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

TELANGANA WATER GRID

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

CLIENT:	CONSULTANT :
RURAL WATER SUPPLY AND SANITATION DEPARTMENT (WATER GRID), TELUNGANA.	WAPCOS LIMITED

PROJECT :	PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT
SUPPLIER / CONTRACTOR:	L&T Construction, Water, Smart World and Communication

JOB Ref. No. : LE150883

	NAME	SIGN	DATE
DSGN			
CHKD			
APPD			

TITLE :

DESIGN OF SUMP - 250KL CAPACITY BIJURUGUDA AT SIRPUR-U MANDAL

DOC./DRG. No.	SIZE	REV.
LE150883-C-WS-RW-DC-1192	A4	A

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☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

Submitted sir,

Sub: RWS&S-TDWSP- Bijuriguda 250KL clear water sump in Sirpur U Mandal– Komarambheem Asifabad Segment-Adilabad District-Designs -Approval-Reg.

*****

Kindly pursue the Designs of the following 250KL Clear Water sump at Bijuriguda (V), Sirpur U (M), submitted by the Executive Engineer TDWSP Asifabad Division, Adilabad district for approval.

1. **250 KL Clear Water Sump.**

The Executive Engineer TDWSP Asifabad Division has submitted Structural Designs & Drawings of 250KL Clear Water sump based on the field conditions and as per the estimate provisions, the structural designs & drawings for the above structure is verified with RWS&S standard Type Designs and submitted for approval.

The following design parameters were considered:

- Capacity : 250KL
- Net SBC of Soil : 10.0 t/sqm
- Grade of concrete & Steel : M 30 & Fe 415
- Dia of sump Inner to Inner: 10.00m
- Sidewall Height :3.65 mts
- Sidewall Thickness:200mm
- Top Slab thickness: 150 to 100 mm tapered
- Raft Slab thickness: 250mm

As per the above parameters the structural design and drawings of the clear water sump is verified, as per similar Type designs available and approved by the RWS&S Department considering the SBC and type of soil, duly following IS codes, IS: 456-2000, SP:16, 34, IS:3370 and IS 1893-2002 (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.

30/4/16

AEE (Designs)	DEE (Designs)	Superintending Engineer,
TDWSP,Nirmal Circle	TDWSP,Nirmal Circle	TDWSP,Nirmal Circle

Design Of 250 KL Capacity Sump at

Data

Location						
Safe bearing Capacity	sbc		Safe	100	Kn/m^2	
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^2	10 mm	150 mm	150
	Horizontal	465 mm^2	10 mm	150 mm	160
Outer face	Vertical	664 mm^2	10 mm	100 mm	110
	Horizontal	465 mm^2	10 mm	150 mm	160

Bottom slab

Safe bearing Capacity	sbc			100	Kn/m^2	
Th. Of Bottom Slab	bsth	Provided th is Sufficient		0.300	m	0.18 m
Dia of Bottom Slab	dbs			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		Ast	Dia	spacing Provided	Required
	Top mesh	408 mm^2	12 mm	150 mm	150
	Bottom mesh	240 mm^2	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^2)			11.26	Kn-m
Max +ve BM		mpbms	(bmcfps*pas*hbgl^2)			3.00	Kn-m
Max. Ring compression		mrts	rtcfs*pas*d/2			156.37	Kn
Th. Of Side Wall			(MAX(mbm,mbms)*10^6*6/(2*1000))^0.			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 BendingSteel inner side		Astm	MAX(pt*sth*10^4,bmi*10^6/(130*0.87*e			497	mm^2 on each side
Area of steel outer face		Astpbm	MAX(pt*sth*10^4,(bmo*10^6/(130*0.87			664	mm^2 on each side
Area of Steel for Hoop		Asth	MAX(pt*sth*10^4,CEILING(mrt*1000/1			929	mm^2 for two sides
Vertical Steel	Spacing						
inner face		vsp					
	Spacing		FLOOR(pi*dbi^2/4*1000/Astm,25)			150	mm
Provide 10 mm dia TOR @ 150 mm C/c							
Outer face		vspo	FLOOR(pi*dbo^2/4*1000/astpbm,25)			110	mm
Provide 10 mm dia TOR @ 110 mm C/c spacing							
Horizontal Steel							
	Spacing	hsp	FLOOR(pi*dbh^2/2*1000/Asth,25)			160	mm
Provide 10 mm dia TOR @ 160 mm C/c on both faces in staggered fashion							
Design Of Bottom Slab							
Projection from side wall		ps				0.15	m
Dia of Bottom Slab		dbs	d+2*sth+2*ps			10.70	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			400.46	Kn
Wt of Ring Beam			pi*(d+rb/1000)*rb*drb*25/10^6			72.81	Kn
Wt Of Side wall			pi*(d+sth)*sth*(h-dtrb)*25			536.73	Kn
Wt of Haunch			pi*(d-bh)*bh^2/2*25			23.93	Kn
Total Load		wbs				1033.93	Kn
						10.34	sq m 0.29319
Max Pr on Soil		prb	Wbs/(pi*(d)*1)			32.91	Kn/m^2
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*((dbs/2)^2-((d+sth)/2)^2)-wbs/			-1.61 mrb	6.76 Kn-m
Circuferential Moment		mti	1/16*prb*(3*(dbs/2)^2-((d+sth)/2)^2)-wb			6.34 mtb	6.76 Kn-m
for uplift	Net uplift load on bottom slab					-3	Kn/m^2
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*(dbs/2)^2/			6.76 Kn-m	10.73 Kn-m
Max Circumferential moment		mt	IF(wl>hbgl,0,CEILING(prb*(dbs/2)^2/16			6.76 Kn-m	10.73 Kn-m

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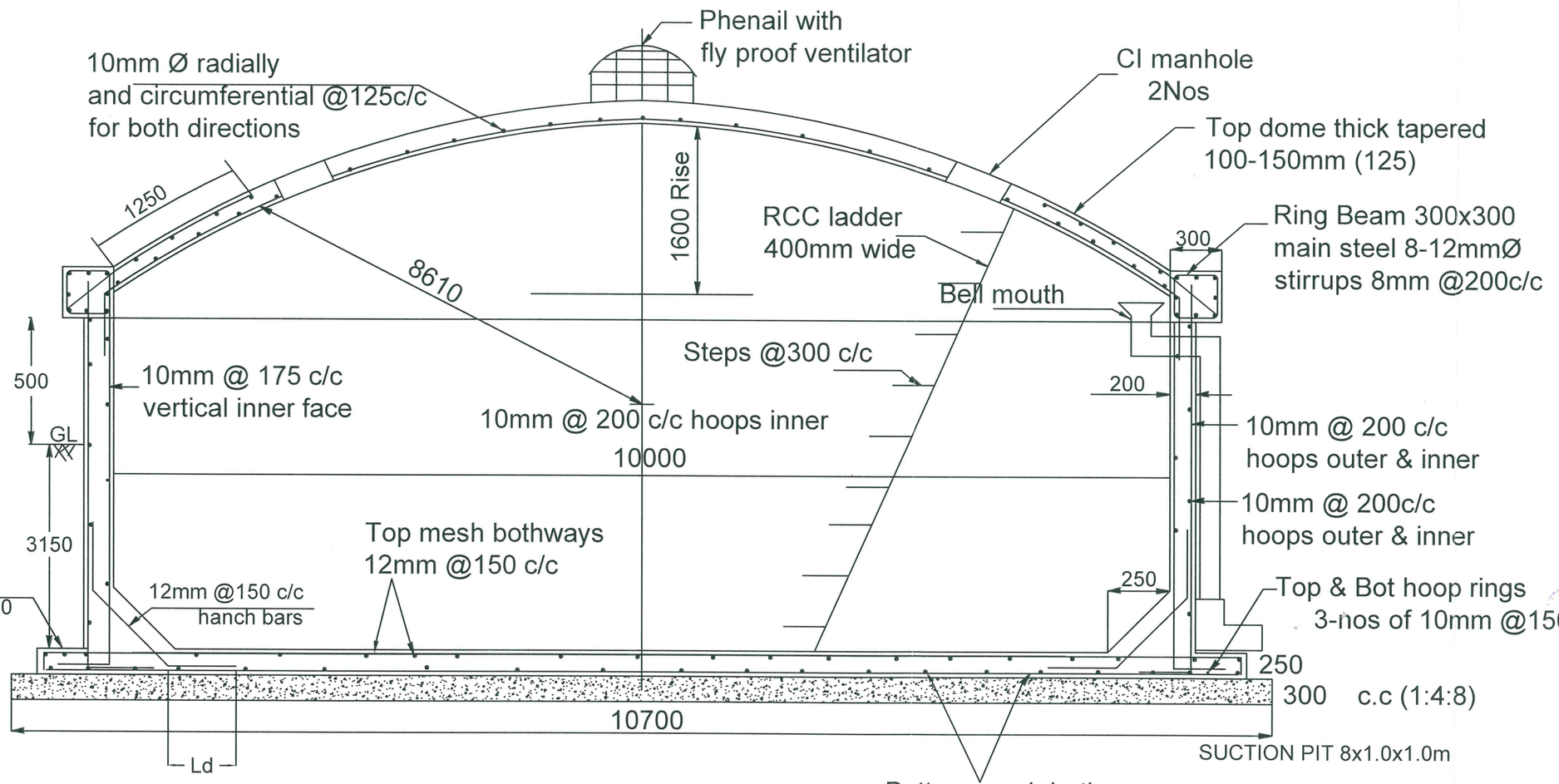
30/4/16
SE NIRMAL

Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

Executive Engineer
TDWSP Asifabad

250 KL SUMP



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

Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
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Executive Engineer
TDWSP Asifabad

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SE, NIRMAL

CHECKED BY	SIGN	DATE
CIVIL & STRUCTURAL		
MECHANICAL		
ELECTRICAL		
INSTRUMENTATION		

REV.NO.	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR INFORMATION				

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)

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

JOB No : LE150883

NAME	SIGN	DATE

TITLE :
BIJURUGUDA AT SIRPUR-U MANDAL
SUMP - 250KL

SCALE

PROJECTION

DRAWING No. LE150883-C-WS-RW-DC-1192

SIZE A3 | REV. A

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L&T CONSTRUCTION - Chennai

TELANGANA DRINKING WATER SUPPLY PROJECT

200 KL SUMP AT BIJURUGUDA, SIRPUR-U 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 Bijuruguda 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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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 Geotechnolgies, 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
- Grain size distribution
- Bulk density
- 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*NC*Sc*dc + q * (Nq-1) * Sq * dq + 0.5 * B * r * Nr* Sr* dr * 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 200 KL Sump Bijuruguda, sirpur-U 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	3.0	10
	4.0	12

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

For ANJI DRILLING AND GROUTING WORKS

(DR. D. BABU RAO)

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Former Professor of Civil Engineering

Consulting Geotechnical Engineer

MCH Panelist No. 2490/TP/2000-2

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TELANGANA DRINKING WATER SUPPLY PROJECT

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

200 KL SUMP BIJURUGUDA 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	0	60		
1.0			1,5	80		
2.0						
3.0			3.0	>100		
4.0						
5.0		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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TELANGANA DRINKING WATER SUPPLY PROJECT

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

250 KL SUMP BIJURUGUDA 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			0	60		
1.0			1,5	80		
2.0		Gravel				
3.0			3.0	>100		
4.0						
5.0		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 BIJURUGUDA IN ADILABAD DT.

BH No	Depth m	Soil	Moisture content %	Specific Gravity	Grain size, percentage				γ KN/ Cum	Shear Parameters	
					Gr >4.75 mm	Sa 4.75 to 0.075mm	Si .075to .002mm	Cl <.002 mm		c	ϕ
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 γ ...Unit weight

c ...Cohesion, kN /sq ϕ... Angle of internal friction , deg

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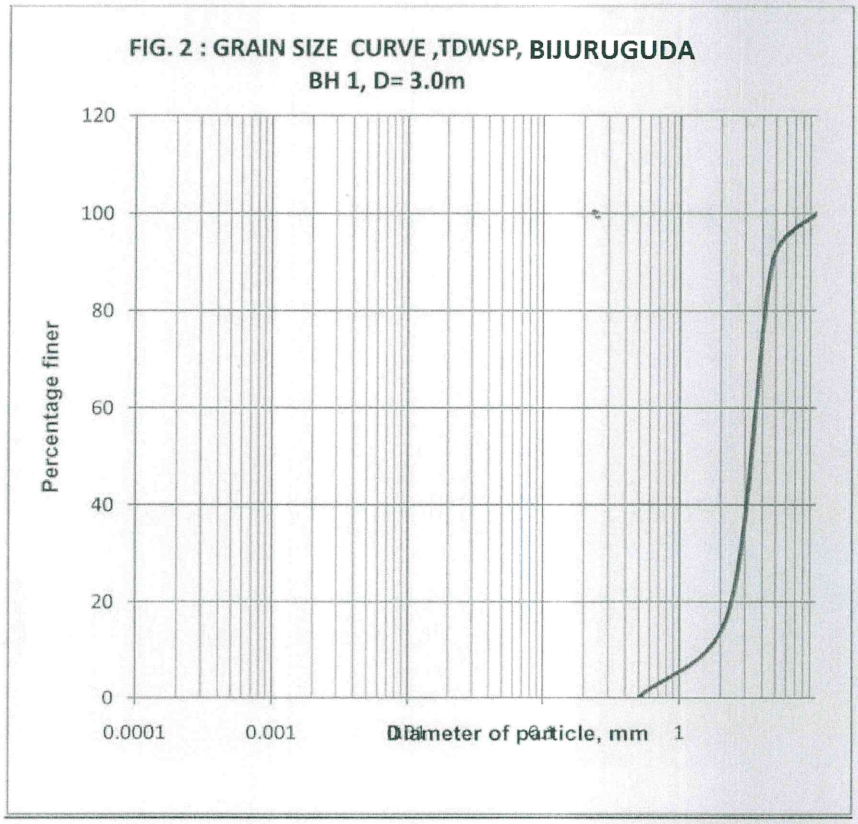

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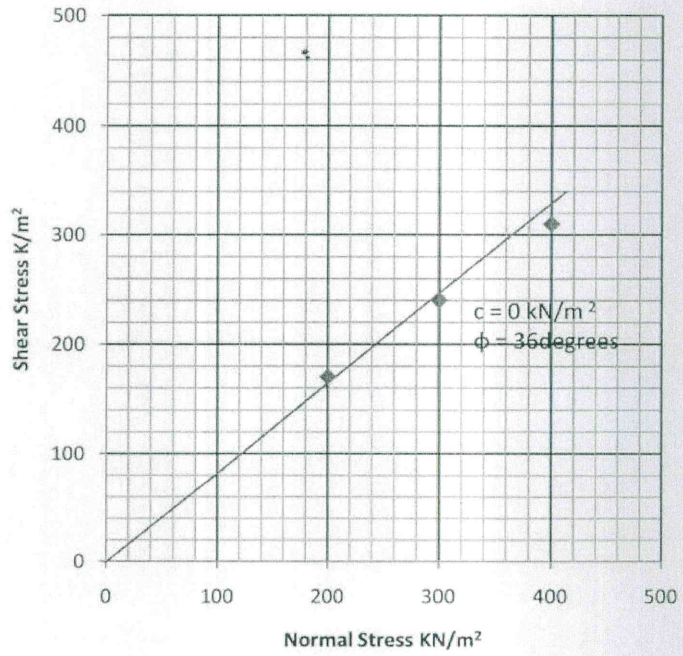
Fig.3 : Direct Shear Test - Graph
BIJURUGUDA ,BH-1; D= 3.0 m



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APPENDIX

CALCULATION OF SBC

TELANGANA DRINKING WATER SUPPLY PROJECT, 250 KL SUMP AT BIJURUGUDA, ADILABAD DT.

Project:	Geotechnical investigationfor construction of 200 kl Sump at Navedari, Adilabad dt.				
		Gravel			
	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	=	$Si = p\ B\ (1 - \mu^2)\ I_s / Es$	
p =	Net Bearing Capacity kN/m²	=	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/m2
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

Pe missible Settlement 40 mm

Allowable Pressure from settlements considerations 715.044 kN/m2

SBC on shear failure criteria = 462.78 kN/m²

Hence, Allowable SBC **400 kN/m2**

LARSEN & TOUBRO LIMITED Construction - Chennai

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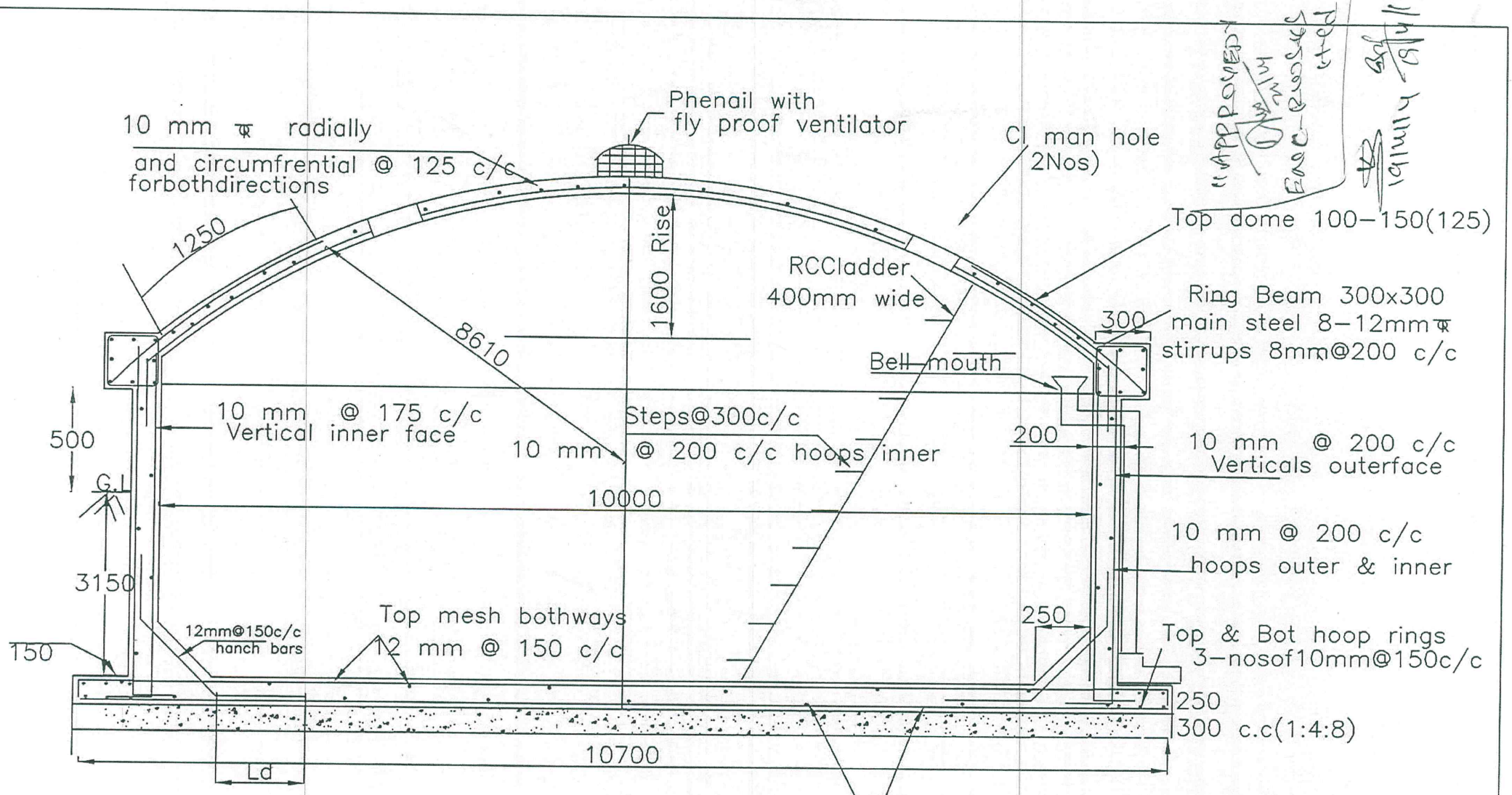
Dy. Executive Engineer
TDWSP Asifabad

Executive Engineer
TDWSP Asifabad



All dimensions are in 'mm'

Concrete mix V.R.C.C M30

Steel Fe–415

Reinforcement Details shall be as per IS – SP34

250 KL SUMP

Designed for uplift GWT @ 2.0 below GL
SCHEME : CPWSS
LOCATION:
SBC 10T/SQM