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Design The Circular Water Tank by Using the STAAD Pro Software

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Abstract: Water tank 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 tank 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 con 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 manly 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 x 7/5= 2.8m. ~ 4m.
   4. Height of conical dome (h_3) =D/7=7/7=1m.

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

   Volume of circle = $\pi r^2 h$
   $150= \pi \times 3.5^2 \times h$
   $h=150/(\pi \times 3.5^2) = 3.89$ m.
   add free bord =1.1m.
   total height =4m.

3) *<u>Step-3</u>. 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 ~ 7m.
   $\sin\Theta$ =B/H =D/2/R_1 = 7/2/7=0.5
   Θ = 30*
   $\sin\Theta$ = 0.5
   $\cos\Theta$ = 0.866

thickness of top dome is assumed 0.1m

   Dead load =2.5 KN/M^2
   Live load =1.5 KN/M^2
   Total load = 4 KN/M^2
   T_1 = 4 x7/(1+0.866)= 15 KN/M.
   Meridional stress = P/A =15/(1000 x 100) = 0.15 KN/MM^2

2. Hoop Tension: -
   a. T_2= WR_1[COS Θ-(1/(1+COS Θ))] = 4 x 7 [0.866-(1/1+0.866)] = -8.08 KN/M

   Hoop stress = P/A = 8.08 x 10^3 /1000 x 100 = 0.0808 N/MM

   $\boxed{0.0808<8}$

   Hence the design is ok.

   Providing minimum reinforcement 0.3% in circumferential and radial direction.

   A_{st} = 0.3 x 1000 x 100 /100 = 300mm^2

   Providing 8mm Φ bar

   Spacing = (π/4) d^2 x 1000/ A_{st}= (π/4)8^2 x 1000/ 300 = 167.55mm

   Providing $_8$mm Φ bar @ 160mm c/c (A_{st} = 314.15mm^2)

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

   Horizontal component of meridional force (T):

   W_1 = T_1 cosΘ = 15 x 0.866 = 12.99 KN/M ~13 KN/M

   Total hoop tension on beam (T) = W x D /2 = 13 x7 / 2 = 45.5 KN

   A_{st} for hoop tension = T/σ_{st} = 45.5 x 10^3 /130 = 350mm^2

   Providing 12 mm Φ bar

   Spacing = (π/4) d^2 x 1000/ A_{st}= (π/4)12^2 x 1000/ 350 = 323.13mm

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

   Stress at comprasion zone:

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

   let width assume 230 mm

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

   D= 138.47mm

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

   Double shear providing 8 mm Φ bar two legged stirrups

   $S_{vertical}=\frac{0.87 fyAsv}{0.4 b}$

   Asv (area of vertical stirrups) = 2 x $\frac{\pi}{4}$ x8^2 = 100 mm^2

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

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

5) *Step-5. Design of Cylindrical Wall*

   1. Hoop tension (T_2)=γ_w x h_2 x $\frac{D}{2}$ = 9.81 x 4x $\frac{7}{2}$ =137.34KN

   A_{st}=T/σ_{st} = $\frac{137.34 X 1000}{130}$ = 1056.461 mm^2

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

   Providing 12mm Φ bar @120 mm c/c

   Thickness of wall: -

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

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

   t = 94.97mm~100 mm

   Distribution steel: -

   $A_{st} = \frac{0.3 X 1000 X 100}{100}$ = 300 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

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

Weight of water = γ_w x h = 9.81 x 4 = 40KN/M^2

Self-weight = 0.18 x 25 = 4.5KM/M^2

Total loads = 44.5 KN/M^2

$R_2 = (\frac{D^\circ}{2})^2 + h_2^2 / (2 \text{ x } h_2) = (\frac{6.8}{2})^2 + 1^2 / (2 \text{ x } 1)$

= 6.8m.

sinΘ= 0.5

Θ= 30*

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

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

a. 0.9<8 Hence the design is ok

Providing minimum % of steel 0.3%

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

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

7) *Step-7. Design of bottom ring beam*

1. Out word thrust for bottom beam

T_3 cosΘ = 162.165 x 0.866 = 140.434 KN/M

2. Hoop tension on beam $= \frac{WXD}{2} = \frac{140.434 X 7}{2}$

= 491.519 KN

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

$\boxed{2.73 < 8}$

Hence the structure is safe.

Total load on beam: -

Vertical load on beam:

= T_2sinΘ_1 +T_3 sinΘ_2

= 137.34 x 0.5 + 162.165 x 0.

= 135b KN/M

Self-weight of beam = 0.3 x 0.6 x 25 = 4.5 KN/M

Load of bottom dome = 0.18 x 25 = 4.5 KN/M

Total UDL load = 135 + 4.5 + 4.5+ 144KN/M

Total load $= \frac{\pi}{D} XUDL = \frac{\pi}{7} X \ 144 = 3166$KN

Maximum negative bending moment at support = C_1WR^2 (2Θ)

Assumed Number of supports 8

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

Maximum Positive bending moment at support = C_2WR^2 (2Θ)

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

Maximum torsional moment at support = C_3WR^2 (2Θ)

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

Maximum shear force at support $= \frac{W}{2 \, XNo.columns} = \frac{3166}{2 X 8} = 197.8$ KN

Calculate Depth of beam
$M = Qbd^2$
$197.87 = 2.85 \text{ x } 300 \text{ x } d^2$
D = 468.91 mm
Providing depth of beam 550mm and 50 mm cover total depth 600mm
$A_{st} = \frac{M}{\sigma stXjXd} = \frac{197.87\ X\ 1000000}{130\ X\ 0.86\ X\ 550} = 3217.92\ mm^2$
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)
$Ʊ_v = \frac{M}{bXd} = \frac{197.87\ X\ 1000}{300\ X\ 550} = 1.19\ N/mm^2$
Percentage of steel (Pt) = $\frac{100\ XAst}{bXd} = \frac{100\ X\ 3217.92}{300\ X\ 600} = 0.019$
$Ʊ_c = \frac{0.75-0.19}{0.75-100} = \frac{0.36-x}{0.36-0.4}$
$Ʊ_c$=0.4

$\boxed{Ʊ_v > Ʊ_c}$

It is design for shear
Shear taken by concrete = 0.35 x 300 x 550 = 57.75 KN
Net shear force = 197.87-57.75 = 140.06 KN
Provide 10mm ϴ bar 4 legged vertical stirrups.
Area of vertical steel (A_{sv})= 4 x $\frac{\pi}{4}$ x d^2 = 4 x $\frac{\pi}{4}$ x 7^2 = 314.15 mm^2
$S_v = \frac{AsvX\sigma svXd}{Vs} = \frac{314.15\ X\ 175\ X\ 550}{140.06} = 215.88$ mm
Provided 10 mm ϴ Bar 4 legged vertical stirrups @200 mm c/c

Column details:
Total bear load on column = 3166KN
Dead load of the column = 0.35 x 0.35 x 25 x 15
= 45.93 KN
Total dead weight of the column = 45.93 x 8
= 367.5
Total load on column = 3166 + 367.5 = 3533.5 KN
Load of 1 column = 3533.5/8 = 441.68 KN
Providing 20mm Φ bar 150mm c/c
(A_{st} = 47123.88 mm^2)

Seismic load from IS 1893:2002
Response spectrum method
For RC $T_u = 0.75\ h^{0.75}$
Horizontal seismic coefficient $A_n = \frac{ZI}{2}$ x S_a/g
T<0.1S it is given from table No.2
Z = zone factor II = 0.1
R = response factor = 3 To 5 =5 from table No.7
I = Impact factor = 1.5 From Table No.6
S_a/g = soil classification
Base shear (V_b) = A_n x W

Wind load:
$P_z = 0.6\ V_z^2$
$V_z = V_b \text{ x } K_1 \text{ x } K_2 \text{ x } K_3 \text{ x } K_4$
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 = Topography factor = 1
K_4 = Importance factor = 1
V_z = 40.0998
P_z = 24.059 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

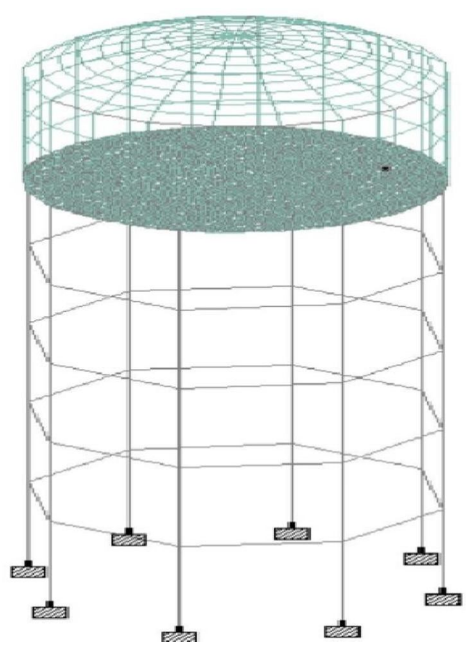

Figure
Molding Diagram

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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.

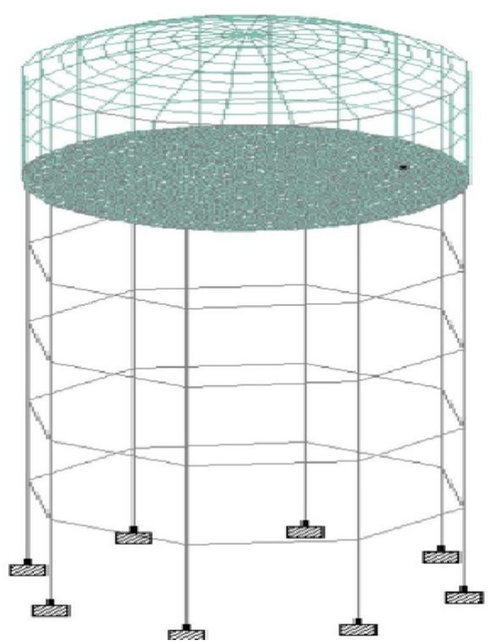
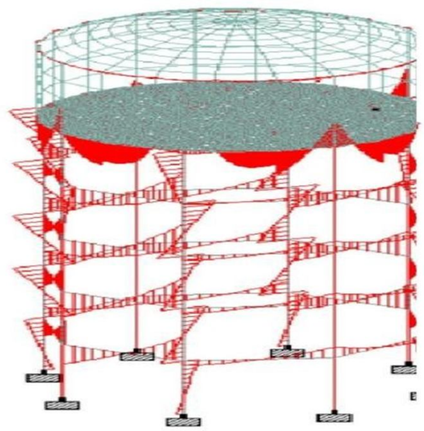


Figure
Support Diagram

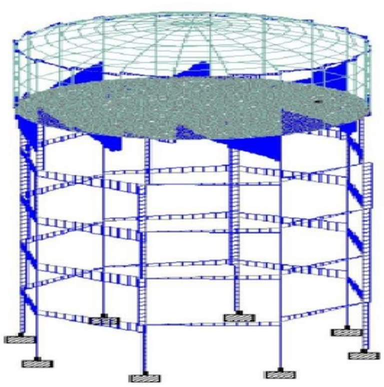
XI. RESULTS

A. *Bending Moment*



Figure

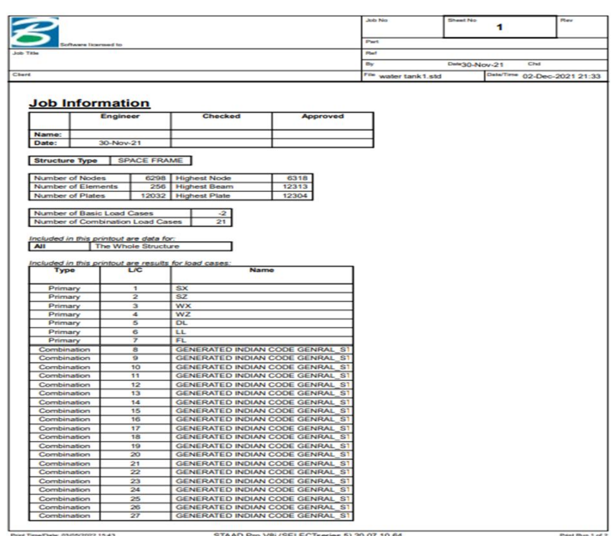
B. *Shear Force*



Figure

1) *Reports On Stadd Pro*

Job Information



Job No	Sheet No 1	Rev
Part		
Ref		
By	Date 30-Nov-21	Chd
File water tank1.std	Date/Time 02-Dec-2021 21:33	

Software licensed to
Job Title
Client

Job Information

	Engineer	Checked	Approved
Name:			
Date:	30-Nov-21		

Structure Type	SPACE FRAME

Number of Nodes	6298	Highest Node	6318
Number of Elements	256	Highest Beam	12313
Number of Plates	12032	Highest Plate	12304

Number of Basic Load Cases	-2
Number of Combination Load Cases	21

Included in this printout are data for:

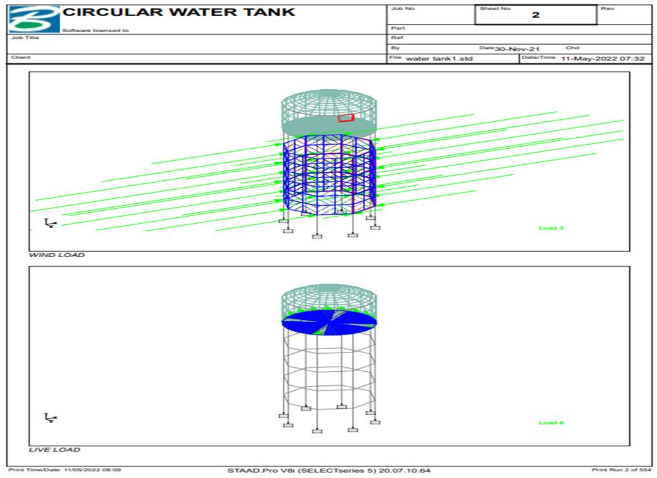
All	The Whole Structure

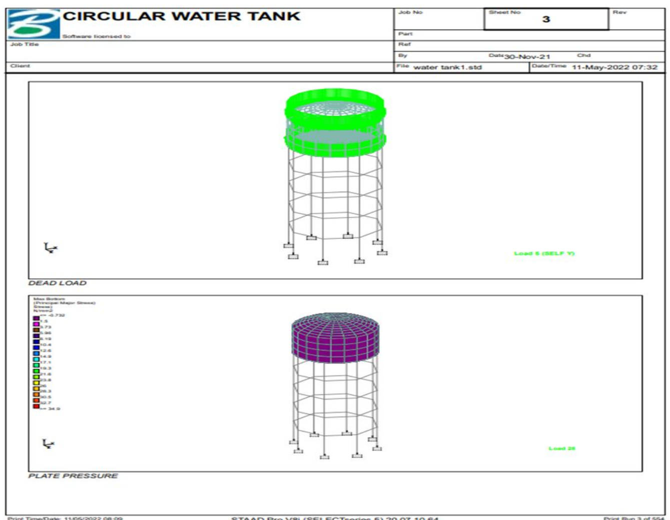
Included in this printout are results for load cases:

Type	L/C	Name
Primary	1	SX
Primary	2	SZ
Primary	3	WX
Primary	4	WZ
Primary	5	DL
Primary	6	LL
Primary	7	FL
Combination	8	GENERATED INDIAN CODE GENRAL_S1
Combination	9	GENERATED INDIAN CODE GENRAL_S1
Combination	10	GENERATED INDIAN CODE GENRAL_S1
Combination	11	GENERATED INDIAN CODE GENRAL_S1
Combination	12	GENERATED INDIAN CODE GENRAL_S1
Combination	13	GENERATED INDIAN CODE GENRAL_S1
Combination	14	GENERATED INDIAN CODE GENRAL_S1
Combination	15	GENERATED INDIAN CODE GENRAL_S1
Combination	16	GENERATED INDIAN CODE GENRAL_S1
Combination	17	GENERATED INDIAN CODE GENRAL_S1
Combination	18	GENERATED INDIAN CODE GENRAL_S1
Combination	19	GENERATED INDIAN CODE GENRAL_S1
Combination	20	GENERATED INDIAN CODE GENRAL_S1
Combination	21	GENERATED INDIAN CODE GENRAL_S1
Combination	22	GENERATED INDIAN CODE GENRAL_S1
Combination	23	GENERATED INDIAN CODE GENRAL_S1
Combination	24	GENERATED INDIAN CODE GENRAL_S1
Combination	25	GENERATED INDIAN CODE GENRAL_S1
Combination	26	GENERATED INDIAN CODE GENRAL_S1
Combination	27	GENERATED INDIAN CODE GENRAL_S1

Print Time/Date: 03/05/2022 15:43 STAAD.Pro V8i (SELECTseries 5) 20.07.10.64 Print Run 1 of 2

2) Loads Acting On A Structure





3) Loas Case

CIRCULAR WATER TANK

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Job No	Sheet No 4	Rev
Part		
Ref		
By	Date 30-Nov-21	Chd
File water tank1.std	Date/Time 11-May-2022 07:32	

Job Title

Client

1 SX : Seismic Loading

Code	Direction	Factor
	X	1.000

2 SZ : Seismic Loading

Code	Direction	Factor
	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	kN/m	GY	-3.125	-	-	-	-
90	UNI	kN/m	GY	-3.125	-	-	-	-
91	UNI	kN/m	GY	-3.125	-	-	-	-
92	UNI	kN/m	GY	-3.125	-	-	-	-
93	UNI	kN/m	GY	-3.125	-	-	-	-
94	UNI	kN/m	GY	-3.125	-	-	-	-
95	UNI	kN/m	GY	-3.125	-	-	-	-
96	UNI	kN/m	GY	-3.125	-	-	-	-
97	UNI	kN/m	GY	-3.125	-	-	-	-
98	UNI	kN/m	GY	-3.125	-	-	-	-
99	UNI	kN/m	GY	-3.125	-	-	-	-
100	UNI	kN/m	GY	-3.125	-	-	-	-
101	UNI	kN/m	GY	-3.125	-	-	-	-
102	UNI	kN/m	GY	-3.125	-	-	-	-
103	UNI	kN/m	GY	-3.125	-	-	-	-
104	UNI	kN/m	GY	-3.125	-	-	-	-
105	UNI	kN/m	GY	-3.125	-	-	-	-

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5 DL : Beam Loads Cont...

Beam	Type		Direction	Fa	Da (m)	Fb	Db	Ecc. (m)
4558	UNI	kN/m	GY	-3.125	-	-	-	-
4566	UNI	kN/m	GY	-3.125	-	-	-	-
4595	UNI	kN/m	GY	-3.125	-	-	-	-
4729	UNI	kN/m	GY	-3.125	-	-	-	-
4744	UNI	kN/m	GY	-3.125	-	-	-	-
4769	UNI	kN/m	GY	-3.125	-	-	-	-
4864	UNI	kN/m	GY	-3.125	-	-	-	-
4921	UNI	kN/m	GY	-3.125	-	-	-	-
4927	UNI	kN/m	GY	-3.125	-	-	-	-
4952	UNI	kN/m	GY	-3.125	-	-	-	-
4986	UNI	kN/m	GY	-3.125	-	-	-	-
5216	UNI	kN/m	GY	-3.125	-	-	-	-
5238	UNI	kN/m	GY	-3.125	-	-	-	-
5239	UNI	kN/m	GY	-3.125	-	-	-	-
5356	UNI	kN/m	GY	-3.125	-	-	-	-
5362	UNI	kN/m	GY	-3.125	-	-	-	-
5363	UNI	kN/m	GY	-3.125	-	-	-	-
5377	UNI	kN/m	GY	-3.125	-	-	-	-
5382	UNI	kN/m	GY	-3.125	-	-	-	-
5549	UNI	kN/m	GY	-3.125	-	-	-	-
5590	UNI	kN/m	GY	-3.125	-	-	-	-
5611	UNI	kN/m	GY	-3.125	-	-	-	-
6487	UNI	kN/m	GY	-3.125	-	-	-	-
6733	UNI	kN/m	GY	-3.125	-	-	-	-
7207	UNI	kN/m	GY	-3.125	-	-	-	-
9217	UNI	kN/m	GY	-3.125	-	-	-	-
9264	UNI	kN/m	GY	-3.125	-	-	-	-
9360	UNI	kN/m	GY	-3.125	-	-	-	-
9704	UNI	kN/m	GY	-3.125	-	-	-	-
12305	UNI	kN/m	GY	-3.125	-	-	-	-
12309	UNI	kN/m	GY	-3.125	-	-	-	-
12313	UNI	kN/m	GY	-3.125	-	-	-	-

5 DL : Selfweight

Direction	Factor	Assigned Geometry
Y	-1.000	ALL

6 LL : Floor Loads

Load (N/mm^2)	Min Ht. (m)	Max Ht. (m)	Min X (m)	Max X (m)	Min Y (m)	Max Y (m)
-0.001	15.000	15.000	-	-	-	-

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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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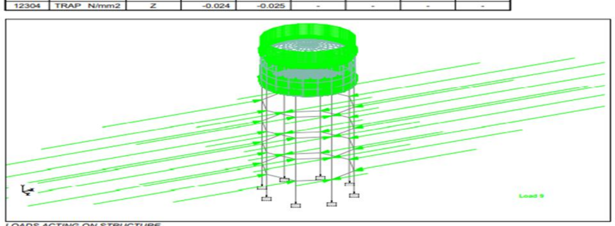
7 FL : Plate Loads Cont...

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

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4) Displacement

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Beam End Displacements

Displacements shown in italic indicate the presence of an offset

Beam	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant (mm)
9	9	1:SX	1.054	-0.041	0.000	1.055
		2:SZ	0.000	0.000	1.059	1.059
		3:WX	-0.295	0.001	0.000	0.295
		4:WZ	0.292	-0.001	0.000	0.292
		5:DL	-0.005	-0.206	0.000	0.206
		6:LL	-0.000	-0.007	0.000	0.007
		7:FL	0.068	-1.036	0.000	1.038
		28:GENERATE	-0.004	-0.185	-1.588	1.599
	10	1:SX	1.057	-0.028	0.002	1.057
		2:SZ	0.002	0.028	1.057	1.057
		3:WX	-0.088	0.000	-0.085	0.122
		4:WZ	0.085	0.000	0.088	0.122
		5:DL	0.003	-0.156	-0.004	0.156
		6:LL	0.000	-0.004	-0.000	0.004
		7:FL	0.136	-0.609	-0.027	0.625
		28:GENERATE	0.000	-0.182	-1.588	1.599
10	10	1:SX	1.057	-0.028	0.002	1.057
		2:SZ	0.002	0.028	1.057	1.057
		3:WX	-0.088	0.000	-0.085	0.122
		4:WZ	0.085	0.000	0.088	0.122
		5:DL	0.003	-0.156	-0.004	0.156
		6:LL	0.000	-0.004	-0.000	0.004
		7:FL	0.136	-0.609	-0.027	0.625
		28:GENERATE	0.000	-0.182	-1.588	1.599
	11	1:SX	1.059	0.000	0.000	1.059
		2:SZ	0.000	0.041	1.054	1.055
		3:WX	0.000	-0.001	-0.292	0.292
		4:WZ	0.000	0.001	0.295	0.295
		5:DL	0.000	-0.206	0.005	0.206
		6:LL	0.000	-0.006	0.000	0.006
		7:FL	0.115	-0.714	0.025	0.724
		28:GENERATE	0.000	-0.240	-1.577	1.590
11	11	1:SX	1.059	0.000	0.000	1.059
		2:SZ	0.000	0.041	1.054	1.055
		3:WX	0.000	-0.001	-0.292	0.292
		4:WZ	0.000	0.001	0.295	0.295
		5:DL	0.000	-0.206	0.005	0.206
		6:LL	0.000	-0.006	0.000	0.006
		7:FL	0.115	-0.714	0.025	0.724
		28:GENERATE	0.000	-0.246	-1.577	1.596
	12	1:SX	1.057	0.028	-0.002	1.057
		2:SZ	-0.002	0.028	1.057	1.057
		3:WX	0.088	0.000	-0.085	0.122
		4:WZ	-0.085	0.000	0.088	0.122

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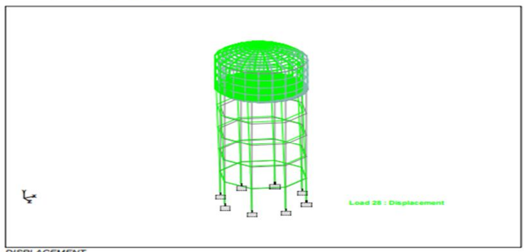
Beam End Displacements Cont...

Beam	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant (mm)
		7:FL	4.384	-3.381	-0.133	5.538
		28:GENERATE	-0.009	-1.042	-13.111	13.153



DISPLACEMENT

Beam Maximum Moments

Distances to maxima are given from beam end A.

Beam	Node A	Length (m)	L/C		d (m)	Max My (kNm)	d (m)	Max Mz (kNm)
9	9	2.679	1:SX	Max +ve	0.000	0.009	0.000	4.075
				Max -ve	2.679	-0.010	2.679	-3.292
			2:SZ	Max +ve			0.000	8.760
				Max -ve	2.679	-0.007	2.679	-9.090
			3:WX	Max +ve	0.000	0.621	2.679	0.965
				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	-0.621	2.679	-0.971
			5:DL	Max +ve	0.000	0.051	2.679	1.383
				Max -ve	2.679	-0.050	1.116	-0.548
			6:LL	Max +ve	0.000	0.002	2.679	0.020

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5) Bending Moment

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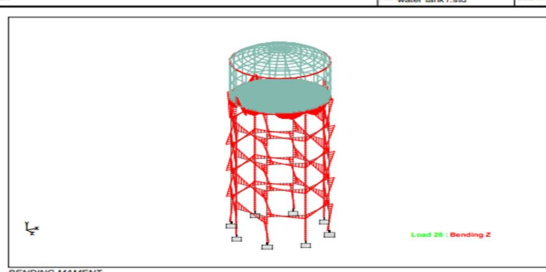

BENDING MAMENT

Beam Maximum Shear Forces

Distances to maxima are given from beam end A.

Beam	Node A	Length (m)	L/C		d (m)	Max Fz (kN)	d (m)	Max Fy (kN)
9	9	2.679	1:SX	Max +ve			0.000	2.750
				Max -ve	0.000	-0.007		
			2:SZ	Max +ve			0.000	6.664
				Max -ve	0.000	-0.002		
			3:WX	Max +ve				
				Max -ve	0.000	-0.235	0.000	-0.762
			4:WZ	Max +ve	0.000	0.235	0.000	0.762
				Max -ve				
			5:DL	Max +ve			0.000	1.849
				Max -ve	0.000	-0.037	2.679	-2.506
			6:LL	Max +ve				
				Max -ve	0.000	-0.002	0.000	-0.015
			7:FL	Max +ve				
				Max -ve	0.000	-0.261	0.000	-2.299
			28:GENERATE	Max +ve				
				Max -ve	0.000	-0.031	2.679	-12.251
10	10	2.679	1:SX	Max +ve			0.000	6.664
				Max -ve	0.000	-0.002		

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6) Shear Force

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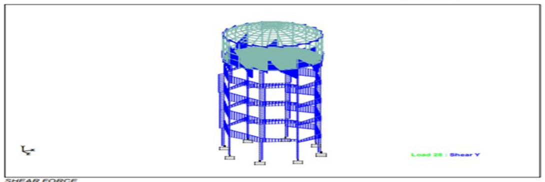

SHEAR FORCE

Reactions

Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kNm)	Moment MY (kNm)	Moment MZ (kNm)
1	1:SX	-3.007	36.143	0.000	0.001	0.001	9.313
	2:SZ	0.000	-0.019	-5.571	-11.858	0.012	-0.001
	3:WX	1.206	-0.836	-0.000	-0.000	-0.000	-2.966
	4:WZ	-1.192	0.832	0.000	0.000	0.000	2.930
	5:DL	-0.077	186.848	-0.000	-0.001	-0.001	0.046
	6:LL	0.004	5.758	-0.000	-0.000	-0.000	-0.005
	7:FL	0.583	918.427	-0.002	-0.004	-0.004	-0.162
	28:GENERATE	-0.070	168.192	8.356	17.786	-0.018	0.042
2	1:SX	-4.286	24.375	-1.270	-1.259	-0.000	10.585
	2:SZ	-1.270	-24.359	-4.286	-10.583	-0.000	1.260
	3:WX	0.530	0.002	0.521	1.025	0.812	-1.050
	4:WZ	-0.521	0.002	-0.530	-1.050	-0.812	1.025
	5:DL	-0.171	142.575	0.171	0.190	0.001	0.189
	6:LL	-0.003	3.706	0.003	0.004	0.000	0.004
	7:FL	-0.353	540.088	0.472	0.629	0.047	1.166
	28:GENERATE	1.752	164.856	6.583	16.046	0.001	-1.719
3	1:SX	-5.571	0.016	0.000	0.000	0.011	11.859
	2:SZ	0.000	-36.124	-3.007	-9.313	-0.000	-0.000

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7) Reactions

CIRCULAR WATER TANK

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Reactions Cont...

Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kNm)	Moment MY (kNm)	Moment MZ (kNm)
	3:WX	0.000	0.833	1.192	2.930	0.000	-0.000
	4:WZ	-0.000	-0.837	-1.206	-2.966	-0.000	0.000
	5:DL	0.000	186.752	0.078	0.049	0.001	-0.001
	6:LL	0.000	5.754	-0.004	-0.005	0.000	-0.000
	7:FL	-0.109	633.297	-0.382	-0.526	-0.059	0.800
	28:GENERATE	0.000	222.263	4.582	14.013	0.001	-0.001
4	1:SX	-4.286	-24.397	1.270	1.259	-0.001	10.585
	2:SZ	1.271	-24.400	-4.286	-10.583	0.000	-1.260
	3:WX	-0.530	0.001	0.521	1.025	-0.812	1.050
	4:WZ	0.521	0.003	-0.530	-1.050	0.812	-1.025
	5:DL	0.171	142.753	0.171	0.192	-0.000	-0.191
	6:LL	0.003	3.714	0.003	0.004	-0.000	-0.004
	7:FL	0.268	283.907	0.152	0.198	0.043	0.348
	28:GENERATE	-1.752	165.078	6.583	16.048	-0.001	1.717
5	1:SX	-3.007	-36.145	-0.000	-0.001	0.001	9.314
	2:SZ	-0.000	0.004	-5.571	-11.858	-0.012	0.001
	3:WX	-1.206	-0.833	0.000	0.000	-0.000	2.966
	4:WZ	1.102	0.820	-0.000	-0.000	0.000	-2.030
	5:DL	0.078	186.614	0.000	0.001	-0.001	-0.048
	6:LL	-0.004	5.748	0.000	0.000	-0.000	0.005
	7:FL	-0.186	347.968	0.002	0.005	-0.004	0.911
	28:GENERATE	0.071	167.947	8.356	17.788	0.017	-0.044
6	1:SX	-4.286	-24.340	-1.271	-1.261	0.001	10.583
	2:SZ	-1.271	24.396	-4.286	-10.584	0.001	1.260
	3:WX	-0.530	-0.002	-0.521	-1.025	0.812	1.050
	4:WZ	0.521	0.006	0.530	1.050	-0.812	-1.025
	5:DL	0.170	142.760	-0.171	-0.189	0.000	-0.188
	6:LL	0.003	3.714	-0.003	-0.004	0.000	-0.004
	7:FL	0.265	283.842	-0.149	-0.185	-0.042	0.361
	28:GENERATE	2.060	91.890	6.275	15.706	-0.001	-2.060
7	1:SX	-5.571	-0.014	-0.000	-0.000	-0.013	11.858
	2:SZ	-0.000	36.116	-3.008	-9.314	0.000	0.000
	3:WX	-0.000	0.836	-1.192	-2.930	0.000	0.000
	4:WZ	0.000	-0.840	1.205	2.966	-0.000	-0.000
	5:DL	-0.001	186.725	-0.079	-0.049	0.001	0.001
	6:LL	-0.000	5.752	0.004	0.005	0.000	0.000
	7:FL	-0.112	633.170	0.382	0.525	0.067	0.809
	28:GENERATE	-0.001	113.878	4.441	13.927	0.001	0.001
8	1:SX	-4.285	24.361	1.271	1.261	0.000	10.583
	2:SZ	1.271	24.386	-4.286	-10.584	-0.001	-1.260
	3:WX	0.530	0.000	-0.521	-1.025	-0.812	-1.050
	4:WZ	-0.521	0.004	0.530	1.050	0.812	1.025
	5:DL	-0.171	142.606	-0.172	-0.193	-0.001	0.191
	6:LL	-0.003	3.708	-0.003	-0.004	-0.000	0.004

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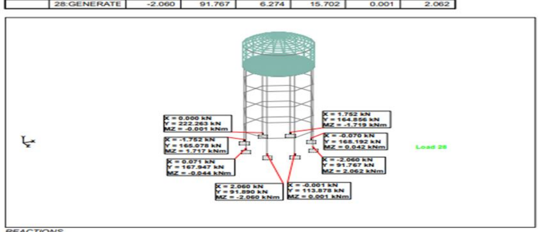
CIRCULAR WATER TANK

Software licensed to

Job Title	Job No	Sheet No 554	Rev
	Part		
	Ref		
	By	Date 30-Nov-21	Chd
Client	File water tank1.std	Date/Time 11-May-2022 07:32	

Reactions Cont...

Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kNm)	Moment MY (kNm)	Moment MZ (kNm)
	7:FL	-0.355	540.332	-0.476	-0.641	-0.048	1.178
	28:GENERATE	-2.060	91.767	6.274	15.702	0.001	2.062



REACTIONS

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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 tobe the safer side.

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