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Possibilities of using rain water in households

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Abstract: Water management from precipitation, especially from torrential rain, presents importance because the water does not require treatment in a municipal wastewater treatment plant, it has loads very different of municipal wastewater. The authors aim to present storm water management issues by presenting solutions to water discharges from individual plots, but also possible uses for different uses in the household and its subsequent discharge into public sewers for wastewater. The proposed solutions are simple, do not require substantial investment, but also contributes to reducing the amount of water from precipitation discharged directly into public sewers.

Keywords: water management, precipitation, storm water management

1. INTRODUCTION

On the surface, atmospheric precipitation falls as liquid (rain) or solid form (snow, sleet, hail). When calculating sewage the precipitations liquid are important because they lead to the formation of debts more significant than those resulting from melting snow. Depending on their intensity and duration, rains are classified in heavy rainfall, with a long time but low intensity, and torrential rains, high intensity and short duration. These torrential rains are taken into account in determining the debits which underlying sizing sewage. Observed in recent years that due to climate change, we get long periods of dry weather followed by high intensity rainfall. Phenomena are extreme even if the average annual precipitation has not changed significantly.

Due to intensive urbanization has changed the nature of the surface area of the settlement. Emergence of large consolidated and waterproofed surfaces (such as roads, alleys, parking lots, roofs, etc.), increased the average runoff coefficient. This means that we go away more from the natural flow conditions, where a big part of precipitation are infiltrated into the soil, and reach in situation where large volumes of water are discharged into public sewers. Because this water washes surfaces above, it cannot be considered clean water.

In case of separation system of sewer, where water from precipitation is channeled separately from wastewater, treatment is required prior before downloading in the receiving water. In case of unitary sewage, where rainwater is channeled together with wastewater, all water will be treated in municipal sewage station leading to hinder its operation. Of course that transport and processing costs increase. Disadvantage of unitary sewerage system is that it combines two different nature water that actually requires a different treatment [1], [2].

2. POSSIBILITY OF USING RAIN WATER IN THE HOUSEHOLD

Using rain water in the household does not necessarily make significant money savings. The issue is rather to protect drinking water resources by using rain water for some uses where the quality of drinking water is not necessarily.

On what you can use rain water

Gardening and green spaces. It is the most justified and at the same time easier to use rain water in their household. If we limit only to this use, the investment is very low, only needed the collection tank and a water distribution system. Water distribution may be submitted under gravity or by pumping. If it requires a high pressure pump is required of course. If the collecting tank is located above the field flow can be free. The only obstacle to this solution is that into the winter, agricultural water consumption is very low, even zero. In this situation the water must fall into public sewers and collecting tank prepared for the cold. If the tank is above ground, it must be emptied there is a danger of ice formation. Underground tanks will not empty, but must be provided with an overflow pipe, so that the excess water to drain. A simple installation is shown in Figure 1.

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Figure 1 Plastic container placed over a gutter covered with grill

Washing machine. This possibility exists and is exploited in many European countries, selling tanks to capture and water clarification. Rainwater has the advantage that is a water of a very low hardness good for washing. Low hardness water also prolongs the life of the machine, with very small deposits. It should be noted that through method of collecting and because atmospheric dust rainwater contains organic and mineral impurities.

Toiletries and other household maintenance.

For toilet flushing and other household maintenance also need water not drinking water quality. However we must not neglect regular sanitary cleaning. Rainwater does not contain chlorine, which leads to rapid formation of germs.

Of the total water consumed in the household, the studies presents following scale of household consumption, Table 1:

Table 1 Proportion of household consumption

Personal hygiene	36 %	Drinking water	47 %
Drinking and cooking	5 %	Drinking water	
Washing dishes	6 %	Drinking water	
Toilets	33 %	Rainwater can be	53 %
Washing machine	13 %	Rainwater can be	
Others	7 %	Rainwater can be	

It can be concluded, therefore, that half the amount of water used in a household may be inferior to drinking water quality.

In Figure 2 is shown a structure of complex systems to capture rainwater for use. It shall include [3]:

- Storage tank;
- Connection of the collection surface (roof);
- Equipped with filter and overflow pipe with siphon (with connection to sewer);
- Pump sampling system to ensure pressure in household installation.

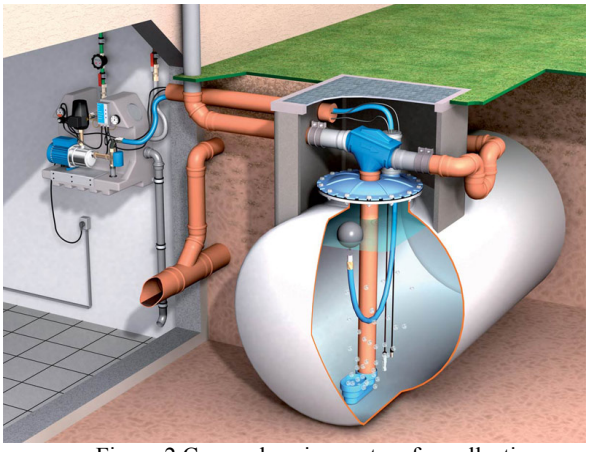

Figure 2 Comprehensive system for collecting rainwater to ensure the pump pressure in household and connection with sewer system

Where and how to collect rainwater.

As regards the use of rainwater, it should be collected from clean surfaces. In a domestic environment these surfaces are rooftops. If possible will be chosen roofs facing north because such areas shall not muscle.

3. FACTORS AFFECTING WATER QUALITY COLLECTED

The main factors influencing rainwater quality collected are [4]:

- Areas for which it is collected, it is recommended "clean" surfaces;
- The possibility of system to separate solid particles from water (by filtering and filing);
- Protection against the ingress tank light (light leading to the formation of algae);
- Protection against gas canal (siphon protection through an appropriate);
- Protection against ingress of insects or rodents;
- The sampling of water from collection tank (not disturbed dirt off the bottom of the tank);
- Regular inspection and maintenance of plant

On the other hand not recommended collecting rainwater from [4]:

- Roof coverings which contain asbestos concrete;

- Grassy roofs;
- Bitumen roofing;
- Metal roofs
- Roofs heavily loaded with dust;
- Road surfaces.

Manufacturers offer a wide range of such facilities, from the simplest, Figure 1, consisting of reservoirs located near drainage pipes, to complex installations, as in Figure 2. But it is a wrong recommendation to set the tank volume according to the number of residents (beneficiary). Reserve - theoretical - rainwater that can be collected depends on the size actually collecting surface and rainfall in the area. A computational model for a waterstorage basin is presented in the next chapter.

4. REDUCE DIRECT STORMWATER RUNOFF

Direct runoff of stormwater from a parcel can be achieved by retaining water volume (even full volume), and water use in the household, (as shown in the previous chapter), or infiltration into the soil. The problem is determining the volume of a waterstorage basin for rain calculation according to the norms in force.

Consider a plot with a total area of S_t= 600m^2,(common area for a lot of house newly built areas, surrounding cities). A partition of this area, depending on the flow coefficients " Ø" would be:

S_t	600 m^2	$Ø_{mediu}$ = 0.36
S_{grass}	350 m^2	$Ø_{grass}$ = 0.05
S_{roof}	150 m^2	$Ø_{roof}$ = 0.95
$S_{platform}$ (platforms are considered made of tiles with joints filled with sand)	100 m^2	$Ø_{platform}$ = 0.6

Average coefficient of discharge is a weighted average of the individual flow coefficients from the components surfaces.

$$\Phi_m = \frac{\sum_{i=1}^{n} S_i \cdot \Phi_i}{\sum_{i=1}^{n} S_i} \qquad (4.1)$$

and during rain calculation

$$t_p = t_{cs} + \frac{L}{60 \cdot v_i} \qquad (4.2)$$

where:

t_{cs} is the time of superficial concentration in minutes;

L segment length of drainage channel for the batch, in meters;

v_i water leakage speed in the channel, m/s

Considering the lowland areas, t_{cs} = 12min, length L = 40m, (corresponding to a batch of S = 600m^2) and v_i = 0.70m/s (corresponding self-cleaning velocity) results in a period of rain equal to:

t_p= 12+ 40/(60·0.7)= 13 min.

According to STAS 9470-73, area 13, and the frequency f 1/2, resulting rainfall intensity i = 180l/s • ha.

Discharge of precipitation will be:

$$Q = m \cdot i \cdot S_t \cdot \Phi_m \qquad (4.3)$$

Q= 0.8·180·600·10^{-4}·0.36= 3l/s, (reduction coefficient “m” was considered of 0.8).

Multiplying the resulting debit with rain duration result the waterstorage basin volume:

V= Q·t_p = 3·13·60= 2340 l = 2.34m^3.

This means a volume of 2.50 - 3.00m^3, corresponding to a torrential rain. Volume of water for household use is lower, taking into account only "clean" areas for collection. Calculus presented can be easily adapted to other areas, different in size and nature.

Solutions to storm water infiltration into the soil and groundwater enrichment are multiple. Their presentation goes beyond the paper. A simple infiltration rain gutter is shown in Figure 3:

Figure 3 Gutter for rainwater infiltration into the soil, made of perforated tiles

5 ADVANTAGES AND DISADVANTAGES OF THE USE OF RAINWATER

Some advantages of using rainwater in the household:

- Reducing drinking water consumption;
- Use of water with a very low hardness;
- Reducing the amount of water that runs into public sewers, this is particularly important when the wastewater is channeled with that of precipitation;
- Refresh groundwater using rainwater to garden and green spaces maintenance;
- Execution of the tank in modular variant, expandable;
- Execution of tank and pipe from recycled organic materials;
- The work can be executed under its own;
- Creating a pool of water for dry periods.

Disadvantages of using rainwater:

- Rainwater is not drinking water, even if it is considered conventional clean;
- Rainwater can't be storage for a long period due to organic loading;
- Storage tanks are big and require proper hydraulic equipment;
- Need for pumping water stored from the reservoir for use;
- Due to climate change that led to the formation of high intensity rainfall but rare, resulting large storage tanks;
- The need to extend water network inside the building, the two networks, the drinking water and rainwater serving common objects but must not interfere;
- Rainwater are often more acidic, thus requiring a prior treatment for certain uses;
- Drinking water supply does not recover steadily, it depends on the rainy and dry periods, so we can not completely discard the water network.

CONCLUSIONS

Use of rainwater in household is justified, even if economically not appear any immediate advantages.

You cannot cancel channeling public, whichever solution is adopted.

It is worth experimenting with simple installation, even improvised, at least for gardening and grass maintenance.

Creating a pool of water infiltration into the soil is also an interesting experiment that can be performed by direct labor of beneficiary. Such a pool can integrate very pleasant in decor. Overflow pipe should not be missed. Through it avoids flooding basin when rain is beyond rain intensity calculation.

Need groundwater enrichment is a must at this stage, mainly due to intensive urbanization. Infiltration of rainwater on individual parcels is one of many ways to achieve this, while reducing the amount of rainwater discharged into the public sewers.

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