

The background of the slide is a photograph of an industrial facility. It features numerous large, white, horizontal pipes running across the top. Below these, there are more pipes, some of which are connected to large, white, curved machinery components. To the right, there are large, red, vertical cylindrical tanks. The overall scene is a complex industrial environment, likely a water treatment plant or a large-scale manufacturing facility.

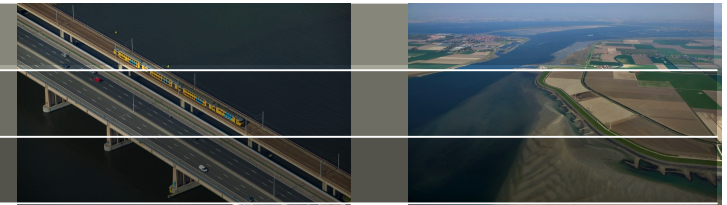
WANDA

Deltares

The Deltares logo is a stylized white symbol on a green background, resembling a combination of a lowercase 'd' and a wave or a stylized '3'.

Wanda 4 Liquid

Wanda 4 Liquid

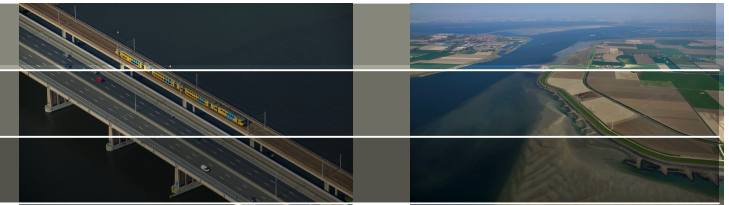


- Wat is nieuw
- Wat is veranderd
- Wat is ongewijzigd

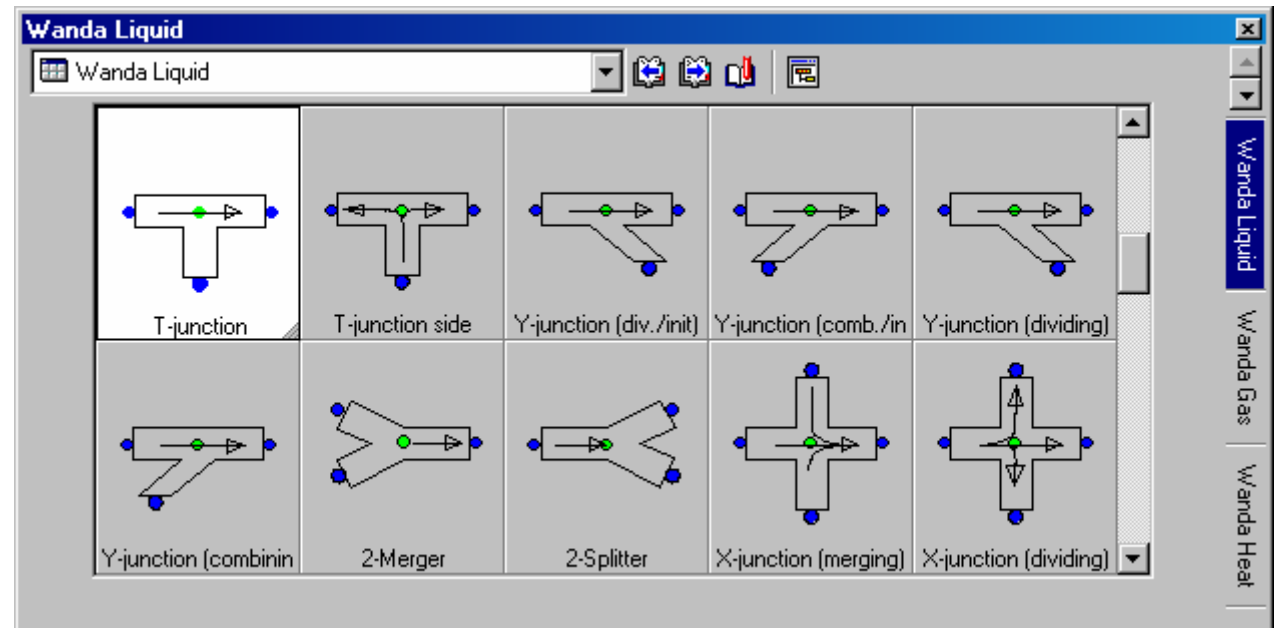




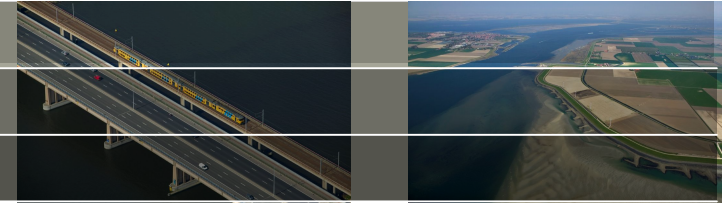
Wanda 4 Liquid - nieuw



3 en 4 node
componenten



Wanda 4 Liquid - nieuw



3 en 4 node componenten

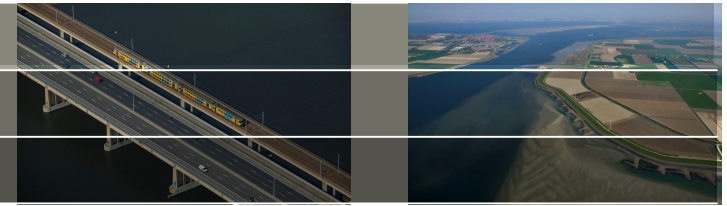
- Complex weerstandsmodel
- Locale verliezen afhankelijk van oppervlakte verhouding en debietverhouding
- Formules en tabellen in handboeken (Idelchik, Miller)

In WANDA 3 in feite niet correct te berekenen (iteratief bepalen)

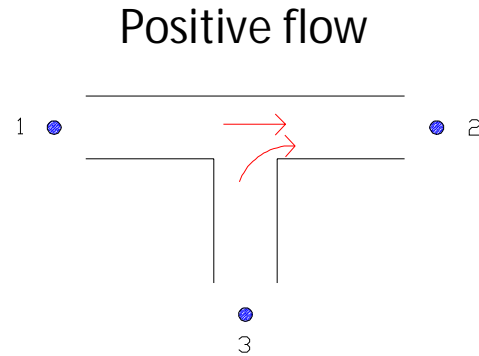
In WANDA 4 correcte weerstandsberekening

- Snel
- In tijdsimulatie continue herbepaling coëfficiënten o.b.v. actuele Q's

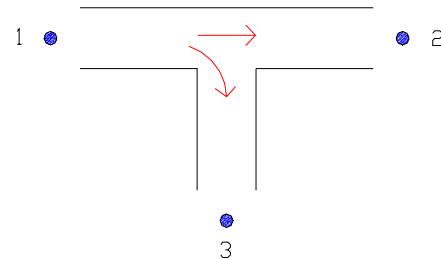
T – Junction



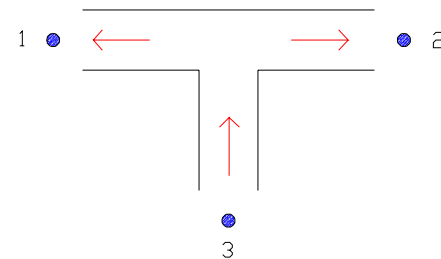
1) *COMBINING*



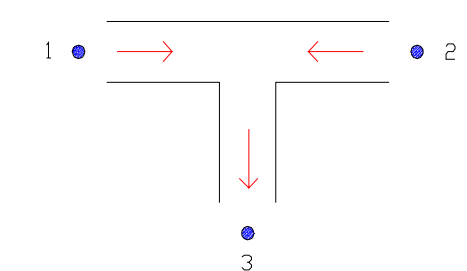
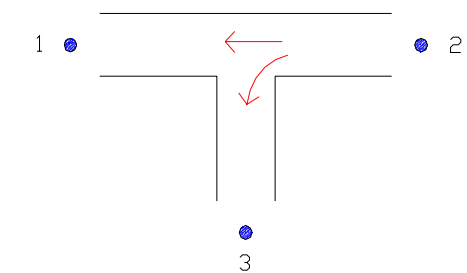
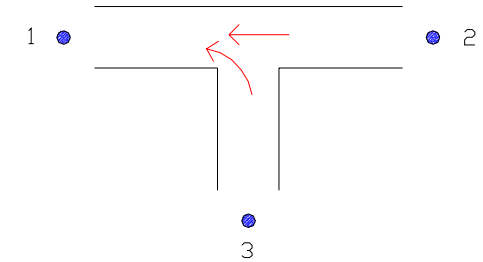
2) *DIVIDING*



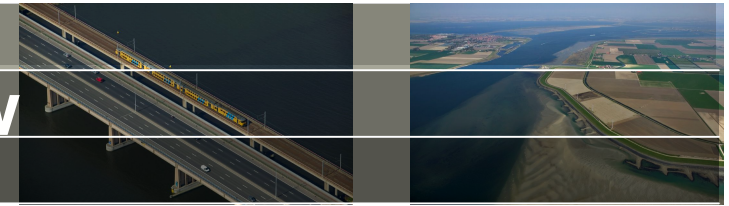
3) *UNKNOWN*



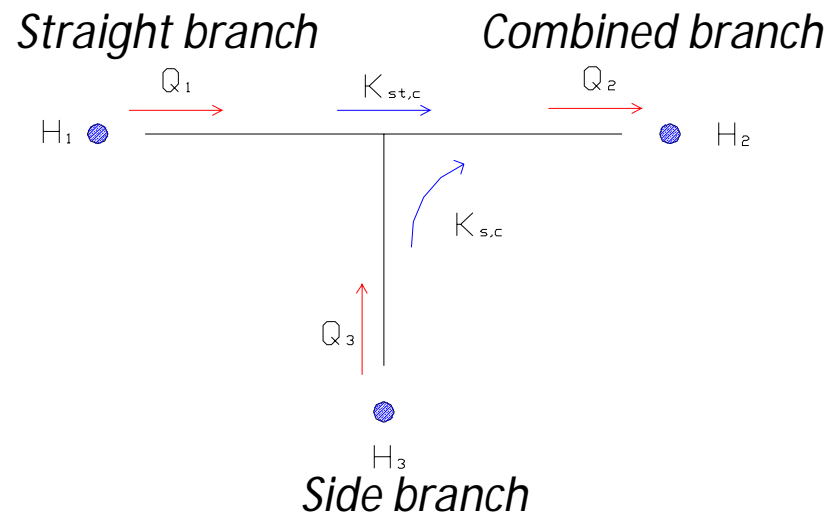
Negative flow



T – Junction – combining flow

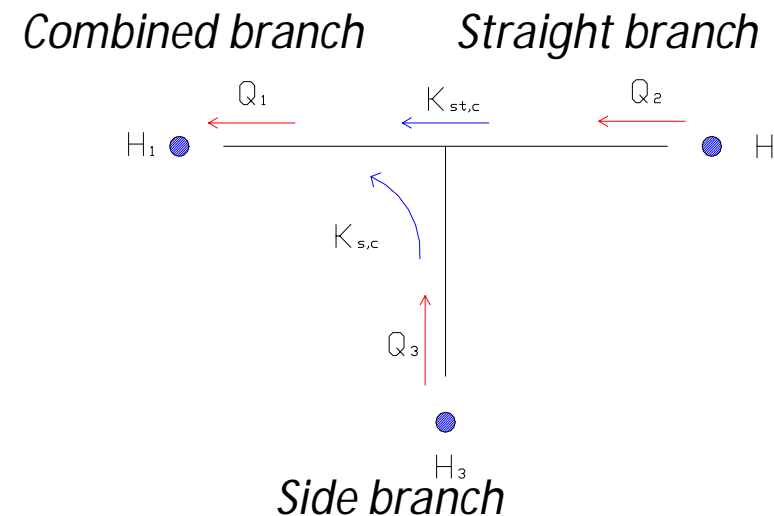


POSITIVE FLOW



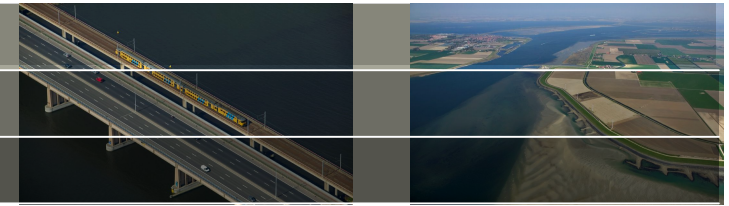
- Continuity equation:
- $Q_1 + Q_3 = Q_2$
- Head loss:
- $H_1 - H_2 = K_{st} (w_2^2/2g)$
 - $H_3 - H_2 = K_s (w_2^2/2g)$

NEGATIVE FLOW

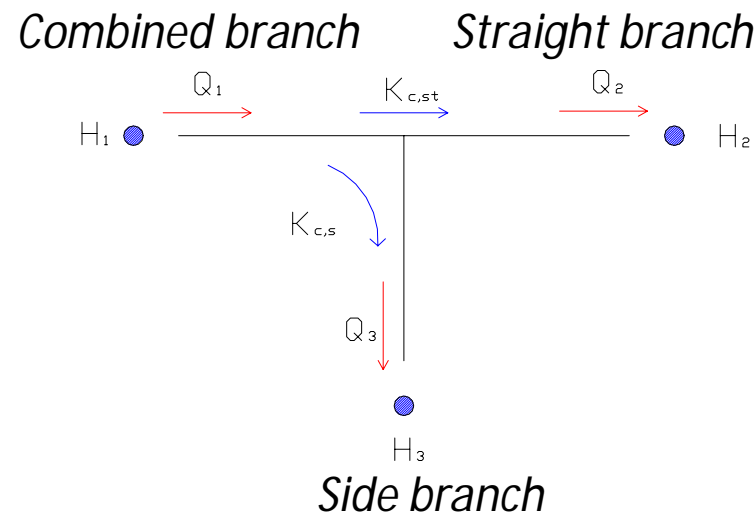


- Continuity equation:
- $Q_2 + Q_3 = Q_1$
- Head loss:
- $H_2 - H_1 = K_{st} (w_1^2/2g)$
 - $H_3 - H_1 = K_s (w_1^2/2g)$

T – Junction – Dividing flow

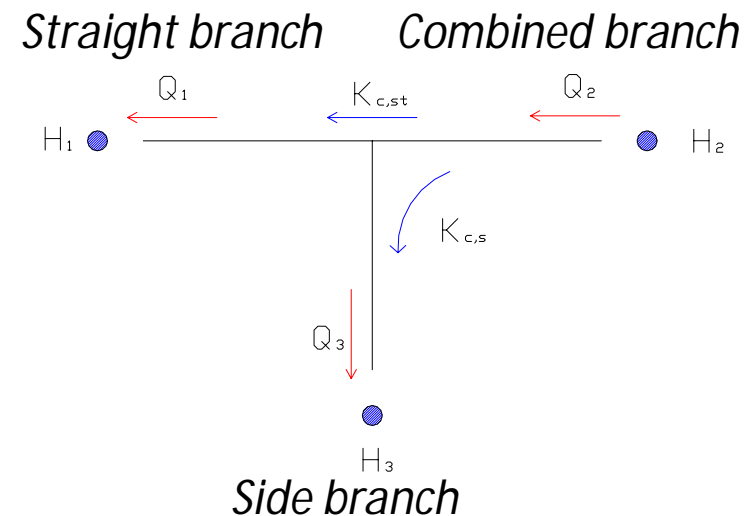


POSITIVE FLOW



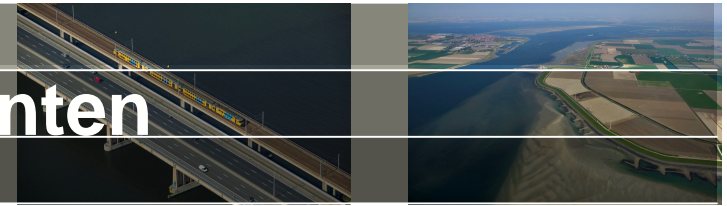
- Continuity equation:
- $Q_2 + Q_3 = Q_1$
- Head loss:
- $H_1 - H_2 = K_{st} (w_1^2/2g)$
 - $H_1 - H_3 = K_s (w_1^2/2g)$

NEGATIVE FLOW



- Continuity equation:
- $Q_1 + Q_3 = Q_2$
- Head loss:
- $H_2 - H_1 = K_{st} (w_2^2/2g)$
 - $H_2 - H_3 = K_s (w_2^2/2g)$

T – Junction - verliescoëfficiënten



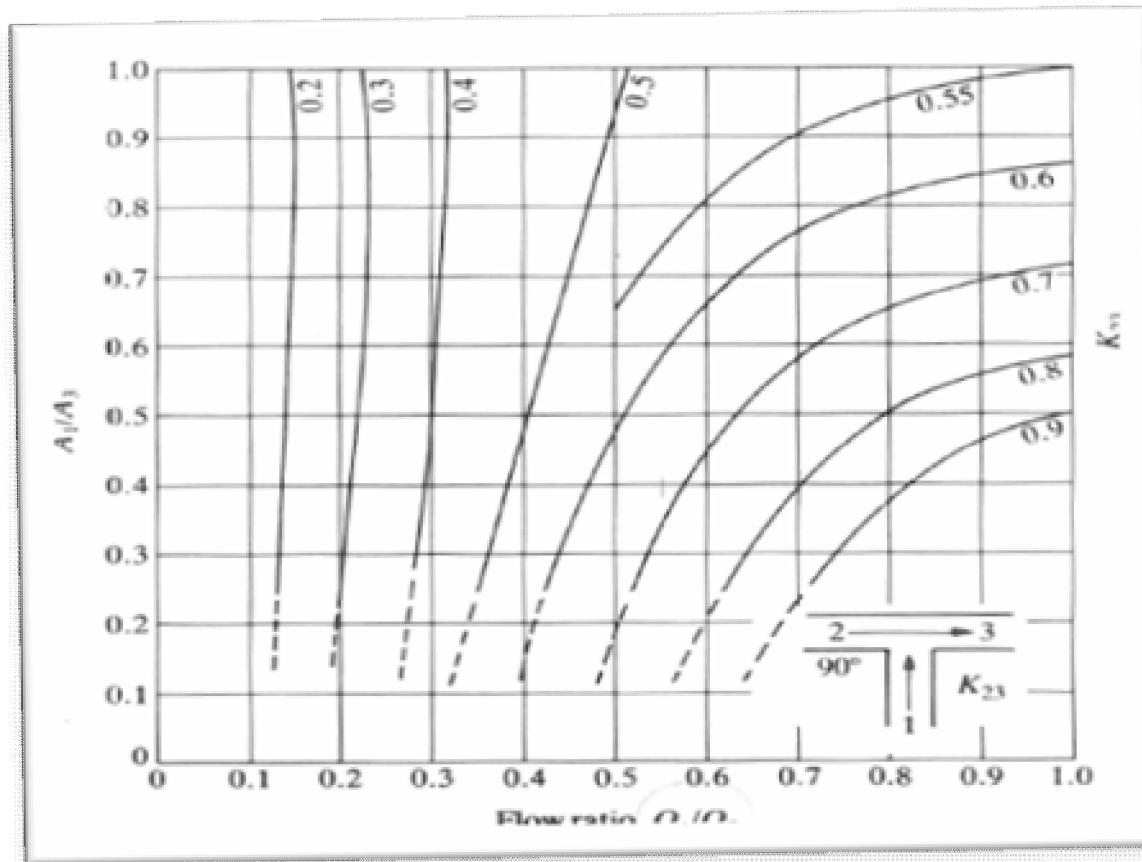
IDELCHIK HANDBOOK

1. COMBINING	{	<i>Straight passage:</i>	$K_{st} \approx 1.55 \frac{Q_s}{Q_c} - \left(\frac{Q_s}{Q_c}\right)^2$
		<i>Side passage:</i>	$K_s = A \left[1 + \left(\frac{Q_s A_c}{Q_c A_s}\right)^2 - 2 \left(1 - \frac{Q_s}{Q_c}\right)^2 \right]$
2. DIVIDING	{	<i>Straight passage:</i>	$K_{st} = \tau_{st} \cdot \frac{Q_s}{Q_c}$
		<i>Side passage:</i>	$K_s = A' \left[1 + \left(\frac{Q_s A_c}{Q_c A_s}\right)^2 \right]$

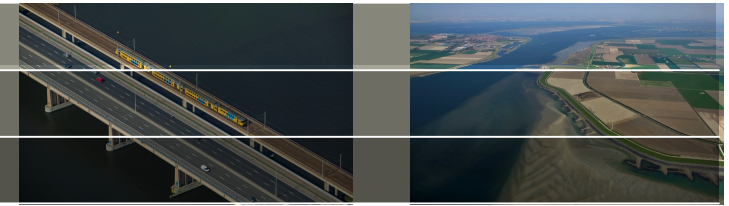
- A_s = Area of the side branch;
- A_c = Area of the combined branch;
- Q_s = discharge in the side branch;
- Q_c = discharge in the combined branch;
- A, A' and τ_{st} functions of Q_s, Q_c, A_s, A_c

T – Junction - verliescoëfficiënten

MILLER HANDBOOK



T – Junction



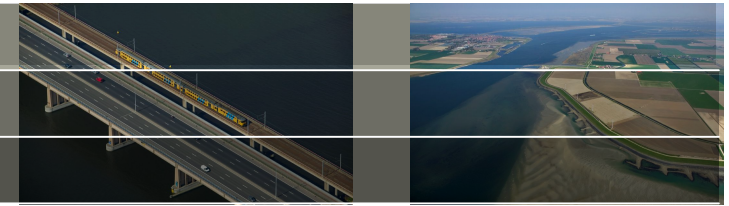
Invoerparameter: formule / tabel (Idelchik of Miller of andere bron)

Type	T-junction (prototype)
Model name	
Sequence number	
Disuse	NO
Reference id	
Diameter straight branch	500.0 (mm)
Diameter side branch	250.0 (mm)
Xi method	Formula

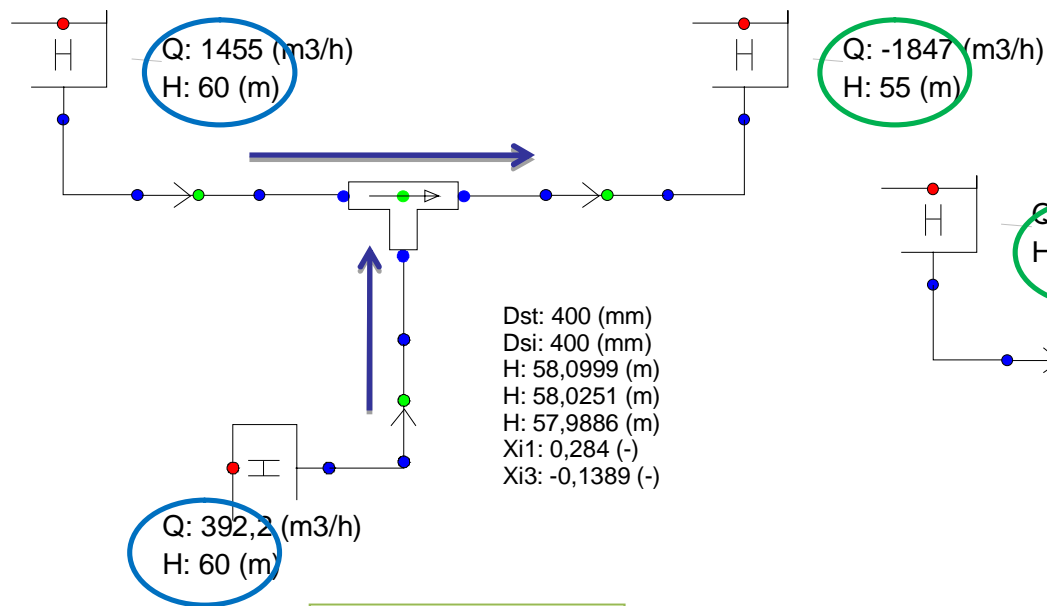
Type	T-junction (prototype)
Model name	
Sequence number	
Disuse	NO
Reference id	
Diameter straight branch	500.0 (mm)
Diameter side branch	250.0 (mm)
Xi method	Table
Xi tables valid for	Both
Xi combining straight	...
Xi combining side	...
Xi dividing straight	...
Xi dividing side	...

Tabel: Combining / Dividing / Both

T – Junction - test resultaten



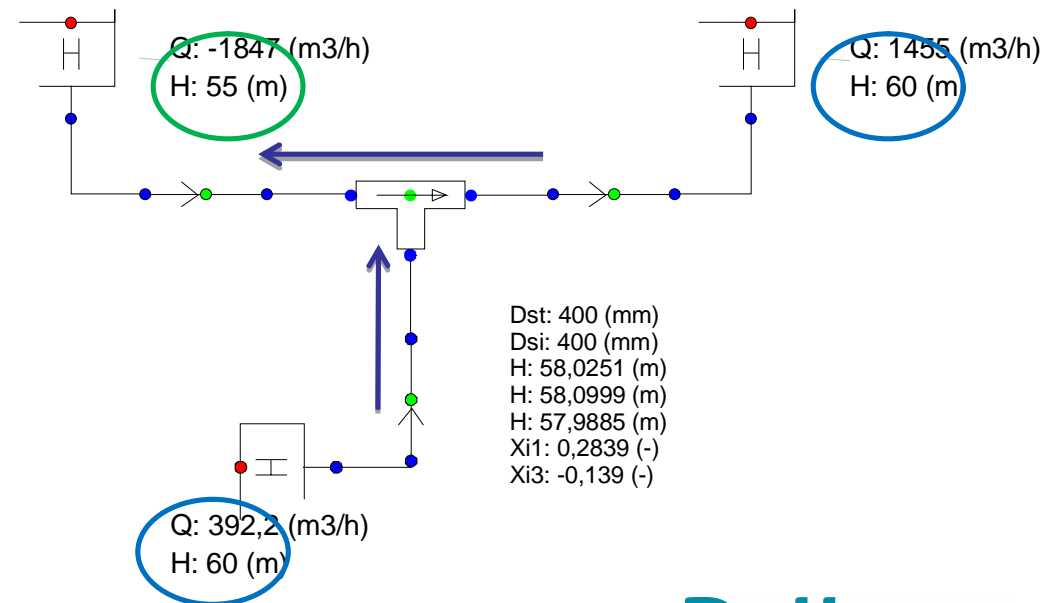
Positive flow



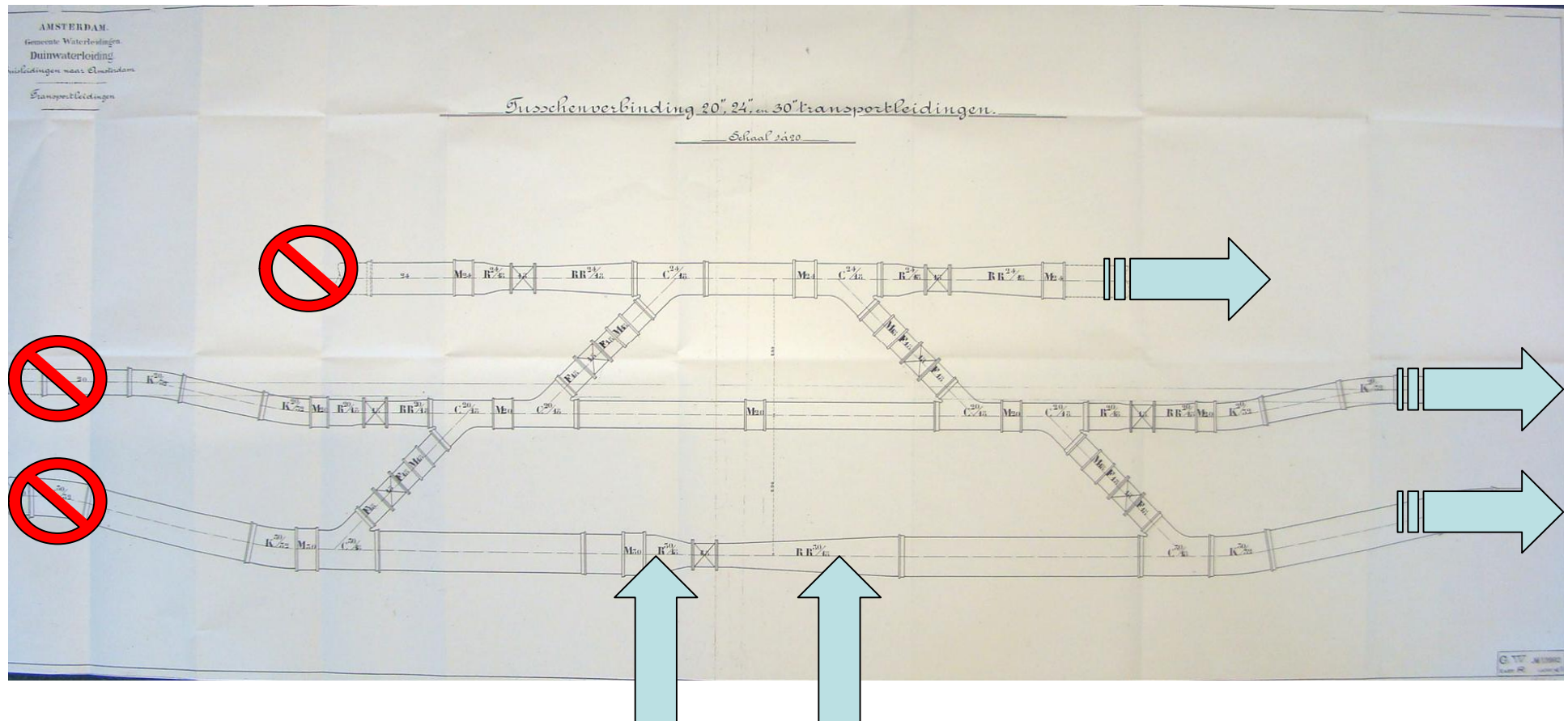
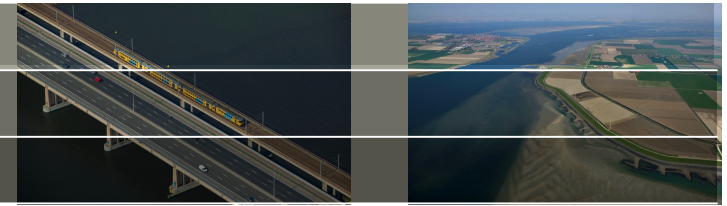
$$K_{\text{straight}} = 0,28$$

$$K_{\text{side}} = 0,139$$

Negative flow



T- Y – Junction praktijkgeval

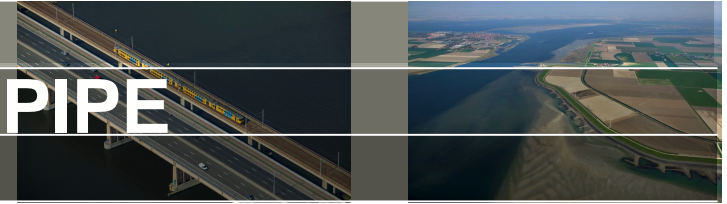


Nieuwe aansluitingen

Deltares



Wanda 4 Liquid – “all in one” PIPE



Wanda 3 diverse “waterslag” PIPE’s:

PIPE – rough	input: k-waarde
PIPE – lambda	input: lambda
PIPE – xi-losses	input: k-waarde + tabel extra verliezen ksi
PIPE – eq.D	input: k-waarde + tabel extra verliezen L_{eqD}

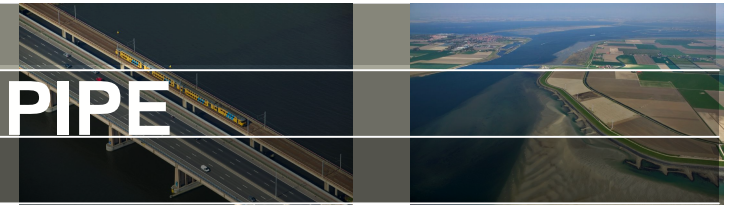
t.b.v. EPANET import

PIPE – Epanet	keuze uit diverse weerstandsmodellen:
	Darcy-Weisbach (k-waarde)
	Chezy-Manning
	Hazen-Williams

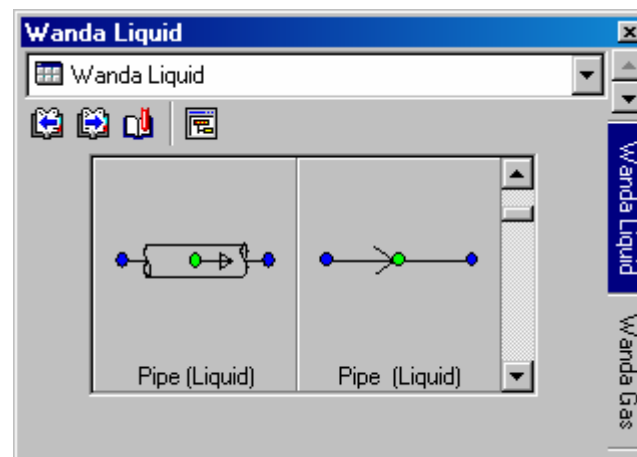
t.b.v. adviesproject:

PIPE met bi-directionele extra locale verlies (ksi)

Wanda 4 Liquid – “all in one” PIPE



Alle PIPE's vervangen door 1 nieuwe alles omvattend type
WENS: waterslag PIPE met rechthoekige doorsnede



Twee verschillende (maar vertrouwde) symbolen voor zelfde model

Wanda 4 Liquid – “all in one” PIPE

Keuze invoer m.b.v. drop-down list:

- Doorsnede:
 - **rond**
 - rechthoekig
- Wrijvingsmodel:
 - **Darcy-Weisbach k-waarde**
 - Darcy-Weisbach lambda-waarde
 - Chezy-Manning
 - Hazen- Williams

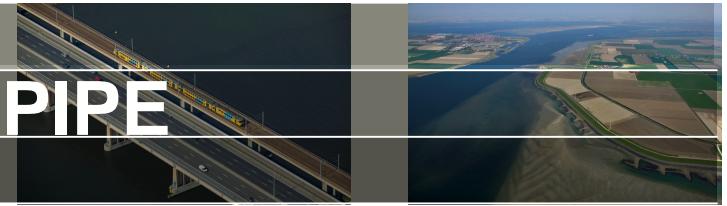
Untitled1 PIPE P1

Cross section	Circle
Inner diameter	500.0 (mm)
Friction model	D-W k
Wall roughness	2.500 (mm)
Dynamic friction	Quasi-steady
Additional losses	Xi
Local losses coeff	4.800 (-)
Geometry input	l-h
Profile	TABLE

Untitled1 PIPE P1

Reference id	
Cross section	Rectangle
Inner width	500.0 (mm)
Inner height	750.0 (mm)
Fillet size	50.00 (mm)
Fillet structural contribution	67.00 (%)
Friction model	C-M
n coefficient	0.1000 (-)
Additional losses	None
Geometry input	Length
Length	200.000 (m)
H-node height check	

Wanda 4 Liquid – “all in one” PIPE



Keuze invoer m.b.v. drop-down list (vervolg 2):

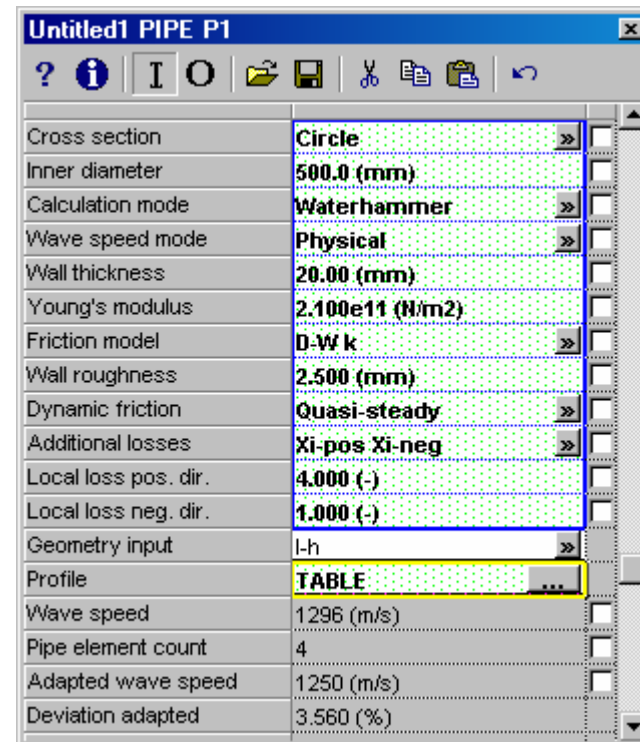
- Extra verliezen
 - **geen**
 - Xi waarde (onafh. stroomrichting)
 - Xi waarde Pos / Xi waarde Neg
 - Xi tabel
 - L_equivalente #D tabel
- Dynamic friction
 - **Quasi steady**
 - geen

Wanda 4 Liquid – “all in one” PIPE

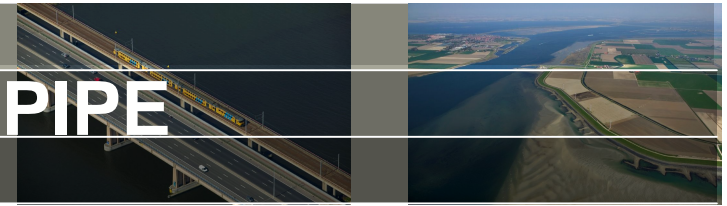
Keuze invoer m.b.v. drop-down list (vervolg 3):

Alleen in Transient mode

- Calculation mode
 - **Waterhammer**
 - Rigid column
- Wave speed mode
 - **Physical**
 - Specified



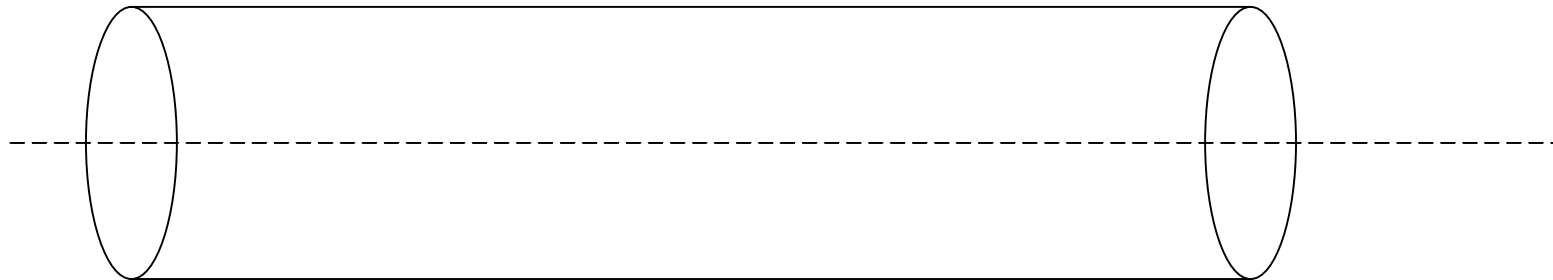
Wanda 4 Liquid – “all in one” PIPE



Wijziging in geometry definitie / referentie hoogteligging:

Wanda 3.7 binnen bovenkant

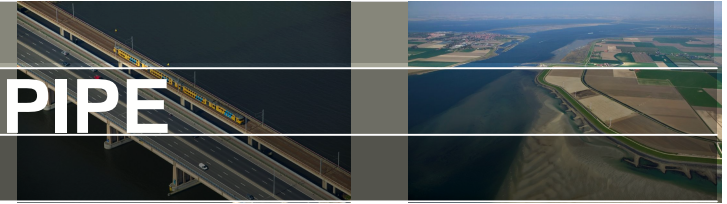
Wanda 4 hartlijn



Voor cavitatiemodel is b.b.k. bepalend: hartlijn + $\frac{1}{2} D$

Min/Max pressure: t.o.v. hartlijn

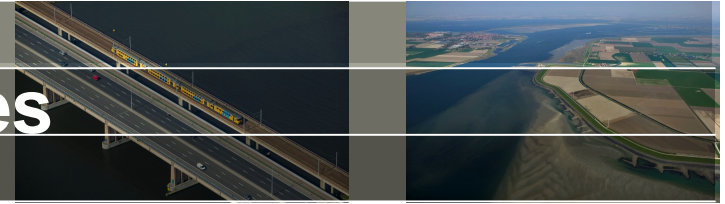
Wanda 4 Liquid – “all in one” PIPE



Alle WANDA 3.7 modellen (en ouder) worden automatisch geconverteerd naar de nieuwe PIPE

ingevoerde profielen worden $\frac{1}{2}$ D naar beneden verschoven

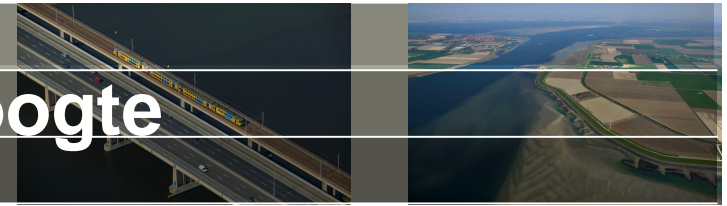
Wanda 4 Liquid – H-node types



Meerdere type H-node:

- Standaard invoer: elevation tbv Pressure bepaling
- Met demand: extra invoer: Q of Q(t) tabel
 (ter vervanging van TAP)
- Init Head tbv head specificatie in geïsoleerde delen

Wanda 4 Liquid - snelheidshoogte

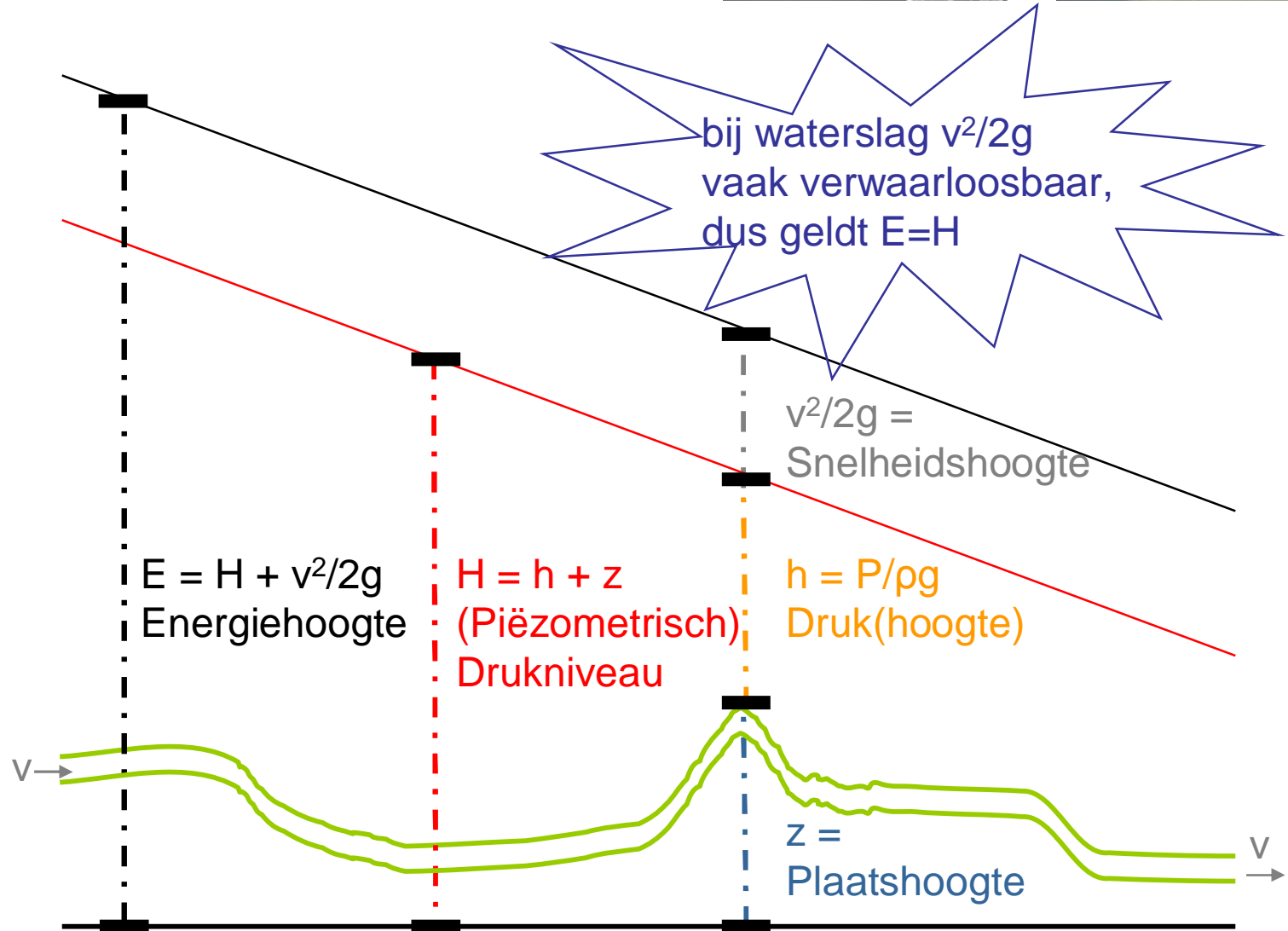


Energie
Gradiënt

Hydraulische
Gradiënt

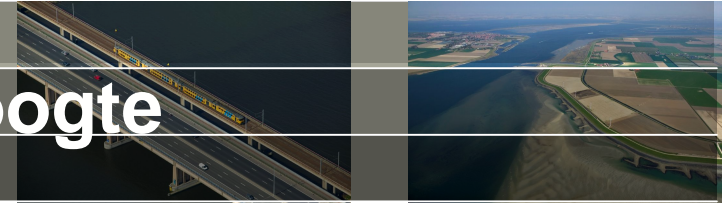
Leidingprofiel

Referentievlak



Deltares

Wanda 4 Liquid - snelheidshoogte



In WANDA 4 wordt snelheidshoogte term **wel** in rekening gebracht

Orde grootte: $v = 1 \text{ m/s}$ $v^2/2g \approx 0,05 \text{ m}$

$v = 3 \text{ m/s}$ $v^2/2g \approx 0,46 \text{ m}$

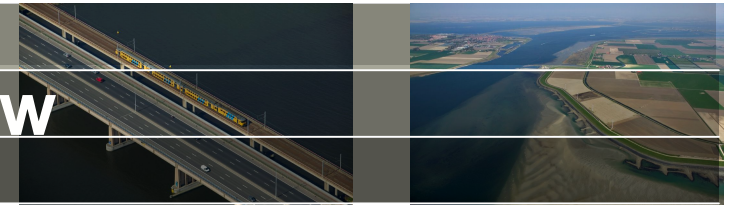
Alleen voor die componenten waarbij een snelheid bekend is (dus bijvoorbeeld PUMP niet)

Gevolg: Pressure in WANDA 4 is klein beetje lager dan in WANDA3

(0,005 – 0,05 Bar ; 0,5 - 5 kPa)

HEAD berekening ONGEWIJZIGD

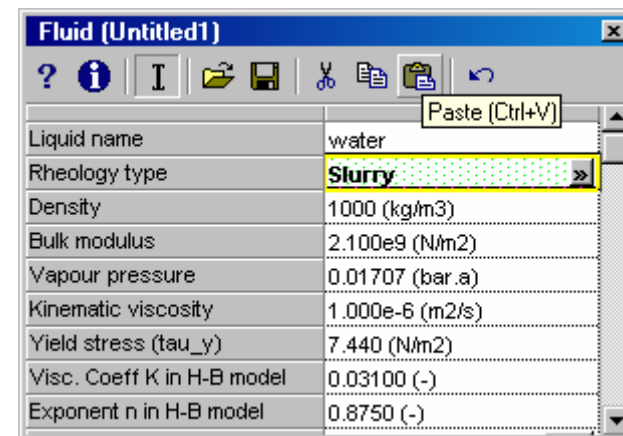
Wanda 4 Liquid – Fluid window



NIEUW (Optie): weerstandsmodel voor slurries
(Niet-Newtons gedrag)

Keuze in Fluid window: **Newtonian** / Slurry

I.g.v. Slurry: extra invoerparameters voor Herschel-Bulkley model



Wanda 4 Liquid – Output property

Veranderd:

Volgorde output property

Per connect node Q, H, P, v

(eerst primaire rekengrootheden,
daarna afgeleide rekengrootheden)

