

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)	couter 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	296 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
	Bottom mesh	369 mm ²	12 mm	200 mm	200
		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	
Meridinal 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	asttrb	HV/130		610.53 mm ²	
No of bars		$asttrb/(\pi*dbrb^2/4)$		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					
	For H ² /Dt		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	$(bmcf*10^4h^3)$			5.65 Kn-m
Max +ve BM	mpbm	$(bmcfp*10^4h^3)$			1.57 Kn-m
Max. Ring Tension	mrt	$(rtcf*10^4h^2/2)$			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 °
Soe wall ht below GL	hbg1	h-dgl			2.35 m
Coeff. Of active Earth pr	Ka	$(1-\sin(\Phi))$			0.34
		$(1+\sin(\Phi))$			
Pa		$IF(wi>hbg1,Ka*gs*hbg1,Ka*gs*hbg1+hbg$			37.88 Kn/m ²
					3.07
From Table of IS 3370 Coefficients					
	For H ² /Dt		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	mrtc			89.19 Kn	
Th. Of Side Wall	(MAX(mbm,mbms)*10^6*(2*1000))^0.			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	0.12 %
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	dbb	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
<u>Load on Bottom Slab</u>					
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)*bh^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*((dbb/2)^2-((d+sth)/2)^2)-wbs/			-1.39 mrb 5.54 Kn-m
Circuferential Moment	mti	1/16*prb*(3*(dbb/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*(dbb/2)^2/			5.54 Kn-m 1.47 Kn-m
Max Circuferential moment	mt	IF(wl>hbgl,0,CEILING(prb*(dbb/2)^2/16			5.54 Kn-m 1.47 Kn-m

sump-11

sump

Base Slab Th for Uncracked Condition

Th	bsthr	$IF(mr=0, sth*1000, (max(mr, mt)*6*10^6/l$	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 0.35% min for TOP STEEL =	0.24 % 480 mm ²	
		min for TOP STEEL =	240 mm ²	
Area of Steel	Astr	$mr*10^6/(130*.87*de)$	369 mm ²	
Spacing				
Top Steel	Asttp	$pi*(dbbs^2/4)*1000/max(Astmn, astr)$	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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GEOTECHNICAL INVESTIGATION REPORT

TELANGANA DRINKING WATER SUPPLY PROJECT

KOMARAM BHEEM - ASIFABAD- SEGMENT 22

ASIFABAD , ADILABAD DISTRICT

150 KL SUMP AT LODDI GUDA, THIRIYANI (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

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TELANGANA DRINKING WATER SUPPLY PROJECT

150 KL SUMP AT LODDIGUDA, THIRIYANI (M) IN ADILABAD DT.

1. INTRODUCTION

M/s. L & T Construction, Water & Effluent Treatment is proposing to construct 150 KL Sump at Loddiguda, Thiriyani (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.

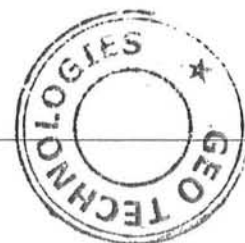
Analysis of borehole data , Laboratory tests and geotechnical investigation report have been made by Prof. D Babu Rao, ME (IIT,R) , Ph.D. (USA), MIGS, Empanelled Consulting Geo technical Engineer & Director, Geo technologies, Former Professor of Civil Engineering, Osmania University.

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 150 KL Sump at Loddiguda, Thiriyani (M) in Adilabad Dt.
- Conducting SPT at regular intervals, where feasible
- Collection of undisturbed / disturbed samples from the Bore holes


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- Preparation of Technical Report recommending suitable foundations and safe bearing capacity

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 6 – 7 Jan ,2016.

The following relevant data was recorded during Rotary drilling operations.

- Nature of strata
- Details of samples


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- Core Recovery (CR)
- Rock Quality Designation (RQD)

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	R.L.	Drilled depth
1	550.0	6 m

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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.

The following tests were conducted on cores from hard rock from 1.5 m depth.:

- Unconfined compressive strength (as per IS: 9143)

Table 1 gives the rock properties of Cores.

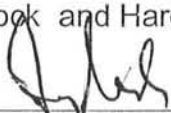
No cores were available in weathered rock .

5. SUB SOIL PROFILE

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

Depth	Strata	N value
0 – 1 m	Top soil	-
1 – 1.5 m	Weathered rock	>100
1.5 – 6.0	Hard rock	Cores

. 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.


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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)

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.

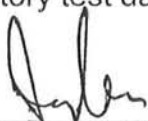
These foundation settlements are evaluated using elastic theory. The pressure distribution below the footing is assumed as 2 V: 1 H for estimating the settlement. Since rock formation is available at shallow depth. The settlement will be within the permissible limit. Hence open foundation is suitable.

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 weathered /hard


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rock exist from 1 to 6 m depth.

Hence shallow foundation is feasible and same is recommended.

8.0 RECOMMENDATIONS

Based on Field Investigations and laboratory testing, the following Recommendations are made for construction of Sump at Loddiguda, Triyani Mandal

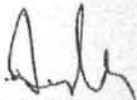
a) Open foundations resting at 2 m below GL, are recommended. The structure is likely to result in saturation and inundation of the sub soil during long – time operation,

b) SBC is recommended as follows :

Location		BH 1
S. No.	Depth (m)	Recommended SBC t/ sq m
1	2.0	10
2	3.0	12
3	4.0	13

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

For ANJI DRILLING AND GROUTING WORKS



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TELANGANA DRINKING WATER SUPPLY PROJECT

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

SUMP AT LODDIGUDA IN ADILABAD DT.




Type of Boring: Core drilling

Dia of Boring: NX

Date : 6-7 Jan 2016

GL: 550.00

Drilled depth = 6 m

Depth, m	Profile	Soil	Sample Depth m	N value	CR, %	RQD%
0		Top soil	0	>100	Small pieces	
1.0		Weathered	1.5			
2.0		Hard rock			52	36
3.0			3.0	61	46	
4.0			4.5	72	60	
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						
16.0						



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