

## Design Of 250 KL Capacity Sump at

### Data

Location				
Safe bearing Capacity	sbc	Safe	100 Kn/m <sup>2</sup>	
Capacity	v		250 KL	
Free Board	fb		0.25 m	
Dead Storage	ds		0.20 m	
Dia of sump	d		10.00 m	
Projection from side wall	ps		0.15 m	
Depth of the tank	h		3.65 m	
Depth of tank above GL	dgl		0.50 m	
Depth of tank below GL			3.15 m	
thickness of PCC (lean mix cc1:6:10)	couter wt		0.00 m	
Th. Of Bottom Slab	bsth	Provided th is Sufficient	0.300 m	0.18 m
Depth of Water table below GL	wl	Safe Against Uplift	3.00 m	

### Top Dome

Rise of the dome			1.60	
Radius of the dome			8.61	
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	169 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		3.65 m	
Th. Of Side wall	sth		0.200 m	184 mm
Depth of tank above GL	dgl		0.50 m	

### Moments

Inner Side	8.43 Kn-m
Outer Side	11.256 Kn-m

### Hoop force

Inner Side	120.65 Kn	(Tension)
Outer Side	156.37 Kn	(Compression)

### Reinforcement

			Dia	Spacing Provided	Required
Inner face	Vertical	497 mm <sup>2</sup>	10 mm	150 mm	150
	Horizontal	465 mm <sup>2</sup>	10 mm	150 mm	160
Outer face	Vertical	664 mm <sup>2</sup>	10 mm	100 mm	110
	Horizontal	465 mm <sup>2</sup>	10 mm	150 mm	160

### Bottom slab

Safe bearing Capacity	sbc		100 Kn/m <sup>2</sup>		
Th. Of Bottom Slab	bsth	Provided th is Sufficient	0.300 m	0.18 m	
Dia of Bottom Slab	db		10.70 m		
Size of Haunch	bh		0.25 m		
effective cover to reinforcement for raft slab	covraft		67 mm		
Moments	Radial		6.76 Kn-m		
	Circumferential		10.73 Kn-m		
Reinforcement	Top mesh	Ast	Dia	spacing Provided	Required
		408 mm <sup>2</sup>	12 mm	150 mm	150
	Bottom mesh	240 mm <sup>2</sup>	10 mm	200 mm	200

	bmcfps	0.0077	0.00596	0.0059	
Max Ring Tension	rtcfs	0.579	0.61586	0.617	
Max. -ve BM	mbms	(bmcfs*pas*hbgl <sup>2</sup> )		11.26	Kn-m
Max +ve BM	mpbms	(bmcfps*pas*hbgl <sup>2</sup> )		3.00	Kn-m
Max. Ring compression	mrts	rtcfs*pas*d/2		156.37	Kn
Th. Of Side Wall		(MAX(mbm,mbms)*10 <sup>6</sup> *(2*1000)) <sup>0.0</sup>		184	mm
				Th. Provided is Sufficient	
Eff Th. Of Side wall	edswi			150	mm
Max Inner face moment	bmi	MAX(mpbms,mbm)		8.43	Kn-m
Max outer face moment	bmo	MAX(mpbm,mbms)		11.26	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 <sup>4</sup> ,bmi*10 <sup>6</sup> /(130*0.87*e		497	mm <sup>2</sup> on each side
Area of steel outer face	Astpbm	MAX(pt*sth*10 <sup>4</sup> ,(bmo*10 <sup>6</sup> /(130*0.87		664	mm <sup>2</sup> on each side
Area of Steel for Hoop	Asth	MAX(pt*sth*10 <sup>4</sup> ,CEILING(mrt*1000/1:		929	mm <sup>2</sup> for two sides
Vertical Steel Spacing					
<u>Inner face</u>	vsp				
Spacing		FLOOR(pi*dbi <sup>2</sup> /4*1000/Astm,25)		150	mm
Provide 10 mm dia TOR @ 150 mm C/c					
<u>Outer face</u>	vspo				
Spacing		FLOOR(pi*dbo <sup>2</sup> /4*1000/astpbm,25)		110	mm
Provide 10 mm dia TOR @ 110 mm C/c spacing					
<u>Horizontal Steel</u>					
Spacing	hsp	FLOOR(pi*dbh <sup>2</sup> /2*1000/Asth,25)		160	mm
Provide 10 mm dia TOR @ 160 mm C/c on both faces in staggered fashion					
<b>Design Of Bottom Slab</b>					
Projection from side wall	ps			0.15	m
Dia of Bottom Slab	dbb	d+2*sth+2*ps		10.70	m
Size of Haunch	bh			0.25	m
Dia of Bar top	dbbs			12	mm
Dia of Bar bottom	dbbsb			10	mm
Load on Bottom Slab					
Wt of Top Dome		2*pi*rd*hd*wd		400.46	Kn
Wt of Ring Beam		pi*(d+rb/1000)*rb*drb*25/10 <sup>6</sup>		72.81	Kn
Wt Of Side wall		pi*(d+sth)*sth*(h-dtrb)*25		536.73	Kn
Wt of Haunch		pi*(d-bh)*bh <sup>2</sup> /2*25		23.93	Kn
Total Load	wbs			1033.93	Kn
				10.34	sq m
Max Pr on Soil	prb	Wbs/(pi*(d)*1)		32.91	Kn/m <sup>2</sup>
Bottom Slab is designed as circular Slab loaded with UDL and Simply Supported on edges					
				r	5.1
					4.35
Radial moment	mri	3/16*prb*((dbb/2) <sup>2</sup> -((d+sth)/2) <sup>2</sup> )-wbs/		-1.61	mrb
Circuferential Moment	mti	1/16*prb*(3*(dbb/2) <sup>2</sup> -((d+sth)/2) <sup>2</sup> )-wb		6.34	mtb
for uplift		Net uplift load on bottom slab		-3	Kn/m <sup>2</sup>
for uplift		max Radial moment		-10.73	-10.73 Kn-m
		max Circuferential Moment		-10.73	-10.73 Kn-m
Max Radial Moment	mr	IF(wl>hbgl,0,CEILING(3*prb*(dbb/2) <sup>2</sup> /		6.76	Kn-m
Max Circumferential moment	mt	IF(wl>hbgl,0,CEILING(prb*(dbb/2) <sup>2</sup> /16		6.76	Kn-m

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## TELANGANA DRINKING WATER SUPPLY PROJECT

### 200 KL SUMP AT NAVEDARI , WANKIDI (M) IN ADILABAD DT.

#### 1. INTRODUCTION

M/s. L &T Construction, Water & Effluent Treatment is proposing to construct 200 KL Sump at Navedari, Wankidi (M). The work is taken up under Segment 22 , Komaram Bheem Project , TDWSP, Asifabad 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.

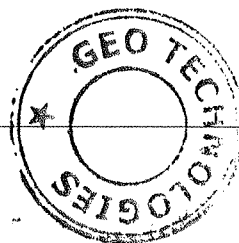
#### 2. SCOPE OF WORK

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

- Drilling Borehole at (1) location for 200 KL Sump in Navedari , 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



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**GEOTECHNICAL INVESTIGATION REPORT**

**TELANGANA DRINKING WATER SUPPLY PROJECT**

**KOMARAM BHEEM - ASIFABAD- SEGMENT 22**

**ASIFABAD , ADILABAD DISTRICT**

**250 KL SUMP AT NAVEDARI, WANKIDI (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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**MCH Panellist No. 2490 /TP/2000-2**

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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:

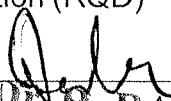
Rotary Drilling was done using TC / Diamond bits. The size of the casing used was 125 to 75 mm, yielding samples of NX size.

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

Drilling was performed on 7 Jan ,2016.

The following relevant data was recorded during Rotary drilling operations.

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

  
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**b) STANDARD PENETRATION TEST (SPT):**

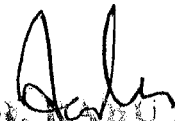
SPT split spoon sampler of standard dimensions was driven into the soil from the borehole bottom using 63.5 kg hammer with a fall of 75 cm height. The SPT weight was lifted to the specified height and allowed to fall freely on the anvil with the use of cat-head winch with one to one and half turn of 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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#### 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.

Hard gravel from 0 – 4.5 m depth was followed by SDR to 6 m depth. The following tests were conducted on soils :

- Specific gravity                      Bulk density
- Grain size distribution              Direct shear test

All the Tests were conducted in accordance with IS: 2720 (Methods of Tests for Soils ).. Table 1 gives the soil properties.

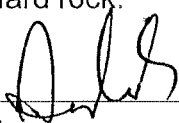
Fig 2 & 3 plot typical Grain size curve & Mohr's envelope.

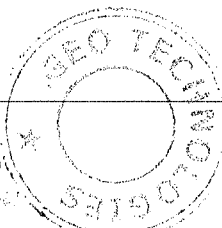
#### 5. SUB SOIL PROFILE

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

Depth	Strata	N value
0 – 4.5 m	Gravel	60 -100
4,5 - 6 m	SDR	>100 Refusal

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

The following equation is used to calculate Ultimate Bearing Capacity (UBC),

$$UBC = C * N_c * S_c * d_c + q * (N_q - 1) * S_q * d_q + 0.5 * B * r * N_r * S_r * d_r * W'$$


Safe bearing capacity (SBC) is the maximum intensity of loading that the foundation will safely carry without the risk of shear failure of soil irrespective of any settlement that may occur. Safe Bearing Capacity can be obtained by dividing the UBC with suitable factor of safety.

$$SBC = UBC / 2.5$$

### 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.

  
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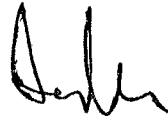


**ALLOWABLE BEARING CAPACITY:**

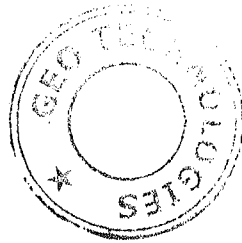
Allowable Bearing capacity (ABC) is the net intensity of the loading which the foundation will carry without undergoing settlement in excess of the permissible value for the structure under consideration but not exceeding the net safe bearing capacity (SBC).

**7.0 DISCUSSION ON FOUNDATION OPTIONS**

From sub soil profile , it can be seen that hard gravel is present from 0 to 4.5 m depth below ground level. Hence shallow foundation is feasible and same is recommended.



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## 8.0 RECOMMENDATIONS


Based on Field Investigations and laboratory testing, the following Recommendations are made for construction of 250 KL Sump at Navebari, Adilabad Dt..

- a) Open foundations resting in gravel at a depth of 3 m below GL are recommended. OHBR is likely to result in saturation and inundation of the sub soil during long – time operations.
- b) SBC is recommended as follows. Even though allowable bearing capacity is 40 t / sq m, Recommended SBC at 3 m depth is 25 t / sq m.

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

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

For ANJI DRILLING AND GROUTING WORKS



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# TELANGANA DRINKING WATER SUPPLY PROJECT

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

**200 KL SUMP AT WANKIDI IN ADILABAD DT.**

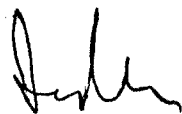
Type of Boring: Core drilling

Dia of Boring: NX

Date : 7 Jan 2016

Drilled depth = 6 m

Depth, m	Profile	Soil	Sample Depth m	N value	CR, %	RQD%	
0	Gravel	Gravel	0	60			
1.0			1.5	80			
2.0							
3.0			3.0	>100			
4.0							
5.0	SDR	SDR	4.5	>100			
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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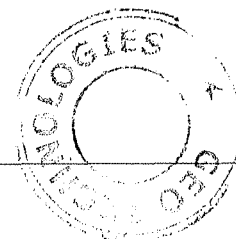


TABLE 1

SUMMARY OF SOIL PROPERTIES

TELANGANA DRINKING WATER SUPPLY PROJECT

200 KL SUMP AT NAVEDARI IN ADILABAD DT.

BH No	Depth m	Soil	Moisture content %	Specific Gravity	Grain size, percentage				$\gamma$ KN/ Cum	Shear Parameters	
					Gr	Sa	Si	Cl		c	$\phi$
					>4.75 mm	4.75 to 0.075mm	.075to .002mm	<.002 mm			
1	1,5	Gravel		2.68	100	0	0	0	18.3	0	35

Samples are non – plastic

NOTATION : Gr ... Gravel Sa ... Sand Si ... Silt Cl... Clay  $\gamma$  ...Unit weight

c ...Cohesion, kN /sq  $\phi$ ... Angle of internal friction , deg



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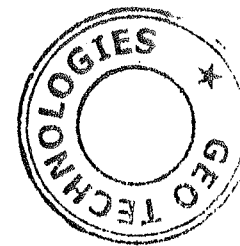
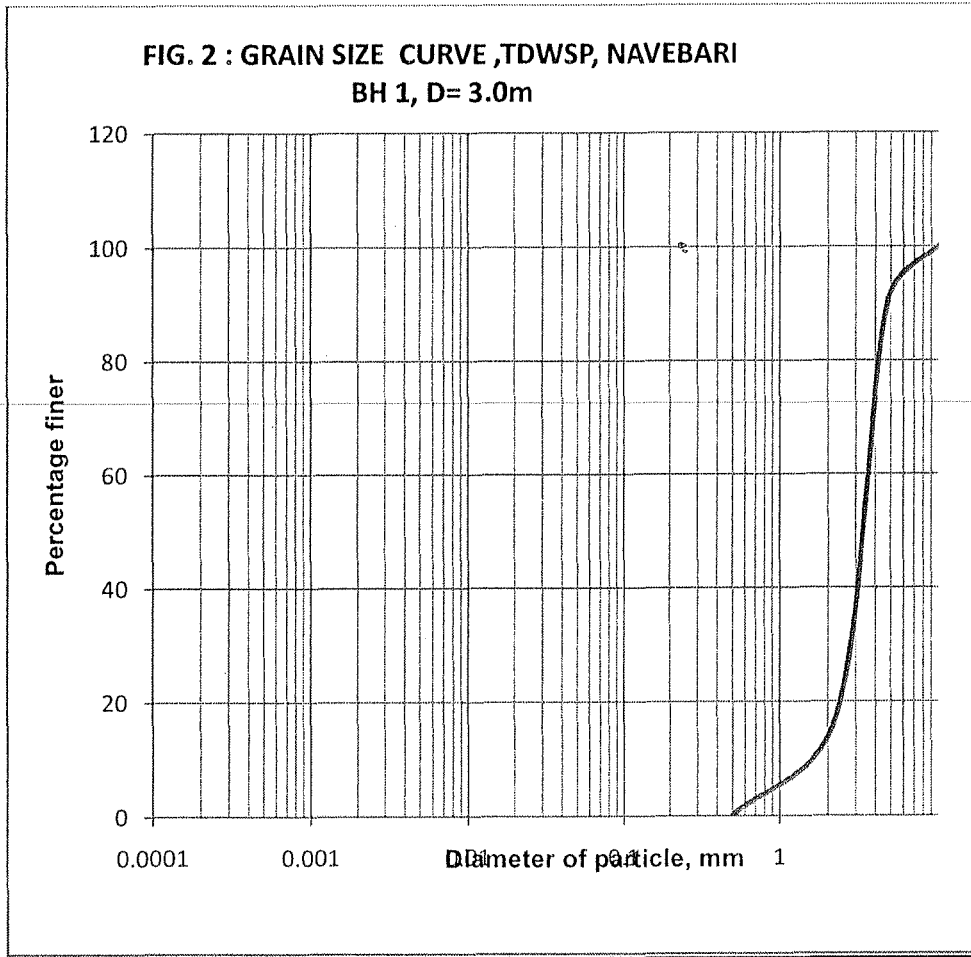


FIG. 2 : GRAIN SIZE CURVE ,TDWSP, NAVEBARI  
BH 1, D= 3.0m



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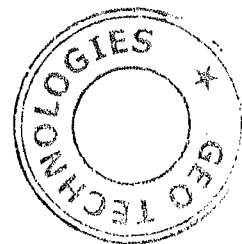
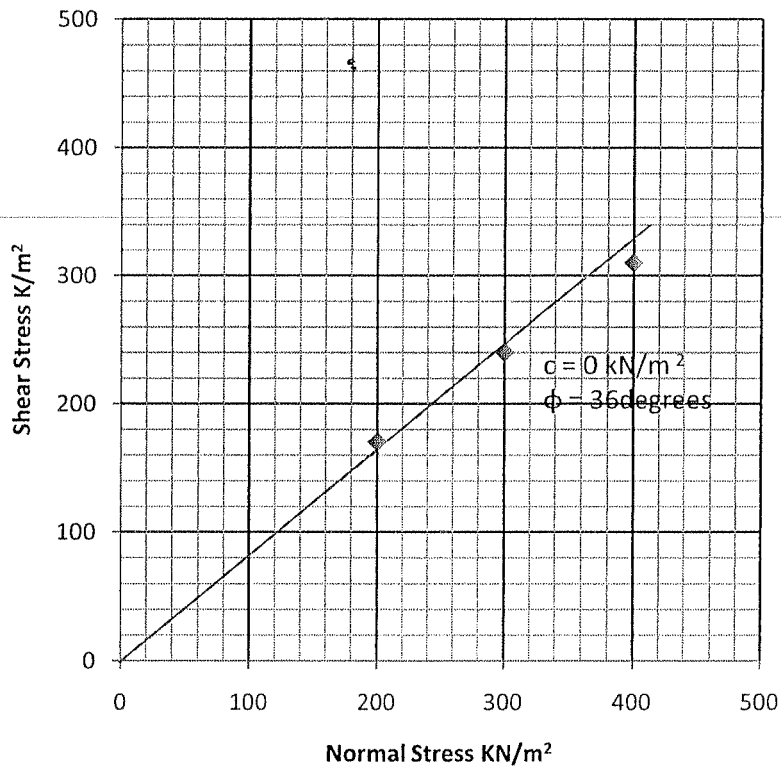
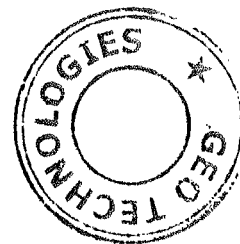


Fig.3 : Direct Shear Test - Graph  
WANKIDI ,BH-1; D= 3.0 m



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APPENDIX

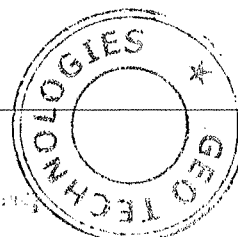
**CALCULATION OF SBC**

**TELANGANA DRINKING WATER SUPPLY PROJECT, 200 KL SUMP AT  
NAVEDARI, ADILABAD DT.**

<b>Project:</b>	<b>Geotechnical investigation for construction of 200 kl Sump at Navedari, Adilabad dt.</b>			
		<b>Gravel</b>		
Structures		Sump		
Reference Borehole		BH-1		
Bed Level/Ground Level		129.248		
Scour Level/Undisturbed GL		0.000		
Foundation Level		-3.000		
Thickness of overburden soil, m		3.000		
Depth of excavation required, m		3.000		
Width of foundation, m		6.00		
SPT value of the soil in the zone of influence		>100		
Angle of Internal friction, Degrees		35		
Unit weight of over-burden soil, kN/Cu.m.		18.00		
Length of foundation, m		6.00		
Shear strength of soil, kN/Sq.m.		0		
Bearing capacity factor Nc		46.12		
Bearing capacity factor Nq		33.30		
Bearing capacity factor Ny		48.03		
Depth factor, dc		1.26		
Depth factor, dq		1.13		
Depth factor, dy		1.13		
Shape Factor, sc		1.20		
Shape Factor, sq		1.20		
Shape Factor, sy		0.60		
Inclination Factor, ic		1.00		
Inclination Factor, iq		1.00		
Inclination Factor, iy		1.00		
Water Table Correction Factor, w		0.50		
Ultimate Bearing Capacity, UBC1, kN/Sq.m.		0.00		
Ultimate Bearing Capacity, UBC2, kN/sq.m.		1442.48		
Ultimate Bearing Capacity, UBC3, kN/Sq.m.		390.10		
Ultimate Bearing Capacity, UBC, kN/Sq.m.		1832.58		
SBC with a factor of safety of 2.5, kN/Sq.m.		733.03		



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The above capacity is verified based on settlement criteria and calculations are provided below.

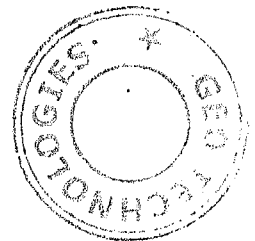
Allowable SBC on the basis of Settlements are estimated in the following pages.

Refer, 9.2.3.2 I S 8009 Part 1 equation 11	=	$S_i = p B (1 - \mu^2) I_s / E_s$
p = Net Bearing Capacity kN/m <sup>2</sup>	=	400 kPa
μ = Poissons ratio (0.3 to 0.5 )	=	0.35
I = Influence factor from Table 2 of I S 8009 P-1 for L/B =1	=	1
E = Elastic modulus of rock (assume as Dense Sand Es From Bowels, Table 2.8 and 5.5 )	=	80000 kN/m <sup>2</sup>
B= Breadth of foundation	=	6.0 m
D = Depth of foundation	=	3.0 m
Depth Factor (Refer, Fig.12 of I S 8009 Part 1 ) For L/B = 1, SQRT(LB)/D= 4	=	0.85
	$S_i$	$= 400 * 6 * (1 - 0.35^2) * 1 * 0.85 / 80000 * 1000$
	=	22.3763 mm
		40 mm
Pe missible Settlement		715.044 kN/m <sup>2</sup>
Allowable Pressure from settlements considerations		462.78 kN/m <sup>2</sup>
SBC on shear failure criteria	=	

Hence, Allowable SBC **400 kN/m<sup>2</sup>**



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



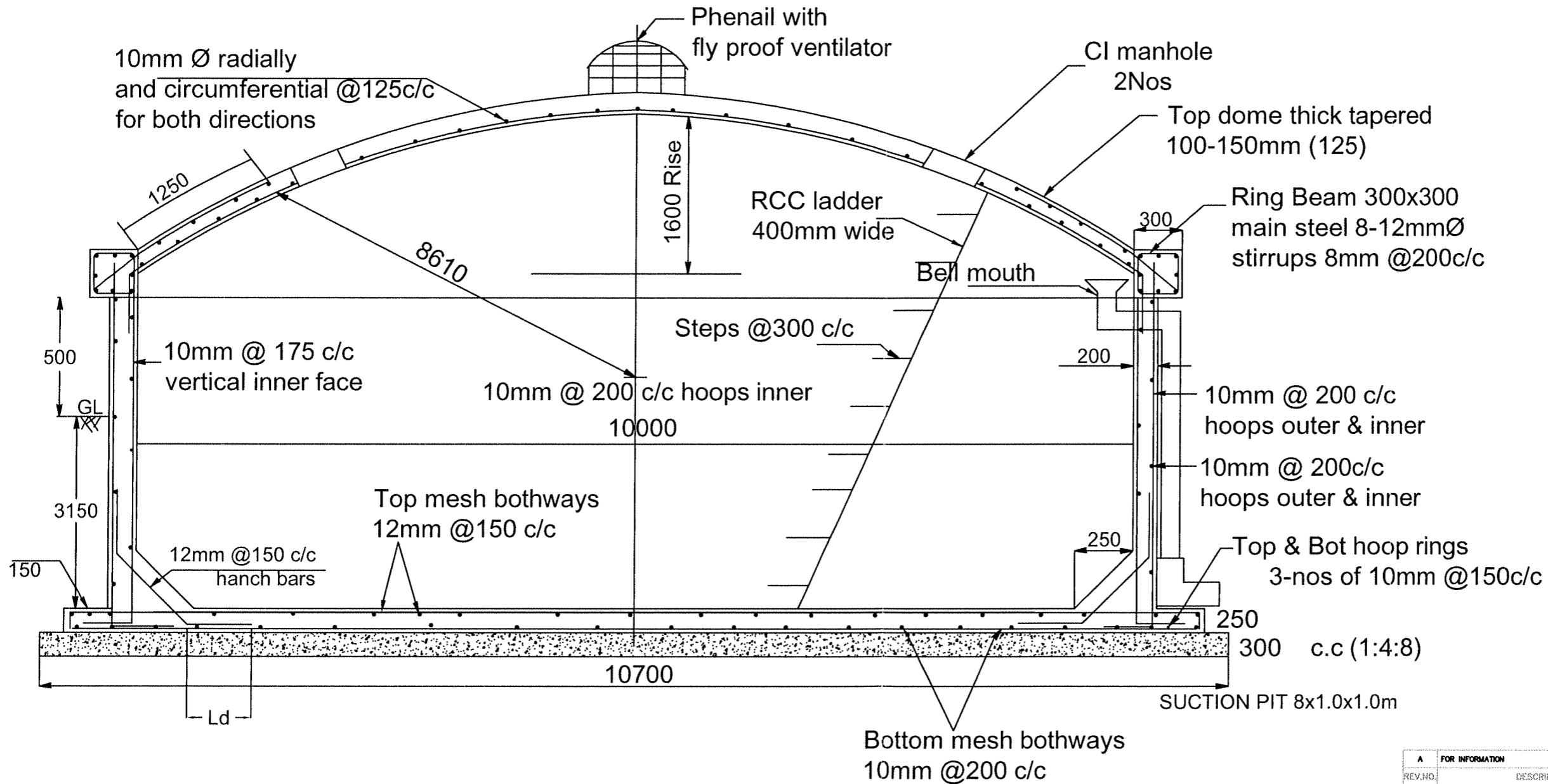
  
Asst. Executive Engineer  
AEE/TDWSP/ASF  
TDWSP Asifabad

  
Dy. Executive Engineer  
TDWSP Asifabad

  
Executive Engineer  
TDWSP Asifabad

**" APPROVED "**  
SE, TDWSP  
NIRMAL

# 250 KL SUMP



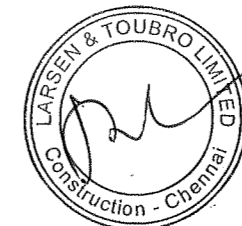
All dimensions are in 'mm'  
 Concrete mix V.R.C.C M30  
 Steel Fe-415  
 Reinforcement details shall be as per IS-SP34

*Heethmed*  
 Asst. Executive Engineer  
 TDWSP Asifabad

*[Signature]*  
 Dy. Executive Engineer  
 TDWSP Asifabad

*[Signature]*  
 Executive Engineer  
 TDWSP Asifabad

"APPROVED"  
*[Signature]*  
 SE, TDWSP  
 NIRMAL



CHECKED BY	SIGN	DATE
CIVIL & STRUCTURAL		
MECHANICAL		
ELECTRICAL		
INSTRUMENTATION		

FOR INFORMATION		DESIGNED	DRAWN	CHECKED	APPROVED
REV. NO.	DESCRIPTION				
REVISIONS					
<b>L&amp;T Construction</b> Water, Smart World & Communication.					
CLIENT: RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA.			CLIENT: RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA.		
PROJECT: PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (PRIMARY GRID)					
SUPPLIER/CONTRACTOR: <b>L&amp;T Construction</b> Water & Effluent Treatment SBG					
PROJECT NAME	LE150883	TITLE	SCALE		
		WANKIDI MANDAL - NAVADERI			
		SUMP - 250KL			
DRAWING NO.	LE150883-C-WS-RW-DIC-1202	SCALE	REV		
		A3	A		
RELEASED FOR: <input type="checkbox"/> PRELIMINARY <input type="checkbox"/> TENDER <input type="checkbox"/> INFORMATION <input checked="" type="checkbox"/> APPROVAL <input type="checkbox"/> CONSTRUCTION					