

**Submitted sir,**

**Sub:** RWS&S-TDWSP- Buggagutta 60KL GLBR in Triyani Mandal–Komarambheem Asifabad Segment-Adilabad District-Designs -Approval-Reg.

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Kindly puruse the Designs of the following 60KL GLBR at Buggagutta(V), Triyani (M), submitted by the Executive Engineer TDWSP Asifabad Division, Adilabad district for approval.

**1. 60 KL GLBR.**

The Executive Engineer TDWSP Asifabad Division has submitted Structural Designs & Drawings of 60KL 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 : 60KL
- Net SBC of Soil : 15.0 t/sqm
- Grade of concrete & Steel : M 30 & Fe 500
- Dia of GLBR Inner to Inner : 6.00m
- Sidewall Height : 2.60mts
- 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)  
TDWSP,Nirmal Circle



DEE (Designs)  
TDWSP,Nirmal Circle



Superintending Engineer,  
TDWSP,Nirmal Circle



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

**TELANGANA WATER GRID**



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

<b>CLIENT:</b> RURAL WATER SUPPLY AND SANITATION DEPARTMENT (WATER GRID), TELUNGANA.	<b>CONSULTANT :</b> WAPCOS LIMITED
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<b>PROJECT :</b>	PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT
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<b>SUPPLIER / CONTRACTOR:</b>	L&T Construction, Water, Smart World and Communication
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<b>JOB Ref. No. :</b> LE150883	<b>TITLE :</b>																
<table border="1"><thead><tr><th></th><th>NAME</th><th>SIGN</th><th>DATE</th></tr></thead><tbody><tr><td>DSGN</td><td></td><td></td><td></td></tr><tr><td>CHKD</td><td></td><td></td><td></td></tr><tr><td>APPD</td><td></td><td></td><td></td></tr></tbody></table>		NAME	SIGN	DATE	DSGN				CHKD				APPD				<b>DESIGN OF GLBR - 60KL CAPACITY BUGGAGUTTA AT TRIYANI MANDAL</b>
	NAME	SIGN	DATE														
DSGN																	
CHKD																	
APPD																	

<b>DOC./DRG. No.</b>	<b>SIZE</b>	<b>REV.</b>
LE 1 5 0 8 8 3 - C - W S - R W - D C - 1 4 7 5	A4	A

<b>RELEASED FOR</b>	<input type="checkbox"/> PRELIMINARY	<input type="checkbox"/> INFORMATION	<input checked="" type="checkbox"/> APPROVAL	<input type="checkbox"/> CONSTRUCTION
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# **DESIGN CALCULATION**

## **PROJECT TITLE**

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

## **UNIT**

**60 KL GLBR**

**DCI NO: - LE150883-C-WS-RW-DC-1562**

## **PRINCIPAL CLIENT**

**RURAL WATER SUPPLY  
AND  
SANITATION DEPARTMENT,  
TELANGANA**

## **CONTRACTOR**

**L&T CONSTRUCTION  
WATER & EFFLUENT TREATMENT SBG**

## DESIGN OF GLBR

### BASIC DATA

Diameter = 6.0 m  
Water depth = 2.3 m  
Free board = 0.3 m

### CAPACITY CHECK

Required capacity = 60 KL

Capacity of section

Clear diameter = 6.0 – 2 x plaster thickness  
= 6.0 – 2 x 0.012  
= 5.976 m

Water depth = 2.30 m

Volume =  $(\pi * d * d / 4) * H$   
=  $(\pi * 5.976 * 5.976 / 4) * 2.3 = 64.51 \text{ m}^3$  (including dead storage)

Volume-Dead storage =  $64.51 - 4.20 = 60.31 \text{ m}^3$

Net volume =  $60.31 \text{ m}^3 > 60 \text{ m}^3$  hence O.K.

ELEMENT:

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

SBC – 15 t/m<sup>2</sup>

GROUND WATER TABLE: NO GWT

Tank type : Ground storage reservoir				
Tank Geomtry : Circular with slab				
60 KL GLBR				
Basic data				
General				
No	Description	Notation	Value	Unit
(A)	Unit weight			
	Unit weight of concrete	Uwc	25.0	kN/m <sup>3</sup>
	Unit weight of water	Uww	10.00	kN/m <sup>3</sup>
	Unit weight of plaster	Uwp	21.0	kN/m <sup>3</sup>
	Unit weight of IPS	Uips	21.0	kN/m <sup>3</sup>
	Unit weight of soil	Uws	18.0	kN/m <sup>3</sup>
(B)	Material			
	Grade of concrete of container	Fck	30	N/mm <sup>2</sup>
	Grade of Steel	Fy	500	N/mm <sup>2</sup>
	Mass & Wt relation factor	g	9.81	
(C)	Loading			
	Finishing load on top slab	Fl	1.00	kN/m <sup>2</sup>
	Live load on top slab	LI	1.50	kN/m <sup>2</sup>
	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	60	m <sup>3</sup>
		Vwl	60000	liter
(F)	Geometry data			
	Height between Bottom slab & FSI	Hw	2.3	m
	Depth below ground	Dbgl	0.6	m
	Water depth	Wd	2.3	
	Diameter of tank required	Diar	5.80	m
	Diameter of tank provide	Diat	6	m
	Actual capacity of tank	Tcap	64.167	m <sup>3</sup>
		Tcapl	64167	liter
(G)	RCC geometry data			
	Bottom slab thickness	Thkbs	200	mm
	Top Slab thickness	Thkts	200	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				
60 KL GLBR				
Mass & Weight Calculation				
	RCC			
(A)	Bottom slab			
	Out to out dia of bottom slab	Bso	6.95	m
	Thickness of bottom slab in m	thkbsm	0.20	m
	Volume of bottom slab	Vbs	7.59	m <sup>3</sup>
	Weight of bottom slab	wtbs	189.68	kN
	Mass of bottom slab	Mbs	19336	kg
(B)	Side wall			
	C/C wall dia	Wdiacc	6.18	m
	Total height of wall	Wht	2.60	m
	Thickness of wall in meter	thkwmm	0.18	m
	Volume of side wall	Vw	8.83	m <sup>3</sup>
	Weight of side wall	Ww	220.67	kN
	Mass of side	Mw	22494	kg
(C)	Top slab			
	Out to out dia of top slab	Tso	6.35	m
	Thickness of top slab in m	thktsm	0.200	m
	Surface area of top slab		31.67	
	Volume of top slab	VTs	6.33	m <sup>3</sup>
	Weight of top slab	wts	158.35	kN
	Mass of top slab	Mts	16141	kg
(D)	bottom IPS			
	Area of Bottom IPS	Arips	28.27	m <sup>2</sup>
	Weight of bottom IPS	Wips	11.88	kN
	Mass of bottom IPS	Mips	1211	kg
(E)	Plaster			
	Area of Plaster on wall	Arpsw	49.01	m <sup>2</sup>
	Weight of plaster on wall	Wpsw	20.58	kN
	Mass of plaster on wall	Mpsw	2098	kg
	Area of Plaster top slab	Arpsts	28.27	m <sup>2</sup>
	Weight of plaster on top slab	Wpsts	11.88	kN
	Mass of plaster on top slab	Mpsts	1211	kg
(F)	Finishing load			
	Area of Finishing load	Arfl	31.66922	m <sup>2</sup>
	Weight of finishing load	Wfl	31.66922	kN
	Mass of finishing load	Mfl	3228.259	kg
(H)	Water			
	Weight of water up to FSL	Wwfsl	641.67	kN
	Mass of water upto FSL	Mwfsl	65410	kg
	Weight of water in free board	Wwfb	83.70	kN
	Mass of water in free board	Mwfb	8532	kg
	Total weight of water	Tww	725.36	kN
	Total mass of water	Tmw	73941	kg
	Total mass		139660	kg
	Total wt		1370	kN

Tank Geomtry : Circular with slab				
60 KL GLBR				
Parameter of spring mass Model				
(A)	H/D calculation			
	Height of tank including Freeboard	H	2.6	m
	Inside Diameter of tank	D	6	m
	H/D ratio - Ra	Ra	0.433	
	D/H ratio Rb	Rb	2.31	
(B)	Mass calculation			
	Total mass of water	M	73941	kg
	Calculation of Impulsive mass			
	$mi/m = \frac{\tanh(0.866d/h)}{0.866 d/h}$			
	Mi/m - Ratio Rd	Rd	0.4823	
		Mi	35664	kg
	Calculation of Convective mass			
	$mc/m = 0.23 * \frac{\tanh(3.68h/d)}{h/d}$			
	Mc/m - Ratio Re	Re	0.489	
		Mc	36140	kg
	Total mass of water	Tm	71804	
(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	0.975	m
	$hc/h = \frac{1 - \cosh(3.68 h/d) - 1}{3.68 h/d \sinh(3.68 h/d)}$	Rg	0.585	
		Hca	1.520	m
(D)	Calculation of Height Hi* & Hc* Hi for hydrodynamic pressure on tank wall and base slab			
	For H/D < 1.33			
	$hi^*/h = \frac{0.866d/h * - 0.125}{2 \tanh(0.866 d/h)}$			
	For H/D > 1.33			
	hi*/h = 0.45	Rh	0.912	
		hib	2.370	m
	$hc^*/h = \frac{1 - \cosh(3.68 h/d) - 2.01}{3.68 h/d \sinh(3.68 h/d)}$	Ri	0.853	
		Hcb	2.217	m
(E)	Calculation of spring stiffness			
	$kc = 0.836 * mg/h * \tanh^2(3.68 h/d)$	Kc	197778	

Tank Geomtry : Circular with slab				
60 KL GLBR				
Time Period				
(A)	Ci			
	Coefficient for Calculation of Time period in Impulsive mode time			
	$Ci = \frac{1}{(h/d)^{0.5} (0.46 - 0.3 \cdot h/d + 0.067(h/d)^2)}$	Ci	4.434	
(B)	Cc			
	Coefficient for Calculation of Time period in Convective mode time			
	$Cc = \frac{2 \cdot \pi}{(3.68 \cdot \tanh(3.68h/d))^{0.5}}$	Cc	3.413	
(C)	Time period in Impulsive mode			
	$Ti = Ci \cdot H \cdot (mdwt)^{0.5} / (tw/D)^{0.5} (E)^{0.5}$			
	mass density of water	mdwt	1019.368	kg/m <sup>3</sup>
		Ti	0.013	second
(D)	Time period in Convective mode			
	$Tc = Cc \cdot (D/g)^{0.5}$	Tc	2.669	second

Tank Geomtry : Circular with slab			
60 KL 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 supported tank	Grfac	2
	Response reduction factor for under ground tank	Ugrfac	4
	Response factor for partial under ground Tank above ground		1.30 m
	Tank below ground		0.60
	Total heighth of tank		2.60
	Ratio for partial burried	Rpb	0.231
	Partial R	Prfac	2.462
(C)	Calculation for Sa/g : for impulsive mode		
	Time Period Ti		0.0130 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 coefficient for implusive mode		
	$A_{hi} = Z / 2 * I / R * Sa/g$	Ahi	0.076172
(E)	Calculation for Sa/g : for convective		
	Time Period Tc		2.67 second
	Sa/g : For Soft soil	saga1	0.626
	Sa/g : For Medium soil	sagb1	0.509
	Sa/g : For hard soil	sagc1	0.375
	Sag for 0.5 % damping = sag * 1.75	sag1	0.89
(F)	Seismic coefficient for implusive mode		
	$A_{hc} = Z / 2 * I / R * Sa/g$	Ahc	0.027
(G)	Calculation of base shear due to implusive mode		
	$V_i = A_{hi} * ( \text{Mass of tank} + \text{Mass of water in impulsive mode} ) \times G$		
		Vi	60.40 kN
(H)	Calculation of base shear due to convective mode		
	$V_c = A_{hc} * ( \text{Mass of water in convective mode} ) \times G$		

Tank Geomtry : Circular with slab				
60 KL GLBR				
Horizontal seismic coefficient				
		Vc	9.63	kN
(I)	Total base shear			
	$V = (V_i^2 + V_c^2)^{0.5}$	V	61	
(J)	Moment at bottom of wall Impulsive mode Mombti : $A_{hi} * (m_i * h_i + M_w * h_w + M_t * h_t) * G$			kn-m
	Impusive mass of water	35664	0.98	34773
	Mass of wall	22494	1.30	29242
	Mass of plaster	2098	1.30	2728
	Mass of top slab	16141	2.70	43581
	Mass of topslab finishing	3228	2.80	9039
				119363
	Moment = $A_{fi} * (\Sigma M * H) * G$	mombti	89.2	
	Center of gravity of slab =slab thickness /2		0.100	
(K)	Moment at bottom of wall Convective mode Mombtc : $A_{hc} * (m_c * h_c) * G$	mombtc	14.64	kn-m
(L)	Total bending moment momto $= ((mombti^2 + mombtc^2))^{0.5}$	Momto	90.39	kn-m

Tank Geomtry : Circular with slab				
60 KL GLBR				
Horizontal seismic coefficient				
(M)	Over turning moment			
	Impulsive mode			
	$a_h i^*(m_i^*(h_i^*+t_{hkbs})+m_w(h_w+t_{hkbs})+m_t(h_w+t_{hkbs}+t_{hkts}/2)+m_b*t_{hkbs}/2)$			
	Item	mass	distance	
	Impulsive mass of water	35664	2.57	91666
	Mass of wall	22494	1.50	33741
	Mass of plaster	2098	1.50	3147
	Mass of top slab	16141	2.90	46810
	Mass of topslab finishing	3228	3.00	9685
	Mass of bottom slab	19336	0.10	1934
	Mass of Bottom lps	1211	0.20	242
				187224.36
	Moment = $A_{fi} * (\Sigma M * H) * G$	momovei	139.90	kn-m
(N)	Over turning moment			
	Convective mode			
	moment = $A_{hc} * M_c * (h_c^*+t_{hkbs})G$	momovec	23.28	
	Total Moment of overturining	Momovrto	141.83	
	P/A	preaa	36.11	
	M/z	Prebb	4.30	
	P/a+m/z	Pmax	40.42	< SBC O.K
	Pa/-m/z	Pmin	31.81	> 0 O/K
(P)	Sloshing Wave Height			
	$W_{avh} = A_{hc} * R * D/2$	Wavh	0.201	
(Q)	Anchore Requiriment			
	h/d ratio	0.4333		
	1/a <sub>hi</sub>	13.1282		
	$h/d < 1/a_{hi}$	No anchorage required		

Tank Geomtry : Circular with slab						
60 KL 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						
$P_{iw} = Q_{iw} * (y) * a_{hi} * \rho * G * h * \cos \phi$						
for maximum value angle $\phi = 0$ , $\cos \phi = 1$						
$Q_{iw} = 0.866 * (1-(y/h)^2) * \tanh(0.866D/h)$						
Table						
Diameter of Tank = 6.00 m						
Total Height of tank = 2.60 m						
D/h = 2.31 ratio						
$\tanh(0.866D/h) = (A) = 0.964$						
$A_{hi} * \rho * G * h * \cos \phi = (C) = 1943$						
No	y/h	Y	$(1-(y/h)^2)$ (B)	$Q_{iw} = 0.866 * A * B$	Piw kn/m2	
1	0	0.00	1	0.835	1.6	
2	0.1	0.26	0.99	0.826	1.6	
3	0.2	0.52	0.96	0.801	1.6	
4	0.3	0.78	0.91	0.760	1.5	
5	0.4	1.04	0.84	0.701	1.4	
6	0.5	1.30	0.75	0.626	1.2	
7	0.6	1.56	0.64	0.534	1.0	
8	0.7	1.82	0.51	0.426	0.8	
9	0.8	2.08	0.36	0.301	0.6	
10	0.9	2.34	0.19	0.159	0.3	
11	1	2.60	0	0.000	0.0	
Pressure on wall due to impulsive load at Y = 0					1.6	

Tank Geomtry : Circular with slab						
60 KL GLBR						
Hydrodynamic Pressure						
B	Impulsive hydrodynamic pressure at base slab					
Pressure on slab due to impulsive load						
$P_{ib} = 0.866 \times a_{hi} \times \rho \times g \times h \times \sinh(1.732 x/h) / \cosh(0.866 l/h)$						
y = 0 at base slab						
at center x = D/2 = 3.000						
L' = 3.000						
$\sinh(1.732 \times x/h)$ 3.621						
$\cosh(0.866 l/h)$ 1.542						
Pib 3.951 kn/m2						
C	Convective hydrodynamic pressure at base of wall					
Pressure on wall due to convective mode						
$P_{cw} = Q_{cw}(y)(A_{hc}) \times \rho \times G \times D \times (1 - 1/3 \cos^2 \phi) \times \cos \phi$						
$Q_{cw} = 0.5625 \times \cosh(3.674 y/d) / (\cosh 3.674 h/d)$						
for maximum value angle phi = 0, cos phi = 1						
$\cosh(3.674 \times H/d) : (A)$ 2.5586992						
$A_{hc} \times \rho \times G \times D \times (1 - 1/3 \cos^2 \phi) \times \cos \phi = (C)$ 1066						
No	y/d	Y	$\cosh(3.674 \times y/d)$ (B)	$Q_{cw} = 0.5625 \times A / B$	Pi kn/m2	
1	0	0.00	1.000	0.220	0.234	
2	0.1	0.60	1.068	0.235	0.250	
3	0.2	1.20	1.282	0.282	0.301	
4	0.3	1.80	1.671	0.367	0.392	
5	0.4	2.40	2.289	0.503	0.536	
6	0.5	3.00	3.218	0.708	0.754	
7	0.6	3.60	4.588	1.009	1.075	
8	0.7	4.20	6.583	1.447	1.543	
9	0.8	4.80	9.477	2.083	2.221	
10	0.9	5.40	13.664	3.004	3.202	
11	1	6.00	19.717	4.335	4.621	
Pressure on wall due to convective load at Y = 0				Pcw	0.23	

Tank Geomtry : Circular with slab				
60 KL GLBR				
Hydrodynamic Pressure				
D	Convective hydrodynamic pressure at base of slab			
Pressure on slab due to convective mode				
	ahc	0.0271664		
$P_{cb} = Q_{cb} * a_{hc} * \rho * g * D$				
	$A_{hc} * \rho * G * D$	1599		
$Q_{cb} = 1.125(x/D - 4/3(x/d)^3) \operatorname{sech}(3.674h/d)$				
x = d / 2				
	h	2.60		
	d	6.00		
	x	3		
	x/d	0.5		
	$\cosh(3.675h/d)$	2.5586992		
	$\operatorname{sech}(3.674 h/d)$	0.3908236		
qcb		0.1465588		
Pcb		0.2343495	kn/m2	
Final summary				
1	Impulsive hydrodynamic pressure at base of wall	Piw	1.622	kn/m2
2	Impulsive hydrodynamic pressure at base slab	Pib	3.951	kn/m2
3	Convective hydrodynamic pressure at base of wall	Pcw	0.234	kn/m2
4	Impulsive hydrodynamic pressure at base of wall	Pcb	0.234	kn/m2
E	Pressure due to wall inertia			
$P_{ww} = a_{hi} * t * \rho * G$				
Ahi	hor. Seismic coef. In impls	0.0761719		
t	wall thickness	0.175	m	
$\rho * G$	mass density * G	25	kn/m3	
Pww		Pww	0.333252	kn/m2

Tank Geomtry : Circular with slab					
60 KL GLBR					
Hydrodynamic Pressure					
F	Pressure due vertical excitation				
	$P_v = a_v * (\rho * g * h * (1-y/h))$				
	$a_v = 2/3 * (Z / 2 * I/R * S_a/g)$				
z	zone factor		0.1		
I	Importance factor		1.5		
R	response factor		2.462		
sa/g	acceleration		2.5		
			Av	0.051	
for y = 0 at base level					
	$\rho * g * h * (1-y/h)$	25.506			
			Pv	1.295227	kn/m2
F	Maximum hydrodynamic pressure				
	$P_{max} = ((P_{iw} + P_{ww})^2 + P_{cw}^2 + p_v^2)^{0.5}$				
			Pmax	2.357	kn/m2
Pmax is about		9.0647985 %	< 33.33 %		
Maximum hydraudyamic froce in normal condition				26.00	kn/m2
As hydraudyamic force < 33 % it will not govern in design					

SUMP : 60 KL			FORMULA	
PROJECT: PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)	GLBR AT	CLIENT	RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA	
	Different village	DATE	23/03/2016	REV
STRUCTURE	DESIGN CALCULATION FOR GLBR			0
<b>DESIGN CALCULATION DATA</b>				
<b>General Data</b>	Required Capacity of Sump	Sumpcap	60.000	m <sup>3</sup>
Location				
<b>Hydraulic Features</b>	Ground Level	GL	0.00	m
Dead Storage	Ds	0.15	m	
Free Board	FB	0.30	m	
Basic Shape :	Circular with flat slab			
unit weight of concrete	uwc	25.000	kN/m <sup>3</sup>	
unit weight of water	uww	10.000	kN/m <sup>3</sup>	
unit weight of plaster	uwp	21.000	kN/m <sup>3</sup>	
live load at roof slab	lrf	1.500	kN/m <sup>2</sup>	
Finish load	Fl	1.000	kN/m <sup>2</sup>	
<b>Geometry Data</b>				
Diameter	Dia	6.00	m	
Depth of tank above GL		2.00		
Depth of tank below GL		0.60		
Water depth : With Dead storage	Wd	2.30	m	
Top Slab thickness	Tshk	0.150	m	
As per tender Specification				

Bottom slab thickness	Bsthk	0.200	m
plaster thickness	pt	0.012	m
<b>Permissible stress ( As per IS 456 &amp; IS 3370)</b>			
Concrete			
Concrete grade -FCK	fck	30	N/mm <sup>2</sup>
per. stress in con. for direct comp	fckc	8.0	N/mm <sup>2</sup>
per. stress in con in com.due to bending	fckbc	10.0	N/mm <sup>2</sup>
per. stress in con. for direct tension	fckt	1.5	N/mm <sup>2</sup>
per. stress in con. In ten due to bending	fcktb	2.0	N/mm <sup>2</sup>
modulus of elasticity for container	em	2.74E+04	N/mm <sup>2</sup>
Reinforcement	fy	500	N/mm <sup>2</sup>
per. Ten. str.- steel tension due to bending	fyc	130	N/mm <sup>2</sup>
per. Ten. str.- steel tension due to direct ten	fyuc	130	N/mm <sup>2</sup>
Modular ratio	md	9.33	
Dimension for minimum steel	Dmin	15.0	m
Mass & Wt relation factor	g	9.810	
<b>[A] CAPACITY OF CONTAINER</b>			
<b>Volume Calculation</b>			
Water Depth with Dead Storage	Wdd	2.300	
Inside Diameter		6.000	
Clear Inside Diameter without plaster	Diac	5.976	
total volume	vt	64.51	m <sup>3</sup>
dead storage	vdd	4.21	m <sup>3</sup>
net volume	vn	60.30	m <sup>3</sup> > 60.000 OK
<b>[B] TOP SLAB DESIGN</b>			
Concrete grade	Fck	30	N/mm <sup>2</sup>
Steel	Fy	500	N/mm <sup>2</sup>
Clear cover	Cv	45	mm
Slab Diameter	Lx	6.000	m
Slab type	St	1	Simply supported

Width	B	1000 mm
Depth	D	200 mm
Maximum Bar dia	Db	10 mm
Density of concrete	Wd	25 kN/m <sup>3</sup>
Loading		
Live load	LI	1.5 kN/m <sup>2</sup>
Finishing load	FI	1 kN/m <sup>2</sup>
CALCULATION		
Calculation of loading		
Self wt ( Dead load)	DI	5 kN/m <sup>2</sup>
Total Load	TI	7.5 kN/m <sup>2</sup>
Effective depth	De	150 mm
Bending Moment	Bm	8.438 kN-m
Modular ratio		9.33
K	k	0.42
j = 1-k/3	j	0.9
Ast		502.7 mm <sup>2</sup>
Provide : 10 dia - 150 c/c		
<b>[C] CYLINDRICAL WALL</b>		
inner diameter	cyid	6.000 m
top thickness	cytt	0.175 m
bottom thickness	cybt	0.175 m
Water depth	cyh	2.300 m
coefficient of constant height	cyc	0.000
free board		0.300 m
height of wall fir design	cyhh	2.600 m
increment in thickness	cyith	0.000 m
Hoop Force ; Wall free at Top and hinge at bottom condition		
F = $\text{coe} \times H \times D / 2$		
F= Hoop force		

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

Ration  $H^2/DT$  6.438  
Enter Value for Auto serach 9.000

h

hoop force

	sr. no	depth from top in meter	thickness at section	coefficient	hoop force in wall = Coe. X rad * height * unit wt of liquid	area of steel required = force / 1300	actual tensile stress in concrete = force/(thk*wid	Minimum Area of steel in mm2 on each face
	sr. no	area of steel requid	dia of bar	bar spacing	area of steel prod			
Minimum % steel as per IS 3370-2009	1	0.260	0.175	0.012	0.9	7	0.005	210
	2	0.520	0.175	0.101	7.9	61	0.044	210
	3	0.780	0.175	0.220	17.1	132	0.094	210
Maximum Dimension	4	1.040	0.175	0.339	26.4	203	0.146	210
6.000	5	1.300	0.175	0.459	35.8	275	0.197	210
Permissible dimension for 0.24 % steel	6	1.560	0.175	0.566	44.1	339	0.243	210
15.000	7	1.820	0.175	0.644	50.2	386	0.277	210
	8	2.080	0.175	0.655	51.1	393	0.281	210
Minimum Steel	9	2.340	0.175	0.563	43.9	338	0.242	210
0.240	10	2.600	0.175	0.340	26.5	204	0.146	210
	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	275.171	10	200	785			
	6	339.337	10	200	785			
	7	386.291	10	200	785			
	8	392.897	10	200	785			
	9	337.926	10	200	785			
	10	210.000	10	200	785			

weight of wall straight part tapered part plaster total weight	cyspw cypw cypw ticy	195.2 0.0 12.3 207.5	kN kN kN kN	$=Pl()*(cwid+cytt)*cyn*cytt*uwc$ $=Pl()*(cwid+cytt+(cylt-cytl)/3)*cyn*(1-cyc)*(cylt-cytl)/2*uw$ $=(cwid-pt)*Pl()*(pt*(trdd+cylt+mrdd/2-cyxa))*uwp$ $=cyspw+cypw+cypw$									
Maximum moment in wall													
	sr. no	depth from top in meter	thickness at section	coefficient	moment in wall = Coe. X height <sup>3</sup> * unit wt of liquid	effective depth	Area of steel		Minimum Area of steel in mm2				
							required	required					
Minimum % steel as per IS 3370-2009	1	0.260	0.175	0.00008	0.014	0.120	1	210					
	2	0.520	0.175	0.00026	0.045	0.120	3	210					
	3	0.780	0.175	0.00067	0.118	0.120	8	210					
Maximum Dimension	4	1.040	0.175	0.00166	0.292	0.120	21	210					
#REF!	5	1.300	0.175	0.00285	0.501	0.120	36	210					
Permissible dimension for 0.24 % steel	6	1.560	0.175	0.00421	0.739	0.120	53	210					
15.000	7	1.820	0.175	0.00482	0.846	0.120	60	210					
Minimum Steel	8	2.080	0.175	0.00290	0.510	0.120	36	210					
#REF!	9	2.340	0.175	-0.00368	-0.647	0.120	-46	210					
	10	2.600	0.175	-0.01780	-3.129	0.120	-223	210					
	sr. no	area of steel reqd	dia of bar	bar spacing	area of steel prod	distance							
	1	210.000	10	200	393	0.260							
	2	210.000	10	200	393	0.520							
	3	210.000	10	200	393	0.780							
	4	210.000	10	200	393	1.040							
	5	210.000	10	200	393	1.300							
	6	210.000	10	200	393	1.560							
	7	210.000	10	200	393	1.820							
	8	210.000	10	200	393	2.080							
	9	210.000	10	200	393	2.340							
	10	210.000	10	200	393	2.600							
Vertical steel	0.240		%										
as compression only, I provide min r/f	4.200		cm2										
area of steel required total on both face													

## FOUNDATION DESIGN

### WALL FOOTING DESIGN

PROJECT : P16\_02\_Adilabad W.S.S

JOB : P16\_02

UNIT : 60KL 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
				modular		
Safe bearing capacity of soil	Sbc	150.0	kN/m2	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	2.30	m			
free board	fb	0.30	m			
Wall above Ground		2.00	m			
Clear cover	Cv	50	mm			
Maximum size of bar dia	Db	10	mm			
Water depth with free board	Wd	2.60	m			
minimum % steel	pt	0.24	%			
Moment						
Due to Water	Mtw	3.25	kN-m	( From Analysis Result)		
Due to soil if any	Mts	0.50	kN-m			
Wt from top dome/slab/column/wall	Slabwt	11.30	kN-m			

#### Wall geometry ( Figure 1 )

Straight portion	lb	2.600	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)	tth	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	2.600	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	Lever Arm m	Moment kN-m
		W	Dist	W * dist
Wall Straight portion	W1	11.38	0.39	4.41
Wall Tapered portion	W2	0.00	0.30	0.00

Walkway/slab	P	11.30	0.39	4.38
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	11.70	0.70	8.19
Total downward load		39.00		19.12
Total restoring moment @ toe	TRM	19.1		kN-m
Total over turning moment		3.3		kN-m
F.S.against over turning		5.9		
Check for over turning	Hense o.k			
Total moment due to vertical load	Tmv	19.1		kN-m
Total moment due to horizontal load	Tmh	3.3		kN-m
Total vertical load	TPv	39.0		kn
Net Moment	Tmn	15.9		kN-m
M/p	E	0.41		m
Ecc	Ecc	0.056		m
b/6	Aec	0.15		m
Net moment From ECC	Mdg	2.172		
Property of footing				
Width of footing		1.00		m
Depth of footing		0.93		m
Footing Area	Fare	0.93		m <sup>2</sup>
Modulus of section	Fz	0.14		m <sup>3</sup>
Pressure distribution				
Pressure due to direct load =P/A	prea	42.16		kN/m <sup>2</sup>
Pressure due to moment =M/Z	Preb	15.23		kN/m <sup>2</sup>
Pressure				
Maximum pressure - P/A + M/Z	Pmax	57.39		kN/m <sup>2</sup>
Minimum pressure - P/A + M/Z	Pmin	26.93		kN/m <sup>2</sup>
Check for SBC				
Maximum pressure < SBC		OK		
Minimum presure > 0		OK		
Pressure difference		30.46		
Pressure difference / m		32.93		
Pressure at outer Wall face - A	preow	47.51		kN/m <sup>2</sup>
Pressure at inner Wall face B	preiw	41.75		kN/m <sup>2</sup>
Pressure at point C	preiw1	26.93		kN/m <sup>2</sup>
Design of Toe - At Point A				
Moment at face of outer wall				
Due to rectangle diagram	Mreco	2.14		kN-m
	Mtrio	0.30		kN-m
Total moment due to upward		2.43		kN-m

pressure			
Net moment at A from Toe side	Toem	2.43	kN-m
Thickness at toe		200	mm
Effective depth	Def toe	145	mm
Ast required =		150	mm <sup>2</sup>
Check for minimum steel			
top		240	mm <sup>2</sup>
bottom		0	mm <sup>2</sup>

#### Design Steel

Main steel - Top		240	mm <sup>2</sup>
Main steel - bottom		150	mm <sup>2</sup>
Distribution steel - top		240	mm <sup>2</sup>
Distribution steel - bottom		0	mm <sup>2</sup>

#### Design of heel : At point B & C

##### Design at point B

Due to rectangle diagram (upward)	Mreci	2.7	kN-m
	Mtrii	0.5	kN-m
Total Upward moment		3.2	kN-m
Due to water (down ward)		2.6	kN-m
Net downward moment at B from heel side	heelm	0.6	kN-m
Thickness Provided		200	mm
	defheel	145	mm
Ast required =		37	mm <sup>2</sup>
Check for minimum steel - straight portion			
top		240	mm <sup>2</sup>
bottom		0	mm <sup>2</sup>
Design Steel			

Main steel - Top		240	mm <sup>2</sup>
Main steel - bottom		0	mm <sup>2</sup>
Distribution steel - top		240	mm <sup>2</sup>
Distribution steel -bottom		0	mm <sup>2</sup>

##### 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	145	mm
Ast required =		0	mm <sup>2</sup>
Check for minimum steel - tapered portion			
Average thickness	thav	0.20	m
top		240	mm <sup>2</sup>
bottom		0	mm <sup>2</sup>
Design Steel			
Main steel - Top		240	mm <sup>2</sup>
Main steel - bottom		0	mm <sup>2</sup>
Distribution steel - top		240	mm <sup>2</sup>
Distribution steel -bottom		0	mm <sup>2</sup>

SUMMARY							
Pressure Check							
1>	P/A + M/Z	57.4	<	150	OK		
2>	P/A - M/Z	26.9	>	0	OK		
Reinforcement							
	AstR			+		Astp	
<b>Toe</b>		dia	spc		dia	spc	
Top - main	240	10	200	0	0	393	OK
Bottom main	150	10	200	0	0	393	OK
Top - Dist	240	10	200	0	0	393	OK
Bottom - Dist	0	10	200	0	0	393	OK
<b>Heel Straight portion</b>							
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
<b>Heel tapered portion</b>							
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	11.38	0.54	6.11
Wall Tapered portion	W2	0.00	0.63	0.00
Walkway/slab	P	11.30	0.54	6.07
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		<b>30.54</b>		<b>16.84</b>
Total restoring moment @ heel	TRMs	16.8	kN-m	
Total over turning moment due to soil		0.5	kN-m	
F.S.against over turning		33.7		
Check for over turning	Hense o.k			
Total moment due to vertical load	Tmv1	16.8	kN-m	
Total moment due to horizontal load	Tmh1	0.5	kN-m	

Total vertical load	TPv1	30.5	kn
Net Moment	Tmn1	16.3	kN-m
M/p	E1	0.53	m
Ecc	Ecc1	-0.072	m
b/6	Aec1	0.15	m
Net moment From ECC	Mdg1	-2.2131	
Property of footing			
Width of footing		1.00	m
Depth of footing		0.93	m
Footing Area	Fare1	0.93	m <sup>2</sup>
Modulus of section	Fz1	0.14	m <sup>3</sup>
Pressure distribution			
Pressure due to direct load =P/A	prea1	33.02	kN/m <sup>2</sup>
Pressure due to moment =M/Z	Preb1	-15.5	kN/m <sup>2</sup>
Pressure			
Maximum pressure - P/A + M/Z	Pmax1	17.50	kN/m <sup>2</sup>
Minimum pressure - P/A + M/Z	Pmin1	48.54	kN/m <sup>2</sup>
Check for SBC			
Maximum pressure < SBC		OK	
Minimum presure > 0		OK	
Pressure difference		-31.04	kN/m <sup>2</sup>
Pressure difference / m		-33.56	kN/m <sup>2</sup>
Pressure at outer Wall face - A	preow1	38.47	kN/m <sup>2</sup>
Pressure at inner Wall face B	preiw1	32.60	kN/m <sup>2</sup>
<b>Design of Toe - At Point A</b>			
Moment at face of outer wall			
Due to rectangle diagram	Mreco1	2.18	kn-m
Due to triabgular diagram	Mtrio1	-0.15	kn-m
Total moment due to upward pressure		2.03	kn-m
Total downward moment due to soil		0.49	kn-m
Net moment at A from Toe side	Toem1	-1.55	kn-m
Thickness at toe		200	mm
Effective depth	Def Toe1	145	mm
Ast required =		-95.36	mm <sup>2</sup>
Check for minimum steel			
top		240	mm <sup>2</sup>
bottom		0	mm <sup>2</sup>
Design Steel			
Main steel - Top		240	mm <sup>2</sup>
Main steel - bottom		0	mm <sup>2</sup>
Distribution steel - top		240	mm <sup>2</sup>
Distribution steel - bottom		0	mm <sup>2</sup>
<b>Design of heel : At point B</b>			
<b>Design at point B</b>			
Due to rectangle diagram (upward)	Mreci1	3.30	kn-m
	Mtrii1	-1.02	kn-m
Total Upward moment	heelm1	2.28	kn-m
Net downward moment at B from heel side			
Thickness Provided	defheel1	145	mm
Steel required at bottom		141	mm <sup>2</sup>
Ast required =			
Check for minimum steel - straight portion			
top		240	mm <sup>2</sup>
bottom		0	mm <sup>2</sup>
Design Steel			

Main steel - Top	240	mm2
Main steel - bottom	141	mm2
Distribution steel - top	240	mm2
Distribution steel -bottom	0	mm2

### SUMMARY

#### Pressure Check

1>	P/A + M/Z	17.5	<	150.0	OK
2>	P/A - M/Z	48.5	>	0	OK

#### Reinforcement

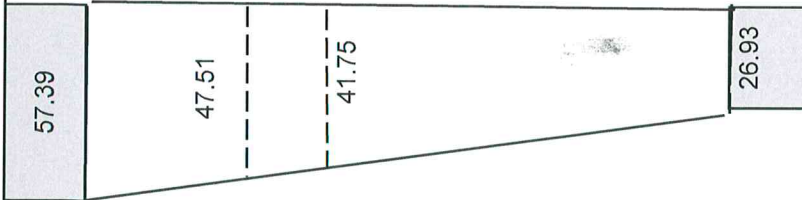
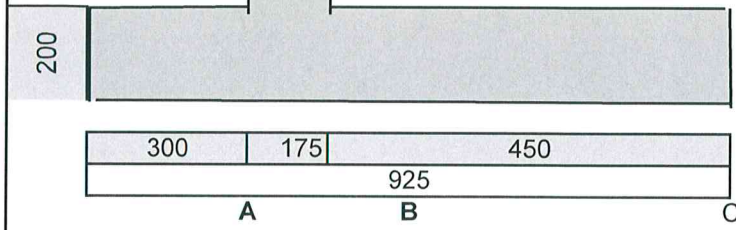
	AstR	dia	spc	+	dia	spc	Astp	
Toe								
Top - main	240	10	200				393	OK
Bottom main	0	10	200		0	0	393	OK
Top - Dist	240	10	200		0	0	393	OK
Bottom - Dist	0	10	200		0	0	393	OK

#### Heel Straight portion

Top - main	240	10	200		0	0	393	OK
Bottom main	141	10	200		0	0	393	OK
Top - Dist	240	10	200		0	0	393	OK
Bottom - Dist	0	10	200		0	0	393	OK

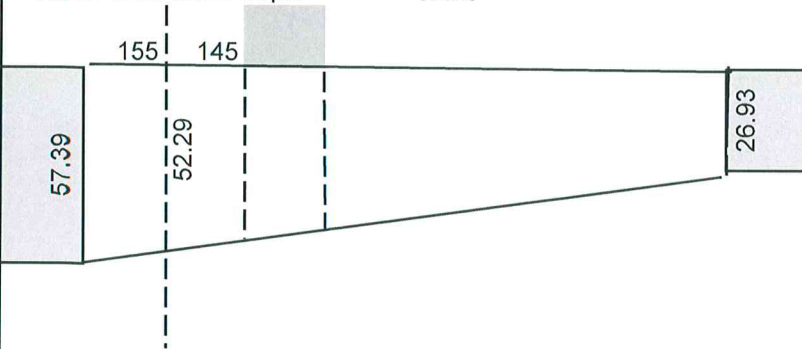
### SHEAR CHECK FOR WATER

Cover    50  
Dia       10



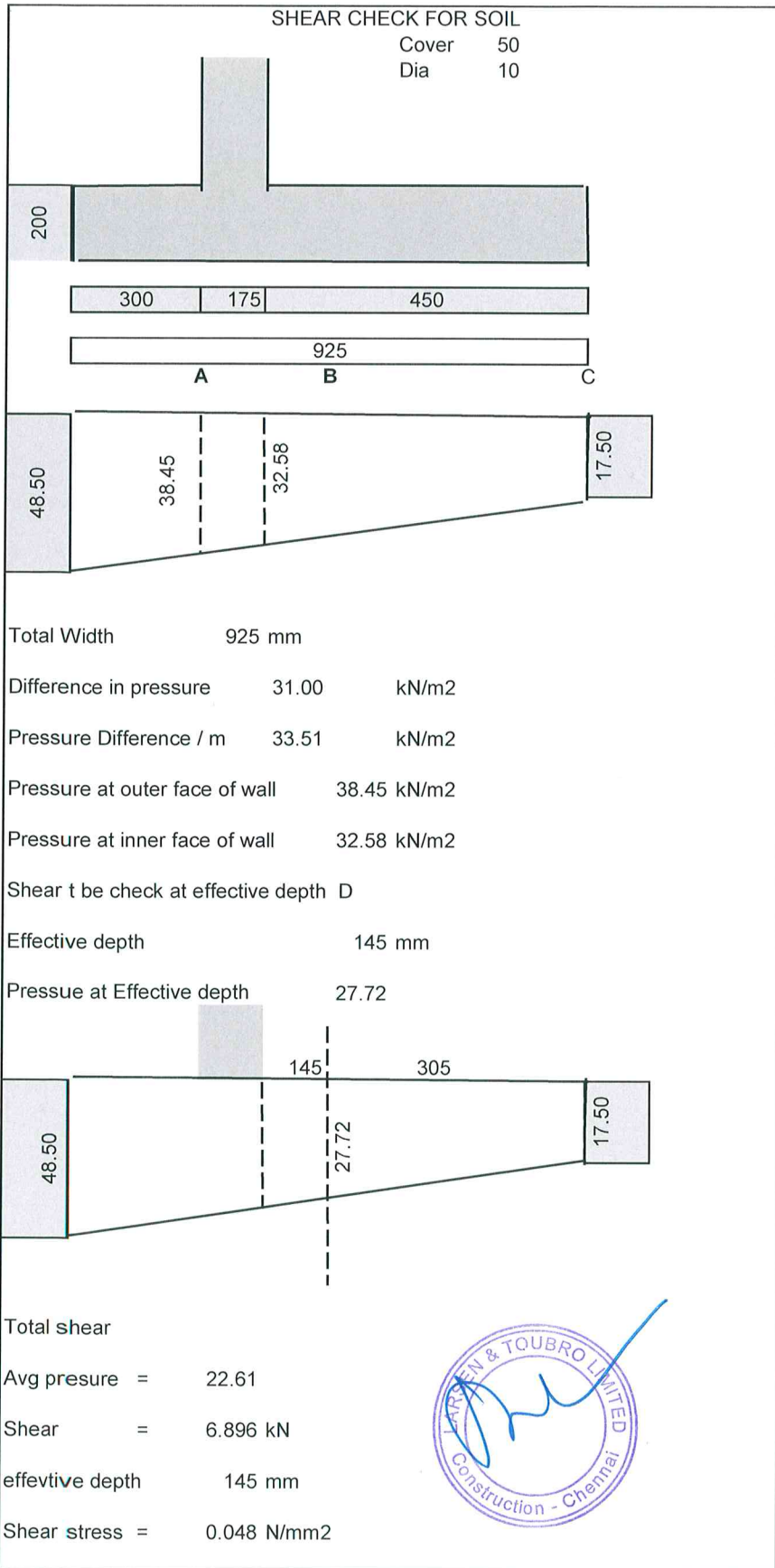
Total Width                    925 mm  
 Difference in pressure        30.46            kN/m<sup>2</sup>  
 Pressure Difference / m      32.93            kN/m<sup>2</sup>  
 Pressure at outer face of wall    47.51 kN/m<sup>2</sup>  
 Pressure at inner face of wall    41.75 kN/m<sup>2</sup>  
 Shear to be check at effective depth D  
 Effective depth                    145 mm

Pressure at Effective depth            52.29



Total shear

Avg pressure =            54.84  
 Shear         =            8.5 kN  
 effective depth            145 mm  
 Shear stress =            0.059 N/mm<sup>2</sup>



**APPROVED**  
23/04/16  
SE, NIRMAL

**“Designs Vetted”**



*Asst. Executive Engineer*  
**Asst. Executive Engineer**  
TDWSP Asifabad

*Dy. Executive Engineer*  
**Dy. Executive Engineer**  
TDWSP Asifabad

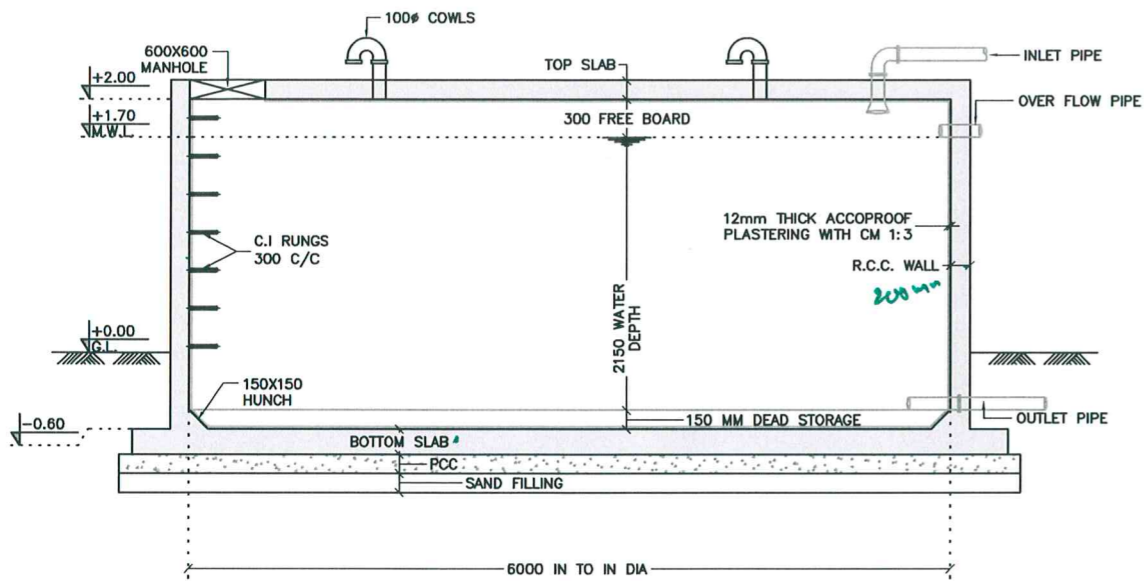
*Executive Engineer*  
**Executive Engineer**  
TDWSP Asifabad

**SCHEDULE OF PIPE**

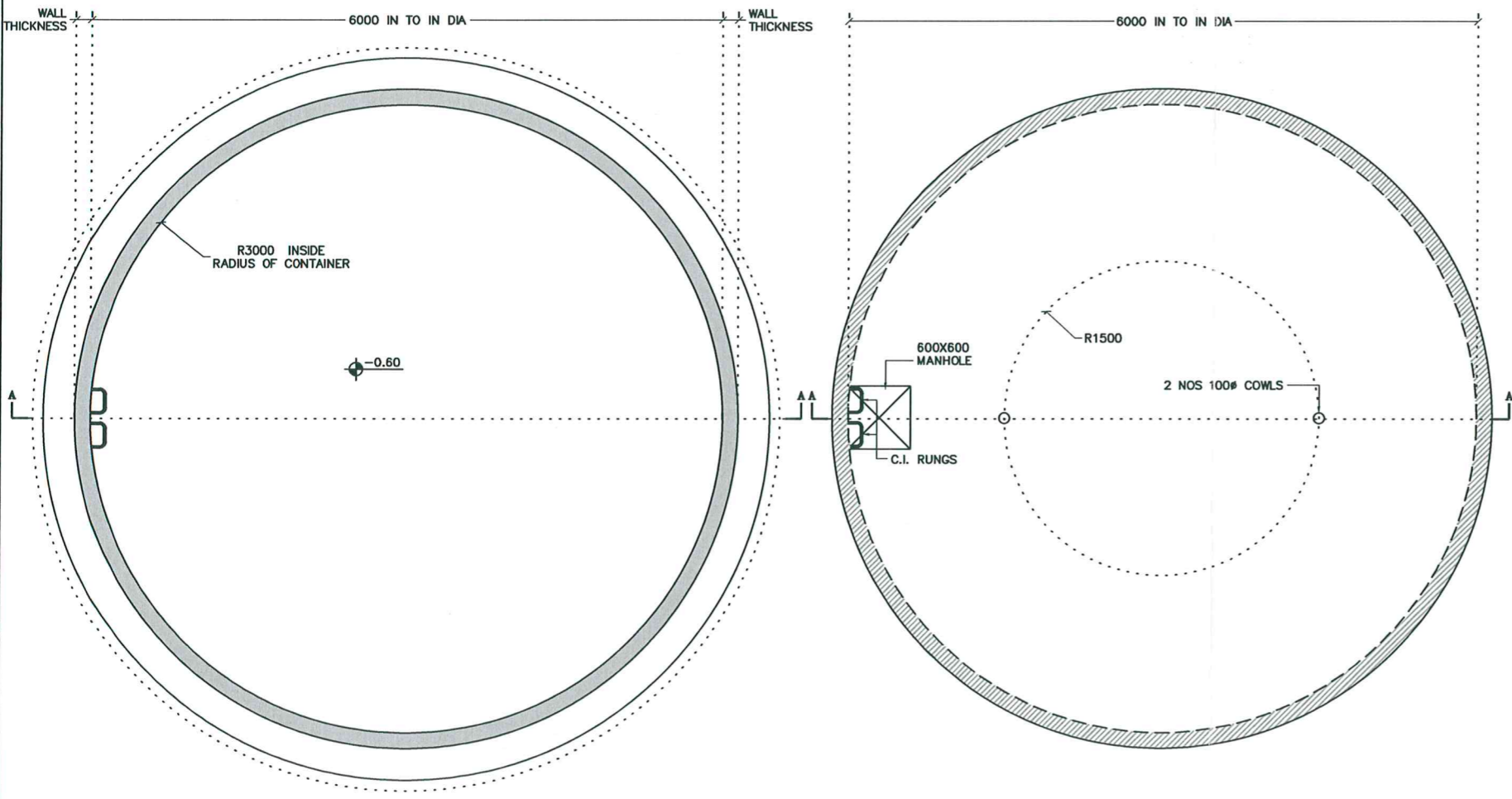
INLET PIPE SIZE	-
OUTLET PIPE SIZE	-
OVER FLOW PIPE SIZE	-

**NOTES :**

- <1> ALL DIMENSION ARE IN MM AND LEVELS ARE IN METER.
- <2> LOCATION & LEVELS OF INLET,OUTLET & OVEFFLOW PIPE SHALL BE VARIFIED WITH ENGINEER INCHARGE BEFORE EXECUTION



SECTION : A - A



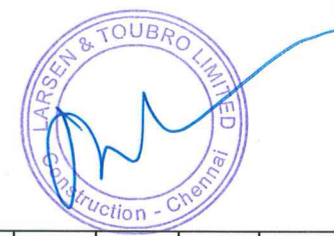
BOTTOM PLAN

TOP PLAN

"Drawings Vetted"



APPROVED  
P.30/4/16  
SE, NIRMAL



A	FOR APPROVAL	28/03/16	-	DGP	RMM	-
REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED

REVISIONS



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	TITLE :	SCALE : 1:50															
<table border="1"> <tr> <th>NAME</th> <th>SIGN</th> <th>DATE</th> </tr> <tr> <td>DSGN</td> <td>HMP</td> <td>28/03/16</td> </tr> <tr> <td>DRWN</td> <td>DGP</td> <td>28/03/16</td> </tr> <tr> <td>CHKD</td> <td>RMM</td> <td>28/03/16</td> </tr> <tr> <td>APPD</td> <td>-</td> <td>28/03/16</td> </tr> </table>	NAME	SIGN	DATE	DSGN	HMP	28/03/16	DRWN	DGP	28/03/16	CHKD	RMM	28/03/16	APPD	-	28/03/16	60KL CAPACITY GLBR AT BUGGAGUTTA (GENERAL ARRANGEMENT DRAWING)	PROJECTION
NAME	SIGN	DATE															
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CHKD	RMM	28/03/16															
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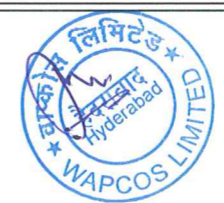
DRAWING No. LE150883-C-W-S-RW-GA-1561  
COMP. DATA : P16-02\_49-01-01 SHEET 1 OF 1

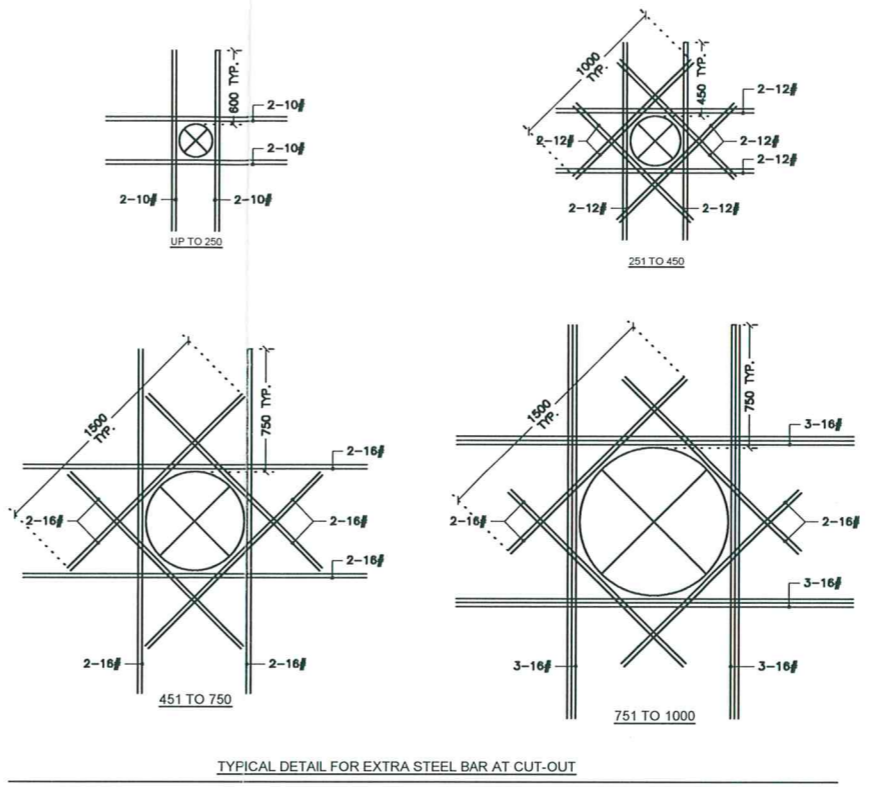
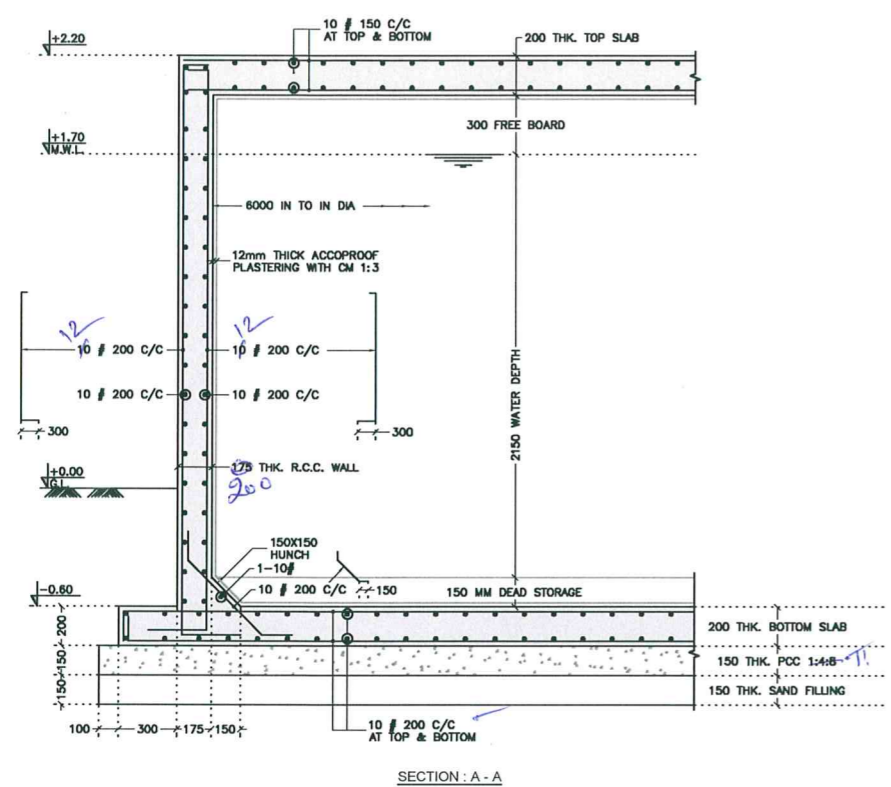
RELEASED FOR  PRELIMINARY  TENDER  INFORMATION  APPROVAL  CONSTRUCTION

*[Signature]*  
Asst. Executive Engineer  
TDWSP Asifabad

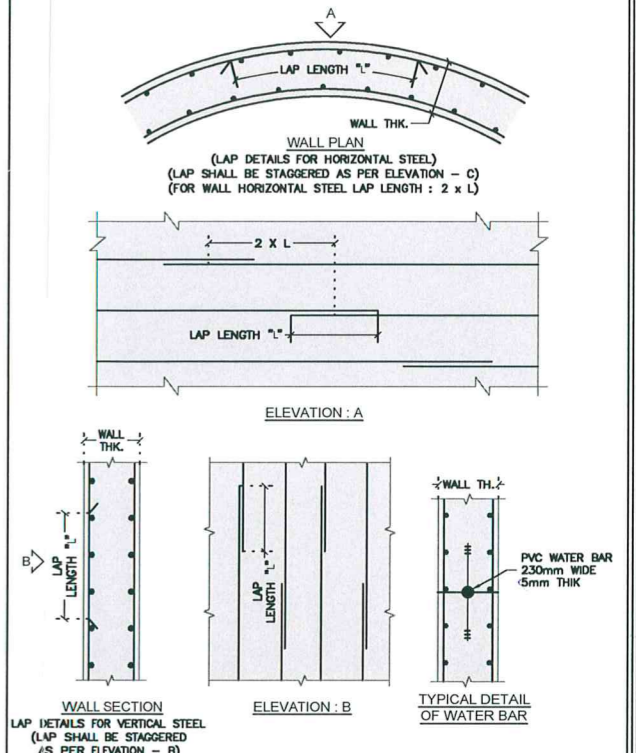
*[Signature]*  
Dy. Executive Engineer  
TDWSP Asifabad

*[Signature]*  
Executive Engineer  
TDWSP Asifabad





SCHEDULE OF PIPE		LAP LENGTH SCHEDULE	
INLET PIPE SIZE	-	DIA OF BAR	LAP LENGTH "L" IN mm
OUTLET PIPE SIZE	-	8	368
OVER FLOW PIPE SIZE	-	10	460
		12	552
		16	736
		20	920
		25	1150



- NOTES:-
- ALL DIMENSION ARE IN MM AND LEVELS ARE IN METER.
  - ALL CONCRETE MIX M:30 WITH MAXIMUM FREE WATER CEMENT RATIO OF 0.45 AND MAXIMUM CEMENT CONTENT OF 400kg/m<sup>3</sup> FOR WATER RETAINING STRUCTURE.
  - ALL CONCRETE SHALL BE MACHINE MIXED AND MACHINE VIBRATED.
  - f - INDICATE HYSD-TMT BAR FE-500 GRADE 1 CONFORMING TO IS 1786-LATEST REVISION.
  - CLEAR COVER TO WATER RETAINING STRUCTURE
    - (A) BOTTOM SLAB : 50mm
    - (B) WALL WATER FACE : 45mm & SOIL FACE : 30mm
    - (C) TOP SLAB : 45mm
  - FOUNDATION SHALL REST ON IN-SITU SOIL AND IT SHALL NOT BE ON FILLING MATERIAL i.e. MADE UP SOIL OR HIGHLY COMPRESSIBLE SOIL.
  - BACK FILLING SHALL BE DONE IN WELL COMPACTED AND WELL WATER LAYER NOT EXCEEDING 150mm IN DEPTH.
  - SBC CONSIDERED IN DESIGN IS 15 T/42 & NO GROUND WATER TABLE.
  - INLET & OVERFLOW PIPE SHALL BE DECIDED AS PER SITE CONDITION.
  - LOCATION & LEVELS OF INLET, OUTLET & OVERFLOW PIPE SHALL BE VERIFY WITH ENGINEER INCHARGE BEFORE EXECUTION.

APPROVED  
SE, NIRMAL  
An.

REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	28/03/16	RPS	NSP	RMM	-

REVISIONS

**L&T Construction**  
Water, Smart World & Communication.

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

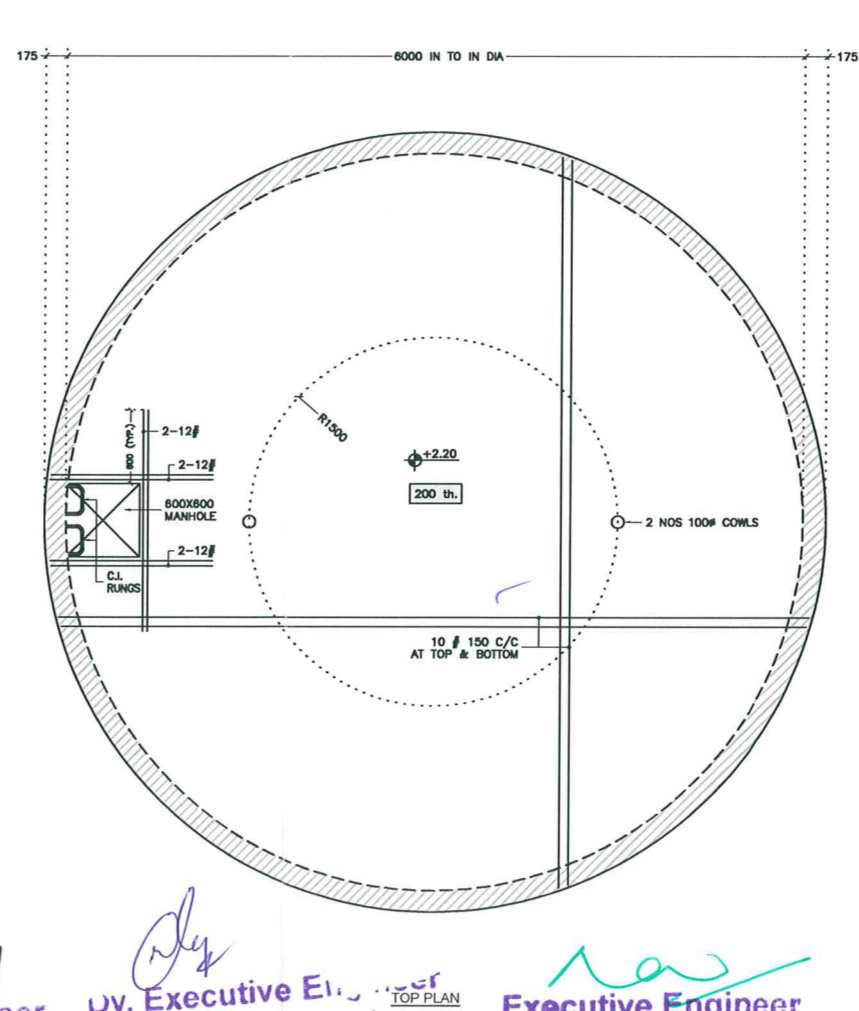
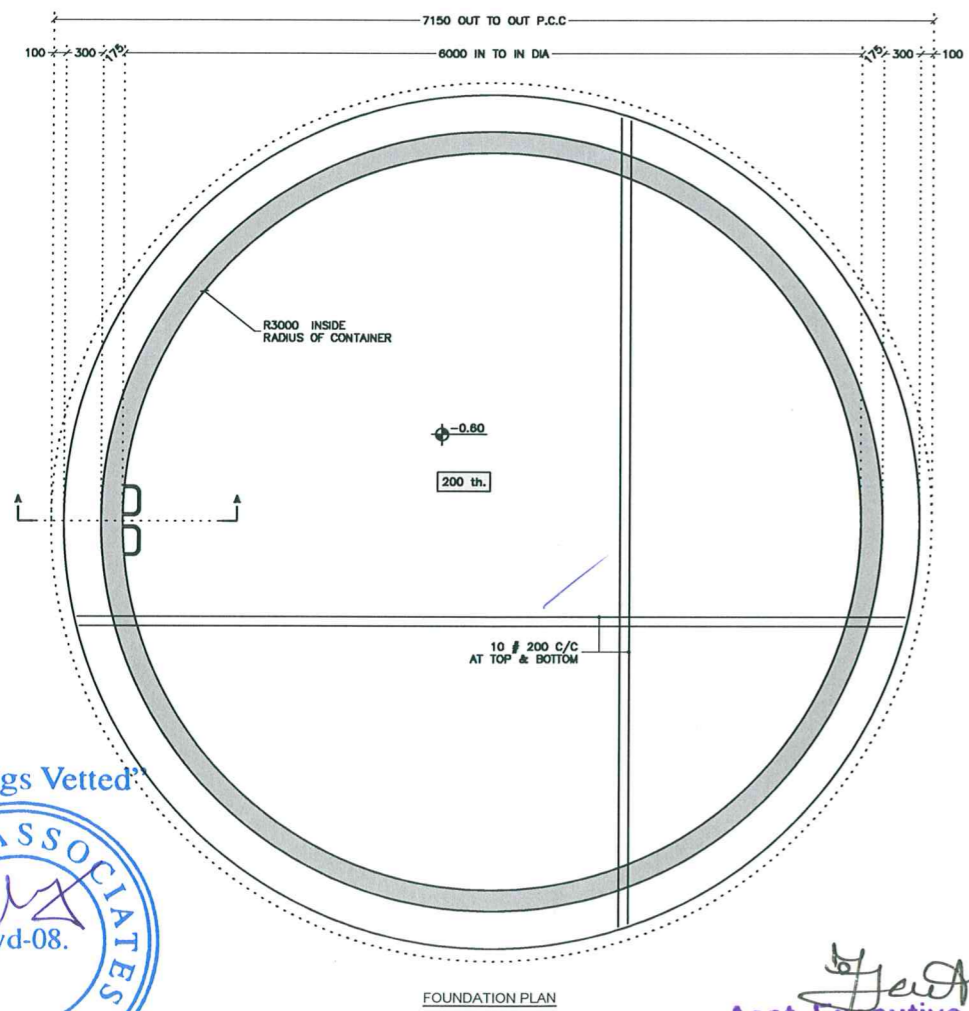
PROJECT: PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT

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

JOB No.: LE150883 TITLE: 60KL CAPACITY GLBR AT BUGGAGUTTA (STRUCTURAL DETAILS) SCALE: 1:40,25 PROJECTION: A2

DRAWING No. LE150883-C-WS-RW-RC-1564 SIZE: A2 REV. A  
COMP. DATA: P16-02\_49-02-01 SHEET 1 OF 1

RELEASED FOR:  PRELIMINARY  TENDER  INFORMATION  APPROVAL  CONSTRUCTION



"Drawings Vetted"

M/S. S. K. ASSOCIATES  
Hyd-08.

Asst. Executive Engineer  
TDWSP Asifabad

Jy. Executive Engineer  
TDWSP Asifabad

Executive Engineer  
TDWSP Asifabad

WAPCOS LIMITED  
Hyderabad

GEOTECHNICAL INVESTIGATION REPORT

TELANGANA DRINKING WATER SUPPLY PROJECT

KOMARAM BHEEM - TRIYANI-SEGMENT 22

TRIYANI, ADILABAD DISTRICT

60KL GLBR BUGGUTTA AT TRIYANI (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

GEOTECHNOLOGIES

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OSMANIA UNIVERSITY

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Email: [dbaburao2000@yahoo.com](mailto:dbaburao2000@yahoo.com)

## TELANGANA DRINKING WATER SUPPLY PROJECT

### 60 KL GLBR AT BUGGAGUTTA, TRIYANI (M) IN ADILABAD DT.

#### 1. INTRODUCTION

M/s. L &T Construction, Water & Effluent Treatment is proposing to construct 60KL GLBR at BUGGAGUTTA, TRIYANI (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 60KL GLBR at BUGGAGUTTA 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. B. 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 15-20 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)

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


**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.

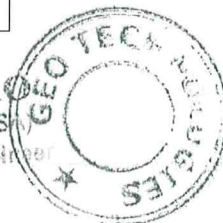
When the number of blows exceeded 50 to penetrate the first or second 15 cm length of the sampler, the SPT 'N' is regarded as more than 100 as described in IS 2131 - 1981. The test is terminated in such case and a record of the penetration of the sampler under 50 blows is made. SPT refusal is recorded 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	6 m

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



#### 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 Geotechnologies, 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 – 6 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

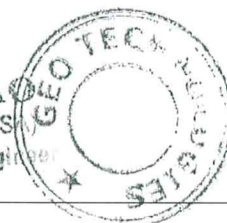
In general, the following pertains to foundations resting in soils.

. 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



#### **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 6 m depth.

Hence shallow foundation is feasible and same is recommended.

  
**Dr. D. BABU RAO**  
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Consulting Geotechnical Engg.  


## 8.0 RECOMMENDATIONS

Based on Field Investigations and laboratory testing, the following Recommendations are made for construction of GLBR at BUGGAGUTTA, TRIYANI (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	15
2	2.0	16
3	3.0	17

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

*For ANJI DRILLING AND GROUTING WORKS*

(DR. D. BABU RAO)

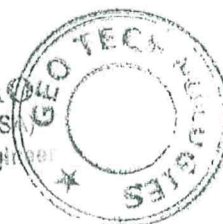
M. E( IIT,R), Ph. D. (USA), MIGS

Former Professor of Civil Engineering

Consulting Geotechnical Engineer

MCH Panelist No. 2490/TP/2000-2

  
**DR. D. BABU RAO**  
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Consulting Geotechnical Engineer



TELANGANA DRINKING WATER SUPPLY PROJECT

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

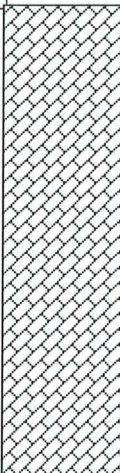
60KL GLBR AT BUGGAGUTTA, TRIYANI (M) IN ADILABAD DT.

Type of Boring: Core drilling

Dia of Boring: NX

Date : 15-20 Jan 2016

Drilled depth = 06 m

Depth, m	Profile	Soil	Sample Depth m	N value	CR, %	RQD%		
0		Sand stone	0	>100				
1.0			1.5	>100				
2.0								
3.0								
4.0					3.0	>100		
4.5					4.5	>100		
5.0					5	>100		
6.0					6	>100		
7.0								
8.0								
9.0								
10.0								
11.0								
12.0								
13.0								
14.0								
15.0								
16.0								

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 Consulting Geotechnical Engineer  
 SAI SANGI'S  
 TECHNICAL SERVICES



Adopt 250 kN / sq m .

$$= 658 \text{ kN / sq m}$$

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

For permissible settlement of 40 mm,

**b) Settlement Criterion :**

$$\text{Allowable } q = 1 / 18 [ 2 N^2 B R r + 6 ( 100 + N^2 ) D R q ] = 1205 \text{ kN / sq m}$$

With a F.S. of 3.0 ,

$$\text{Correction factors } Rq = Rr = 0.5$$

Assumed depth of foundation = 1.5 m inside rock

Assumed width of foundation = 4 m

Assumed value of  $N = 50$

**a) Shear Criterion :**

SAND STONE AT 2 M DEPTH

TYPICAL CALCULATIONS FOR OPEN FOUNDATIONS RESTING IN

GLBR AT BUGGAGUTTA , TRIYANI (M) IN ADILABAD DT.

CALCULATION OF SBC

APPENDIX

Executive Engineer  
TDMSP Asifabad

Dy. Executive Engineer  
TDMSP Asifabad

Asst. Executive Engineer  
TDMSP Asifabad



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

10 t / sq m , for settlement less than 12 mm.

For this very poor rock , net allowable bearing pressure is recommended as

3 of the Code

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

**Foundations on Rocks) :**

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

$$\text{Settlement} = 0.0025 \times 4.5 \times 1000 = 11.25 \text{ mm OK}$$

For a pressure of 25 t/ sq m,

$$\text{Settlement} = 0.0045 \text{ m per unit pressure of } 1 \text{ kg / sq cm}$$

$$\text{For } N = 50, B = 4,$$

**foundations:**

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