STORMWATER STRUCTURES IN COMBINED SEWERS

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Abstract**:** For sewage disposal in urban areas combined sewers are applied. For water resources protection in sewage disposal, sanitary water separates from precipitation water. Before the outlet into receiver, we try to apply water purification and improve wastewater quality as much as possible. Stormwater structure or stormwater overflow is used in combined sewers for reduce the peak discharge reduction. Criteria for location of stormwater overflow in combined sewage system can be : critical discharge outlet in absolute dimension; choice the place where the unloaded combined water show the least water pollution; to insure to process upstream precipitation water in retention structure .In combined sewers, side overflow is usually applied. Correct dimensioning of stormwater overflow is very important, because wastewater treatment plant loading depends on it, as well as loading of receivers with surplus of waste water.
In these paper will be described design principles of storm water overflow with application of low of mass unkempt and quantity of motion on overflow.
Keywords: storm water structure, combined sewers, wastewater, precipitation water

ENTLASTUNGSBAUWERKE IN DER MISCHKNALISATION

Zusammenfassung**:** In den ausgebauten Abwasserableitungssystemen urbaner Siedlungen wird Mischkanalisation vernendet. Zum Zwecke des Schutzes von Wasserresourcen ist man bestrebt, bei der Abwasserentsorgung Fäkalwasser vom Niderschlagenwasser zu trennen und sie in höchstem Masse zu klären, bevar sie in den Regenüberlaufbecken abgeleitet werden. Entlastungsbauwerke oder Regenüberlaufe werden im Mischkanalisationssystem zur Verringerung des Spitzendurichflusses verwendet. Beim Aufstellen des Regenüberlaufs in das Mischwasserarbeitungssystem soll ermöglich werden, dass der kritische Durchfluss Q_{krit} in voller Grosse abgeleitet werden kann, und zwar an der Stelle, wo das entlastete Mischwasser die geringste Verschmutzung aufweist; es soll auch die Bearbeitung der Niederschlagwässer in dem stramabwärtsliegenden Retentionsbauwerk ermöglicht werden. In der Mischkanalisation wird am häufigsten die Streichwehr verwendet. Eine vorschriftsmassige Dimensionierung des Regenüberlaufs ist sehr wichtig, weil davon die Belastung der Kläranlange und des Űberlaufbeckens abhängt. Daher wird man in dieser Arbeit Grundsätze der Dimensionierung des Regenüberlauf durch die Anwendung des Gesetzes von der Erhaltung der Masse und der Bewegungsquantität darstellen.
Schlüsselbegriffe**:** Entlastungsbauwerke, Mischkanalisation, Abwasser, Niederschlagwasser

1.Introduction

The fundamental task of sewage system is to remove all waste and polluted water from the human environment quickly, directly and systematically, with the most favourable higienic, technical, technological and economic conditions. It implies procedures of collecting and draining different kinds of urban water.

Waste water is water which in the course of its usage changes its basic structure, i.e. its physical, chemical or biological features to the extent that its repeated usage is not possible without purification or discharging it into the natural water system.

Waste water is a part of hydrological cycle, i.e. water used for supplying the population by means of water supply system is returned to the natural environment through the sewage system. Beside this type waste water also includes:

- precipitation water in huge quantities and of different structure which depends on the area it washes out and whether it comes into natural receiver through the sewers or they are dispersed
- water from industrial factory units, municipal objects, etc.

Waste water is divided into groups according to their origin and basic features:

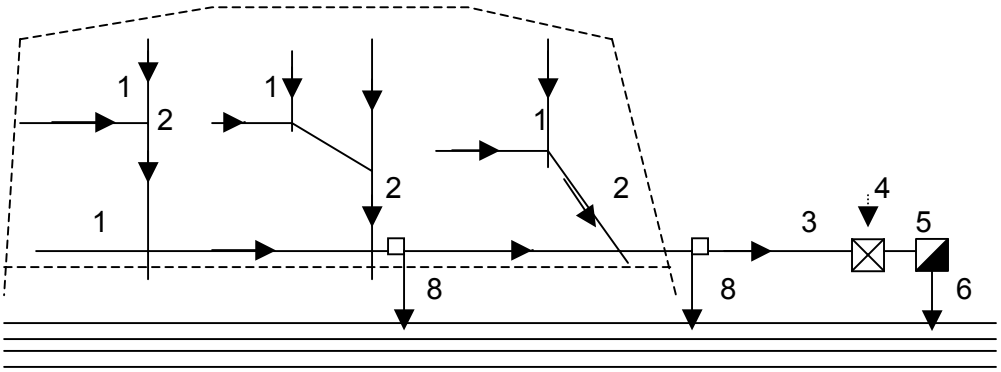
- household waste water
- industrial waste water (technological and cooling)
- precipitation/storm water from rain, snow, as well as from street washing because they all go into the same system of channels as precipitation water.

The most dangerous of all for human health is used water because it conatins all kinds of everyday waste in the suspended form. This kind of waste is mineral and organic in nature, so it in the same way as microorganisms can cause rotting in waste water. The structure and amount of household waste water differ in size and depend on the standards of living of the population. They are deterministic in character.

2.Combined sewers

Combined sewers drain all catgories of waste water (household, industrial, precipitation) through the common channels and collectors. The biggest part of it is precipitation water. The ratio between precipitation and other types of water in the channels is between 1:20 and 1:60.

Due to the fact that all waste water is drained through the common channels it is necessary to purify the waste water prior to letting it into the receiver.



8-water overflow

Figure 1. Scheme of combined sewers

Precipitation water has the key role in dimensioning combined sewers. Depending on their intensity, dry and rainy seasons, they have periodical influence on the system. Household and industrial water have constant influence. During the dry season household and industrial water runs through the collector and causes sedimentation. In the rainy season precipitation water dilutes waste water where dilution equals

$$Q_{otj} = Q_{otp}(1+n) \qquad (1)$$

where: Qotp – flow of waste water

Qotj – flow continuing to flow through the system

n – dilution coefficient

When dilution passes the prescribed value, before discharging it into the receiver it is neccessary to divide faeces water from precipitation.

Rain disburdening structures are placed in combined sewers. These are objects which during heavy rains channel diluted water directly or through the rain pools into the collector. It is conducted on the base of the pollution level which can be put into the receiver without degrading the quality of water under the level permitted for the particular receiver, i.e. the pollution in the receiver must be within the limits of sustainable development.

Disburdening structures in combined sewers were built with an overflow in the waterstream, such as rain pools, rain overflow pools and channels with space under the ascent.

The role of disburdening sstructures is hydraulic and ecological. Hydraulic role refers to limiting the flow in different parts of sewage system: channels, pumps, purification equipment, retention pools. It is important for economic reasons because it directly influences realization and overheads (current and fixed costs).

The ecological role refers to the protection of water resources, i.e. reduction of waste which is released into the receiver.

The rain overflow in the sewer is placed at points where the critical flow can be channeled completely and precipitration water can be processed in the downstream detention structure.

3.Stormwater overflows

The role of stormwater/rain overflows in combined sewers is to channel that quantity of water which is in the rainy season higher than the expected flow into the other part of the sewer or to release it directly into the receiver.

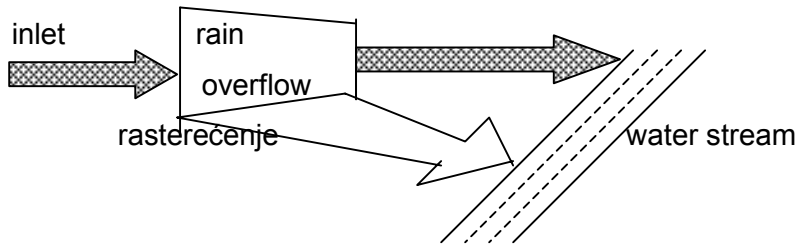
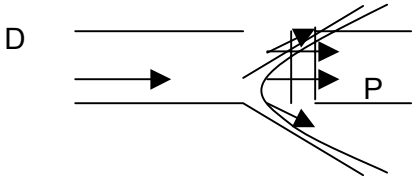


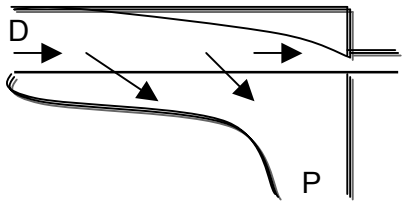
Figure 2. Rain overflows in combined sewers reduce the main stream

Depending on the position of the overflow and the direction of the inlet towards the sleeper, rain overflows can be divided into the following types:

a) vertical or frontal overflow – the sleeper is across the inlet



b) side overflow – the overflow is parallel to the inlet



The stormwater overflow is placed at the point where the disburdened combined water shows the lowest level of pollution.

Forming overflows

The basic conditions for dimensioning overflows are the following: the stram which remains in the channel has to be at least 50l/s in volume and the speed in the channels in the dry season in the area of the inlet and outlet should be at least 0,5m/s.

The appropriate dimensioning of the overflow directly influences loading of the receiver with waste, as well as the sewer as a whole.

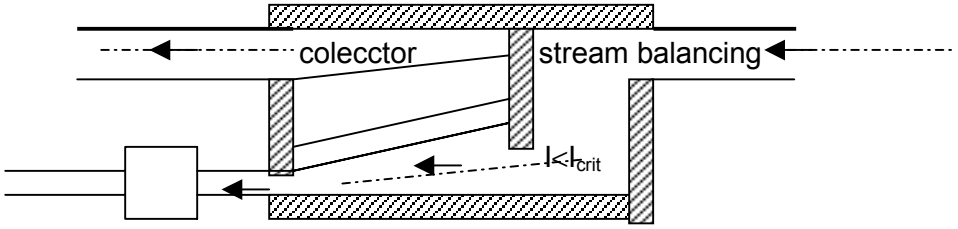


Figure 3.The side overflow sketch

Rain overflow pool

Water supply and economic reasons influence the position of the rain overflow pool.

There are three types: collective, free flow and linking pools.

- Collective pools are placed at the points where the heaviest burdening/loading/stream from washing out is expected. They are made for small washing out areas with short flow times (the calculated time of the stormwater flow in the net of channels is not more than 15 to 20 minutes).
- Free flow pools are placed at larger washing out areas when the flow period to the pool is more than 15 or 20 minutes. They mechanically purify(filter) waste water. Overflow on the concentrator is activated after the pool is filled with water and the water stream channels mechanically filtered mixed water in the rainy season. During the process of filling, these pools serve as retention objects, and after that as concentrators with an overflow to the main stream, mostly for the critical stream. The contents of the pool are channeled into the filtering plant (purification system) when the rain stops.
- Linking pools are a combination of collective and free flow pools. They consist of the collector and the filter. They are placed at those points where the heavies streams are expected during the longer flowing periods or in streams with the constant level of pollution. In a collector of a linking pool water is first retained and after the filling it passes throgh the part where it is filtered.

Channels with the retarded flow

There are two types of disburdening objects

a) with space under the retarded part of the flow with upstream disburdening which acts as a collector on the main channel,
b) with space under the retarded part of the flow with downstream disburdening which acts as a free flow stream serially connected without pool overflow.

The advantages of channels with retarded part of the flow are: no need for an additional object beside the channel, it has natural dischanrge fall. The biggest disadvantage is the possibility of sedimentation.

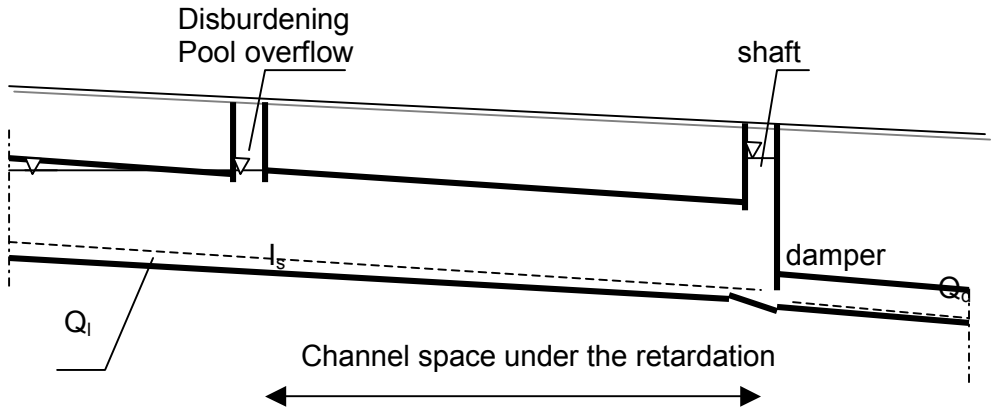


Figure 4. Channel with space under the retarded part of the flow with upstream disburdening

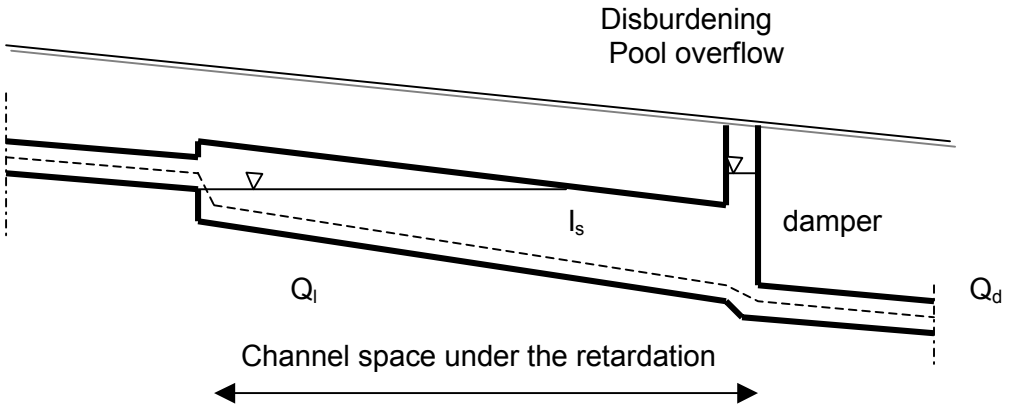


Figure 5. Channel with space under the retarded part of the flow with downstream disburdening

Because of the increasing pollution of water supply and high costs of collecting and purifying waste water the stress has to be put on managing disburdening structures. The functioning of these structures has to be adjusted to filters in order to protect the flow. The operation of the purificating machines depends on the size of overflow pool, position of disburdening structures in the sewage system. In order to be able to successfuly manage sewers it is neccessary to install a symulator of the flow in the sewer as well as constantly measure the volume of the flow at several points in the sewer.

Disburdening of outlets in the rainy period is accidental. The sewage system for discharging waste water together with stormwater has complex structure, aims, limitations as well as various connections with the environment. Planning and managing these systems is a complex and structured task which also requires complex calculations in order to be realized. There are several problems in planning of sewers such as many undertemined, uncertain and accidental influences of inlet sizes and requested outlet conditions of the system. Sewers are a stohastic system.

4. Conslusion

a) Water supply management and economic reasons are fundamental tasks of projects for waste water collection procedures and processing of stormwater as well as avoiding channeling precipitation into the sewers, wherever it is possible.
b) In combined sewers stormwater disburdening structures are built for other flows and due to technical, water management and economic reasons they are not channeled into purifying(filtering plants.
c) In case of stormwater flows high pollution can occur which can cause heavy loading when coming into the flows.
d) This loading appears occassionally, but can be several times higher than those which are regulary present in outlets of filters.
e) The major task of processing stormwater is to limit its flow and channel it to the filter so that the desired value of the stream is kept and at the same time the heaviest flows of the processed stormwater is kept within prescribed limits.

The aim of processing stormwater has to be the highest possible reduction of total emissions from stormwater overflows and filters within the framework of water supply management requirements.

This aim can be realized by using different procedures from decreasing the flow to keeping waste. Stormwater disburdenings have to be considered together with the filters for the particular washing out area of a water flow. The requirements set for filter outlets and stormwater overflows have to be adjusted in order to be more effective and water flow protected.

Regional and specific values of precipitation, flow time, falls, retention capacity of a channel and big polluters have an important role for overflow quantities as well as for the pollution level and therefore have to be considered.

5. References

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