The Upgraded Family Well

How to construct

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Introduction

Very large numbers of family owned wells have been built in Zimbabwe. This number far exceeds 100 000. In almost every case the family itself has excavated the well and in many cases also lined it with bricks. This investment in time and money provides a great asset to the family for generations.

Some years ago the government of Zimbabwe initiated a program where assistance was given to families who had taken their own initiative to dig and partly protect their own well. This was partly based on bacteriological evidence which revealed that improving the "head works" (the surrounding concrete apron, raised collar and lid and water run off) of a well greatly improved the quality of water withdrawn from the well and also made the well much safer for children. It also became widely accepted that sources of water owned by families, were far more readily and willingly maintained than those placed in communal settings. The technology chosen was simple, traditional and easily maintained – the rope and bucket. Even such simple systems could provide sufficient water for domestic use and many also to water vegetable gardens in the homestead.

It is now well established that improvements in the design of the "head-works" of a well can improve both safety of the well from a child's point of view and also the quality of the water. Building a strong concrete "apron," raised collar (fitted with tin lid) and a water run-off helps to make the well head more hygienic. It greatly reduces waste water being discharged at the head of the well pouring back into the well chamber. The water run off leads unused or waste water away from the well head. This water can be utilised effectively by planting a valuable tree at the end of the run-off. Further improvements can be made by adding a windlass system to the upgraded well. The windlass system, which is commonly used in Zimbabwe has at least two advantages. First it makes lifting of the bucket from the well chamber much easier. Second, the chain or rope which is used to raise the bucket is hygienically stored on the windlass drum and does not lay on the ground or where it may pick up bacteria from the surrounding environment. When a contaminated rope or chain is placed back down the well, there is a chance of contaminating the water in the well chamber.

The aim of the apron and run-off and the windlass system is to make the well head as hygienic as possible, and to ensure that used or waste water drains away from the well head and into a seepage area which is best planted with a tree (like a banana). The tree roots absorb and recycle the water to produce use a valuable product like fruit.

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The siting of a well is also important to prevent contamination from underground sources such as pit toilets. Underground contamination from pit toilets varies considerably from one location to the next. In sandy soils, the extent of contamination from the pit toilet may be limited. Where the toilet pit is cut into fractured decomposing granite or soils with water capillaries, then the potential for contamination is greater. Also areas with high water tables which penetrate the toilet pit are far more likely to be a threat than in areas where the water table is low. Shallow pit toilets also help reduce the potential for contamination. Also hollows in the ground, sometimes used for garbage or for brick making can partly fill with rain water during the wet season and this too may contaminate well water if the well is close by.

Earlier well manuals describe a method where the windlass is supported by brick columns. This manual describes a method where stout treated gum poles are inserted into a concrete anchor which is placed on the well slab. This manual describes the step by step construction of an upgraded family well in two stages. The first stage is to build the protective well slab and apron and water run-off and which is used with a raised collar and lid. The second stage is to upgrade this further by fitting a windlass system

Existing style of Upgraded Family well

As a rule of thumb, the distance between a domestic well and a pit toilet should be 30 metres. This distance can be reduced if the soil is sandy, or if the well water is deeper (5m or more) and if the pit toilet is shallower. Updated Blair VIPs have a pit which is wider (1.4m) but shallower (2m) to partly overcome this problem. Shallower pit systems, contaminate wells less than deep pits.

 

Views of a simple poorly protected well head and down the well chamber

STAGES OF CONSTRUCTION

It is assumed that the well has been dug and lined with bricks and a slab has already been placed above the well and water is being raised with a rope and bucket. The upgrading procedure follows the following steps

Stage 1 (initial upgrade)

1. Make new well slab with central hole and allow to cure
2. Fit new well slab over existing well and raise a central collar around the well access hole
3. Build a water run off and plant a tree in a seepage area at the end of the run-off
4. Fit a lid over the well access hole

Stage 2 (second upgrade)

1. Build a windlass support system using stout gum poles (as windlass supports and windlass bearings) anchored in a strong concrete base.

2. Procure a suitable small steel windlass and fit to slots made in the windlass supports (gum poles).

3. Remove the original raised central collar and replace with the windlass system by embedding in strong cement mortar.

Note

The system can be built by proceeding direct to the windlass stage. The initial upgrade is very valuable, but the second (with a windlass) may be preferred if a windlass system is available.

The step by step procedure

1. Making the well slab

In this case the well slab is made in reinforced concrete and is 1.4m in diameter with a central hole 40cm in diameter. A mix of 20 litres (half cement bag) of PC 15 cement and 100 litres of sharp clean river sand is used to make the slab. 3mm wire can be used as steel reinforcing. An area of earth is levelled and sand laid over it and made wet and smooth. In this case 1.4m diameter steel shuttering has been used for the mould. Half the concrete mix is added first and spread level inside the shuttering. The steel wires are then laid in a grid formation about 150mm apart. The second half of the concrete mix is then added and smoothed off. This slab is allowed to cure for at least 7 days and kept wet at all times.

The shuttering is laid down on level ground overlaid by sand which is wetted. Half the concrete mix is added and levelled off.

The 3mm steel reinforcing wires are added in a grid formation. Then the second half of the concrete mix added and smoothed off. The shuttering is then removed. This is allowed to harden overnight and then kept wet under a plastic sheet or wet sand for a week before moving.

2. Adding the concrete slab to the existing well cover.

If the existing well cover is made of concrete and firmly placed then the new well cover can be added on top. In this case the new slab had a diameter of 1.4m, much larger than the original slab. This larger slab is designed to have a rim made of bricks as shown later.


The new well slab is placed over the original well slab in a bed of cement mortar. The slab level is adjusted so it slopes very slightly towards the side where the run-off will be built.

3. Adding the central raised collar to the slab

Special shuttering for the central raised collar is added to the slab over and around the central hole. The inner shutter has a diameter of 40cm and is 15cm deep. The outer shutter has a diameter of 55cm and is 15cm deep. Thus the wall thickness of the raised collar is 7.5cm. Its height is 7.5cm over a slab with a thickness of 7.5cm.


The annular space between the shuttering is filled with a strong concrete mix of 3 parts river sand and one part PC 15 cement with a ring of steel wire half way up the collar. This is left to start hardening and the shuttering is removed some hours later.

4. Building up the support for the wider well slab

Once the concrete slab is laid on top of the well and made level, the side walls of the well are built up. In many cases the outer well diameter is less than 1.4m. A 1.4m slab diameter is required in this method to ensure that the concrete anchor which holds the treated gum poles which support the windlass has enough room to be mounted. Side channels on wither side of the anchor are required to allow water flow.

The larger slab is supported by layers of bricks built beneath it as shown in the photos. This lower layer of bricks is extended forwards to support the water run-off channel which will be built later.

5. Laying the bricks which form the outer rim of the well slab.

Once the well slab is fully supported the brick rim surrounding the slab can be built. The bricks are laid around the rim of the slab with the water drainage side being opened up so water will drain down the water channel.

Bricks being laid so that drained water will flow into the water channel.

6. Building the water run-off channel

The water run-off channel is built at least 3m long with bricks. The lower bricks are laid so they slope slightly inwards towards the centre. Brick walls are laid on each side to form a clear channel along which the water can flow from the apron into the seepage area at the end of the channel.


The water run-off channel is built in bricks as shown. It is about 3m long and slopes from the well head down to a seepage area.

7. Dig a hole and plant a tree in the seepage area

A hole is dug at least 0.5m deep about 0.5m from the end of the water run-off. This is filled with good soil and compost and planted with a tree like a banana.


Water flowing down the run-off should drain into a seepage area. This is best made into a hole filled with humus like soil and planted with a suitable tree like a banana, which can absorb the water and also produce valuable fruit.

8. Plastering the well head

Once the brick work is complete the well head is plastered with strong cement mortar. This can be made up of 2 parts of river sand, 4 parts pit sand and one part PC15 cement. Skilful use of cement mortar can add strength and beauty to the well head. Particular attention is paid to the section where the water runs from the well slab down into the run-off channel. It is important that the slab drains completely and that all waste water flows easily downwards into the run off channel and then down into the seepage area. This a slope is required along the water run-off channel.


The well head and run-off are plastered with strong cement mortar


The strong mortar work extends down the slope leading from the slab to the water run-off channel.

9. Completing the first upgrade

The first stage of the family well upgrade does not include a windlass system. A lid is fitted over the raised collar of the well head and water is withdrawn with a bucket and rope or chain. Even at this stage the well will be safer to use and the water quality will be improved. However further improvements can be made by adding a windlass system.

Water can be withdrawn using the simple rope or chain and bucket from the well chamber.

Well upgrade – first stage – bucket and chain.

Second stage upgrade – adding a windlass system

The windlass system

The windlass system is very commonly used in Zimbabwe on family wells. It makes lifting water easier and also wraps the rope or chain hygienically around the windlass drum which reduces contamination of the rope or chain. This helps to reduce contamination of the well water from above. In earlier programs of well upgrading the mass produce steel windlass was supported by a brick built windlass support using rubber bearings. This system has been replaced by a windlass support system using stout pressure treated gum poles mounted in a very strongly made concrete anchor. The treated gum poles act as both supports and bearings for the steel windlass. The windlass used in this system is small and neat and well matched to the well head.

The steel windlass

The windlass used in this description is currently mass produced by V&W Engineering. The drum section is 30cm long and made from 65mm galvanised pipe, the end plates being 15cm in diameter. The shaft is 70cm long and made of 20mm round bar with 20cm of round bar projecting from either side of the drum. The handle measures 20cm long (vertical) and 15cm (horizontal).

The windlass support system

The windlass supports are constructed from two pressure treated gum poles 80cm long with a diameter of 80mm to 90mm. A 25mm hole is cut into one poles and slot in the second to hold the windlass. Both gum poles are embedded in a high strength concrete anchor which also provides an opening for access of the bucket into the well.

10. Making the windlass support and anchor system

Two pressure treated gum poles measuring 80cm long and between 80mm and 90mm in diameter are cut to the same length. These will serve to mount the windlass and also act as bearings. The wider the poles the better as larger bearing surfaces will last longer.

Two holes are drilled with a brace and bit 25mm wide and 75mm down through the two poles. In one of the poles the hole is opened up with a saw and wood chisel as shown.

A mould can be made of bricks or with steel shuttering into which the strong concrete mix supporting the two poles is caste. The mould measures 90cm across and 70cm across. It is 15cm deep. The poles are placed 55cm apart. The inner well access hole is formed around a round mould 40cm in diameter. The windlass is mounted through the holes in the poles which are supported by hand on either side of the central hole. A very strong mix of concrete consisting of 2 parts quarry stone, two parts river sand and one part P15 cement is made up. This is added to the mould around the poles. A number of lengths of 3mm or strong barbed wire are added around the poles and within the concrete to provide strength to the concrete around the poles.

Further stages in making the important windlass support anchor


The concrete is added to the mould with plenty of reinforcing wire


The mould is filled up so the concrete is at least 15cm deep


The concrete is allowed to harden a little. Then central round mould is removed followed by the windlass. The concrete work can be shaped up to be neat. The concrete anchor, supporting the two windlass support poles is left to cure for at least 2 weeks and is kept wet at all times. In the future this concrete anchor will be put to the test as the windlass is used.

11. Adding the windlass system to the well

Once the windlass system has thoroughly cured it can be added to the well cover. If a raised collar system has been added first it must be removed with a hammer and chisel. The concrete anchor of the windlass support system must be attached strongly to the well cover.

Once the raised collar system was been removed and the well cover cleaned down some strong cement mortar is laid down around the well access hole for the windlass system to lay in.

The windlass system is mounted around the well access hole leaving enough room on either side to allow water to drain away down into the run off system. A further layer of mortar is added to the well slab and finishing touches are made all over the well to make it neat, strong and tidy. The new upgraded family well can then be put to use.

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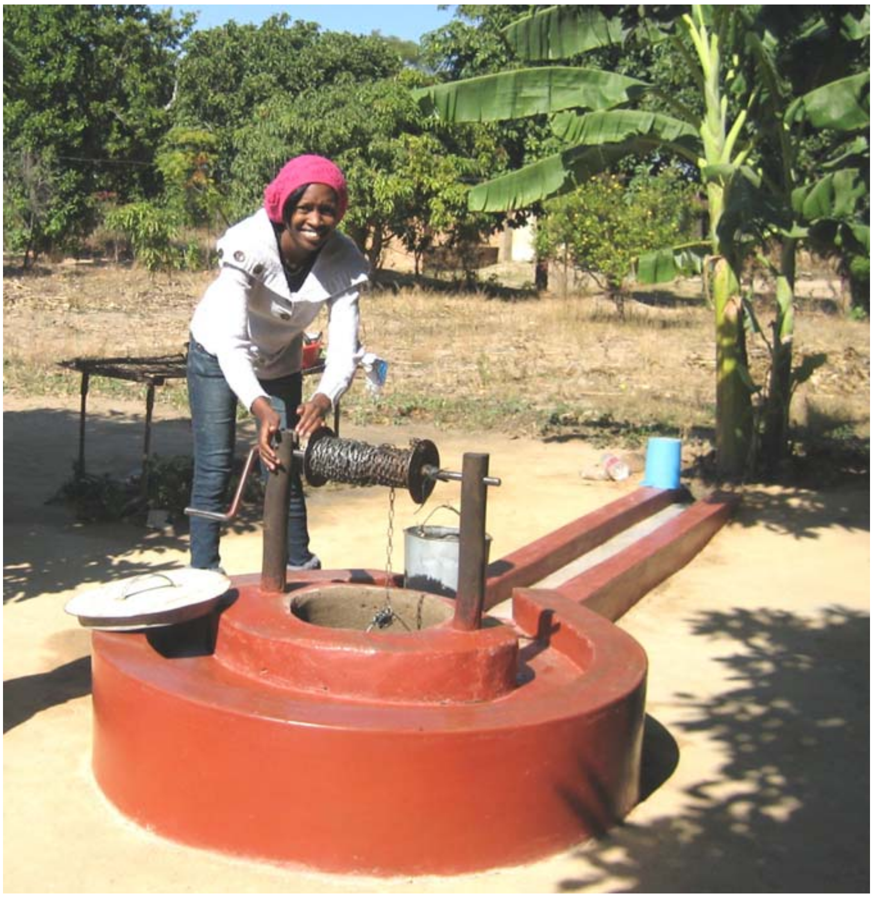
The final Upgraded Family Well

In this case a step was made to the side of the apron. All surfaces of the well are plastered and allowed to cure. In the case shown in this manual, the proud family waxed the well with cobra polish.

The windlass is mounted on the poles and is kept in position by attaching a length of rubber tubing around the windlass shaft. The windlass can be held in place in the slotted pole either with a nut and bolt passing through the pole or by nailing a piece of wood within the slot above the windlass shaft.

Views of the finished well.



Upgraded family wells are a huge asset to any family. Countless thousands of Zimbabwean families now extract their water from their own well, both in the rural and per– urban areas. The method described in this booklet is relatively simple to construct and long lasting. It has the advantage of not only making the well safer for children but also improving water quality without the use of a more complex hand pumping system. The method is traditional and simple to manage and maintain. Family owned vegetable plots can also be watered from family wells.

Perhaps the biggest advantage of the family owned well is that the water supply is under the control of the family itself. Maintenance can be a difficult issue with any communal or public supply. It is possible that hundreds of thousands of Zimbabweans now take their water from household wells. It is important to ensure that the well is safe for children and the water drawn water is safe to drink

Furthermore the Government of Zimbabwe endorsed this method of providing water supplies. Family wells are a part of traditional life in Zimbabwe

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