DESIGN CALCULATION

PROJECT TITLE

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

UNIT

90 KL GLBR AT MADHARAM GUTTA

DCI NO: - LE150883-C-WS-RW-DC-1590

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 = 3.25 m
Free board = 0.3 m

CAPACITY CHECK

Required capacity = 90 KL

Capacity of section

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

Water depth = 3.4 m

Volume = (pi * d x d ./ 4) x H
= (Pi* 5.976 x 5.976 / 4) * 3.4 = 95.36 m^3 (including dead storage)

Volume-Dead storage = 95.36 – 4.20 = 91.16 m^3

Net volume = 91.16 m^3 > 90 m^3 hence O.K.

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

SBC – 15 t/m^2

GROUND WATER TABLE: NO GWT

Tank type : Ground storage resrvoir				
Tank Geomtry : Circular with slab				
90 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	90	m3
		Vwl	90000	liter
(F)	Geometry data			
	Height between Bottom slab & FSl	Hw	3.4	m
	Depth below ground	Dbgl	0.5	m
	Water depth	Wd	3.4	
	Diameter of tank required	Diar	5.85	m
	Diameter of tank provide	Diat	6	m
	Actual capcity of tank	Tcap	94.855	m3
		Tcapl	94855	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				
90 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	m3
	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	3.70	m
	Thickness of wall in meter	thkwm	0.18	m
	Volume of side wall	Vw	12.56	m3
	Weight of side wall	Ww	314.03	kN
	Mass of side	Mw	32011	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	m3
	Weight of top slab	wtts	158.35	kN
	Mass of top slab	Mts	16141	kg
(D)	bottom IPS			
	Area of Bottom IPS	Arips	28.27	m2
	Weight of bottom IPS	Wips	11.88	kN
	Mass of bottom IPS	Mips	1211	kg
(E)	Plaster			
	Area of Plaster on wall	Arpsw	69.74	m2
	Weight of plaster on wall	Wpsw	29.29	kN
	Mass of plaster on wall	Mpsw	2986	kg
	Area of Plaster top slab	Arpsts	28.27	m2
	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	m2
	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	948.55	kN
	Mass of water upto FSL	Mwfsl	96692	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	1032.25	kN
	Total mass of water	Tmw	105224	kg
	Total mass		181347	kg
	Total wt		1779	kN

Tank Geomtry : Circular with slab				
90 KL GLBR				
Parameter of spring mass Model				
(A)	H/D calculation			
	Height of tank including Freeboard	H	3.7	m
	Inside Diameter of tank	D	6	m
	H/D ratio - Ra	Ra	0.617	
	D/H ratio Rb	Rb	1.62	
(B)	Mass calculation			
	Total mass of water	M	105224	kg
	Calculation of Impulsive mass			
	$mi/m = \frac{\tanh(0.866d/h)}{0.866\ d/h}$			
	Mi/m - Ratio Rd	Rd	0.6311	
		Mi	66408	kg
	Calculation of Convective mass			
	$mc/m = 0.23 * \frac{\tanh(3.68h/d)}{h/d}$			
	Mc/m - Ratio Re	Re	0.365	
		Mc	38416	kg
	Total mass of water	Tm	104824	
(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	1.388	m
	$hc/h = 1-\frac{\cosh(3.68\ h/d)-1}{3.68\ h/d \sinh(3.68\ h/d)}$	Rg	0.642	
		Hca	2.375	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	0.667	
		hib	2.469	m
	$hc^*/h = 1-\frac{\cosh(3.68\ h/d)-2.01}{3.68\ h/d \sinh(3.68\ h/d)}$	Ri	0.735	
		Hcb	2.719	m
(E)	Calculation of spring stiffness			
	$kc = 0.836*mg/h*\tanh^2(3.68\ h/d)$	Kc	223471	

Tank Geomtry : Circular with slab				
90 KL GLBR				
Time Period				
(A)	Ci			
	Coefficient for Calculation of			
	Time period in Impulsive mode time			
	Ci = 1 / (h/d)^0.5*(0.46-0.3*h/d+0.067(h/d)^2)	Ci	4.238	
(B)	Cc			
	Coefficient for Calculation of			
	Time period in Convective mode time			
	Cc = 2 * pi / (3.68*tanh(3.68h/d))^0.5	Cc	3.311	
(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	0.018	second
(D)	Time period in Convective mode			
	Tc = Cc * (D/g)^0.5	Tc	2.589	second

Tank Geomtry : Circular with slab				
90 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	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		0.50	
	Total heigth of tank		3.70	
	Ratio for partial burried	Rpb	0.135	
	Partial R	Prfac	2.270	
(C)	Calculation for Sa/g : for impulsive mode			
	Time Period Ti		0.0177	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	0.082589	
(E)	Calculation for Sa/g : for convective			
	Time Period Tc		2.59	second
	Sa/g : For Soft soil	saga1	0.645	
	Sa/g : For Medium soil	sagb1	0.525	
	Sa/g : For hard soil	sagc1	0.386	
	Sag for 0.5 % damping = sag * 1.75	sag1	0.92	
(F)	Seismic coeficient for implusive mode			
	Ahc = Z / 2 * I /R * Sa/g	Ahc	0.030	
(G)	Calculation of base shear due to			
	implusive mode			
	Vi = Ahi * (Mass of tank + Mass of water in impulsive mode) x G			
		Vi	98.83	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				
90 KL GLBR				
Horizontal seismic coefficient				
		Vc	11.44	kN
(I)	Total base shear			
	V = (Vi^2+ Vc^2)^ 0.5	V	99	
(J)	Moment at bottom of wall			
	Impulsive mode			
	Mombti : Ahi*(mi*hi+Mw*hw+Mt*ht)* G			kn-m
	Impusive mass of water	66408	1.39	92141
	Mass of wall	32011	1.85	59220
	Mass of plaster	2986	1.85	5524
	Mass of top slab	16141	3.80	61337
	Mass of topslab finishing	3228	3.90	12590
				230812
	Moment = Afi * (Sigma M * H) * G	mombti	187.0	
	Center of gravity of slab			
	=slab thickness /2		0.100	
(K)	Moment at bottom of wall			
	Convective mode			
	Mombti : Ahc*(mc*hc)* G	mombtc	27.18	kn-m
(L)	Total bending moment			
	momto			
	= ((mombti^2+mombtc^2))^0.5	Momto	188.97	kn-m

Tank Geomtry : Circular with slab				
90 KL 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	66408	2.67	177232
	Mass of wall	32011	2.05	65622
	Mass of plaster	2986	2.05	6121
	Mass of top slab	16141	4.00	64565
	Mass of topslab finishing	3228	4.10	13236
	Mass of bottom slab	19336	0.10	1934
	Mass of Bottom Ips	1211	0.20	242
				328952.67
	Moment = Afi * (Sigma M * H)* G	momovei	266.52	kn-m
(N)	Over turning moment			
	Convective mode			
	moment = Ahc*Mc*(hc*+thkbs)G	momovec	33.41	
	Total Moment of overturining	Momovrto	268.60	
	P/A	preaa	46.89	
	M/z	Prebb	8.15	
	P/a+m/z	Pmax	55.04	< SBC O.K
	Pa/-m/z	Pmin	38.74	> 0 O/K
(P)	Sloshing Wave Height			
	Wavh = Ahc * R * D/2	Wavh	0.207	
(Q)	Anchore Requriment			
	h/d ratio	0.6167		
	1/ahi	12.1081		
	h/d < 1/ahi	No anchorage required		

Tank Geomtry : Circular with slab		
90 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				
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 =	6.00	m		
Total Height of tank =	3.70	m		
D/h	1.62	ratio		
tanh(0.866D/h) = (A)	0.886			
Ahi *ro * G * h * Cos phi = C)	2998			

No	y/h	Y	(1-(y/h)^2 (B)	Qiw = 0.866* A * B	Piw kn/m2
1	0	0.00	1	0.768	2.3
2	0.1	0.37	0.99	0.760	2.3
3	0.2	0.74	0.96	0.737	2.2
4	0.3	1.11	0.91	0.698	2.1
5	0.4	1.48	0.84	0.645	1.9
6	0.5	1.85	0.75	0.576	1.7
7	0.6	2.22	0.64	0.491	1.5
8	0.7	2.59	0.51	0.391	1.2
9	0.8	2.96	0.36	0.276	0.8
10	0.9	3.33	0.19	0.146	0.4
11	1	3.70	0	0.000	0.0

Pressure on wall due to impulsive load at Y = 0	2.3

Tank Geomtry : Circular with slab					
90 KL 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 =		3.000			
L' =		3.000			
sinh(1.732*x/h)		1.914			
cosh(0.866*l'/h)		1.257			
Pib		3.953	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)		4.8704953			
Ahc *ro * G * D *(1-1/3cosph^2) Cos phi = C)		1192			

No	y/d	Y	cosh(3.674*y/d) (B)	Qcw = 0.5625*A / B	Pi
					kn/m2
1	0	0.00	1.000	0.115	0.138
2	0.1	0.60	1.068	0.123	0.147
3	0.2	1.20	1.282	0.148	0.176
4	0.3	1.80	1.671	0.193	0.230
5	0.4	2.40	2.289	0.264	0.315
6	0.5	3.00	3.218	0.372	0.443
7	0.6	3.60	4.588	0.530	0.631
8	0.7	4.20	6.583	0.760	0.906
9	0.8	4.80	9.477	1.094	1.304
10	0.9	5.40	13.664	1.578	1.881
11	1	6.00	19.717	2.277	2.714
Pressure on wall due to convective load at Y = 0				Pcw	0.14

Tank Geomtry : Circular with slab					
90 KL GLBR					
Hydrodynamic Pressure					
D	Convective hydrodynamic pressure at base of slab				
Pressure on slab due to convective mode					
	ahc	0.0303684			
Pcb = Qcb*ahc* ro* g * D					
Ahc *ro * G * D		1787			
Qcb = 1.125(x/D-4/3(x/d)^3)sech(3.674h/d)					
x = d /2					
	h	3.70			
	d	6.00			
	x	3			
	x/d	0.5			
	cosh(3.675h/d)	4.8704953			
	sech(3.674 h/d)	0.2053179			
qcb		0.0769942			
Pcb		0.1376259	kn/m2		

Final summary				
1	Impulsive hydrodynamic pressure at base of wall	Piw	2.301	kn/m2
2	Impulsive hydrodynamic pressure at base slab	Pib	3.953	kn/m2
3	Convective hydrodynamic pressure at base of wall	Pcw	0.138	kn/m2
4	Impulsive hydrodynamic pressure at base of wall	Pcb	0.138	kn/m2

E	Pressure due to wall inertia				
Pww = ahi*t*rom* G					
Ahi	hor. Seismic coef. In impls	0.0825893			
t	wall thickness	0.175	m		
rom*G	mass density* G	25	kn/m3		
Pww			Pww	0.361328	kn/m2

Tank Geomtry : Circular with slab					
90 KL 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		2.270		
sa/g	acceleration		2.5		
			Av	0.055	
for y = 0 at base level					
ro*g* h*(1-y/h)		36.297			
			Pv	1.998496	kn/m2
F	Maximum hydrodynamic pressure				
Pmax	=((Piw+Pww)^2+Pcw^2+pv^2)^0.5				
			Pmax	3.332	kn/m2
Pmax is about		9.0045093	%	< 33.33 %	
Maximum hydraudyanmic froce in normal condition				37.00	kn/m2
As hydraudyanmic force < 33 % it will not govern in design					

SUMP : 90 KL					FORMULA
PROJECT: PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)	GLBR AT	CLIENT			
	Madharam Gutta	RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA			
STRUCTURE	DESIGN CALCULATION FOR GLBR	DATE		REV	
		23/03/2016		0	

DESIGN CALCULATION

DATA

General Data				
Required Capacity of Sump	Sumpcap	**90.000**	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	**6.00**	m	
Depth of tank above GL		**3.20**		
Depth of tank below GL		**0.50**		
Water depth : With Dead storage	Wd	**3.40**	m	
Top Slab thickness	Tsthk	**0.200**	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	3.400			
Inside Diameter		6.000			
Clear Inside Diamater without plaster	Diac	5.976			
total volume	**vt**	**95.37**	m3		
dead storage	vdd	4.21	m3		
net volume	vn	91.16	m3 >	90.000	OK
[B] TOP SLAB DESIGN					
Concrete grade	Fck	30	N/mm2		
Steel	Fy	500	N/mm2		
Clear cover	Cv	45	mm		
Slab Diameter	Lx	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/m3
Loading				
Live load	LI		1.5	kN/m2
Finishing load	FI		1	kN/m2
CALCULATION				
Calculation of loading				
Self wt (Dead load)	DI		5	kN/m2
Total Load	TI		7.5	kN/m2
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	mm2
Provide : 10 dia - 150 c/c				

Roof slab design as circular slab.

[C] CYLINDRICAL WALL

inner diameter	cyid	6.000	m
top thickness	cytt	**0.175**	m
bottom thickness	cybt	**0.175**	m
Water depth	cyh	**3.400**	m
coefficient of constant height	cyc	**0.000**	
free board		0.300	m
height of wall fir design	cyhh	3.700	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 13.038
Enter Value for Auto serach **12.000**

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 Aréa of steel in mm2 on each face
	m	mm		kN	mm2		
1	0.370	0.175	0.001	0.1	1	0.001	210
2	0.740	0.175	0.098	10.8	83	0.060	210
3	1.110	0.175	0.197	21.9	168	0.120	210
4	1.480	0.175	0.300	33.3	257	0.184	210
5	1.850	0.175	0.412	45.8	352	0.252	210
6	2.220	0.175	0.536	59.5	457	0.328	210
7	2.590	0.175	0.661	73.4	565	0.404	210
8	2.960	0.175	0.756	83.9	645	0.462	210
9	3.330	0.175	0.737	81.8	629	0.450	210
10	3.700	0.175	0.496	55.0	423	0.303	210

Minimun % steel as per IS 3370-2009

Maximum Dimension
6.000
Permissible dimension for 0.24 % steel
15.000
Minimum Steel
0.240

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	256.532	**10**	**200**	785
5	352.065	**10**	**200**	785
6	457.499	**10**	**200**	785
7	564.738	**10**	**200**	785
8	645.260	**10**	**200**	785
9	628.951	**10**	**200**	785
10	423.239	**10**	**200**	785

weight of wall					
straight part	cyspw	288.6	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	17.5	kN		=(cyid-pt)*PI()*pt*(trdd+cyh+mrdd/2-cyxa)*uwp
total weight	tlcy	306.1	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	0.370	0.175	0.00000	0.000	0.120	0	210
Minimun % steel as per IS 3370-2009	2	0.740	0.175	-0.00005	-0.024	0.120	-2	210
	3	1.110	0.175	0.00005	0.024	0.120	2	210
Maximum Dimension	4	1.480	0.175	0.00010	0.049	0.120	3	210
#REF!	5	1.850	0.175	0.00020	0.099	0.120	7	210
Permissible dimension for 0.24 % steel	6	2.220	0.175	0.00104	0.527	0.120	38	210
15.000	7	2.590	0.175	0.00209	1.060	0.120	75	210
Minimum Steel	8	2.960	0.175	0.00244	1.238	0.120	88	210
#REF!	9	3.330	0.175	-0.00029	-0.148	0.120	-11	210
	10	3.700	0.175	-0.00967	-4.900	0.120	-349	210

	sr. no	area of steel requd	dia of bar	bar spacing	area of steel prod	distance
	1	210.000	**10**	**200**	393	0.370
	2	210.000	**10**	**200**	393	0.740
	3	210.000	**10**	**200**	393	1.110
	4	210.000	**10**	**200**	393	1.480
	5	210.000	12 **10**	**200**	393	1.850
	6	210.000	**10**	**200**	393	2.220
	7	210.000	**10**	**200**	393	2.590
	8	210.000	**10**	**200**	393	2.960
	9	210.000	**10**	**200**	393	3.330
	10	210.000	**10**	**200**	393	3.700

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 : 90KL 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	**0.50**	m					
Water depth	wtd	**3.40**	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	**3.70**	m					
minimum % steel	pt	**0.24**	%					
Moment								
Due to Water	Mtw	**4.85**	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	**3.700**	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	3.700	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	16.19	0.39	6.27
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	16.65	0.70	11.66
Total downward load		48.76		24.45

Total restoring moment @ toe	TRM	24.4	kN-m
Total over turning moment		4.9	kN-m
F.S.against over turning		5.0	
Check for over turning	Hense o.k		
Total moment due to vertical load	Tmv	24.4	kN-m
Total moment due to horizontal load	Tmh	4.9	kN-m
Total vertical load	TPv	48.8	kn
Net Moment	Tmn	19.6	kN-m
M/p	E	0.40	m
Ecc	Ecc	0.061	m
b/6	Aec	0.15	m
Net moment From ECC	Mdg	2.957	

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	52.72	kN/m2
Pressure due to moment =M/Z	Preb	20.74	kN/m2
Pressure			
Maximum pressure - P/A + M/Z	Pmax	73.45	kN/m2
Minimum pressure - P/A + M/Z	Pmin	31.98	kN/m2
Check for SBC			
Maximum pressure < SBC		OK	
Minimum presure > 0		OK	
Pressure difference		41.47	
Pressure difference / m		44.84	
Pressure at outer Wall face - A	preow	60.00	kN/m2
Pressure at inner Wall face B	preiw	52.16	kN/m2
Pressure at point C	preiw1	31.98	kN/m2

Design of Toe - At Point A

Moment at face of outer wall			
Due to rectangle diagram	Mreco	2.70	kN-m
	Mtrio	0.40	kN-m
Total moment due to upward pressure		3.10	kN-m
Net moment at A from Toe side	Toem	3.10	kN-m
Thickness at toe		200	mm
Effective depth	Deftoe	145	mm
Ast required =		191	mm2
Check for minimum steel			
top		240	mm2
bottom		0	mm2
Design Steel			
Main steel - Top		240	mm2
Main steel - bottom		191	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	3.2	kN-m
	Mtrii	0.7	kN-m
Total Upward moment		3.9	kN-m
Due to water (down ward)		3.7	kN-m
Net downward moment at B from heel side	heelm	0.2	kN-m
Thickness Provided		200	mm
	defheel	145	mm
Ast required =		11	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	145	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	73.5	<	150	OK				
2>	P/A - M/Z	32	>	0	OK				
Reinforcement									
	AstR						Astp		
Toe		dia	spc	+	dia	spc			
Top - main	240	10	200		0	0	393	OK	
Bottom main	191	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	16.19	0.54	8.70
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	2.70	0.78	2.09
Total downward load		**34.81**		**19.01**

Total restoring moment @ heel	TRMs	19.0	kN-m
Total over turning moment due to soil		0.5	kN-m
F.S.against over turning		38.0	
Check for over turning	Hense o.k		
Total moment due to vertical load	Tmv1	19.0	kN-m
Total moment due to horizontal load	Tmh1	0.5	kN-m

Total vertical load	TPv1	34.8	kn
Net Moment	Tmn1	18.5	kN-m
M/p	E1	0.53	m
Ecc	Ecc1	-0.069	m
b/6	Aec1	0.15	m
Net moment From ECC	Mdg1	-2.4053	
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	37.64	kN/m2
Pressure due to moment =M/Z	Preb1	-16.9	kN/m2
Pressure			
Maximum pressure - P/A + M/Z	Pmax1	20.77	kN/m2
Minimum pressure - P/A + M/Z	Pmin1	54.50	kN/m2
Check for SBC			
Maximum pressure < SBC		OK	
Minimum presure > 0		OK	
Pressure difference		-33.73	kN/m2
Pressure difference / m		-36.47	kN/m2
Pressure at outer Wall face - A	preow1	43.56	kN/m2
Pressure at inner Wall face B	preiw1	37.18	kN/m2

Design of Toe - At Point A			
Moment at face of outer wall			
Due to rectangle diagram	Mreco1	2.45	kn-m
Due to triabgular diagram	Mtrio1	-0.16	kn-m
Total moment due to upward pressure		2.29	kn-m
Total downward moment due to soil		0.41	kn-m
Net moment at A from Toe side	Toem1	-1.88	kn-m
Thickness at toe		200	mm
Effective depth	Deftoe1	145	mm
Ast required =		#####	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	3.76	kn-m
	Mtrii1	-1.11	kn-m
Total Upward moment	heelm1	2.66	kn-m
Net downward moment at B from heel side		200	mm
Thickness Provided	defheel1	145	mm
Steel required at bottom		164	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	164	mm2
Distribution steel - top	240	mm2
Distribution steel -bottom	0	mm2

SUMMARY

Pressure Check

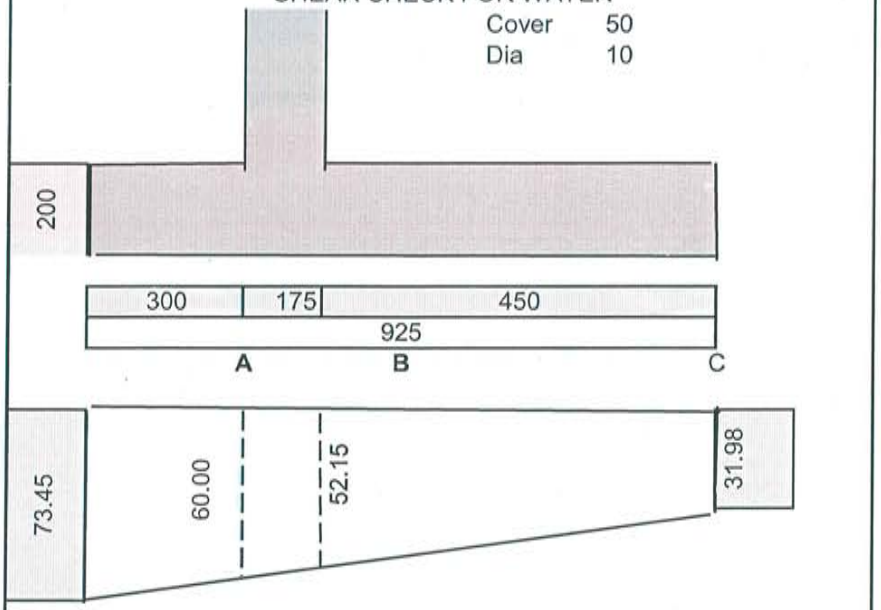
1>	P/A + M/Z	20.8	<	150.0	OK
2>	P/A - M/Z	54.5	>	0	OK

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	164	10	200		0	0	393	OK
Top - Dist	240	10	200		0	0	393	OK
Bottom - Dist	0	10	200		0	0	393	OK

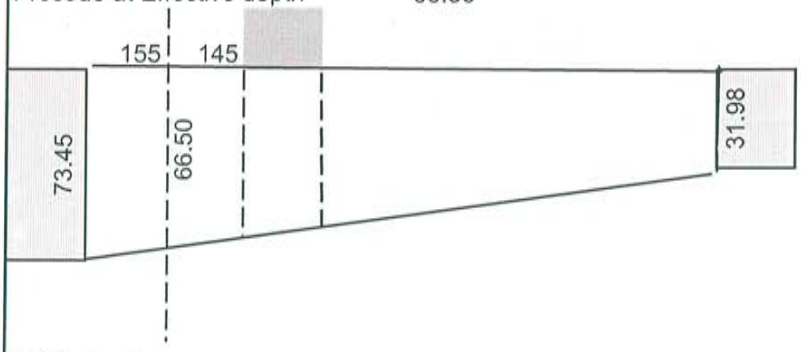
SHEAR CHECK FOR WATER

Cover 50
Dia 10



Total Width	925	mm
Difference in pressure	41.47	kN/m2
Pressure Difference / m	44.83	kN/m2
Pressure at outer face of wall	60	kN/m2
Pressure at inner face of wall	52.15	kN/m2
Shear t be check at effective depth	D	
Effective depth	145	mm

Pressue at Effective depth 66.50



Total shear

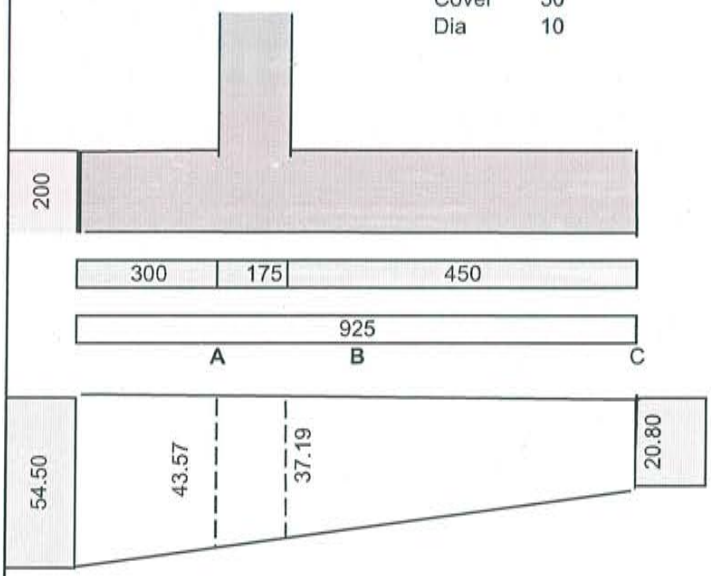
Avg presure	=	69.98
Shear	=	10.85 kN
effevtive depth		145 mm
Shear stress	=	0.075 N/mm2

"Designs Vetted"

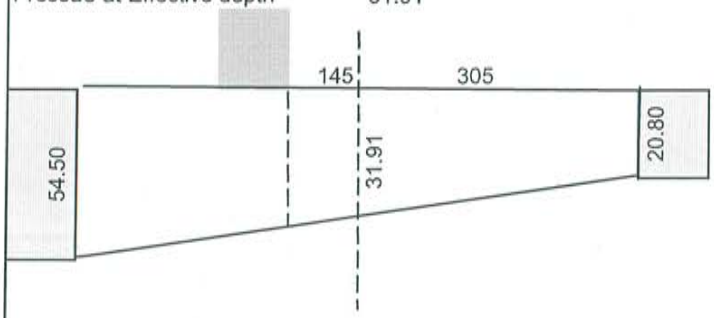
M/S. S.K. ASSOCIATES
Hyd-68.

SHEAR CHECK FOR SOIL

Cover 50
Dia 10



Total Width	925 mm	
Difference in pressure	33.70	kN/m2
Pressure Difference / m	36.43	kN/m2
Pressure at outer face of wall	43.57	kN/m2
Pressure at inner face of wall	37.19	kN/m2
Shear t be check at effective depth	D	
Effective depth	145 mm	
Pressue at Effective depth	31.91	



Total shear

Avg presure = 26.36

Shear = 8.039 kN

effevtive depth 145 mm

Shear stress = 0.055 N/mm2

"APPROVED

17/11/16

SE, TDWSP

NIRMAL

LARSEN & TOUBRO LTD. Komaram Bheem - Asifabad Segment Construction-TDWSP -ADILABAD

Superintendent Engineer

TDWSP Nirmal

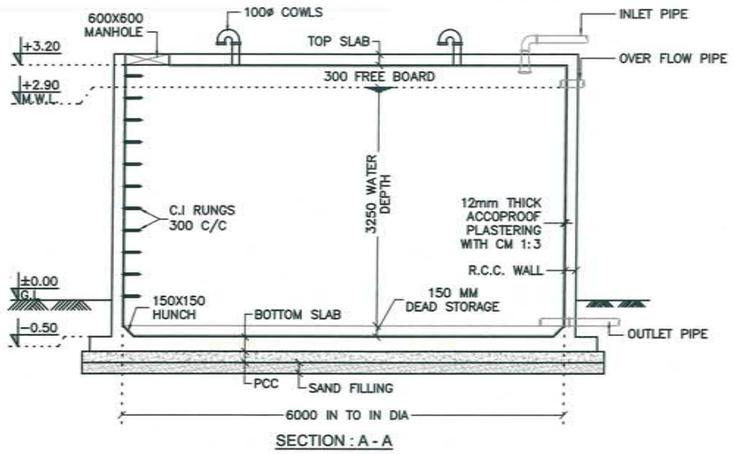
"Designs Vetted"

V.V.S.K. ASSOCIATES

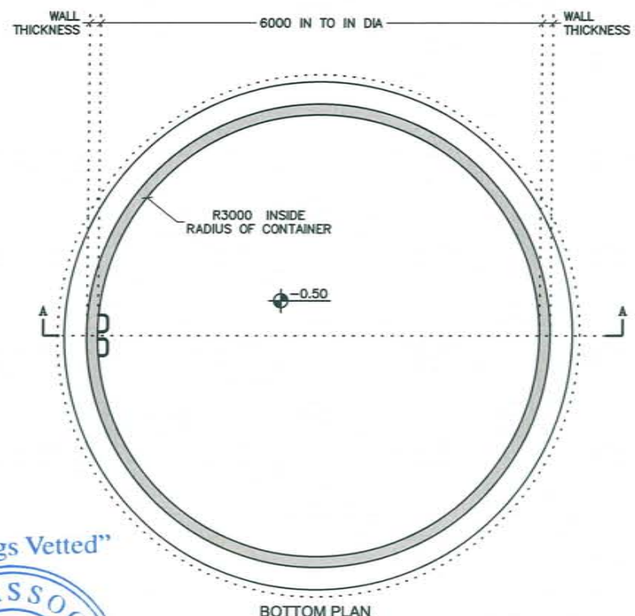
Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

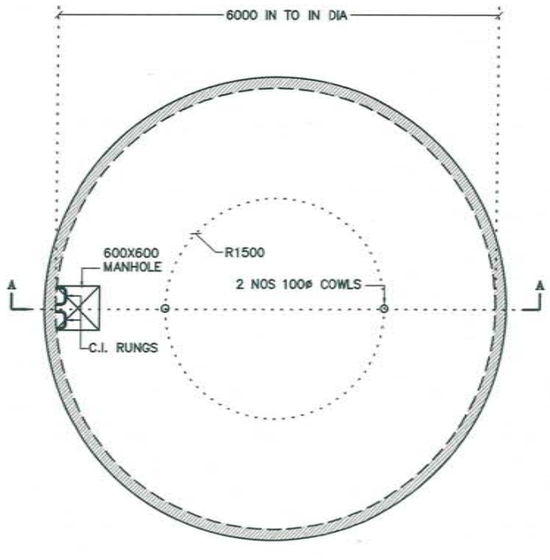
Executive Engineer
TDWSP Asifabad



SECTION : A - A



BOTTOM PLAN



TOP PLAN

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 & OVERFLOW PIPE SHALL BE VARIFIED WITH ENGINEER INCHARGE BEFORE EXECUTION

"APPROVED
7/11/16
SE, TDWSP
NIRMAL

WAPCOS LIMITED

Superintendent Engineer
TDWSP Nirmal

LARSEN & TOUBRO LTD. Komaram Bheem - Asifabad Segment Construction TDWSP ADILABAD

REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	04/07/16	–	DAP	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		04/07/16
DRWN	DAP		04/07/16
CHKD	RMM		04/07/16
APPD	–		04/07/16

TITLE : 90KL CAPACITY GLBR AT MADHARAM GUTTA
(GENERAL ARRANGEMENT DRAWING)

SCALE 1:50

PROJECTION

DRAWING No. LE150883-C-WS-RW-GA-1589 | SIZE A3 | REV. A

COMP. DATA : P16-02_48-01-01 SHEET 1 OF 1

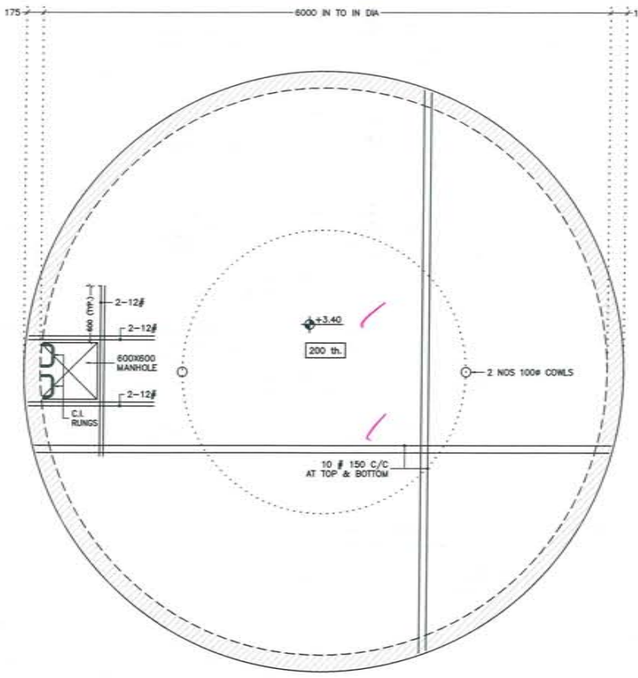
RELEASED FOR ☐ PRELIMINARY ☐ TENDER ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

"Drawings Vetted"
ASSOCIATES Hyd-08

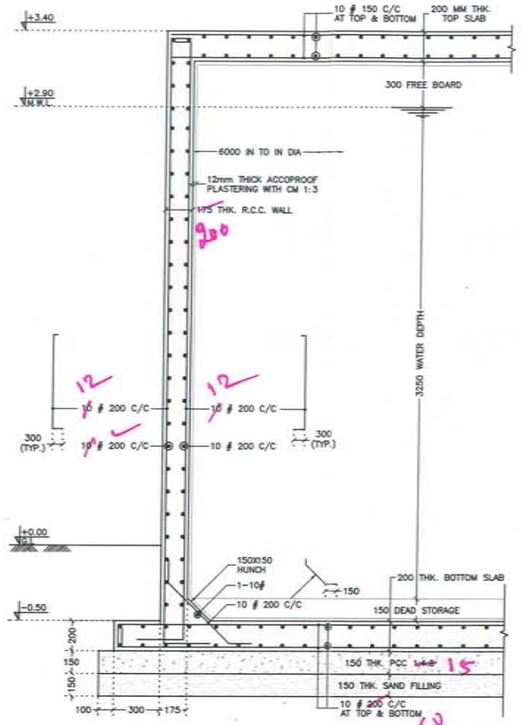
Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

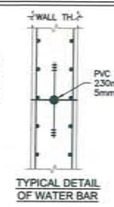
Executive Engineer
TDWSP Asifabad



TOP PLAN

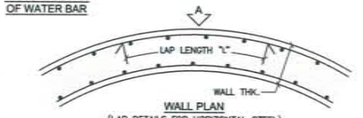


SECTION : A - A

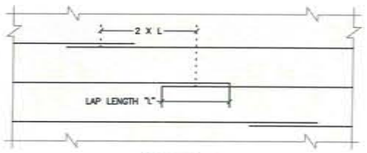


TYPICAL DETAIL OF WATER BAR

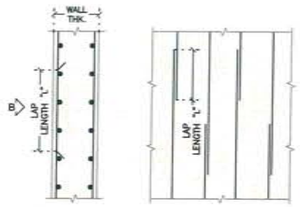
LAP LENGTH SECHDULE	
DIA OF BAR	LAP LENGTH "L" IN mm
8	368
10	480
12	552
16	736
20	920
25	1150



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



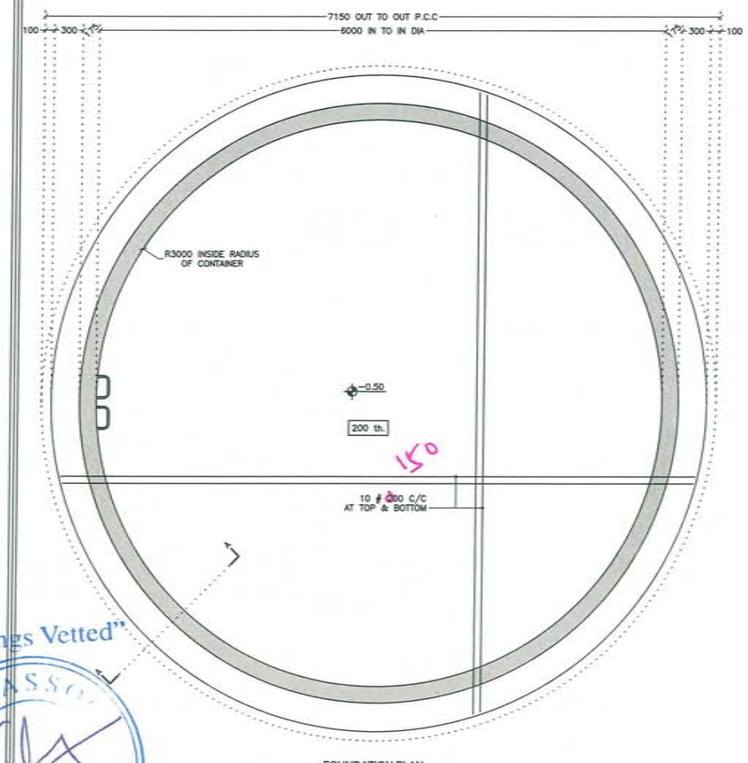
WALL SECTION
LAP DETAILS FOR VERTICAL STEEL
(LAP SHALL BE STAGGERED AS PER ELEVATION – B)

ELEVATION : B

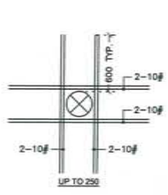
NOTES :-

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

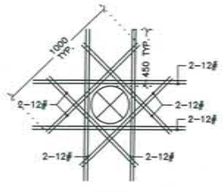
"APPROVED"
17/11/16
SE, TDWSP
NIRMAL



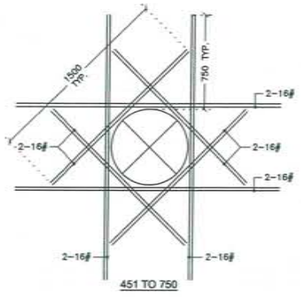
FOUNDATION PLAN



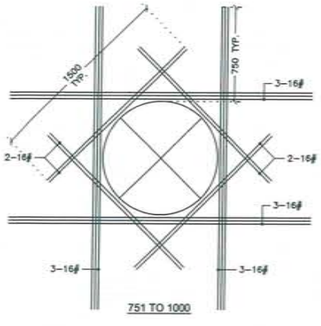
UP TO 250



251 TO 450



451 TO 750



751 TO 1000

TYPICAL DETAIL FOR EXTRA STEEL BAR AT CUT-OUT

"Drawings Vetted"

Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

Executive Engineer
TDWSP Asifabad

Superintendent Engineer
TDWSP Nirmal

REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	21/07/16	RPS	DAP	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		21/07/16
DRWN	DAP		21/07/16
CHKD	RMM		21/07/16
APPD	–		21/07/16

TITLE : 90KL CAPACITY GLBR AT MADHARAM GUTTA (STRUCTURAL DETAILS)

SCALE 1:50

PROJECTION

DRAWING No. LE150883-C-WS-RW-RC-1592 | SIZE A2 | REV. A

COMP. DATA : P16-02_48-02-01 | SHEET 1 OF 1

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