Submitted sir,

Sub:RWS&S-TDWSP- Devaguda 250KL OHBR- 25mtr in Utnoor Mandal–KomarambheemAsifabad Segment-Adilabad District-Designs -Approval-Reg.

*****

Kindly pursue theDesigns of the following 250KLOHBR – 25mtrat Devaguda(V) ,Utnoor (M), submitted by the Executive Engineer TDWSP Asifabad Division ,Adilabad district for approval.

1. **250 KL OHBR – 25mtr.**

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

The following design parameters were considered:

- Capacity :250KL
- Net SBC of Soil : 15.0 t/sqm
- Grade of concrete &Steel : M 30 & Fe 500
- Height of staging : 25mts
- Dia of Shaft Inner to Inner : 5.25mts
- Dia of Tank Inner to Inner : 8.6mts
- Thickness of shaft :250mm
- Top Dome thickness: 125mm
- Bottom Domethickness : 250 mm
- RaftSlab thickness: 1100mm
- Depth of Foundation : 3.00 mts

As per the above parameters the structural design and drawings of the OHBR 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.

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

REV. NO.	DESCRIPTION	DESIGNED	CHECKED	APPROVED
A	For Approval	04.04.16 AKHB	07.04.16 RR	08.04.16 BRJ

REVISIONS

LARSEN & TOUBRO LIMITED
CONSTRUCTION DIVISION
Water,Smart World & Communication IC

CLIENT:	CONSULTANT :
TELANGANA DRINKING WATER SUPPLY PROJECT, GOVERNMENT OF TELANGANA	

PROJECT :	Providing drinking water to habitations in Komarambheem-Asifabad Segment in Adilabad District
SUPPLIER / CONTRACTOR	L&T CONSTRUCTION Water & Effluent Treatment SBG

JOB Ref. No. : LE150883

	NAME	SIGN	DATE
DSGN	AKHB		04.04.16
CHKD	RR		07.04.16
APPD	BRJ		08.04.16

TITLE :

250 KL capacity OHBR -25m staging height - Design Calculations

DOC./DRG. No. LE150883-C-WS-CW-DC-3027

SIZE A4 | REV. A

RELEASED FOR ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

LARSEN & TOUBRO LIMITED
ECC Division – EDRC

PROJECT:	Providing drinking water to habitations in Komarambheem-Asifabad Segment in Adilabad District	DOCUMENT NO. LE150883-C-WS-CW-DC-3027		DATE 04-Apr-2016
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Design of Over head Reservior

(1)	**DATA:**			
	Capacity of Tank		250	m^3
	Unit weight of RCC=		25	kN/m^3
	Unit weight of PCC=		24	kN/m^3
	Unit weight of soil =		18	kN/m^3
	Unit weight of sand filling inside bottom of shaft =		18	kN/m^3
	Unit weight of water=		10	kN/m^3
	Staging Height		25	m
	Net S.B.C of Soil =		150	kN/m^2
(2)	**PERMISSIBLE STRESS:**			
	Grade of concrete;	f_{ck} =	M30	N/mm^2
	Grade of steel;	f_y =	Fe500	N/mm^2
Ref Table 1 of IS:3370	Allowable stress as per IS:3370 relating to resistance to cracking			
	Allowable direct tensile stress in concrete	σ_{at} =	1.5	N/mm^2
	Allowable bending tensile stress in concrete	σ_{bt} =	2.0	N/mm^2
Ref Table 4 of IS:3370	Allowable stress in steel under direct tension, bending & shear =	σ_{st}	130	N/mm^2
	Allowable stress in steel under direct compression =	σ_s	140	N/mm^2
		σ_{st2} =	150	N/mm^2
IS 456:200	Allowable stress in steel under direct tension, bending & shear =	σ_{st}	230	N/mm^2
	Allowable stresses as per IS:456 for strength calculations			
Ref Table 21 of IS:456	Allowable direct compressive stress in concrete	σ_{cc} =	8	N/mm^2
	Allowable bending compressive stress in concrete	σ_{cbc} =	10	N/mm^2
	Modular ratio = $m = \frac{280}{3\sigma_{cbc}} =$	m =	9.33	
	Neutral axis co-efficient; $n = \frac{m\sigma_{cbc}}{m\sigma_{cbc} + \sigma_{st}} =$	n =	0.42	
	Lever arm coefficient; j = 1-n/3 =	j =	0.86	
	Moment coefficient = K=0.5 x σ_{cbc} x (n x j) =		1.81	N/mm^2

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(3)	**Volume calculation**		
	Diameter of tank, D =	8.80	m
	Internal dia of tank =8.8-0.2 =	8.60	
	Rise of Top Dome =8.8/5	1.76	m
	Diameter of supporting shaft =	5.00	m
	Rise of bottom dome = =8.8/5	1.00	m
	Width of conical portion =(8.8-5)/2	1.90	m
	Depth of conical portion = =(8.8-5)/2	1.90	m
	Height of cylindrical portion of tank	4.10	m
	Centre to centre Diameter of Internal shaft =	1.40	m
	Outer diameter of internal shaft = =1.4+(200)/1000	1.60	m
	Total height of Internal shaft =(1.76+4.1+1.9)-1-2	4.76	m
	Free board, F.B =	0.30	m
	Height of water column in cylindtical portion of tank		
	=1+4.76-0.3-1.9	3.56	m
	Cross sectioon area of tank at top of conical portion		
	=πx8.6x8.6/4	58.09	m^2
	Cross sectioon area of tank at bottom of conical portion		
	=πx5x5/4	19.63	m^2
	Volume of conical portion		
	=1.9/3x(58.09+19.63+(58.09x19.63)^0.5)	70.61	m^2
	Radius of curvature of bottom dome =((5/2)^2+1^2)/2*1	3.63	m
	Volume of bottom dome =π/3x1^2*(3x3.625-1)	10.34	m^3
	Volume of water in cylindrical portion		
	=πx8.6x8.6x3.56/4	206.79	m^3
	Volume of internal shaft =πx1.6x1.6x(4.76-0.3)/4	8.97	m^3
	Total volume of tank without free board =		
	=70.61+206.79-10.34-8.97	258.09	m^3
	Total volume of tank with free board =	276.34	m^3

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(4) Design of Top dome:

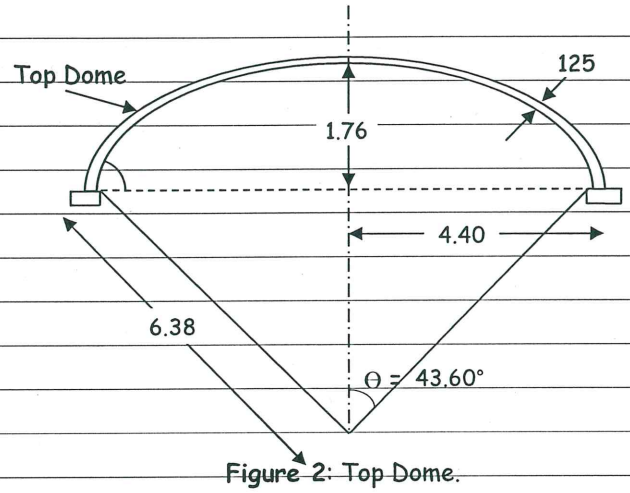

Figure 2: Top Dome.

Radius of the chord, r =		4.40	m
Rise of the top dome, h =		1.76	m
Radius of the shell surface = $(r^2 + h^2)/2h$ =		6.38	m
Semi-central angle is given by			
$\sin\theta = r_3/R$ = 0.69 that is, θ =		43.60°	
=		0.761	rad
Thicknes of the dome =		125	mm
Self weight of dome (wg) = 0.125 X 25		3.13	kN/m^2
Live load w_l =		1.50	kN/m^2
Total load, w = = 1.5 + 3.125 =		4.63	kN/m^2
Weight of the dome = $2\pi Rhw_g$ =	2π x 6.38 x 1.76 x 3.125 =	220.48	kN
Live load on the dome = $2\pi Rhw_l$ =	2π x 6.38 x 1.76 x 1.5 =	105.83	kN
Total load on top dome =	220.48 + 105.83 =	326.31	kN
Meridional thrust = $N_o = (wR)/(1+\cos\theta)$ =		17.11	kN/m
Meridional Stress = 0.01711/0.125 =		0.14	MPa
		0.14 < 8 (OK)	
As the stress is only nominal, provide the min. reinforcement of		0.24	%
A_{sm} = 0.24*(125)*(1000)/100		300.00	mm^2/m

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	Dia of bar =			10	
	Spacing of bar required =			125	mm
	Provide 10 mm dia bar @ 125 mm c/c in meridional direction				
	Circumferential force = wR[cos Θ-(1/(1+cos Θ)] =			4.25	kN/m
	Hoop stress = 0.00425/0.0015			0.03	MPa
				0.03 < 8 (OK)	
	As the stress is only nominal, provide the min. reinforcement of			0.24	%
	A_{sm} = 0.24*(125)*(1000)/100			300.00	mm^2/m
	Dia of bar =			10	mm
	Spacing of bar =			125	mm
	Provide 10 mm dia bar @ 125 mm c/c in circumferential direction				
(5)	**Design of beam at balcony level and balcony slab**				
	Design of balcony				
	Clear width of walkway			0.75	m
	Width of beam at this level			400	mm
	cantilever span of balcony from beam			0.35	m
	Thickness of slab			150	mm
	Self weight of slab			1.31	kN/m
	Live load on slab			1.50	kN/m^2
	Load due to finishes			1.20	kN/m^2
	Total load acting on the walkway slab =0.15x25+1.5+1.2=			6.45	kN/m^2
	Max BM at Support =6.45x0.35²/2=			0.4	kN-m
	effective Depth required =			14.88	mm
	Provided 150 mm uniform thickness for walkway slab				
	Cover to the reinforcement			25	mm
	Diameter of bar			10	mm
	effective depth provided			120	mm
	Area of steel required			29.82	mm^2/m
	Minimum percentage of steel required =			0.24	%
	Minimum Area of steel required on center of slab =			360.00	mm^2/m

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	Spacing of 10 mm dia tor steel =			210	mm c/c
	Provide 10 mm radial bar @ 200 mm c/c and anchored into the ring beam				
	Area of steel provided =			374.00	mm^2/m
	percentage of steel provided =			0.31	
	Diameter of distribution bar =			10	mm
	Spacing of 10 mm dia tor steel =			200	mm c/c
	10 mm dia tor steel @ 200 mm c/c as distribution steel				
	Total weight of slab =				
	$=2\pi$ x(8.8/2+0.4+0.35/2)x0.35x(0.15)x25			41.03	kN
	Design of top ring Beam				
	Hoop thrust on ring beam is same as the horizontal component of				
	the meridional thrust from the top dome. The hoop tension in the				
	ring beam is, therefore, equal to				
	Hoop Tension = T= No $\cos(\theta)$R =			54.52	kN
	Where R =			4.40	m
	Size of the web of the ring beam:				
	b=			400	mm
	D=			300	mm
	Area of tension steel required, As= =(54.52x1000)/130			419.38	mm^2
	Minimum percentage of steel =			0.24	%
	Minimum steel A_{min} =			288.00	mm^2
	Cover to the reinforcement =			25	mm
	Dia of bar =			12	mm
	Number of bars			8	Nos.
	Area of steel provided =			905	mm^2
	Stress in concrete = $T/[A_g + (m-1)A_{st}]$ =				
	= (54.52x1000)/[(400x300)+(9.33-1)x904.78] =			0.43	N/mm^2
	0.43 < 1.5 (Safe)				
	Provide a ring beam of size 400 mm by 300 mm.				
	Provide 8 mm dia stirrups at 175 mm centres.				

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	Self weight of beam = 2π (4.6) (0.4 X 0.3) (25) =			86.71	kN
(6)	**Design of vertical wall of tank**				
	Total Wall height =			4.10	m
	height of water column =			3.56	m
	Radius of tank			4.40	m
	Maximum hoop tension, T =	=10x3.56x4.4		156.64	kN
	Thicknesss of wall =			200	mm
	Ast required on each face =	=156.64x1000/(130x2)		602.46	mm2
	Minimum Ast required as per IS 3370			0.24	%
	Ast minimum required on each face	=(0.0024x1000x200)/2		240	mm2
	Dia of bar provided =			10	mm
	Spacing required on each face			130	mm
	Provide 10 mm dia @ 130 mm centres on both faces				
	Area of steel provided			604.15	mm^2
	Stress in concrete = $T/[A_g + (m-1)A_{st}]$ =			0.76	N/mm^2
	0.76 < 1.5 (Safe)				
	Vertical Steel				
	Minimum area of steel on each face			240	mm^2
	Diameter of bar provided			10	mm
	Provide 10 mm dia tor steel at spacing =			200	mm
	Area of steel provided			392.70	mm^2
	Total weight of cylindrical wall				
	=2πx4.4x4.1x200x25/1000			566.74	kN
(7)	**Design of Middle Ring Beam:**				
	Breadth of Bottom Ring Beam	=		400	mm
	Depth of Bottom Ring Beam	=		600	mm
	Beam Size: 400 X 600				
	Load due to top dome				
	=Meridional Thrust X Sin θ	= 17.11 x sin 43.6 =		11.8	kN/m
	Load due to Top Ring Beam	= 0.4 x 0.3 x 25 =		3	kN/m

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	D. Load from Walkway Slab (DL) = 0.35 x (0.15 x 25 + 1.2) =			1.73	kN/m
	L. Load from Walkway Slab (LL) = 0.75 x 1.5 =			1.13	kN/m
	Load due to cylindrical wall = 0.2 x 4.1 x 25 =			20.5	kN/m
	Self weight of Ring beam = 0.4 x 0.6 x 25 =			6	kN/m
	Total Vertical Load (V_1) =11.8 + 3 + 20.5 + 6 + 1.73 + 1.13 =			44.16	kN/m
	Angle of inclination of conical dome with vertical =			45	°
	Horizontal Force (H) $= V_1 \cot\theta$ = 44.16 x cot 45 =			44.16	kN/m
	Hoop Tension due to Vertical Load =44.16 x 8.8 / 2			194.3	kN
	Hoop Tension due to water pressure = $H_w = \frac{w \times h \times d \times D}{2}$				
	Horizontal force due to water pressure =10x3.86x0.6			23.16	kN/m
	Hoop Tension due to water pressure = 23.16 x 8.8 / 2 =			101.9	kN
	Total Hoop Tension = 194.3 + 101.9			296.2	kN
	Ast = 296.2 x 1000 / 130			2278.46	mm^2
	Dia of bar provideded=			20	mm
	Provide 8 bars of 20 mm dia (4 @ top & 4 @ bottom)				
	Ast Provided =			2513.28	mm^2
	Max. tensile stress =296.2 x 1000 / (400x600+(9.33-1)x2513.28) =			1.14	N/mm^2
				Safe <1.5 N/mm2	
	Dia of 2 legged stirrups=			8	mm
	Spacing of nominal shear reinforcement 2L-Y8 =			250	mm c/c
	Provide 8 mm dia Stirrups @ 250 mm C/C				
	Total weight of beam			165.88	kN
(8)	**Design of conical dome :**				
	The Meridional thrust in the conical dome is due to the vertical				
	forces transferred to it at its base. The total Load consists of				
	a) Weight of water on top of the conical dome				
	b) Weight of top dome, Cylindrical Wall & beams				
	c) Self weight of the conical dome				
	Thickness of conical dome slab			250	mm

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	Average Dia. of Conical Dome =(8.8 + 5) / 2 =	6.9	m
	Average Depth of water = 3.86 + 1.9 / 2 =	4.81	m
	Wt of water above Conical dome = π x 6.9 x 4.81 x 1.9 x 10 =	1981.06	kN
	Length of conical dome	2.69	m
	Self weight of conical dome slab = 3.14 x 6.9 x 2.69 x 0.25 x 25	364.44	kN
	Load from Top Dome, Top Ring Beam, Cylindrical Wall & Bottom Ring Beam		
	= 3.14 x 8.8 x 44.16	1220.85	kN
	Total Load at base of conical slab=1981.06 + 364.44 + 1220.85	3566.35	kN
	Load per unit length (V_2) = 3566.35 / (3.14 x 5)	227.04	kN/m
	Meridional Thrust $T = V_2 \cos ec\theta$ =227.04 x cosec 45 =	321.08	kN
	Meridional Stress =321.08x1000 / (250 x 1000) =	1.28	N/mm^2
	The stress is within safe limit < 8 N/mm2		
	Hoop Tension		
	p = Water Pressure = 10 x 3.86 =	38.6	kN/m^2
	q = self weight of conical dome = 0.25 x 25 =	6.25	kN/m^2
	θ = 45 =	0.785	rad
	H = (38.6 cosec 45 + 6.25 cot 45) x 8.8 / 2	267.69	kN
	Area of steel required for Hoop tension:		
	Diameter of bar provided =	16	mm
	Ast = 267.69 x 1000 / 130	2059.15	mm^2/m
	Area of steel required on each face = = 2059.15 / 2	1029.58	mm^2/m
	Provide 16 mm dia tor steel at spacing = 1000 x 201.06/1029.58 =	175	mm
	Area of steel provided on each face =	1148.91	mm^2/m
	Minimum percentage of steel required =	0.24	%
	Minimum area of steel required on each face =	300	mm^2/m
	Max. Tensile Stress= 267.69 x1000 / (250x1000+(9.33-1)x2297.82)=	0.99	N/mm^2
	Safe < 1.5 N/mm2		
	Area of steel required in the meridional direction:		
	Diameter of bar provided =	16	mm
	Ast = 321.08 x 1000 / 130	2469.85	mm^2/m

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	Area of steel required on each face = = 2469.85 / 2 =	1234.93	mm^2/m
	Provide 16 mm dia tor steel at spacing = 1000 x 201.06/1234.93 =	150	mm
	Area of steel provided on each face =	1340.4	mm^2/m
	Minimum percentage of steel required =	0.24	%
	Minimum area of steel required on each face =	300	mm^2/m
	Max. Tensile Stress= 321.08 x1000 / (250x1000+(9.33-1)x2680.8)=	1.18	N/mm^2
	Safe < 8 N/mm2		
	Provide hoop reinforcement of 16 mm dia bars @ 175 mm c/c		
	Provide meridional reinforcement of 16 mm dia bars @ 150 mm c/c on each face		
(9)	**Design of bottom dome and internal shaft**		

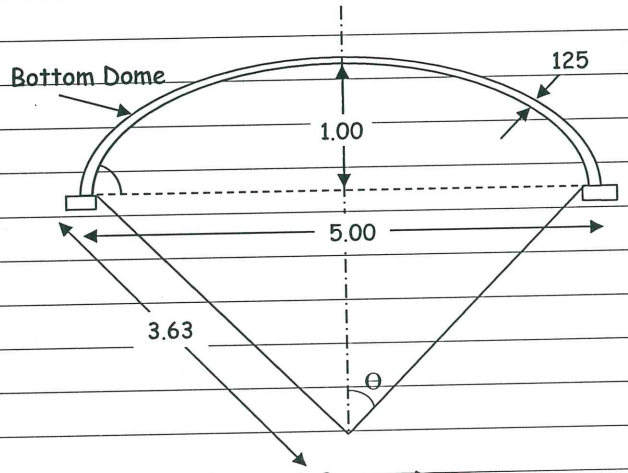

Figure 4: Bottom Dome.

	Diameter at base of dome =	5.00	m
	Rise of bottom dome =	1.00	m
	Thickness of bottom dome, t =	250	mm
	Radius of the shell surface = $(rarius^2 + rise^2)/(2 \times rise)$ =	3.63	m
	Weight of the dome slab = 2 x π x 3.63 x 1 x 0.25 x 25 =	142.55	kN
	Thickness of walls of Internal shaft =	200	mm
	Internal diameter of vertical shaft =	1200	mm
	External diameter = 1200 + 2 x 200 =	1600	mm

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.	Weight of water over bottom dome =			879.0	kN
	Weight of vertical shaft =			104.68	kN
	Total weight on dome =			1126.21	kN
	Load/unit area = w =			57.36	kN/m^2
	Meridional thrust = T_1 = = $wR/(1+\cos\theta)$			120.74	kN
	where, $\cos\theta$ =			0.725	rad
	Meridional stress = (120.74*1000)/(130*1000) =			0.929	N/mm^2
	0.929 < 8 (Safe)				
	Circumferential force = $wR[\cos\theta - (1/(1+\cos\theta)]$ =			30.12	kN
	Hoop stress = (30.12*1000)/(130*1000) =			0.23	N/mm^2
	0.23 < 1.5 (Safe)				
	Provide minimum reinforcement of			0.24	%
	Minimum steel required, A_{st} =			600	mm^2
	Diameter of bar provided =			12	mm
	Spacing of bar required =			180	mm
	Provide 12 mm dia bar at 180 mm centres both radially and in circumferential direction.				
	Maximum hoop compression in the internal shaft =				
	=10 x 4.46 x ((1600 - 200)/1000)/2 =			31.22	kN
	Hoop stress = = (31.22 x 1000)/(130 x 1000) =			0.24	N/mm^2
	0.24 < 8 (Safe)				
	Provide minimum reinforcement of			0.24	%
	Minimum steel required, A_{st} =			480	mm^2
	Diameter of bar provided =			10	mm
	Spacing of bar required =			160	mm
	Provide 10 mm dia bar at 160 mm centres in both directions.				
(10)	**Design of bottom ring beam**				
	Horizontal component of thrust from conical shell = H_1 =			227.04	kN
	Horizontal thrust from bottom dome = H_2 =			90.41	kN
	Net compressive force in ring beam = (H_1-H_2) =			136.63	kN

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	Hoop compression = = 136.63 (5/2) = .			341.58	kN
	Dimensions of bottom ring beam :				
	b =			350	mm
	D=			450	mm
	Compressive stress =			2.169	N/mm^2
	2.169 < 8 (Safe)				
	Provide minimum reinforcement of			0.24	%
	Minimum steel required, A_{st} =			378	mm^2
	Diameter of bar provided =			12	mm
	Number of bars required =			4	Nos.
	Provide 8 mm dia 2-legged stirrups at 200 mm centres.				
	Weight of bottom ring beam = $2\pi \times 5 \times (0.35 \times 0.45) \times 25$=			123.70	kN
(11)	**Design of supporting cylindrical shaft**				
	Centre to centre Diameter of shaft =			5.00	m
	Height of shaft (above G.L.) =			25	m
	Thickness of shaft wall above G.L. =			250	mm
	Minimum thickness of shaft required as per IS: 11682-1985			150	mm
	Total depth of foundation below G.L. =			3.00	m
	Deptht of shaft (below G.L.) = = 3 - 1.1 =			1.90	m
	Thickness of shaft wall below G.L. =			350	mm
	Self weight of shaft above G.L. = $\pi \times 5 \times 25 \times 25 \times 0.25$ =			2454.37	
	Self weight of shaft below G.L. = $\pi \times 5 \times 25 \times 1.9 \times 0.35$ =			261.14	kN
	Thickness of shaft wall above G.L. =			250	mm
	Loads acting on shaft at ground level:				
	(1) Top dome			326.31	kN
	(2) Top ring beam			86.71	kN
	(3) Balcony			41.03	kN
	(4) Cylindrical Wall			566.74	kN
	(5) Middle ring beam			165.88	kN
	(6) Conical wall			364.44	kN

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	(7) Bottom spherical dome			142.55	kN
	(8) Internal shaft			104.68	kN
	(9) Bottom ring beam			123.70	kN
	Weight of tank portion =			**1922.03**	kN
	(10) Supporting shaft			2715.51	kN
	Total Dead load on top of footing =			**4637.54**	kN
	(11) Weight of water (Hydro test condition)=			2763.41	kN
	(12) Weight of water (Working condition)=			2580.94	kN
	Wind pressure:				
	Basic wind speed, V_b=			50	m/s
	Risk Coefficient, k_1=			1.08	
	Terrain, height and structure size factor, k_2=			1.11	
	Topography factor, k_3=			1	
	Design wind speed, $V_z = V_b \times k_1 \times k_2 \times k_3$ =			59.94	m/s
	$Pz = 0.6\ V_z^2$ =			2.16	kN/m^2
Ref Pg.	**Total moment due to wind load about base of footing , M**			**3488.66**	**kN-m**
Wind load	Area of cross section of shaft, $A = \pi [(2.625)^2 - (2.375)^2)]$ =			3.93	m^2
calculation	Second moment of area, I :				
	I = (π/4) [(2.625^4) - (2.375^4)] =			12.30	m^4
	Stress at base section:				
	Tank empty condition:				
	W =			4376.40	kN
	Outer dia of shaft, D =			5.35	m
	Mean radius of shaft, r =			2.50	m
	M =			3488.66	kN-m
	e = (M/W) =			0.80	m
	e/r = 0.8/2.5 =			0.32	m
	e/r <= 1/2 (OK)				
IS 11682-1985	***This section is under compression only***				
	$\sigma cv = (W/2\pi\ r\ t)[1 + (2e/r)]$ =			1.31	N/mm^2
	1.31 < 0.38x 30 (Safe)				

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	Tank working condition + wind:				
	P =			6957.34	kN
	M =			3488.66	kN-m
	e= M/W =			0.5	m
	e/r = 0.5/2.5 =			0.2	
IS 11682-	**e/r <= 1/2 (OK)**				
1985	σcv = (W/2π r t)[1 + (2e/r)] =			1.77	N/mm^2
	1.77 < 0.38x 30 (Safe)				
	Tank Hydro test condition				
	W =			7139.80	kN
	M =			0	N-mm
	e = M/W =			0	
IS 11682-	σcv = (W/2π r t)[1 + (2e/r)] =			1.3	N/mm^2
1985	**1.3 < 0.38 x 30 (Safe)**				
IS 11682-	Provide minimum longitudnal reinforcement of			0.25	%
1985	Area of steel required on each face, A_{st} =			312.5	mm^2
	Diameter of bar provided =			12	mm
	>=10 mm (OK)				
	Spacing of bar required =			360	mm
	Spacing of bar provided =			200	mm
	Provide 12 mm dia bar at 200 mm centres vertically on each faces.				
	Area os steel provided on each face =			314.2	mm^2
	Circumferential reinforcement in shaft:				
IS 11682-	Provide minimum circumferential reinforcement of			0.2	%
1985	Area of steel required on each face, A_{st} =			250	mm^2
	Minimum steel required per meter length on each face =			200	mm^2
	Diameter of bar provided =			10	mm
	Spacing of bar required =			310	mm
	Spacing of bar provided =			200	mm
	Area of steel provided per metre length of shaft=			392.70	mm^2

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		> 200 (OK)	
	Provide 10 mm dia bar at 200 mm centres circumferentially on each faces.		
	Area os steel provided =	253.4	mm^2
	Check for seismic forces		
	Height of staging above groung level =	25.00	m
	Stiffness of shaft, k = 3 EI/l^3 =		
IS 456-2000	$E = 5000(f_{ck})^{0.5}$ =	27386.13	N/mm^2
	I = (π/4) [(2.625^4) - (2.375^4)] =	12.30	m^4
	l= length of staging =	25.00	m
	k=	64690.85	kN/m
	Seismic coefficient is given by : $A_h = \frac{Z}{2}\frac{I}{R}\left(\frac{S_a}{g}\right)$		
IS: 1893-2002	where, Zone Factor, Z =	0.1	
	Importance Factor, I =	1.75	
	Response reduction Factor R =	3	
	Spectral Acceleration , (S_a/g)		
	Tank Empty condition :		
	Weight of tank Container =	1922.03	kN
	Weight of 1/3 of staging = (1/3) x (2454.37) =	818.12	kN
	Seismic weight for tank empty condition, W_s=	2740.16	kN
	Time period when tank empty, T_e = $2\pi\ [(W_s/9.81) / k]^{0.5}$		
	= 2π x {(2740.16/9.81)/(64690.85)}^0.5=	0.41	sec
IS: 1893-2002	For rocky, or hard soil sites, corresponding S_a/g =	2.42	
	The design horizontal seismic coefficient, A_h =	0.07	
	Maximum horizontal seismic force acting at top of staging =	193.58	kN
	Moment due to seismic forces at top of footing:		
	Total load, W =	4376.40	kN
	Moment, M=	5207.19	kN-m
	e= M/W =	1.19	m

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	e/r = 1.19/2.5 =	0.48	
IS 11682-1985		**e/r <= 1/2 (OK)**	
	$\sigma cv = (W/2\pi r t)[1 + (2e/r)]$ =	1.55	N/mm^2
		1.55 < 0.40 x 30 (Safe)	
	Tank Full condition :		
	Weight of tank Container =	1922.03	kN
	Weight of 1/3 of staging = (1/3) x (2454.37) =	818.12	kN
	Weight of water =	2580.94	kN
	Seismic weight for tank full condition =	5321.10	kN
	Time period when tank full, T =	0.58	sec
IS: 1893-2002	For rocky, or hard soil sites, corresponding Sa/g =	2.42207788	
	The design horizontal seismic coefficient, A_h =	0.07	
	Maximum horizontal seismic force acting at top of staging =	375.90	kN
	Moment due to seismic forces at top of footing:		
	Total load, W =	6957.34	kN
	Moment, M=	10111.80	kN-m
	e= M/W =	1.45	
	e/r = 1.45/2.5 =	0.58	
IS 11682-1985		**e/r > 1/2**	
	Ref table 1	3.9	N/mm^2
		3.9 < 0.40 x 30 (Safe)	
	Check for stress at openings:		
	Size of opening : width =	1	m
	height =	2	m
	Maximum vertical compressive stress in concrete at outside diameter of shaft shell is given by :		
IS 11682-1985	$\sigma_{cv} = \frac{W}{2(\pi-\beta) r t}\left[1 + \frac{2\left\{\frac{e}{r} + \frac{\sin\beta}{\pi-\beta}\right\}\{(\pi-\beta)\cos\beta + \sin\beta\}}{(\pi-\beta) - \frac{1}{2}\sin 2\beta - \frac{2\sin^2\beta}{(\pi-\beta)}}\right]$		

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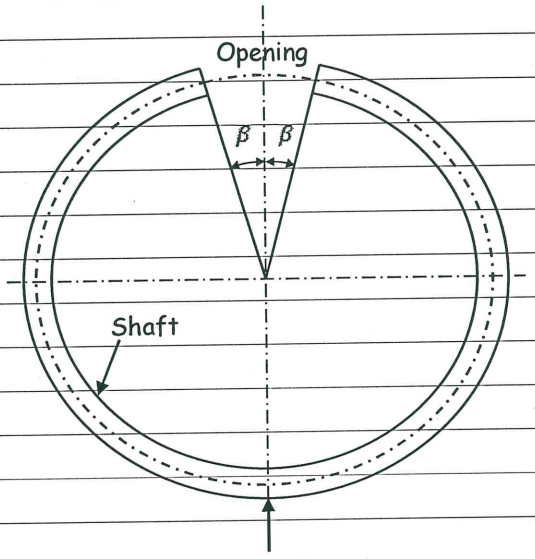

	Where,		
	ß = half the angle substended by neutral axis as a chord on the circle of radius r =	0.20	rad
	W = Total vertical load above section under consideration in N =	6957	kN
	M = Moment in vertical plane at the section under consideration in N-mm =	10111.8	kN-m
	e = M/W =	1.45	m
	r = Mean radius of circular shaft in mm =	2.50	mm
	t = Thickness of shaft in mm =	250	mm
Ref.	e/r =	0.581	
Table 2		5.73	N/mm^2
		5.73 < 0.40 x 30 (Safe)	
(12)	**Design of raft foundations**		
	Total load from tank and shaft =	7218.49	kN
	Load from Staircase on Raft slab:		
	Total weight of staircase =	1060	kN

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	Total Load from staircase =			1060.00	kN
	Diameter of raft slab, D =			11.0	m
	Thickness of raft slab, t =			1100	mm
	Self weight of footing =			2613.41	kN
	Weight of Earth filling inside the shaft upto G.L.				
	= [π (4.65²)/4] X 1.9 X 18 =			580.79	kN
	Weight of earth filling over the raft slab upto G.L.				
	= [π (11²-5.35²)/4] X 1.9 X 18 =			2481.32	kN
	Total load acting on raft slab, W =			13954.01	kN
	Net S.B.C. of soil =			150	kN/m²
	Gross S.B.C at depth of 3 m below G.L. (For normal load)=			204	kN/m²
	Gross S.B.C at depth of 1.9 m below G.L. (For seismic/wind load)=			241.5	
	Area of footing, A =			95.03	m²
	Direct load, W =			13954.01	kN
	Moment M =			10111.80	kN-m
From staad	Moment from staircase column (seismic case) =			40.00	kN-m
	Total moment =			10151.80	
	Section modulas, Z=			130.67	m⁴
	Maximum intensity of soil pressure at base = [W/A + M/Z] =			224.52	kN/m²
	224.52 < 241.5 (Safe)				
	Minimum intensity of soil pressure at base = [W/A - M/Z] =			69.14	kN/m²
	69.14 >0 (No tension)				
	Adopt Diameter of raft slab = 11 m				
	Projection of raft beyond face of shaft =			2.825	m
	Maximum net soil pressure, w =			162.82	kN/m²
	The loading at base is taken as annular loading on the mean diameter of the shaft.				
	Diameter of raft slab = 2a =			11.0	m
	Diameter of the shaft = 2b =			5.00	m
	Radial moment at centre of foundation is given by:				

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$M_r = \frac{W}{8\pi}\left[2\log_e\left(\frac{a}{b}\right)+1-\left(\frac{b}{a}\right)^2\right]-\frac{3}{16}w.a^2$	=	392.53	kN-m/m
Moment at junction of footing and tank walls at a radius of 2.5 m is given by:			
$M_{max} = \frac{W}{8\pi}\left[2\log_e\left(\frac{a}{b}\right)+1-\left(\frac{b}{a}\right)^2\right]-\frac{3}{16}w(a^2-b^2)$	=	583.33	kN-m/m
Design ultimate moment = M_{ur} = (1.5 x 583.33) =		874.995	kN-m/m
Effective depth required d = $[M_u/.133\ f_{ck}\ b]^{0.5}$ =		468.29	mm
Effective depth provided at the section =		1040.00	mm
		(OK SAFE)	
Compute parameter:			
M_u/bd^2 =		0.809	
Refer Table-4 of SP : 16 and read out the percentage reinforcement as:			
p_t= 100 A_{st} / bd =		0.19216	
Area of steel required, Ast =		1998.46	mm^2/m
Diameter of bar provided =		20	mm
Cover to the reinforcement =		50	mm
Actual effective depth at the section =		1040	
Spacing of bar required =		155	mm
Spacing of bar provided =		150	mm
Provide 20 mm dia bar at 150 mm centres both ways at bottom of footing.			
Area of steel provided =		2026.83	mm^2/m
Design ultimate moment = M_{uc} = (1.5 x 392.53) =		588.795	kN-m/m
Compute parameter:			
M_u/bd^2 =		0.54	
Refer Table-4 of SP : 16 and read out the percentage reinforcement as:			

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.	p_t= 100 A_{st} / bd =	0.1266	
	Area of steel required, Ast =	1316.64	mm^2/m
	Diameter of bar provided =	20	mm
	Cover to the reinforcement =	50	mm
	Effective depth at the section =	1040	
	Spacing of bar required =	230	mm
	Spacing of bar provided =	200	mm
	Provide 20 mm dia bar at 200 mm centres both ways at top of footing.		
	Check for shear :		
	Intensity of soil pressur, p =	162.82	kN/m^2
	Cantilever projection of raft = (11-5-0.35)/2 =	2.825	m
	Max. SF at a distance 'd' from the support = 162.82(2.825-1.04) =	290.63	kN
	Shear stress , t_v = V/bd = 290.63x 1000/1000(1040) =	0.28	N/mm^2
	percentage steel at the section, 100As/bd =	0.192	%
	The allowable shear stress for 0.192 % tension reinforcement is		
	k x t_c =	0.32	N/mm^2
	Slab is safe in shear (OK)		
(13)	**Stability Check** - Tank empty conditon		
	Wind force	348.93	kN
	Moment due to wind force	3488.66	kN-m
	Seismic force	193.58	kN
	Moment due to seismic force	5207.19	kN-m
	Max. horizontal force	348.93	kN
	Max. overturning moi = OM	5207.19	kN-m
	Total vertical DL		
	=(Top container(without water) + shaft + stair case + raft + earth inside and outside)	11373.07	kN
	0.9 DL =0.9 x 11373.07	10235.76	kN
	Restoring moment = I=DL x (raft dia)/2 =11373.07 x 11/2	62551.86	kN-m
	Check for safety against overturning		
	Factor of Safety =OM/RM = 5207.19/62551.86 =	12.01	

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				>1.5 safe Ok
	Check for safety against sliding			
	Factor of Safety =(0.9DL x μ)/(Max horizontal force)			
			=10236x0.4/349	11.73
				>1.25 safe Ok
(14)	**Stability Check** - Tank full conditon			
	Seismic force			375.90 kN
	Moment due to seismic force			10111.80 kN-m
	Max. horizontal force			375.90 kN
	Max. overturning moı = OM			10111.80 kN-m
	Total vertical DL			
	=(Top container (with water) + shaft + stair case + raft + earth inside and outside)			13954.01 kN
	0.9 DL		=0.9 x 13954.01	12558.61 kN
	Restoring moment = I=DL x (raft dia)/2		=13954.01 x 11/2	76747.05 kN-m
	Check for safety against overturning			
	Factor of Safety =OM/RM		= 10111.8/76747.05 =	7.59
				>1.5 safe Ok
	Check for safety against sliding			
	Factor of Safety =(0.9DL x μ)/(Max horizontal force)			
			=12559x0.4/376	13.36
				>1.25 safe Ok

CALCULATION OF STRESSES IN SHAFT SECTION AT BASE OF SHAFT
(As per Clause 8.2.5.2 of IS:11682-1985)
Tank Operating condition+SL - Table-1

LEVEL	Width of opening (m)	Grade of concrete	ID m	thk m	Axial load (KN)	Moment KN-m	BETA β (Deg)	ALPHA α (Rad)	BETA (Rad)	Modular ratio (m)
0.000	**0.000**	**30**	4.75	0.250	6957.3	10111.80	0.00	2.478368	0	9.3300

p	ALPHA (assumed) (Deg)	e m	e/r	A	B	A/B	σ_{cv}' N/mm^2	σ_{cv} N/mm^2	σ_{sy} N/mm^2
0.0025	142	1.4534	0.58	1.5146921	2.619963669	0.58	**3.798**	**3.905 < 12 ok**	**4.202 < 249 ok**
					(e/r - A/B)=	0.00000			

mp	1-p+mp	1-p	sin α cos α	sin β cos β	sin β cos α	sin α	α cos α	sin β	β cos α	mp.π.cos α
0.023325	1.020825	0.9975	-0.485147863	0	0	0.615661	-1.95298	0	0	-0.05774353
					A	B	B'			
					1.5146921	2.619964	5.239927			

CALCULATION OF STRESSES IN SHAFT SECTION AT BASE OF SHAFT
(As per Clause 8.2.5.2 of IS:11682-1985)
Tank Operating condition+SL - Table-2

LEVEL	Width of opening (m)	Grade of concrete	ID m	thk m	Axial load (KN)	Moment KN-m	BETA β (Deg)	ALPHA α (Rad)	BETA (Rad)	Modular ratio (m)
0.000	**1.000**	**30**	4.75	0.250	6957.3	10111.80	11.31	1.902409	0.1973954	9.3300

p	ALPHA (assumed) (Deg)	e m	e/r	A	B	A/B	σ_{cv}' N/mm^2	σ_{cv} N/mm^2	σ_{sy} N/mm^2
0.0025	109	1.4534	0.58	0.610819764	1.053218822	0.58	**5.512**	**5.727 < 12 ok**	**26.552 < 249 ok**

(e/r - A/B)= 0.00000

mp	1-p+mp	1-p	sin α cos α	sin β cos β	sin β cos α	sin α	α cos α	sin β	β cos α	mp.π.cos α
0.023325	1.020825	0.9975	-0.307830738	0.192307538	-0.063849115	0.945519	-0.61936	0.196116	-0.0642657	-0.02385685
					A	B	B'			
					0.610819764	1.053219	2.638046			

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Wind Load Calculation:

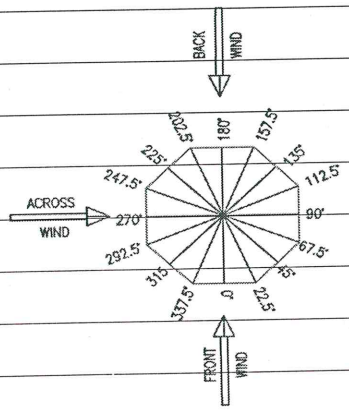
Basic Wind Speed V_b (m/s) =	50 m/s
Risk Coefficient K_1 =	1.08
Terrain Factor K_2 (For Category-1 & Class-B) =	1.11
Topography factor K_3 =	1
Design Wind Speed V_z = $V_b \times K_1 \times K_2 \times K_3$ =	59.94 m/s
Design Wind Pressure acting $P_z = 0.6 \times V_z^2$ =	2155.68 N/m^2
	2.16 kN/m^2

External Pressure Coefficient on shaft and top Cylindrical wall of bowl:

Refer Table-18 (IS: 875 (Part-3) - 1987)

Height of the Tank above ground level (h) =	31.00 m
Average outer Diameter of the shaft (D) =	6.9 m
Ratio h/D = 31/6.9 =	4.49

From Table-18 use the coefficients for the nearest curve of h/D =1



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θ in degrees	Shaft (C_{pe})	Wall (C_{pe})
0	1	1
15	0.8	0.8
30	0.1	0.1
45	-0.7	-0.7
60	-1.2	-1.2
75	-1.6	-1.6
90	-1.7	-1.7
105	-1.2	-1.2
120	-0.7	-0.7
135	-0.5	-0.5
150	-0.4	-0.4
165	-0.4	-0.4
180	-0.4	-0.4
195	-0.4	-0.4
210	-0.4	-0.4
225	-0.5	-0.5
240	-0.7	-0.7
255	-1.2	-1.2
270	-1.7	-1.7
285	-1.6	-1.6
300	-1.2	-1.2
315	-0.7	-0.7
330	0.1	0.1
345	0.8	0.8

PROJECT:	Providing drinking water to habitations in Komarambheem-Asifabad Segment in Adilabad District	DOCUMENT NO. LE150883-C-WS-CW-DC-3027		DATE 04-Apr-2016
TITLE :	250 KL Capacity OHBR - 25 m staging height	DESIGNED AKHB/RRG	CHECKED RR	PAGE

Internal Pressure Coefficient :

Refer Clause 6.2.3.1 (IS: 875 (Part-3) - 1987)

Internal Pressure coefficients for openings not more than 5% (C_{pi}) = +0.2

-0.2

Wind Load acting on the shaft (Case-1)

θ in degrees	Shaft (C_{pe})	Shaft (C_{pi})	wind force /m ht	$F_{along\ wind}$	$F_{across\ wind}$
0	1	0.2	1.56	1.56	0
15	0.8	0.2	1.17	1.13	0.303
30	0.1	0.2	-0.2	-0.173	-0.1
45	-0.7	0.2	-1.76	-1.245	-1.245
60	-1.2	0.2	-2.73	-1.365	-2.364
75	-1.6	0.2	-3.51	-0.908	-3.39
90	-1.7	0.2	-3.71	0	-3.71
105	-1.2	0.2	-2.73	0.707	-2.637
120	-0.7	0.2	-1.76	0.88	-1.524
135	-0.5	0.2	-1.37	0.969	-0.969
150	-0.4	0.2	-1.17	1.013	-0.585
165	-0.4	0.2	-1.17	1.13	-0.303
180	-0.4	0.2	-1.17	1.17	0
195	-0.4	0.2	-1.17	1.13	0.303
210	-0.4	0.2	-1.17	1.013	0.585
225	-0.5	0.2	-1.37	0.969	0.969
240	-0.7	0.2	-1.76	0.88	1.524
255	-1.2	0.2	-2.73	0.707	2.637
270	-1.7	0.2	-3.71	0	3.71
285	-1.6	0.2	-3.51	-0.908	3.39
300	-1.2	0.2	-2.73	-1.365	2.364
315	-0.7	0.2	-1.76	-1.245	1.245

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	330	0.1	0.2	-0.2	-0.173	0.1
	345	0.8	0.2	1.17	1.13	-0.303
				SUM =	7.01	0
	Wind Load acting on the shaft (Case-2)					
	θ in degrees	Shaft (C_{pe})	Shaft (C_{pi})	wind force /m ht	$F_{along\ wind}$	$F_{across\ wind}$
	0	1	-0.2	2.34	2.34	0
	15	0.8	-0.2	1.95	1.884	0.505
	30	0.1	-0.2	0.59	0.511	0.295
	45	-0.7	-0.2	-0.98	-0.693	-0.693
	60	-1.2	-0.2	-1.95	-0.975	-1.689
	75	-1.6	-0.2	-2.73	-0.707	-2.637
	90	-1.7	-0.2	-2.93	0	-2.93
	105	-1.2	-0.2	-1.95	0.505	-1.884
	120	-0.7	-0.2	-0.98	0.49	-0.849
	135	-0.5	-0.2	-0.59	0.417	-0.417
	150	-0.4	-0.2	-0.39	0.338	-0.195
	165	-0.4	-0.2	-0.39	0.377	-0.101
	180	-0.4	-0.2	-0.39	0.39	0
	195	-0.4	-0.2	-0.39	0.377	0.101
	210	-0.4	-0.2	-0.39	0.338	0.195
	225	-0.5	-0.2	-0.59	0.417	0.417
	240	-0.7	-0.2	-0.98	0.49	0.849
	255	-1.2	-0.2	-1.95	0.505	1.884
	270	-1.7	-0.2	-2.93	0	2.93
	285	-1.6	-0.2	-2.73	-0.707	2.637
	300	-1.2	-0.2	-1.95	-0.975	1.689
	315	-0.7	-0.2	-0.98	-0.693	0.693

PROJECT:	Providing drinking water to habitations in Komarambheem-Asifabad Segment in Adilabad District	DOCUMENT NO. LE150883-C-WS-CW-DC-3027	DATE 04-Apr-2016
TITLE :	250 KL Capacity OHBR - 25 m staging height	DESIGNED AKHB/RRG	CHECKED RR / PAGE

	330	0.1	-0.2	0.59	0.511	-0.295
	345	0.8	-0.2	1.95	1.884	-0.505
				Σ	7.02	0

	Total horizontal force acting on the shaft due to wind :		
	Horizontal Wind load acting on the shaft per m height =	7.02	kN/m
	Height of Shaft above the GL upto bottom of Top Bowl =	31	m
	Depth of Shaft below the GL upto top of footing =	1.9	m
	Total Horizontal wind load acting on the shaft = 7.02x31 =	217.62	kN
	Maximum moment acting at the base of the shaft =		
	= 217.62x(31/2+1.9) =	3373.11	kN-m
	Force acting on the roof of the structure:		
Ref. Table 19	Structure according to the shape is (c)		
	H=	32.76	
	D=	8.8	
IS: 875	H/D =	3.722727	
(Part 3)-1987	C_{pe} for above value of H/D =	-1	
	C_{pi} =	0	
	Force acting on the roof of the structure, $P = 0.785\ D^2\ (p_i - C_{pe}\ p_d)$ =	131.3073	kN
	e = 0.1 D =	0.88	
	Moment about the base of tank =	115.5504	kN-m
	Total Moment =	**3488.66**	kN-m

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DESIGN OF STAIR CASE

DESIGN OF STAIR CASE

* Maximum span of flight is designed and the same reinforcement is provided for all flights and landing slab.

Design data :

fck	=	25 N/mm²
fy	=	500 N/mm²
Tread , T	=	250 mm
Rise , R	=	167 mm
Thickness of Waist slab , D	=	150 mm

T = 250

W = 300.65 R = 167

Dead load :

On landing area,	Self wt.of slab	=	3.75 KN/m²
	Finish load	=	1.2 KN/m²
	Total dead load	=	4.95 KN/m²

On Stair area,

Flight load = 1/ T (D * W + T * R / 2) * 25

= 1 / 0.25 (0.15 * 0.30 + 0.25 * 0.17 / 2) * 25

= 6.60 KN/mm²

Span for stair area 2.5 m

Span for landing area =

l_1 = 1 m

l_2 = 1 m

Clause 33.1., IS : 456,

Effective span,

ES = A + B + C = 2.5 m

Live load :

Live on landing & stair area = 4 KN/m²

Factored loads,

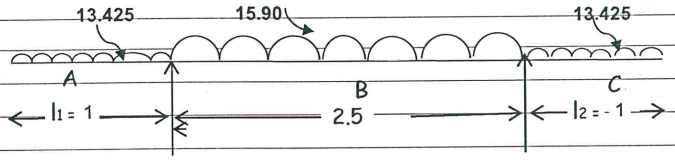
On landing area, = 1.5 * (DL + LL)

= 13.43 KN/m²

On stair area, = 1.5 * (DL + LL)

= 15.90 KN/m²

Loading diagram ,



From staad

Ra	=	33.33 KN
Rb	=	33.33 KN

From staad

Maximum B.M.

	LARSEN & TOUBRO LIMITED Water,Smart World & Communication IC			
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TITLE :	250 KL Capacity OHBR - 25 m staging height	DESIGNED AKHB/RRG	CHECKED RR	PAGE

	Mu =		7.00 KN-m
	Clear cover in mm	=	30 mm
	Assuming dia of bar as	=	10 mm
	Effective depth, d	=	115 mm
	Table , SP : 16		
	Reinforcement :		
	Mu/bd^2	=	0.53 N/mm^2
	pt	=	0.12 %
	Ast(req)	=	143.51 mm^2
	Required 10 Dia.	@	547 mm c/c
	Provide 10 Dia.	@	125 mm c/c
	therefore,		
	pt(prov)	=	0.55 %
	Ast(prov)	=	628.3 mm^2
	Minimum reinforcement required =(0.12/100)*1000*150		187.2 mm^2
	Provide 8 mm dia 200 mm spacing c/c		251.2 mm^2
	Reinforcement provided		
	pt(prov)	=	0.17 %
	Check for shear :		
	Actual shear stress,Vu	=	33.33 KN
	T_V	=	0.29 N/mm^2
	for pt	=	0.55
	Allowable shear stress,T_c	=	0.507 N/mm^2
			> T_V
	NO SHEAR REINFORCEMENT IS REQUIRED		
	Check for deflection :		
	(From IS:456:2000 clause 23.2)		
	Allowable span /depth ratio	=	20.00
	% of tension reinforcement	=	0.55
	fs = 0.58*415*(143.51/628.32)	=	54.98
	From Fig 4 Modification factor for tension Rft (Mft)	=	2.00
	From Fig 5 Modification factor for tension Rft (Mfc)	=	1.00
	Modified span /depth ratio = l/d x Mft x Mfc	=	40.00
	Actual span/depth ratio 2.5*1000/115	=	21.74
	Actual span/depth ratio < Modified span/depth ratio	=	safe

"Designs Vetted"

APPROVED
30/7/16
SE, NIRMAL

M/s. S.K. ASSOCIATES Hyd-08.

LARSEN & TOUBRO LTD. Komarambheem - Asifabad Segment Construction-TDWSP -ADILABAD

WAPCOS LIMITED हैदराबाद Hyderabad

Asst. Executive Engineer TDWSP Asifabad

Dy. Executive Engineer TDWSP Asifabad

Executive Engine TDWSP Asifabad

SCHEDULE OF COLUMNS:

COLUMN MARKED	C1	VC1
TOP OF COLUMN	EL(+)23.500	TOP OF SLAB
VERTICAL REINF.	4 NOS. Y16 (a)	4 NOS. Y8 (c)
TIES	Y8 AT 200 C/C (b) (1 TIE PER SET)	Y6 AT 200 C/C (d) (1 TIE PER SET)
CROSS SECTION OF COLUMN		
COLUMN SIZE	250 x 250	150 x 150
COLUMN STARTING LEVEL	TOP OF THE RAFT	TOP OF THE DOME

FOR LOCATION AND SIZE OF INLET, OUTLET, SCOUR & OVERFLOW PIPES REFER APPROVED G.A DRAWING.

LEGEND:

NGL : NATURAL GROUND LEVEL.
TOC : TOP OF CONCRETE

NOTES:-

1. ALL DIMENSIONS ARE IN mm & ALL LEVELS SHALL BE IN METRES.
2. GRADE OF CONCRETE SHALL BE M30 - 43 GRADE CEMENT, 20MM DOWN SIZE AGGREGATE WITH MINIMUM CEMENT CONTENT OF 320 kg/cum.
3. Y INDICATES HYSD BARS OF GRADE Fe500 CONFORMING TO IS: 1786-1985.
4. CLEAR COVER TO MAIN REINFORCEMENT SHALL BE :
   a) RAFT = 50mm
   b) BEAMS (ALL ROUND) = 30mm
   c) SHAFT = 30mm
   d) COLUMNS = 40mm
   e) WALL = 30mm(FREE FACE), 45mm (WATER FACE).
   f) TOP DOME = 30mm
   g) BOTTOM DOME = 30mm(FREE FACE), 45mm (WATER FACE).
5. ALL LAPS SHALL BE 46 TIMES DIA OF BAR AND SHALL BE STAGGERED.
6. THREE COATS OF EPOXY PAINT TO INNER SURFACE OF THE RESERVOIR INCLUDING ROOF AND 2 COATS OF WEATHER PROOF EMULSION PAINTING FOR EXTERNAL SURFACES.
7. SAFE BEARING CAPACITY OF SOIL IS CONSIDERED AS 15T/Sqm.

REV.	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	AKHB 04.04.16	MGS 06.04.16	RR 07.04.16	BRG 08.04.16

LAST BAR NO. (70)

L&T Construction
Water, Smart world & Communication

CLIENT : GOVERNMENT OF TELANGANA
RURAL WATER SUPPLY AND SANITATION DEPARTMENT
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	AKHB		04.04.2016
DRWN	MGS		06.04.2016
CHKD	RR		07.04.2016
APPD	BRJ		08.04.2016

TITLE : 250 KL CAPACITY & STAGING HEIGHT 25m OHBR NUMERATION & RC DETAILS

SCALE 1:100, 1:50 & 1:25
PROJECTION
DRG. No. LE150883-C-WS-CW-NR-3028 | SHEET 1 OF 1 | SIZE A0 | REV. A

CHECKED BY	SIGN	DATE
CIVIL & STRUCTURAL	-	-
PROCESS	-	-
MECHANICAL	-	-
ELECTRICAL	-	-
INSTRUMENTATION	-	-

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