**Design of**

**Underground Water Tank**

A Training Report Submitted

In Partial Fulfilment of the Requirements

For the Degree of

**Bachelor of Engineering**

**In**

**Civil Engineering**

**ABSTRACT**

The Underground tanks are used to store water, liquid petroleum, petroleum products and similar liquids. The force analysis of the 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 i.e. rectangular underground water tank.

This report includes requirement of water tank, survey, excavation methods, Reduced Levels, Average Depth of UGWT, Soil on which it is constructed, Depth of water Table, Type of Mix Design and Capacity of the tank.

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1. **Introduction**

Gyanganga society is a residential society being constructed by Goel Ganga Developers formally known as Goel Ganga pvt. Ltd. Ii is being constructed in Rahatani village in PCMC Municipal Corporation.

Society has proposed 5 buildings each of seven floors having 4 flats per floor.

Thus in this project an attempt has been made to design a water tank for storing drinking and utility water to serve daily requirement of the entire society.

The project work consisted of the following –

1. Requirement
2. Survey
3. Excavation
4. Design Requirments
5. Approval from RCC Consultant
6. PCC and Water Proofing
7. **Requirement**

Water is one of the basic necessarily for a human.An absolute “minimum water requirement” for humans is independent of lifestyle and culture, can be defined only for maintaining human survival.

Different sectors of society use water for different purposes i.e. drinking, cooking food, bathing and washing clothes, sanitation and many other daily use utilities. The water required for each of theseactivities varies with climatic conditions, lifestyle, culture, tradition, diet, technology and wealth.

Water requirements for a society varies upon various factors i.e. No of buildings in society, No of floors in each building, No of flats on each floor etc etc. Moreover if society consists of row houses then water requirement for society increases as per gardening needs. Amenities like common garden, swimming pool, gymnasium, play ground, jogging park and club house have become additional factors of increased water requirement of a society now a days.

**Specifications of GyanGanga Society:**

1. Total no of Floors = 7
2. No. Of Flats on each floor = 4
3. Total no. of Flat = Total no. of floors \* No. of flats on each floor

= 7\*4

= 28 flats

1. Average no of person per flat = 6
2. Total no. of personliving in bldg = No of Flat \* Avg people per flat

= 24\*6

= 168

1. Total no. of Buildings in society = 5
2. Total person in society = 168 \* 5 = 840

According to Indian Standard,

Consumption of water per person per day (WCPPPD) = 135 ltrs.

WCPPPD includes following division of water requirement:

1. Drinking Water – 4 ltrs
2. Cooking Food – 6 ltrs
3. Dish/ Vassal washing – 25 ltrs
4. Bathing – 25 ltrs
5. Washing Clothes – 20 ltrs
6. Sanitation – 45ltrs
7. Wiping floor – 5 ltrs
8. Watering plants – 5 ltrs

Hence Calculated Total water consumption per day for GyanGanga society

= WCPPPD \* Total person

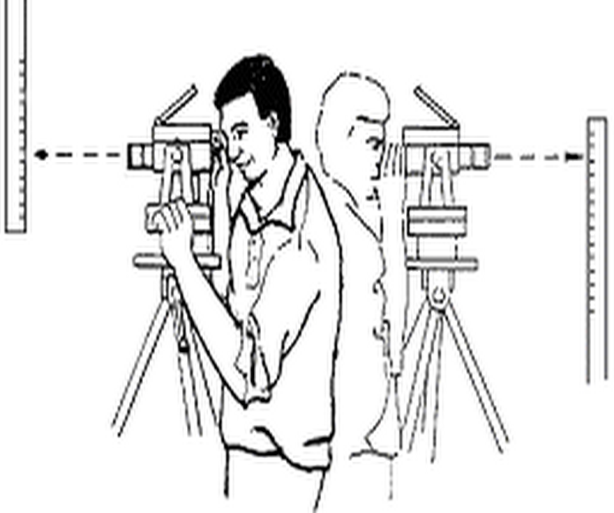
= 135\*840

= 1,13,400ltrs

&,

Capacity of the constructed under ground water tank= 1,78,000 LTRS

1. **Survey**



Detailed survey of the location was carried out for 1 day using the Dumpy Level Instrument at GyanGanga site.

Dumpy Level is a instrument which can be used to perform all the steps involved in the survey work such as simple leveling and height measurements etc., with average level of accuracy.

The survey work was carried out by ‘Simple Leveling’ method using the benchmark of RL 100.00m.

In the simple leveling method, the difference of level between two points is determined by setting the leveling instrument midway between the points.

Suppose A and B are two points whose difference of level is to be determined. The level is set up at ‘O’, exactly midway between A and B. After proper temporary adjustment, the staff reading on A and B are taken. The difference of these reading gives the difference of level between A and B.

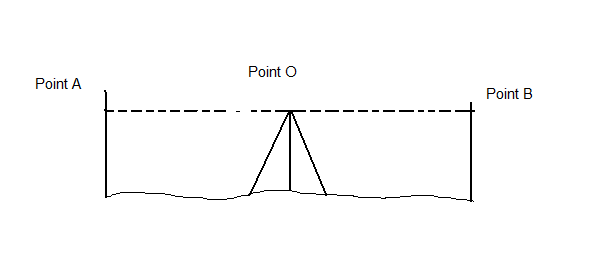


FIG 3.1

Thus in course of the survey, important points of the tank were recorded.

After the survey work, the data in the form of points and their coordinates was transferred on the paper and further calculation has been done to using the recorded reduced levels.

1. **EXCAVATION**

**Excavation** is the preliminary activity of the construction project. It starts from the pits for the building foundations and continues up to the handing over of the project.

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**Scope of the work:**

* Setting out of corner benchmarks.
* Survey for ground levels.
* Survey for top levels
* Excavation to approved depth.
* Dressing of loose soil.
* Making up to cut off level
* Constructing dewatering wells and interconnecting trenches.
* Marking boundaries of the building.
* Constructing protection bunds and drains

**Working Procedure:**

* The extent of soil and rock strata is found by making trial pits in the construction site. The excavation and depth is decided & approved according to the concerned site’s R.C.C consultant.then, excavation is carried out as follows-
* Setting out or ground tracing is the process of laying down the excavation lines and center lines etc. on the ground before the excavation is started. The center line of the longest outer wall of the building is marked on the ground by stretching a string between wooden or mild steel pegs. Each peg may be projected about 25 to 50 mm form the ground level and 2m from the edge of the excavation. The boundary is marked with the lime powder. The center lines of other walls are marked perpendicular to the longer walls & the excavation work is started with the help of JCB machine. Digging is done up to a depth(Approved by R.C.C consultant) of 3.5 meters

**Removal of Excess Soil**

· Estimate the excavated stuff to be re-utilized in filling, gardening, preparing roads, etc.As far as possible try to carry excavation and filling simultaneously to avoid double handling. Select and stack the required material in such a place that it should not obstruct other construction activities. The excess or unwanted material should immediately be carried away and disposed off by employing any of the following methods.

* Departmental labour.
* Tractor.
* Trucks.

1. **DESIGN REQUIREMENT OF CONCRETE (I. S. I)**

In water retaining structure a dense impermeable concrete is required

therefore, proportion of fine and course aggregates to cement should be

such as to give high quality concrete.

Concrete mix weaker than M20 is not used. The minimum quantity of

cement in the concrete mix shall be not less than 30 kN/m3

.

The design of the concrete mix shall be such that the resultant concrete is

sufficiently impervious. Efficient compaction preferably by vibration is

essential. The permeability of the thoroughly compacted concrete is

dependent on water cement ratio. Increase in water cement ratio increases

permeability, while concrete with low water cement ratio is difficult to

compact. Other causes of leakage in concrete are defects such as

segregation and honey combing. All joints should be made water-tight as

these are potential sources of leakage.

Design of liquid retaining structure is different from ordinary R.C.C,

structures as it requires that concrete should not crack and hence tensile

stresses in concrete should be within permissible limits.

A reinforced concrete member of liquid retaining structure is designed on

the usual principles ignoring tensile resistance of concrete in bending.

Additionally it should be ensured that tensile stress on the liquid retaining

face of the equivalent concrete section does not exceed the permissible

tensile strength of concrete as given in table 1. For calculation purposes

the cover is also taken into concrete area.

Cracking may be caused due to restraint to shrinkage, expansion and

contraction of concrete due to temperature or shrinkage and swelling due

to moisture effects. Such restraint may be caused by .

(i) The interaction between reinforcement and concrete during shrinkage

due to drying.

(ii) The boundary conditions.

(iii) The differential conditions prevailing through the large thickness of

massive concrete.

Use of small size bars placed properly, leads to closer cracks but of

smaller width. The risk of cracking due to temperature and shrinkage

effects may be minimized by limiting the changes in moisture content and

temperature to which the structure as a whole is subjected. The risk of

cracking can also be minimized by reducing the restraint on the free

expansion of the structure with long walls or slab founded at or below

ground level, restraint can be minimized by the provision of a sliding

layer. This can be provided by founding the structure on a flat layer of

concrete with interposition of some material to break the bond and

facilitate movement.

In case length of structure is large it should be subdivided into suitable

lengths separated by movement joints, especially where sections are

changed the movement joints should be provided.

Where structures have to store hot liquids, stresses caused by difference

in temperature between inside and outside of the reservoir should be taken

into account.

The coefficient of expansion due to temperature change is taken as 11 x

10-6 /° C and coefficient of shrinkage may be taken as 450 x 10-6 for initial

shrinkage and 200 x 10-6 for drying shrinkage.

**5.1 JOINTS IN LIQUID RETAINING STRUCTURES**

**5.1.1 MOVEMENT JOINTS.** There are three types of movement joints.

(i)***Contraction Joint*.**It is a movement joint with deliberate discontinuity

without initial gap between the concrete on either s0ide of the joint. The

purpose of this joint is to accommodate contraction of the concrete.

The joint is shown in Fig.5.1 (a).



FIG 5.1(a)

A contraction joint may be either complete contraction joint or partial

contraction joint. A complete contraction joint is one in which both steel

and concrete are interrupted and a partial contraction joint is one in which

only the concrete is interrupted, the reinforcing steel running through as

shown in Fig.5.1(b).



FIG5.1(b)

(ii)***Expansion Joint*.**It is a joint with complete discontinuity in both

reinforcing steel and concrete and it is to accommodate either expansion

or contraction of the structure. A typical expansion joint is shown in

Fig.5.2



FIG5.2

This type of joint requires the provision of an initial gap between the

adjoining parts of a structure which by closing or opening accommodates

the expansion or contraction of the structure.

(iii) ***Sliding Joint***. It is a joint with complete discontinuity in both

reinforcement and concrete and with special provision to facilitate

movement in plane of the joint. A typical joint is shown in Fig. 5.3



FIG5.3

This type of joint is provided between wall and floor in some cylindrical

tank designs.

**5.2.2. CONTRACTION JOINTS**

This type of joint is provided for convenience in construction.

Arrangement is made to achieve subsequent continuity without relative

movement. One application of these joints is between successive lifts in a

reservoir wall. A typical joint is shown in Fig.5.4.



FIG5.4

The number of joints should be as small as possible and these joints

should be kept from possibility of percolation of water.

**5.2.3 TEMPORARY JOINTS**

A gap is sometimes left temporarily between the concrete of adjoining

parts of a structure which after a suitable interval and before the structure

is put to use, is filled with mortar or concrete completely as in Fig.5.5(a)

or as shown in Fig.5.5 (b) and (c) with suitable jointing materials. In the

first case width of the gap should be sufficient to allow the sides to be

prepared before filling.



FIG5.5A



FIG5.5B



FIG5.5C

**6. GENERAL DESIGN REQUIREMENTS (I.S.I)**

**6.1 Plain Concrete Structures.** Plain concrete member of reinforced

concrete liquid retaining structure may be designed against structural

failure by allowing tension in plain concrete as per the permissible limits

for tension in bending. This will automatically take care of failure due to

cracking. However, nominal reinforcement shall be provided, for plain

concrete structural members.

**6.2. Permissible Stresses in Concrete.**

**(a) For resistance to cracking.** For calculations relating to the resistance

of members to cracking, the permissible stresses in tension (direct and

due to bending) and shear shall confirm to the values specified in Table 1.

The permissible tensile stresses due to bending apply to the face of the

member in contact with the liquid. In members less than 225mm. thick and

in contact with liquid on one side these permissible stresses in bending

apply also to the face remote from the liquid.

**(b) For strength calculations.** In strength calculations the permissible

concrete stresses shall be in accordance with Table 1. Where the

calculated shear stress in concrete alone exceeds the permissible value,

reinforcement acting in conjunction with diagonal compression in the

concrete shall be provided to take the whole of the shear

**7. P.C.C & WATER PROOFING**

**7.1 Plane cement concrete (P.C.C.)-**

After approving(Bearing capacity of soil) from R.C.C consultants construction of under ground water tank is started. 150mm thk plane cement concrete (p.c.c) is done as per mix design M-20.

The ratio is as follows-

Cement-----------50 kg

Metal -------------20mm @224 kg

Crush sand-------207 kg

Fly ash -----------224 kg

Fosroc chemical—248 ml

Water ------------37.20 ml

**7.2 Water Proofing-**

* Water proofing is done at the top of the P.C.C by rough shabad flooring.
* First 20 mm morter of 1:6 ratio is applied, & above this rough shabad flooring is done.
* Joints are filled with cement between the rough shabad flooring.
* After this 12mm plaster coat is applied.
* Steel reinforcement is set as per consultant drawing.

8.CONCLUSION

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. Particularly design of

under ground water tank involves lots of mathematical formulae and

calculation. It is also time consuming. Hence program gives a solution to

the above problems.

There is a little difference between the design values of program to that of

manual calculation. The program gives the least value for the design.

Hence designer should not provide less than the values we get from the

program. In case of theoretical calculation designer initially add some

extra values to the obtained values to be in safer side.