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A Case Study on Water Storage Tank Design and Constrution for Domestic Purpose in Shashemene Town, Ethiopia

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Abstract
Shashemene town is located 250km south of Addis Abeba, main city of Ethiopia and have about **122,046** population. The town has been blessed with flat terrain.The only limited factor is water .Currently, Shashemene town water supply office is supplying a water for these population once a week due to lack of enough water storage tank and continuous electric supply.The previous water supply system did not fit with current population. The recommended water storage tank minimizes water shortage by half and can be constructed by low cost. Average consumption of **35lpcd** per person was taken for domestic purpose. The construction of the water storage tank involves different steps that are site clearance from the design area,land leveling, materials selection which included water, cement, sand and gravel. The recommended Tank dimension (Length X Width X Height of 18m X 18m X 2m) for structure included. Tank is backfilled with near soil or by selected materials.
Keywords: Storage Tank, Design, Construction, Discharge, Per capita demand

1. INTRODUCTION

In Ethiopia, one in six children dies before their fifth birthday. Diarrhea, a water-borne disease, is attributable to over 22 per cent of these deaths(Unicef). This indicate that the country have no sufficient access for potable water. To reduce this inabilities water storage is needed. "Infectious diseases caused by pathogenic bacteria, viruses, protozoa and helminthes are the most common and widespread health risk associated with drinking water." (WHO, 2004. Guidelines For Drinking Water Quality 3rdEd. p. 123). Good desease free water storage reduces the above mentioned health risk. Storage reservoirs or tanks 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. Due to the population expansion , the water demand has unexpectedly increased. So, it is needed to conserve water for the increasing demand of the water supply by minimizing the water loses as much as possible to meet the drinking water requirement in the country. The tank storage structure is the only water source to store drinking water and help people to use for domestic,institutional,agricultural,public and industria purposes. Tanks are small reservoirs they represent an important water resource for people, crops, livestock and fish.New investment in major water supply which is difficult due to the high cost of big projects including the electricity as a for large water supply project. Those factors that significantly influence the performance of a tank were used to formulate a tank modernization index.(Balasubramanian and Govindasam 1991).

This study aims at designing and constructing a low cost water storage tank to meet with current water demand for domestic purposes.

1.1 Per capita Demand

For the purposes of estimation of total requirement, the water demand is expressed in liters/capita/day i.e. per capita demand. From the current water demand of Shashemenne town, average water consumption of 35l/d is taken.

1.2 Design Period

Before designing and construction a water supply scheme, it is the engineer's duty to assure that the water works should have sufficient capacity to meet the future water demand of the town for number of years. For our case, we are solving the current problems due to budget shortage.

2. RESULTS AND DISCUSSION

2.1.Tank Size

The total water storage requirements for a given water supply system where the treatment plant is capable of satisfying only the maximum day demand may be calculated using the following equation:
S = A + B + C
Where: S = Total Storage requirement, m^3;
A = Fire Storage, m3 (equal to required fire flow over required duration);
Advisory Organisation (IAO)
B = Peak balanced storage, m3, 25% of maximum day demand
C = Emergency storage, m3, 25 % of A + B or 15 % average daily design flow or 40 % of average daily design

flow when no fire storage(Newfoundland and Labrador Guidelines for the Design, Construction and Operation of Water and Sewerage Systems (2005). For the population of 122,046,and 35lpcd, Total demand=(122,046*35)=4,271,610 litre per day. S=30%(day demand) was taken. S=4271610*0.30=1,281,483litre=1281.644m^3. The tank should be filled twice a day, hence a size having dimensions of **18m*18m*2m** is recommended for the tank.

2.2.Design of Water storage tank

While designing a tank the following steps should be taken in consideration which include the

- ✓ Wall design
- ✓ Slab design
- ✓ Design of foundation and floor
- ✓ Outlet
- ✓ Inlet

2.3 Design of walls

For the wall construction hollow concrete block is preferred. The design consideration for both plain concrete and hollow concrete block has little difference.

The loads applied to walls of the tanks are:

- ❖ Water Pressure inside the tank;
- ❖ Back fill Pressure on the outside of the tank; and
- ❖ Earth quake and Other.

2.4 Quantity Estimation of Water Storage Tank

The calculations of these quantities are based on the following assumptions:

Standard size of Hollow Concrete Block 400 mm x 200 mm x 90 mm have been used.

1:2:3 mix ratio is used for all concrete.

1:4 mix ratio is used for all mortar and plaster .

Inside of the tank should be lined properly.

3. CONSTRUCTION OF STORAGE TANKS

As far as construction of water storage tank is concerned, construction is carried out in the following steps.

- ⇒ Preparation of construction material.
- ⇒ Construction site preparation.
- ⇒ Site clearance and excavation.
- ⇒ Lying of bed and concrete foundation.
- ⇒ Wall Construction.
- ⇒ Out let, inlet and over flow area Construction.
- ⇒ Wall Plastering and lining.

4. Conclusions

Importance of Water Storage in the form of tanks for drinking and washing purposes, are gaining increasing in the present day life. For small capacities we go for rectangular water tanks while for bigger capacities we provide circular water tanks.Ethiopia has lowest water supply coverage levels in the world. Even has low standard compared to Sub-Saharan African countries. Among other things, inappropriate choice of technology, and failure to involve user communities in decision-making processes at the project preparation stage have retarded the growth in water supply coverage.

The storage tank is filled to its freeboard level which is used when supply shortage and electricity is off. With the construction of water storage tanks, even very small quantities of water can be used which was not possible by direct pumping to the field due to more advance time & higher losses. Due to Electricity fluctuation and some time without power supply for couple of days it is more easy to use stored water to directly supply.If the Shashemene town water supply office get a budget,they have to design enough storage tank and all water supply facilities in order to meet current and future water daily demand.

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Fig 1. Shashemene town Location map.

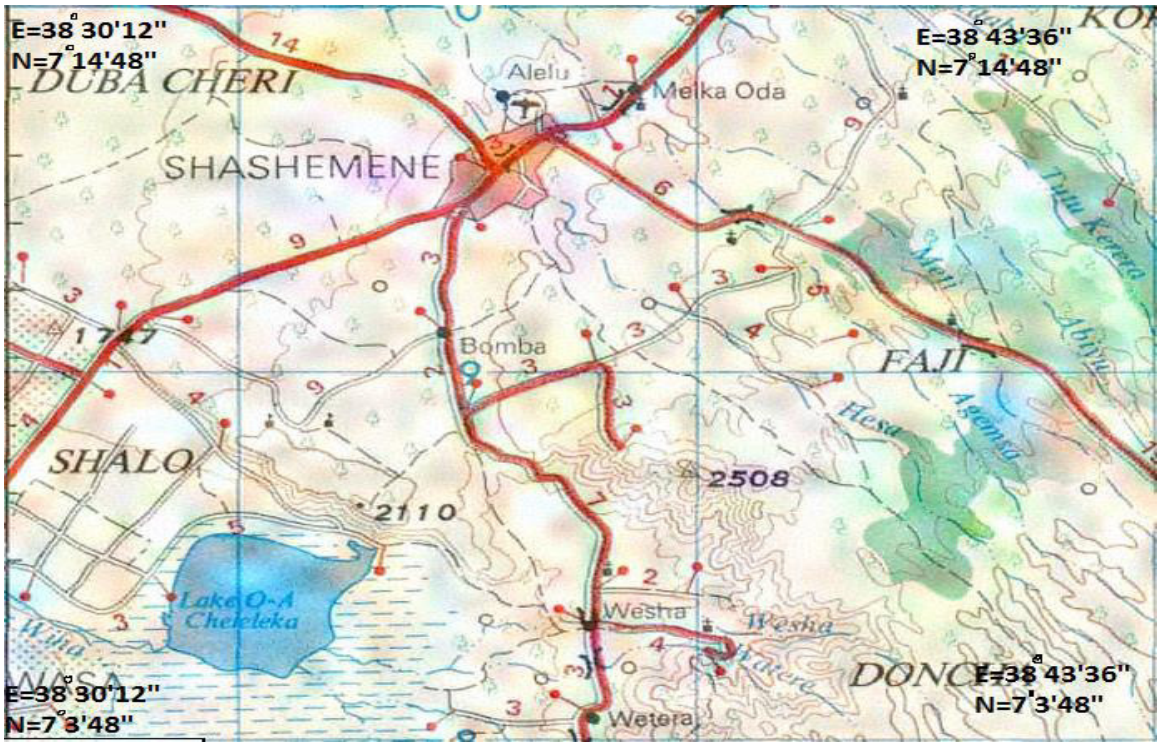

Table 1. Dimensions of Water Storage Tank

Length of Water Storage Tank	17.5m	
Width of Water Storage Tank	17.5m	
Height of WST	2m	
Thickness of plaster	0.01m	
Thickness of floor	0.15m	
	Width(m)	Height(m)
Thickness of slab cover	17	0.1
Thickness of floor under walls	0.95	0.1
1st step of walls	0.83	0.32
2st step of walls	0.71	0.32
3st step of walls	0.59	0.32
4st step of walls	0.47	0.32
5st step of walls	0.35	0.32
6st step of walls	0.23	0.40

Fig 2. Desgn of water storage tank

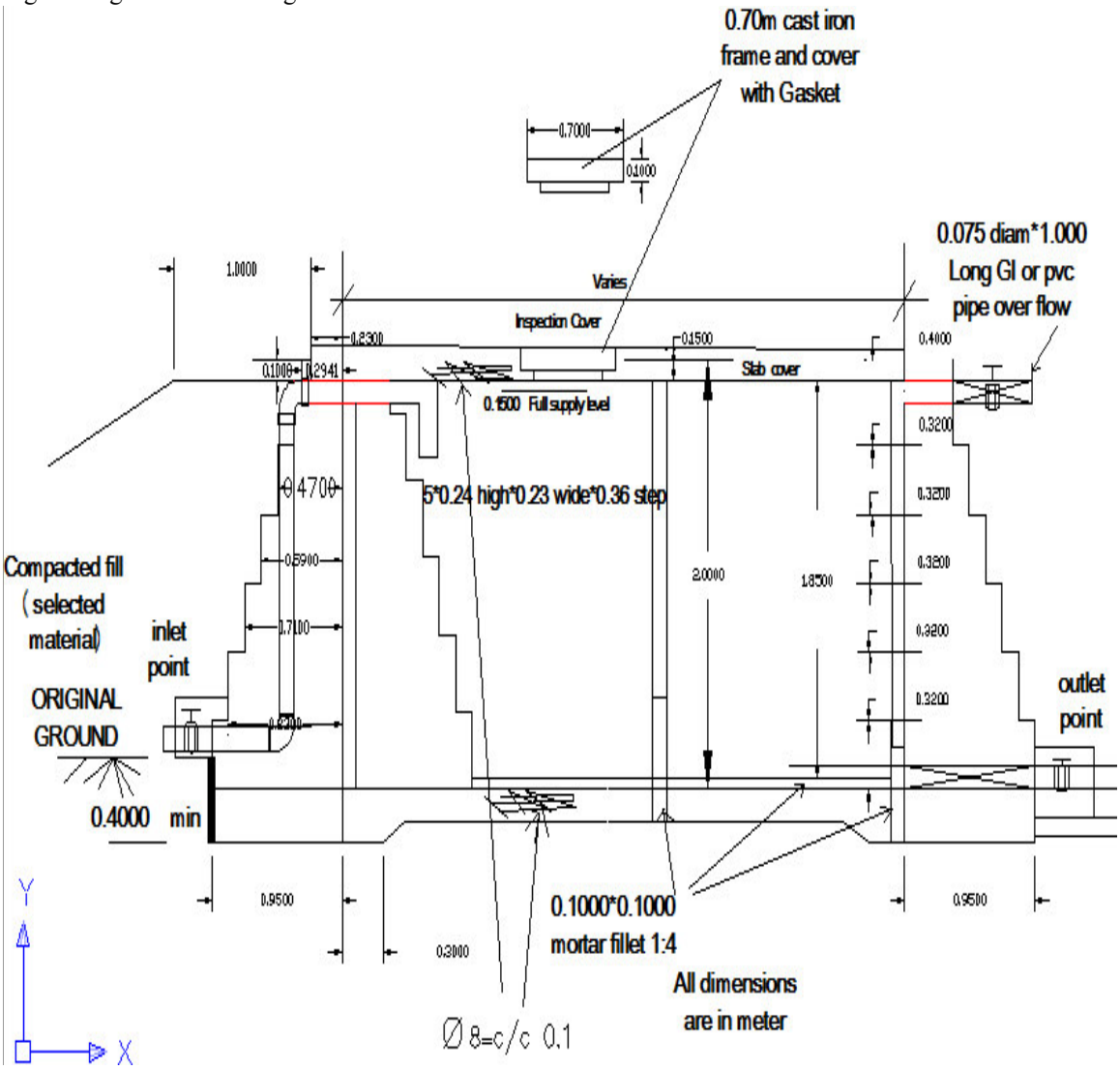

Table 2 Estimate of Material

S/No	Description	Quantity	units
1	R.C.C (1:2:3)	92.95	m^3
a	cement	335	quintal
b	sand	41.82	m^3
c	gravel	83.65	m^3
2	HCB work for steps, walls and plastering (1:4)	97.87	m^3
a	cement	16	quintal
b	sand	3	m^3
c	HCB	1504	No
3	Φ_8	4862	kg
4	Inlet and Exit - Diameter		$1^{1}/_{2}$''
a	Pipe GI SCH40 2" Diameter	1	No
b	Elbow PVC 45 Degrees 2" Diameter	2	No
5	Overflow		3''
a	Pipe GI SCH40 2" Diameter	1	No
6	Cast iron frame and cover with gasket	1	No