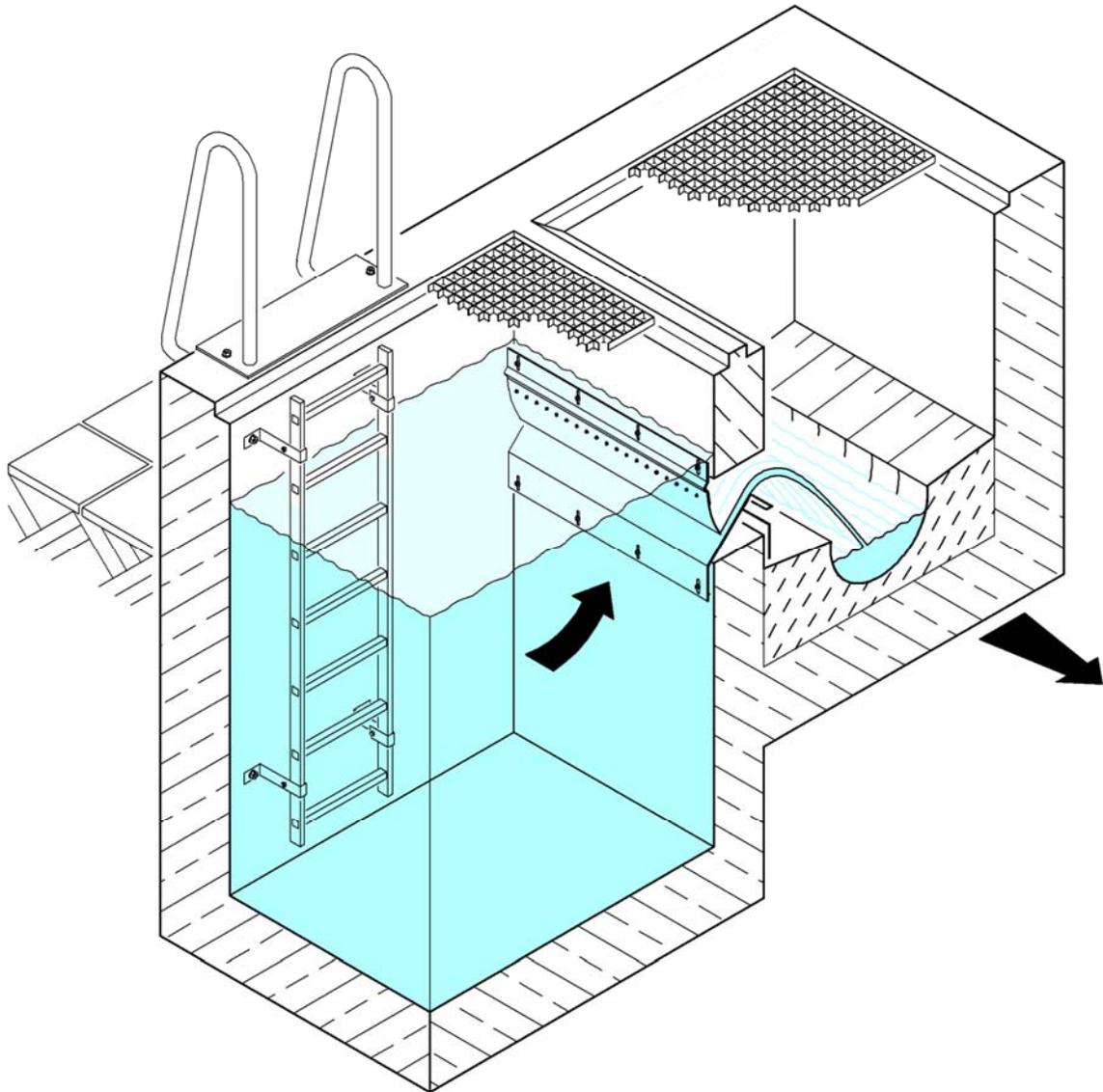


CSO/STORMWATER MANAGEMENT



 **HYDROVEX[®]**

Clari Self Regulating Outlet Slit



JOHN MEUNIER

APPLICATIONS

In CSO treatment using clarifier tanks of the transit type, or in a stormwater drainage system including clarifier treatment tanks, there has, for a long time, been a critical hydraulic problem: the clarifier tank can be fed only up to a limited rate to obtain a minimum separation and guaranty that settled sediments are not put back in suspension. Therefore, a maximum rate load of 10 m/h and an average transit speed of 5 cm/s (1) are usually recommended.

To respect these elements, the configuration shown in **Figure 1** is usually considered. The overflow of the tank is regulated through a slit at the output end of the treatment tank, on a narrow opening. This opening is at an angle, like an underflow baffle arrangement, to capture the floatables inside the tank. The sill of the overflow is located lower than the actual emergency overflow level of the tank, but higher than tank intake weir from the sewer line.

The opening width is calculated to insure that, for a maximum water height in the tank (corresponding to the upstream emergency overflow), the treated flow evacuated through the slit is at the nominal treatment value for the tank. The normal opening of the slit is usually between 3/4" and 2".

This type of arrangement can be difficult to apply in existing concrete structures. Furthermore, modifying the flow capacity later on will be problematic.

Overflow slits have a major hydraulic handicap: the actual overflow value will always vary according to the square root of the upstream load (Torricelli's law). The tank thus reaches the optimum treatment efficiency only when the overflow value equals the nominal treatment flow corresponding to the tank configuration. At lower load, the overflow value will be lower than the nominal treatment flow, leading to losses in pollution reduction. At higher load, the overflow of the tank will increase, consequently suspending already settled sediments and losing treatment efficiency.

The **HYDROVEX® Clari** was developed especially to regulate the overflow of treatment tanks of the transit type for CSO, SSO and stormwater.

Hydraulic optimization and evaluation of the new **HYDROVEX® Clari** was made with the **HUBERT-ENGELS** Laboratory at **DRESDEN'S UNIVERSITY** in Germany. Patents protect this product.

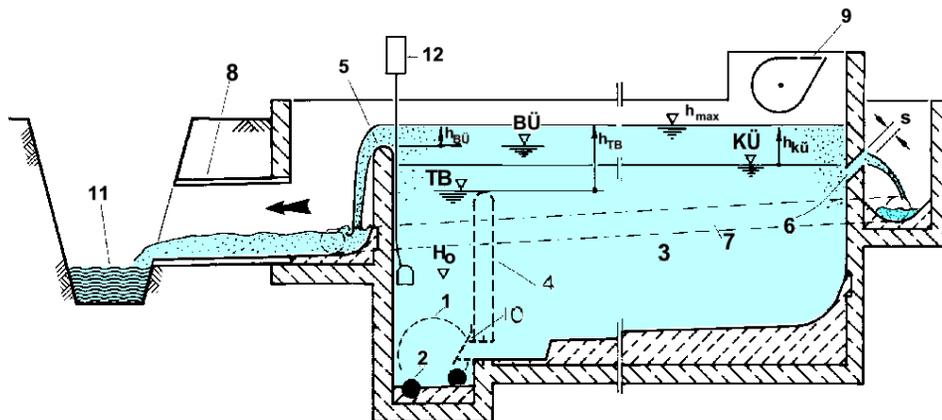


Figure 1: Cut view of a clarifier tank with overflow slit.

- | | | | |
|----|---|-----|---|
| 1. | Inlet pipe to the site | 7. | Treated water outlet |
| 2. | Regulated flow pipe | 8. | Outfall |
| 3. | Clarifier Tank | 9. | HYDROVEX® SFT Sediment Flushing Tank |
| 4. | Inlet weir to the Clarifier Tank (TB) | 10. | HYDROVEX® CCV Check Valve |
| 5. | Emergency Overflow Weir BÜ | 11. | Receiving water |
| 6. | Treated Water Overflow / HYDROVEX® Clari | 12. | Level sensor |

ADVANTAGES

- Simple and robust construction
- No moving parts, bearings or seals
- No wear
- No external monitoring or control required; solid state behavior
- No drive or external energy required
- Near constant flow regulation
- Precise and reliable operation
- Flow value can be modified after the installation
- Acts naturally as an underflow baffle
- The unit implies no footprint as the unit is installed inside a concrete wall section
- Corrosion free; all parts are in stainless steel
- Simple to install
- Minimal inspection required; maintenance free design

CONSTRUCTION

Rather than creating a narrow overflow slit in the back wall of the static clarifier tank, a more important reservation in the wall thickness is kept. This reservation height must be according to dimension “H” from the top drawing and **Figure 2**. The top portion of the opening holds the angled support plate (2) with the pressure band (1). The stainless steel bending sheet (3) is bolted on the support plate. This bending sheet is generally 1mm thick. The support plate angle sets the bending sheet at a definite angle “A”, just on top of the opening. The bottom portion of the concrete opening is fitted with a stiff steel sheet shaped as a beaching plate. It is held in place by a pressure band identical to (1). This pressure band (5) helps to set the beaching plate at a pre-set angle “B”. When the system is at rest, the distance between the bending steel sheet and beaching plate is “EA”. This is the effective overflow slit that will regulate the overflow.

When the upstream tank gets filled, the bending steel sheet dives into the water to a depth “U” and acts as an effective baffle to retain floatables in the tank. According to the width of the wall “B” and the choice of angles “A” and “B”, the selection of the slit is made. Generally, this opening will be between 2 and 4 inches.

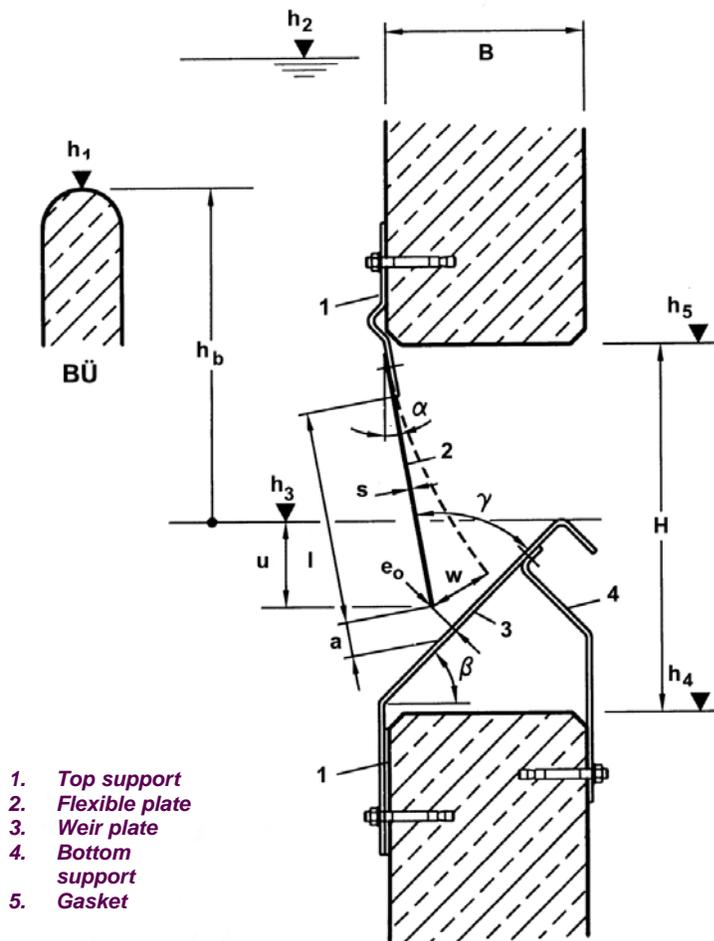


Figure 2: Construction of a HYDROVEX® Clari

OPERATION

As long as the water level in the tank stays under the height h_3 , there is no overflow in the **HYDROVEX® Clari** - **Figure 3A**. The tank acts like a retention tank.

As soon as the water level increases over the beaching area sill, a free overflow occurs – **Figure 3B**.

If the level still rises more, the water will be “blown” towards the outside in a free jet shape through the slit between the beaching plate and the bending sheet - **Figure 3C**. Once this happens, the overflow is regulated by the variation of the distance between the bending sheet to the beaching plate. The flow is then fully regulated and independent from the upstream head. This is the point where the **HYDROVEX® Clari** fully controls the flow and gets a vertical flow curve.

The material quality and performances of the bending steel sheet are chosen to assure that the curvature “W” of the element is below the breaking limit and that the wear limit of the bending sheet is never exceeded. This guarantees an infinite life to the part, under normal conditions.

If the overflow jet has to be limited, the **HYDROVEX® Clari** can be fitted with an outside deflector - **Figure 3D**.

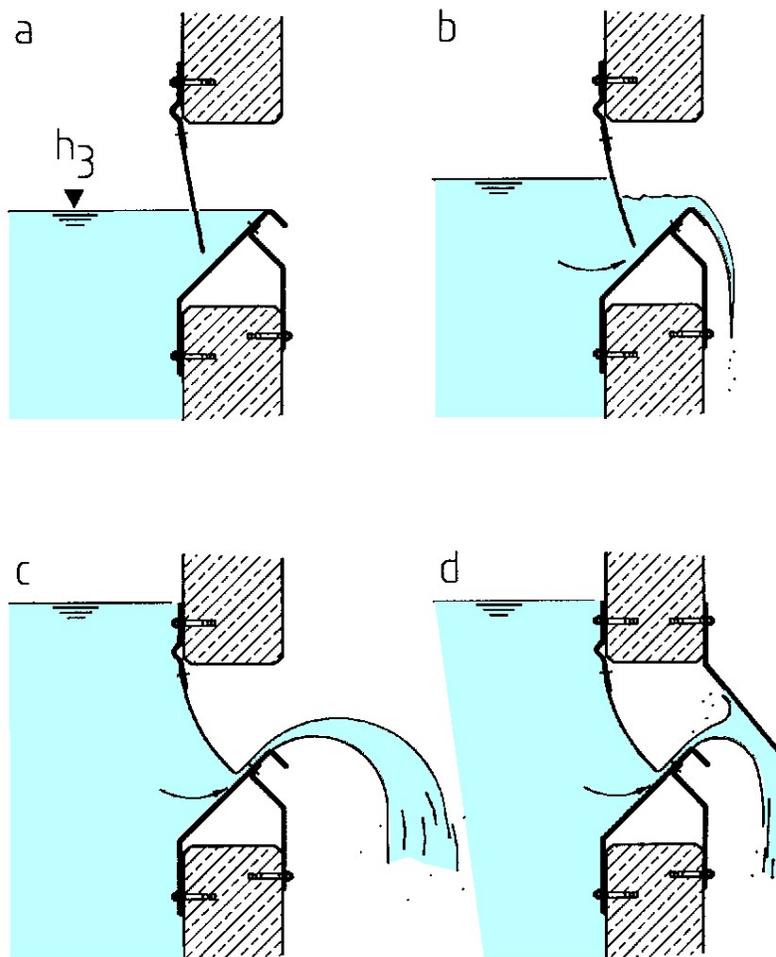


Figure 3: Operation of a HYDROVEX® Clari

FLOW CURVE

Parameter e_0 , \hat{a} , $\hat{\alpha}$ and W , allow unlimited selections. However, only very precise selections allow optimal flow conditions and almost vertical flow curves.

Figure 4 shows the optimal flow curves. Intermediate selections can be extrapolated. For **HYDROVEX® Clari** dimensioning, we use computer software. The required data are specified in **Table 1**. We can supply you with any required selection.

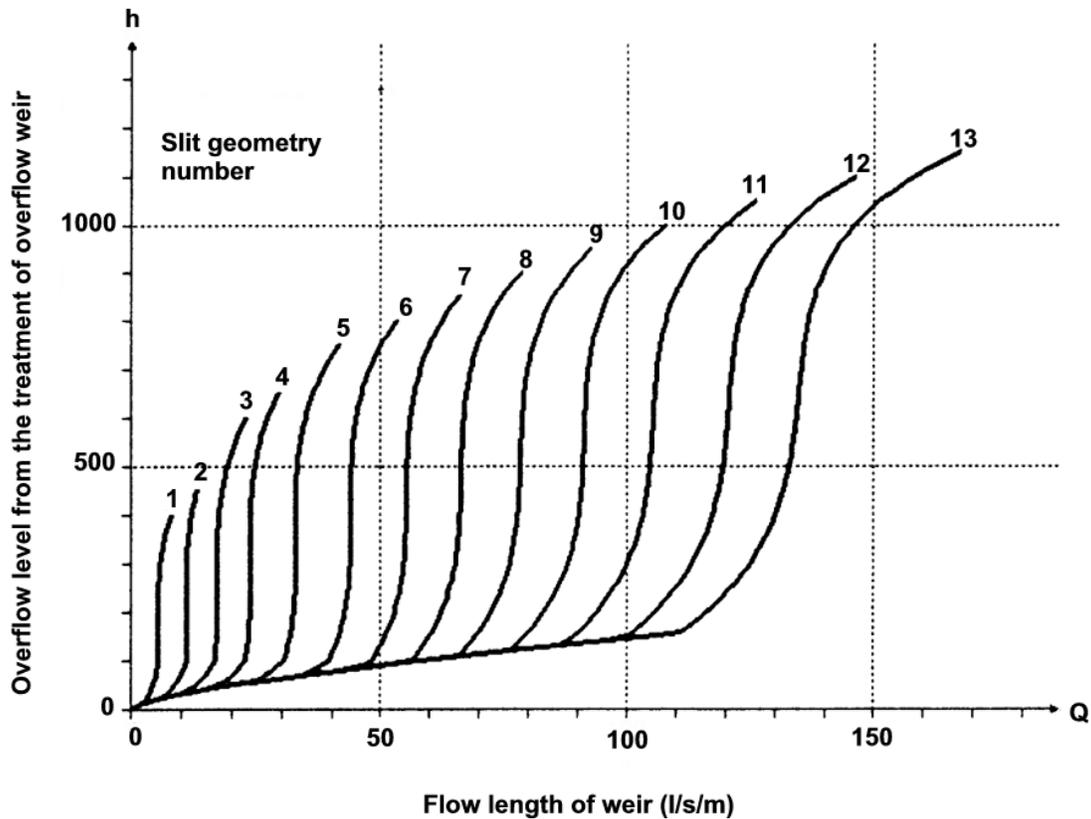


Figure 4: Flow curves diagram

REQUIRED DATA

Clarifier tank emergency overflow weir elevation;
 Maximum water elevation in tank;
 Clarifier tank treatment overflow weir elevation;
 Design treatment flow;
 Bending metal sheet submerged requirement;
 Slit length;
 Wall thickness;
 Horizontal stabilizer;

h_1 = (feet)
 h_2 = (feet)
 h_3 = (feet)
 Q_b = (MGD)
 U = (inches)
 L = (inches)
 B = (inches)
 not required normally

CALCULATED ELEMENTS

Design water head;
 Maximum water head;
 Bending metal sheet thickness;
 Slit opening at rest;
 Bending metal sheet angle;
 Beaching metal ramp angle;
 Maximum load on bending metal sheet;
 Concrete opening lower elevation;
 Concrete opening higher elevation;
 Maximum allowable bending metal sheet displacement;
 $h_b = h_1 - h_3$ (feet)
 $h_{max} = h_2 - h_3$ (feet)
 $d = 1$ mm
 a = (inches)
 α = (degrees)
 β = (degrees)
 σ = (Mpa)
 h_4 = (feet)
 h_5 = (feet)
 w = (inches)

Table 1: Required data for the selection and hydraulic design

ASSEMBLY

The **HYDROVEX® Clari** is delivered in parts. The opening in the back concrete wall has to have the exact required dimensions. The wall surface above and below the opening must be smooth, flat and vertical.

The installation is made with anchoring tracks that are pre-cast in the concrete wall. These tracks are supplied by **John Meunier Inc.** If the installation is performed in an existing structure, standard anchors can also be supplied. Due to particular knowledge, and the necessary special equipment required for installation, we highly recommend that one of our representatives be called to inspect the installation of the **HYDROVEX® Clari**.

MAINTENANCE

The installed **HYDROVEX® Clari** does not typically require any maintenance. We recommend regular visual inspections and the elimination of fats and debris stuck inside the control slit.

TYPICAL SPECIFICATION

Treatment of the tank overflow with a **HYDROVEX® Clari** flow regulator for:

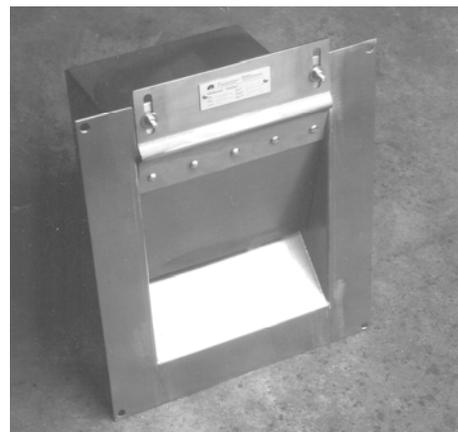
Flow $Q_b = \text{_____} \text{ l/s}$

Slit length $L = \text{_____} \text{ m}$

Design water head $HB = \text{_____} \text{ m}$

Or geometry of slit crack $N = \text{_____} \text{ }^\circ$

Dynamic flow regulation is based on the bending of a spring steel sheet under the action of the upstream water pressure. The bending effectively reduces the available output orifice available to the overflow water, thus throttling the flow to a constant value. The unit is made of 304 stainless steel. The spring steel sheet is made of special stainless steel with particular specifications of the manufacturer. All the anchoring system is also in 304 stainless steel. The flow curve and hydraulic selections are included.



We highly recommend the inspection of the installation by an authorized representative, to assure proper operation of the unit.

Optional: 304 stainless steel spoiler and jet breaker to prevent noise. This part is adapted to the work with anchors.

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ISO 9001 : 2000

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