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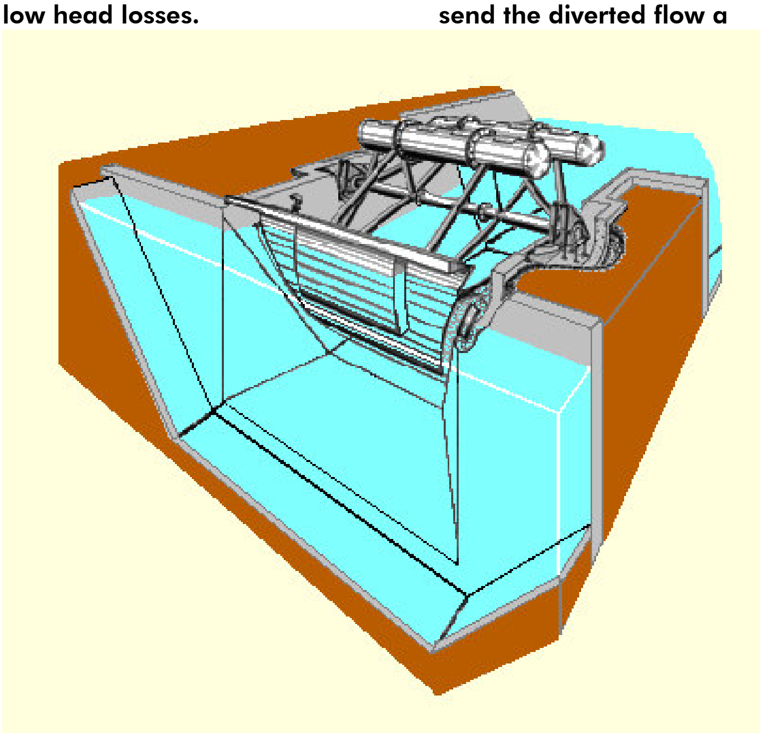
AMIL ® GATES

Constant upstream level control in channels and reservoirs

Function

The normal function of an AMIL® Gate is to maintain a constant upstream water level irrespective of the discharge and variation in water demand. The gate, which is normally closed with small flows, opens progressively as the inflow increases, assuring a maximum discharge with low head losses.



AMIL® Gate is trademark

Applications and advantages

Intake structure

- The upstream water level in the channel or river is kept constant irrespective of the water demand variation (fluctuation).

- Keeping a high upstream water level, it is possible to send the diverted flow a long distance.

Spillway structure

- Maintaining the level of natural or artificial lakes by water overflow control.

Protection for channel banks

- Keeping the banks always under water at the same constant level during dry weather as well as flood periods.

Overflow elimination

- Avoiding overflows due to storms of faulty operation, by deseharging excess water.

Accurate and simple automatic operation

- The lack of any kind of hoisting device has provided such excellent qualities for this type of equipment as precision, rigidity and working security, giving low cost and easily implemented solutions with easy for the hydraulic control of free surface flow.

Passage with low head losses

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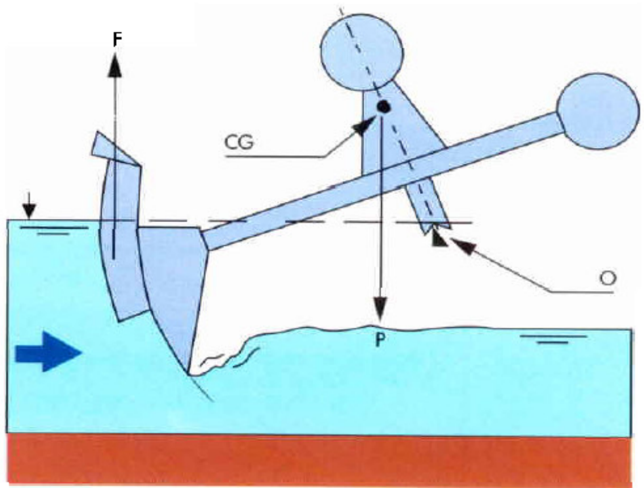
Operating principle



- Controlled water level (N_{mon})

CG - Center of gravity of the moving part

The moving part of the gate is a rigid structure made up of a supporting frame rotating freely around a horizontal shaft; a cylindrical face plate with trapezoidal section, complete with a floater on its upstream side, and with a ballast container ensuring the structure's balance of power.

The hydraulic thrust on the gate leaf passes through the axis and does not affect the equilibrium. Due to the shape of the floater and the ballast position, the center of gravity can be placed in such a way that the torques C_F and C_P generated respectively by Archimedes Thrust F and its own weight P are equal and in opposite direction, whatever the position of the gate, when the upstream water level is at the elevation the rotation axis O.

If the upstream level rises, then: $C_F > C_P$, and the gate opens.

Conversely if the upstream level fall, then $C_F < C_P$ and the gate closes.

This operation continues until the water level reaches its equilibrium point, i.e., when the upstream level is at the same elevation as the rotation axis.

Construction

The gates are welded assemblies of steel plate, pipes and rolled shapes of carbon steel. They require precision sheet-metal work with tight tolerance margins to ensure correct operation without a hitch.

Installation

The gate leaf, in the whole closed position, stops up all the trapezoidal section of the channel. The trapezoidal shape section allow the gate opening and closing operations to be smooth, without any contact with fixed parts and consequently without any friction between the moving gate and the channel's fixed parts.

Furthermore, to avoid any locking in the gate's closed postion, there is a small gap between the side edges of the gate leaf in closed position and the channel walls. Due to this gap, the gate is never fully sealed in the closed position.

Hydraulic characteristics

The Amil® gates are identified by a dimension index D, that is approximately the width in centimeters of the water plane for normalized trapezoidal openings.

By convention, the levels taken as reference are read at the center line of the opening, at a distance from the gate leaf equal to 2D for the upstream water level and 4D for the downstream water level.

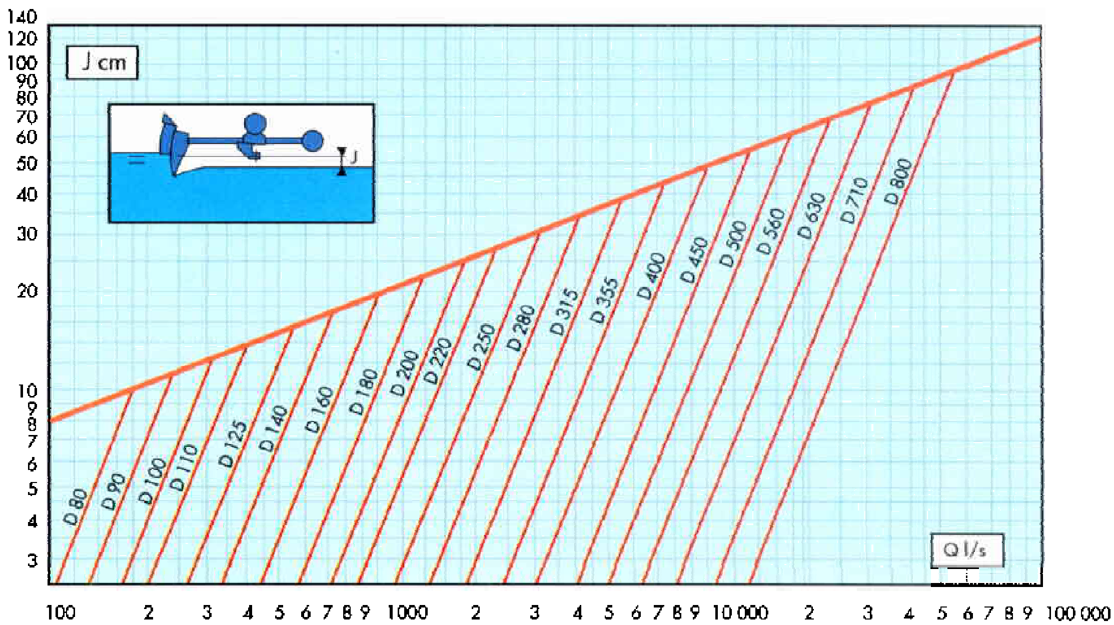
The chart in the following page shows the relationship between the discharge and the minimum head loss for each D size, assuming that the gate is fully open and that the upstream water level is at the height of the trunnion axis. The broken line in the chart shows the limit of discharge for each gate size.

Gate selection

The data required to select the gate suitable for a given structure are:

- Nominal discharge $Q[l/s]$ to be handled at the gate,
- Minimum head differencial Jm[cm] available at nominal discharged for the equipped structure.

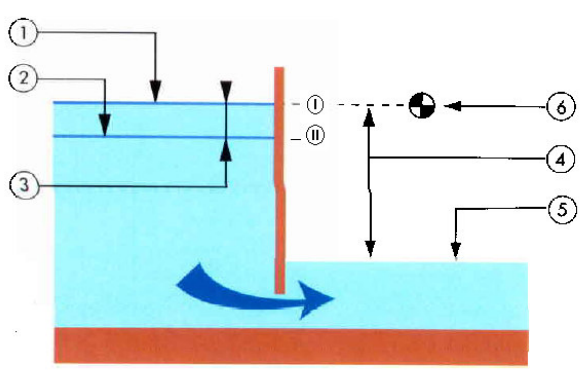
The selected gate is required to show a head loss not higher than the value indicated by the chart on the following page for the desired flow.



Decrement

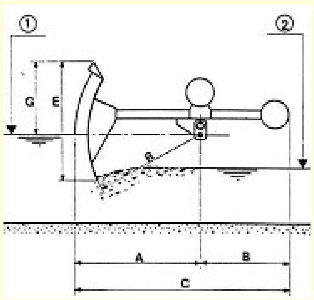
According to the description of the operating principle, the fluctuation of the controlled level during opening, known as the gate decrement can theoretically be zero. In fact, by upstream level control, stability requires the upstream level to rise slightly if the discharge increases. Therefore the gate is balanced so as to maintain some level difference between the closed and fully open positions. In practice this difference in levels works out at about 2% of the D value (D/50).

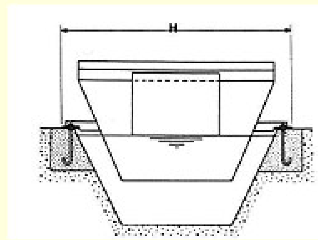
As a rule an Amil® gate is set so that its axis of rotation coincides with the maximum upstream level (position I). Should the axis of rotation be at a level below the upstream level relative to Q = maximum (position II), this results in a discharge increase. So if the upstream level is raised by 2, 5 or 10% D value from the axis of rotation level, the maximum discharge is increased by 6, 12 or 18% and the head losses are increased by 4, 11 or 20%). These considerations make it easier to define the most suitable arrangements for the projected works. The actual downstream level should be lower than or equal to the max downstream level, in order not to affect the flow rate.

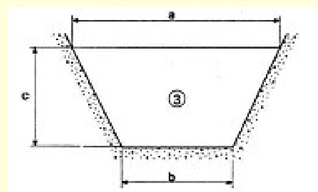


1 – Maximum upstream level at Qmax
2 – Minimum upstream level at Qmin
3 - Decrement
4 – Minimum head loss
5 – Maximum downstream level
6 – Gate axis of rotation

AMIL® Gate – Dimensions







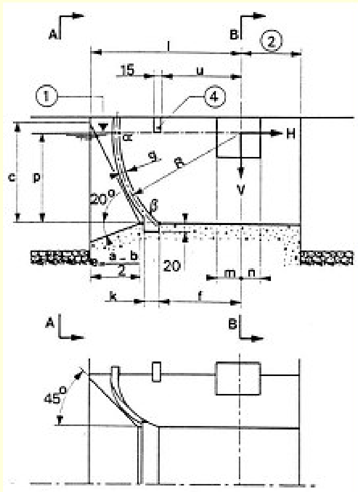
1 – Controlled water level
2 – Downstream level
3 – Span definition

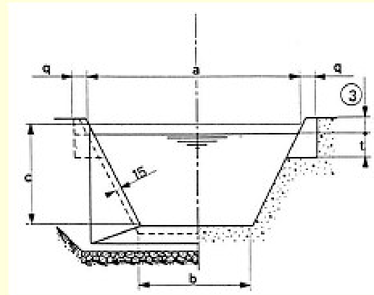
Dimensions in cm

AMIL®		OVERALL DIMENSIONS (Gate open)						SPAN		
D	R	A	B	C	E	G*	H	a	b	c
80	63	71	51	122	45	33	101	85	45	40
90	63	72	51	123	51	35	111	95	50	45
100	63	73	51	124	58	37	122	106	56	50
110	63	74	51	125	67	42	134	118	63	56
125	90	103	71	174	70	47	153	132	71	63
140	90	104	71	175	81	50	171	150	80	71
160	90	106	71	177	95	60	191	170	90	80
180	125	143	101	244	102	68	214	190	100	90
200	125	145	101	246	117	73	236	212	112	100
220	125	148	101	249	134	85	260	236	125	112
250	160	185	117	301	144	91	303	265	140	125
280	160	188	117	304	166	105	336	300	160	140
315	200	232	145	377	181	112	390	335	180	160
355	200	236	145	381	214	135	430	375	200	180
400	250	290	185	475	234	145	474	425	224	200
450	250	295	185	480	268	170	520	475	250	224
500	315	365	236	601	289	183	540	530	280	250
560	315	371	236	607	333	211	605	600	315	280
630	400	463	298	761	361	233	677	670	355	315
710	400	471	298	769	419	265	762	750	400	355
800	450	530	333	863	481	305	871	850	450	400

(*) For some types of gate, the overall height above the upstream level (or above the axis of rotation) depends upon the position of the downstream ballast with the gate closed. Its value appears under the heading "G" in the table.

Civil Engineering Structure





- H Horizontal thrust on the concrete (tf).
- V Vertical thrust on the concrete (tf).
- 1 Controlled upstream level.
- 2 To be defined in function of the structure stability and concrete strength
- 3 Offset, in function of local conditions.
- 4 Insertion recess on left bank for AMIL® D ≥ 500.

α, β : in order to define the groove positions, define the center of a circle with radius ρ , which crosses the points α and β (α at a distance of $R-\frac{g}{2}$ from axis, β at a distance f from the vertical axis projection). With the center defined above, plot the circles with radius ρ and ρ + g.

Dimensions in cm

TTPE		SPAN				CONCRETE STRUCTURE DEFINITION											THRUSTS	
D	R	a	b	c	p	e	f	g	k	L	m	n	q	t	u	ρ	H	V
80	63	85	45	40	36	20	-	-	-	76	15	15	13	15	-	-	0,05	0,05
90	63	95	50	45	40	22	-	-	-	76	15	15	13	15	-	-	0,05	0,05
100	63	106	56	50	45	25	-	-	-	76	15	15	13	15	-	-	0,05	0,10
110	63	118	63	56	50	27	-	-	-	76	15	15	13	15	-	-	0,05	0,10
125	90	132	71	63	56	30	-	-	-	108	18	18	15	20	-	-	0,10	0,15
140	90	150	80	71	63	35	-	-	-	108	18	18	15	20	-	-	0,10	0,15
160	90	170	90	80	71	40	-	-	-	108	18	18	15	20	-	150	0,15	0,20
180	125	190	100	90	80	45	86	15	30	150	23	23	16	20	-	149	0,20	0,30
200	125	212	112	100	90	50	76	15	30	150	23	23	16	20	-	148	0,30	0,40
220	125	236	125	112	100	55	62	15	30	150	23	23	16	20	-	190	0,40	0,40
250	160	265	140	125	112	62	108	15	30	192	25	25	25	15	-	189	0,80	0,50
280	160	300	160	140	125	70	87	15	30	192	25	25	25	15	-	238	1	0,80
315	200	335	180	160	140	77	128	20	40	240	25	25	35	17	-	236	1,50	1
355	200	375	200	180	160	87	102	20	40	240	25	25	35	17	-	298	2	1,50
400	250	425	224	200	180	100	159	20	40	300	33	33	35	22	-	295	3	2
450	250	475	250	224	200	112	133	20	40	300	33	33	35	22	-	375	4	3
500	315	530	280	250	224	125	207	20	40	378	60	40	20	60	200	372	5	4
560	315	600	315	280	250	142	175	20	40	378	60	40	20	60	200	476	8	5
630	400	670	355	315	280	157	272	20	40	480	70	50	30	80	250	472	10	8
710	400	750	400	355	315	175	230	20	40	480	70	50	30	80	250	472	14	10
800	450	850	450	400	360	200	253	20	40	540	80	50	40	90	275	531	20	18

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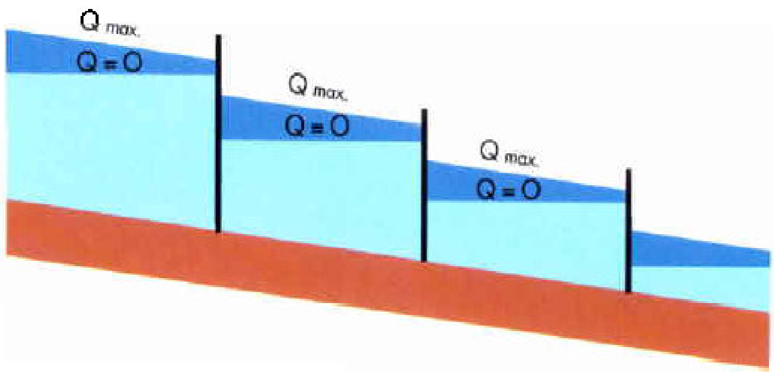
Channel controlled from upstream

- In a channel controlled for constant upstream water level and subdivided into a series of sectors by means of AMIL® gates, the waterline is developed as shown on the figure below with no changes in function of the incoming downstream discharge.

- With large discharges, AMIL® gates working in parallel is the usual solution. This arrangement is very well suited for the flowoff of natural waterways and of large channels, which are wider than they are deep. Synchronous operation of gates installed in this way requires only that the hydraulic conditions in both sluices be even.



- Amil® Gates are installed, as a rule, upstream to the main diversion points. In the cases of Water intakes for adjustable constant discharge, they are arranged with single or double Baffle type Distributors. In the cases when the level variation exceeds the Baffle Distributor® permissible level, an additional Amil® Gate should be installed on the primary Channel, downstream from the respective derivation, or else an AVIS® or AVIO® gate (i.e. a constant downstream water level gate) on the branch channel, upstream from the Baffle Distributors ®.

Conclusions

Constant upstream water level control, which involves an imposed distribution of available discharge among a several users, was the first system developed to control channel levels.

Although more modern control system of better performance currently exist, the principle of upstream Channel level control may in some cases prove to be very interesting.

So Amil® Gates provide, regardless of the discharge, an accurate, safe and cheap means for the automatic water level control in a number of channels.

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