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Design of Overhead Tank with Carbon Fibre/Fiber Rebar as Reinforcement and Time History Analysis using STAAD-Pro software.

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Abstract – *The industry called construction and design, always trying to find new and better technologies, ways, materials and equipment. In this scenario we talk about technology/material, the using Carbon Fibre/fiber as Reinforcement for design the structure. This brings alternative for steel in the designing of the structure and offers design opportunities to enhance the performance of the structure with encouraging innovation.*

Lots of the studies showed that the need of tanks is essential and increasing now days by day over the world. Due these increasing demands, we need to design & build the huge/large storage water tanks structures. But going with traditional/conventional/regular way has limits. It should not been limited to a certain extent structural point of view. Effective overhead water tanks could not be possible with a traditional/conventional/regular approach. Due to their special architectural features and configurations of water tanks are different structure. Materials having high strength and innovative structural systems are needed to be developed to resist the challenges created by construction of the huge storages of water tanks in regions of highly densely populated areas.

In present work, design of the overhead tank using carbon fibre/fiber as reinforcement, has been checked weather can we design or not, do time history analysis or not. In further work, the performance of overhead tank using carbon fibre/fiber as reinforcement will be checked at the several loads, time history analysis, and the maximum considered level criteria STAAD-Pro software.

Key Words: Carbon fibre/fiber rebars, modelling, new material, overhead water tank, STAAD-Pro software.

1. INTRODUCTION

Conventional method of designing an overhead water tank structure with time history analysis has limit. We should thing beyond the limits as need of the water reservoirs is more. Considering the factors like "value of the design base shear is dependent on height (period), type, location, and importance of the structure as well as on the nature of foundation soil" we need to design the structure. Steel is used for the reinforced the structure, which counter balances the tensile force generated in different types of the structures. High reinforcement is needed for the huge water tanks while designing and countering the forces comes across, it is practically to much uneconomical if going with steel. So the new material introduce having 3 to 5 times more characteristic strength than steel.

Overhead Water Tank:

Overhead Water Storage Tank its name suggest and is a usually use to store the water; Tanks are placed over the head that is built on a certain height. The tank may be built of any material, but the idea is to achieve maximum efficiency by placing a tank at some elevated distance. The water from the ground level is filled through pumping. It is achieved with high power motor pumps that send the water to storage at high pressure. These Tanks can be anywhere above a Town or even within your house where it is built on the rooftop. The main purpose is to achieve an even distribution.

Carbon Fibre/fiber Reinforcement/Rebars:

Carbon Fibre/fiber composite reinforcement/rebars has high strength, moderate modulus of elasticity, small deformation, pre-manufactured composite carbon/resin rods. Carbon Fibre/fiber Rebars is used as internal or external reinforcement providing additional strength and stiffness to concrete and masonry structural elements. Carbon Fibre/fiber Rebars rods can be effectively anchored into adjacent members, non-corrosive, light-weight, high-strength, fatigue resistance and non-magnetic, low impact on member appearance and aesthetically pleasing, increasing in-plane or out- of-plane bending capacity of masonry wall, effective topside reinforcing product for slabs and beams, suitable for special engineering structures, structural reinforcement and so on.

Table: Carbon Fibre/fiber Rebars Details

Item	Value
Diameter(mm)	6 ~ 30
Density(g/cm3)	1.5 ~ 1.7
Tensile Strength (MPa)	1500 ~ 2800
E-modulus(GPa)	130 ~ 200

Aim and Objective:

Dissertation's aim is to design the overhead tank using carbon fibre/fiber as reinforcement and time history analysis to improve the structural performance and cost effectiveness.

The work of dissertation is being carried out to achieve the following objectives:

1. Whether to check can design the Overhead Tank Using Carbon Fibre/Fiber rebar as Reinforcement on STAAD-Pro.

2. To do the Time History Analysis

3. To check the performance of the structure.

2. PROBLEM STATEMENT AND METHODOLOGY

Problem statement:

The current IS codes do not properly address using carbon fibre/fiber as a reinforcement. These codes primarily deals with the steel reinforcement. Code are made to assess life safety and are intended to control damage under every condition, but the actual reliability of these codes is not known. Improving design procedures that result in better performance, durability, and sustainability. Designing structures like overhead tanks using carbon fibre/fiber as reinforced material can help us to achieve these goals. Such an approach provides the freedom to develop tools and methods to evaluate the entire life cycle of the building processes, from business dealings, to procurement, through construction and evaluating results. Hence, this procedure is developed to study the design of Overhead Tank using Carbon Fibre/Fiber as Reinforcement and do Time History Analysis see the effect.

Significance of choosing the problem:

Previously, no work executed in India, investigations resulted out that our IS codes are not compile with design the structures using Carbon fibre/fiber as reinforcement. The performance-based design approach is not proposed as an immediate substitute for design to traditional codes. Recent trends show that the number of structures are being designed and constructed using carbon fibre/fiber as reinforcement outside to India. Demand for water and water storages is increasing day by day as the city becomes dense. So there urges a need for more skilled engineers equipped with better tools to evaluate and guarantee the safety and performance of such structures. Using carbon fibre/fiber used as reinforcing material gives the opportunity to clearly define the levels of hazard to be designed against, with the corresponding performance, durable and sustainable, efficient, and the cost-efficient process.

Relevance to Construction Industries:

The new ideas and use of materials in the design and completion of structures have given a great challenge to the construction industries regarding meeting the social needs. Using carbon fibre/fiber as reinforcement is a concept that produces the structure with high level of performance, durable, and sustainable. Industry is allowing to design overhead tank using carbon fibre/fiber rebar as reinforcement to achieve the requirements and helps to boost the productivity. Achieving a quality product within a budget and planned schedule is the goal of all owners in the architecture, engineering and construction industry.

Methodology:

The overall methodology consisted of designing the overhead tank using carbon fibre/fiber and time history analysis. Carbon fibre/fiber is newly invented material which is going to experimentally use as reinforcement material. Perform the time history analysis and study results. The complete analysis and design of the overhead tank using carbon fibre/fiber as a reinforcement and time history analysis was done using the STAAD-Pro software. The method used for the analysis and design of the structure are discussed below.

Time History Analysis:

Time History analysis provides nonlinear evaluation of dynamic structural response under loading which may be varied according to the specified time function. This type of analysis provides the exact response of a structure as a function of time, which is determined using a step-by-step numerical integration of the equation of motion. The peak response can be obtained from the maximum value of the response-history plot.

Procedure for Time History Analysis:

- Open the STAAD-Pro software.
- Open STAAD-Pro software's location where the STAAD-Pro is placed in windows.
- Find EQDATA.TXT excel file.
- Copy this file and paste in your work space.
- Then open work space model.
- After that next step is to define the Time History. For that Go to Load & Cases > Time History.
- New pop up window come.
- Add Integration Time Step as 0.001 > Type as 1 > From External File > File Name.
- Add or Paste file name as EQDATA.TXT (file name) > Add
- Define Param (Parameter) > Damping as 0.05 > Arrival Time as 1, 2, 3, 4, 5, 6. > Add.

3. METHODOLOGY ADOPTED

General:

The total modelling work has been carried out in STAAD-Pro Software to design and check the overhead tank using carbon fibre/fiber as reinforcement and doing time history analysis.

Modeling Work:

Present study is to modelling, overhead water tank of total height 20m, Carbon- Fibre/fiber Reinforced Cement-Concrete. The modeling work is done in STAAD-Pro softwere. The structure is situated in Seismic Zone I with the following seismic, sectional and material properties. The model consists of various elements such as beams, columns, slabs, shear walls for checking the performance against the acceptance criteria.

Table: Seismic, Sectional and Material Properties of Structure

Seismic Zone	I
Soil Type	II
Importance Factor	1
Total Height	20 m
Lower Beam Size	230 mm x 690 mm
Upper Beam Size	230 mm x 350 mm
Bracing Size	230 mm x 300 mm
Column Size	350 mm x 350 mm
Top Slab	120 mm Thick
Shear Wall	150 mm Thick
Bottom Slab	300 mm Thick
Concrete	M30
Rebar	CFR1600

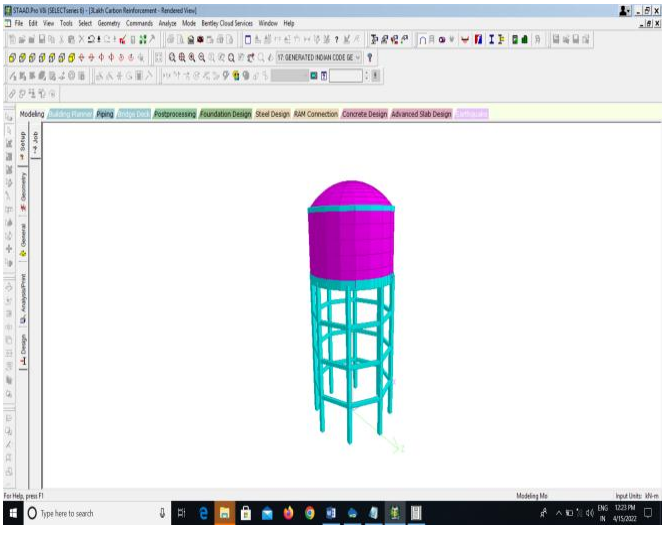

Figure: Plan and 3D View of Overhead Tank.

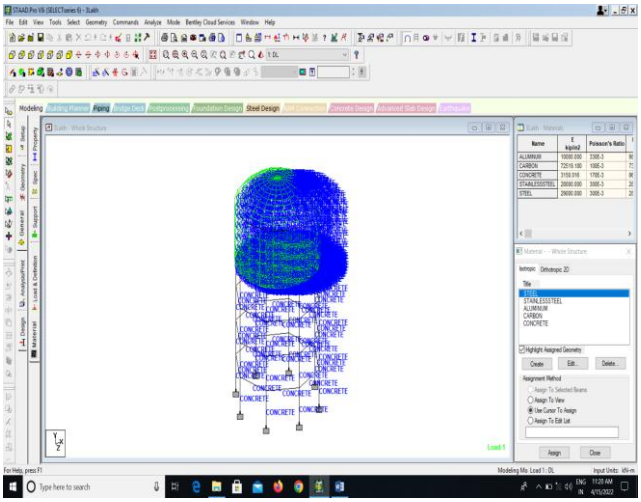

Figure: Defining the Material

4. RESULT AND DISCUSSION

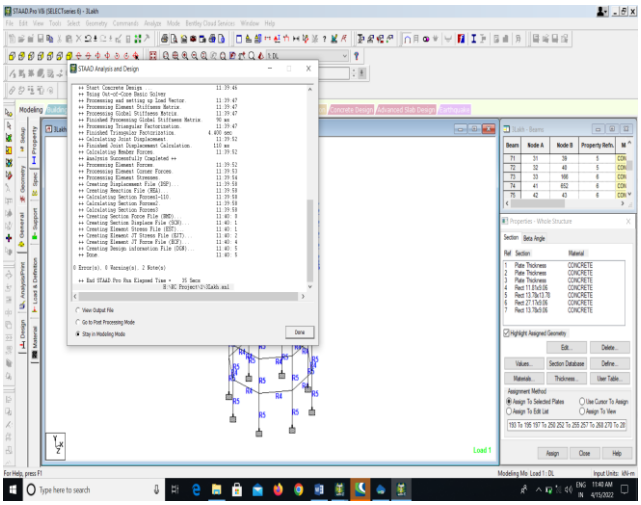

Figure: Perform (Run) Analysis

The type of work is done first time happening.

1) By using STAAD-Pro software we can model the desire structure as Overhead Water Tank using Carbon Fibre/Fiber as Reinforcement and Time History Analysis.
2) We can give input Carbon Fibre/Fiber properties to STAAD-Pro software.
3) After doing analysis work results comes with no error.

5. CONCLUSION

While doing this process get to know that, modelling can happen for the desire structure in STAAD Pro V8i. After modelling, to check can designing of these capacity storages structure with stands practically approach i.e. appropriate reinforcement and economical or not & also the structure's

sustainability. The future plan is to check same structure model in other softwares, and to check from other software what results will come. And also if all passes then go for large amount storage structures.

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