Parts of the waterworks

Waterworks consists of several parts, which may be combined or represented by the type of the waterworks.

A small derivative work with accumulation is usually the most sundry. A typical representative is the majority of smaller mills. Weir waterworks is another wide-spread group. Smaller factories and mainly textile factories on secondary rivers (Jizera, Orlice, Svitava, Sázava, etc.) used to be constructed like that. The main task of the other parts of the waterworks is to deliver a required amount of water to the engine without any loss of the gradient.

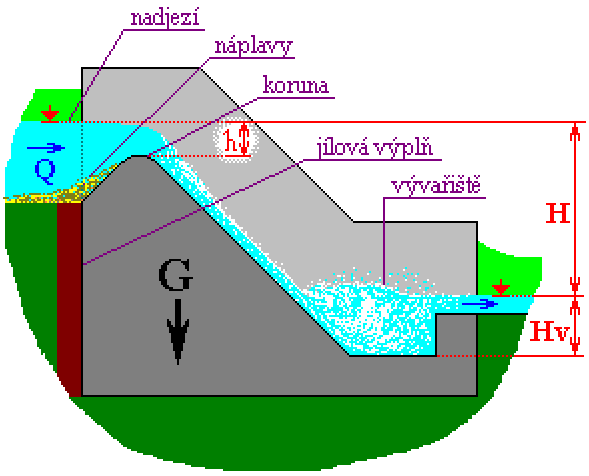
Parts of the waterworks are :

1. **Weirs**
Serve to increase the water surface and to create the water storage
2. **Racks**
Clear water from dirt
3. **Floodgates**
Regulate water flow
4. **Drains**
Remove excess water
5. **Traps**
Capture stones and sand
6. **Raceways**
Bring water to the buckets
7. **Pipeline**
When the water flow needed to be hidden
8. **Waste**
The used water returns
9. **The remediation flow**
After all, we do not let all the water for ourselves
10. **The fish passage**
Fish like to travel too
11. **Bank reinforcement**
Still water runs deep, wild then rips
12. **Ponds**
Accumulate mass of water for the period of drought

Weirs

Weir is used to raise and stabilize water level in the river bed. This makes possible to draw some of the water out of the main stream. The weir throws over the water flow at a certain distance below the point of the beginning of the water right (see point A). The distance is chosen so that the held up water at this point cannot rise. For the derivation of the water works, the weir has such height as it is necessary for the management of the water flume. The weir at the waterworks must have a height H that equals the gradient for the water motor. To avoid the variation of the height of the water level with the variable flow, the flow is usually enlarged and the top of the weir is long. If the enlargement is impossible, the weir is built in the flow at an angle or even almost lengthwise. The small water works are the most common solid weirs with a fixed height. Moving weirs – cylindrical, segmental, etc, are built only at places, where water spilling from the banks during the floods or navigation of the cruise ships would be impossible. Tube rubber dams (manufactured by Strojírny Brno a. s.) allow minor changes of the water or extending boards on the top. Tyrolean weirs combine the water-raising devices and self-cleaning screens.

Sloping concrete weir with a deepened boiler:



This weir is a typical representative of fixed weirs used in modern waterworks standing on both small and large rivers. If it is not set differently, the height of water at the derivative waterworks equals to the height of water in the fume. The drive is separated from the main flow before the weir. This distance is 2 .. 15 m and may be equal to the half of the distance between the weir and the point of beginning of the water right (see point A). The outfall drive provided by bar screens is 1.5 times wider than the actual drive and it smoothly passes into it. The weir has to be massive to not be undermined or tip over by the flood. Since we cannot prescribe nature how much force is allowed to impact on the weir, it is constructed in a way that is strong enough to resist at least the last known hundred year flood (the largest expense, which was recorded from around 1900). The weir body has retained water pressure, the pressure of the accumulated deposits of ice or stranded strains reacted by rapid vacuum and fluid flow along its trailing edge. All these forces are trying to overturn a concrete block. A large weir body and the center of gravity location in the first third of the weir is the only way how to face against these forces. When determining the weight of the dam, it must be taken into account that the whole weir is madelighter by Archimedes water leaking subsoil weir (if it stands on clay or sand, it is as being entirely surrounded by water. If it is directly on the rock, it is considered only one fifth of the total lift force). The weir must be buried deeply into the natural soil and sealed with a layer of clay by the water-side. We must prevented the leakage under the body of the dam, which undermines the bedrock stability of the dam and becomes the outset of its destruction.

Width of the weir:

The width of the weir is proposed by the flow which has to manage the weir safely at the highest backwater, where there is not water performance of the banks or violation of water rights.

This table can be used for quick reference:

flow Q max [ltr. / sec.]	**max overfall (metres) over the top**							
	0.1	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.8**	**1**
50	0.7	0.3						
100	1.3	0.5						
200	2.6	1	0.5					
500		2.4	1.3	0.9	0.6			
1000		4,8	2,7	1,7	1,3	1		
2000			5.3	3.5	2.5	1.9	1.2	
3000			8	5.2	3.8	2.9	1.9	1.3
5000				8.7	6.3	4.8	3.1	2.2
10000				17.4	12.5	9.5	6.2	4.5

minimum width of the weir B [meters]

In the first column, locate the appropriate value of **Q** max (at small streams it should be at least 75 times of the current flow). On the horizontal line seek for the maximum possible overflow of water **h** over the top, where there will not be a threat around the weir. The cell at the intersection of the two values contains the recommended width of the weir in meters. The value of **h** is the difference between the top of the weir and the weir calm surface (rather than a value measured on the top, as it is the case with amateur flow measurement on the weir.) because the level towards the top decreases.

Stilling basin:

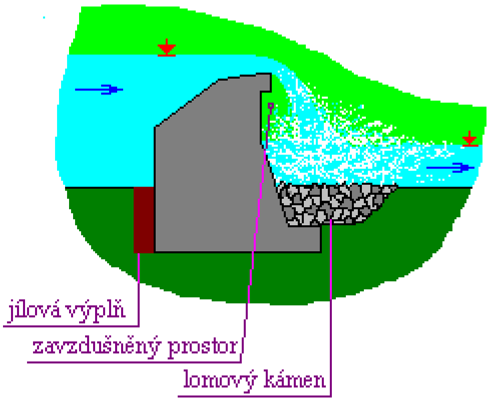
Stilling basin depth is dependent on the total height **H** from which the water falls and it is particularly at the overflow **H**. To avoid the thwarting of the excess energy without the side effects of destruction, the depth of the hollow **Hv** should correspond to the following table:

height H [meters]	**overflow h [meters] over the top**							
	0,1	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,8**	**1**
0,4								
0,5	0,2	0,35	0,45	0,55				
0,6				0,6	0,7			
0,8			0,5		0,75			
				0,65				
1		0,4				0,9		
			0,55		0,8			
1,2	0,25							
				0,7			1	1,3
1,4								
			0,6		0,85			
1,6		0,45				1		
				0,75				1,5
2	0,3		0,65		0,9		1,2	

2,5	0,5	0,8	0,95	1,6
	minimal depths of the stilling basin **Hv** [meters]			

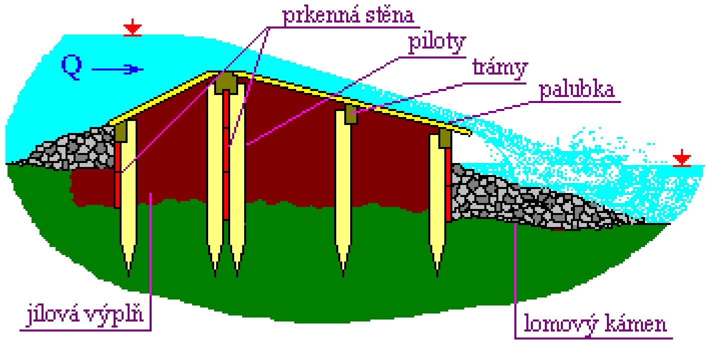
In the first column, locate the appropriate value of **Q** max in liters per second. In the first row, locate the approximate height of the weir **H** in meters. The cell at the intersection of the two values contains the recommended depth of stilling basin **Hv** in meters. The length of the stilling basin is then approximately quintuple of the depth.
Weir is an expensive investment, built for many years in the harsh conditions of streams, therefore the design, calculation and construction are done with the utmost thoroughness.

Perpendicular concrete weir:



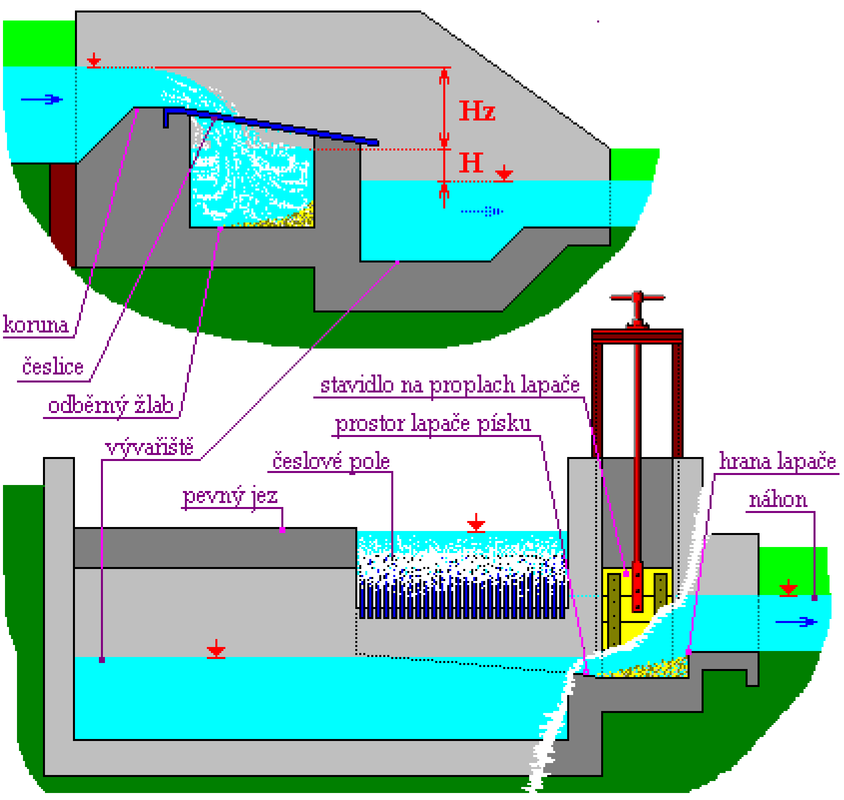
The weir is used in rivulets, streams and small brooks. Its major advantage is the oxygenation of the water even at low level (above 30 cm). It usually does not have a deepened stilling basin; water energy is dissipated by the fragmentation of the water stream on bedrock. Large stones (in the section below the weir) calm down the flow very quickly, but can dangerously impede the runoff during high water. This type of weir may be topped up at a greater height easily by adding the adjustable plate at the top. The second possibility is the metal cupboard with the pipe. This is the way how to obtain from the ordinary weir the Tyrolean weir or directly micro power station.

Wooden weir:



This weir was typical in the past for smaller inferior water works, especially for small wheeled water mills on streams and medium-sized brooks. It required frequent repairs and maintenance of natural stone layers that protected the main body of the weir. The inner space of the weir was filled with large boulders with clay to form a waterproof block. The lifespan of piles of oak and oak boards of transverse walls was up to 100 years. Pine or larch paneling of the upper part were easily damaged by floods. They lasted up to 20 years when the conditions were favorable. Even though it was important for the builders to avoid using of metal items, it was just rust of nails what influenced the lifespan of the building.

The Tyrolean weir:



The weir is a combination of water-raising devices and self-cleaning racks. The figure shows the situation at low water. One part of the stream is dammed by an ordinary oblique or perpendicular concrete weir and applies only at high water. The second part is inferior to the top over the selected width of the desired water flow flowing through the motor. Water falls through racks into a channel with an inclined bottom, which flows into the sand trap. This is just a part of the weir. From this place, the water continues to the drive or pipe. Dirt trapped by racks fall to the water surface of the stilling basin. The racks are thin. Metal or fiberglass rods attached to the top are used the most commonly. If there is too much water, the completely overflown drain flows to the stilling basin. The racks find themselves under water and the flowing water cleans them. All the sand that river carries is deposited on the bottom of the channel. The sand washes out small sluice gate. Weir is used only in larger gradients where the lost momentum **Hz** is not a problem. It is built very low. The height **H** may be only 30 cm. The main gradient for water motor is obtained by a long drive or piping. The overall width must allow the flood flow, the rack field width is designed only for water absorption of the capacity of the engine. In the case of the dry season, all water is fed to the drive. To ensure a minimum flow in the river bed in dry periods, we can carve a hole into the bottom edge of the irrigation. Tyrolean weir is ideal for small hydropower plants, water use, supply of breeding ponds and trout hatcheries. Cink is the company which constructs these weirs in the Czech Republic.