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STRUCTURAL DESIGN FOR RRC SERVICE RESERVIOUR FOR NANDGAON KHANDESHAWAR VILLAGE WATER SUPPLY SCHEME BY USING STADD PRO

Prof. A. N. Humnabad[*1], Kunal Bansod[*2], Saeel Salvi[*3], Shubham Kardel[*4]

[*1]Assistant Professor, Dept. Of Civil Engineering, ICOER, Wagholi, Pune, India.

[*2,3,4]U.G. Student, Dept. Of Civil Engineering, JSPM's Imperial College Of Engineering And Research, Wagholi, Pune, India.

ABSTRACT

While observing the water supply scheme in this village we noticed that, this village situated near Amravati city, and there is lots of surrounding villages workers lived there in after doing their work in MIDC and some stayed permanently due to this increasing population and water demand of village day by day. Since 2003 water supply of village were dependent on flow of Bembla river, this source diminished day by day due to the little rainfall and greater demand of water therefore government implemented some sources there scarcity of water was present therefore the study undertaken.

Keywords: Elevated Service Reservoir, Cylindrical Dome, Structural Design, Staad Pro.

I. INTRODUCTION

Nandgaon Khandeshvar village is situated on Amravati Yeotmal Road about 35 kms away from Amravati This is taluka place and all the civic activities are managed by Village Panchayat. There is temple of Khandeshvar therefore village is known as Nandgaon Khandeshvar. There is pilgrim of God Khandeshvar every year and this village is known as great market place for surrounding villages. In the year 1976, water supply scheme costing Rs 5.50 lacs was commissioned by Maharashtra Jeevan Pradhikaran and handed over to village panchayat for day-to-day maintenance. At present there is acute scarcity of water in said village. Domestic water is a major problem in these areas Vidarbha region in Maharashtra, so as to solve this problem innovative design and strategies and solution to existing problem is essential, hence for that study of ESR is undertaking.

AIM OF THE PROJECT

Making this water reservoir will serve plenty of water to the families of the locality named Nandgaon Khandeshvar to fulfill their daily water demand and also keep in mind that there will be no scarcity of water if the population increases in future up to 2040.

SCOPE OF THE PROJECT

Similar type of structural design project can be prepared for other small Towns / villages with reference of this project by manually or by using software's e.g., stadd pro.

OBJECTIVES OF STUDY

- To reduce the water scarcity in said village
- To plan water supply project by manual and software
- To study of existing water supply project and apply technical concepts
- To estimate of all components using software

II. LITERATURE SURVEY

Mr. Manoj Nallanathel [1], Mr. Ramesh [2], Jagadeesh [3] (2018)-The shape of the tanks plays predominant role in the design of overhead and underground water tanks. Usage of Staad pro in design gives accurate results for shear force and bending moment than convenient method

Bugatha Adilakshmi1, Paliki Suribabu2, Reddi Ramesh3(2016)-They concluded that from chart-1, cost will reduce when bearing capacity of soil increases. From chart-2 they concluded that between 5 lakhs to 10 lakhs capacity there is no so much of cost variation, in this region cost not so much dependent upon soil bearing capacity. From chart-3 they concluded that for 5 lakh liter capacity of water tank, for the wind speed between 33-41 m/s, Cost is approximately constant. Butine the same region for 10 lakhs to above capacity, cost will vary.

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G.P. Deshmukh1, Ankush. S. Patekhede2 (2015) –In this project, emphasis is given on the study of the inbuilt feature of solving seismic coefficient method in STAAD PRO V8i. This method provides the values of time period and base shear, which are very much in agreement with the values of the manually calculated results

Manish N. Gandhi, Prof. A. Rajan (2014)-For basic staging overturning moment is highest as compared to the other staging patterns. The slender staging that results from the low design forces is a very unfavorable feature for seismic areas for elevated water tanks. The current design of RC shaft type circular staging for elevated water tanks are extremely vulnerable to lateral loads cause by earthquake

Neha. S. Vanjari, [2] Kritika. M. Savant,[3] Prashant. S. Sisodia,[4] S. B. Patil (2017) –Elevated Water Tanks provide head for supply of water. When water has to be pumped into the distribution system at high heads without any pumps for supply however pumps are necessary or pumping only till tank is filled.

III. METHODOLOGY

At present there is acute scarcity of water in Nandgaon khandeshwar village govt. of Maharashtra has given approval principally to prepare the detail water supply project. Therefore, the detailed survey including investigation of sources of water is undertaken. This required data is collected for design. Also carrying out the study of existing water supply arraignments and course of action to solve the problem.

IV. MODELING AND ANALYSIS USING SOFTWARE

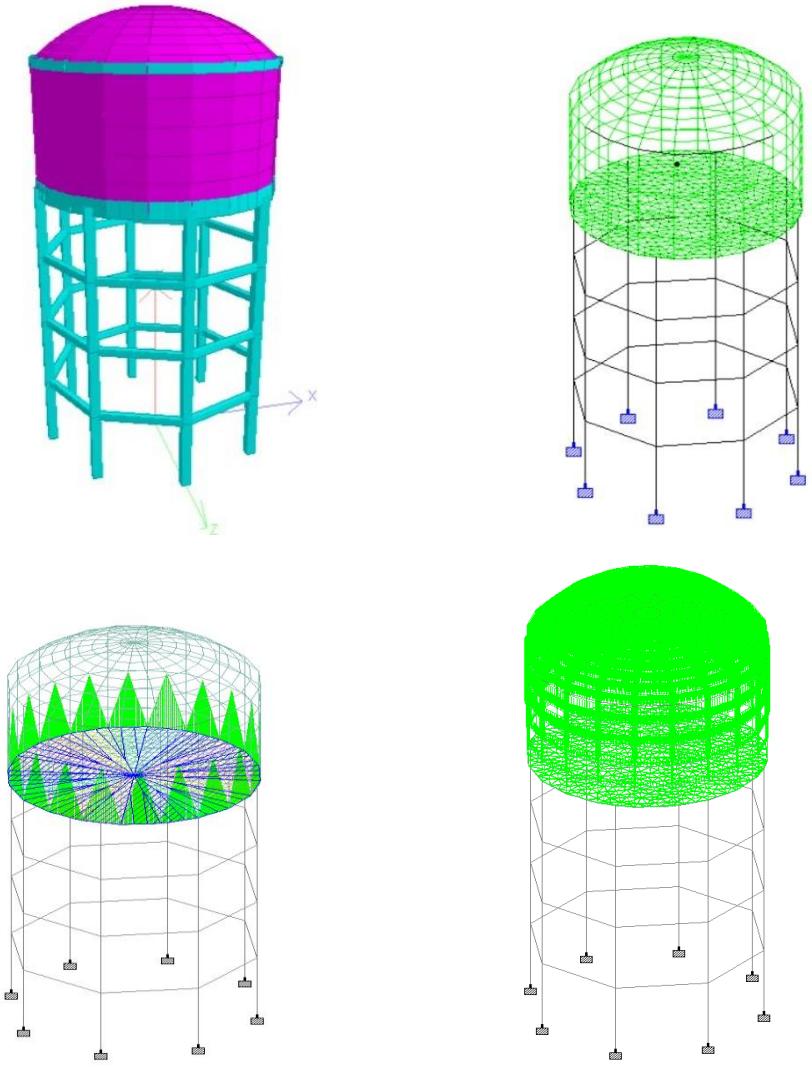

Figure: 3D view of elevated service reservoir.

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V. RESULTS AND DISCUSSION

Followings are the design details of the water reservoir:-

Dimensions:

- No of columns: - eight No.
- Bracing Dimension: - 230 x 300 millimeter
- Column Dimension: - 350 x 350 millimeter
- Bottom Ring beam: - 300 x 690 millimeter
- high Ring beam: - 300 x350 millimeter

Plate Thickness:

- Top dome: - 120 mm
- Cylindrical wall: - 150 mm
- Bottom slab :180mm
- Grade of concrete: M30
- Grade of steel: Fe 500

Clear Cover as per IS: 456, 2000[1]:

- Column: 40mm
- Beam: 25mm
- Plate: 25mm

Reinforcement Details:-

- **Column** :- 12 nos. of 12mm ϕ Fe-500 main bars @ 170 mm c/c ;8mm ϕ Fe-500 bars as stirrup @ 300mm c/c.
- **Beam** :- 6 nos. of 1mm ϕ Fe-500 main bars ; 12mm ϕ Fe-500 bars as stirrup @ 300mm c/c.
- **Plate**: - 12mm ϕ Fe-500 main bars @ 125 mm c/c for base plate, bottom inclined plates & vertical plates.

10mm ϕ Fe-500 main bars @ 125 mm c/c for upper inclined plates & top most plate.

Load Cases: -

1. D.L → Dead Load → Self Weight
2. E.L → Element Load → Plate Loads → Hydrostatic Load.
3. W.L.X → Wind Load at X-direction.
4. W.L.Z → Wind Load at Z-direction.

Note – Seismic load is not considered here as the location of the construction is situated under Zone II (low intensity) as per IS 1893 Part 1

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Bending Moment:

		max bending moment for no 9 and 10				
	L/C		Dist m	Mz kip-in	Dist m	My kip-in
9	1 LOAD C/	Max +ve	3.444	19.785	0	0.769
		Max -ve	1.435	-7.741	3.444	-0.785
	2 LOAD C/	Max +ve	3.444	0.291	0	0.04
		Max -ve	0	-0.287	3.444	-0.041
	3 LOAD C/	Max +ve	3.444	26.906	0	3.738
		Max -ve	0	-26.555	3.444	-3.782
	4 WX	Max +ve	3.444	38.879	0	8.683
		Max -ve	0	-45.659	3.444	-3.733
	5 WZ	Max +ve	3.444	65.452	3.444	3.322
		Max -ve	0	-62.336	0	-6.449
	6 GENERA	Max +ve	3.444	30.114	0	1.214
		Max -ve	1.435	-11.681	3.444	-1.239
	7 GENERA	Max +ve	3.444	70.746	0	11.391
		Max -ve	0	-45.249	3.444	-5.471
	8 GENERA	Max +ve	3.444	102.633	3.444	2.996
		Max -ve	0	-65.261	0	-6.768
	9 GENERA	Max +ve	0	64.333	3.444	3.488
		Max -ve	3.157	-23.163	0	-9.449
	10 GENER	Max +ve	0	84.345	0	8.71
		Max -ve	3.444	-54.451	3.444	-4.978
	11 GENER	Max +ve	3.444	24.091	0	0.971
		Max -ve	1.435	-9.345	3.444	-0.991
	12 GENER	Max +ve	3.444	87.996	0	14.178
		Max -ve	0	-56.131	3.444	-6.777
	13 GENER	Max +ve	3.444	127.855	3.444	3.805
		Max -ve	0	-81.146	0	-8.52
	14 GENER	Max +ve	0	80.847	3.444	4.421
		Max -ve	3.157	-29.318	0	-11.871
	15 GENER	Max +ve	0	105.861	0	10.827
		Max -ve	3.444	-68.5	3.444	-6.162
	16 GENER	Max +ve	3.444	29.678	0	1.154
		Max -ve	1.435	-11.612	3.444	-1.178
	17 GENER	Max +ve	3.444	17.807	0	0.692
		Max -ve	1.435	-6.967	3.444	-0.707
0	1 LOAD C/	Max +ve	0	19.765	3.444	0.763
		Max -ve	2.009	-7.725	0	-0.774
	2 LOAD C/	Max +ve	0	0.29	3.444	0.04
		Max -ve	3.444	-0.285	0	-0.04
	3 LOAD C/	Max +ve	0	26.796	3.444	3.713
		Max -ve	3.444	-26.335	0	-3.733
	4 WX	Max +ve	3.444	82.969	0	0.047
		Max -ve	0	-84.435	3.444	-5.754
	5 WZ	Max +ve	3.444	24.85	3.444	3.519
		Max -ve	0	-20.059	N/A	N/A
	6 GENERA	Max +ve	0	30.082	3.444	1.204
		Max -ve	2.009	-11.656	0	-1.221
	7 GENERA	Max +ve	3.444	109.157	N/A	N/A
		Max -ve	0	-77.257	3.444	-5.941
	8 GENERA	Max +ve	3.444	39.414	3.444	5.186
		Max -ve	1.148	-9.676	0	-0.542
	9 GENERA	Max +ve	0	125.388	3.444	7.868
		Max -ve	3.444	-89.968	0	-1.033
	10 GENER	Max +ve	0	48.136	N/A	N/A
		Max -ve	2.87	-23.088	3.444	-3.26
	11 GENER	Max +ve	0	24.066	3.444	0.963
		Max -ve	2.009	-9.325	0	-0.977
	12 GENER	Max +ve	3.444	136.873	N/A	N/A
		Max -ve	0	-97.005	3.444	-7.487
	13 GENER	Max +ve	3.444	49.695	3.444	6.423
		Max -ve	1.148	-12.242	0	-0.617
	14 GENER	Max +ve	0	156.3	3.444	9.775
		Max -ve	3.444	-112.033	0	-1.231
	15 GENER	Max +ve	0	59.735	N/A	N/A
		Max -ve	2.87	-28.577	3.444	-4.134
	16 GENER	Max +ve	0	29.647	3.444	1.144
		Max -ve	2.009	-11.588	0	-1.161
	17 GENER	Max +ve	0	17.788	3.444	0.686
		Max -ve	2.009	-6.953	0	-0.696

		max shear force for beam no 9 and 10				
Beam	L/C		Dist m	Fy kN	Dist m	Fz kN
9	1 LOAD C/	Max +ve	0	2.427	N/A	N/A
		Max -ve	3.444	-3.185	0	-0.051
	2 LOAD C/	Max +ve	N/A	N/A	N/A	N/A
		Max -ve	0	-0.019	0	-0.003
	3 LOAD C/	Max +ve	N/A	N/A	N/A	N/A
		Max -ve	0	-1.754	0	-0.247
	4 WX	Max +ve	N/A	N/A	N/A	N/A
		Max -ve	0	-2.773	0	-0.407
	5 WZ	Max +ve	N/A	N/A	0	0.321
		Max -ve	0	-4.192	N/A	N/A
	6 GENERA	Max +ve	0	3.613	N/A	N/A
		Max -ve	3.444	-4.806	0	-0.08
	7 GENERA	Max +ve	N/A	N/A	N/A	N/A
		Max -ve	3.444	-7.173	0	-0.553
	8 GENERA	Max +ve	N/A	N/A	0	0.32
		Max -ve	3.444	-8.875	N/A	N/A
	9 GENERA	Max +ve	0	6.218	0	0.424
		Max -ve	3.444	-0.517	N/A	N/A
	10 GENER	Max +ve	0	7.92	N/A	N/A
		Max -ve	N/A	N/A	0	-0.449
	11 GENER	Max +ve	0	2.89	N/A	N/A
		Max -ve	3.444	-3.845	0	-0.064
	12 GENER	Max +ve	N/A	N/A	N/A	N/A
		Max -ve	3.444	-8.937	0	-0.687
	13 GENER	Max +ve	N/A	N/A	0	0.404
		Max -ve	3.444	-11.065	N/A	N/A
	14 GENER	Max +ve	0	7.801	0	0.534
		Max -ve	3.444	-0.617	N/A	N/A
	15 GENER	Max +ve	0	9.929	N/A	N/A
		Max -ve	N/A	N/A	0	-0.557
	16 GENER	Max +ve	0	3.641	N/A	N/A
		Max -ve	3.444	-4.777	0	-0.076
	17 GENER	Max +ve	0	2.185	N/A	N/A
		Max -ve	3.444	-2.866	0	-0.046
10	1 LOAD C/	Max +ve	0	3.183	0	0.05
		Max -ve	3.444	-2.429	N/A	N/A
	2 LOAD C/	Max +ve	0	0.019	0	0.003
		Max -ve	N/A	N/A	N/A	N/A
	3 LOAD C/	Max +ve	0	1.743	0	0.244
		Max -ve	N/A	N/A	N/A	N/A
	4 WX	Max +ve	N/A	N/A	N/A	N/A
		Max -ve	0	-5.492	0	-0.19
	5 WZ	Max +ve	N/A	N/A	0	0.104
		Max -ve	0	-1.473	N/A	N/A
	6 GENERA	Max +ve	0	4.803	0	0.08
		Max -ve	3.444	-3.616	N/A	N/A
	7 GENERA	Max +ve	N/A	N/A	N/A	N/A
		Max -ve	3.444	-9.483	0	-0.165
	8 GENERA	Max +ve	0	2.074	0	0.188
		Max -ve	3.444	-4.66	N/A	N/A
	9 GENERA	Max +ve	0	10.432	0	0.292
		Max -ve	N/A	N/A	N/A	N/A
	10 GENER	Max +ve	0	5.61	N/A	N/A
		Max -ve	3.444	-1.125	0	-0.061
	11 GENER	Max +ve	0	3.842	0	0.064
		Max -ve	3.444	-2.893	N/A	N/A
	12 GENER	Max +ve	N/A	N/A	N/A	N/A
		Max -ve	3.444	-11.881	0	-0.21
	13 GENER	Max +ve	0	2.564	0	0.231
		Max -ve	3.444	-5.854	N/A	N/A
	14 GENER	Max +ve	0	13.012	0	0.361
		Max -ve	N/A	N/A	N/A	N/A
	15 GENER	Max +ve	0	6.984	N/A	N/A
		Max -ve	3.444	-1.434	0	-0.08
	16 GENER	Max +ve	0	4.774	0	0.076
		Max -ve	3.444	-3.644	N/A	N/A
	17 GENER	Max +ve	0	2.865	0	0.045
		Max -ve	3.444	-2.186	N/A	N/A

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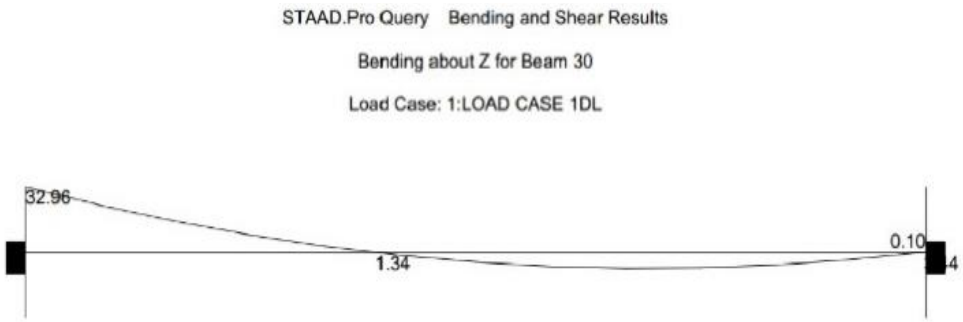
SF calculation:-



Dist.m	Fy(kN)	Mz(kip-in)
0.000000	3.8842	32.9609
0.287013	3.4165	23.6881
0.574025	2.9488	15.6033
0.861038	2.4811	8.7066
1.148051	2.0134	2.9979
1.435064	1.5457	-1.5227
1.722076	1.0780	-4.8553
2.009089	0.6104	-6.9998
2.296102	0.1427	-7.9563
2.583115	-0.3250	-7.7247
2.870127	-0.7927	-6.3051
3.157140	-1.2604	-3.6974
3.444153	-1.7281	0.0984

Load calculation:-

Wind intensity -

Intensity	Height
1.5	19
1.2	15
1	12
0.75	10

Exposure factor – 1

1. Dead Load – 1) Self wet

2) Paraphet wall=0.125x20x1.3=3KN/m

2. Live Load =Floor Load =1KN/m
3. Hydrostatic Pressure= δgh

= 1000x9.81x5

=49.050 KN/m

4. Wind load x =Factor =1

Z = Factor =1

5. Load combination = Indian Standard Code
6. Material = concrete IS 456

Fc = 3000 KN/m

Fy min = 50000 KN/m

Fy sec = 50000KN/m

Max min = 16 mm

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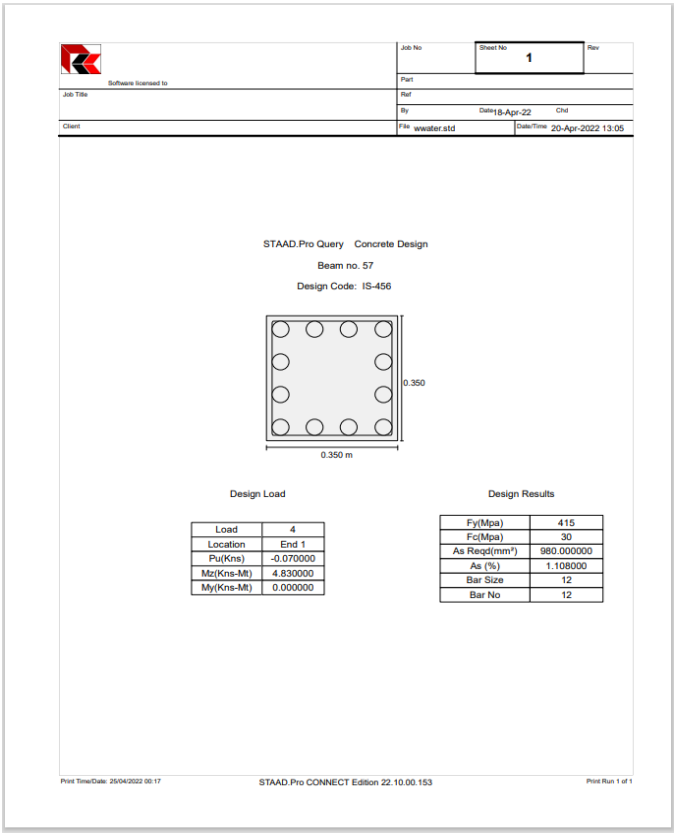
Max sec = 12mm



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Job No | Sheet No 1 | Rev

Part

Job Title | Ref

By | Date 18-Apr-22 | Chd

Client | File wwater.std | Date/Time 20-Apr-2022 13:05

STAAD.Pro Query Concrete Design

Beam no. 57

Design Code: IS-456

Design Load

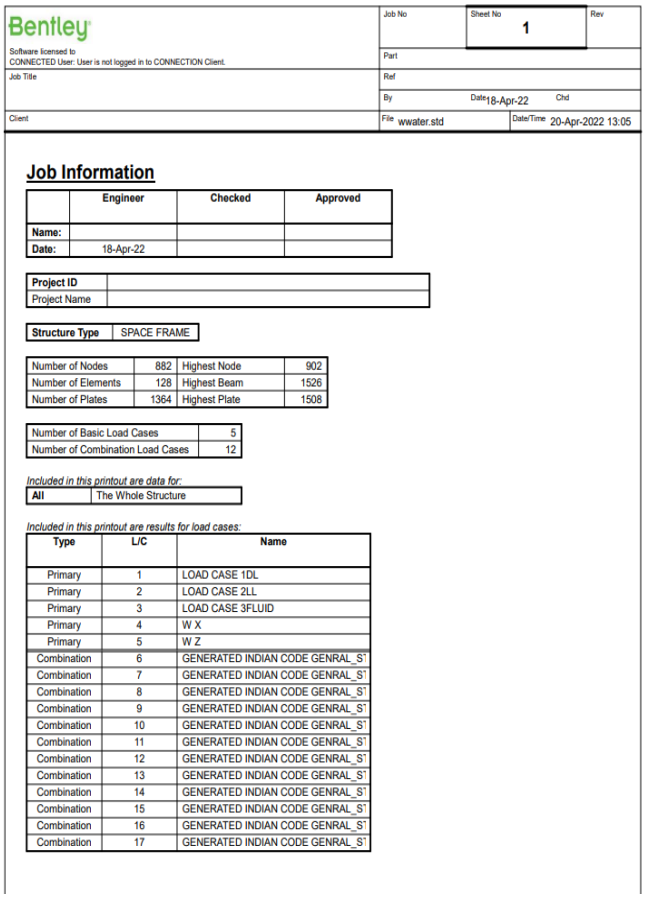
Load	4
Location	End 1
Pu(Kns)	-0.070000
Mz(Kns-Mt)	4.830000
My(Kns-Mt)	0.000000

Design Results

Fy(Mpa)	415
Fc(Mpa)	30
As Reqd(mm²)	980.000000
As (%)	1.108000
Bar Size	12
Bar No	12

Print Time/Date: 25/04/2022 00:17 STAAD.Pro CONNECT Edition 22.10.00.153 Print Run 1 of 1

CONCRETE DESIGEN FOR COLUMNS



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Part

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By | Date 18-Apr-22 | Chd

Client | File wwater.std | Date/Time 20-Apr-2022 13:05

Job Information

	Engineer	Checked	Approved
Name:			
Date:	18-Apr-22		

Project ID	
Project Name	

Structure Type	SPACE FRAME

Number of Nodes	882	Highest Node	902
Number of Elements	128	Highest Beam	1526
Number of Plates	1364	Highest Plate	1508

Number of Basic Load Cases	5
Number of Combination Load Cases	12

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	LOAD CASE 1DL
Primary	2	LOAD CASE 2LL
Primary	3	LOAD CASE 3FLUID
Primary	4	W X
Primary	5	W Z
Combination	6	GENERATED INDIAN CODE GENRAL_S1
Combination	7	GENERATED INDIAN CODE GENRAL_S1
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

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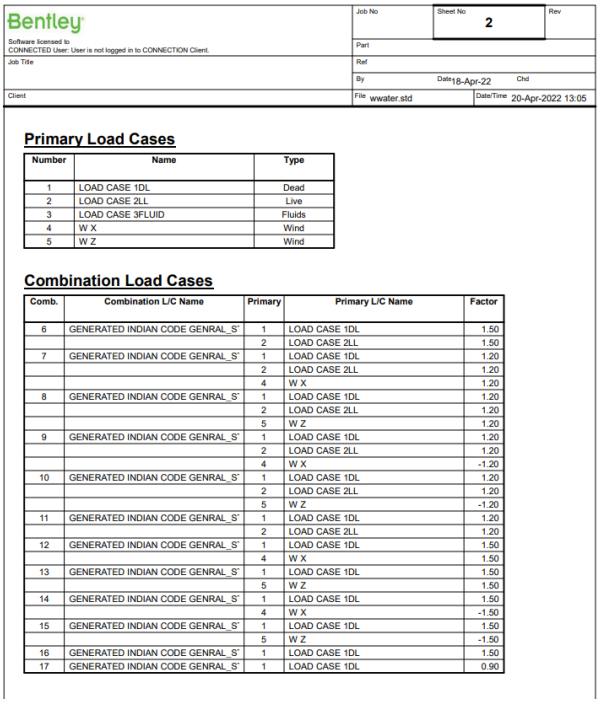

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Job Title
Client
Job No | Sheet No 2 | Rev
Part
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Primary Load Cases

Number	Name	Type
1	LOAD CASE 1DL	Dead
2	LOAD CASE 2LL	Live
3	LOAD CASE 3FLUID	Fluids
4	W X	Wind
5	W Z	Wind

Combination Load Cases

Comb.	Combination L/C Name	Primary	Primary L/C Name	Factor
6	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.50
		2	LOAD CASE 2LL	1.50
7	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.20
		2	LOAD CASE 2LL	1.20
		4	W X	1.20
8	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.20
		2	LOAD CASE 2LL	1.20
		5	W Z	1.20
9	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.20
		2	LOAD CASE 2LL	1.20
		4	W X	-1.20
10	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.20
		2	LOAD CASE 2LL	1.20
		5	W Z	-1.20
11	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.20
		2	LOAD CASE 2LL	1.20
12	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.50
		4	W X	1.50
13	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.50
		5	W Z	1.50
14	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.50
		4	W X	-1.50
15	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.50
		5	W Z	-1.50
16	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	1.50
17	GENERATED INDIAN CODE GENRAL_S'	1	LOAD CASE 1DL	0.90

VI. CONCLUSION

The project can be useful for field engineers while implementing other water supply projects. By knowing the current population of village i.e., 16857 souls with rate of water supply 40LPCD water demand are 674320 liters (0.7 MLD) as we considered expected population in 2040 will be 32500 souls then with the same rate demand in liters will increase twice i.e. (1.4 MLD).

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