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Analysis of An Intake Well Treatment Plant Unit Using Analysis Tool

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ABSTRACT

Liquid storage tanks are one of the many important structures that demand greater safety against natural disasters like earthquakes. Specific concentration must be paid while designing the water tank to avoid the potential damage associated with the failure of storage tanks and water treatment plants.

In India at least, most of the components of water treatment plant like clariflocculator, aeration tank, disinfection tank etc. are composed in RCC. Pre-stressed concrete is not economical for small structures. But this construction can be efficient for water treatment plant. The pre-stressed steel strands distribute loads uniformly around the tank circumference efficiently. In pre-stressed concrete, compressive stresses are applied to the concrete prior to loading. The entire cross section is essentially in compression under service loads, which takes advantage of concrete's considerable compressive strength but minimal tensile strength. Since concrete deforms under sustained loads (creep), pre-stressed concrete was not practical until the advent of high strength pre-stressing bars and strands. In case of RCC tanks, moisture and temperature differential may cause bend and crack of concrete walls which can be avoided by using pre-stressed concrete. The aim of study is to design the components of water treatment plants using R.C.C. water treatment plant. The components are designed for the same storage capacity for both RCC water treatment plant. Design of components of RCC water treatment plant are analyzed based on various important parameters. The modeling and analysis part of the water tank design was carried out by using STAAD PRO.

Keywords : Analysis, Stress, Forces, Deflection, Staad.Pro

I. INTRODUCTION

Wastewater treatment plants (WWTPs) are well known facilities located at the end of sewage systems and used to remove contaminants from wastewaters in order to avoid water pollution and consequently damages to the environment and public health.

India debts for 2.45% of land region and 4% of water assets of the sector however represents 16% of the sector populace. With the existing populace growth-rate (1.nine according to cent according to year), the populace is anticipated to pass the 1.five billion mark through 2050. The Planning Commission, Government of India has anticipated the water call for boom from 710 BCM (Billion Cubic Meters) in 2010 to nearly 1180 BCM in 2050 with home and commercial water intake anticipated to boom nearly 2.five times. The use of pre-pressured concrete may be very uncommon for creation of water preserving systems because it calls for professional labour, heavy machineries & eager supervision. But this creation may be most cost-efficient for water preserving systems of huge capacity. The overdue Eugene Freyssinet, a outstanding French engineer commonly seemed as the daddy of pre-pressured concrete, changed into the primary to apprehend the want to apply steels of excessive fine and power, pressured to fantastically excessive levels, so as to triumph over the unfavourable outcomes of concrete creep and shrinkage.

In the early 1950s, following strategies used efficiently in Europe for some of years, numerous round pre-pressured concrete tanks have been built withinside the United States the use of post-tensioned excessive tensile-power cord tendons embedded withinside the tank partitions. The posttensioned tendons in maximum early “tendon tanks” have been grouted with a Portland cement-water aggregate after stressing to assist shield them towards corrosion and to bond the tendons to the concrete tank partitions. Others have been unbounded- paper-wrapped person cord or strand tendons that relied on a grease coating and the castin-region concrete for his or her corrosion protection. Later, the usage of unbounded tendons with corrosion-inhibiting grease coatings and plastic sheaths have become extra not unusualplace. Most of the early tendon tanks built with inside the U.S. observed the not unusual place European exercise of vertically pre- stressing the tank partitions to dispose of or manage horizontal cracking. This crack manage helped save you leakage of the contents and corrosion of the pre-stressing metallic. The pre-stressing of concrete has numerous blessings in comparison to conventional bolstered concrete (RC) with out pre-stressing.

II. LITERATURE REVIEW

Anand Khune et.al (2023) objective of the research paper was to analyze the circular UG water well's 1004.8 cubic meter capacity first (10lakh liter) using analytical application STAAD.Pro. M25 grade concrete and Fe 500 steel was used as design components and water pressure, earth pressure, surcharge, and saturated soil pressure was investigated and the results stated that the structure was found stable.

Bijapure Shifa Arif et.al (2022) in the research paper, circular components of water treatment plant resting on ground was analysed and designed considering reinforced cement concrete and prestressed concrete using IS codes. STAAD PRO software was used to cross check the manual design moments. Estimation on the basis of design was carried out for both RCC and PSC components. Using MS EXCEL, spread sheets was prepared for RCC design of components, PSC design of components and estimation of the respective components.

Considering the construction cost for small capacity tanks up to 1000 m3 RCC construction is economical compared to PSC construction. But as the capacity of

the tank goes on increasing, PSC construction becomes economical. For larger capacity tanks PSC construction is economical than RCC construction by 17 % for M40 grade concrete and 15.75 % for M50 grade concrete on average. Prestressed concrete is more durable compared to reinforced cement concrete; therefore, PSC construction requires less maintenance than RCC construction.

Objectives:

- To study the various forces acting on Jackwell Structure.
- To study Traditional analysis of the Jackwell Structure.
- 3D analysis of Jackwell Structure by using standard software STAAD.Pro.
- Design of Jackwell Structure.
- To Study Criteria for Earthquake Resistant Design of Structures. (Liquid Retaining Tanks –Part 2) IS 1893 -2014 (Part- 2).
- To study the Data for Analysis and Design of Circular Shell Structures.

III. Methodology

Step 1- The components of the water treatment plant i.e. clariflocculator, sludge thickener and recirculation sumps are designed manually considering the forces acting on it and earthquake analysis using the RCC using design codes. The nodes are designed in the analytical application STAAD.Pro.

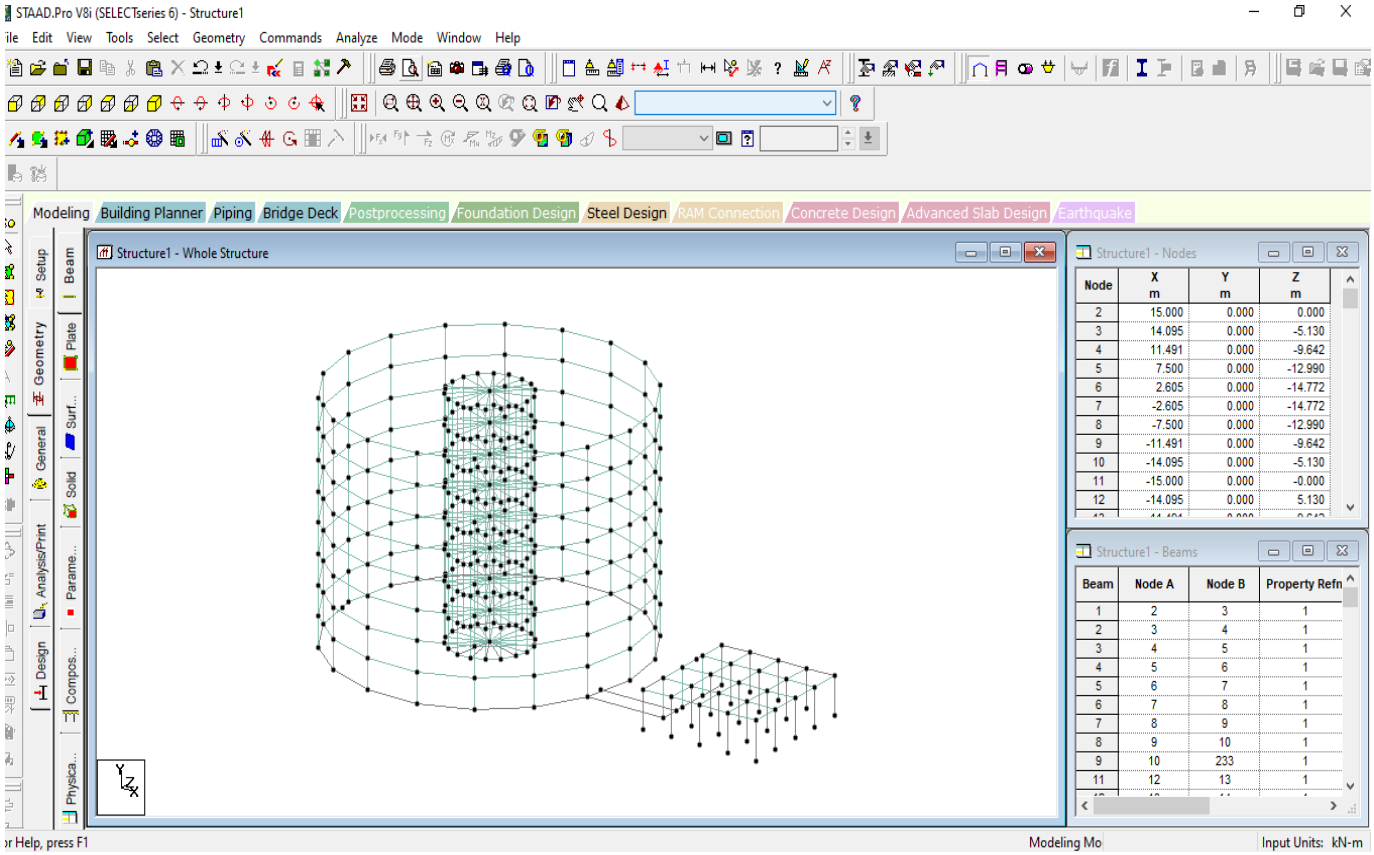


Fig 1 Defining Nodes

Step 2- Defining and Assigning Materials for concrete for the component of Intake well of Treatment plant i.e. clariflocculator, sludge thickener and recirculation sump.

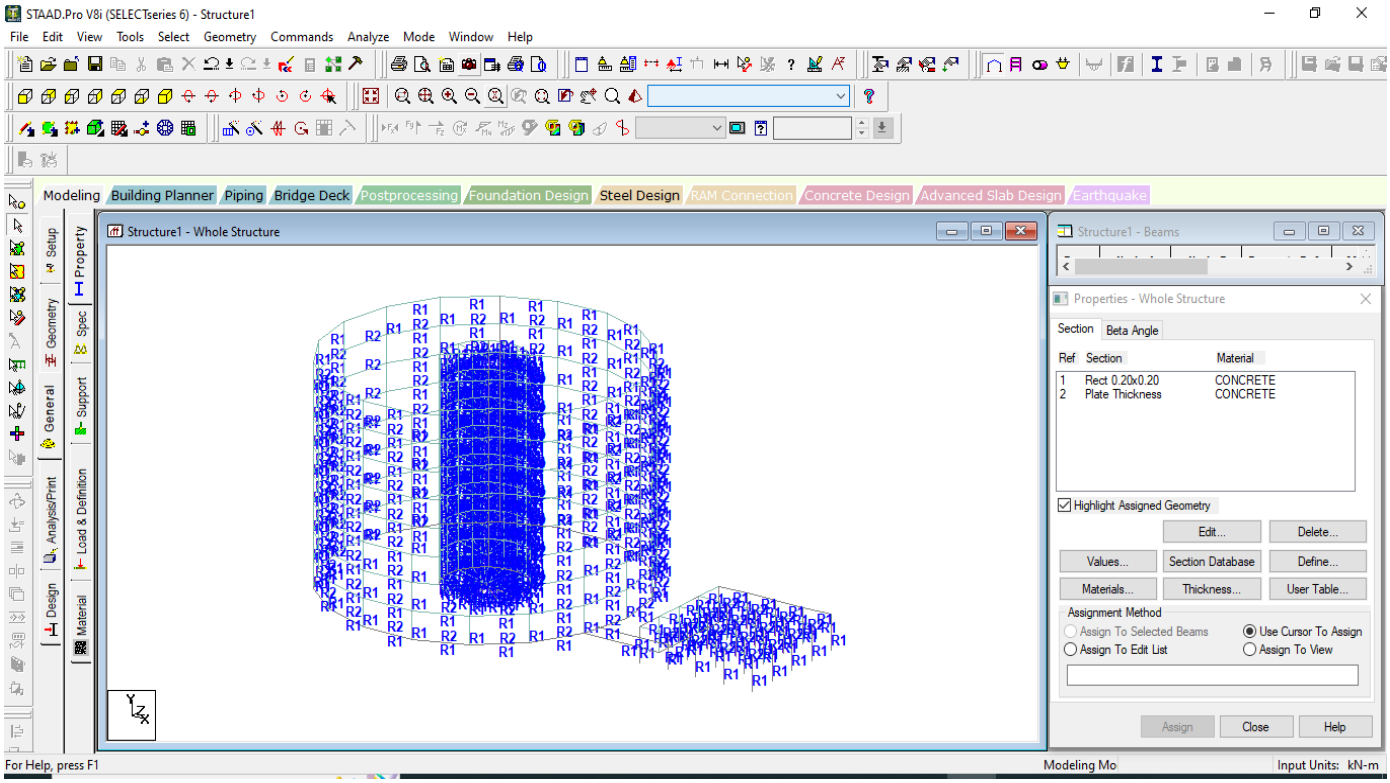


Fig 2 Defining and Assigning Materials for all the components of Intake well and Treatment plant.

Step 3- Assigning Fixed Support at the bottom of the structure in X, Y and Z direction.

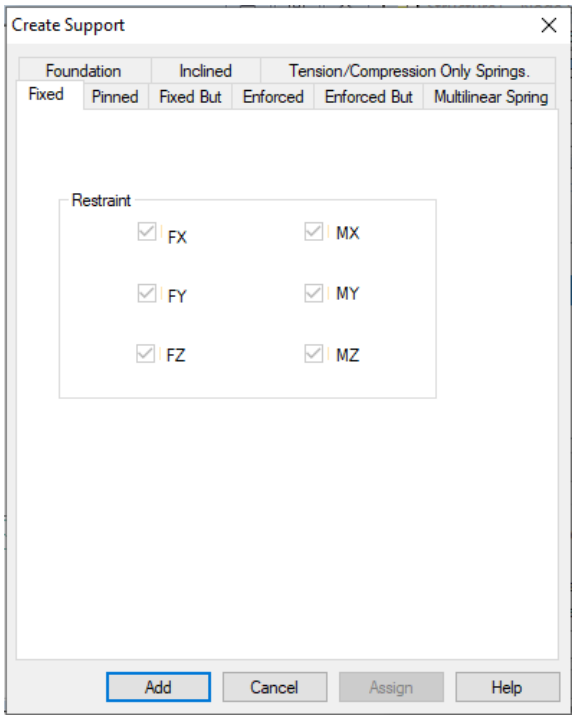


Fig 3 Assigning Fixed Support

Step 4- Assigning self weight load and seismic load to the structure as per IS 1896 Part I : 2016.

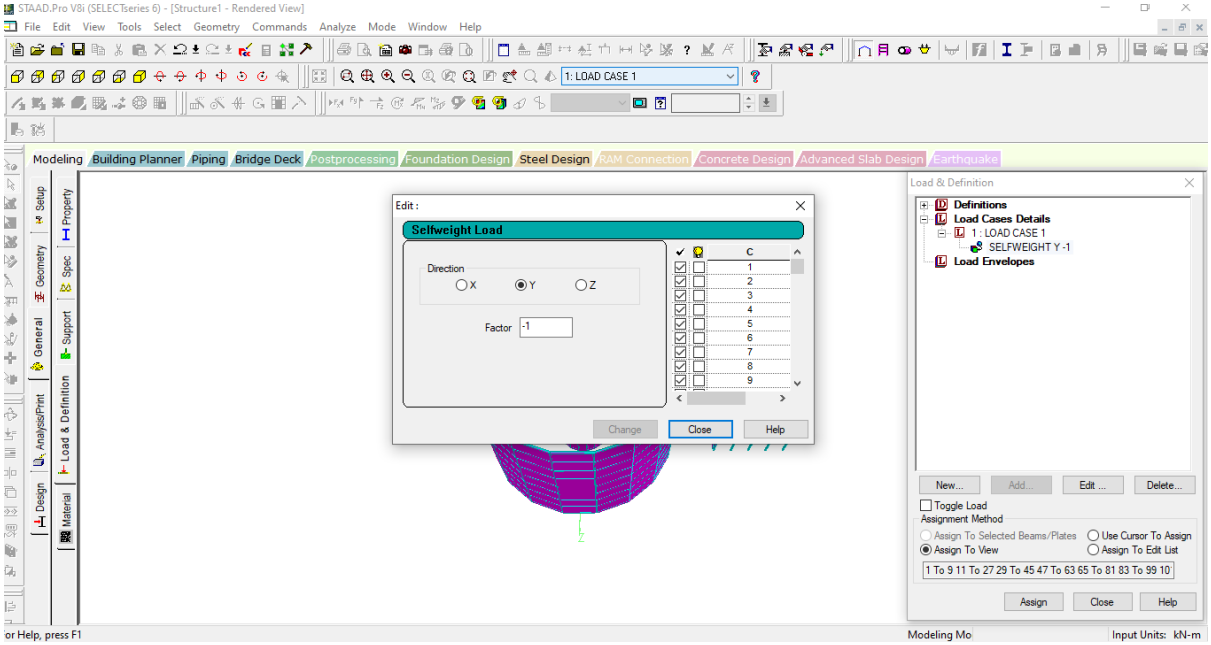


Fig 4 Assigning Load to the model considering different loading condition

Step 5- Analyzing the Structure for Displacement, torsion and Stress Analysis

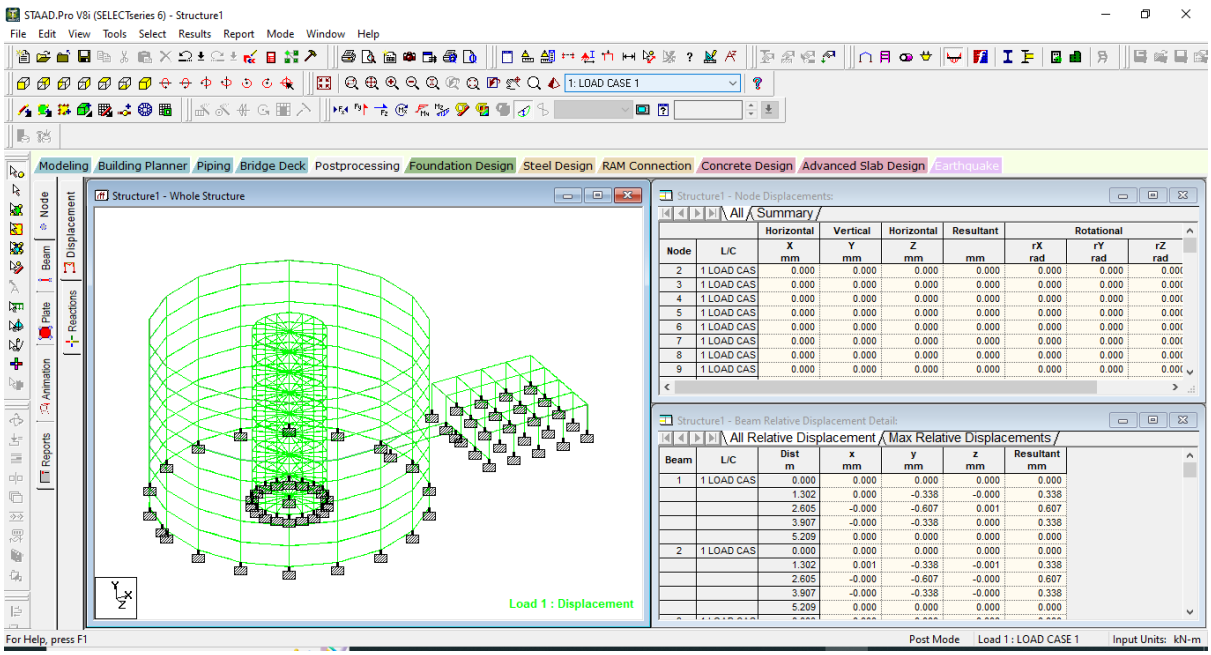


Fig 5 Displacement

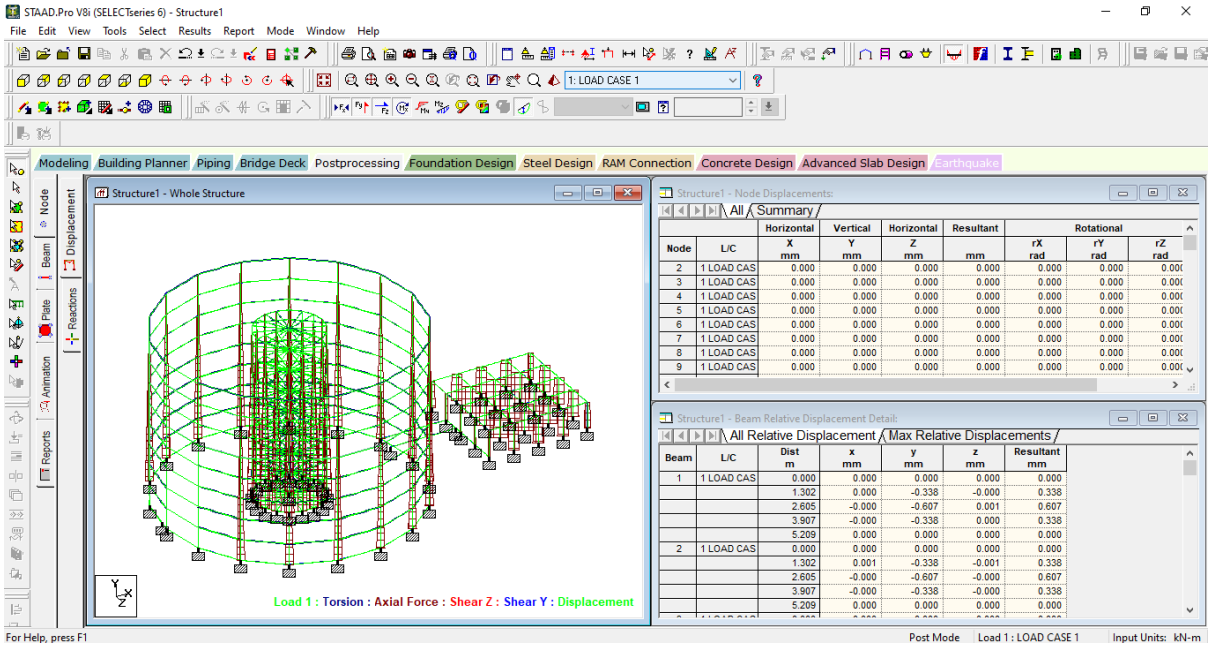


Fig 6 Torsion

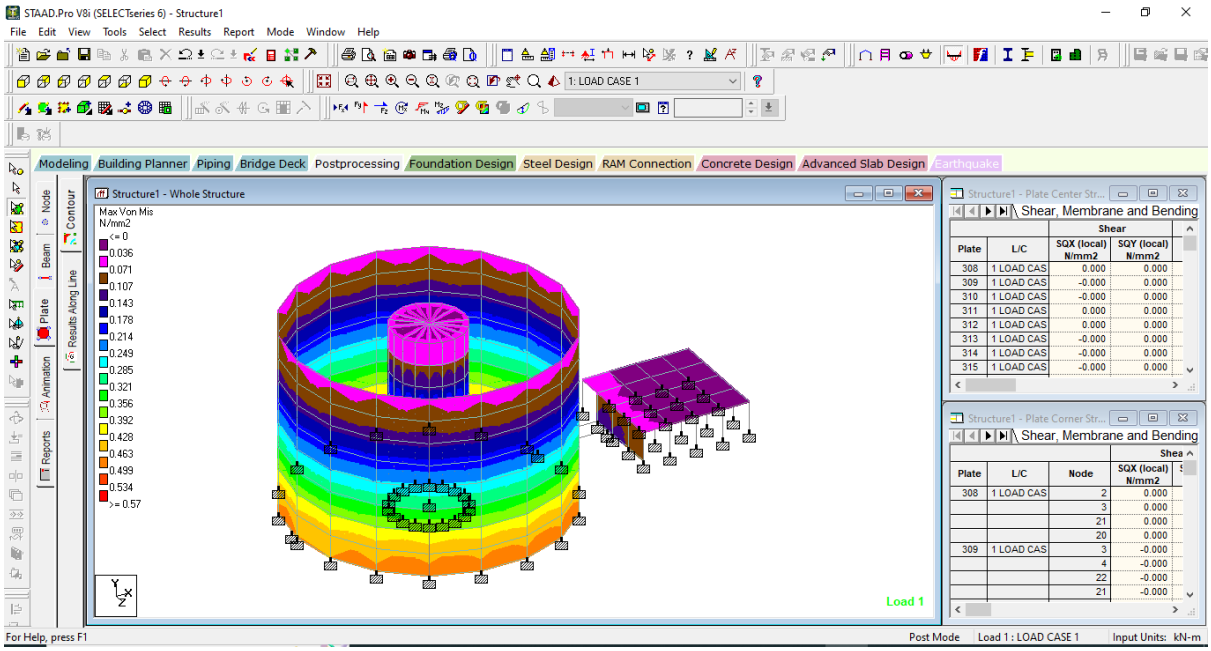


Fig 7 Stress Analysis

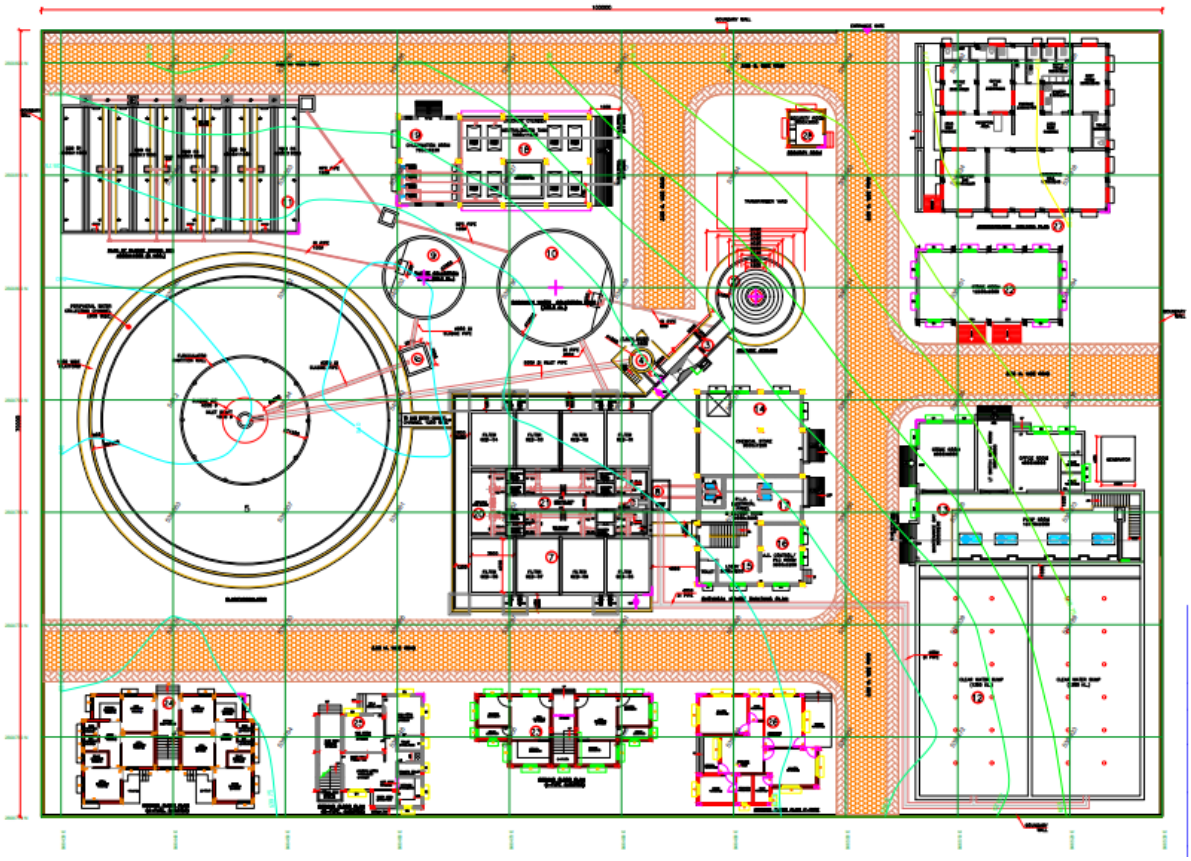


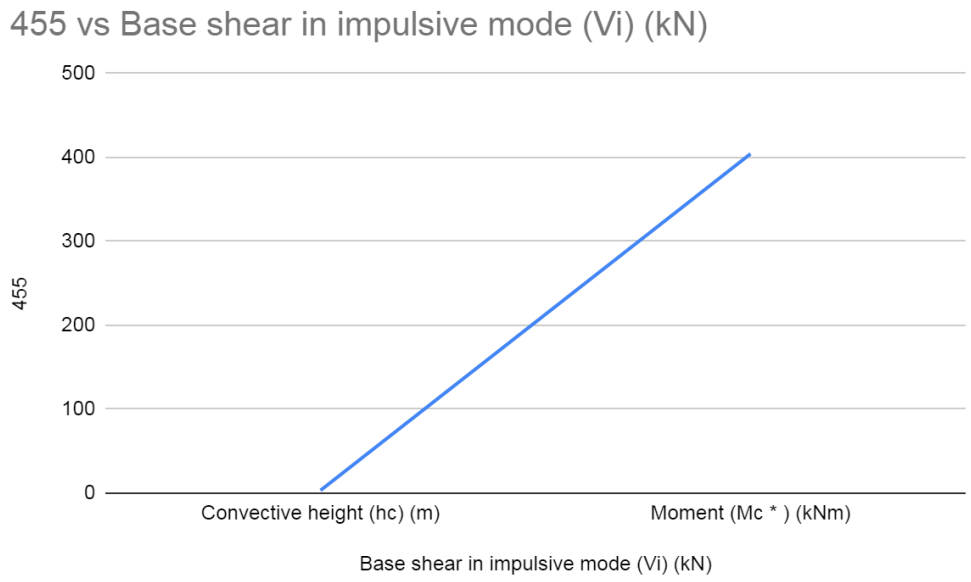
Fig 8 Plan of Water Treatment Plant

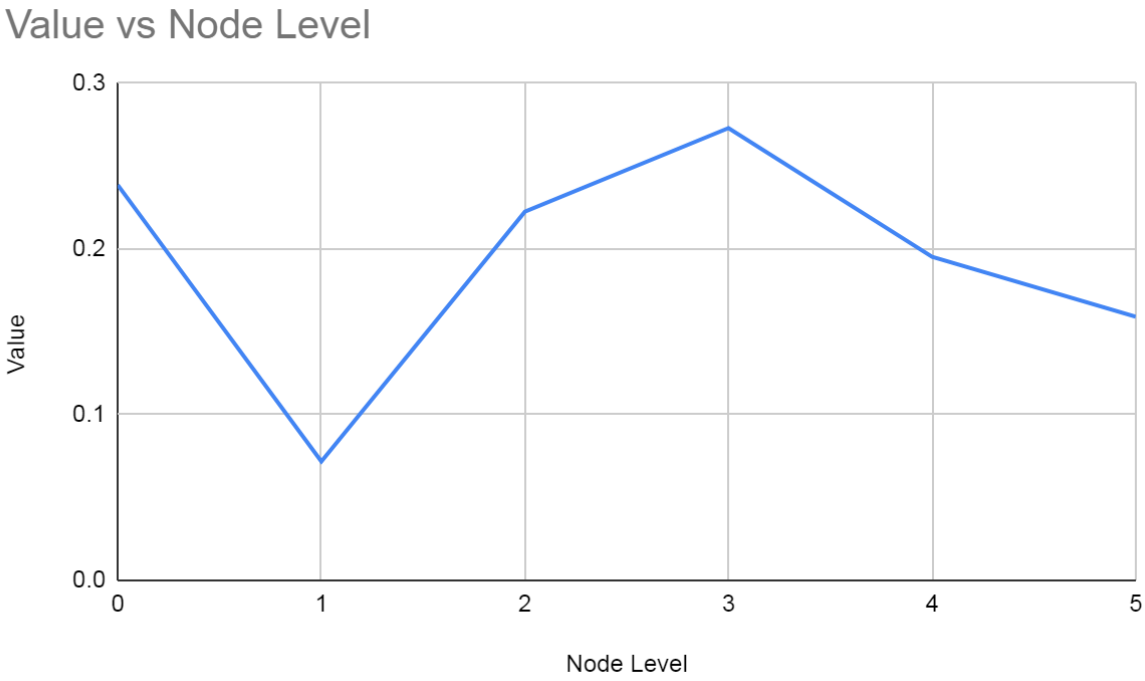
Table 1 Preliminary Data considered for the Intake Well

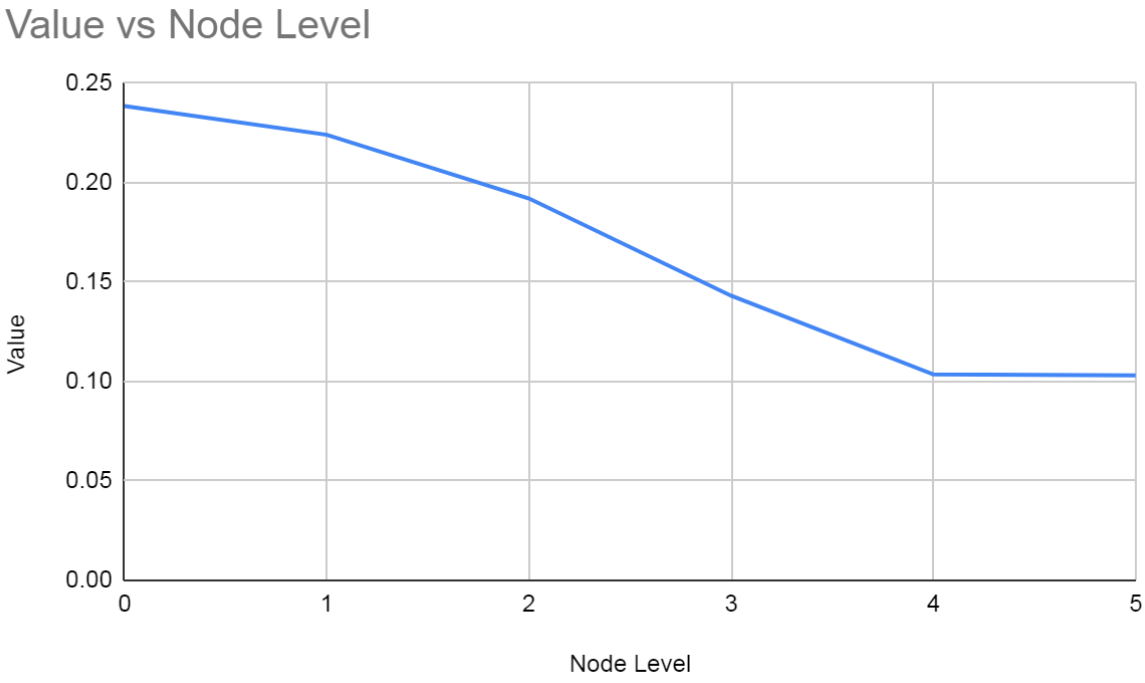
Parameters	Data
Jackwell	6 m Dia
Jackwell	13.2 m Ht
Wall	300 mm thick
Pump House	6 m Dia
Pump House	6.5 m Ht
Bottom IL	90
Bed Level	92.88/100
HFL/FSL	101.7
Roof slab level	109.7
Floor Level	103.2
SBC	30 t/m2
Seismic Zone	III
Roof Beam	230 x 450 mm

Gantry Beam	700 x 300 mm
Corbel Beam	300 x 500/300 mm
Lintel Beam	230 x 300 mm
Floor Beam	300 x 600 mm
Column	300 x 450 mm
Roof Slab	150 mm thick
Cant. Roof Slab	150 mm thick
Floor Slab	150 mm thick
Cant. Floor Slab	120 mm thick
Steel	Fe415
Concrete	M 25

IV. Analysis Result







V. CONCLUSION

In the study, circular components of water treatment plant resting on ground was analysed and designed considering reinforced cement concrete using IS codes. STAAD PRO software is used to cross check the manual design moments. Using MS EXCEL, spread sheets are prepared for RCC design of components and estimation of the respective components.

Base Shear

Base shear is an estimate of the maximum lateral force that will occur due to seismic ground motion at the base of the structure. Here the base shear was evaluated and compared with the values of STAAD.Pro. Minor gap was visible in the results which stated that both methods state that using analytical applications such as staad.pro provides the desirable results and create an ease in analyzing the structures.

Structure Model Acceleration

The acceleration was valuated in X and Y direction in m/s2 for the node level from 0-5. The linear values were visible for the X direction where as the values varied for the Y Direction considering the same loading parameters.

Bending Moment

The bending moment at a section through a structural element may be defined as the sum of the moments about that section of all external forces acting to one side of that section. The moment calculated was 404.3 kN-m.

By the software computation for the acceleration at different node level in both X and Y direction by using response spectrum analysis it has been found that acceleration for intake water tank is changed as compared with manual calculation.

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