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DESIGN OF CIRULAR WATER TANK USING STAADPRO

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Abstract - Storage reservoirs and overhead tank are used to store water, liquid petroleum, petroleum products and similar liquids. The force analysis of the reservoirs or tanks is about the same irrespective of the chemical nature of the product. All tanks are designed as crack free structures to eliminate any leakage.

This project gives in brief, the theory behind the design of liquid retaining structure (Elevated circular water tank with domed roof and conical base) using working stress method. Elements are design in limit state method.

A water tank is used to store water to tide over the daily requirement. In the construction of concrete structure for the storage of water and other liquids the imperviousness of concrete is most essential. The permeability of any uniform and thoroughly compacted concrete of given mix proportions is mainly dependent on water cement ratio. The increase in water cement ratio results in increase in the permeability.

KEYWORDS: Staad pro v8i,Auto cad 2016,IS:456 RCC Design code

1. INTRODUCTION

A water tank is used to store water to tide over the daily requirement. In the construction of concrete structure for the storage of water and other liquids the imperviousness of concrete is most essential .The permeability of any uniform and thoroughly compacted concrete of given mix proportions is mainly dependent on water cement ratio .The increase in water cement ratio results in increase in the permeability .The decrease in water cement ratio will therefore be desirable to decrease the permeability, but very much reduced water cement ratio may cause compaction difficulties and prove to be harmful also. Design of liquid retaining structure has to be based on the avoidance of cracking in the concrete having regard to its tensile strength.

Cracks can be prevented by avoiding the use of thick timber shuttering which prevent the easy escape of heat of hydration from the concrete mass the risk of cracking can also be minimized by reducing the restraints on free expansion or contraction of the structure.

1.1 OBJECTIVE

1. To make a study about the analysis and design of water tanks.
2. To make a study about the guidelines for the design of liquid retaining structure according to IS Code.
3. To know about the design philosophy for the safe and economical design of water tank.
4. To develop programs for the design of water tank of flexible base and rigid base and the underground tank to avoid the tedious calculations.
5. In the end, the programs are validated with the results of manual calculation given in .Concrete Structure.

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1.2 SOURCES OF WATEER SUPPIY

The various sources of water can be classified into two categories: Surface sources, such as

1. Ponds and lakes;
2. Streams and rivers;
3. Storage reservoirs; and
4. Oceans, generally not used for water supplies, at present. Sub-surface sources or underground sources, such as

1. Springs;
2. Infiltration wells; and

Wells and Tube-wells

1.3 WATER QUANTITY ESTIMATION

The quantity of water required for municipal uses for which the water supply scheme has to be designed requires following data:

Water consumption rate (Per Capita Demand in litres per day per head)

Population to be served.

Quantity= Per demand x Population

1.4 WATER CONSUMPTION RATE

It is very difficult to precisely assess the quantity of water demanded by the public, since there are many variable factors affecting water consumption. The various types of water demands, which a city may have, may be broken into following class.

1.5 FIRE FIGHTING DEMAND

The per capita fire demand is very less on an average basis but the rate at which the water is required is very large. The rate of fire demand is sometimes treated as a function of population and is worked out from following empirical formulae:

2.1 Literature Review

A water distribution network must be designed so that it can supply the desired quantity of water to the consumers at sufficient pressure. The design involves specifying the sizes of different elements of the distribution network and checking the adequacy of this network (Mays 2000). Significant effort has been placed in developing approaches to solve for optimal designs of water distribution systems. **2.1.1 Pipe Characteristics**

A large body of literature exists on the optimization of the pipe network design, reporting the application of classical optimization methods (including linear programming, dynamic programming and nonlinear programming). These methods have been used, sometimes at the cost of considerable simplifications of the optimization models. One of the earliest optimization approaches, the linear programming gradient method was proposed by Alperovitz and Shamir (1977). Other authors followed this innovative course and introduced alternative derivations from the linear programming-based gradient expressions (Quindry et al 1981, Fujiwara et al 1987, Lansey and Mays 1989, Kessler and Shamir 1989, Fujiwara and Khang 1990). These approaches lead to solutions in which pipes have one or two fixed diameter segments. For practical implementation this type of solution is unrealistic.

The state-of-the-art principles and methods of pipe network optimization are presented by Walski (1985). Su et al (1987) presented a basic framework for a model that can be used to determine the optimal least-cost design of a water distribution system subject to conservation of energy and reliability constraints. The limitation of this model is that the resulting pipe diameters may not be commercially available pipe sizes and should be rounded off to the appropriate sizes. These approximated diameters might affect the feasibility of the resulting optimal solution. Fujiwara and Silva (1990) proposed a heuristic method to obtain a least-cost water distribution network design with a given reliability. The method first determines an optimal design without the consideration of reliability. The reliability of the network design is then assessed. An iterative feedback procedure is then employed, which improved the reliability with a small increase in cost.

Nonlinear programming technique has been used as an optimization approach to solve the design optimization problem of water distribution networks (Fujiwara and Khang 1990, Fujiwara and Khang 1991 and Varma et al 1997) in which the diameter is taken to be a continuous variable. A redundancy-constrained minimum-cost design of water distribution networks is presented by Park and Liebman (1993). Redundancy is quantified using the expected shortage due to failure of individual pipes as a measure of reliability that permits incorporation of some considerations of frequency, duration and severity of damage.

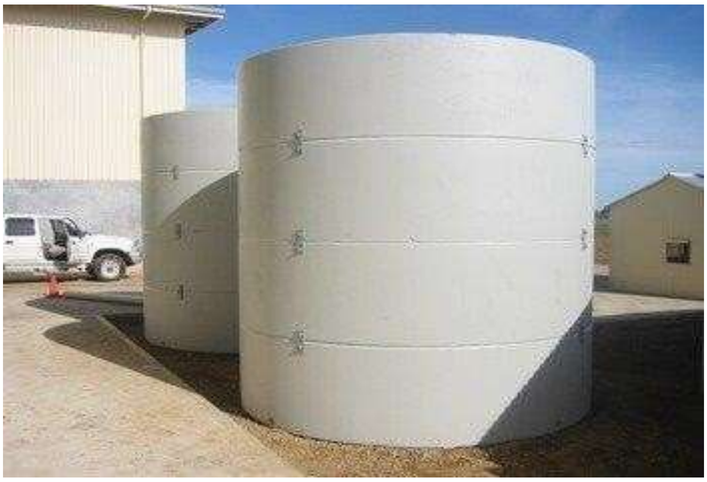
Developments in the field of stochastic optimization have allowed the resolution of design optimization problems formulated as nonlinear mixed integer problems. Genetic algorithms were used by Murphy et al (1993), Simpson et al (1994), Dandy et al (1996), Savic and Walters (1997), Keedwell and Khu (2005), and Keedwell and Khu (2006) and simulated annealing technique was applied by Cunha and Sousa (1999) and Cunha and Sousa (2001). The applications of other evolutionary optimization algorithms such as Ant Colony Optimization (Maeir et al 2003), Shuffled Frog LeapingAlgorithm (Eusuff and Lansey 2003), Tabu Search heuristic (Cunha and Ribeiro 2004), Scatter Search (Lin et al 2007) and Particle-Swarm Harmony Search (Geem 2009 b) to obtain the least-cost design of water distribution network are reported in the literature. Evolutionary algorithms have also enabled researchers to approach water distribution network design optimization as a multiobjective problem, usually to determine the least cost design which maximizes the benefits (Halhal et al 1997, Walters et al 1999, Prasad and Park 2004, Kapelan et al 2005, and Lyroudia et al 2005). Liong and Atiquzzaman (1994) proposed a powerful optimization algorithm, Shuffled Complex Evolution (SCE) linked with EPANET, the network simulation model to solve water distribution network design optimization problems.

Taher and Labadie (1996) developed a prototype decision support system WADSOP (Water Distribution System Optimization Program) to guide water distribution system design and analysis in response to changing water demands, timing, and use patterns; and accommodation of new developments. WADSOP integrates a geographic information system (GIS) for spatial database management and analysis with optimization theory to provide a computer-aided decision support tool for water engineers. Xu and Goulter (1999) proposed a fuzzy linear program optimization approach for the optimal design of water distribution networks. Wu and Simpson (2001) applied a Genetic Algorithm to the optimal design and rehabilitation of a water distribution system. Two benchmark problems of water pipeline design and a real water distribution system are presented to demonstrate the application of the proposed technique.

A Fuzzy linear programming model is formulated by Bhave and Gupta (2004) for minimum cost design of water distribution networks. Future water demands being difficult to predict with any uncertainty are considered as fuzzy demands and modeled by trapezoidal possibility distribution function. The proposed linear programming model avoided iterative procedure and also provided a cheaper solution. A self-adaptive fitness formulation for solving constrained design optimization of water distribution networks is presented by Farmani et al (2005). The method has been formulated to ensure that slightly infeasible solutions with a low objective function value remain fit. The method does not require an initial feasible solution, this being an advantage in real-world applications having many optimization variables. Vairavamoorthy and Ali (2005) proposed a methodology for the optimal design of water distribution systems based on Genetic Algorithms. The objective of the optimization is to minimize the capital cost, subject to ensuring adequate pressures at all nodes during peak demands. The method involves the use of a pipe index vector to control the genetic algorithm search.

The method has been tested on several networks, including networks used for benchmark testing least cost design algorithms, and has been shown to be efficient and robust. A least-cost design of water distribution networks under demand uncertainty is developed by Babayan et al (2005). A new approach to quantifying the influence of demand uncertainty is proposed. The original stochastic model is reformulated as a deterministic one, and it is coupled with an efficient genetic algorithm solver to find robust and economic solutions. Khu and Keedwell (2005) formulated a multi-objective optimization problem for water distribution network design and results are compared with optimization using a single-objective Genetic Algorithm and two- objectives optimization using a non-dominated sorted Genetic Algorithm-II (NSGAII). Atiquzzaman et al (2006) suggested a scheme to assist decision makers in selecting the best alternative water distribution network design solution which is within the available budget and tolerated pressure deficit. A multi objective optimization algorithm, NSGA-II is coupled with water distribution network simulation software-EPANET (Rossman, 2000) to demonstrate the application of the same. Geem (2006) presented a cost minimization model using Harmony Search (HS) algorithm for the design of water distribution networks. The model is applied to five water distribution networks and the results showed that the Harmony Search-based model is suitable for water network design. **2.1.2 Network Layou**

3.2 TYPES OF WATER TANK



Basing on the location of the tank in a building s tank can be classified into three categories. Those are:

- Underground tanks
- Tank resting on grounds
- Overhead tanks

In most cases the underground and on ground tanks are circular or rectangular is shape but the shape of the overhead tanks are influenced by the aesthetical view of the surroundings and as well as the design of the construction

5. CONCLUSIONS

Storage of water in the form of tanks for drinking and washing purposes, swimming pools for exercise and enjoyment, and sewage sedimentation tanks are gaining increasing importance in the present-day life. For small capacities we go for rectangular water tanks while for bigger capacities we provide circular water tanks. Design of water tank is a very tedious method. Without power also we can consume water by gravitational force.

As per the specification the design of the water tank stand was done. Modal and structural analysis is done and achieved the accurate results. Comparison is done for the two materials of different two loads and as per the analysis results structural steel is concluded as better when compared to iron.

According to the results achieved from equivalent stress and total deformation for structural steel is more when compared to iron. This is suggested after the comparison was done for two load conditions. In model analysis, the density of structural steel is more than iron, so that the mode shapes of structural steel are more than iron. The structural analysis has a significant effect on the overall stresses in the water tank stand

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We thank our internal mentor, Mr.B.Sravan kumar, Professor sincerely for his valuable advice and encouraging words throughout this project. The expert supervision and insightful suggestions from Dr. SM.SUBASH , Prof Storage of water in the form of tanks for drinking and washing purposes, swimming pools for exercise and enjoyment, and sewage sedimentation tanks are gaining increasing importance in the present-day life. For small capacities we go for rectangular water tanks while for bigger capacities we provide circular water tanks. Design of water tank is a very tedious method. Without power also we can consume water by gravitational force.

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