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A Case Study on Water Storage Tank Design, Constrution, Operation and Assessment in District Kalat, Balochistan

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Abstract
Balochistan has been blessed with all types of ecological zones; the only limited factor is water. Also grow more food by each drop of water is the cry of the day. For this it is utmost important to take maximum discharge from already design structures. In Balochistan there is no irrigation at night and tubewell is operating full night whose discharge were wasted and Electricity load shedding problems are also there especially at day time. For this a storage tank is required which stores water for further utilization at day time irrigation hours. For the design of storage tank the tube well discharge ,its operating hours and other parameters were assessed. Discharge of tube well was determined by using trajectory method which was 10 lps. Ten hours were taken as operating hours The construction of the water storage tank involves different steps that are removal of vegetation 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 17m X 17m X 1.37m) for scheme incorporated. Tank is backfilled with near by soil. The water stored during night is most beneficially utilized for 6 hr since morning for the command area at the tail of the water course instead of design discharge of tube well of 10 LPS (during day time) for the whole area which was not possible otherwise.
Keywords: Storage Tank, Design, Construction, Discharge, Cost Benefit Ratio

INTRODUCTION

Pakistan is an agricultural country, which having approximately 20 millions hectares of land reserved for agriculture out of 88 million hectares. Due to the expansion in the population, the water demand has drastically increased. So, it is needed to conserve water for the increasing demand of the agriculture by minimizing the water loses as much as possible to meet the crop water requirement in the country. The area is characterized by arid climate predominantly. Most of the areas receives only 150 mm rainfall annually, mostly in winter season when it is not much needed because plants are in dormant condition. It is painful to observe that despite the acute scarcity of this natural resource, it is being squandered at field level. To curtail this criminal wastage of irrigation water, improved water management practices need to be promoted such as lining of watercourses, construction of water storage tanks and provision of off take/check structures. The tank storage structure is the only water source to store rainwater and help farmers through crop growing period and provide stability to agricultural production. The under-development, stagnation and even decline of paddy agriculture during recent years in this region are usually attributed to the constraints in tank water supply. Whatever the shortcomings at their creation, existing irrigation tanks remain an asset to the sustainability of irrigated agriculture. (Anbumozhi *et.al* 2001). Tanks are small reservoirs they represent an important water resource for people, crops, livestock and fish. Considerable efforts have been made to rehabilitate tank irrigation systems in recent decades, but there have been few studies carried out to improve understanding of their hydrology. This paper presents a daily water balance approach, which aims to simulate the dynamic behaviour of tank storage. (Li and Gowing,2009). New investment in major irrigation which is difficult due to the high cost of big projects including the electricity as a constraint for large scale irrigation. Hence emphasis should be placed on modernizing the small irrigation systems such as tanks. To select tanks for modernization, factors that influence the performance of an irrigation tank were identified using a multiple linear regression model. Those factors that significantly influence the performance of a tank were used to formulate a tank modernization index.(Balasubramanian and Govindasam 1991).

MATERIALS AND METHODS

Apple was a major income earning for him. Source of irrigation was deep tube well of 50 Hp generated by electricity. The diameter of tube well pipe was 4 Inches and discharge was 10 ls^{-1}. The design include the water supply, size of the tank and the materials estimation verification. Most important consideration is the quantity of inflow for which the basic parameters are capacity of source (Tube well, Spring) and the operating hours of the scheme were calculated before designing. Size of the tank is designed according the total daily volume available as per crop water requirements.Construction of water storage tank is executed according to the standard

parameters stage wise. The site is thoroughly cleared of vegetation. All trees, shrubs and other growth are removed and their roots dug out. The site then is excavated down to the foundation level and the surface leveled.

RESULTS AND DISCUSSION

Discharge

The discharge of the tube well in study site was calculated by trajectory method. The calculations from the method are given below. As the estimated value comes out to be 9.48 l s^{-1} hence it is recommended to take it as 10 l s^{-1} for safe design purposes.

Area to be irrigated

The annual requirements for the apple trees on 28 ha needs 84000 m^3 of water. The calculation is based on 40 % of the cropped area irrigated from the whole command. In the existing scheme only 8 hectares were irrigated and rest of the land was not possible to be irrigated due to unavailability of water from the source. Due to lining of the storage tank, the area has increased to 18 ha in water stored.

Size of tank

For size of tank we need parameters operating hours which are 10 hours. Volume = 10 x 10 x 3.6 = 360 m^3

Tank Size = $\sqrt{360/1.37}$

= 16.21m

Hence a size having dimensions of 17 x 17 x 1.37 is recommended for the tank

Design of Water storage tank.

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

- Design of walls
- Floor and foundation design
- Inlet
- Outlet

Table 1. Dimensions of Water Storage Tank

Length of Water Storage Tank	17m	
Width of Water Storage Tank	17m	
Height of WST	1.37m	
Thickness of plaster	0.01m	
Thickness of floor	0.15m	
	Width	Height
Add: Thickness of floor under walls	0.89	0.1
1st step of walls	0.59	0.32
2nd step of walls	0.47	0.32
3rd step of walls	0.35	0.32
4th step of walls	0.23	0.41

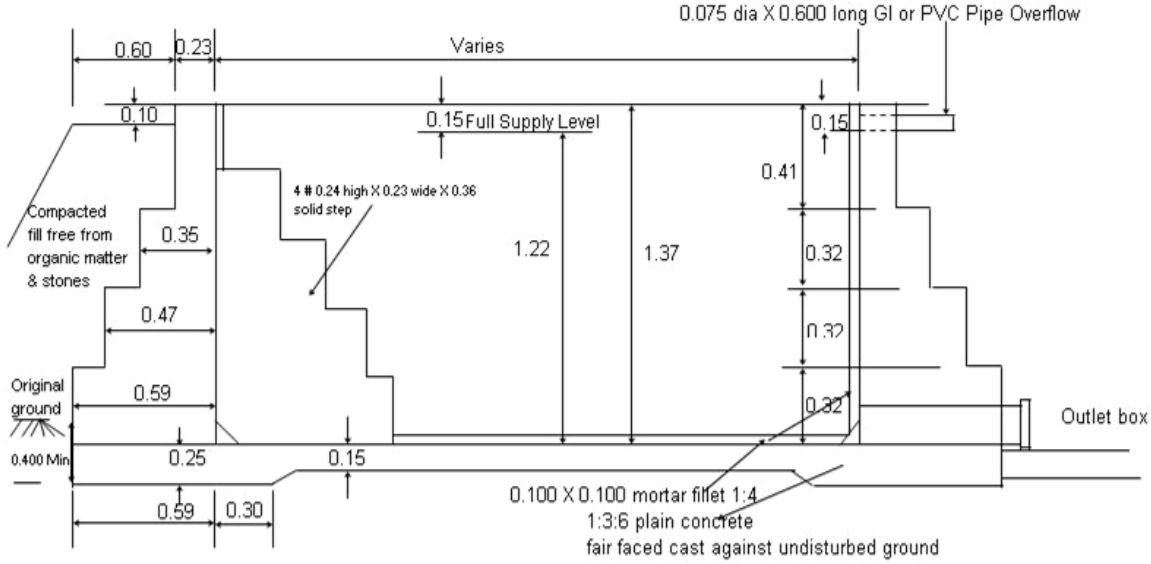

Figure 1.Design Of Water Storage Tank.

Design of walls

The most common construction material for the walls is brick. The design consideration for both bricks and PCC

has little difference.
The walls of the tank could be subjected to three loading conditions:

- Pressure from the water inside the tank;
- Pressure from the earthen backfill on the outside of the tank; and
- Other temporary loading conditions including earthquake loading.

Quantity Estimation of Water Storage Tank
The calculations of these quantities are based on the following assumptions:

- Bricks of a standard size 230 mm x 110 mm x 70 mm have been used.
- All concrete is 1:3:6 mix.
- All mortar and plaster is 1:4 mix.

These calculations do not include allowances for losses (wastages). Losses can vary considerably from place to place and the given situation and /or conditions in which the construction takes place.

CONSTRUCTION OF STORAGE TANKS
As for as construction of water storage tank is concerned it is the most complex procedure which was carried out in following steps.

- Arranging and preparation of construction material.
- Preparation of proposed site for construction.
- Lying of bed and concrete foundation.
- Construction of Walls.
- Construction of outlet box.
- Plaster of Wall

Table 2 Estimate of Material

1	**P.C.C (1:3:6)**				
	Volume	V_1		55.921	m^3
	Cement	=	V_1x0.42	234.87	Bags
	Sand	=	V_1x0.46	25.72	m^3
	Gravel	=	V_1x0.92	51.45	m^3
2	**Brick Masonry (1:4)**				
	Volume	V_2		38.375	m^3
	Ingredients				
	Cement	=	V_2x0.23x8.96	79.08	m^3
	Sand	=	V_2x0.23x1.26	11.12	m^3
	Brick	=	V_2x450	17268.75	m^3
3	**Plaster (1:4)**				
	Volume	V_3		1.56	m^3
	Ingredients				
	Cement	=	V_3x8.96	13.97	Bags
	Sand	=	V_3x1.26	1.96	m^3

Cost and Benefit ratio of Water Storage Tank
The total cost per unit capacity of the tank for various sizes (capacity). High costs, up to Rs 3.4 m was found for tank having a capacity below 400 m^3. This cost increases when the size of tank increases. It is because of the decrease in lining cost due to the reduction in wetted area relative to the increase in excavation cost per unit volume due to the increases surface area of land.

Conclusions
Operating tube well for almost 10 hours in the night time when there is no load shedding. The storage tank is filled to its freeboard level which is utilized during day time when electricity is off. Constructed storage tank decreased up to 30% water losses when compared to a earthen water storage tank. 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 utilize stored water to the field than directly supply.By providing water storage tanks, the farming communities would be able to use the stored water according to their needs. Whereas lining of water storage tank has saved water losses (~30%) hence lining of water courses will do more.

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