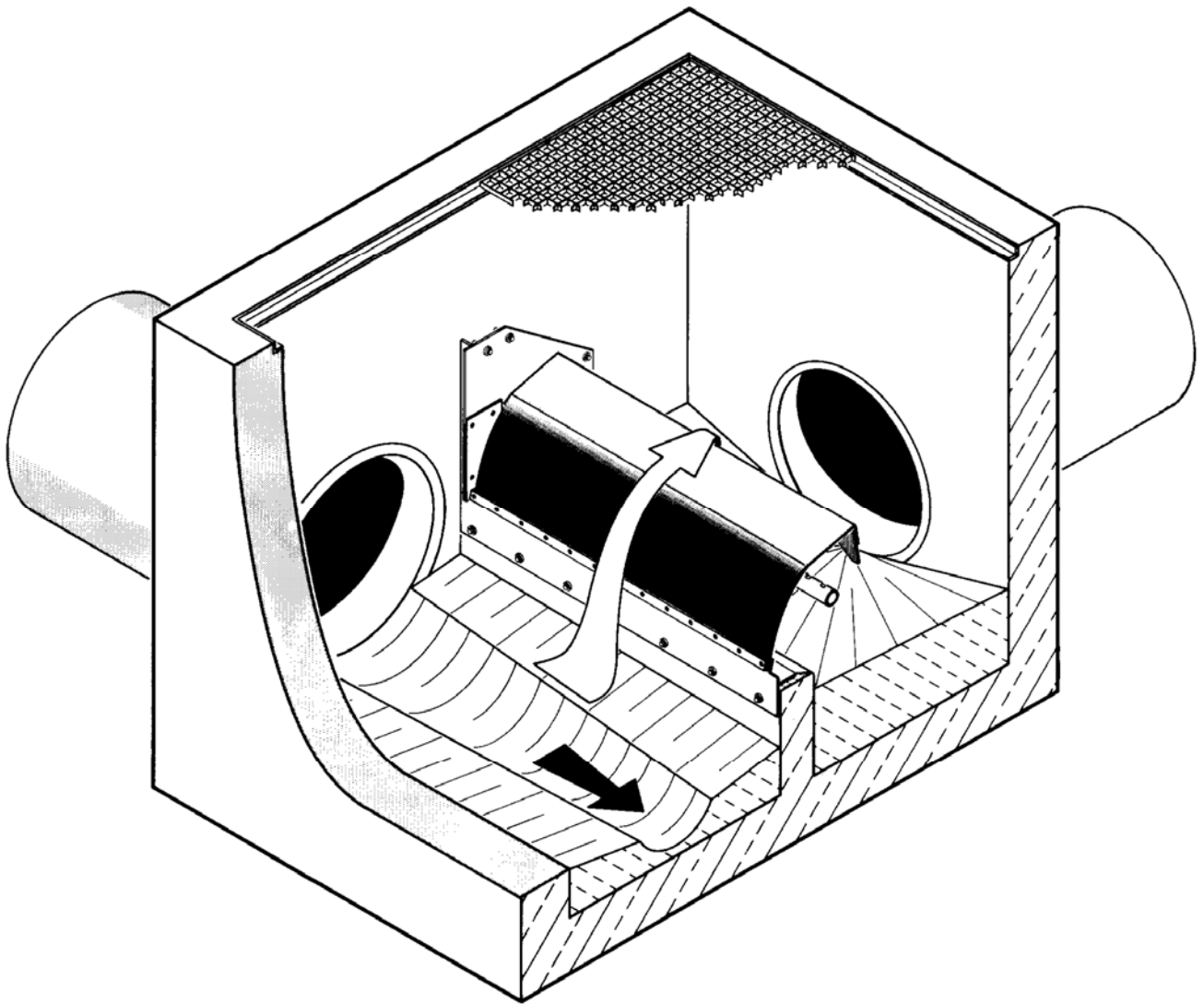


CSO/STORMWATER MANAGEMENT



HYDROVEX[®]
BW Bending Weir



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APPLICATION

Combined sewer systems have overflow structures which discharge excess sewage to avoid overload of sewers and sewage treatment plants.

The excess water is discharged when the water level exceeds a given level. In most cases, the overflow structures are fixed weirs. The height of the crest of the weir W_0 is usually determined from the permissible backwater in the sewer network for a design flowrate of Q_b and the weir length L , see **Figure 4**.

The weir height W_0 affects the passive in-line storage capacity of the sewer system. Quite often, long overflow weirs and correspondingly large structures are required for the optimal use of the in-line storage capacity of the sewer system.

The **HYDROVEX® BW** Bending Weir is a new regulating device, which is more efficient than a conventional fixed weir. A one-meter long bending weir is equivalent to a fixed weir of a length of between 3-12 m for exactly the same flowrate and back water (weir comparison ratio). In contrast to a sluice gate, the bending weir does not allow polluted particles (bed load) to be entrained with overflows.

The **HYDROVEX® BW** Bending Weir operates automatically without the aid of auxiliary power. The flap itself is very light and strong because it is made of tempered high strength stainless steel. One of the flap's special characteristics is the absence of moving bearings, counterweights, sliding seals and axles. This results in a high operational reliability and long lifetime with a low susceptibility to wear.

CONSTRUCTION

The **HYDROVEX® BW** Bending Weir is made of twelve parts, see **Figure 1**. The girder (1) has a T-shaped cross section, is bolted horizontally onto the existing (or new) sill, such that the shorter side, which is bent in the direction of flow would protrude over the crest. The height of the sill is dependent on the bending weir type used and will be calculated for each task with the aid of a computer program.

The sheet of metal, which forms the bending weir, is fastened securely near the top of the girder. The metal sheet is made of three sections: the bending section (2), the sensing section (3) and the reinforcing section (4). The sheet of metal is bent twice, (at the beginning and end of the sending section). The first bend (which is in the direction of flow) is bent for hydraulic reasons, the second serves as reinforcement.

The lateral stabilizer (5) one on each upper corner of the sheet prevents it from warping in uneven flow.

The side plates (6) are situated on each side of the sheet and are aligned parallel to one another. The strength of the side plates is dependent on the model of bending weir and the fastenings on the local conditions of mounting. The side plates can be joined onto the girder and adjusted with rods (to ensure that they are perfectly aligned) or mounted directly onto the existing sidewalls.

Each side plate has a pre-stressing plate (7), which conforms exactly to the curvature of the bending sheet, (i.e. in its resting position the sheet is in a prestressed state). The pre-stressing plate is usually never higher than the water level W_0 (at which a discharge over the flat still occurs).

The aeration pipe (8) is situated between the side plates. It ensures that the overflow jet becomes so aerated that no "weir swing" can set in. The diameter of the aeration pipe and the number of aeration holes are dependent on the model of bending weir, the discharge Q_{max} and the overflow length L . The aeration pipe also prevents the bending sheet from permanently deforming during overload.

Between the side plates of the weir and the side walls of the overflow structure there are aeration slits (11), which allow the passage of air to the aeration pipe. The slits are sealed from the side with a vertical seal (10) so that no water can flow through them. The joint (12) between the girder and the supporting structure is filled with mortar. The mortar acts as a seal and absorbs also the bending moment.

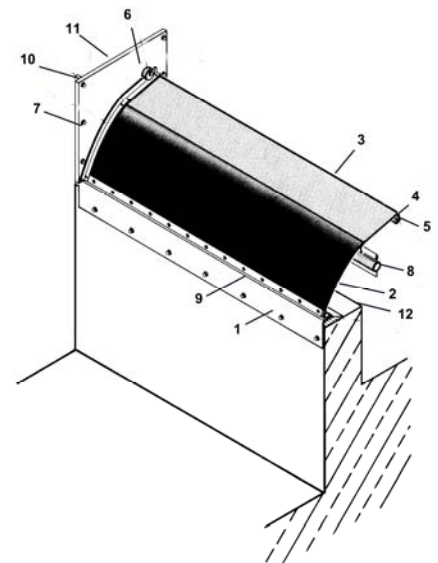


Figure 1: Sections of the Hydrovex® BW Bending Weir

The simple construction of the bending weir makes it highly reliable in operation and easy in installation. The heart of the device is the bending sheet, which can be 0.5-2 mm thick and is made out of high quality elastic stainless steel. The shape of the bending sheet and the selection of materials are the result of extensive laboratory tests and calculations. Behind the apparently simple construction of the flap lies a very complex relationship between the effects of static and dynamic hydraulic forces and the passive restoring forces of the bend in the bending sheet.

Resting Position (1 in Figure 2):

The bending weir is an overflow flap. When the upstream water presses on it, it bends so that a certain volume can flow over it. In its resting position it is in a prestressed state (as long as the upstream side is not immersed completely in water). The bending sheet presses against the prestressing plate, forming a watertight seal up to the water level W_0 .

Onset of Overflow (2 in Figure 2):

As soon as the water level reaches W_{min} the hydrostatic force causes the bending weir to suddenly bend downwards, this in turn leads to a new balance between the dynamic and bending forces. In this situation, the discharge curve is near to being a horizontal line (see Figure 4).

Hysteresis Behavior (3 in Figure 2):

The fact that the discharge flowrate of the bending weir quickly rises, from zero to a certain value, means that the upstream water volume influences the subsequent behavior of the bending weir flap. When the upstream water volume is very small, the overflow volume drops along with the hydrostatic force; because of this the bending sheet begins to move upwards. If the water level falls below W_0 the bending sheet gently snaps back into the resting position.

Because of the sudden downward movement and the gentle snap back of the bending weir, a hysteresis h_w arises, which amounts to a few centimeters of water. In contrast, the fuzzy response of a fixed weir will be avoided.

Rising Water Level (4 in Figure 2):

As the water level rises, the bending sheet bends further, increasing the amount of area available for water to flow over. Each water level is now hysteresis free and corresponds to a certain flowrate.

Bending Sheet at its limit (5 in Figure 2):

In order to avoid permanent deformation of the bending sheet, it is prevented from bending over any further (at the critical tension) by a mechanical stopper. This stopper is in the form of a horizontal pipe, which simultaneously aerates the weir. The vertical load distribution for this state is schematically sketched in Figure 2. Because of the mechanical stopper, the bending weir is able to withstand hydraulic overloads and can also be operated with even higher water levels. In spite of its drawbacks, the bending weir is still clearly superior to a fixed weir (see Figure 4). As the water recedes to W_{min} , the discharge behavior is exactly the same as with rising water level.

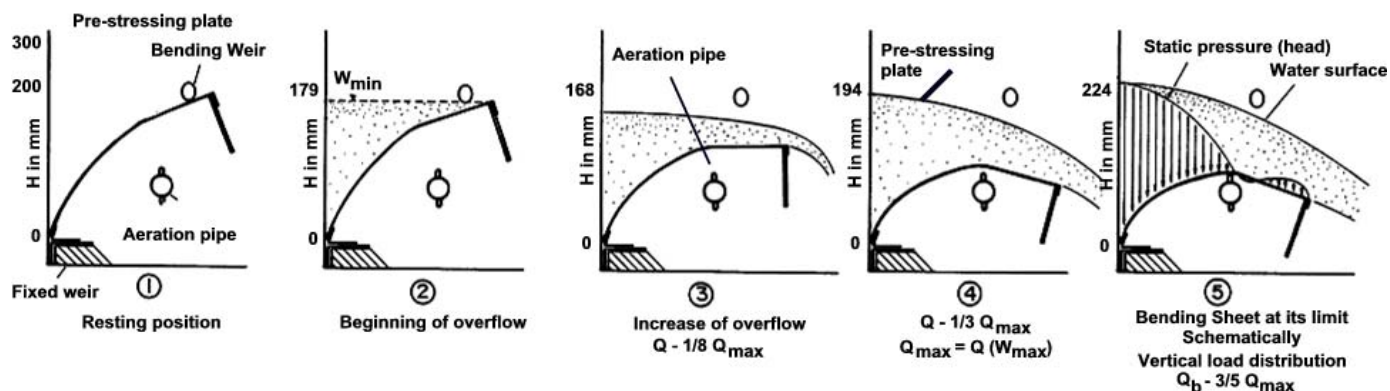


Figure 2: Various operating phases of the Hydrovex® BW Bending Weir

BACK-FLOW PREVENTION

Backpressure from downstream causes the bending sheet to come back to its resting position, thus preventing a back-flow of water into the sewer system. If there was an additional upper stopper the bending weir could “seal” the system.

MODELS AVAILABLE

The following types of bending weir are available:

Type	Maximum Discharge Q_{max} l/s-m (cfs)	Maximum overflow height h_{max} mm (in.)	Design Flowrate Q_b l/s-m (cfs)	Design overflow height h_b mm (in.)
10	505 (17.8)	140 (5.5)	255 (9.0)	75 (3.0)
15	823 (29.1)	194 (7.6)	215 (7.6)	104 (4.1)
20	1160 (41.0)	244 (9.6)	585 (20.7)	131 (5.2)

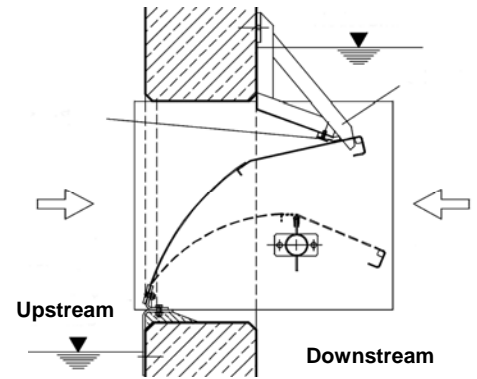


Figure 3: Application of the Bending Weir as an impediment to back-flow (from receiving waters)

Materials:

The girder and main body of the bending weir (bending sheet, aeration pipe, etc.) are made of stainless steel. The side plates are made of PVC

Order Form:

Bending weir type.....
Weir length including side plates $L=...$ m
Design Flow $Q_b=...$ l/s
Design Head $h_b=...$ mm

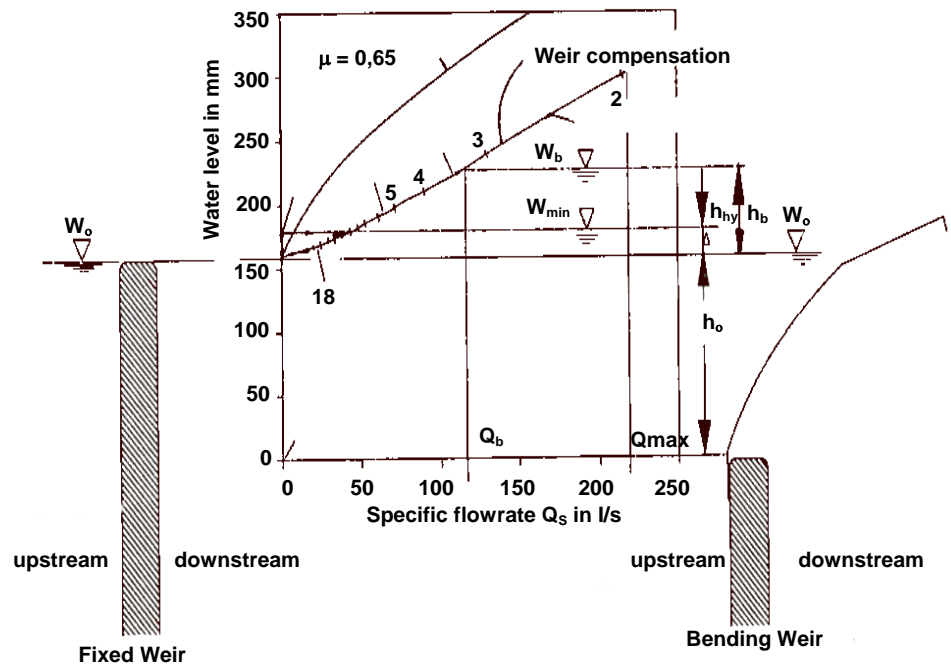


Figure 4: Discharge characteristics of the Hydrovex® BW Bending Weir

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