Storm water treatment
Waste water technology
Electrical engineering
Urban hydrology

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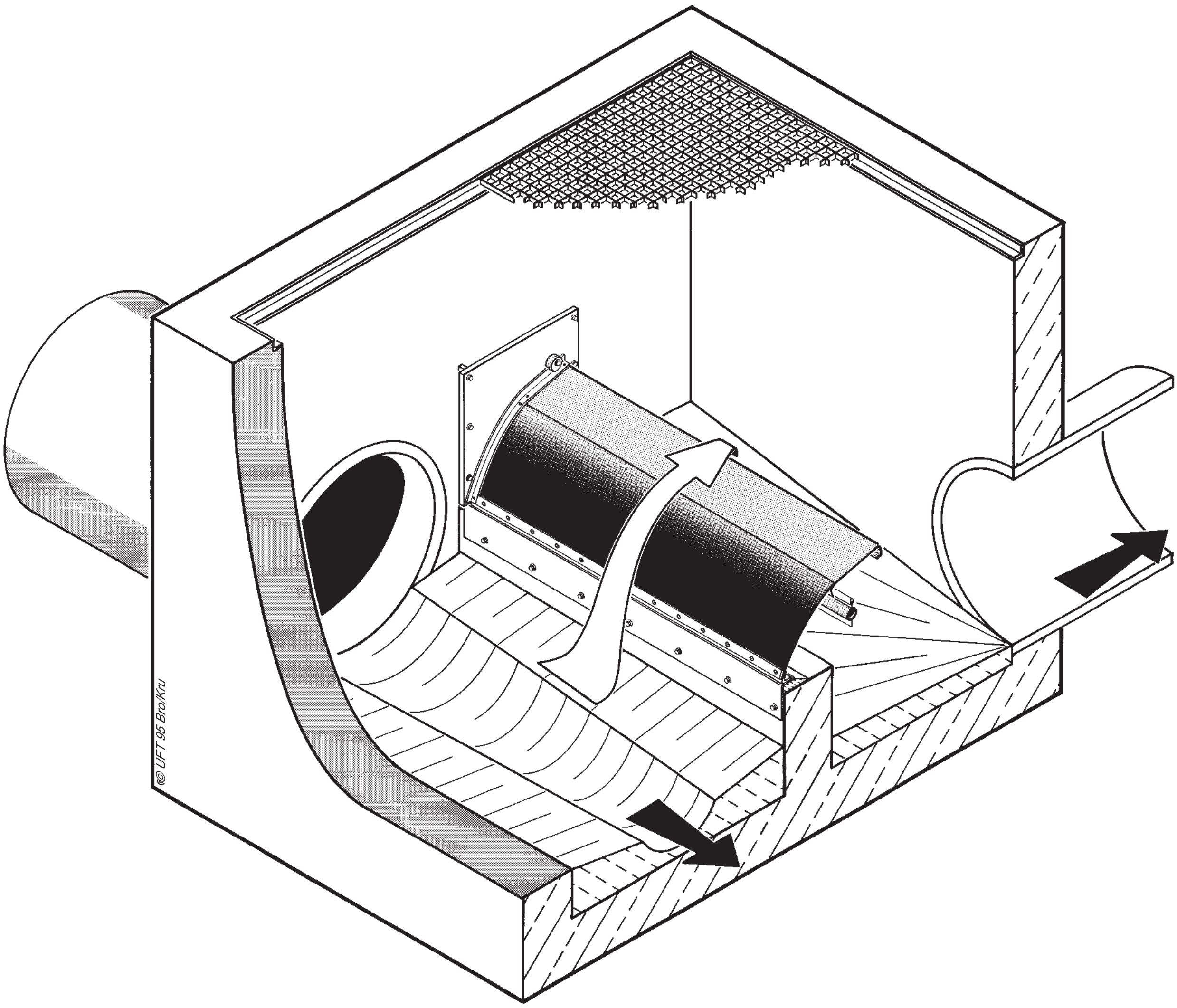
Product Information

Bending Weir
UFT-*FluidBend*

BK
0182



1 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 3. 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 Bending Weir UFT-FluidBend is a 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 Bending Weir UFT-*FluidBend* 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.

Advantages of the bending weir UFT-*FluidBend*

- higher performance compared to a conventional fixed weir
- bending weir of 1 m length can replace approximately 2 to 10 m fixed weir with similar hydraulic characteristics
- gain in accountable storage capacity (activation of retention volume)
- the overflow weir type reduces risk of output from bed load
- selfactuating, without auxiliary power
- little weight
- no moving parts like joints, bearings, slides or hinges
- high reliability of operation
- high durability
- low susceptibility to wear

2 Construction

The Bending Weir UFT-*FluidBend* is made of twelve parts, see Fig. 1. The girder (1) has a L-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

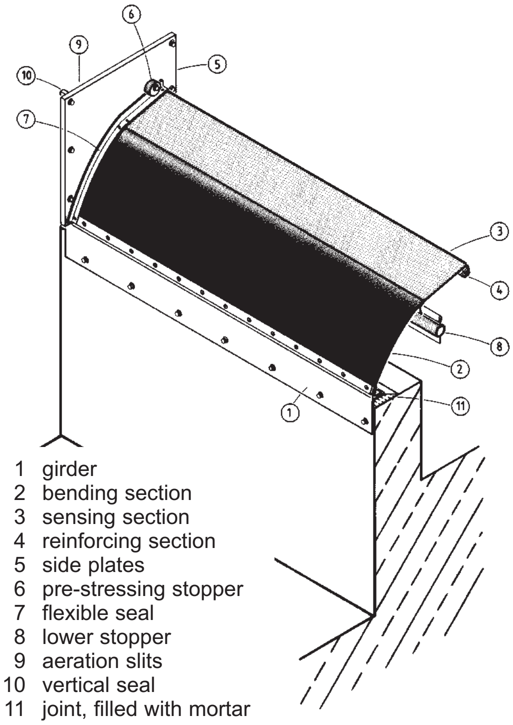


Fig. 1: Sections of the Bending Weir UFT-*FluidBend*

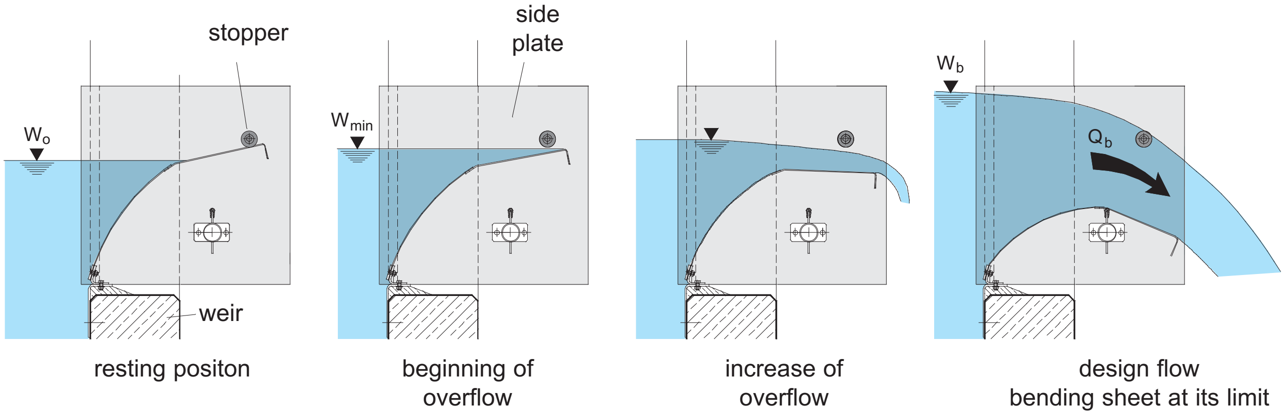


Fig. 2: Various operating phases of the Bending Weir UFT-*FluidBend*

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 one on each upper corner of the sheet prevents it from warping in uneven flow.

The side plates (5) 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 stopper (6), The pre-stressing stopper is usually never higher than the water level W_0 (at which a discharge over the flat still occurs). Flexible seals

Flexible seals (7) prevent the water from leaking between weir and side plates. The lower stopper (8) is situated between the side plates. The lower stopper 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 (9), which allow the passage of air to the lower side of the overflow jet. It ensures that the overflow jet becomes so aerated that no “weir swing” can set in.

The slits are sealed from the side with a vertical seal (10) so that no water can flow through them. The joint (11) between the girder and the supporting structure is filled with mortar. The mortar acts as a seal and absorbs also the bending moment.

3 Operation

The simple construction of the bending weir makes it highly reliable in operation an easy in installation. The heart of the device is the bending sheet, which can be 1-2 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.

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.

3.1 Resting position

In its resting position it is in a prestressed state as long as the upstream water level is not higher than W_{min}. The bending sheet presses against the prestressing stoppers.

3.2 Onset of overflow

As soon as the water level reaches W_{min} the hydrostatic forces cause the bending weir to suddenly bend downwards, this in turn leads to a new balance between the dynamic and ending forces. In this situation, the discharge curve is near to being a horizontal line (see Figure 3).

3.3 Hysteresis behaviour

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 behaviour 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 Δh_{hy} arises, which amounts to a few centimeters of water. In contrast, the fuzzy response of a fixed weir will be avoided.

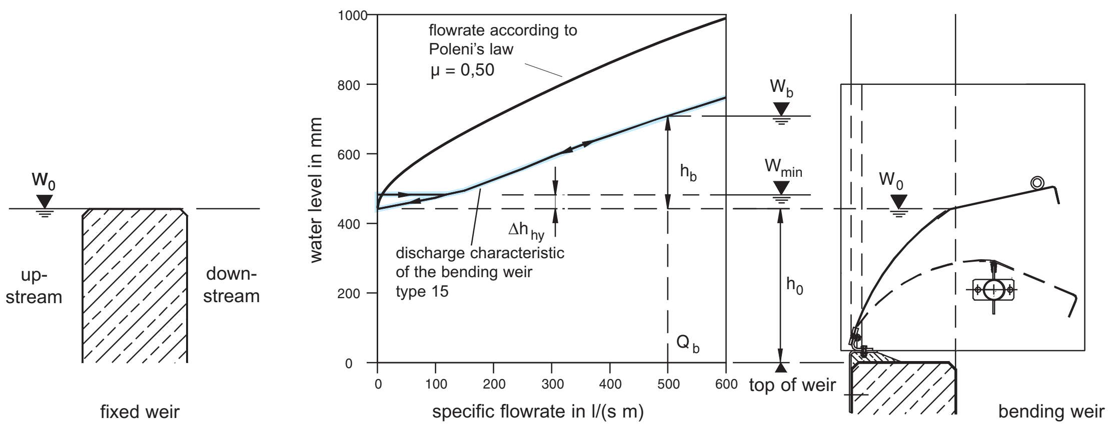


Fig. 3: Discharge characteristics of the Bending Weir UFT-*FluidBend* compared to a fixed weir

3.4 Rising flowrate

As the water level rises with the rising flowrate, 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.

3.5 Bending sheet at its limit

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. Because of the mechanical stopper, the bending weir is able to withstand hydraulic overloads and can also be operated with even higher water levels.

3.6 Backflow prevention

Backpressure from downstream causes the bending sheet to come back to its resting position, thus preventing a backflow of water into the sewer system.

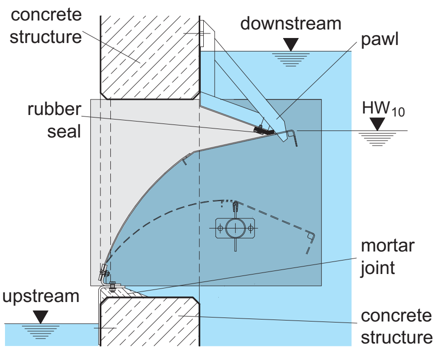


Fig. 4: Application of the Bending Weir as an impediment to backflow (from receiving waters)

Corresponding to the guideline DWA-A 128, the top of a weir should be set not less than the downstream water level with a ten years return period HW_{10}. In cases the water level of the receiving waters rises higher the bending weir can be provided with an additional upper stopper that can “seal” the system.

The leakage fulfils the requirements of the standard DIN 19569 on a level of a lock gate. Bending weirs should not be emerged from downstream permanently.

4 Measurement of overflow acitivity

The known hydraulic characteristic of the device allows the use of the bending weir for the measurement of the overflow activity.

5 Model series

Three standard types of the bending weir are available. The design flowrate and the indicated overflow height in table 1 are guidance values that allow a rough preselection of the devices dimensions. We despose of a dimensioning software which generates an individual hydraulic curve with high precision.

Type	Design flowrate in l/(s·m)	Overflow height W_b - W_0 in mm
BK 10	300	187
BK 15	450	239
BK 20	600	286

Table 1: Available types of Bending Weirs UFT-*FluidBend*

Typical Specification Text

Pos.	Number	Article
1	x	Bending Weir UFT-*FluidBend*

Selfactuating, without auxiliary power operating overflow weir type without moving parts like joints, bearings, slides or hinges for activation of retention volume and regulation of the upstream water level. The known hydraulic characteristic allows the use for the measurement of the overflow activity. To be installed in front of an even and horizontal weir crest. Girder, lower stopper and mounting parts from stainless steel, bending sheet from tempered stainless steel, side plates from PE-HD with flexible seals from EPDM.

Model UFT-*FluidBend*	**type BK ...**
Design flow Qb:	... l/s
Length L1 (side plates included):	... m

Unit ready to be mounted, regulated with required flow rate, includes hydraulic dimensions and technical specifications.

Further Information

- Product Information Spring Loaded Weir UFT-*FluidFlap*, FSK 0183

Bibliography

DWA-Arbeitsblatt DWA-A 166 (2013): Bauwerke der zentralen Regenwasserbehandlung und -rückhaltung. Konstruktive Gestaltung und Ausrüstung. Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V., Hennef : DWA, November 2013.

DWA-Merkblatt DWA-M 176 (2013): Hinweise zur konstruktiven Gestaltung und Ausrüstung von Bauwerken der zentralen Regenwasserbehandlung und -rückhaltung. Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V., Hennef : DWA, November 2013.

DWA-Arbeitsblatt ATV-A 128 (1992): Richtlinien für die Bemessung und Gestaltung von Regenentlastungsanlagen in Mischwasserkanälen. Abwassertechnische Vereinigung e.V., St. Augustin : GFA, April 1992.

Norm DIN 19 569 Teil 4 Nov. 2000. Baugrundsätze für Bauwerke und technische Ausrüstungen. Besondere Baugrundsätze für gehäuselose Absperrorgane.