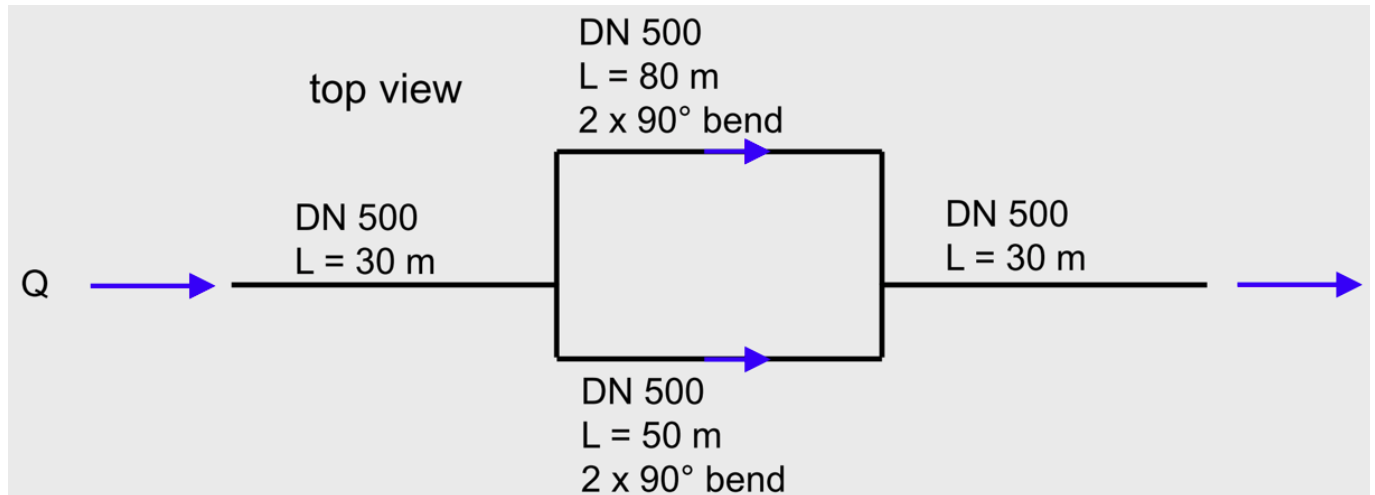


EXERCISE 5 – FLUME, PIPE, BASIN, WEIR

DESCRIPTION

Given:

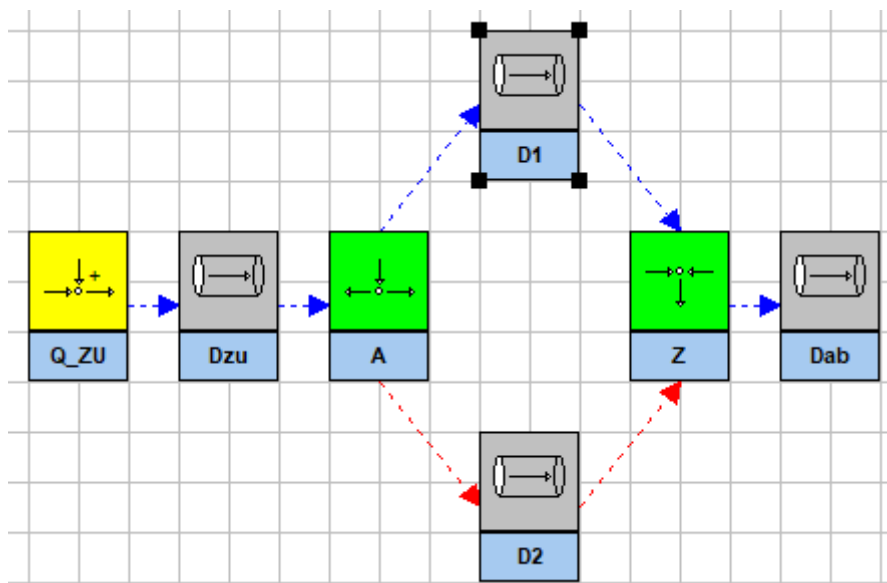
- $Q = 0.25 \text{ m}^3/\text{s}$
- $K = 0.5 \text{ mm}$
- Bottom height $z = 100 \text{ masl}$
- Pressure-head downstream 30m (above bottom height)



TASK

Determine the upstream pressure height and the flow division ratio into the two flow strands.

SYSTEM ABSTRACTION IN HYBEKA



DATA INPUT

General settings:

waterlevel at end of system [mas]

The water level at the system outlet is the bottom height plus the pressure-head downstream.

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		Dzu		250,00

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			0,5		K			0,5				

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
 Dzu
 A
 D1
 D2
 Z
 Dab

order
 flow path
 element

*.PKL

check

find continue

Pipe element Dzu:

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
	Dzu	Q_ZU	A		

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		30			K			0,5				

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
 Dzu
 A
 D1
 D2
 Z
 Dab

order
 flow path
 element

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

Flow divider A:

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
	A	Dzu	D1		
			D2		

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

plot order
 1. outlet
 2. outlet

geometry

longitudinal section			losses		cross section			upstream	cross section			downstream
zo	zu	L	k	c	T	hs	h	B	T	hs	h	B
100	100				K			0,5	K			0,5
	100								K			0,5

adjust invert level

hydraulic losses

losses			coefficient		dimensions				comments
hve	Zeta1	Zeta2	μ	n(c)	T	h,D	Bu	Bo	
	1,00	1,20							0.0 = Q1/Qges Aufteil.
	0,90	0,98							0.2 symetrisch
	0,86	0,83							0.4 Winkel = 90 Grad
	0,83	0,86							0.6 A1/Ages=1.0
	0,98	0,90							0.8 Idelchik Tab. 7-30
	1,20	1,00							1.0 (Idelchik Tab. 7-15)

number dist.
 n a

zeta-table

Q_ZU
 Dzu
A
 D1
 D2
 Z
 Dab

order
 flow path
 element

*.PKL
 check

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

The zeta values originate from the Literature and were selected via the zeta-table button. Here a symmetrical flow division with a direction of 90 degrees is used. (AQ-SYM90-10)

Pipe element D1:

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
	D1	A	Z		

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		80			K			0,5				

adjust invert level

hydraulic losses

losses			coefficient		dimensions				comments
hve	Zeta1	Zeta2	μ	n(c)	T	h,D	Bu	Bo	
	0,30								Seg.krüm. 90 Gr. (ID 6-9)
	0,30								Seg.krüm. 90 Gr. (ID 6-9)

number dist.
n a

zeta-table

Q_ZU	
Dzu	
A	
D1	
D2	
Z	
Dab	

flow path
 element

*.PKL

check

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

The zeta values were selected using the zeta-table button. (D-BEND-SEG3-90)

Pipe element D2:

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
	D2	A	Z		

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		50			K			0,5				

adjust invert level

hydraulic losses

losses			coefficient		dimensions				comments
hve	Zeta1	Zeta2	μ	n(c)	T	h,D	Bu	Bo	
	0,30								Seg.krüm. 90 Gr. (ID 6-9)
	0,30								Seg.krüm. 90 Gr. (ID 6-9)

number dist.
n a

zeta-table

Q_ZU
 Dzu
 A
 D1
D2
 Z
 Dab

flow path
 element

*.PKL

check

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

The zeta values were selected using the zeta-table button. (D-BEND-SEG3-90)

Flow merger Z:

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
	Z	D1	Dab		
		D2			

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	100				K			0,5	K			0,5
100					K			0,5				

adjust invert level

hydraulic losses

losses			coefficient		dimensions				comments
hve	Zeta1	Zeta2	μ	n(c)	T	h,D	Bu	Bo	
	2,78	2,78							0.0 = Q1/Qges Zus.fl.
	1,92	1,92							0.2 A1/Ages=0.75
	1,50	1,56							0.4 ohne Trennblech
	1,56	1,50							0.6 Winkel = 90 Grad
	1,92	1,92							0.8 Idelchik Tab. 7-23
	2,78	2,78							1.0

number dist.

n a

zeta-table

Q_ZU
Dzu
A
D1
D2
Z
Dab



order
 flow path
 element

*.PKL

check

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

close

The zeta values were selected using the zeta-table button. (ZQ-SYM90-OT)

Pipe element Dab:

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
	Dab	Z	ENDE		

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

geometry

longitudinal section			losses		cross section			upstream	cross section			downstream
z0	zu	L	k	c	T	hs	h	B	T	hs	h	B
100		30			K			0,5				

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
 Dzu
 A
 D1
 D2
 Z
 ▶ Dab

flow path
 element

*.PKL

check

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

RESULTS (ERG):

i	element	O	discharge	length	invert	board level	water level		wetted cross-section	velocity	energy level	shear stress	Pr	losses [m]				comment	
			[m³/s]	[m]	[masl]	[m]	[m]	[masl]	[m²]	[m²/s]	[masl]	[N/m²]		o/g	frict.	single (1)	single (2)		transit.
1	Q_ZU	1	0,250	0,000	100,000	0,500	30,465	130,465	0,20	1,27	130,547	4,10	g					0,000	
1	Dzu	1	0,250		100,000	0,500	30,465	130,465	0,20	1,27	130,547	4,10	g	0,100	0,000				d
2	Dzu	1		30,000	100,000	0,500	30,364	130,364	0,20	1,27	130,447	4,10	g					0,000	d
1	A	1	0,250		100,000	0,500	30,364	130,364	0,20	1,27	130,447		g		0,070	0,069			d
2	A	1	0,113		100,000	0,500	30,359	130,359	0,20	0,58	130,376		g					0,000	d
3	A	2	0,137		100,000	0,500	30,353	130,353	0,20	0,70	130,377		g					0,000	d
1	D1	1	0,113		100,000	0,500	30,359	130,359	0,20	0,58	130,376	0,87	g	0,057	0,010				d
2	D1	1		80,000	100,000	0,500	30,292	130,292	0,20	0,58	130,309	0,87	g					0,000	d
1	D2	2	0,137		100,000	0,500	30,353	130,353	0,20	0,70	130,377	1,26	g	0,051	0,015				d
2	D2	2		50,000	100,000	0,500	30,287	130,287	0,20	0,70	130,311	1,26	g					0,000	d
2	Z	1	0,113		100,000	0,500	30,292	130,292	0,20	0,58	130,309		g		0,125				d
3	Z	2	0,137		100,000	0,500	30,287	130,287	0,20	0,70	130,311		g		0,128				d
4	Z	1	0,250		100,000	0,500	30,101	130,101	0,20	1,27	130,183		g					0,000	d
1	Dab	1	0,250		100,000	0,500	30,101	130,101	0,20	1,27	130,183	4,10	g	0,100	0,000				d
2	Dab	1		30,000	100,000	0,500	30,000	130,000	0,20	1,27	130,083	4,10	g					0,000	

The energy level at the outlet is 130.083 masl and 130.547 masl at the inlet.

RESULTS (QVE):

	element	O	1st in-/outlet				2nd in-/outlet					
			element	order	discharge	percental	zeta	element	order	discharge	percental	zeta
▶	A	1	D1	1	0,113	45,3	0,85	D2	2	0,137	54,7	0,84
	Z	1	D1	1	0,113	45,3	1,52	D2	2	0,137	54,7	1,54

45.3 % of the flow flow through D1 and the rest (54.7 %) flow through D2.