Building a Ferrocement Spring Box

Ferrocement consists of metal reinforcement sandwiched between thin layers of cement mortar. Different types of reinforcement are used including wire, wire mesh and steel bar. Ferrocement resists cracking well and due to its thinness, uses very little cement. This results in lighter, less expensive structures than those built with traditional reinforced concrete, while still being comparably strong. Ferrocement structure life can exceed fifty years if proper materials are used and structures are constructed carefully.

The most common use for ferrocement in water and sanitation projects is in the construction of water tanks. However, it can be a useful technology for a variety of other water and sanitation structures including septic tanks, spring boxes and iron removal filters. The purpose of this technical brief is to describe the construction of a ferrocement spring box.

The purpose of a spring box is:

- To protect the spring from contamination
- To guide spring flow into a pipe for collection at the spring site or for a gravity flow pipeline.

Ferrocement is a useful option for spring box construction because:

- Ferrocement spring boxes are very inexpensive relative to traditional reinforced concrete boxes
- Ferrocement spring boxes are simple to construct

STEP 1

Visit the spring you will be capping. Locate spring the eye(s) (see arrows). Measure the size of the spring (height, width and depth) and the spring flow (liters/sec). Survey the area surrounding the spring and the catchment area above it. Identify the potential hazards to the water quality of the spring as well as to the structural integrity of the future spring box. Determine whether all serious hazards can be mitigated before starting construction.

STEP 2

Using 6mm rebar, construct a cube that measures 0.5m per side. Then reinforce the cube and add wing walls. The length of your wing walls will depend on the size of your spring. In the center of the box's back wall, weld four pieces of rebar to form a rectangular opening (see arrow). This is the inlet, where water, directed by the wing walls, will enter the spring box. Its size will depend on spring flow. On the front wall, weld horizontal pieces for the outlet and overflow fittings to rest on.

STEP 3

Once the rebar frame is completed, cover it with a double layer of ½" wire mesh. Cut away the wire mesh that covers the inlet on the back wall and the pipe locations on the front wall.

STEP 4

At the worksite, excavate the area around the spring, clearing away any loose soil and debris and locating the spring eye(s). Then place the rebar frame into position, keeping in mind that the spring box inlet should be located just below the lowest spring eye. If the soil is muddy, place rocks under the spring box frame so that it sits on a solid foundation.

STEP 5

Once the frame is in place, attach short, threaded lengths of pipe for the overflow, outlet and clean-out. Where these pipes meet the box wall they should rest on rebar crosspieces and be tied with wire to the frame. Either a rock or a small concrete pillar should support the other end of each piece. In order to prevent clogging during construction, any open pipe ends should be stuffed with newspaper.

STEP 6

Mix a batch of cement mortar (1:3 cement:sand) with waterproofing compound. Hold a small piece of plywood against the outside of the frame and plaster a thin layer (3mm) of mortar onto the inside of the box. The plywood will prevent the mortar from pushing all the way through the mesh and falling off the frame. Repeat this process on the inside of the wing walls.

STEP 7

Once the inside of the frame has been plastered, let the mortar set for at least one hour. Then plaster the outside of the frame with another 3mm of cement mortar. Cover the box with cement sacks to retard drying and let the mortar cure overnight.

STEP 8

The next day mix another batch of cement mortar (1:3 cement: sand) with waterproofing compound. Plaster the inside and outside of the spring box and wing walls with a second layer of mortar about 8mm thick, making sure that all rebar and mesh are covered. Use remaining mortar to fill any gaps where the vertical edges of the wing walls meet the ground. (Water should still be able to flow **under** the wing walls)

STEP 9

Dig a temporary channel under one of the wing walls. This will allow the water to bypass the spring box. Line the bottom of the spring box with fist sized gravel (Ø 5-10cm). Mix a small batch of concrete (1:2:4 cement:sand:gravel) and pour the spring box floor. Trowel smooth.

By now the second layer of mortar should have set. Mix a small batch of mortar (1:3 cement:sand) with waterproofing compound. Plaster a thin (3mm) finishing layer over the entire tank. Let the box cure overnight.

STEP 10

The next day remove the newspaper plugs from your pipes and fill in the temporary channel beneath the wing wall. Water should now flow from the spring, into the box and out of your clean-out pipe.

STEP 10 cont.

Line the bottom of your catchment area with large rocks and gravel. Using a piece of plastic or sheet metal, form a simple gutter (see arrow) that directs the water from the spring eye, over the catchment and into the spring box. This will prevent the spring flow from washing away the concrete when you pour the floor of the catchment area.

Mix a batch of concrete (1:2:4 cement:sand:gravel) and pour a floor for half of the catchment area. Once this concrete has set, reposition the gutter and pour the other half of the floor. The floor should be flush with the bottom edge of the rectangular inlet opening.

Use any remaining cement to seal the bottom of the wing walls, then backfill the area in front of the wing walls with rubble (see arrow).

STEP 11

Lay a piece of plywood over the top of the spring box and cover it with a sheet of plastic. Construct a wooden form 5cm deep for the lid and place on top of the plastic. Add rebar reinforcement and a handle. Mix a batch of concrete (1:2:4 cement:sand:gravel) and pour the lid.

Let the spring box cure for one week, keeping it damp and wrapped in cement sacks or plastic. Then remove the lid form and connect your pipeline or additional valves and fittings.

Cover the overflow with wire mesh to prevent insects or animals from entering the spring box.

ADDITIONAL NOTES:

- It may be useful to construct a berm above the spring which funnels rain run-off around the spring box
- Fencing around the spring box can prevent large animals from damaging the spring box and prevent vandalism.
- In areas where there is significant risk of spring contamination, fill in the catchment area between the wing walls with large stones. Build this rock pile high enough to cover the spring eyes. Then cover the stones either with a layer of clay or with mesh and cement mortar. If you choose to utilize mesh and mortar, make sure to leave a manhole or other opening that will allow access to the spring.
- The spring box should be checked periodically to ensure that the spring is flowing unobstructed and to flush out any accumulated sediment.

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