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Design and Analysis of Overhead Tank and Analysis of Cracks in Beam by SHC and Other Method

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ABSTRACT

Reinforced concrete tanks are used liquid containing vessels. Such tanks can be ground supported tanks ground storage reservoir and high ground level storage reservoir or elevated water tanks may be referred as elevated storage reservoir .Although most design codes provide guidelines for rectangular and cylindrical tanks, no guidance is provided in EBCS codes for Elevated water tanks. For the analysis and designing the Intze tank along with the EBCS code, ACI code and IS code is used. Therefore, this thesis is study the behavior and design of this type of tanks.

In this study membrane analysis isused to find the meridionalthrustandhoopstress calculation at various components of the Intze tank.

KEYWORDS: Life line systems, Intze tank, Meridional thrust, Hoop stress, EBCS,ACI, IS codes, Wind load.

INTRODUCTION TO OVER HEAD WATER STORAGE TANK

Over head Water Storage Tank is a usual Water storage tank as its name stands for itself these tank is place over the head that built on a certain height. The tank may built to many material but the idea is to achieve maximum efficiency by placing a tank in some elevated distance.

The water from the ground level filled inside the tank through pumping. It achieved with the high power motor pumps that send the water to storage with high pressure. These Tank scan be anywhere above a Town or even within your house where it built on the rooftop. The main purpose is to achieve an even distribution and it maintains constant pressure and flows, at the time of discharge when the water comes down from a certain height it has a sufficient increase in pressure that makes it serves at a constant rate in almost every outlet.

OVERHEADWATERSTORAGETANKAPPLICATIONS

Over head Water Tanks can be use din various applications can serve both Domestic purposes and Commercial Purposes. Constantly maintains the flow in all the general bathroom usages and other water requiring appliances.

DOMESTICAPPLICATIONOFOVERHEADWATERSTORAGETANK

In the Domestic Purposes, the water is utilized in almost every action we perform as like drinking, cooking, bathing, cleaning, washing, and other general uses. Appliances as like washing machine and purifiers need constant flow those needs are satisfied by these overhead tanks at the domestic level.

COMMERCIALAPPLICATIONOFOVERHEADWATERSTORAGETANK

In the Commercial Purposes, the tank employed overhead can benefit not only by storing water, but chemicals also be stocked to maintain the flow when they are used. Industrial buildings,Hospitals,Logisticyards,manufacturing,chemicalindustries etc. these are some of the areas where overhead tanks can benefit.

MECHANICALSCOPEOFWORK DESIGNCRITERIA

The Design Criteria adopted for the works proposed under this detailed project Report is in accordance with the directives and guidelines issued by Ministry of Jal Shakti Department of Drinking Water and Sanitation National Jal Jeevan Mission.

- **Design Criteria for Head Lossor Pressure Drop**

Friction Head Loss per Meter of pipe computed by using **Hazen William** Formula given below:

$Q=1.292\times10^{-5}\times C\times D^{2.63}\times S^{0.54}$

Where,

C-Hazen William coefficient D-Pipe Diameter in mm

Q-Discharge in cubic meter per our S- Friction Slope

Note: StationLossof2misconsideredateverypumpingstation.

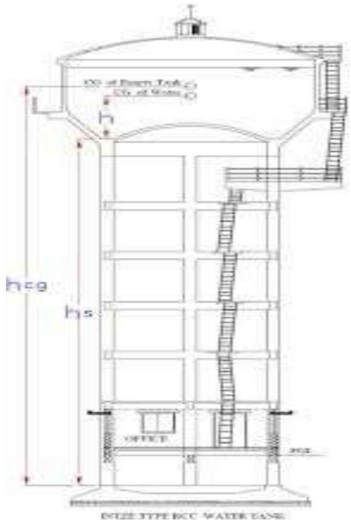
Losses in bends & valves has been accounted for by adding 10% to calculated friction head loss .Hazen William's Roughness coefficient has been adjusted by appropriate multiplication factor i.e.0.949834521 software Water Gems.

- **Hazen William Co-efficient**

It is a factor or value used to indicate the smoothness of the interior of a pipe .The higher the C Factor, the smoother the pipe, the greater the carrying capacity, and the smaller the friction or energy losses from water flowing in the pipe. It used in calculating the relative roughness of a pipe against the size of its diameter.

Following C values for DI and HDPE pipes are adopted ,as per CPHEEO Manual1999.

- DI Pipe C=140
- HDPE Pipe PN6PE-100 C=145



STRUCTIRAL ANALYSIS

Modeling

The structures modeled in STAAD-PRO with the appropriate support condition provided as required.

BASICLOADS

All buildings and structures shall be designed to resist the worst combination of the following loads/stresses under test and working conditions;

- Dead load
- Imposed loads or Live load
- Mono rail load
- Wind load
- Seismic load
- Hydrodynamic pressure load
- Vehicular Surcharge
- Earth pressure
- Pump & Equipment loads

Dead Load

Dead load comprises of the self-weight of all the permanent structural components including walls, floors, columns ,roofs, partitions, stair ways equipment set ,as applicable to individual structures.

The following unit weight of materials hall be considered for computation of loads. LoadsgiveninIS:875(Part-I)shallconsideredforthematerialnotlistedbelow.

Imposed Load

The Imposed loads considered shall not be less than thatspecifiedinIS:875(Part-II). Floors and supporting members, which may be subjected to equipment live loads, shall be designed based on the weight of the equipment or specifically defined loads, whichever is greater.

Following minimum loads shall be considered in the design of structure as per IS875.

Mono rail Loads

Monorail and supporting columns shall be designed for vertical and horizontal forces including impact forces. All lifting beams and monorails shall have their design loads increased for impact factor.

Impact factor:

Impactloadsformonorail,shallbetakenasperIS:875(Part-II).The minimum impact factors to be use din design shall be as follows:

Mono rail loads:

AsperIS875(Part-II)-1987,

a. Impact factor of 10% of lifted load in case of hand operated chain pulley block.
b. Impact factor of 25% of lifted load of electrical pulley and support design.

Wind Load(WDL)

Wind load on structure shall be calculated as per provisions latest version of IS:875- 2015(Part-III).The wind shall be asumed to blow in any direction and most unfavorableconditionshallbeconsidered.Followingparametersshallbeconsideredforthewind load calculation.

Basic wind speed=47m/sec Risk coefficient (k1) =1.00 Terrain category for (K2) Factor =Category-2 Topography factor(k3)=1.0 Importance factor(k4)=1.0

Seismic Load(SL/EQ)

All the structures will be designed for seismic forces using provisions of IS:1893(Part–I)-2016and IS:1893(Part-II)-2014.

The design horizontal seismic coefficient 'Ah'for the structure will be determine using the following expression

Ah=[(Z/2)(I/R)(Sa/g)]

Seismic zone=III Zone Factor (Z)

=0.16

Responsered uction factor for Building-R=3(ForOMRF)andR=5(ForSMRF) Responsered uction factor for OHT's-R=2.5(For OMRF)and R=4(For SMRF)Importance factor,I=1.5

Damping=5%

Hydrodynamic Load

Dynamic Increment of loads due to seismic shall be considered in the design asperlateststandards.Sametobeconsideredinworking/operatingcondition i.e. water level is considered up to TWL for calculating dynamic increment loads.

Deflection Criteria DeflectionCriteriashallbeinaccordancewithIS:456forconcretestructures,forsteel StructuresIS800 shall be followed.

DESIGNMETHODOLOGY

General

TheStructureincontactwithwaterincludingthememberscoveringthesame such as roof of a tanks ,channel, chamber etc. **shall be designed as cracked section with limited crack width of 0.2mm** as per IS3370-2009part-2. Basement RC walls and slabs below ground shall also be designed by cracked method of design as liquid retaining structures.

Design Norms for Foundation

General

All Structures, building foundations ,equipment foundations ,water retainingstructures,trenches,pitsetc.shallbedesignedasperNIT&relevantIScodes.

Foundation

The minimum depth of foundation for all structures, building and frame foundationsandloadbearingwallsshallbeconformingtoIS:1904.

Foundationforallstructuresshallbedecidedbasedonloadingarrangement,load intensity and soil strata. **The safe bearing capacity (SBC) considered for design purpose is as per Soil investigation data.**

DesignforcesareobtainedfromSTAAD-Proanalysisandcheckedforbearing capacity, overturning and sliding. Capacity is increased by 25% for all the loads combinationwithwind/seismic.Thefoundationisdesignedasperlimitstatemethod of design as per IS: 456:2000.

MinimumCovertoReinforcement

MinimumclearcovertomainreinforcementshallbeasperrelevantIScodes.

MinimumPercentageofSteel

Forbuildings:AsperIS:456-2000.

For liquid retaining structure The minimum reinforcements in walls, floor sand roof so fliquid retaining structures in each of twodirectionsatrightanglesshallbeasperIS3370.

Minimum Thickness of Structural Components

Minimum member thickness for different structural elements shall be as per design requirement.

Minimum Bar Diameter

The minimum bar diameter for all the elements shall be as per IS codes.**However, diametershallnotbelessthan10mmformainreinforcementand8mmin case of distribution.**

Minimum Bar Spacing

TheminimumspacingforalltheelementsshallbeconsideredasperIS3370for liquidretainingstructuresandasperIS456forotherStructures.

FOUNDATION DESIGN

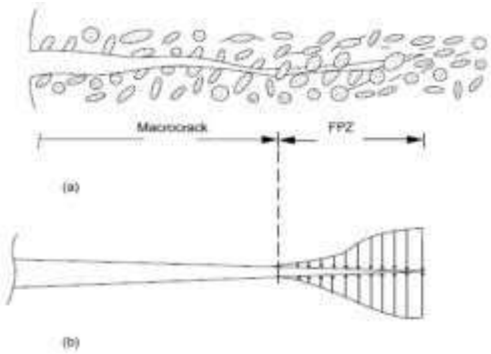
Foundation design shall be based on recommendations provided in the Geotechnical Report. The Owner shall retain the services of a testing firm to confirm that the design conditions are in conformance with design recommendations. The design of the foundation shall be in accordance with the requirements of ACI 301, ACI 318, and the Geotechnical Report.

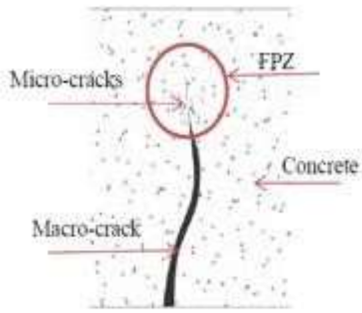
Minimum concrete compressive strength shallbe3,000psiat28days

Analysis of cracks

THE FORMATION OF CONCRETE CRACKS

structure. Mechanical characteristics of cementitious materials are much controlled by defects. For example, microcracks are common in concrete before it is loaded; at places, poresaround the associate of the coarse particles and mortar. The significant mortar contracting is the way that they are brought about. In addition, there are breaks in the mortar network. And as a heap is applied on that single and repeatedly, the two earlier bursts of growth continue ever growing and new bursts emerge. This breaking interface associates with the mortar break and penetrates the mortar. A large scale crack is shaped at the point when many micro cracks have gathered. A huge scale break (ceaseless arisal free crack) and its encompassing district, in a, is appeared in figure underneath. This portion of the analysis is dedicated to the break interaction zone (FPZ), the harmed zone right away in front of the footing free break, and is pertinent in finding a reasonable way to deal with the break transmission. However, only a few of the miniature disappointment procedures that happen inside the FPZ are lattice micro cracking, de bonding of the concrete framework interface, break deviation and fanning. These components impact break energy. The most noteworthy FPZ conclusion stress concerning restricted damage is at the FPZ tip and after that diminishes to zero at the complete scale crack tip.





1.3.2.CRACKED BRANCH

These are the material of toughest technique. For given small of the microcracks, when the cracked tipping is blocked most of its super energies is needed for cracking production, which causes the scattering of the crack. Crack bridging and restricting impact on the crack course is carried out by reinforced concrete from reinforcement. They may make it more feasible for various branches of cracks that improve crack branching & stress redistribution behavior during the failure phase [6]. Therefore, reinforced fails to indicate a ‘size effect on the cracking producing, and failing, operation, in RC beams**.**

RC STRUCTURE DUCTILITY

It is intrinsically linked to the energies of dissipation of the environment. Ductile refers to the abilities of substances to supply proper reformatting of inelasticity after the yield- out but before facture on R.C construction. In the case of steel RC, the malleability mattersbecausetheappliedefforthasburnedthroughthesteelinirreversibleinelastic

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