

Design Of 150 KL Capacity Sump at

Data

Location				
Safe bearing Capacity	sbc	Safe	100 Kn/m ²	
Capacity	v		150 KL	
Free Board	fb		0.25 m	
Dead Storage	ds		0.20 m	
Dia of sump	d		9.00 m	
Projection from side wall	ps		0.15 m	
Depth of the tank	h		2.85 m	
Depth of tank above GL	dgl		0.50 m	
Depth of tank below GL			2.35 m	
thickness of PCC (lean mix cc1:6:10)	coater wt		0.00 m	
Th. Of Bottom Slab	bsth	Provided th is Sufficient	0.200 m	0.13 m
Depth of Water table below GL	wi	Safe Against Uplift	2.00 m	

Top Dome

Rise of the dome			1.40	
Radius of the dome			7.93	
Thickness of Dome	td	150 to 100	0.1	0.125 m
Dia of Reinforcement	db			10 mm
Reinforcement Spacing				125 mm c/c

Provide 10 mm dia Tor @ 125 mm C/c both radially and in the form of circular rings

Top Ring Beam

Width of ring beam	rb		300 mm	
Depth of ring Beam	dtrb	Provided size is sufficient	300 mm	140 mm
Dia of hoop bars	dbrb		12 mm	8 Nos
Dia of Stirrups			8 mm	200 mm 225

Side Wall

Depth of the tank	h		2.85 m	
Th. Of Side wall	sth		0.200 m	144 mm
Depth of tank above GL	dgl		0.50 m	

Moments

Inner Side	5.65 Kn-m
Outer Side	6.873 Kn-m

Hoop force

Inner Side	76.8 Kn	(Tension)
Outer Side	89.19 Kn	(Compression)

Reinforcement

			Dia	Spacing Provided	Required
Inner face	Vertical	334 mm ²	10 mm	200 mm	200
	Horizontal	298 mm ²	10 mm	200 mm	200
Outer face	Vertical	406 mm ²	10 mm	175 mm	190
	Horizontal	296 mm ²	10 mm	200 mm	200

Bottom slab

Safe bearing Capacity	sbc		100 Kn/m ²		
Th. Of Bottom Slab	bsth	Provided th is Sufficient	0.200 m	0.13 m	
Dia of Bottom Slab	db		9.70 m		
Size of Haunch.	bh		0.25 m		
effective cover to reinforcement for raft slab			covraft	67 mm	
Moments	Radial			5.54 Kn-m	
	Circumferential			5.54 Kn-m	
Reinforcement	Top mesh	Ast	Dia	spacing Provided	Required
		369 mm ²	12 mm	200 mm	200
	Bottom mesh	240 mm ²	10 mm	200 mm	200

Design Calculations

Top Dome			
Chord Dia of the Dome	dcd		9.00 m
Rise of the Dome	hd		1.40 m
Radius of the Dome	rd		7.93 m
Theta	th	$\sin^{-1}(dcd/(2*rd))$	34.56 Degrees
Sin(theta)			0.57
Cos(theta)			0.83
Dead load on dome			3.13 Kn/m ²
Live Load			1.50 Kn/m ²
Total Load	wd		4.63 Kn/m ²
Meridional Stress	Ts	$wd*rd*10^3/((1+\cos(th))*td*10^6)$	0.17 N/mm ² Safe
Maximum Hoop Stress	Hs	$wd*rd*10^3/(2*td*10^6)$	0.15 N/mm ² Safe
Ast			300 mm ²

Top Ring Beam			
Maximum Hoop Tension	Ht	$Ts*td*\cos(th)*dcd/2$	79.37 Kn
Area of steel required	astrb	HU/130	610.53 mm ²
No of bars		$astrb/(\pi*dbrb^2/4)$	6 Nos
Provide 8 Nos of 12 mm dia tor and provide 8 mm dia stirrups @ 200 C/c			
Actual Area of Steel Provided	aastrb		905 mm ²
Area of ring beam required	Arb	$(Ht*1000-(m-1)*aastrb*1.5)/1.5$	42052.50 mm ²
Assuming a Square section			
Size of beam	Arb/rb		140.18 mm
Provided size is sufficient			

Side Wall			
Depth of the tank	h		2.85 m
Dia of inner face bars	dbi		10 mm
Dia of outer face bars	dbo		10 mm
Dia of bars for hoop	dbh		10 mm
H ² /Dt			4.52

CASE I : Inside Water and Outside no Earth

From Table of IS 3370 Coefficients

			4	4.52	5
Max BM	bmcf		0.0268	0.02441	0.0222
	bmcfp		0.0077	0.00677	0.0059
Max Ring Tension	rtcf		0.5790	0.59876	0.6170
Max. -ve BM	mbm	$(bmcf*10^3*h^3)$			5.65 Kn-m
Max +ve BM	mpbm	$(bmcfp*10^3*h^3)$			1.57 Kn-m
Max. Ring Tension	mrt	$(rtcf*10^3*h*d/2)$			76.8 Kn

CASE II OUT SIDE SATURATED EARTH AND INSIDE EMPTY

Unit weight of Soil	γs				18 Kn/m ³
Angle of Repose	Phi				30 °
Side wall ht below GL	hbgl	h-dgl			2.35 m
Coeff of active Earth pr	Ka	$(1-\sin(\Phi))$			0.34
		$(1+\sin(\Phi))$			
Pressure	Pa	$IF(wl>hbgl,Ka*γs*hbgl,Ka*γs*hbgl+hbgl)$			37.88 Kn/m ²
					3.07

From IS 3370 Coefficients

			3.0	3.1	4.0
	bmcfs		0.0333	0.03285	0.0268

	bmcfps	0.0097	0.00956	0.0077	
Max Ring Tension	rtcfs	0.519	0.5232	0.579	
Max. -ve BM	mbms	(bmcfs*pas*hbgl ²)		6.87 Kn-m	
Max +ve BM	mpbms	(bmcfps*pas*hbgl ²)		2.00 Kn-m	
Max. Ring compression	mrtfs	rtcfs*pas*d/2		89.19 Kn	
Th. Of Side Wall		(MAX(mbm,mbms)*10 ⁶ *6/(2*1000)) ^{0.5}		144 mm	
					Th. Provided is Sufficient
Eff Th. Of Side wall	edswi			150 mm	
Max Inner face moment	bmi	MAX(mpbms,mbm)		5.65 Kn-m	
Max outer face moment	bmo	MAX(mpbm,mbms)		6.87 Kn-m	
Area of Steel Reinforcement					
Min Steel	pt	0.24%	for <15m span	0.35%	0.24
Area of Bending Steel inner side	Astm	MAX(pt*sth*10 ⁴ ,bmi*10 ⁶ /(130*0.87*e		334 mm ²	on each side
Area of steel outer face	Astpbm	MAX(pt*sth*10 ⁴ ,(bmo*10 ⁶ /(130*0.87		406 mm ²	on each side
Area of Steel for Hoop	Asth	MAX(pt*sth*10 ⁴ ,CEILING(mrt*1000/13		591 mm ²	for two sides
Vertical Steel Spacing					
<u>inner face</u>	vsp				
Spacing		FLOOR(pi*dbi ² /4*1000/Astm,25)		200 mm	
Provide 10 mm dia TOR @ 200 mm C/c					
<u>Outer face</u>	vspo				
Spacing		FLOOR(pi*dbo ² /4*1000/astpbm,25)		190 mm	
Provide 10 mm dia TOR @ 190 mm C/c spacing					
<u>Horizontal Steel</u>					
Spacing	hsp	FLOOR(pi*dbh ² /2*1000/Asth,25)		200 mm	
Provide 10 mm dia TOR @ 200 mm C/c on both faces in staggered fashion					
<u>Design Of Bottom Slab</u>					
Projection from side wall	ps			0.15 m	
Dia of Bottom Slab	dfs	d+2*sth+2*ps		9.70 m	
Size of Haunch	bh			0.25 m	
Dia of Bar	top	dbbs		12 mm	
	bottom	dbbsb		10 mm	
Load on Bottom Slab					
Wt of Top Dome		2*pi*rd*hd*wd		322.74 Kn	
Wt of Ring Beam		pi*(d+rb/1000)*rb*drb*25/10 ⁶		65.74 Kn	
Wt Of Side wall		pi*(d+sth)*sth*(h-dtrb)*25		368.5 Kn	
Wt of Haunch		pi*(d-bh)*bli ² /2*25		21.48 Kn	
Total Load	wbs			778.46 Kn	
				7.78 sq m	0.22075
Max Pr on Soil	prb	Wbs/(pi*(d)*1)		27.53 Kn/m ²	
Bottom Slab is designed as circular Slab loaded with UDL and Simply Supported on edges					
			r	4.6	3.85
Radial moment	mri	3/16*prb*((dfs/2) ² -((d+sth)/2) ²)-wbs/		-1.39 mrb	5.54 Kn-m
Circuferential Moment	mti	1/16*prb*(3*(dfs/2) ² -((d+sth)/2) ²)-wb		5.15 mtb	5.54 Kn-m
for uplift		Net uplift load on bottom slab		0.5 Kn/m ²	
for uplift		max Radial moment		1.47	1.47 Kn-m
		max Circuferential Moment		1.47	1.47 Kn-m
Max Radial Moment	mr	IF(wl>hbgl,0,CEILING(3*prb*(dfs/2) ² /		5.54 Kn-m	1.47 Kn-m
Max Circumferential moment	mt	IF(wl>hbgl,0,CEILING(prb*(dfs/2) ² /16		5.54 Kn-m	1.47 Kn-m

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sump

Base Slab Th for Uncracked Condition

Th	bsth	$lF(mr=0,sth*1000,(max(mr,mt)*6*10^6/l$	0.129 m	0.067 m
			Provided th is Sufficient	
Eff Depth	de	bsth*1000-covraft	133 mm	
Area of Steel				
Min Steel	Astmin	0.24% for <15m span 0.36% min for TOP STEEL = min for TOP STEEL =	0.24 % 480 mm ² 240 mm ²	
Area of Steel	Astr	$mr*10^6/(130*.87*de)$	369 mm ²	
Spacing				
Top Steel	Asttp	$pi*(dbbs^2/4)*1000/max(Astmin,astr)$	200 mm	
Provide 12 mm dia TOR @ 200 mm c/c in the form of mesh at top				
Bottom Steel	Astb	$pi*(dbbsb^2/4)*1000/(Astminb)$	200 mm	
Provide 10 mm dia TOR @ 200 mm c/c in the form of mesh at bottom				
Check For SBC				
Load from tank Portion	wbs		778.46 Kn	
Weight of Bottom Slab	wbsi	$pi*(dbs^2/4)*bsth*25$	369.48 Kn	
Weight of water	ww	$pi*(d^2/4)*h*10$	1813.04 Kn	
Total	W	wbs+wbsi+ww	2960.98 Kn	
Pr on Soil.	pr s	$w/(pi*dbs^2/4)$	40.07 Kn/m ²	Safe
Check For Uplift				
Depth of Water	dw	h-hgl-wl+bsth	0.55 m	
Wt of Sump upto side walls only	We	wbs-wtdome+wbsi	825 Kn	
Uplift Pr	Pu	$pi*dbs^2/4*dw*10$	406 Kn	
Resisting load		cc wt+str wt	825 Kn	
Factor of Safety against Uplift	F	We/Pu	2.04	
			Safe Against Uplift	

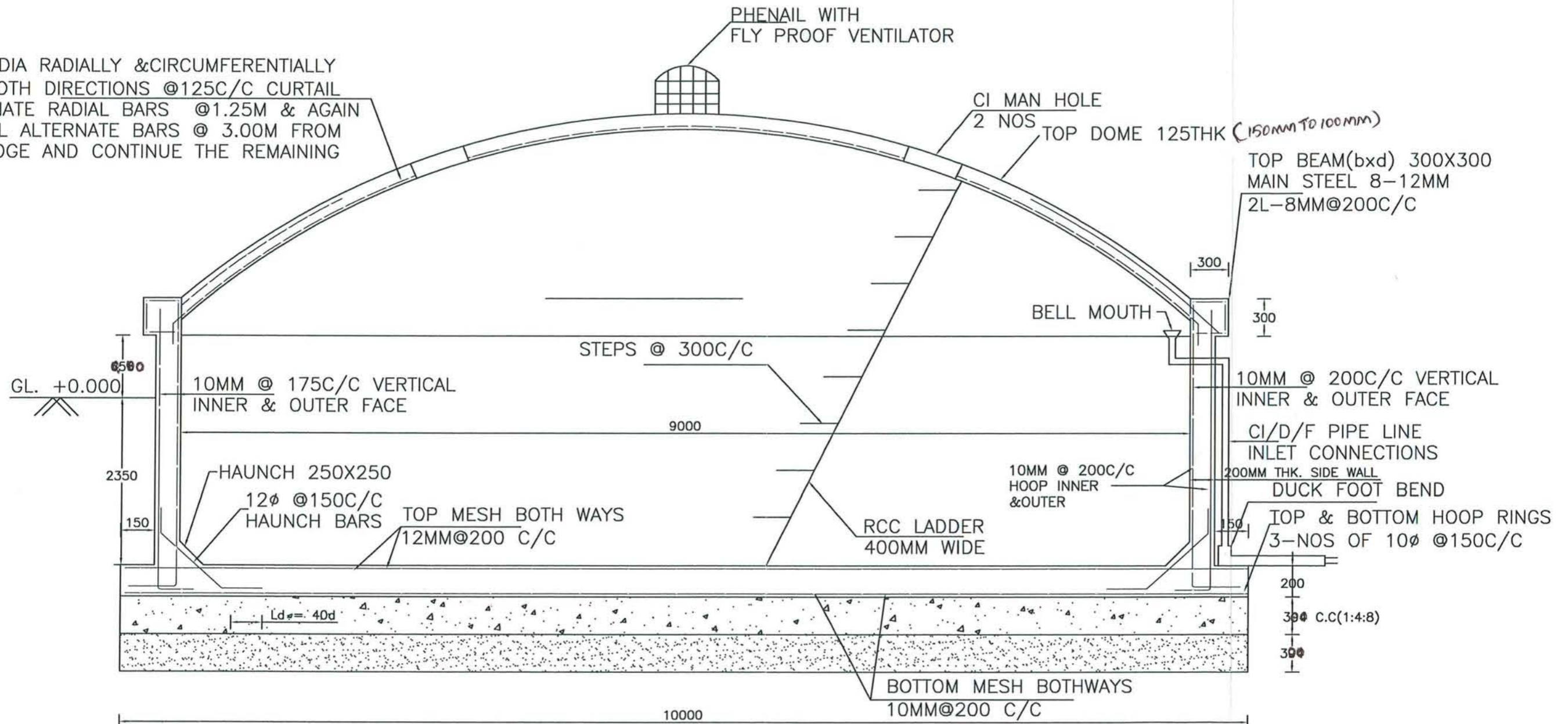

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150KL SUMP

10MM DIA RADIALLY & CIRCUMFERENTIALLY FOR BOTH DIRECTIONS @125C/C CURTAIL ALTERNATE RADIAL BARS @1.25M & AGAIN CURTAIL ALTERNATE BARS @ 3.00M FROM THE EDGE AND CONTINUE THE REMAINING BARS



All dimensions are in 'mm'
 Concrete mix V.R.C.C M30
 Steel Fe-415
 Reinforcement details shall be as per IS-SP34

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CIVIL & STRUCTURAL		
MECHANICAL		
ELECTRICAL		
INSTRUMENTATION		

A FOR INFORMATION		DESIGNED	DRAWN	CHECKED	APPROVED
REV. NO.	DESCRIPTION				
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 (PRIMARY GRID)					
SUB-PROJECT CONTRACTOR: L&T Construction Water & Effluent Treatment SBG			SCALE		
JOB No	LE150883	TITLE	WANKIDI MANDAL - GANESHPUR		SCALE
NAME	SIGN	DATE			
			SUMP - 150KL		REDUCTION
			DRAWING No. LE150883-W-WS-WT-PP-		SIZE REV.
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