Toilet rainwater harvesting system

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Gravity Fed Rainwater Harvesting System For Flushing Toilets

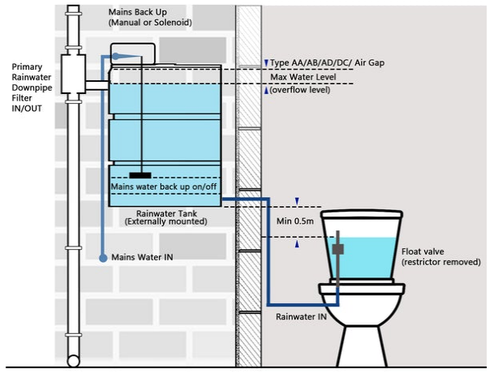
We're often asked *"Can I plumb the rainwater into my toilet cistern to flush the toilet"*. The simple answer is yes, with some caveats!

The conventional way would be to opt for a standard underground rainwater harvesting system which provides a large amount of storage out of sight. However, an underground system requires a pump and controls to deliver the rainwater to where is is required and so requires power, maintenance and a large excavation for the underground tank. This isn't always possible and so an above ground rainwater harvesting water system may be considered.

Here we describe the principles of a simple gravity fed rainwater system which allows ground floor toilet cisterns to fill and flush using rainwater. This system can also be used to irrigate garden spaces, assuming the garden level is below the base of the tank. This systems should not be confused with an indirect underground rainwater harvesting system which delivers rainwater to a loft tank which then drains by gravity.

An outline diagram of a gravity fed rainwater system for flushing a downstairs toilet or for irrigation is shown below (more images of **actual installations can be seen here**).

The tank is typically sited on an external wall:



System components:

1. Primary Rainwater Downpipe Filter - this is required to screen out leaves and debris from the stored rainwater. In turn this limits decomposing organic matter in the tank and the potential blockage of downstream components (pipe and float valve).

2. Rainwater Storage tank - this should be sized according to the demand, for example a 100l tank would provide ~25 flushes on a low flush cistern. Another consideration is how the tank is placed. If it will be fixed to an external wall then the tank size will be limited by the strength of the wall. If the tank will be located on a raised plinth, the tank size limit will be determined by the strength of the plinth. The base of the tank must be at least 0.5m above the top water level in the cistern it is delivered to or greater than the 'breaking pressure' if delivered to a soaker hose.

3. Mains Water Top up - this can be a mechanical (**e.g. RainAid**) or solenoid valve (see here) which simply fills the tank a small amount if the tank is nearing empty, ensuring there is always some water to flush the toilet or water plants.

Notes:

1. Atmospheric pollution and the surfaces from which rainwater will be collected means it is likely to contain faecal, biological and pathogenic contamination. This places it in fluid category 5, that is to say it poses a serious health hazard. To meet the Water Fittings Regulations in the UK, fluid category 5 protection can only be achieved through the installation of either a Type AA, **AB air gap** or AD air gap, or through the use of a Type DC pipe interrupter (a device that incorporates an air gap), to separate the mains water supply and a water reuse system. This applies to the mains back up device, be it mechanical or electrical (solenoid). The mains back up feed can exit the property close to the back up valve, leaving short piece of mains water pipe which should be insulated.

2. Some areas of the UK are at risk of freezing and so an above ground tank may not be suitable for these areas. Experience indicates tanks placed against external walls rarely freeze due to the thermal mass and loss of the adjacent building. Mitigation can be in the form of a tank fleece.

3. When drilling any rainwater tank do not allow the plastic swarf to enter the tank. Plastic swarf, with its long stringy nature, is notorious for causing downstream blockages particularly in modern float valves. A simple way to avoid this is to part drill the tank externally and then cut with a Stanley knife, pushing the cut out away from the tank internal to external.

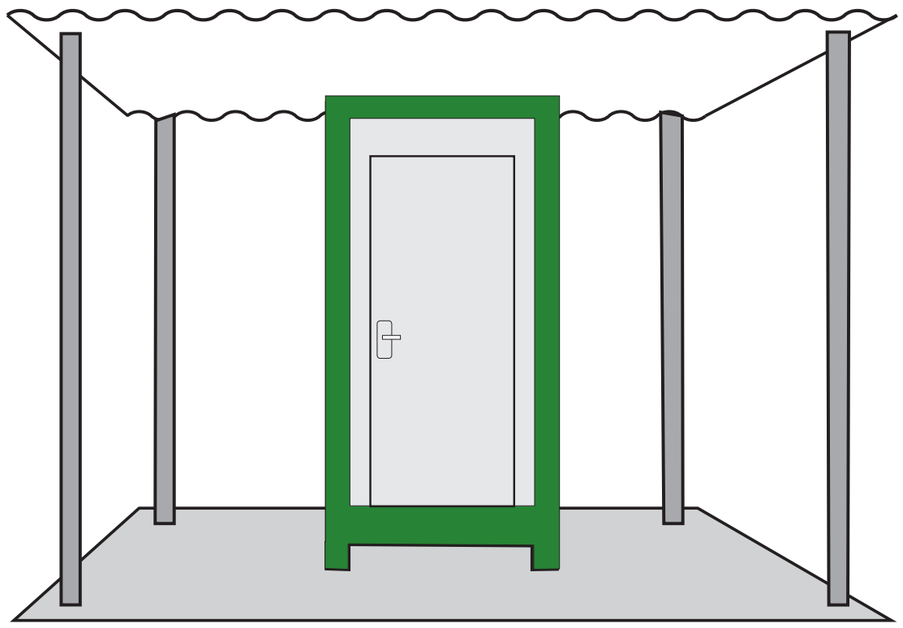
4. Delivery pipework should be 22mm to minimise hydraulic losses. The number of bends and reducers should be limited.

5. The flow restrictor in any downstream float valve **must** be removed since the the operating pressure could be as low as ~0.05 bar - i.e. very low. An elevated tank results in higher pressure and greater flow. With the flow restrictor removed from the toilet cistern float valve, the fill time of a cistern under such low pressure is comparable to the fill time under low mains pressure. The flow test on the inlet float valve should ideally be completed in advance of the installation to ensure adequate flow can be achieved.

5. The system above should incorporate a calmed inlet so the bottom sediment is not disturbed and resuspended.

Summary:

Gravity fed rainwater harvesting systems provide a simple and inexpensive alternative to conventional underground rainwater harvesting systems. The benefits are: lower capital and installation costs, reduced maintenance and operational costs, since a pump is not required to pump the rainwater. However, gravity fed systems may be limited by tank size, typically have low pressure and the tank maybe exposed to freezing risk.



The toilet will be sited away from the main workshop, to make laying the sewer pipe to the manhole simpler. A water tank on a stand will be sited behind the toilet unit, with pipework feeding the cistern. A shelter will be erected over the toilet to extend the rain catchment area. Gutters will direct water into the holding tank, which will in turn fill the cistern. The system shown on the left will be adapted to suit.