimentary) rock was seen from GL to 05 m depth, No cores were procured in the BH.

5. SUB SOIL PROFILE

Based on Field and Laboratory tests, the following idealized sub soil profile is evolved.

Depth	Strata	N value
0 – 5 m	Sandstone	>100

. In Hard rock, no SPT can be conducted. However, in SDR strata, SPT can be conducted with N values tending to be 'refusal'. This is the criterion for distinguishing between Soft rock /Weathered rock and Hard rock.

6.0 SHALLOW FOUNDATIONS

In general, the following pertains to foundations resting in soils.

. A properly designed foundation has to satisfy the following two limit states.

1) Limit state of collapse (i.e. Shear strength)

2) Limit state of serviceability (i.e. Settlement)

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Consulting Geotechnical Engineer
GEO TECH SERVICES

SHEAR CRITERIA:

The first criterion is depends on shear strength. The calculations are based on "TERZAGHI" bearing capacity equation as recommended by IS: 6403 (with factor of Safety) which takes care of L/B ratio (shape), foundation depth etc., along with other parameters.

SETTLEMENT CRITERIA:

The intensity of loading that will cause a permissible settlement or specified settlement of the structure is termed as allowable bearing pressure. The settlement in this type of layer will be elastic settlement.

These foundation settlements are evaluated using elastic theory. The pressure distribution below the footing is assumed as 2 V: 1 H for estimating the settlement. Since rock formation is available at shallow depth. The settlement will be within the permissible limit. Hence open foundation is suitable.

ALLOWABLE BEARING CAPACITY:

Allowable Bearing capacity (ABC) is the net intensity of the loading which the foundation will carry without undergoing settlement in excess of the permissible value for the structure under consideration but not exceeding the net safe bearing capacity (SBC).

7.0 DISCUSSION ON FOUNDATION OPTIONS

From sub soil profile and laboratory test data, it can be seen that Sand stone

(Sedimentary) rock exists 0 to 5 m depth.

Hence shallow foundation is feasible and same is recommended.

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8.0 RECOMMENDATIONS

Based on Field Investigations and laboratory testing, the following Recommendations are made for construction of GLBR at BEJJUR, BEJJUR (M), Adilabad Dt. ,

a) Open foundations resting in sandstone at 2 m below GL ,are recommended. The structure is likely to result in saturation and inundation of the sub soil during long – time operation,

b) SBC is recommended as follows :

Location		BH 1
S. No.	Depth (m)	Recommended SBC t/ sq m
1	1.0	10
2	2.0	11
3	3.0	12

c) The actual size of foundations will be based on loads from the superstructure.

For ANJI DRILLING AND GROUTING WORKS

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Former Professor of Civil Engineering
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TELANGANA DRINKING WATER SUPPLY PROJECT

FIG 1 : Record of Boring, *Bore Hole No : 1*

GLBR AT BEJJUR, BEJJUR (M) IN ADILABAD DT.

Type of Boring: Core drilling **Dia of Boring: NX**

Date : 10-15 Jan 2016 **Drilled depth = 05 m**

Depth, m	Profile	Soil	Sample Depth m	N value	CR, %	RQD%
0			0	>100		
1.0			1.5	>100		
2.0						
3.0			3.0	>100		
4.0		Sand stone	4.5	>100		
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						
16.0						

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APPENDIX

CALCULATION OF SBC

GLBR AT BEJJUR , BEJJUR(M) IN ADILABAD DT.

TYPICAL CALCULATIONS FOR OPEN FOUNDATIONS RESTING IN

SAND STONE AT 2 M DEPTH

a) Shear Criterion :

Assumed value of N = 50

Assumed width of foundation =4 m

Assumed depth of foundation = 1,5 m inside rock

Correction factors Rq = Rr = 0.5

With a F.S. of 3.0 ,

Allowable $q = 1 / 18 \ [2 N^2 B Rr + 6 (100 + N^2) D Rq]$ =1205 kN / sq m

b) Settlement Criterion :

For permissible settlement of 40 mm,

Allowable Bearing Pressure = 12.25 N (B + 0.3) / B

= 658 kN / sq m

Adopt 250 kN / sq m .

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c) ***As per IS : 8009 (Fig. 2) Code of Practice for calculation of settlements of foundations:***

For N = 50, B = 4,

Settlement = 0.0045 m per unit pressure of 1 kg / sq cm

For a pressure of 25 t/ sq m,

Settlement = 0.0025 x 4.5 x1000 = 11.25 mm OK

d) ***As per IS : 12070 (Code of Practice for Design & Construction of Shallow Foundations on Rocks) :***

Weathered and disintegrated rock is treated under Classification No. V of Table 3 of the Code

For this *very poor* rock , net allowable bearing pressure is recommended as 10 t / sq m , for settlement less than 12 mm.

Keeping the above considerations in view, Recommended Safe Bearing Capacity is 10 t per sq m

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