Analysis of Elevated Water Tank Considering Lateral Forces Using Analysis Tool Midas

Swati Bharti[1] Hitesh Kodwani[2]
[1]Research Scholar [2]Assistant Professor
[1,2]Department of Civil Engineering
[1,2]Sam College of Engineering and Technology, Bhopal-462021, Madhya Pradesh, India

Abstract— Water tanks are used to storing the water for future use like commercial and domestic and water tanks are used since orient times for the purpose of storage of water and various resources. Therefore, this project deals with the optimum working of RCC water Tank and Fluro Polymer water tanks. Elevated water tanks are one of the most significant help structures in seismic tremor inclined locales. Insignificant urban communities and furthermore in provincial territories raised water tanks frames a fundamental piece of the water gracefully conspire. These structures have enormous mass amassed at the highest point of supporting structure thus these structures are particularly helpless against level powers because of tremor. Raised water tanks that are insufficiently damage and planned have endured broad harm during past quakes. The raised water tanks must stay practical much after the quakes as water tanks are required to give water to drinking and putting out fires reason. Subsequently, it is essential to check the seriousness of these powers for a specific locale. Toward the end of the analysis, it reasons that the aggregate sum of materials utilized for the development of Fluro Polymer water tank is lesser than the development of RCC water tank. Consequently, Fluro Polymer tanks are progressively preferred choice over RCC water tank. These tanks are valuable in such zones where waterways don't stream for the entire years and water accessible just during rainstorm season through heavy rainfall.

Keywords: Water Tank, MIDAS, Concrete Rebars, Polymer, Analysis, Seismic Tremor

I. INTRODUCTION

The elevated water tank is one of the most significant structures in a seismic tremor occasion. The elevated water tank is developed for holding water at a specific stature to pressurize the water dissemination framework. In case of an earthquake, raised water tanks were vigorously harmed or fell during the tremor. Because of the high affectability of the raised water tanks to the quake qualities, for example, top ground quickening, recurrence substance and the length of seismic tremor records.

The strengthened concrete solid overhead water putting away tank is the best putting away office utilized for residential and in any event, for modern purposes. The water is a significant wellspring of each creation. In everyday life, one can't live without water. The underlying motivation behind fortified concrete solid overhead water tank is to protect perpetual gracefully of water with the adequate stream to a bigger territory by gravity and this capacity to keep performing considerably after its hit by seismic tremors, so persistent flexibly of the water is made accessible in quake influenced territories.

A water tower likewise fills in as a store to help with water needs during top use times. A water tower is a raised structure supporting a water tank built at tallness adequate to pressurize a water flexibly framework for the circulation of consumable water and to give crisis stockpiling to fire assurance. In certain spots, the term standpipe is utilized conversely to allude to a water tower particularly one with tall and restricted extents. Water towers can gracefully water in any event, during forces blackouts since they depend on hydrostatic weight delivered a rise of water (because of gravity) to drive the water into residential and mechanical water dispersion frameworks.

The current work aims to determine the variation in strength and cost of a roundabout raised water tank utilizing fluoropolymer as a substitution in concrete considering wind pressure according to I.S. 875-III:2015 After the finishing of the examination a near report is done concerning parameters like Shear Force, Bending Moment and Displacement variety of sections and propping bars alongside the cost investigation. Following qualities are classified and analyzed between the two models. The models were readied utilizing an explanatory program Midas GEN.

The first fluoropolymer, polytetrafluoroethylene (PTFE) was found by Dr Roy Plunkett from DuPont in 1938. This disclosure was trailed by the improvement of different fluoropolymers in the late '40s. At first, PTFE was utilized in military applications, however other modern applications were created in the late '40s. The greater part of the thermoplastic fluoropolymers was blended during the '50s and '60s, which set off the improvement of the erosion security utilization of these tars.

The fluoropolymers utilized for consumption assurance can be separated into two gatherings: completely fluorinated and incompletely fluorinated polymers. The main gathering of polymers additionally called perfluoro polymers comprises of PTFE, FEP, and PFA. The somewhat fluorinated polymers, generally utilized in the Chemical Processing Industry (CPI) applications, are PVDF, ECTFE, and ETFE. When contrasted with the somewhat fluorinated saps, the completely fluorinated polymers have higher upper help temperatures and better concoction opposition at higher temperatures, yet lower mechanical properties.

A fluoropolymer has been utilized to adjust concrete mortar for conceivable application in the waterproofing of solid structures. The fluoropolymer adjusted concrete mortar didn't encounter any debasement Fluoro innovation giving high toughness, UV opposition and hostile to consumption properties to materials, for example, design films and coatings, caulks, and wire and link. Fluoro polymers lessen rubbing and oppose erosion.

II. WIND PRESSURE

Wind moving toward a structure is a perplexing marvel where the stream design produced around a structure is confused by the mutilation of the mean stream, the stream detachment, the vortex arrangement, and the wake improvement. Enormous breeze pressure vacillations happen on the outside of a structure because of the previously mentioned qualities. Subsequently, huge streamlined burdens are forced on the auxiliary framework and extraordinary limited fluctuating forces follow up on the exteriors.

Under the aggregate impact of these fluctuating forces, a structure will vibrate in rectilinear and torsional modes. The sufficiency of such motions is subject to the idea of streamlined forces and the dynamic attributes of the structure.

Fig. 1: Elevated water tank

III. MIDAS GEN

Midas Gen is a ground-breaking building plan and examination arrangement that gives rehearsing engineers the ability to advantageously and effectively perform structural plan and investigation of building and general structures. Regardless of whether they are planning and breaking down traditional or complex structures, this coordinated arrangement permits them to precisely carry out their responsibility, increase functional outcomes, and improve their efficiency.

Midas Gen accompanies a graphical UI which emforcess designers to forcesfully imagine the models of structures, effectively get to enter/yield capacities, control records and information, and compute properties of segment shapes. Its natural demonstrating capacities make it simple to create models of regular structures that have complex structures and various components. To smooth out the displaying of structures, Midas Gen lets clients use its structure wizards which permit them to rapidly create models by essentially characterizing parameters.

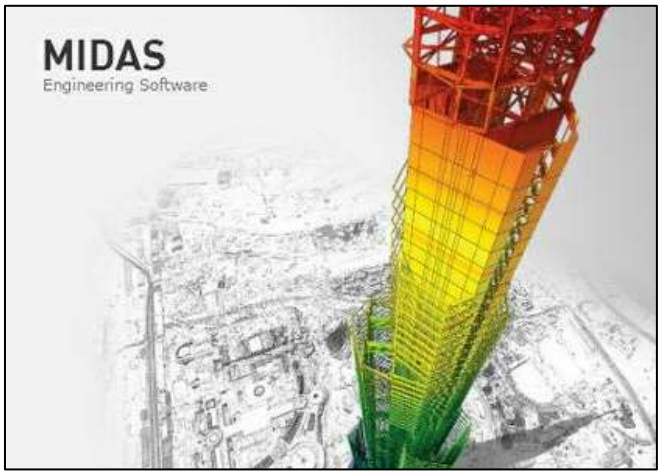

Fig. 2: Midas Gen

IV. OBJECTIVES OF THE STUDY

1) To know about the design philosphy for safe economical and to increament of life span of circular water by using fluoro polymer and other polymer.
2) To prepare a comparative study of water tank with and without fluoro polymer as per I.S. 3370 L.S.M.
3) To study the guide lines for the mix design of concrete according to code IS 10262:2009..
4) The structure can be with stand with higher temperature with help of this polymer.
5) This study will cover understanding about the behaviour of fluoro polymer in structure stability.

V. LITERATURE REVIEW

Santosh Rathod and M. B. Ishwaragol (2018)the research paper introduced the conduct of the Reinforced concrete solid overhead water tank of limit one lakh litre and a correlation was made in the middle of the model with various organizing tallness and with various base width and the examination was done utilizing Staad.pro Software. Water levels for example full tank level, Earthquake zone III was considered in the investigation. A similar report was completed concerning Bending second, Shear Force and Displacement variety of the segments and supporting bars with various organizing stature and base width of the water tank.

The ends expressed that bending moment worth has marginally expanded because of the expansion in organizing stature and the bowing second expanded by 2.9%, 3.1% separately because of the breeze load on the water tank. It was seen that as the stature of the barrel-shaped divider diminishes and base width builds the benefit of bowing second definitely expanded by 32.0% and 38.8%. The base shear esteem has marginally expanded because of the expansion in organizing stature and the base shear was expanded by 3.3%, 3.6% separately. The tallness of the round and hollow divider diminished and base width expands the estimation of base shear radically expanded by 45.0% and 47.0%. The dislodging esteem has expanded because of decreased stature of the barrel-shaped divider and expansion in base width, the relocation is expanded by 39.38% and 46.4% individually.

ReshamDhakalet.al. (2020) the primary objective of the research paper was to present functions of optimization with the maximum upsurge, the maximum downsurge, and the damping of surge waves. The worst condition of upsurge and downsurge was determined through 1-D numerical simulation of the hydropower system by using method of characteristics (MOC). Moreover, the sensitivity of dimensions of a double chamber surge tank was discussed to identify their impact on objective functions; finally, the optimum dimensions of the double chamber surge tank was found using non-dominated sorting genetic algorithm II (NSGA-II) to control the water level oscillations in the surge tank under transient processes. The volume of the optimized double chamber surge tank is only 44.53% of the total volume of the simple surge tank, and it serves as an effective limiter of maximum amplitudes of oscillations.

Results stated, in the hydropower system with multiple units, controlling the water level oscillation in surge tank was a major issue. The most effective operation mode should be adopted to limit the amplitude of surge in the surge tank. Surge can be killed by acceptance of load in multiple stages.

VI. METHODOLOGY

Following steps are considered for analysis of study

1) Step 1: To prepare a literature survey related to our study

Literature Survey was prepared for the past study undertaken till date and shortcomings were identified on which further research needs to be executed. This step further dealt with presenting the applicatations of Fluro Polymer and its advantages and elevated water tanks with its classifications and future prospects of general applications of FluroPolymerin various other industries.

2) Step 2: To prepare geometrical structure of the study using analysis tool MIDAS Gen

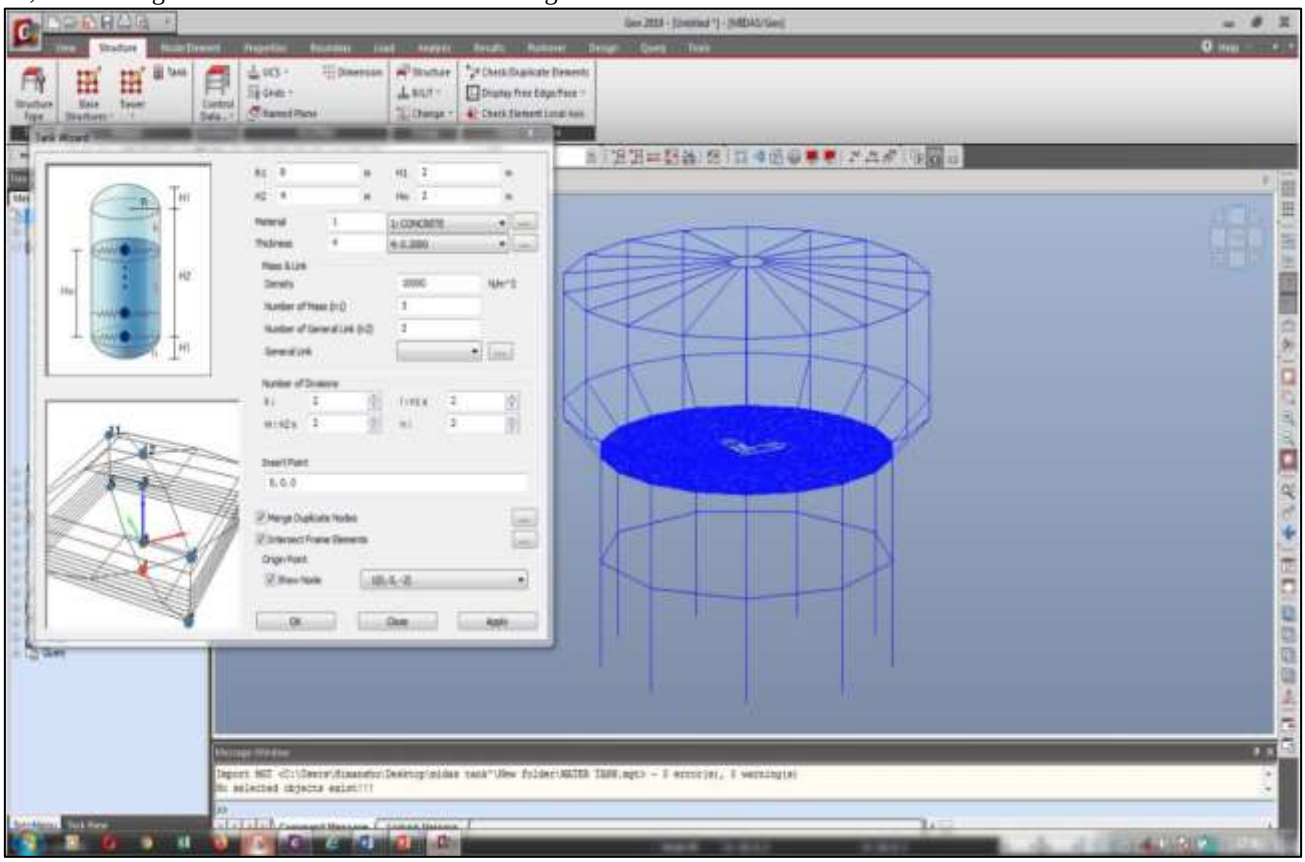

Fig. 3: Modelling of geometry

Step 3: Modelling of General RCC structure and Structure with fluoro polymer concrete

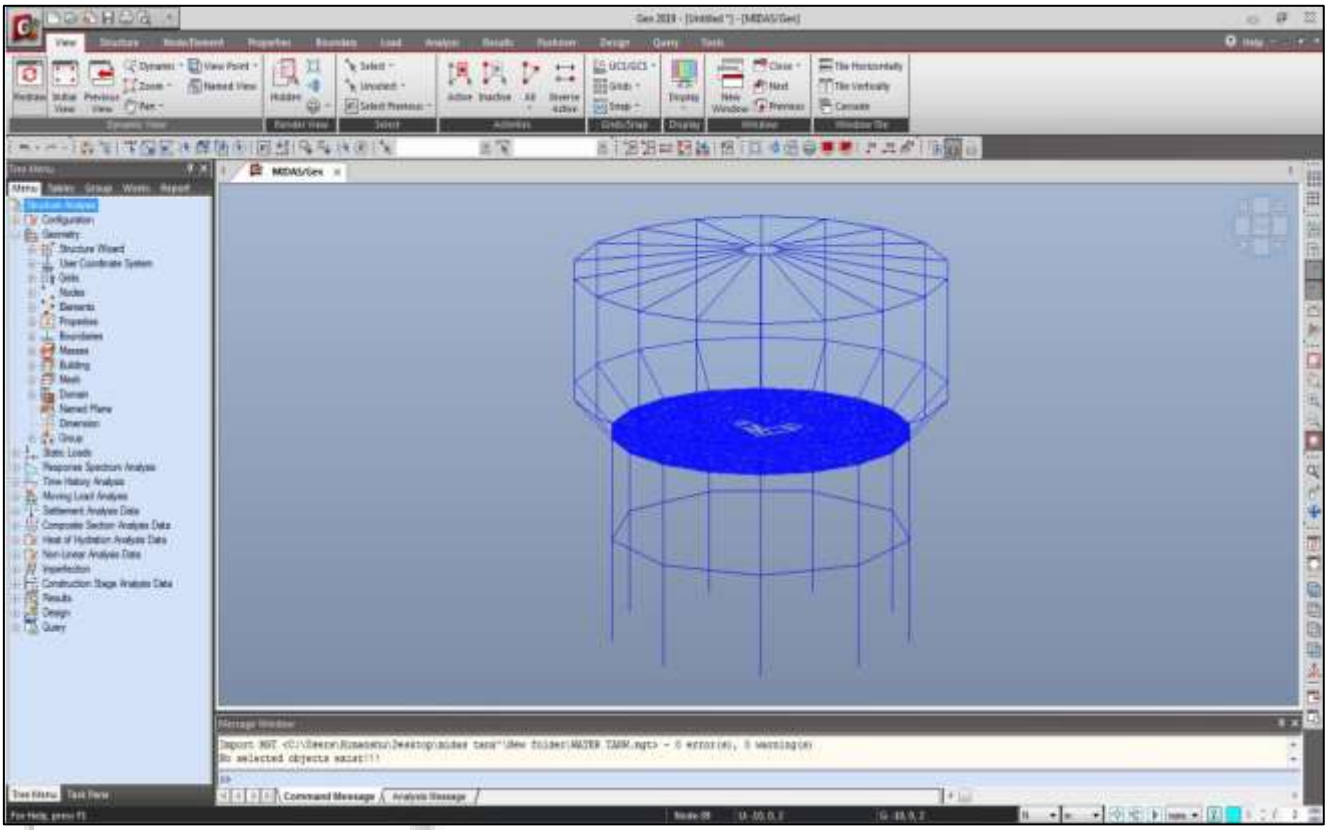

Fig. 4: Modelling of RCC Water Tankusing Midas GEN

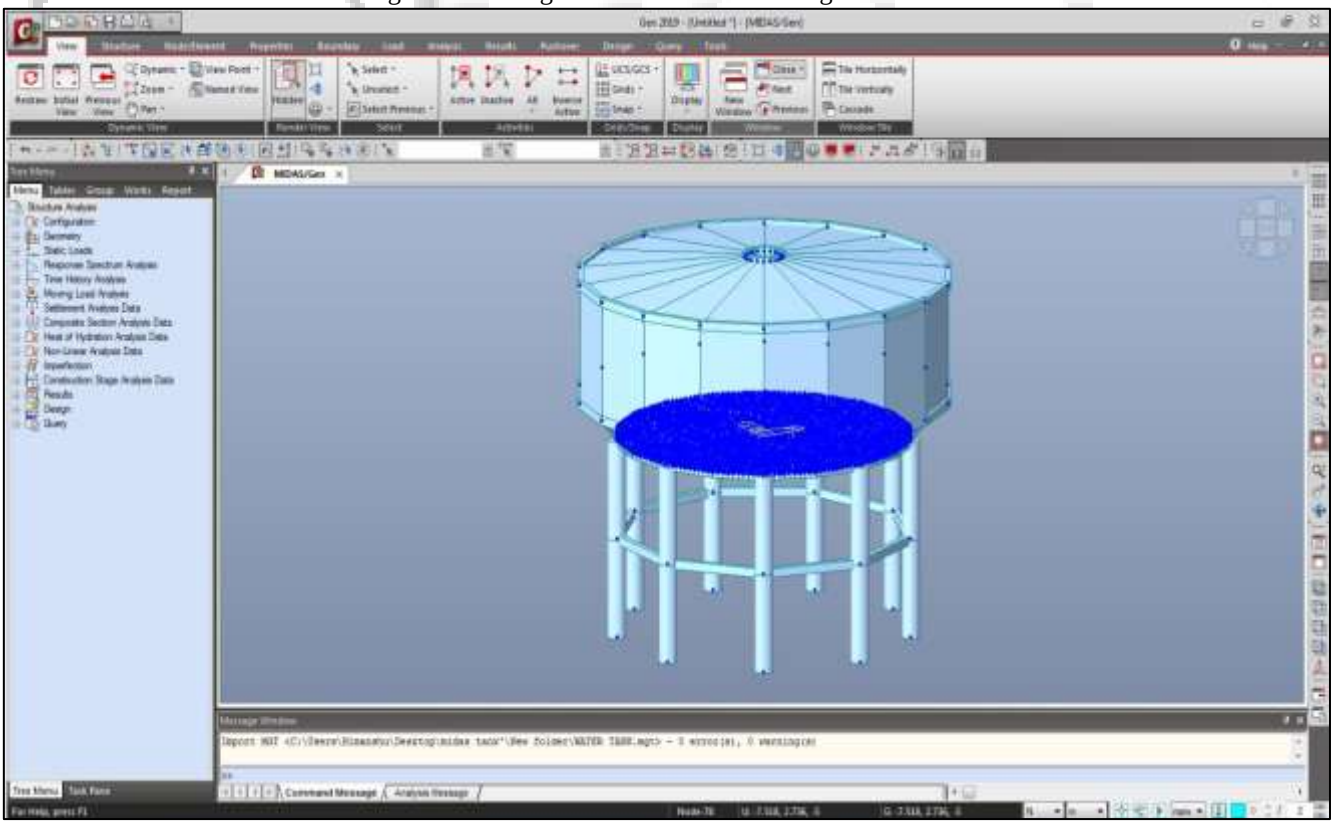

Fig. 5: Modelling of Fluoro Polymer Water Tank using Midas GEN

3) Step 3 to create material for structural sections

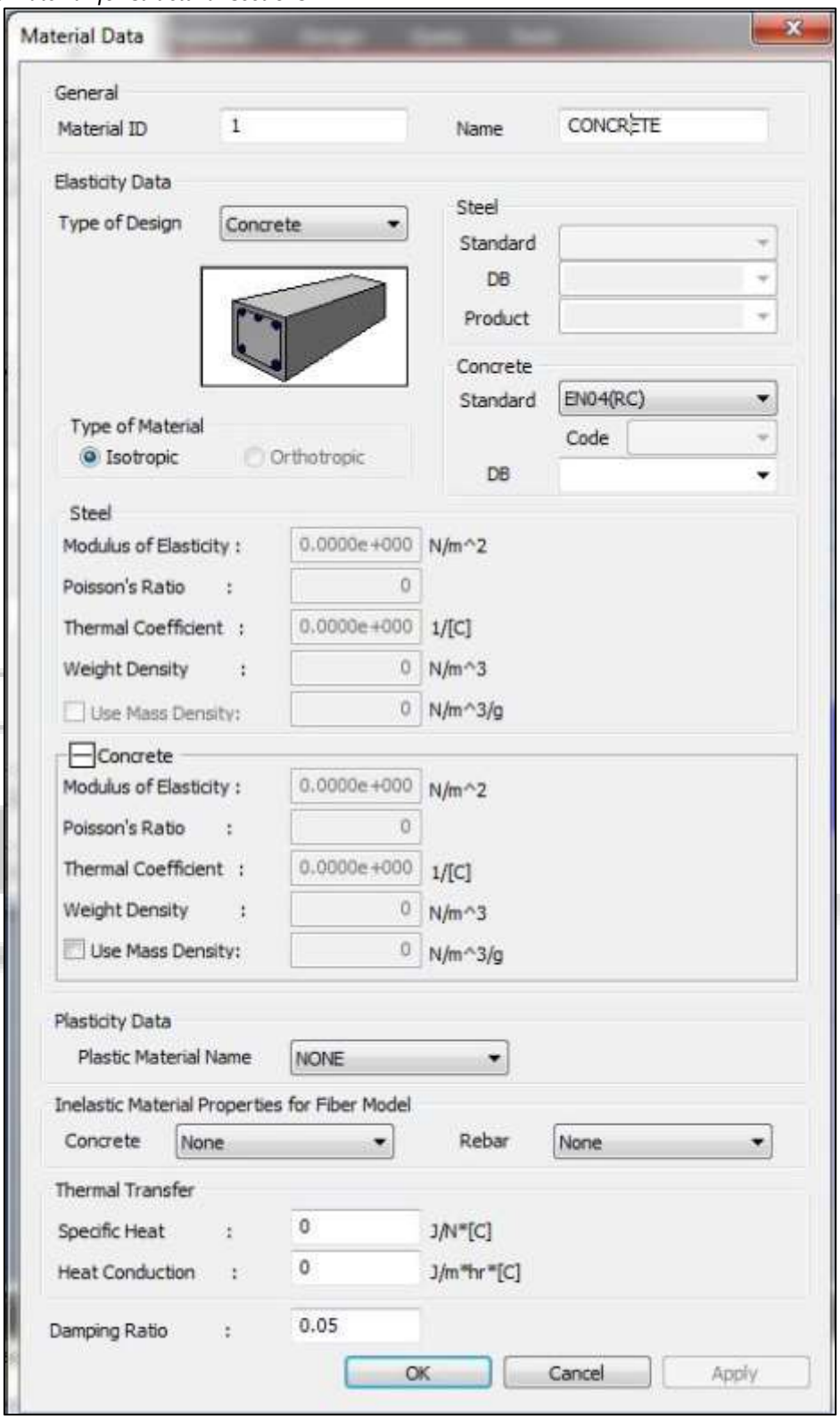

Fig. 6: Material Creation

4) Step 4 To Assign and create sectional properties

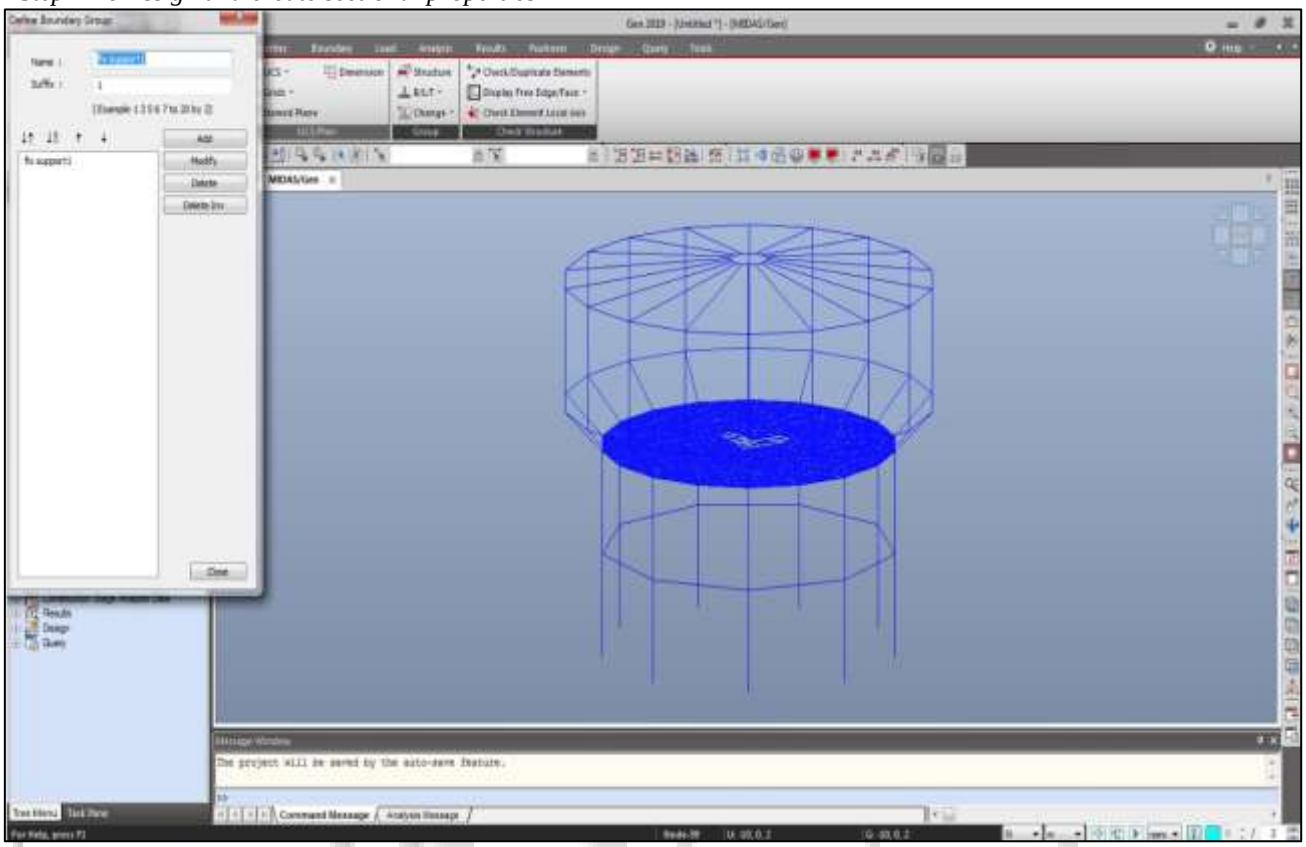

Fig. 7: Assigning fixed end condition at bottom

5) Step 5: Assign weak spring at base beams and cylindrical surface

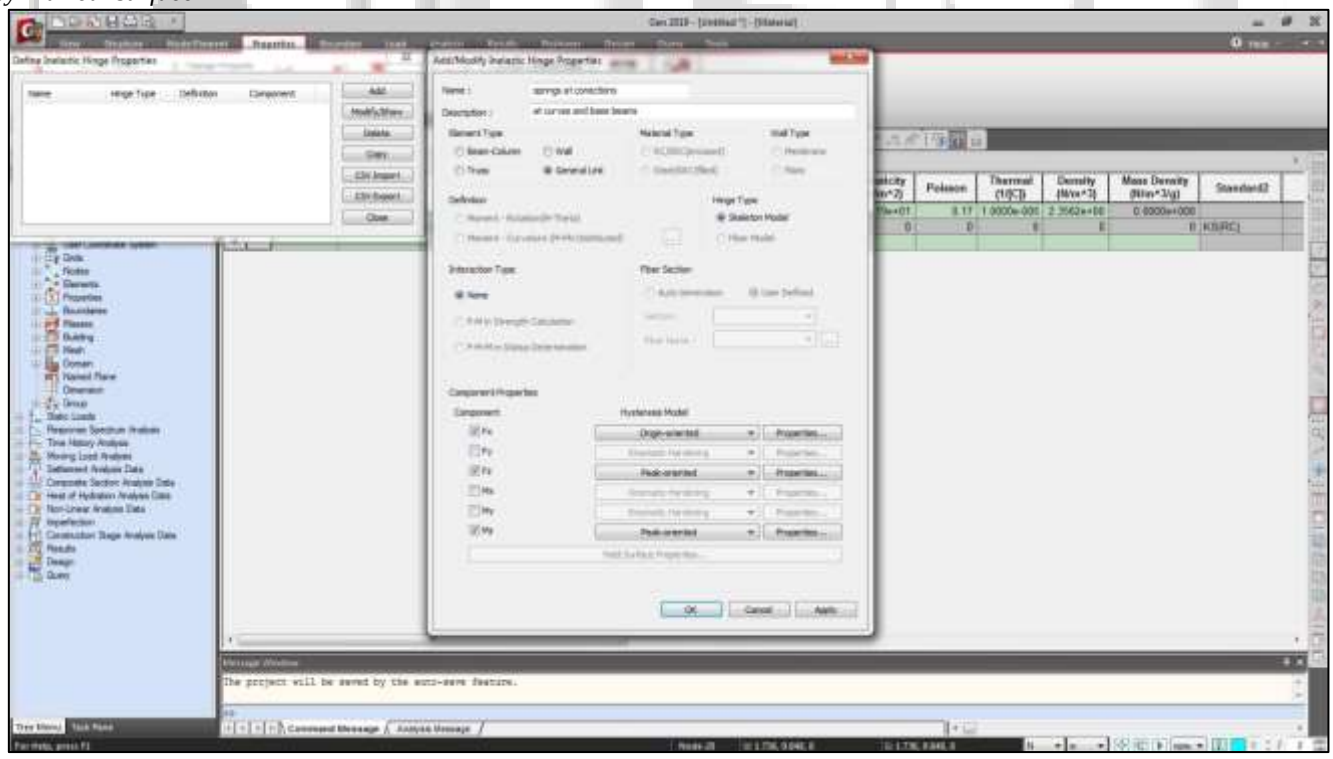

Fig. 8: Assigning weak springs

6) Step 6: Assigning Hydrostatic Pressure (full condition)

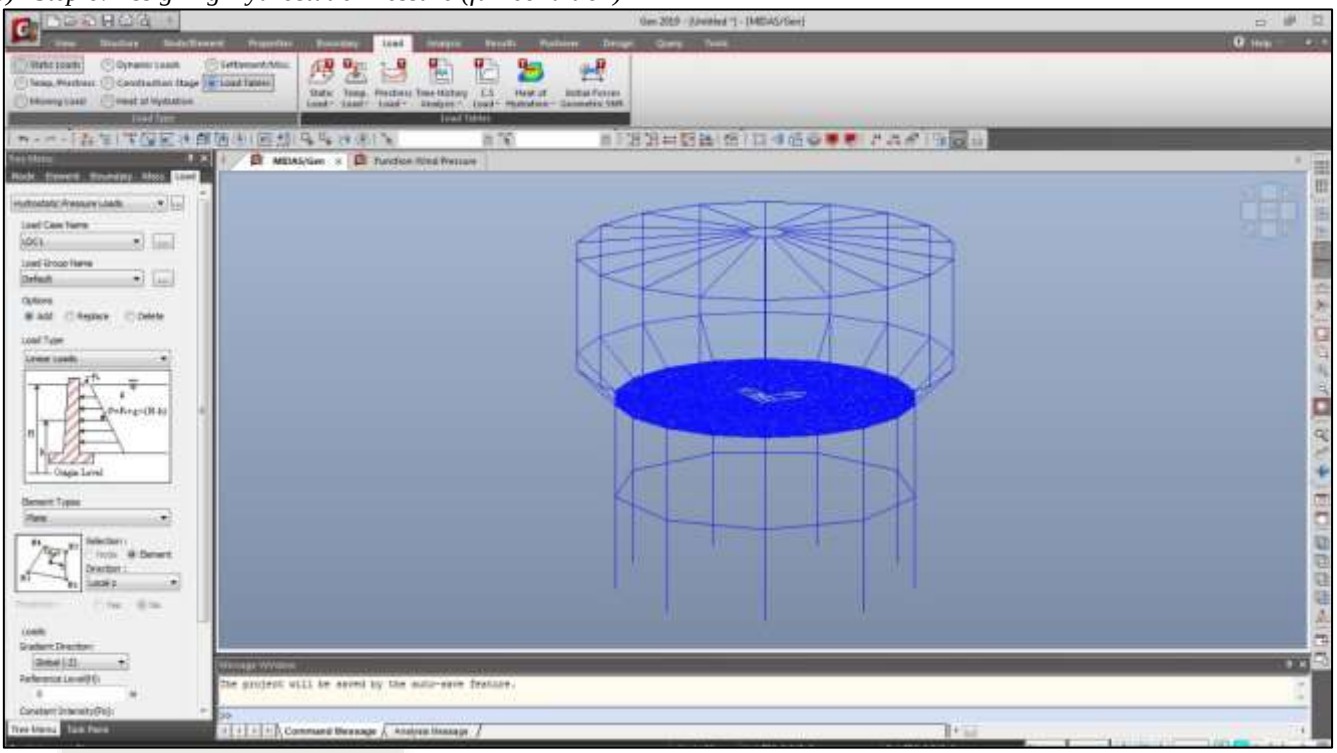

Fig. 9: Assigning Hydrostatic load

7) Step 7: Assigning Wind Pressure as per I.S. 875-III: 2015 (47 m/s wind speed)

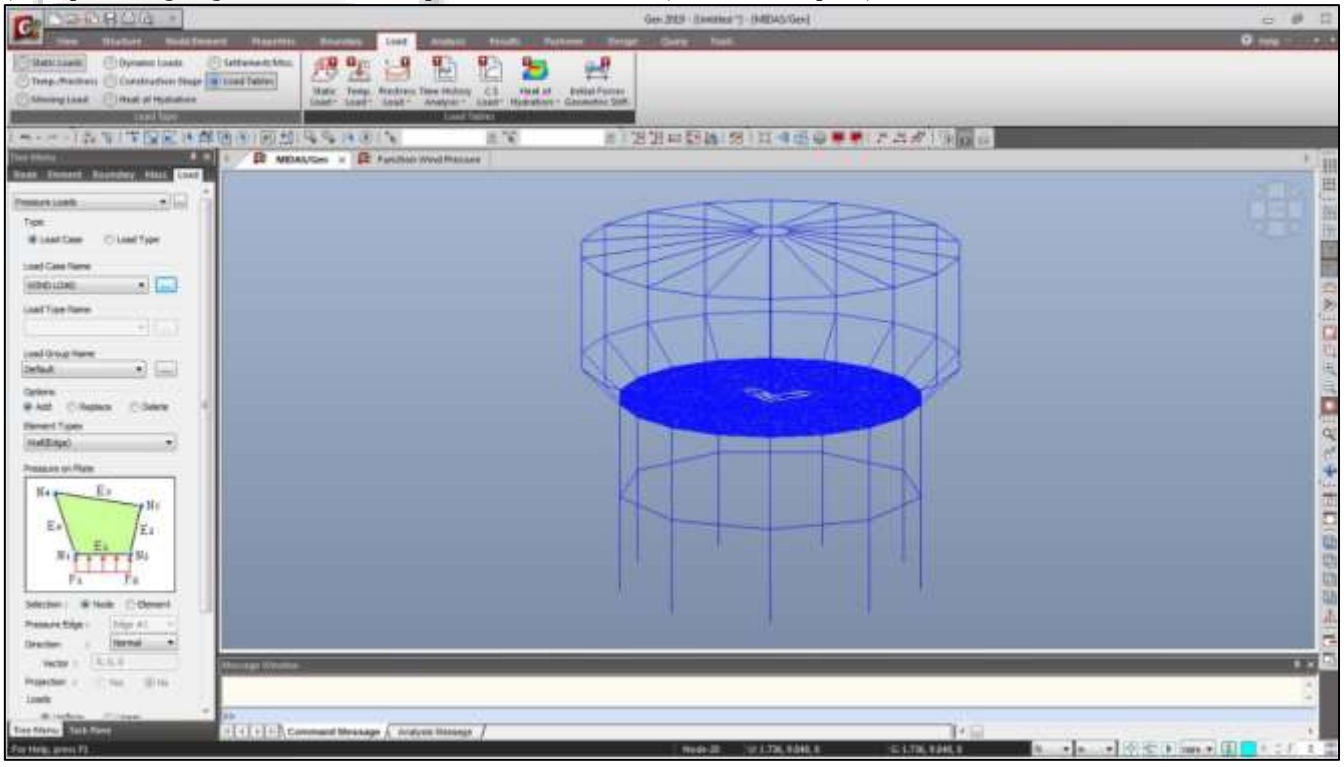

Fig. 10: Assigning Wind pressure

B. Step 8: Analysis of structure using analysis tool MIDAS gen

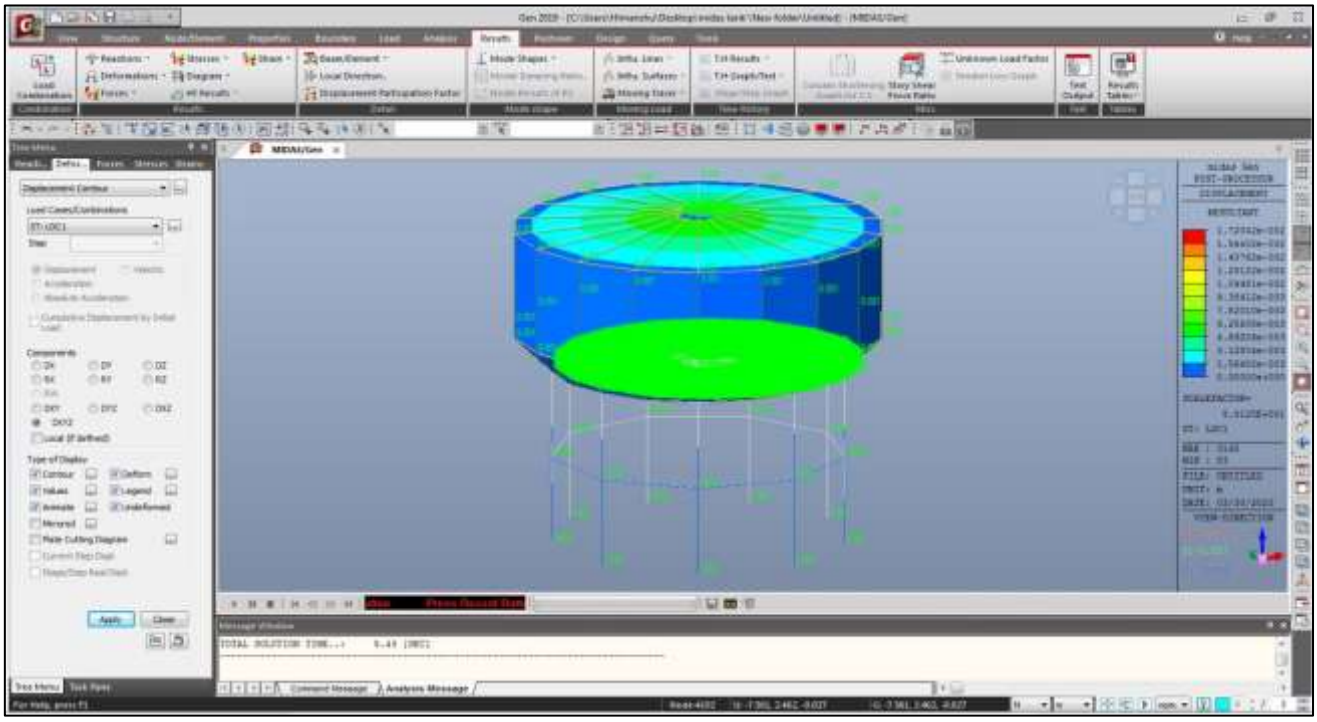

Fig. 11: Analysis results

VII. GEOMETRICAL DATA

Height of the tank	3.5 m
Staging height (linear)	6 m
Base diameter of tank	8 m
Diameter of Sphere	8 m
Number of columns	6
Grade of Concrete	M30
Grade of Steel	Fe415
Size of column	500 mm^2
Size of Beam	500 X 350 mm
Plate Thickness	800 mm
Wall Thinkness	450 mm
Cover Thickness	300 mm

Table 1: Details of Parameter

In this study we have adopted following dimension for comparative analysis to determine variation due to advances in concrete properties by fluoropolymer concrete.

SR.NO.	PARAMETER	DESCRIPTION
1	Concrete	M 30
2	Rebar	FE 500
3	Modulus of Elasticity	1.95xE5 MPa
4	Ultimate Tensile Strength	1860 MPa
5	Soil type	Medium
6	Wind Pressure	47 m/s
7	Hydraulic pressure	Tension & stress

Table 2: Details of Material Used in the Project

VIII. ANALYSIS RESULTS:

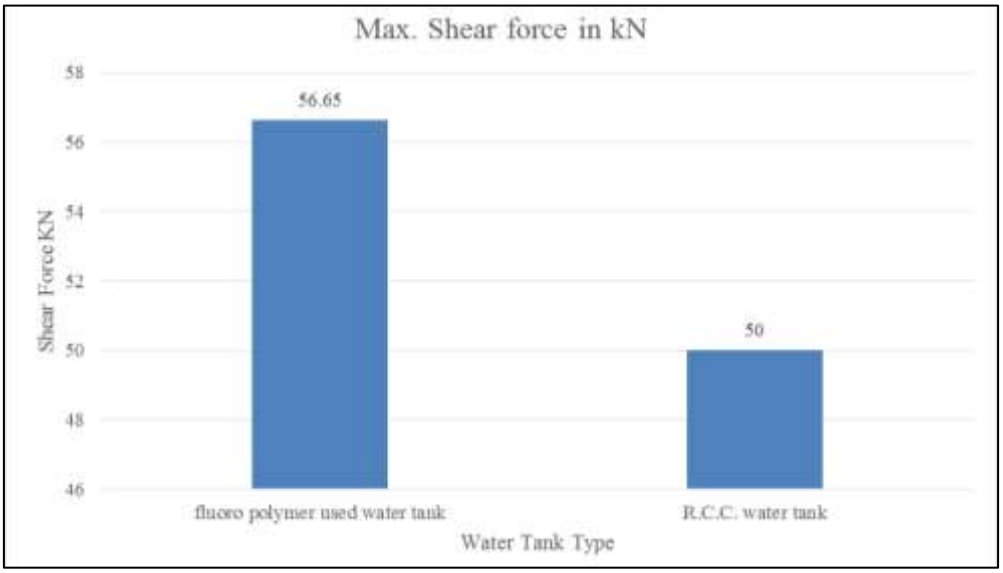

Fig. 12: Shear Force

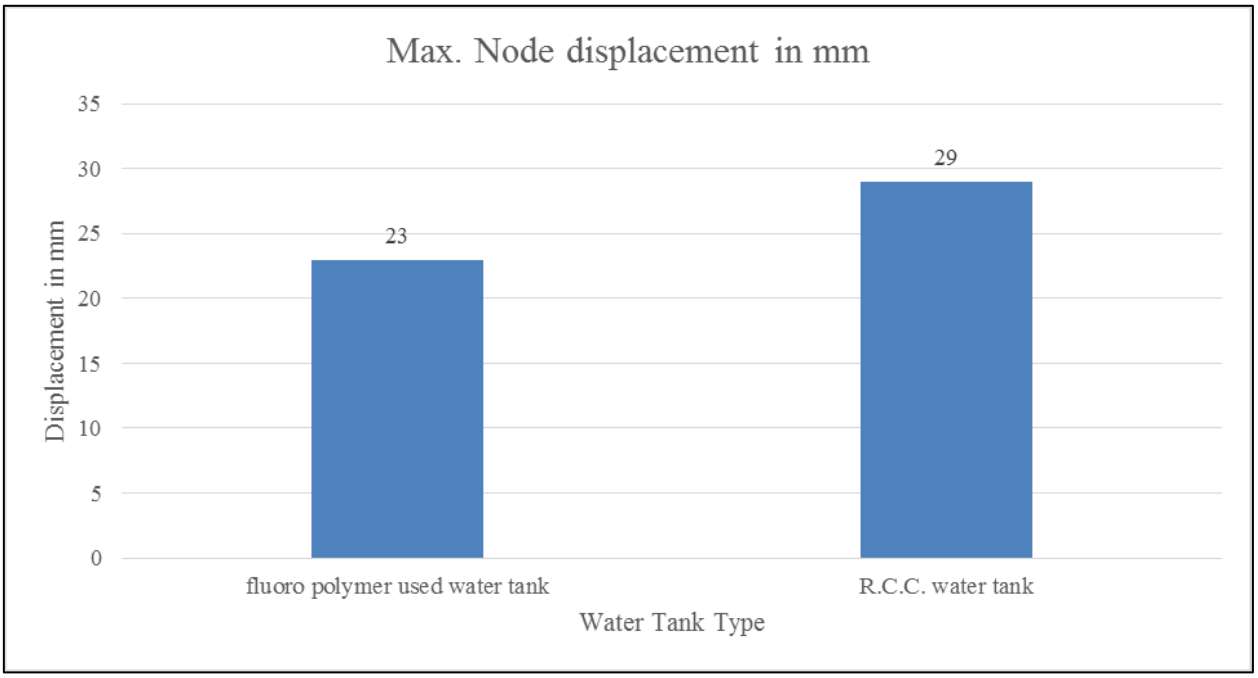

Fig. 13: Displacement

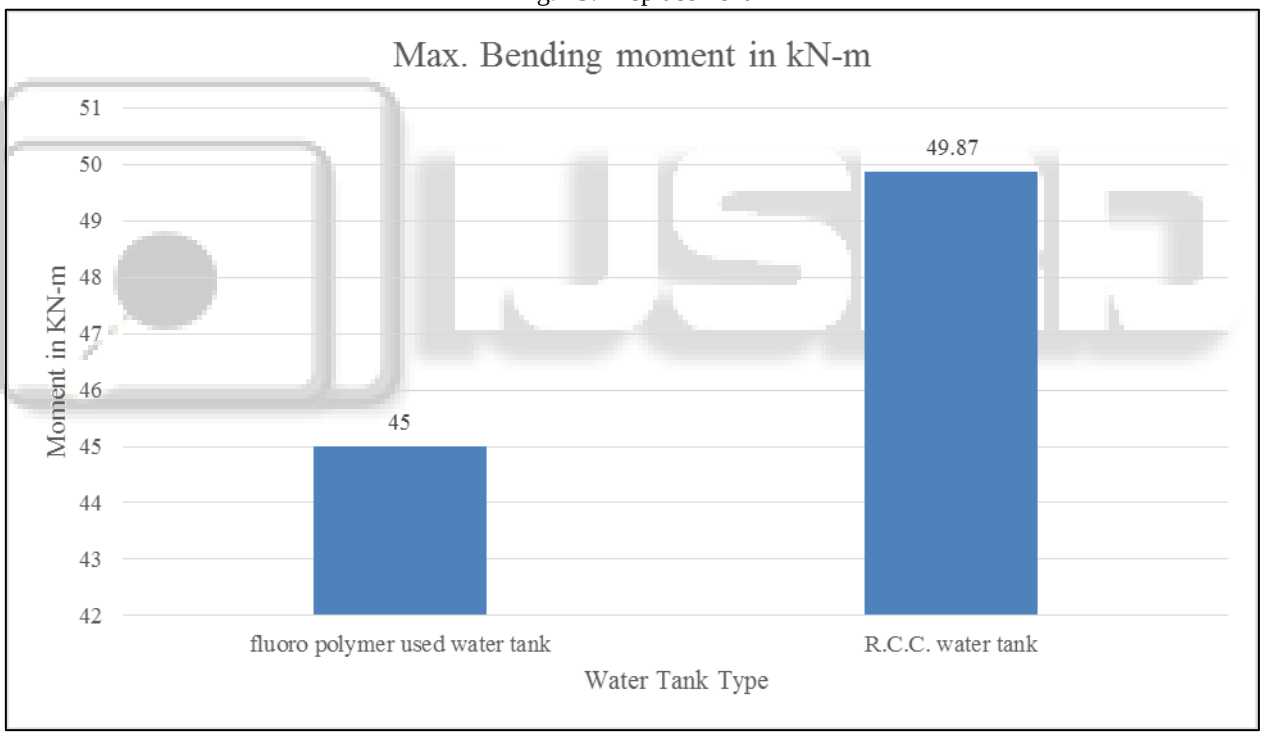

Fig. 14: Moment

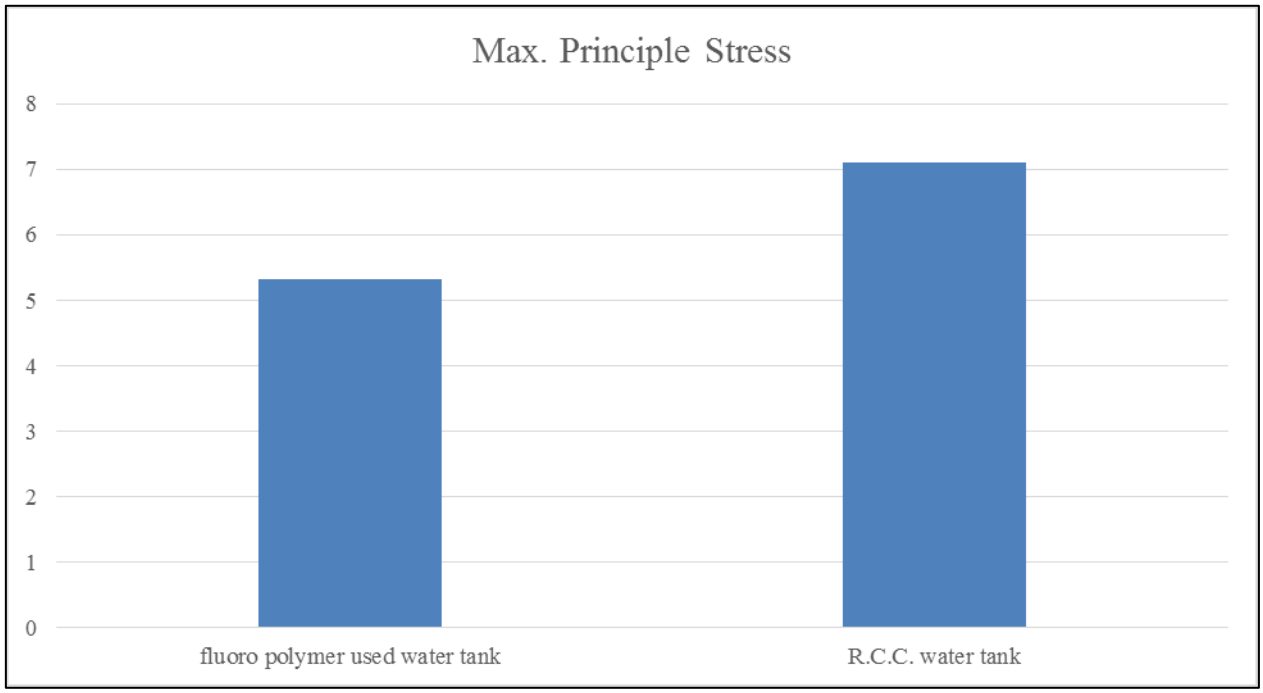

Fig. 15: Principal Stresses.

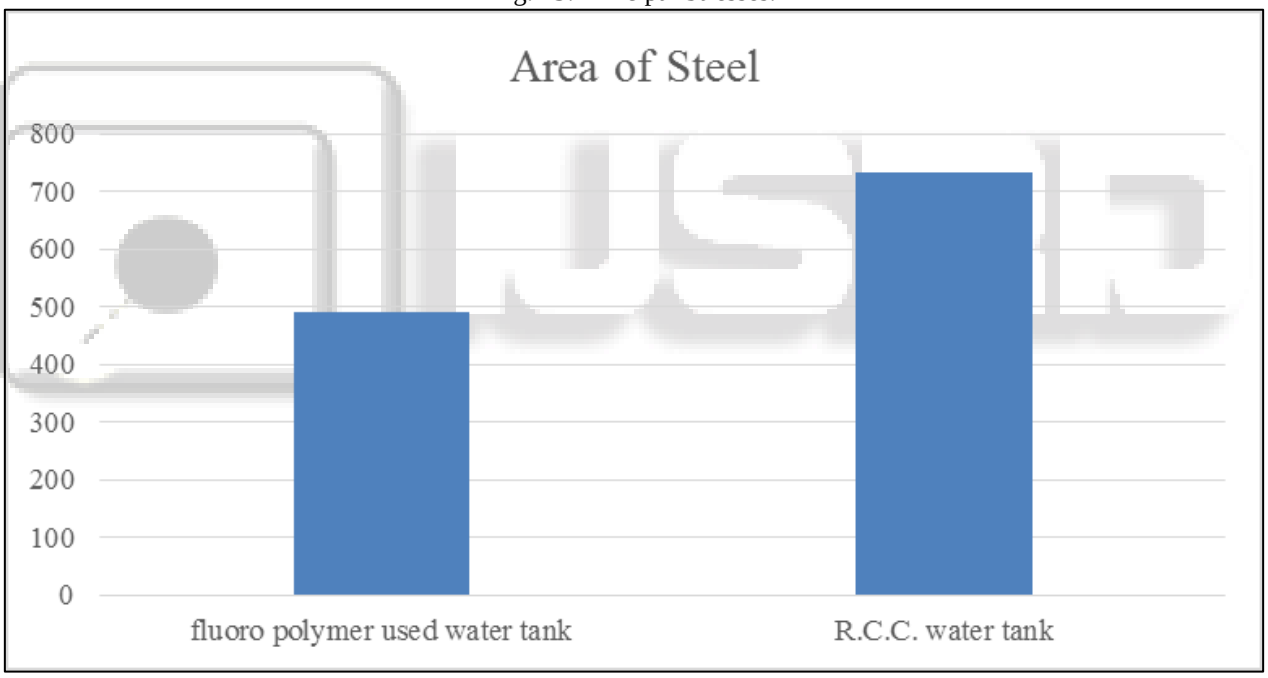

Fig. 16: Area of steel

IX. CONCLUSION:

From the above results, the following conclusions has been observed

1) Considering the shape and geometry, over-turning moment is found to be greater in RCC water tank when compared to the tank of fluro polymer.Under seismic loading, fluro polymer water tank is recommended.
2) fluro polymer tank experiences greater displacement when compared to RCC water tanks due to its support conditions.
3) Fluro polymer water tank experiences greater base shear when compared to RCC water tank.
4) While considering maximum principal stress, it may be both the Fluro Polymer water tank and RCC water tanks having the same capacities. But in the result RCC water tank is greater than FLuro Polymer water tank.For RCC water tank-7.1 N/mm2 and for Fluro Polymer water tank-5.32 N/m2
5) While considering Hoop tension, it may be RCC water tank is more than FLuro Polymer water tank.For RCC water tank -180KN and for Fluro Polymer water tank -120KN.
6) Area of steel, In project may be RCC water tank isgreater than FLuro Polymer water tank.For RCC water tank-734 mm2For Fluro Polymer water tank -490 mm2.

7) As per cost analysis, Fluro Polymer water tank is found to be economical when compared to the other two tanks. extensions.

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