Water for the World

Designing Roof Catchments
Technical Note No. RWS. 1.D.4

Roof catchments collect rainfall from a roof and channel it through a gutter into storage for use by individual households. The amount of water available for use depends on three factors: the amount of annual rainfall, the size of the catchment area and the capacity of the storage tank. This technical note discusses how to design a roof catchment to take advantage of the maximum amount of rainfall available.

Useful Definition

FOUL FLUSH - The first run-off from a roof after a rainfall.

The design process should result in the following two items which should be given to the person in charge of construction:

1. A list of all labor, materials and tools needed as shown in Table 1. This will help make sure that adequate quantities of materials are available so construction delays can be prevented.

2. A plan of the roof catchment system with all dimensions as shown in Figure 1.

Annual Rainfall

Find the annual rainfall rates for the region. This information should be available from the national geographical institute, the Ministry of Agriculture, a meterological institute or university, or an airport. The amount of annual rainfall is measured in millimeters per year.

Table 1. Sample Materials List

Item	Description	Quantity	Estimated Cost
Labor	Foreman Laborers	____ ____	____ ____
Supplies	Corrugated sheet metal, plastic or tiles (for roofing) Metal gutters, wood or bamboo (for gutters) Wire, rope or local fiber (to secure gutters to roof) Tar or caulk (to seal gutter connection to downpipe) Nails Wire screen	____ ____ ____ ____ ____ ____	____ ____ ____ ____ ____ ____
Tools	Hammer Machete (to split bamboo) Wire cutters Saw Chisel	____ ____ ____ ____ ____	____ ____ ____ ____ ____

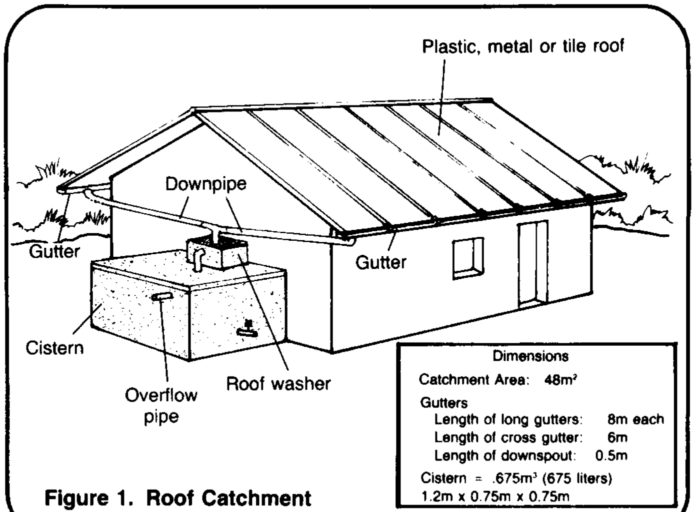

Figure 1. Roof Catchment

Catchment Areas

The roof of the house is the catchment area for the rainfall. To collect rainfall, the roof must be constructed of appropriate material, have sufficient surface area, and have adequate slope for water to run-off.

Corrugated galvanized steel or aluminum sheet metal, corrugated plastic or baked tile make the best catchment surfaces. Sheet metal is especially attractive because it is light-weight and requires little maintenance. Tiles also make excellent surfaces and are usually cheaper than sheet metal because they can be produced locally. The disadvantage of tile is the weight. A much stronger roof structure is needed to support tile. Tile roofs may even start to sag or leak after a time if structures are not strong enough.

To determine the amount of rainfall available for use as a water supply, it is necessary to know the area of the roof. Figure 2 shows how to determine the roof area available for water collection.

The effective roof area for collecting water is not the roof area itself but the ground area covered by the roof. In Figure 1, the effective water collecting area is $48m^2$ ($8m \times 6m = 48m^2$). The roof must slope as shown so that the water will flow into the gutter system installed to move the water to storage.

Using this information and the annual rainfall, it is easy to determine how much water will be available for use. Worksheet A shows how to make this calculation.

In the worksheet example, an average of 85 liters of water per day would be available to a family. For a family of six, each person would be able to use 14 liters per day. This is an average amount. During some months, more than 2560 liters will be available, while during the dry months, no rain may fall at all. A cistern will be needed to ensure adequate storage during the dry months.

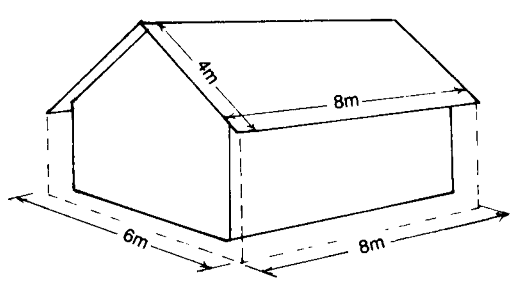

Figure 2. Roof Catchment Area

Worksheet A. Volume of Water Available from a Roof Catchment

Calculate the amount of water available from the catchment by following these steps and referring to Table 1. Figures used are the catchment size in Figure 2 and assumed rainfall of 800mm per year.

1. Multiply annual rainfall by the catchment area.

$\underline{48m^2} \times \underline{800mm} = \underline{38400}$ liters/year.

2. Multiply this total by 80 percent. Not all water will be available because of losses due to evaporation and run-off that does not flow into the gutters. To be safe, figure a 20 percent loss for a rain catchment.

$\underline{38400}$ liters x .80 = $\underline{30720}$ liters/year.

3. Divide the total by 12 to get average monthly rainfall.

$\frac{30720 \text{ liters/year}}{12 \text{ months/year}} = \underline{2560}$ liters/month.

4. Divide again by 30 to determine liters per day.

$\frac{2560 \text{ liters/month}}{30 \text{ days/month}} = \underline{85}$ liters/day.

Gutters

Gutters must be installed on both sloping sides of the roof to collect all the run-off and channel it into the cistern. The gutters must be as long as the edge of the roof. Figure 1 shows a typical gutter design. There must also be a downpipe on a third side of the house so that water from both catchment surfaces is channeled to a single cistern. The design of gutters is quite simple and local materials can be used for them.

Metal gutters are the most durable and require the least maintenance, but are the most expensive. Gutters can be made of wood or bamboo. These materials are often available and inexpensive but will usually not last as long as metal because they will rot. Wood and bamboo gutters can be installed to overlap and can be tied together with wire, rope, or local fiber to avoid leakage. If wood is used, it should be hollowed out to form a channel. If bamboo is used, it must be split and the inside joint partitions removed. All gutters must have a small but uniform slope to prevent the formation of pools of water in the gutters. Still water can be a breeding place for mosquitoes.

A downpipe must be installed. The downpipe channels the water from the gutter into a cistern for storage. The joint where the downpipe and gutter connect must be sealed. If metal gutters are used, a connection can be sealed with a caulking compound. If bamboo is used, tar will prove the best material for sealing the connection.

During periods of no rain, dust, dead leaves, and bird droppings will accumulate on the roof. These materials are washed off with the first rain and will enter the cistern and contaminate the water if some basic steps are not taken.

To prevent leaves and other debris from entering the downpipe, a coarse mesh screen should be placed in the gutter over the downpipe. The mesh will catch the large debris but let the water through. The screen must be cleaned periodically to prevent clogging.

A downpipe that can be moved manually away from the cistern can be installed to divert the first flow of water from the roof. An example appears in Figure 3. When the pipe is moved away from the cistern, water simply runs to waste. For this method to be effective, someone must be at the house to move the pipe.

Several other techniques are available for diverting the first roof run-off from the storage tank. In Figure 4, water from the gutters runs through the downpipe and into a small box built on top of the cistern. The first run-off is caught by this box.

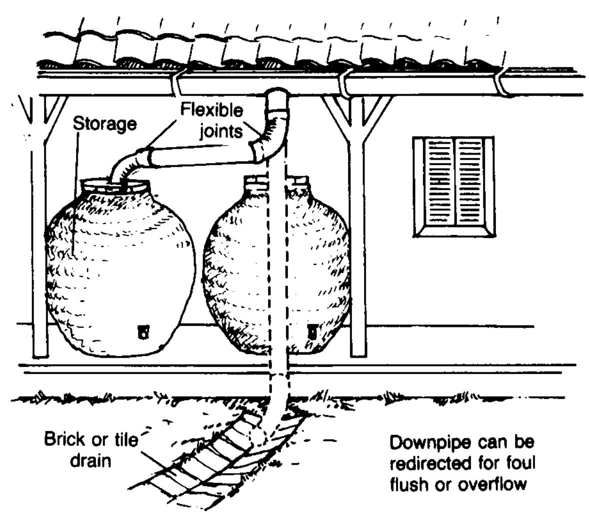

Figure 3. Flexible Downpipe

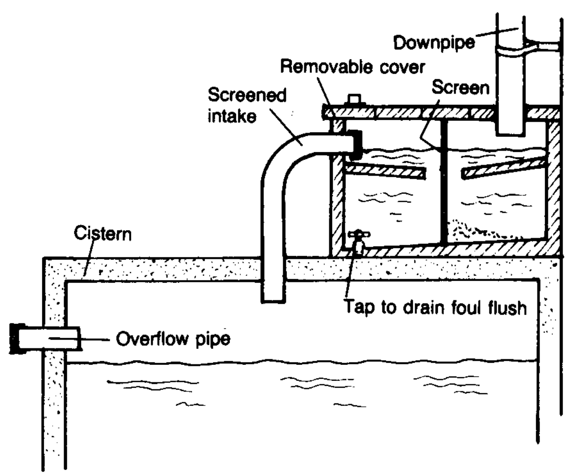

Figure 4. Foul Flush Box

When the box fills, water runs over the top of it into a channel that leads it to storage. A drain then empties the box of the dirty water. This small foul flush or first wash collection box can be made from concrete or from metal. It is most useful when permanent concrete cisterns are designed, because of the extra cost.

A small charcoal-sand filter box can also be installed as in Figure 5. As the rain water passes through the filter, sediment and debris are removed and clear water flows to storage. The advantage of this design and the box for the foul flush is that no one has to be present to divert the water flow from the roof.

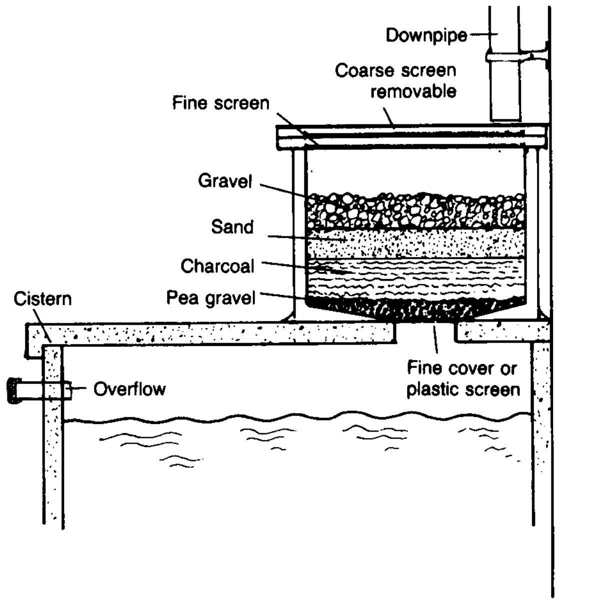

Figure 5. Filter System

Figure 6 offers another example of a useful and easily installed device for diversion of the foul flush. The downspout has two outlets. One runs to storage the other to waste. A lever on the outside is used to make water flow into one of the two channels. After the first wash flows to waste, the lever must be switched so that water runs into the cistern.

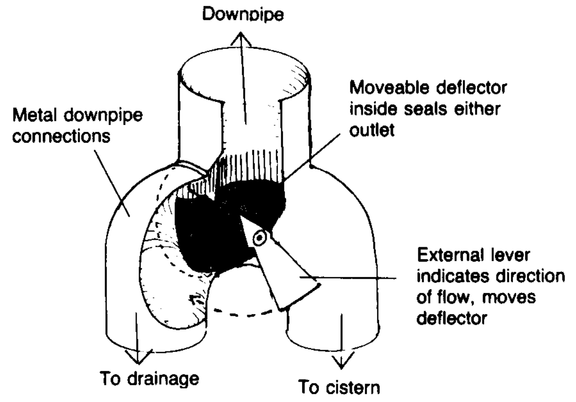

Figure 6. Roof Washer Device In Downpipe

No matter which method is used to divert the first wash, the quality of water collected in the cistern must be checked. Water from roof catchments may need treatment before it can be consumed.

Cisterns

A cistern is an important part of a rainfall catchment system. There must be some type of cistern to collect and store rainwater. Several designs can be considered. The choice will depend on the amount of water needed, the amount of water available, rainfall distribution, cost, and availability of space. Basic design considerations and plans for household cisterns are shown in "Designing a Household Cistern," RWS.5.D.1, which should be used with this technical note to design an effective catchment system.

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.