

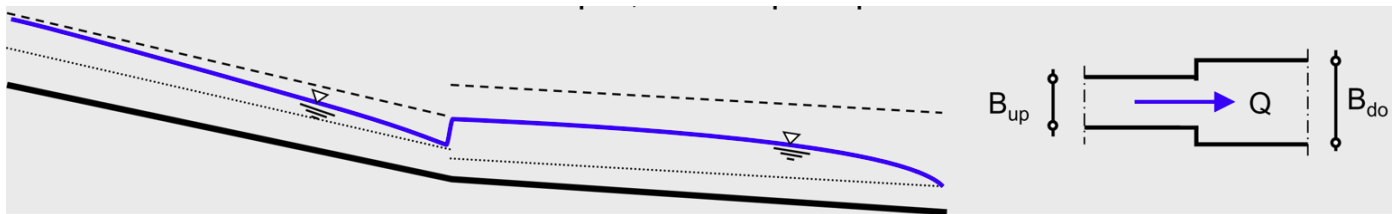
FLUME 4 – FRICTION, SINGLE LOSS WITH BORDA-CARNOT

DESCRIPTION

This example illustrates friction losses and a single loss occurring when the cross section of a flume abruptly changes.

Given:

- $Q = 1.5 \text{ m}^3/\text{s}$, $H = 1 \text{ m}$
- Downstream:
 - $h_2 = h_{gr}$ (critical flow depth)
 - $I_s = 1 \text{ ‰}$
 - $K_{st} = 50$
 - $B = 1.2 \text{ m}$
 - $L = 50 \text{ m}$
- Upstream:
 - $I_s = 5 \text{ ‰}$
 - $K_{st} = 75$
 - $B = 0.8 \text{ m}$
 - $L = 50 \text{ m}$

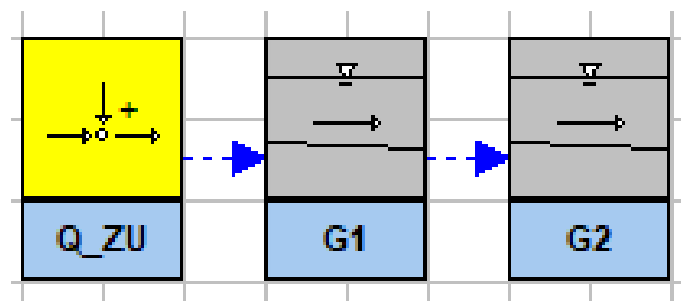


TASK

Determine the normal and critical depth, flow depth upstream / downstream.

SYSTEM ABSTRACTION IN HYBEKA

The system is very simple. To represent it, we only need a flow changer to represent the inflow into the flume and two open channel elements for the flume itself.



DATA INPUT

General settings:

waterlevel at end of system [mas]

The water level at the system outlet is left empty and critical flow depth will be used as starting point.

Flow changer Qzu:

HYBEKA for windows input of data

HYBEKA Ergebnisse Plot

data in detail | system | geometry | hydraulic losses | count elements

system/flow path

description of element	element	inlet	outlet	division	Qin/Qout
Zufluss	Q_ZU		G1		1500,00

insert division-line
 elements of *.ERK file
 create *.TAU file
 no plotting

geometry

longitudinal section			losses		cross section			upstream	cross section			downstream
zo	zu	L	k	c	T	hs	h	B	T	hs	h	B
100,3			75		T		1	0,8				

adjust invert level

hydraulic losses

losses			coefficient		dimensions				comments
hve	Zeta1	Zeta2	μ	n(c)	T	h,D	Bu	Bo	

number dist.
n a

zeta-table

Q_ZU

G1
G2

flow path
 element

*.PKL

check

A B D G M P Q R S T U V W Z find continue

Note: zo is chosen arbitrarily.

Flume element G1:

HYBEKA for windows input of data

HYBEKA Ergebnisse Plot

data in detail | system | geometry | hydraulic losses | count elements

system/flow path

description of element	element	inlet	outlet	division	Qin/Qout
Gerinne (B = 0,8 m)	G1	Q_ZU	G2		

insert division-line
 elements of *.ERK file
 create *.TAU file
 no plotting

geometry

longitudinal section			losses		cross section			upstream	cross section			downstream
zo	zu	L	k	c	T	hs	h	B	T	hs	h	B
100,3	100,05	50			T		1	0,8				

adjust invert level

hydraulic losses

losses			coefficient		dimensions			comments
hve	Zeta1	Zeta2	μ	n(c)	T	h,D	Bu	Bo

number dist.
n a

zeta-table

- Q_ZU
- G1**
- G2

Navigation icons:

order

- flow path
- element

*.PKL

check

Flume element G2:

HYBEKA for windows input of data

HYBEKA Ergebnisse Plot

data in detail | system | geometry | hydraulic losses | count elements

system/flow path

description of element	element	inlet	outlet	division	Qin/Quit
Gerinne (B = 1,2 m)	G2	G1	ENDE		

insert division-line elements of *.ERK file create *.TAU file no plotting

geometry

longitudinal section			losses		cross section				upstream	cross section			downstream
zo	zu	L	k	c	T	hs	h	B		T	hs	h	B
100,05	100	50	50		T		1	1,2					

adjust invert level

hydraulic losses

losses			coefficient		dimensions				comments
hve	Zeta1	Zeta2	μ	n(c)	T	h,D	Bu	Bo	

number dist.
n a

zeta-table

Q_ZU	G1	G2
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order

flow path

element

*.PKL

check

A B D G M P Q R S T U V W Z find continue close

RESULTS:

i	element	Q	discharge [m³/s]	length [m]	invert [masl]	board level [m]	water level		wetted cross-sectio [m²]	velocity [m³/s]	energy level [masl]	shear stress [N/m²]	Pr o/g	losses [m]				comment
							[m]	[masl]						frict.	single (1)	single (2)	transit.	
▶ 1	Q_ZU	1	1,500	0,000	100,300	1,000	0,838	101,138	0,67	2,24	101,393	13,47	o				0,000	
1	G1	1	1,500		100,300	1,000	0,838	101,138	0,67	2,24	101,393	13,47	o	0,273	0,000			V
2	G1	1		50,000	100,050	1,000	0,738	100,788	0,59	2,54	101,117	17,64	o				0,078	V
1	G2	1	1,500		100,050	1,000	0,888	100,938	1,07	1,41	101,039	10,96	o	0,225	0,000			
2	G2	1		50,000	100,000	1,000	0,542	100,542	0,65	2,31	100,813	31,70	o				0,000	gr V

The critical water depth is 0.542 m. The flow depth downstream is 0.888 m and upstream is 0.838 m.