

5.2 M DIAMETER FERROCEMENT WATER TANK DESIGN REPORT

31st July 2023

**Prepared by:
Sheilla Constance Apio**

ANALYSIS MODEL

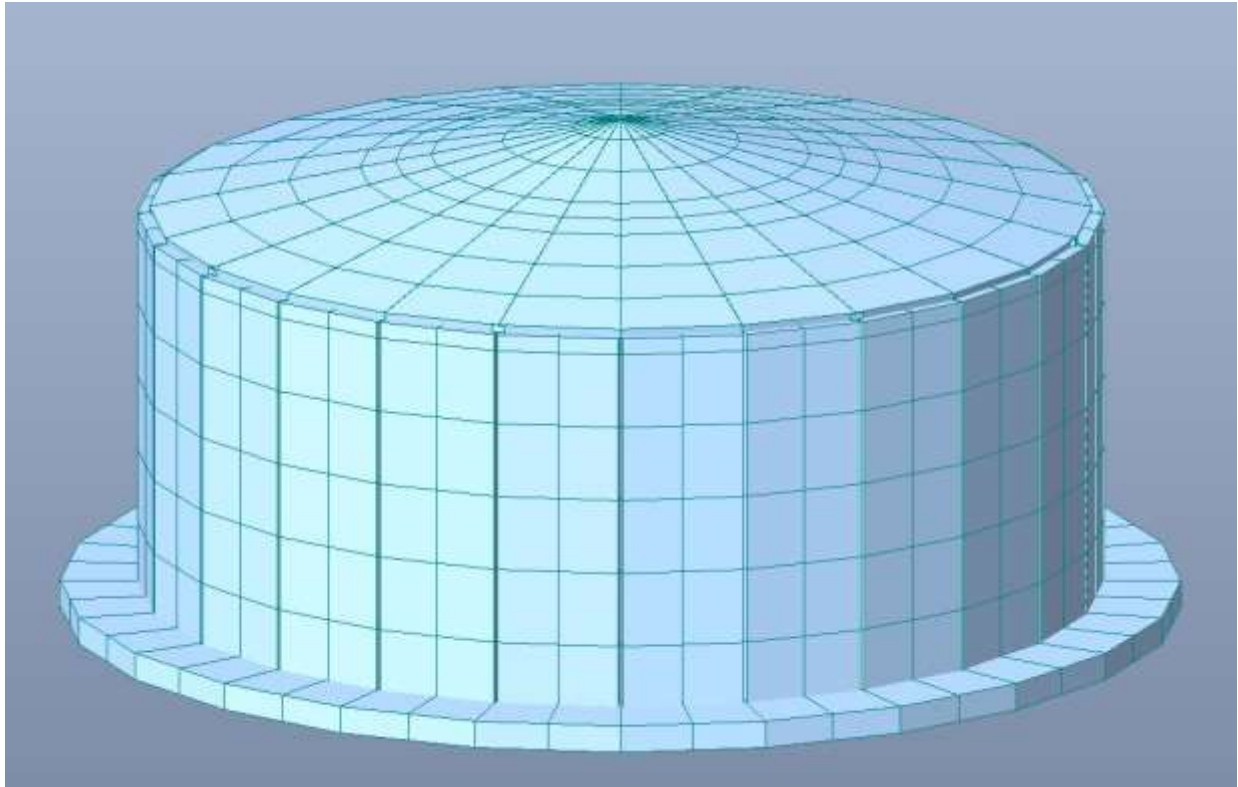


Figure 1 Analysis model

MODEL SUPPORTS

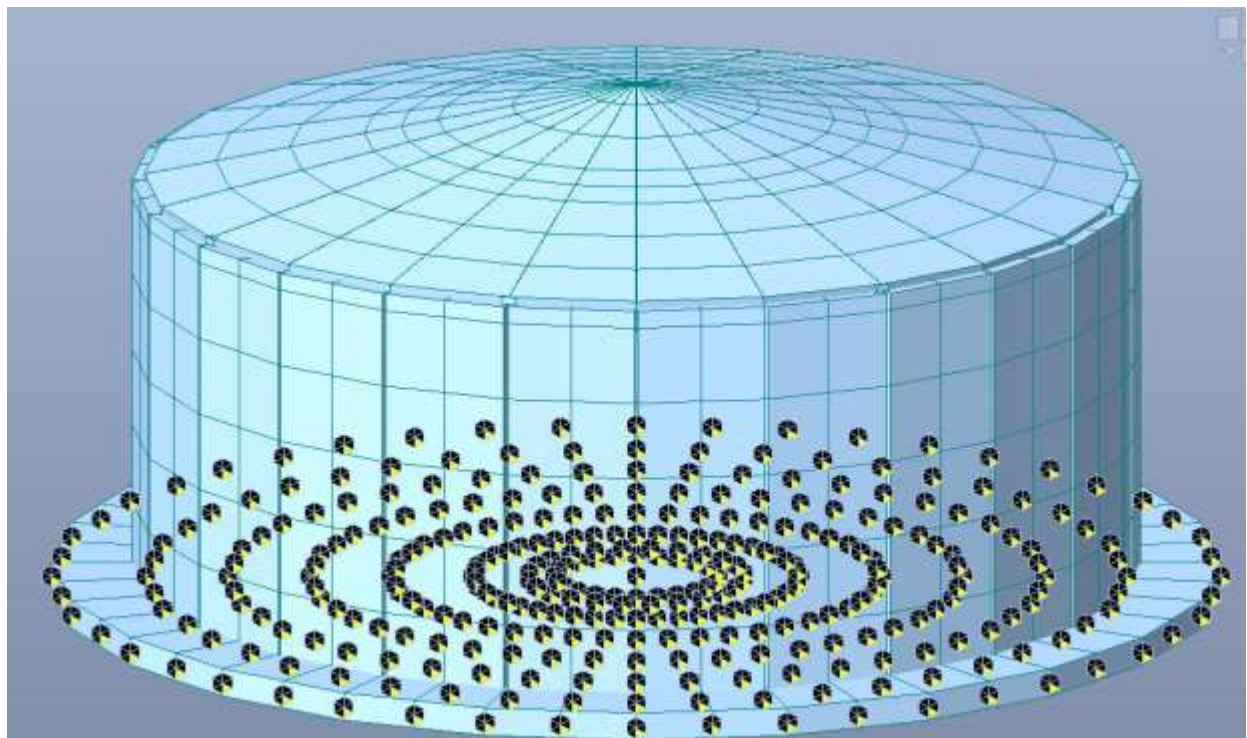


Figure 2 support conditions (using surface springs based on 150 kN/m² soil capacity)

WATER LOADING

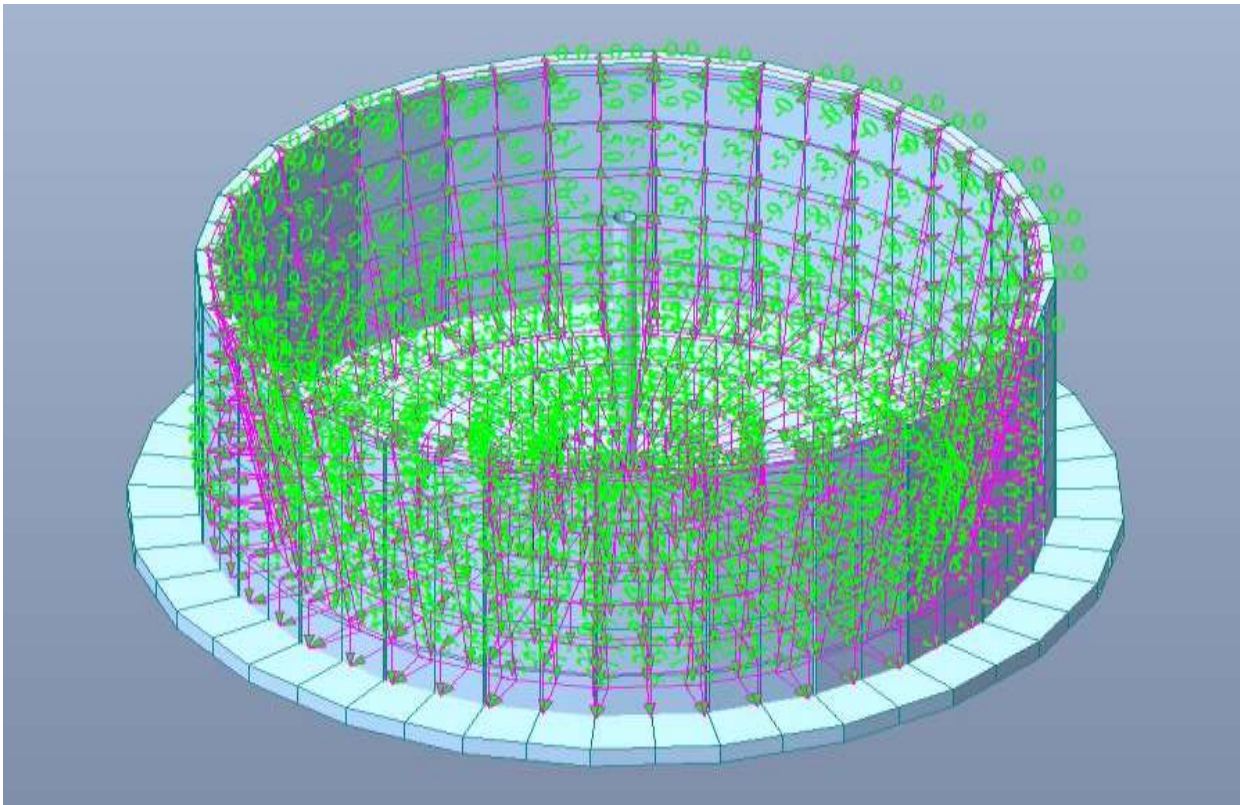


Figure 3 Applied water pressure based 10 kN/m³ water density

ROOF LOAD

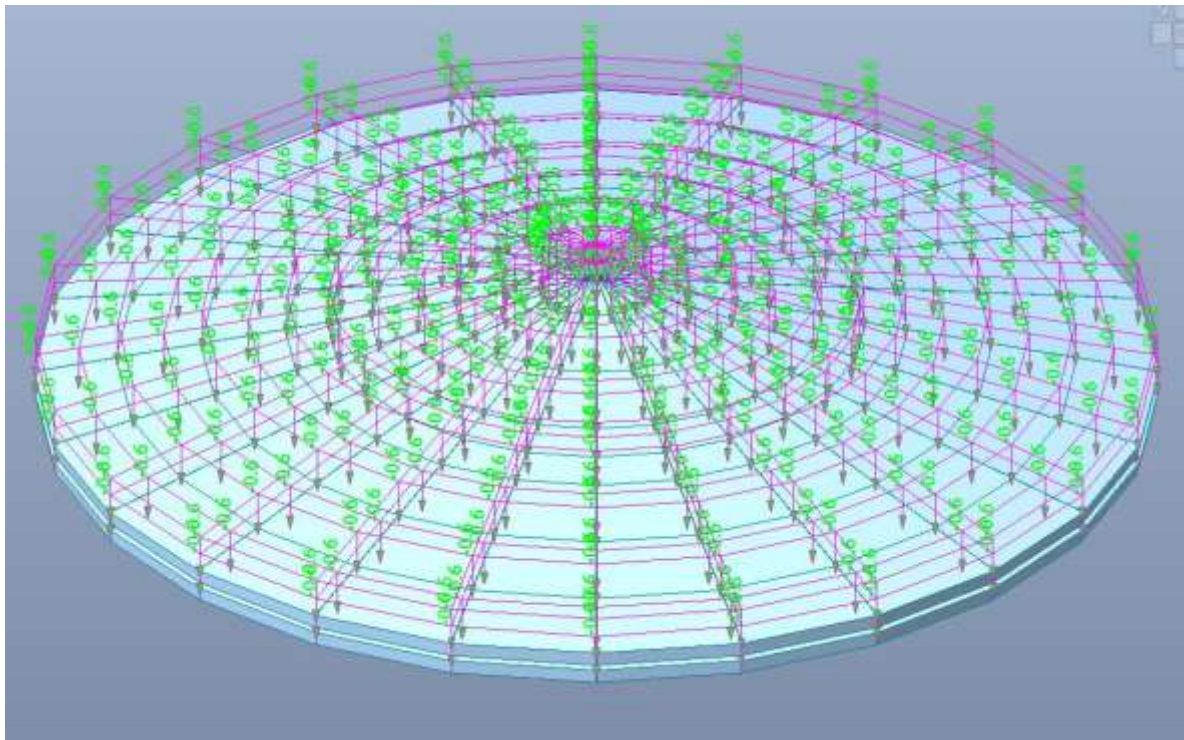


Figure 4 roof loading

STEEL SUPPORT FRAME

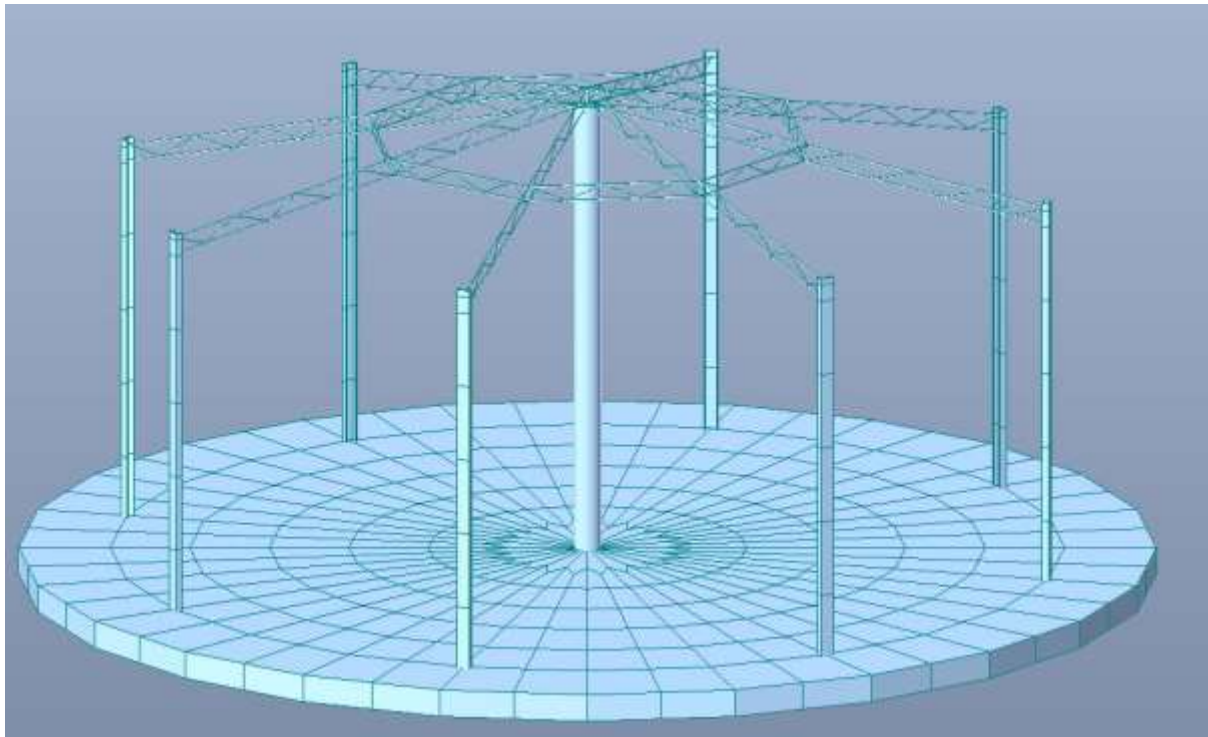


Figure 5 steel frame

MODAL DISPLACEMENT

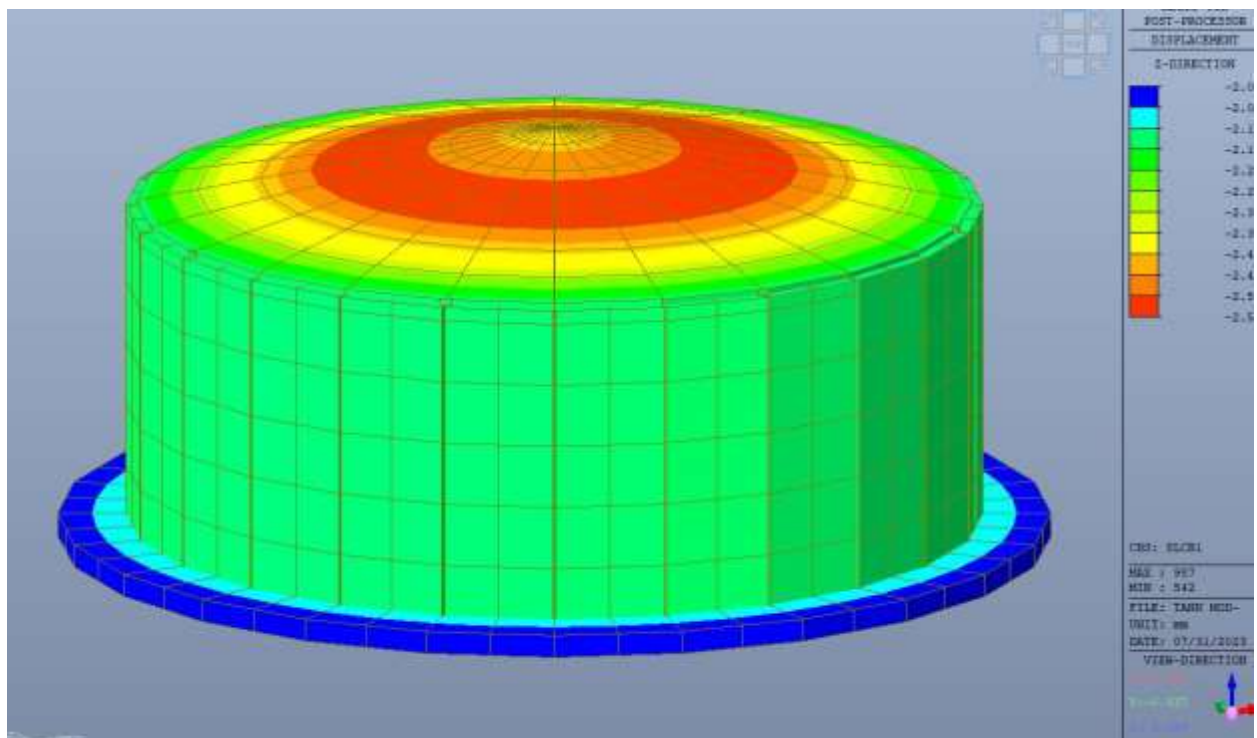


Figure 6 vertical displacement of model

Project Name : 5.2 m diameter Ferrocement Water Tank
Created :31/07/2023
User Name : Sheila

TANK DIMENSIONS

No.	Section	Dimension (m)
1.	Tank height	2.3
2.	Tank height (to roof)	2.8
3.	Diameter	5.2

LOAD CASES AND COMBINATIONS

No.	Name	Combination
1	cLCB1	1.35D + 1.5L
2	cLCB2	SERV :1.0D+ 1.0L
3	cLCB3	SERV :1.0D + 0.5L
4	cLCB4	SERV :1.0D + 0.3L

D - DEAD LOAD

L -LIVELOAD

SERV - Serviceability

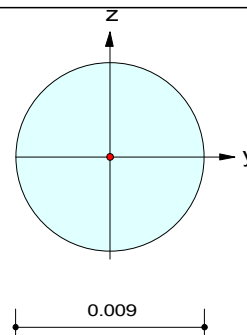
LOADS

No.	Section	DEAD LOAD (kN/m2)	LIVE LOAD (kN/m2)
1.	Roof load	-0.25	-0.60

	Company		Project Title	5.2 m dia Water Tank design
	Author	Sheila	File Name	D:\...\tank models_meshed.mgb

1. Design Information

Design Code : Eurocode3:05
 Unit System : kN, m
 Member No : 181
 Material : S460 (No:1)
 (Fy = 460000, Es = 210000000)
 Section Name : 9 mm round bars (No:1)
 (Built-up Section).
 Member Length : 0.09165



2. Member Forces

Axial Force Fxx = -16.359 (LCB: 1, POS:J)
 Bending Moments My = 0.00000, Mz = -0.0000
 End Moments Myi = -0.0000, Myj = 0.00000 (for Lb)
 Myi = -0.0000, Myj = 0.00000 (for Ly)
 Mzi = 0.00000, Mzj = -0.00000 (for Lz)
 Shear Forces Fyy = 0.00003 (LCB: 1, POS:1/2)
 Fzz = -0.0001 (LCB: 1, POS:1/2)

Outer Dia.	0.00900		
Area	0.00006	Asz	0.00006
Qyb	0.00001	Qzb	0.00001
Iyy	0.00000	Izz	0.00000
Ybar	0.00450	Zbar	0.00450
Wely	0.00000	Welz	0.00000
ry	0.00225	rz	0.00225

3. Design Parameters

Unbraced Lengths Ly = 0.09165, Lz = 0.09165, Lb = 0.09165
 Effective Length Factors Ky = 1.00, Kz = 1.00
 Equivalent Uniform Moment Factors Cmy = 1.00, Cmz = 1.00, CmLT = 1.00

4. Checking Results

Slenderness Ratio

$KL/r = 186.0 < 200.0$ (Memb:1158, LCB: 1)..... O.K

Axial Resistance

$N_{Ed}/MIN[Nc_{Rd}, Nb_{Rd}] = 16.3589/22.8648 = 0.715 < 1.000$ O.K

Bending Resistance

$M_{Edy}/M_{Rdy} = 0.00000/0.05589 = 0.000 < 1.000$ O.K

$M_{Edz}/M_{Rdz} = 0.00000/0.05589 = 0.000 < 1.000$ O.K

Combined Resistance

$RNRd = MAX[M_{Edy}/M_{ny_Rd}, M_{Edz}/M_{nz_Rd}]$

$R_{max1} = (M_{Edy}/M_{ny_Rd})^{\alpha} + (M_{Edz}/M_{nz_Rd})^{\beta}$

$R_{com} = N_{Ed}/(A \cdot f_y / \gamma_{M0})$, $R_{bend} = M_{Edy}/M_{y_Rd} + M_{Edz}/M_{z_Rd}$

$R_{c_LT1} = N_{Ed}/(X_{iy} \cdot A \cdot f_y / \gamma_{M1})$

$R_{b_LT1} = (k_{yy} \cdot M_{Edy}) / (X_{i_LT} \cdot W_{ply} \cdot f_y / \gamma_{M1}) + (k_{yz} \cdot M_{sdz}) / (W_{plz} \cdot f_y / \gamma_{M1})$

$R_{c_LT2} = N_{Ed}/(X_{iz} \cdot A \cdot f_y / \gamma_{M1})$

$R_{b_LT2} = (K_{zy} \cdot M_{Edy}) / (X_{i_LT} \cdot W_{ply} \cdot f_y / \gamma_{M1}) + (K_{zz} \cdot M_{sdz}) / (W_{plz} \cdot f_y / \gamma_{M1})$

$R_{max} = MAX[RNRd, R_{max1}, (R_{com} + R_{bend}), MAX(R_{c_LT1} + R_{b_LT1}, R_{c_LT2} + R_{b_LT2})] = 0.716 < 1.000$.. O.K

Shear Resistance

$V_{Edy}/V_{y_Rd} = 0.000 < 1.000$ O.K

$V_{Edz}/V_{z_Rd} = 0.000 < 1.000$ O.K

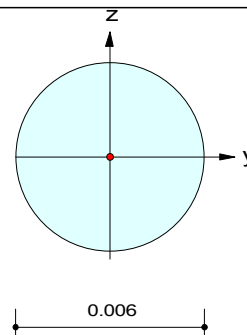
5. Deflection Checking Results

$L/250.0 = 0.0013 > 0.0000$ (Memb:470, LCB: 4, POS: 0.1m, Dir-Z)..... O.K

	Company		Project Title	5.2 m dia Water Tank design
	Author	Sheila	File Name	D:\...\tank models_meshed.mgb

1. Design Information

Design Code : Eurocode3:05
 Unit System : kN, m
 Member No : 859
 Material : S460 (No:1)
 (Fy = 460000, Es = 210000000)
 Section Name : 6 mm round bars (No:2)
 (Built-up Section).
 Member Length : 0.21966



2. Member Forces

Axial Force Fxx = -2.0431 (LCB: 1, POS:I)
 Bending Moments My = -0.0001, Mz = 0.00000
 End Moments Myi = -0.0001, Myj = 0.00005 (for Lb)
 Myi = -0.0001, Myj = 0.00005 (for Ly)
 Mzi = 0.00000, Mzj = 0.00000 (for Lz)
 Shear Forces Fyy = 0.00000 (LCB: 3, POS:1/2)
 Fzz = -0.0008 (LCB: 1, POS:I)

Outer Dia.	0.00600		
Area	0.00003	Asz	0.00003
Qyb	0.00000	Qzb	0.00000
Iyy	0.00000	Izz	0.00000
Ybar	0.00300	Zbar	0.00300
Wely	0.00000	Welz	0.00000
ry	0.00150	rz	0.00150

3. Design Parameters

Unbraced Lengths Ly = 0.21966, Lz = 0.21966, Lb = 0.21966
 Effective Length Factors Ky = 1.00, Kz = 1.00
 Equivalent Uniform Moment Factors Cmy = 1.00, Cmz = 1.00, CmLT = 1.00

4. Checking Results

Slenderness Ratio

$KL/r = 173.4 < 200.0$ (Memb:514, LCB: 1)..... O.K

Axial Resistance

$N_{Ed}/MIN[Nc_{Rd}, Nb_{Rd}] = 2.04308/2.19427 = 0.931 < 1.000$ O.K

Bending Resistance

$M_{Edy}/M_{Rdy} = 0.00006/0.01656 = 0.004 < 1.000$ O.K

$M_{Edz}/M_{Rdz} = 0.00000/0.01656 = 0.000 < 1.000$ O.K

Combined Resistance

$RNRd = MAX[M_{Edy}/M_{ny_Rd}, M_{Edz}/M_{nz_Rd}]$

$R_{com} = N_{Ed}/(A*fy/Gamma_{M0})$, $R_{bend} = M_{Edy}/My_{Rd} + M_{Edz}/Mz_{Rd}$

$Rc_{LT1} = N_{Ed}/(Xiy*A*fy/Gamma_{M1})$

$Rb_{LT1} = (kyy*M_{Edy})/(Xi_{LT}*Wply*fy/Gamma_{M1}) + (kyz*Msdz)/(Wplz*fy/Gamma_{M1})$

$Rc_{LT2} = N_{Ed}/(Xiz*A*fy/Gamma_{M1})$

$Rb_{LT2} = (Kzy*M_{Edy})/(Xi_{LT}*Wply*fy/Gamma_{M1}) + (Kzz*Msdz)/(Wplz*fy/Gamma_{M1})$

$R_{max} = MAX[RNRd, (R_{com}+R_{bend}), MAX(Rc_{LT1}+Rb_{LT1}, Rc_{LT2}+Rb_{LT2})] = 0.939 < 1.000$.. O.K

Shear Resistance

$V_{Edy}/Vy_{Rd} = 0.000 < 1.000$ O.K

$V_{Edz}/Vz_{Rd} = 0.000 < 1.000$ O.K

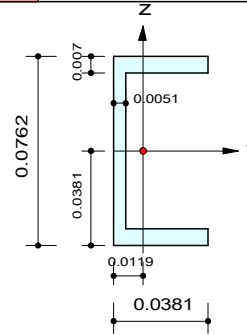
5. Deflection Checking Results

$L/250.0 = 0.0006 > 0.0000$ (Memb:874, LCB: 4, POS: 0.1m, Dir-Z)..... O.K

	Company		Project Title	5.2 m dia Water Tank design
	Author	Sheila	File Name	D:\...\tank models_meshed.mgb

1. Design Information

Design Code : Eurocode3:05
 Unit System : kN, m
 Member No : 71
 Material : S275 (No:5)
 (Fy = 275000, Es = 210000000)
 Section Name : C channel (No:3)
 (Rolled : C 76x38x6.70).
 Member Length : 0.09165



2. Member Forces

Axial Force Fxx = -0.7853 (LCB: 1, POS:J)
 Bending Moments My = 0.04386, Mz = 0.05812
 End Moments Myi = 0.01718, Myj = 0.04386 (for Lb)
 Myi = 0.01718, Myj = 0.04386 (for Ly)
 Mzi = -0.0216, Mzj = 0.05812 (for Lz)
 Shear Forces Fyy = -0.8696 (LCB: 1, POS:1/2)
 Fzz = -0.2911 (LCB: 1, POS:1/2)

Depth	0.07620	Web Thick	0.00510
Top F Width	0.03810	Top F Thick	0.00700
Bot.F Width	0.03810	Bot.F Thick	0.00700
Area	0.00086	Asz	0.00039
Qyb	0.00229	Qzb	0.00034
Iyy	0.00000	Izz	0.00000
Ybar	0.01190	Zbar	0.03810
Wely	0.00002	Welz	0.00000
ry	0.02950	rz	0.01120

3. Design Parameters

Unbraced Lengths Ly = 0.09165, Lz = 0.09165, Lb = 0.09165
 Effective Length Factors Ky = 1.00, Kz = 1.00
 Equivalent Uniform Moment Factors Cmy = 0.85, Cmz = 0.85, CmLT = 1.00

4. Checking Results

Slenderness Ratio

$KL/r = 185.1 < 200.0$ (Memb:1, LCB: 1)..... O.K

Axial Resistance

$N_{Ed}/MIN[Nc_{Rd}, Nb_{Rd}] = 0.785/235.400 = 0.003 < 1.000$ O.K

Bending Resistance

$M_{Edy}/M_{Rdy} = 0.04386/6.46250 = 0.007 < 1.000$ O.K

$M_{Edz}/M_{Rdz} = 0.05812/2.13950 = 0.027 < 1.000$ O.K

Combined Resistance

$RNRd = MAX[M_{Edy}/M_{ny_Rd}, M_{Edz}/M_{nz_Rd}]$

$R_{max1} = (M_{Edy}/M_{ny_Rd})^{\alpha} + (M_{Edz}/M_{nz_Rd})^{\beta}$

$R_{com} = N_{Ed}/(A \cdot f_y / \gamma_{M0})$, $R_{bend} = M_{Edy}/M_{y_Rd} + M_{Edz}/M_{z_Rd}$

$R_{c_LT1} = N_{Ed}/(X_{iy} \cdot A \cdot f_y / \gamma_{M1})$

$R_{b_LT1} = (k_{yy} \cdot M_{Edy}) / (X_{i_LT} \cdot W_{ply} \cdot f_y / \gamma_{M1}) + (k_{yz} \cdot M_{sdz}) / (W_{plz} \cdot f_y / \gamma_{M1})$

$R_{c_LT2} = N_{Ed}/(X_{iz} \cdot A \cdot f_y / \gamma_{M1})$

$R_{b_LT2} = (K_{zy} \cdot M_{Edy}) / (X_{i_LT} \cdot W_{ply} \cdot f_y / \gamma_{M1}) + (K_{zz} \cdot M_{sdz}) / (W_{plz} \cdot f_y / \gamma_{M1})$

$R_{max} = MAX[RNRd, R_{max1}, (R_{com} + R_{bend}), MAX(R_{c_LT1} + R_{b_LT1}, R_{c_LT2} + R_{b_LT2})] = 0.037 < 1.000$.. O.K

Shear Resistance

$V_{Edy}/V_{y_Rd} = 0.010 < 1.000$ O.K

$V_{Edz}/V_{z_Rd} = 0.005 < 1.000$ O.K

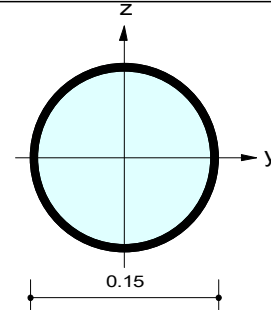
5. Deflection Checking Results

$L/300.0 = 0.0001 > 0.0000$ (Memb:18, LCB: 2, Dir-X)..... O.K

	Company		Project Title	5.2 m dia Water Tank design
	Author	Sheila	File Name	D:\...\tank models_meshed.mgb

1. Design Condition

Design Code : SSRC79
 Unit System : kn, m
 Element Number : 895
 Material : S275 (No:4)
 Section : GI Pipe (No:4)
 Member Length : 2.57271
 Concrete filled option for Pipe/Tube = Filled



2. Member Force

Axial Forces $F_{xx} = -45.301$ (LCB: 1, POS:J)
 Bending Moments $M_y = -0.0095$, $M_z = 0.00470$
 End Moments $M_{yi} = 0.00277$, $M_{yj} = -0.0095$ (for Lb)
 $M_{yi} = 0.00277$, $M_{yj} = -0.0095$ (for Ly)
 $M_{zi} = -0.0014$, $M_{zj} = 0.00470$ (for Lz)
 Shear Forces $F_{yy} = -0.0024$ (LCB: 1, POS:1/2)
 $F_{zz} = 0.00477$ (LCB: 1, POS:1/2)

Concrete Section

Type = Filled Section ($F_c = 12000$)
 $D_c = 0.13800$
 Area (A_c) = 0.01496

Steel Section

Sect Name = GI Pipe ($F_y = 275000$)
 Outer Dia. = 0.15000 Wall Thk = 0.00600
 Area (A_s) = 0.00271

Main Rebar

None

3. Design Parameter

Moment Coefficients $C_{my} = 0.85$, $C_{mz} = 0.85$
 Effective Length Factors $K_y = 1.00$, $K_z = 1.00$
 Unbraced Length $L_y = 2.57271$, $L_z = 2.57271$, $L_u = 2.57271$

4. Modified Properties of Composite Section

Yield Stress $F_{my} = F_y + 1.0 \cdot F_{yr} \cdot (A_r/A_s) + 0.85 \cdot F_c \cdot (A_c/A_s) = 331206$
 Modulus of Elasticity $E_m = E_s + 0.4 \cdot E_c \cdot (A_c/A_s) = 246138446$
 Radius of Gyration $R_{my} = r_y = 0.05096$, $R_{mz} = r_z = 0.05096$

5. Stress Checking Results

Axial Stresses

Slenderness Ratio : $KL/r = 50.5 < 200.0$ O.K
 $f_a/F_a = 16689/166725 = 0.100 < 1.000$ O.K

Bending Stresses

Major Axis

$f_{by}/F_{by} = 101/206250 = 0.000 < 1.000$ O.K

Minor Axis

$f_{bz}/F_{bz} = 50/206250 = 0.000 < 1.000$ O.K

Combined Stresses (Compression+Bending)

$R_{com} = (f_a/F_a)^2 + \text{SQRT}([C_{my}/(1-f_a/F'_{ey})] \cdot f_{by}/F_{by})^2 + [C_{mz}/(1-f_a/F'_{ez})] \cdot f_{bz}/F_{bz})^2$
 $R_{com} = 0.011 < 1.000$ O.K

Shear Stresses

$f_{vy}/F_{vy} = 4/110000 = 0.000 < 1.000$ O.K
 $f_{vz}/F_{vz} = 4/110000 = 0.000 < 1.000$ O.K

PROJECT TITLE : 5.2 m dia Water Tank design

	Company		Client	
	Author	Sheila	File Name	tank models_meshed.rcs

midas Gen - RC-Slab Flexural Design [Eurocode2:04] Gen 2019

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=====
 [[[*]]] SLAB DESIGN MAXIMUM RESULT DATA : DOMAIN 5.2 m Tank-Roof slab, Dir 2.
 =====

Thk	Elem	POS	AsReq	AsUse		M_Ed(LCB)	M_Rd	Rat	CHK
0.0750	1799	BOT	7.1500e-005	0.0001	|	0.41490(	1) 2.90199	0.143	OK
	1798	TOP	7.1500e-005	0.0001	|	1.05086(	1) 2.90199	0.362	OK

<< BOTTOM >>

-. Information of Parameters.

Elem No. : 1799
 Thickness : 0.0750 m.
 Materials : fck = 12000.0000 KPa.
 fcd = 8000.0000 KPa.
 fyk = 460000.0000 KPa.
 Covering : dB = 0.0200 m.
 dT = 0.0200 m.
 LCB No. : 1

-. Information of Design.

b = 0.0010 m. (by Code Unit Length).
 d = 0.0550 m.
 lambda = 0.800
 a = lambda * x = 0.007 m.
 eta = 1.000
 Cc = eta*fcd*b*a = 0.0564 kN.
 M_Rd = Cc*(d-a/2) = 2.9020 kN-m./m.

-. Information of Moments and Result.

Rein. Bar : P6 @200
 As_req = 7.1500e-005 m^2/m. (7.1500e-005 m^2/m.)
 M_Ed = 0.4149 kN-m./m.
 M_Rd = 2.9020 kN-m./m.
 RatM = M_Ed / M_Rd = 0.143 < 1.0 ---> O.K !

-. Check ratio of neutral axis depth to effective depth.

x/d = 0.081

PROJECT TITLE : 5.2 m dia Water Tank design

	Company		Client	
	Author	Sheila	File Name	tank models_meshed.rcs

midas Gen - RC-Slab Flexural Design [Eurocode2:04] Gen 2019

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=====
 [[[*]]] SLAB DESIGN MAXIMUM RESULT DATA : DOMAIN 5.2 m Tank-Roof slab, Dir 1.
 =====

Thk	Elem	POS	AsReq	AsUse		M_Ed(LCB)	M_Rd	Rat	CHK
0.0750	1903	BOT	7.1500e-005	0.0001	|	0.36686(	1) 2.90199	0.126	OK
	1830	TOP	7.1500e-005	0.0001	|	0.56690(	1) 2.90199	0.195	OK

<< BOTTOM >>

-. Information of Parameters.

Elem No. : 1903
 Thickness : 0.0750 m.
 Materials : fck = 12000.0000 KPa.
 fcd = 8000.0000 KPa.
 fyk = 460000.0000 KPa.
 Covering : dB = 0.0200 m.
 dT = 0.0200 m.
 LCB No. : 1

-. Information of Design.

b = 0.0010 m. (by Code Unit Length).
 d = 0.0550 m.
 lambda = 0.800
 a = lambda * x = 0.007 m.
 eta = 1.000
 Cc = eta*fcd*b*a = 0.0564 kN.
 M_Rd = Cc*(d-a/2) = 2.9020 kN-m./m.

-. Information of Moments and Result.

Rein. Bar : P6 @200
 As_req = 7.1500e-005 m^2/m. (7.1500e-005 m^2/m.)
 M_Ed = 0.3669 kN-m./m.
 M_Rd = 2.9020 kN-m./m.
 RatM = M_Ed / M_Rd = 0.126 < 1.0 ---> O.K !

-. Check ratio of neutral axis depth to effective depth.

x/d = 0.081

PROJECT TITLE : 5.2 m dia Water Tank design

	Company		Client	
	Author	Sheila	File Name	tank models_meshed.rcs

midas Gen - RC-Slab Flexural Design [ACI318-14] Gen 2019

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=====
 [[[*]]] SLAB DESIGN MAXIMUM RESULT DATA : DOMAIN 5.2 m Tank-Base slab, Dir 2.
 =====

Thk	Elem	POS	AsReq	AsUse	Mu(LCB)	pMn	Rat	CHK
0.1500	4136	BOT	0.0002	0.0003	4.67450(1)	14.1686	0.330	OK
	4125	TOP	0.0002	0.0003	0.81590(1)	14.1686	0.058	OK

<< BOTTOM >>

-. Information of Parameters.

Elem No. : 4136
 Thickness : 0.1500 m.
 Materials : $f_c = 12000.0000$ KPa.
 $F_y = 400000.0000$ KPa.
 Covering : $d_B = 0.0200$ m.
 $d_T = 0.0200$ m.
 LCB No. : 1

-. Information of Design.

$\phi = 0.900$
 $b = 0.0254$ m. (by Code Unit Length).
 $d = 0.1300$ m.

-. Information of Moments and Result.

Rein. Bar : P9 @200
 $As_{req} = 0.0002 \text{ m}^2/\text{m}. (0.0002 \text{ m}^2/\text{m}.)$
 $As_{use} = 0.0003 \text{ m}^2/\text{m}. (0.0003 \text{ m}^2/\text{m}.)$
 $M_n = As_{use} * F_y * [d - As_{use} * F_y / (1.7 * f_c * b)] = 15.7429 \text{ kN-m./m.}$
 $\phi M_n = \phi * M_n = 14.1686 \text{ kN-m./m.}$
 $\mu = 4.6745 \text{ kN-m./m.}$
 $RatM = \mu / \phi M_n = 0.330 < 1.0 \text{ ---> O.K !}$

PROJECT TITLE : 5.2 m dia Water Tank design

	Company		Client	
	Author	Sheila	File Name	tank models_meshed.rcs

midas Gen - RC-Slab Flexural Design [ACI318-14] Gen 2019

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=====
 [[[*]]] SLAB DESIGN MAXIMUM RESULT DATA : DOMAIN 5.2 m Tank-Base slab, Dir 1.
 =====

Thk	Elem	POS	AsReq	AsUse		Mu(LCB)	pMn	Rat	CHK
0.1500	3843	BOT	0.0002	0.0003	|	4.67416(1)	14.1686	0.330	OK
	4195	TOP	0.0002	0.0003	|	0.81590(1)	14.1686	0.058	OK

<< BOTTOM >>

-. Information of Parameters.

Elem No. : 3843
 Thickness : 0.1500 m.
 Materials : $f_c = 12000.0000$ KPa.
 $F_y = 400000.0000$ KPa.
 Covering : $d_B = 0.0200$ m.
 $d_T = 0.0200$ m.
 LCB No. : 1

-. Information of Design.

$\phi = 0.900$
 $b = 0.0254$ m. (by Code Unit Length).
 $d = 0.1300$ m.

-. Information of Moments and Result.

Rein. Bar : P9 @200
 $As_{req} = 0.0002 \text{ m}^2/\text{m}. (0.0002 \text{ m}^2/\text{m}.)$
 $As_{use} = 0.0003 \text{ m}^2/\text{m}. (0.0003 \text{ m}^2/\text{m}.)$
 $M_n = As_{use} * F_y * [d - As_{use} * F_y / (1.7 * f_c * b)] = 15.7429 \text{ kN-m./m.}$
 $\phi M_n = \phi * M_n = 14.1686 \text{ kN-m./m.}$
 $\mu = 4.6742 \text{ kN-m./m.}$
 $RatM = \mu / \phi M_n = 0.330 < 1.0 \text{ ---> O.K !}$

SOIL PRESSURE

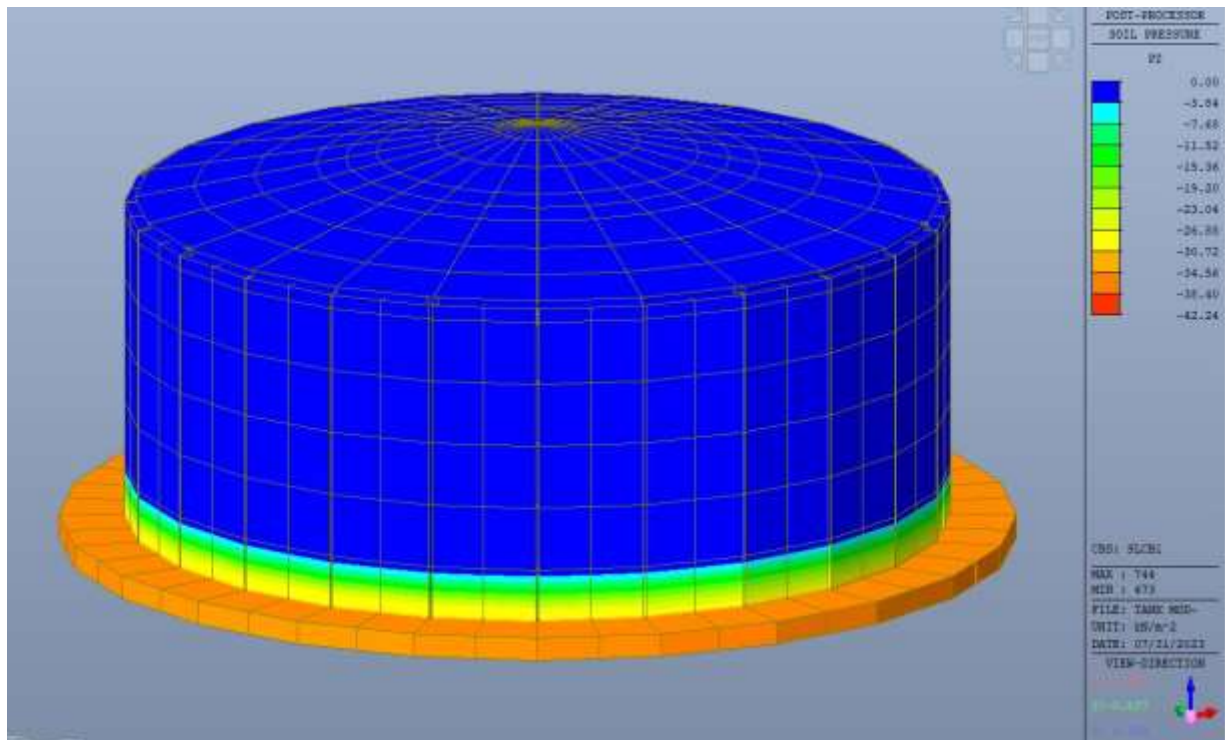


Figure 7 pressure on soil

Since the soil pressure is less than the allowable soil pressure (150kN/m²), the tank base is ok.

PROJECT TITLE : 5.2 m dia Water Tank design

	Company		Client	
	Author	Sheila	File Name	tank models_meshed.rcs

midas Gen - RC-Mesh Flexural Wall Design [Eurocode2:04] Gen 2019

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 [[[*]]] MESHED WALL DESIGN MAXIMUM RESULT DATA : DOMAIN 5.2 m Tank-Walls. (Vertical)
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-. Information of Parameters.

Elem No. : 4813
 LCB No. : 1
 Materials : fck = 12000.0000 KPa.
 fyk = 460000.0000 KPa.
 Thickness : t = 0.1500 m.
 Covering : Dw = 0.0250 m.

-. Information of Design.

Alpha_cc = 1.000 (Default or User Defined).
 gamma_c = 1.500 (for Concrete)
 gamma_s = 1.150 (for Reinforcement)
 fcd = Alpha_cc * fck / gamma_c = 8000.0000 KPa.
 fyd = fyk / gamma_s = 400000.0000 KPa.
 Nu = 0.6 * (1 - fck / 250) = 0.5712 (fck in MPa)

-. Design Forces.

Sig_Edx = -293.1501 KPa.
 Sig_Edy = 22.5911 KPa.
 Tau_Edxy = -42.2841 KPa.

Sig_Ed_max = 22.5911 KPa. (y-dir)
 Sig_Ed_min = -293.1501 KPa. (x-dir)
 Tau_Edxy = -42.2841 KPa.

(Sig_Ed_min in Tension or Sig_Ed_max * Sig_Ed_min <= Tau_Edxy^2 --> Rebar Required!)

ftd_max = |Tau_Edxy| - Sig_Ed_max = 19.6930 KPa. (y-dir)
 ftd_min = |Tau_Edxy| - Sig_Ed_min = 335.4342 KPa. (x-dir)

f'tdx = 335.4342 KPa.
 f'tdy = 19.6930 KPa.
 Sig_cd = 2 * |Tau_Edxy| = 84.5682 KPa.

rhoy_req = max(f'tdy/fyd, 0.002) = 0.0020
 rhox_req = max(f'tdx/fyd, 0.001, 0.25 * rhoy_req) = 0.0010

b = 1.0 m. (by Unit Length).
 Asx_Req = 0.0001 m^2/m. (0.0001 m^2/m.)
 Asy_Req = 0.0003 m^2/m. (0.0003 m^2/m.)
 Asx_use = 0.0003 m^2/m. (0.0003 m^2/m.)
 Asy_use = 0.0003 m^2/m. (0.0003 m^2/m.)
 ftnx = Asx_use / (b * t) * fyd = 848.0000 KPa.
 ftny = Asy_use / (b * t) * fyd = 848.0000 KPa.

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-. Information of Result.
Rein. Bar_x : P9 @200 (Hor.)
Rein. Bar_y : P9 @200 (Ver.)
Rat_x = f'tdx/ftnx = 0.396
Rat_y = f'tdy/ftny = 0.023
Rat_cd = Sig_cd/(Nu*fcd) = 0.019
Rat = Rat_y = 0.023 < 1.0 ---> O.K !

Project Name : 5.2 m diameter Ferrocement Water Tank
Created :31/07/2023
User Name : Sheila

DESIGN RESULTS

TRUSS MEMBERS

No.	Section	Dimensions	Status
1.	Main members	9 mm diameter round bar	OK
2.	Internal members	9 mm diameter round bar	OK

STEEL MEMBERS

No.	Section	Dimensions	Status
1.	Composite GI pipe (filled with mortar and 4T9 main bar with T6 mm links at 200mm spacing)	150 mm diameter	OK
2.	C channel	76x38x6.7 mm section	OK

Concrete elements

No.	Section	Reinforcement	Status
1.	Roof slab (150 mm thick)	Top mesh reinforcement (A142) T6-200 mm -Middle (Radial & Longitudinal bars) Bottom mesh reinforcement (A142)	OK
2.	Wall (150 mm thick)	T9 at 200 mm vertical bars T9 at 200mm horizontal bars	OK
3.	Base slab (150 mm thick)	T9 at 200 mm (main and distribution bars)	OK