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Design The Circular Water Tank by Using the STAAD Pro Software

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Abstract: Water tanks are very useful for storage of water to involve the consumption of water we need to hold on to the capacity of water as much required. Now a day's storage tanks are suitable for all types of environment we live as old a civilized technique. Water is the common need for all the living organisms to survive. Portable water is imperative for good health of human beings. It is most important to supply portable water to every individual and every faction; hence it is very requisite to store water. Water is generally stored in the tanks the stored water is supplied to every faction through pipelines. In the project, we have planned and designed a circular reinforced cement concrete water tank. A circular tank is manually designed. It is further analyzed using the debut analysis software STAADPRO.

I. INTRODUCTION

The form of water tanks initiate with the application parameters, hence the type of materials used and the design of water tank was control by these wavering:

- 1) Locale of the water tank.
- 2) Volume of tank to hold water.
- 3) What purpose the water to be used?
- 4) Temperature of locale where are the stored, have to do with for freezing.
- 5) Pressure required for the supplying water.
- 6) How can it water to be delivered to the water tank.
- 7) Wind and earthquake design considerations allow water tanks to survive seismic and high wind incidents

For the duration of history, wood, ceramic and stone has been used for the water tanks. These were all naturally eventuate and manufactured and some tanks are however in service. There are many custom configurations that include various rectangular cubes form tanks, cone bottom and special form for specific design requirements. A functional water container should do no harm to the water is at risk of to a number of environs negative influences, as well as bacteria, viruses, algae, replace in pH, and collection of minerals. Correctly designed water tank systems work to alleviate these refusal effects.

II. DESIGN PHILOSOPHIES

This is the philosophies for the design of Structures:

Working stress method
Ultimate load method
Limit state method.

A. Stages in Structural Design

- 1) Planning of Structure
- 2) Drawing Study
- 3) Load Combinations
- 4) Analysis of Structures
- 5) Structural Design

III. OBJECTIVE FOR STUDY

- A. Create Modeling of the Water Tank by using the software STADDPROV8I.
- B. Put in the properties of water tank.
- C. Put in the different load combinations as per I.S. code
- D. Put in and designing of Water Tank.
- E. Study in location under the condition of Chhattisgarh.

IV. LITERATURE REVIEW

Water supply system is mainly based on network of pipes by joining other components to provide a stability & balanced service. These connections networks are sometimes used underground and ground to surface. Due to the destruction of pipes constantly the soil; pipes are used manmade on the availability at the time. Failure in water supply may eventuate to surrounding soil, it increase in internal water pressure, surface traffic, Which disturbed to water supply to consumers and these cause reduction in responsibility of the system.

S.K. Khariya, (2019) 75 K.L. capacity overhead tank at village Bargaon, Block Pathatiya on 12 M. staging use the different portion are different concrete mix for economical design Water tank is the most important container to store water therefore, Crack width calculation of water tank is also necessary.

M. V. Waghmare and S.N.Madhekar, (2013) to studied conduct of tank under sloshing effect. Different specification has been considered such as height of container, bottom of water in tank (30%, 50%, 70% and full) and height of staging etc. It is notice that Sloshing of water in tank depends not only on the volume of water in tank but also on staging height and facett ratio (h/D).

V. PROBLEM IDENTIFICATION

To analyze the circular over head water tank by study of allocation in IS 3370 (2009), Double dome model of over head water tank was taken. Then it was calculating by manually through the Limit State Method. After that STAAD. Pro is used to compares the design and create the structure boost and economical by tough different dimension for same capacity tank. For easy cost prediction of tanks, this study therefore examines the cost effectiveness in terms of amount of materials and design of structure. In case of spot structure are used for working stress method because the designed structure is crack free.

VI. METHODOLOGY

To reach the objectives of the study that is to calculate and design of over head water tank using STADD PRO method, which needs the basic requirements such as safety, durability, it antiquated proposed to follow the following methodology.

- 1) Locale survey.
- 2) Geotechnical investigation.
- 3) Structural planning.
- 4) Analysis and design in STADDPRO
- 5) Detailing of the design.

VII. DESIGN COMPONENTS OF TANK

The components of R.C. Cover head circular tank. The various components of elevated tank are as follows.

- 1) Top Roof Dome The dome at top usually 100mm to 150mm thick with reinforcement along the meridian and latitudes. The rise is usually 1/5th of the span.
- 2) Ring Beam The ring beam is necessary to resist the horizontal component to the thrust of the dome. The ring beam will be designed for hoop tension induced.
- 3) Circular Wall this has to be designed for hoop tension caused due to horizontal water pressure and to resist bending moment induced to wall by liquid load.
- 4) Bottom Slab this will be designed for total load above it. The slab will also be designed for the total load above it. The slab will also be designed as a slab spanning in both directions.
- 5) Bottom Beams the bottom beam will be designed as continuous beam to transfer the entire load above it to the columns

A. Staging Portion

Columns & Braces

- 1) *Columns*: These are to be designed for the total load transferred to them. The columns will be braced at intervals and have to be designed for wind pressure and seismic loads which ever govern.
- 2) *Braces*: The braces are the members connecting the columns at intermediate height to columns. It is provided in slender columns to increase the column's load carrying capacity
- 3) *Foundation*: As per IS: 11682-1985, a combined footing or raft footing with or without tie beam or raft foundation should be provided for all supporting columns

B. Design Data Using In Water Tank

Assuming Data

- 1) Capacity of water tank 1.50 Lakhs Liters
- 2) Staging of height in water tank 15.00M.
- 3) Size of water tank Ø 7.00 M. Height 4.00M.
- 4) Free Board 0.10M.
- 5) Rise of Top Dom 30*
- 6) 1 person is use water 135LPCD
- 7) Design for 1000Person
- 8) Thickness of Bottom slab 0.18M.
- 9) Thickness of Top Dom 0.10M.
- 10) Thickness of Cylindrical wall 0.15M.
- 11) Top Ring beam 0.23 x 0.23M.
- 12) Bottom Ring beam 0.30 x 0.60M.
- 13) Column size 0.35 x 0.35M.
- 14) Braising size 0.23 x 0.30M.
- 15) Parapet wall thickness 0.125 M. x height 1.2M.

VIII. MANUAL DESIGN OF ELEVATED CIRCULAR WATER TANK

1) *Step-1. Basic dimensions of tank: -*

1. Assume diameter of tank = 7m.
2. Rise of top dome (h_1) = $D/7 = 7/7 = 1m$.
3. Height of cylindrical wall (h_2) = $2D/5 = 2 \times 7/5 = 2.8m \sim 4m$.
4. Height of conical dome (h_3) = $D/7 = 7/7 = 1m$.

2) *Step-2. Calculate the volume of tank:*

$$\text{Volume of circle} = \pi r^2 h$$

$$150 = \pi \times 3.5^2 \times h$$

$$h = 150 / (\pi \times 3.5^2) = 3.89 \text{ m.}$$

$$\text{add free bord} = 1.1m.$$

$$\text{total height} = 4m.$$

3) *Step-3. Design of top Dome*

1. Meridional force: -

$$T_1 = WR_1 / (1 + \cos\Theta)$$

$$R_1 = \{ (D/2)^2 + h_1^2 \} / 2 \times h_1 = \{ (7/2)^2 + 1^2 \} / 2 \times 1 = 6.625 \sim 7m.$$

$$\sin\Theta = B/H = D/2/R_1 = 7/2/7 = 0.5$$

$$\Theta = 30^*$$

$$\sin\Theta = 0.5$$

$$\cos\Theta = 0.866$$

thickness of top dome is assumed 0.1m

$$\text{Dead load} = 2.5 \text{ KN/M}^2$$

$$\text{Live load} = 1.5 \text{ KN/M}^2$$

$$\text{Total load} = 4 \text{ KN/M}^2$$

$$T_1 = 4 \times 7 / (1 + 0.866) = 15 \text{ KN/M.}$$

$$\text{Meridional stress} = P/A = 15 / (1000 \times 100) = 0.15 \text{ KN/MM}^2$$

2. Hoop Tension: -

$$a. T_2 = WR_1[\cos \Theta - (1/(1+\cos \Theta))] = 4 \times 7 [0.866 - (1/1+0.866)] = -8.08 \text{ KN/M}$$

$$\text{Hoop stress} = P/A = 8.08 \times 10^3 / 1000 \times 100 = 0.0808 \text{ N/MM}$$

$$0.0808 < 8$$

Hence the design is ok.

Providing minimum reinforcement 0.3% in circumferential and radial direction.

$$A_{st} = 0.3 \times 1000 \times 100 / 100 = 300 \text{ mm}^2$$

Providing 8mm Φ bar

$$\text{Spacing} = (\pi/4) d^2 \times 1000 / A_{st} = (\pi/4) 8^2 \times 1000 / 300 = 167.55 \text{ mm}$$

Providing 8mm Φ bar @ 160mm c/c ($A_{st} = 314.15 \text{ mm}^2$)

4) Step -4. Design of top ring beam (B_1)

Horizontal component of meridional force (T):

$$W_1 = T_1 \cos \Theta = 15 \times 0.866 = 12.99 \text{ KN/M} \sim 13 \text{ KN/M}$$

$$\text{Total hoop tension on beam (T)} = W \times D / 2 = 13 \times 7 / 2 = 45.5 \text{ KN}$$

$$A_{st} \text{ for hoop tension} = T / \sigma_{st} = 45.5 \times 10^3 / 130 = 350 \text{ mm}^2$$

Providing 12 mm Φ bar

$$\text{Spacing} = (\pi/4) d^2 \times 1000 / A_{st} = (\pi/4) 12^2 \times 1000 / 350 = 323.13 \text{ mm}$$

Providing 12mm Φ bar @ 200mm c/c ($A_{st} = 565 \text{ mm}^2$)

Stress at compression zone:

$$\sigma_{ct} = \frac{T}{Ag + (m-1)A_{st}}$$

let width assume 230 mm

$$1.3 = \frac{45.5 \times 1000}{230 \times D + (10-1)350}$$

$$D = 138.47 \text{ mm}$$

Providing size of the top ring beam is 230 x 230 mm

Double shear providing 8 mm Φ bar two legged stirrups

$$S_{\text{vertical}} = \frac{0.87 f_y A_{sv}}{0.4 b}$$

$$A_{sv} \text{ (area of vertical stirrups)} = 2 \times \frac{\pi}{4} \times 8^2 = 100 \text{ mm}^2$$

$$S_v = \frac{0.87 \times 415 \times 100}{0.4 \times 230} = 392.59 \text{ mm}$$

Providing 8 mm Φ bar two legged stirrups @ 161mm c/c

5) Step-5. Design of Cylindrical Wall

$$1. \text{ Hoop tension (T}_2\text{)} = \gamma_w \times h_2 \times \frac{D}{2} = 9.81 \times 4 \times \frac{7}{2} = 137.34 \text{ KN}$$

$$A_{st} = T / \sigma_{st} = \frac{137.34 \times 1000}{130} = 1056.461 \text{ mm}^2$$

$$\text{Area of face} = A_{st} / 2 = 1056.461 / 2 = 528.23 \text{ mm}^2$$

Providing 12mm Φ bar @ 120 mm c/c

Thickness of wall: -

$$\sigma_{ct} = \frac{T}{Ag + (m-1)A_{st}}$$

$$a. = \frac{137.34 \times 1000}{1000 \times t + (10-1)1056.46}$$

$$t = 94.97 \text{ mm} \sim 100 \text{ mm}$$

Distribution steel: -

$$A_{st} = \frac{0.3 \times 1000 \times 100}{100} = 300 \text{ mm}^2$$

Providing 8 mm Φ bar @ 160 mm c/c

6) Step-6. Design of spherical bottom dome

Assume thickness of dome is 0.18m

$$\text{Meridional force } T_3 = \frac{WR}{1+\cos\theta}$$

$$\text{Weight of water} = \gamma_w \times h = 9.81 \times 4 = 40\text{KN/M}^2$$

$$\text{Self-weight} = 0.18 \times 25 = 4.5\text{KN/M}^2$$

$$\text{Total loads} = 44.5 \text{ KN/M}^2$$

$$R_2 = \left(\frac{D}{2}\right)^2 + h_2^2 / (2 \times h_2) = \left(\frac{6.8}{2}\right)^2 + 1^2 / (2 \times 1)$$

$$= 6.8\text{m.}$$

$$\sin\Theta = 0.5$$

$$\Theta = 30^\circ$$

$$T_3 = \frac{44.5 \times 6.8}{1+0.866} = 162.165 \text{ KN/M}$$

$$\text{Meridional stress} = \frac{P}{A} = \frac{162.165 \times 1000}{1000 \times 100} = 0.9$$

a. $0.9 < 8$ Hence the design is ok

Providing minimum % of steel 0.3%

$$A_{st} = \frac{0.3 \times 1000 \times 180}{100} = 540 \text{ mm}^2$$

Providing 10mm Φ bar @ 140mm c/c ($A_{st} = 560\text{mm}^2$)

7) Step-7. Design of bottom ring beam

1. Out word thrust for bottom beam

$$T_3 \cos\Theta = 162.165 \times 0.866 = 140.434 \text{ KN/M}$$

2. Hoop tension on beam $= \frac{W \times D}{2} = \frac{140.434 \times 7}{2}$

$$= 491.519 \text{ KN}$$

3. Hoop stress $= \frac{P}{A} = \frac{491.519 \times 1000}{300 \times 600} = 2.73 \text{ N/mm}^2$

$$2.73 < 8$$

Hence the structure is safe.

Total load on beam: -

Vertical load on beam:

$$= T_2 \sin\Theta_1 + T_3 \sin\Theta_2$$

$$= 137.34 \times 0.5 + 162.165 \times 0.$$

$$= 135\text{b KN/M}$$

$$\text{Self-weight of beam} = 0.3 \times 0.6 \times 25 = 4.5 \text{ KN/M}$$

$$\text{Load of bottom dome} = 0.18 \times 25 = 4.5 \text{ KN/M}$$

$$\text{Total UDL load} = 135 + 4.5 + 4.5 = 144\text{KN/M}$$

$$\text{Total load} = \frac{\pi}{D} \times UDL = \frac{\pi}{7} \times 144 = 3166\text{KN}$$

$$\text{Maximum negative bending moment at support} = C_1 WR^2 (2\Theta)$$

Assumed Number of supports 8

$$= 0.066 \times 144 \times 3.5^2 \times \frac{\pi}{4} = 91.439 \text{ KN.M}$$

$$\text{Maximum Positive bending moment at support} = C_2 WR^2 (2\Theta)$$

$$= 0.03 \times 144 \times 3.5^2 \times \frac{\pi}{4} = 41.56 \text{ KN.M}$$

$$\text{Maximum torsional moment at support} = C_3 WR^2 (2\Theta)$$

$$= 0.005 \times 144 \times 3.5^2 \times \frac{\pi}{4} = 6.92 \text{ KN.M}$$

$$\text{Maximum shear force at support} = \frac{W}{2 \times \text{No. columns}} = \frac{3166}{2 \times 8} = 197.8 \text{ KN}$$

Calculate Depth of beam

$$M = Qbd^2$$

$$197.87 = 2.85 \times 300 \times d^2$$

$$D = 468.91 \text{ mm}$$

Providing depth of beam 550mm and 50 mm cover total depth 600mm

$$A_{st} = \frac{M}{\sigma_{st} X j X d} = \frac{197.87 \times 1000000}{130 \times 0.86 \times 550} = 3217.92 \text{ mm}^2$$

Providing 28 mm Φ bar 6 No. @158 mm c/c

Check for shear (IS:2000 pg.No.83 / IS 3370 part-2 table No. 3)

$$\tau_v = \frac{M}{bXd} = \frac{197.87 \times 1000}{300 \times 550} = 1.19 \text{ N/mm}^2$$

$$\text{Percentage of steel (Pt)} = \frac{100 X A_{st}}{bXd} = \frac{100 \times 3217.92}{300 \times 600} = 0.019$$

$$\tau_c = \frac{0.75-0.19}{0.75-100} = \frac{0.36-x}{0.36-0.4}$$

$$\tau_c = 0.4$$

$$\tau_v > \tau_c$$

It is design for shear

$$\text{Shear taken by concrete} = 0.35 \times 300 \times 550 = 57.75 \text{ KN}$$

$$\text{Net shear force} = 197.87 - 57.75 = 140.06 \text{ KN}$$

Provide 10mm Θ bar 4 legged vertical stirrups.

$$\text{Area of vertical steel (A}_{sv}\text{)} = 4 \times \frac{\pi}{4} \times d^2 = 4 \times \frac{\pi}{4} \times 7^2 = 314.15 \text{ mm}^2$$

$$S_v = \frac{A_{sv} X \sigma_{sv} X d}{V_s} = \frac{314.15 \times 175 \times 550}{140.06} = 215.88 \text{ mm}$$

Provided 10 mm Θ Bar 4 legged vertical stirrups @200 mm c/c

Column details:

$$\text{Total bear load on column} = 3166 \text{ KN}$$

$$\text{Dead load of the column} = 0.35 \times 0.35 \times 25 \times 15 = 45.93 \text{ KN}$$

$$\text{Total dead weight of the column} = 45.93 \times 8 = 367.5$$

$$\text{Total load on column} = 3166 + 367.5 = 3533.5 \text{ KN}$$

$$\text{Load of 1 column} = 3533.5/8 = 441.68 \text{ KN}$$

Providing 20mm Φ bar 150mm c/c

$$(A_{st} = 47123.88 \text{ mm}^2)$$

Seismic load from IS 1893:2002

Response spectrum method

$$\text{For RC } T_u = 0.75 h^{0.75}$$

$$\text{Horizontal seismic coefficient } A_n = \frac{ZI}{2} \times S_a/g$$

$T < 0.1S$ it is given from table No.2

$$Z = \text{zone factor II} = 0.1$$

$$R = \text{response factor} = 3 \text{ To } 5 = 5 \text{ from table No.7}$$

$$I = \text{Impact factor} = 1.5 \text{ From Table No.6}$$

S_a/g = soil classification

$$\text{Base shear (V}_b\text{)} = A_n \times W$$

Wind load:

$$P_z = 0.6 V_z^2$$

$$V_z = V_b \times K_1 \times K_2 \times K_3 \times K_4$$

V_b = basic wind speed = 39 in Chhattisgarh from IS 875 part III

K_1 = Probability factor = 1.06 from table-1

K_2 = Terrain roughness and height factor = 0.97 from table -2

$K_3 = \text{Topography factor} = 1$

$K_4 = \text{Importance factor} = 1$

$V_z = 40.0998$

$P_z = 24.059 \text{ m/s}$

IX. DESIGNING OF CIRCULAR WATER TANK IN STAADPRO

A. Procedure

Open STAAD.pro.

Click on new project > add file name>Select 'space'.

Length (in m), Force (in KN).

choose add beam choice and click on finish.

Go to Geometry>Run structure wizard > choose surface/plate model > cylindrical surface. shut it to transfer to modelling

Length :3

Division on length: one

Start radius: 3.5

Division on periphery: 8(column)

End radius: 3.5

victimisation Add beam choosing prime node and bottom node.

Repeat on outer boundary for needed variety of columns.

Copy all vertical members victimisation ctrl + C and paste aside victimisation ctrl + V.

Add intermediate nodes on length to feature required variety of beams in horizontal direction.

Connect all node in a very plane to make a circular beam.

Repeat an equivalent method at prime to urge circular beam.

Geometry>Run structure wizard> choose surface/plate model >Spherical cube choose spherical cap (Bottom dome).

shut it to transfer to modelling Diameter of sphere: Base Diameter:

Shift the obtained Spherical cap to prime beam Measure distance victimisation 'display node

to node distance' tool Select all plates > Right click mouse>Move > add (-) sign to {above|higherthan|on prime of} distance to rest on top beam.

- Geometry>Run structure wizard > choose surface/plate model > cylindrical surface
Length: 19
Division on length: one
Start radius3.5
Division on periphery:
End radius: a pair of 3.5
- Shift the obtained conelike dome to prime beam Measure distance victimisation 'display node to node distance' tool
Select all plates > Right click mouse>Move > add
(-) sign to {above|higherthan|on prime of} distance to rest on top beam.
- Geometry>Run structure wizard > choose surface/plate model > cylindrical surface
Length: 15
Division on length: one
Start radius: 3.5
Division on periphery:
End radius: a pair of.5
- Shift the obtained cylindrical surface to prime beam live distance victimisation 'display node to node distance' tool
Select all plates > Right click mouse>Move > add
(-) sign to {above|higherthan|on prime of} distance to rest on top beam.
- Geometry>Run structure wizard> choose surface/plate model >Spherical cube choose spherical cap (Top dome).
shut it to transfer to modelling
Diameter of sphere:
Base Diameter:

- Shift the obtained conic dome to high beam live distance exploitation 'display node to node distance' tool choose all plates > Right click mouse>Move > add (-) sign to {above|higherthan|on high of} distance to rest on top beam.
- Finally Check dimensions of tank exploitation 'display node to node distance' tool to verify. Any corrections to be created area unit corrected.

B. General Properties

Click 'property' at left of screen> outline needed dimensions for individual components. Assign the property for numerous components exploitation any of the options gift per your convenient.

Click 'Support' > produce >Select 'fixed' >click Add> assign inside a part of beam.

CLICK 'LOAD AND DEFINITION'

To apply wind load initial, we've to outline it in initial section.

Enter your values. Keep exposure as -1.

Click 'Load case details' to feature metric capacity unit, LL & WL.

Add self-weight as metric capacity unit Add Water load as LL Add Wind Load Select material as concrete and assign for entire tank

C. Analysis

Click 'Analysis and print'> Run analysis >Check for Zero errors>Post process Apply given masses to ascertain deflected form of structure, beam moments and forces.

X. DESIGN

Click on 'Design' >Select parameters to incorporate in our design.

Define parameters with various values Select the specified command to instruct software package to design in keeping with IS code.

Detailing of reinforcement and amount of concrete is gift in computer file.

A. Modeling Of The Tank

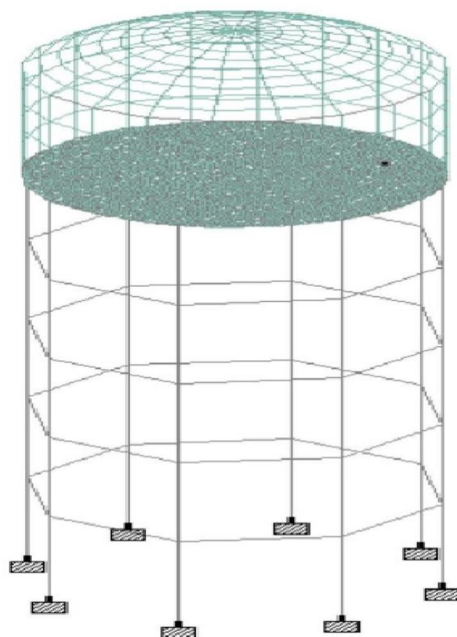


Figure
Molding Diagram

B. Assigning The Material

As after creating the beams and columns we will assign material to them as we require. Our design is concrete design hence we have assigned the concrete material to the beams and columns.

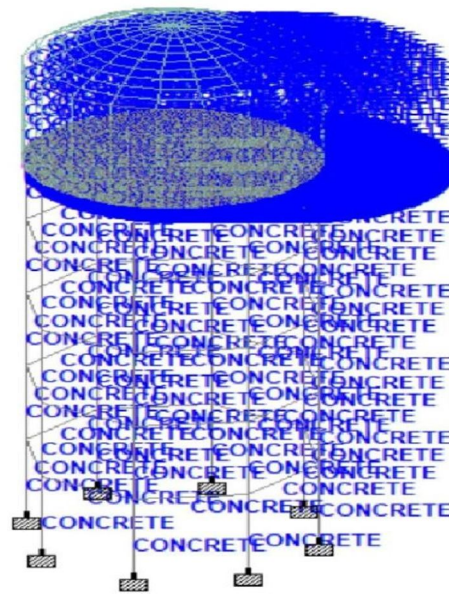


Figure
Properties Diagram

C. Specifying Supports

The supports are first created (as we created fixed supports) and then these are assigned to all the lowermost nodes of structure where we are going to design the foundation.

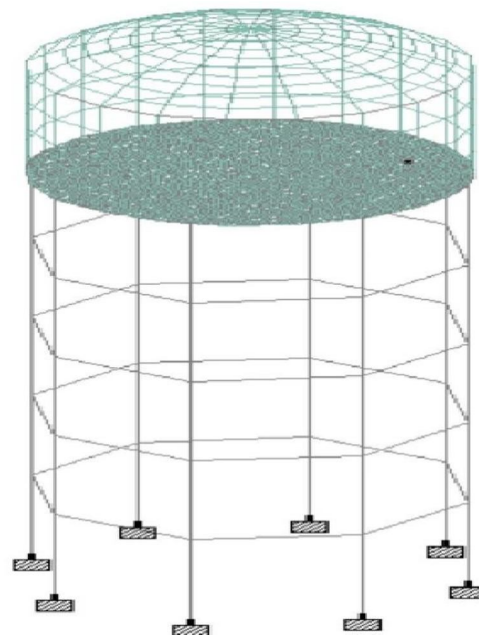
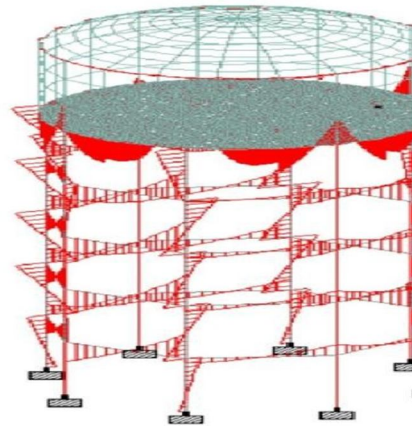


Figure
Support Diagram

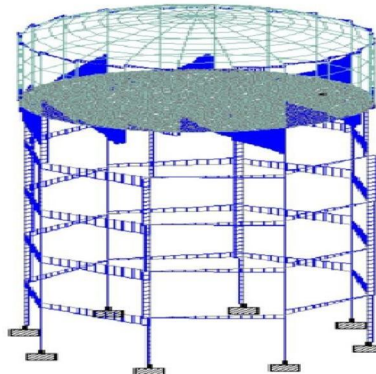
XI. RESULTS

A. Bending Moment



Figure


B. Shear Force



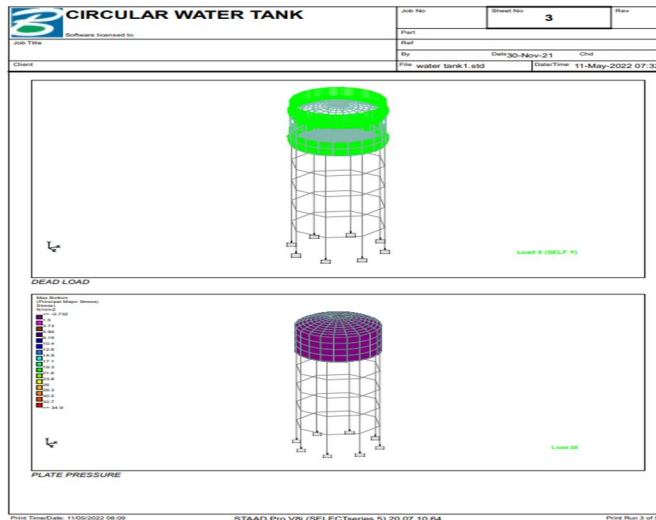
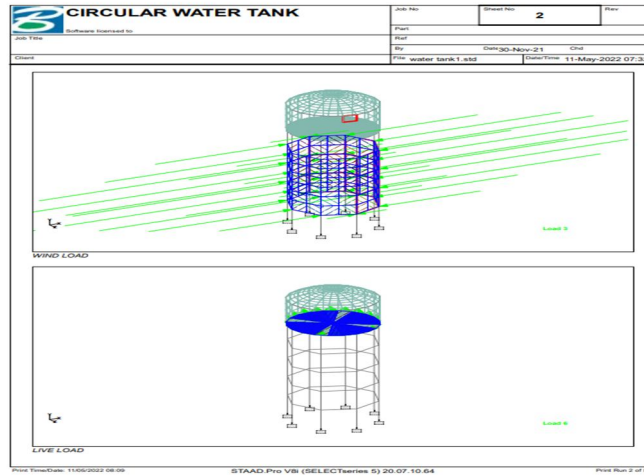
Figure

1) Reports On Stadd Pro

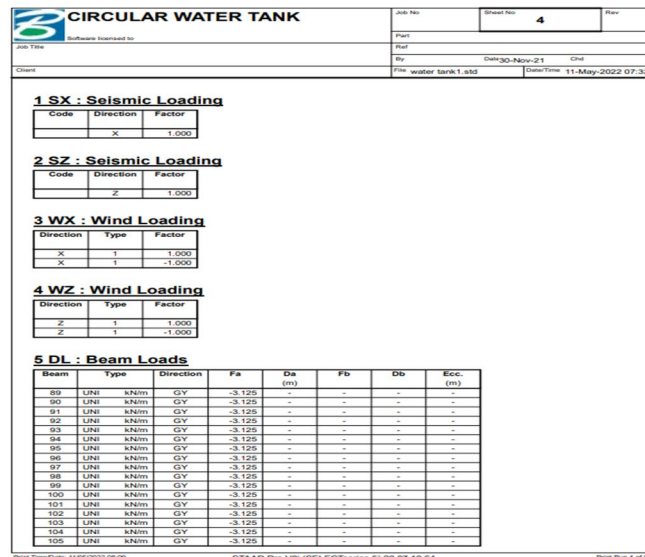
Job Information

		Job No.	Sheet No.	1	Date
File Name: Path:		Date: 30-Nov-21 User:			
Client:		File: water tank1.sbt Date/Time: 02-Dec-2021 21:33			
Job Information					
Name: Date: 30-Nov-21		Engineer: Checked:		Approved:	
Structure Type SPACE FRAME					
Number of Nodes: 6298 Highest Node: 6318		Number of Elements: 256 Highest Beam: 12313		Number of Plates: 12032 Highest Plate: 12064	
Number of Basic Load Cases: 2		Number of Combination Load Cases: 21			
Included in this printout are data for:					
All The Whole Structure					
Included in this printout are results for load cases:					
Type	LC	Name			
Primary	1	SX			
Primary	2	SY			
Primary	3	SZ			
Primary	4	WX			
Primary	5	WY			
Primary	6	WZ			
Primary	7	LL			
Primary	8	FLL			
Combination	9	GENERATED INDIAN CODE GENERAL S1			
Combination	10	GENERATED INDIAN CODE GENERAL S1			
Combination	11	GENERATED INDIAN CODE GENERAL S1			
Combination	12	GENERATED INDIAN CODE GENERAL S1			
Combination	13	GENERATED INDIAN CODE GENERAL S1			
Combination	14	GENERATED INDIAN CODE GENERAL S1			
Combination	15	GENERATED INDIAN CODE GENERAL S1			
Combination	16	GENERATED INDIAN CODE GENERAL S1			
Combination	17	GENERATED INDIAN CODE GENERAL S1			
Combination	18	GENERATED INDIAN CODE GENERAL S1			
Combination	19	GENERATED INDIAN CODE GENERAL S1			
Combination	20	GENERATED INDIAN CODE GENERAL S1			
Combination	21	GENERATED INDIAN CODE GENERAL S1			
Combination	22	GENERATED INDIAN CODE GENERAL S1			
Combination	23	GENERATED INDIAN CODE GENERAL S1			
Combination	24	GENERATED INDIAN CODE GENERAL S1			
Combination	25	GENERATED INDIAN CODE GENERAL S1			
Combination	26	GENERATED INDIAN CODE GENERAL S1			
Combination	27	GENERATED INDIAN CODE GENERAL S1			

2) Loads Acting On A Structure



3) Loas Case



CIRCULAR WATER TANK

Job No: Sheet No: **4** Rev:

Part: Rev: Date: 09/30/Nov/21 Cnt: 1

By: Date: 11-May-2022 07:32

File: water tank1.ssd

Print Time/Date: 11/05/2022 08:09 STAAD.Pro V8i (SELECTseries 5) 20.07.10.64 Print Run 4 of 254

1 SX : Seismic Loading

Code	Direction	Factor
X	X	1.000

2 SZ : Seismic Loading

Code	Direction	Factor
Z	Z	1.000

3 WX : Wind Loading

Direction	Type	Factor
X	1	1.000
X	-1	-1.000

4 WZ : Wind Loading

Direction	Type	Factor
Z	1	1.000
Z	-1	-1.000

5 DL : Beam Loads

Beam	Type	Direction	Fa	Da (m)	Fb	Db	Ecc. (m)
89	UNI	MNm	GY	-3.125	-	-	-
90	UNI	kNm	GY	-3.125	-	-	-
91	UNI	MNm	GY	-3.125	-	-	-
92	UNI	MNm	GY	-3.125	-	-	-
93	UNI	kNm	GY	-3.125	-	-	-
94	UNI	MNm	GY	-3.125	-	-	-
95	UNI	MNm	GY	-3.125	-	-	-
96	UNI	MNm	GY	-3.125	-	-	-
97	UNI	kNm	GY	-3.125	-	-	-
98	UNI	MNm	GY	-3.125	-	-	-
99	UNI	MNm	GY	-3.125	-	-	-
100	UNI	kNm	GY	-3.125	-	-	-
101	UNI	MNm	GY	-3.125	-	-	-
102	UNI	MNm	GY	-3.125	-	-	-
103	UNI	kNm	GY	-3.125	-	-	-
104	UNI	MNm	GY	-3.125	-	-	-
105	UNI	kNm	GY	-3.125	-	-	-

CIRCULAR WATER TANK

Job No: _____ Sheet No: **8** Rev: _____

Part: _____

Ref: _____

By: **Om30-Nov-21** Chd

Client: **water tank 1.ssd** Date/Time: **11-May-2022 07:32**

5 DL : Beam Loads Cont...

Beam	Type	Direction	Fa	Fb	Fc	Ecc. (m)
4558	UNI	kN/m	GV	-3.125	-	-
4566	UNI	kN/m	GV	-3.125	-	-
4566	UNI	kN/m	GV	-3.125	-	-
4729	UNI	kN/m	GV	-3.125	-	-
4744	UNI	kN/m	GV	-3.125	-	-
4769	UNI	kN/m	GV	-3.125	-	-
4854	UNI	kN/m	GV	-3.125	-	-
4921	UNI	kN/m	GV	-3.125	-	-
4927	UNI	kN/m	GV	-3.125	-	-
4952	UNI	kN/m	GV	-3.125	-	-
4986	UNI	kN/m	GV	-3.125	-	-
5216	UNI	kN/m	GV	-3.125	-	-
5238	UNI	kN/m	GV	-3.125	-	-
5239	UNI	kN/m	GV	-3.125	-	-
5356	UNI	kN/m	GV	-3.125	-	-
5362	UNI	kN/m	GV	-3.125	-	-
5363	UNI	kN/m	GV	-3.125	-	-
5377	UNI	kN/m	GV	-3.125	-	-
5382	UNI	kN/m	GV	-3.125	-	-
5549	UNI	kN/m	GV	-3.125	-	-
5590	UNI	kN/m	GV	-3.125	-	-
5611	UNI	kN/m	GV	-3.125	-	-
6487	UNI	kN/m	GV	-3.125	-	-
6733	UNI	kN/m	GV	-3.125	-	-
7207	UNI	kN/m	GV	-3.125	-	-
9217	UNI	kN/m	GV	-3.125	-	-
9264	UNI	kN/m	GV	-3.125	-	-
9360	UNI	kN/m	GV	-3.125	-	-
9704	UNI	kN/m	GV	-3.125	-	-
12305	UNI	kN/m	GV	-3.125	-	-
12309	UNI	kN/m	GV	-3.125	-	-
12313	UNI	kN/m	GV	-3.125	-	-

5 DL : Selfweight

Direction	Factor	Assigned Geometry
Y	-1.000	ALL

6 LL : Floor Loads

Load	Min Hx (m)	Max Hx (m)	Min X (m)	Max X (m)	Min Y (m)	Max Y (m)
-0.001	15.000	15.000	-	-	-	-

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CIRCULAR WATER TANK

Job No: _____ Sheet No: **9** Rev: _____

Part: _____

Ref: _____

By: **Om30-Nov-21** Chd

Client: **water tank 1.ssd** Date/Time: **11-May-2022 07:32**

7 FL : Plate Loads

Plate	Type	Direction	Fa	Fb	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)
109	TRAP	N/mm2	Z	-0.010	-0.011	-	-	-
110	TRAP	N/mm2	Z	-0.011	-0.013	-	-	-
111	TRAP	N/mm2	Z	-0.013	-0.016	-	-	-
112	TRAP	N/mm2	Z	-0.016	-0.020	-	-	-
113	TRAP	N/mm2	Z	-0.020	-0.025	-	-	-
114	TRAP	N/mm2	Z	-0.025	-0.029	-	-	-
115	TRAP	N/mm2	Z	-0.029	-0.033	-	-	-
116	TRAP	N/mm2	Z	-0.033	-0.036	-	-	-
117	TRAP	N/mm2	Z	-0.036	-0.039	-	-	-
118	TRAP	N/mm2	Z	-0.039	-0.039	-	-	-
119	TRAP	N/mm2	Z	-0.039	-0.039	-	-	-
120	TRAP	N/mm2	Z	-0.039	-0.036	-	-	-
121	TRAP	N/mm2	Z	-0.036	-0.033	-	-	-
122	TRAP	N/mm2	Z	-0.033	-0.029	-	-	-
123	TRAP	N/mm2	Z	-0.029	-0.025	-	-	-
124	TRAP	N/mm2	Z	-0.025	-0.020	-	-	-
125	TRAP	N/mm2	Z	-0.020	-0.016	-	-	-
126	TRAP	N/mm2	Z	-0.016	-0.013	-	-	-
127	TRAP	N/mm2	Z	-0.013	-0.011	-	-	-
128	TRAP	N/mm2	Z	-0.011	-0.010	-	-	-
129	TRAP	N/mm2	Z	-0.010	-0.011	-	-	-
130	TRAP	N/mm2	Z	-0.011	-0.013	-	-	-
131	TRAP	N/mm2	Z	-0.013	-0.016	-	-	-
132	TRAP	N/mm2	Z	-0.016	-0.020	-	-	-
133	TRAP	N/mm2	Z	-0.020	-0.025	-	-	-
134	TRAP	N/mm2	Z	-0.025	-0.029	-	-	-
135	TRAP	N/mm2	Z	-0.029	-0.033	-	-	-
136	TRAP	N/mm2	Z	-0.033	-0.036	-	-	-
137	TRAP	N/mm2	Z	-0.036	-0.039	-	-	-
138	TRAP	N/mm2	Z	-0.039	-0.039	-	-	-
139	TRAP	N/mm2	Z	-0.039	-0.039	-	-	-
140	TRAP	N/mm2	Z	-0.039	-0.036	-	-	-
141	TRAP	N/mm2	Z	-0.036	-0.033	-	-	-
142	TRAP	N/mm2	Z	-0.033	-0.029	-	-	-
143	TRAP	N/mm2	Z	-0.029	-0.025	-	-	-
144	TRAP	N/mm2	Z	-0.025	-0.020	-	-	-
145	TRAP	N/mm2	Z	-0.020	-0.016	-	-	-
146	TRAP	N/mm2	Z	-0.016	-0.013	-	-	-
147	TRAP	N/mm2	Z	-0.013	-0.011	-	-	-
148	TRAP	N/mm2	Z	-0.011	-0.010	-	-	-
149	TRAP	N/mm2	Z	-0.010	-0.011	-	-	-
150	TRAP	N/mm2	Z	-0.011	-0.013	-	-	-
151	TRAP	N/mm2	Z	-0.013	-0.016	-	-	-
152	TRAP	N/mm2	Z	-0.016	-0.020	-	-	-
153	TRAP	N/mm2	Z	-0.020	-0.025	-	-	-

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CIRCULAR WATER TANK

Job No: _____ Sheet No: **276** Rev: _____

Part: _____

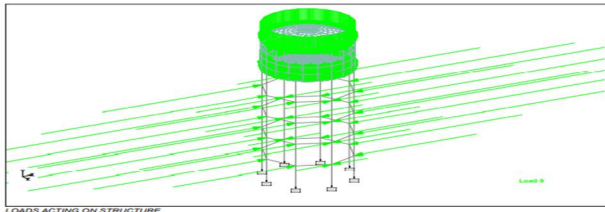
Ref: _____

By: **Om30-Nov-21** Chd

Client: **water tank 1.ssd** Date/Time: **11-May-2022 07:32**

7 FL : Plate Loads Cont...

Plate	Type	Direction	Fa	Fb	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)
12288	TRAP	N/mm2	Z	-0.026	-0.026	-	-	-
12289	TRAP	N/mm2	Z	-0.026	-0.026	-	-	-
12290	TRAP	N/mm2	Z	-0.026	-0.026	-	-	-
12291	TRAP	N/mm2	Z	-0.026	-0.026	-	-	-
12292	TRAP	N/mm2	Z	-0.026	-0.026	-	-	-
12293	TRAP	N/mm2	Z	-0.026	-0.025	-	-	-
12294	TRAP	N/mm2	Z	-0.025	-0.025	-	-	-
12295	TRAP	N/mm2	Z	-0.025	-0.024	-	-	-
12296	TRAP	N/mm2	Z	-0.024	-0.024	-	-	-
12297	TRAP	N/mm2	Z	-0.024	-0.023	-	-	-
12298	TRAP	N/mm2	Z	-0.023	-0.023	-	-	-
12299	TRAP	N/mm2	Z	-0.023	-0.023	-	-	-
12300	TRAP	N/mm2	Z	-0.023	-0.023	-	-	-
12301	TRAP	N/mm2	Z	-0.023	-0.023	-	-	-
12302	TRAP	N/mm2	Z	-0.023	-0.024	-	-	-
12303	TRAP	N/mm2	Z	-0.024	-0.024	-	-	-
12304	TRAP	N/mm2	Z	-0.024	-0.025	-	-	-



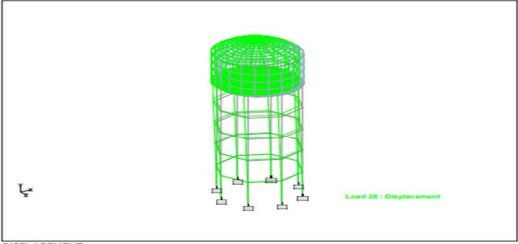
LOADS ACTING ON STRUCTURE

Print Time/Date: 11/05/2022 08:00 STAAD Pro V8i (SELECTseries 5) 20.07.10.64 Print Run 276 of 664

4) Displacement

Beam	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant
9	9	1.SX	0.000	0.000	0.000	1.055
		2.SZ	0.000	0.000	0.000	0.292
		3.WX	0.000	0.000	0.000	0.963
		4.WZ	0.000	0.000	0.000	0.762
		5.DL	0.000	0.000	0.000	1.849
		6.LL	0.000	0.000	0.000	2.506
		7.FL	0.000	0.000	0.000	0.015
		28.GENERATE	0.000	0.000	0.000	2.299
10	10	1.SX	0.000	0.000	0.000	1.055
		2.SZ	0.000	0.000	0.000	0.292
		3.WX	0.000	0.000	0.000	0.963
		4.WZ	0.000	0.000	0.000	0.762
		5.DL	0.000	0.000	0.000	1.849
		6.LL	0.000	0.000	0.000	2.506
		7.FL	0.000	0.000	0.000	0.015
		28.GENERATE	0.000	0.000	0.000	2.299
100	100	1.SX	0.000	0.000	0.000	1.055
		2.SZ	0.000	0.000	0.000	0.292
		3.WX	0.000	0.000	0.000	0.963
		4.WZ	0.000	0.000	0.000	0.762
		5.DL	0.000	0.000	0.000	1.849
		6.LL	0.000	0.000	0.000	2.506
		7.FL	0.000	0.000	0.000	0.015
		28.GENERATE	0.000	0.000	0.000	2.299
11	11	1.SX	0.000	0.000	0.000	1.055
		2.SZ	0.000	0.000	0.000	0.292
		3.WX	0.000	0.000	0.000	0.963
		4.WZ	0.000	0.000	0.000	0.762
		5.DL	0.000	0.000	0.000	1.849
		6.LL	0.000	0.000	0.000	2.506
		7.FL	0.000	0.000	0.000	0.015
		28.GENERATE	0.000	0.000	0.000	2.299
12	12	1.SX	0.000	0.000	0.000	1.055
		2.SZ	0.000	0.000	0.000	0.292
		3.WX	0.000	0.000	0.000	0.963
		4.WZ	0.000	0.000	0.000	0.762
		5.DL	0.000	0.000	0.000	1.849
		6.LL	0.000	0.000	0.000	2.506
		7.FL	0.000	0.000	0.000	0.015
		28.GENERATE	0.000	0.000	0.000	2.299

Beam	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant
7.FL			4.784	-3.381	-3.133	6.538
28.GENERATE			-0.009	-1.042	-13.111	13.153

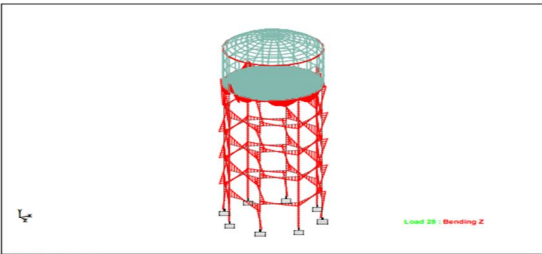


DISPLACEMENT

Beam	Node A	Length (m)	L/C	Max +ve	d (m)	Max My (kNm)	d (m)	Max Mz (kNm)
9	9	2.679	1.SX	0.000	0.009	0.000	0.000	4.075
			2.SZ	Max -ve	2.679	-0.010	2.679	-3.292
				Max +ve				8.763
				Max -ve	2.679	-0.007	2.679	-9.090
			3.WX	Max +ve	0.000	0.021	2.679	0.963
				Max -ve	2.679	-0.009	0.000	-1.076
			4.WZ	Max +ve	2.679	0.009	0.000	1.071
				Max -ve	0.000	-0.021	2.679	-0.971
			5.DL	Max +ve	0.000	0.051	2.679	1.383
				Max -ve	2.679	-0.050	1.116	-0.545
			6.LL	Max +ve	0.000	0.002	2.679	0.020

Beam Maximum Moments

5) Bending Moment

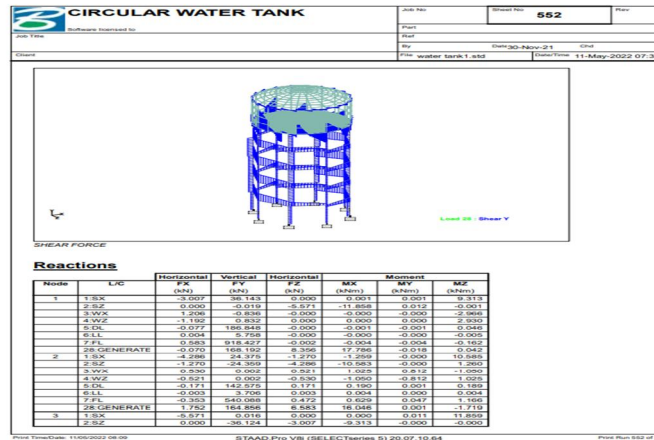


BENDING MOMENT

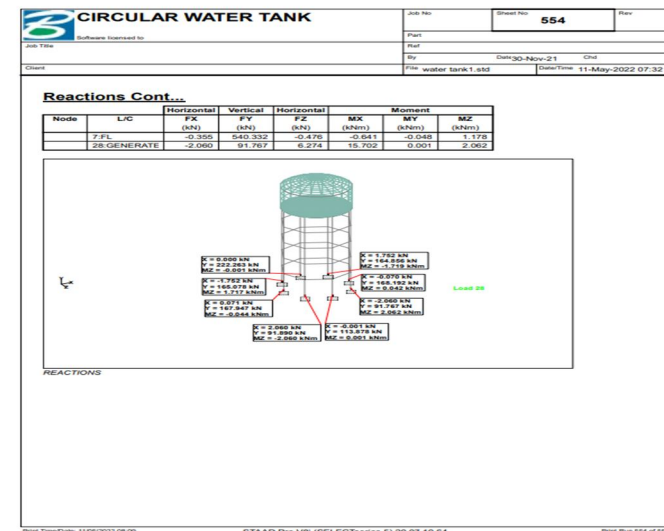
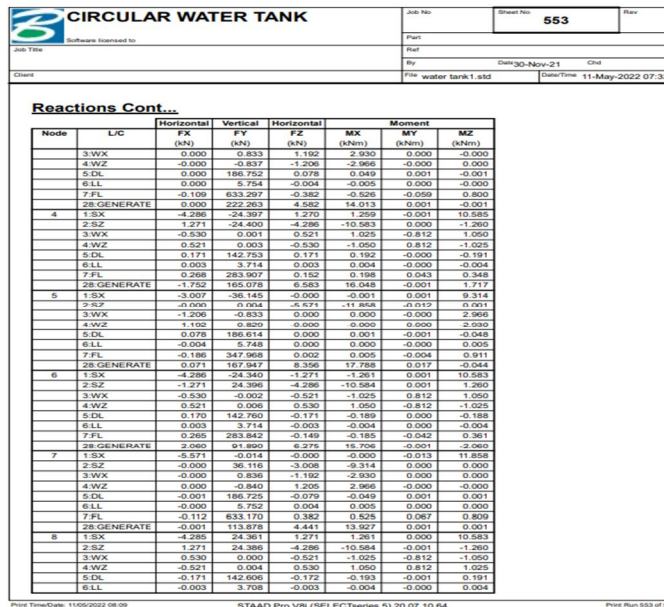
Beam	Node A	Length (m)	L/C	Max +ve	d (m)	Max Fz (kN)	d (m)	Max Fy (kN)
9	9	2.679	1.SX	Max +ve	0.000	-0.007	0.000	2.750
			2.SZ	Max +ve	0.000	-0.002	0.000	6.664
				Max -ve	0.000	-0.002		
			3.WX	Max +ve	0.000	-0.235	0.000	-0.762
				Max -ve	0.000	0.235	0.000	0.762
			4.WZ	Max +ve	0.000	-0.037	2.679	1.849
				Max -ve	0.000	-0.037	2.679	-2.506
			5.DL	Max +ve	0.000	-0.002	0.000	-0.015
				Max -ve	0.000	-0.261	0.000	-2.299
			7.FL	Max +ve	0.000	-0.031	2.679	-12.251
				Max -ve	0.000	-0.002	0.000	8.664
			28.GENERATE	Max +ve	0.000	-0.002	0.000	
				Max -ve	0.000	-0.002	0.000	

Beam Maximum Shear Forces

6) Shear Force



7) Reactions



XII. CONCLUSION

It concludes that the efficiency and reliability of the software in the field of designing is much better to that of them annual work. It has been seen that these off ware generated results were more efficient and economical which included the various different conditions under the designing conditions which are difficult to consider when done manually

- 1) The structural elements of water tank are safe in leakage free, flexure and shear.
- 2) Quantity of steel provided for structure is economical and adequate.
- 3) Proposed sizes of structural elements can be used in water tank as it is.
- 4) The design of beam, slab, column, footing and stair case are out of danger in deflection, bending, shear and other aspects.

Water tanks are considered to be effusive; but they are constructed to reach present and coming time population. They are considered to highly unreasonable and safely store the portable water. Water can be distributed to number of homes, Industries and public places which means of a network of a water distribution system. Hence water tanks are considered to be supporting systems and useful for the community. In circular tanks, as height increases as side wall thickness are to be increases and roof slab and floor slab depth are decreases. The circular water tanks are economical for average capacities. Design of water tank is a very irksome method. Particularly design of underground water tanks are lots of mathematical formulae and calculation. It is also more time consuming.

XIII. SCOPE OF FURTHERWORK

Design of water tank is a very difficult method. It uses for lots of mathematical calculation & uses of formulas for unusually design of overhead water tank. It is to be time consuming method. Thus works arte gives a solution to the above problems. There is a small difference between the design values of works to that of manual calculation. This works gives the least value for the design. Thus the designer should not provide less than the values we get from the works. In case of theoretical calculation designer initially added some extra values to the obtained values to be the safer side.

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