COMPARATIVE STRUCTURAL ANALYSIS OF OVERHEAD WATER TANK FOR DIFFERENT HEIGHT

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Abstract: Water tanks are an important municipal and industrial structure. The design and construction methods used in reinforced concrete are influenced by the prevailing construction practices, physical properties of the material and climatic conditions. Before starting the design, the most appropriate type of tank installation and the correct assessment of loads are made, including the static balance of the structure, especially with regard to the overturning of overhanging elements. The work presented in the research work consists of a comparative analysis of the upper water tank in terms of shear force, bending moment and other parameters. From the results it is observed that the model-3 has the highest moment (kNm) as compared to the other models and have the maximum value of 170 kNm and the minimum value of 90 kNm for model-7.

Keywords: Hydrodynamic Pressure, Elevated Water Tank, STAAD Pro V8i.

1. Introduction

Storage tanks and the upper tank are used to store water, liquid oil, petroleum products and similar liquids. These structures are made of masonry, steel, reinforced concrete and prestressed concrete. Of these, masonry and steel tanks are used for lower capacity. The cost of steel tanks is high, and therefore they are rarely used for water storage. Reinforced concrete tanks are high, and therefore they are rarely used for water storage. Reinforced concrete tanks are very popular because, in addition to simple structures and structures, they are cheap, monolithic in nature and can be protected from leaks.

As a rule, cracks are not allowed to form in any part of the structure of liquid-retaining tanks, and they are made watertight using a richer mixture (not less than M20) of concrete. In addition, sometimes waterproof materials are also used to make watertight tanks. The permeability of concrete is directly proportional to the water-cement ratio.

2. Review of Literature

Saleth, R.M [1] studied that the moment of the column in the reinforcement increases due to the increase in the height of the water tank. The moment of a column is minimum for radial fastening. The shear force in the mount increases by increasing the height of the setting. The shear force in the mount is minimal for radial mounting.

Issar Kapadia. et al. [6] investigated that for the same capacity, the same geometry, the same height, with the same system of setting, in the same Zone, with the same importance factor and the reduction factor of the reaction; the reaction of the equivalent static method to the dynamic

one differs significantly.

Nallanathel. M. et al. [9]. Static analysis of the interaction of the water structure shows that both water and structure achieve selection at the same time due to the assumption that water sticks to the container and acts as the structure itself, and the structure and water have the same stiffness, while in dynamic analysis we considered two mass models.

3. Modeling

The modeling is carried out in the STAAD software, mentioned as follows.

- Model-I: Rectangular water tank-6m height by IS code
- Model-II: Rectangular water tank-9m height by IS code
- Model-III: Rectangular water tank-12m height by IS code
- Model-IV: Rectangular water tank-6m height by ACI code
- Model-V: Rectangular water tank-9m height by ACI code
- Model-VI: Rectangular water tank-12m height by ACI code
- Model-VII: Rectangular water tank-6m height by British code
- Model-VIII: Rectangular water tank-9m height by British code
- Model-IX: Rectangular water tank-12m height by British code
- Model-X: Rectangular water tank-15m height by IS code

Table 1: Properties of Model-I & IV

Particulars	Dimension
Plan dimension of water tank	4.0 m X 6.0 m
Depth of water tank	2.0 m
Thickness of water tank	200 mm
Height of Column	6.0 m
Size of Beam	350 mm X 500 mm
Size of Column	400 mm X 600 mm

Table 2: Properties of Model-II & V

Particulars	Dimension
Plan dimension of water tank	4.0 m X 6.0 m
Depth of water tank	2.0 m
Thickness of water tank	210 mm
Height of Column	9.0 m
Size of Beam	350 mm X 500 mm
Size of Column	450 mm X 650 mm

Table 3: Properties of Model-III & VI

Particulars	Dimension
Plan dimension of water tank	4.0 m X 6.0 m
Depth of water tank	2.0 m
Thickness of water tank	220 mm
Height of Column	12.0 m
Size of Beam	350 mm X 550 mm
Size of Column	450 mm X 750 mm

Fig. 1 Elevation of Model-III

4. Results

The analysis is carried out in STAAD software and the results in terms of shear force, bending moment and other parameter is obtained as follows.

Fig. 2 Displacement for all the models

From the above Fig. 2 it is observed that the model-10 has the highest displacement as compared to the other models and have the maximum value of 37 mm.

Fig. 3 Reaction for all models

From the above Fig. 3 it is observed that the model-10 has the highest reaction (kN) as compared to the other models and have the maximum value of 1100 kN and the minimum value of 500 kN for model-4.

Fig. 4 Plate stresses for all models

From the above Fig.4 it is observed that the model-3 has the highest Plate stresses (N/mm²) as compared to the other models and have the maximum value of 0.4 N/mm² and the minimum value of 0.275 N/mm² for model-4.

Fig. 5 Moment for all models

From the above Fig. 5 it is observed that the model-3 has the highest moment (kNm) as compared to the other models and have the maximum value of 170 kNm and the minimum value of 90 kNm for model-7.

Fig. 6 Plate stresses for all models

From the above Fig. 6 it is observed that the model-10 has highest the membrane stress (N/mm²) as compared to the other models and have the maximum value of 1 N/mm² and the minimum value of 0.5 N/mm² for model-7.

Fig. 7 Drift for all models

From the above Fig.7 it is observed that the model-10 has the highest drift (mm) as compared to the other models and have the maximum value of 0.9 cm and the minimum value of 0.5 cm for model-7.

Fig. 8 Average Displacement for all models

From the above Fig.8 it is observed that the model-10 has the highest Average Displacement (cm) as compared to the other models and have the maximum value of 3.6 cm and the minimum value of 1.0 cm for model-7.

Fig. 9 Frequency for all models

From the above Fig.9 it is observed that the model-7 has the highest Frequency as compared to the other models and have the maximum value of 60 Hz.

Fig. 10 Time Period for all models

From the above Fig. 10 it is observed that the model-10 has the Time Period (sec) as compared to the other models and have the maximum value of 2.25 sec and the minimum value of 0.1 sec for model-1.

5. Conclusion

The conclusions from the above study are as follows:

- i. From the above results it is observed that the model-3 has the highest moment (kNm) as compared to the other models and have the maximum value of 170 kNm and the minimum value of 90 kNm for model-7.
- ii. From the above results it is observed that the model-10 has the membrane stress (N/mm²) as compared to the other models and have the maximum value of 1 N/mm² and the minimum value of 0.5 N/mm² for model-7.
- iii. From the above results it is observed that the model-10 has the drift (mm) as compared to the other models and have the maximum value of 0.9 cm and the minimum value of 0.5 cm for model-7.
- iv. From the above results it is observed that the model-10 has the Average Displacement (cm) as compared to the other models and have the maximum value of 3.6 cm and the minimum value of 1.0 cm for model-7.

- v. From the above results it is observed that the model-7 has the highest Frequency as compared to the other models and have the maximum value of 60 Hz.

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