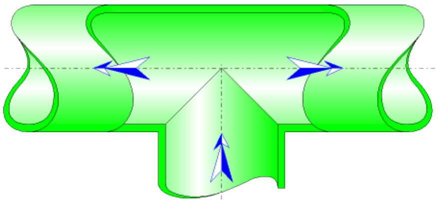
Symmetric dividing sharp-edged T-junction
Circular Cross-Section
(MILLER)



Model description:

This model of component calculates the minor head loss (pressure drop) generated by the flow in a symmetric dividing sharp-edged T-junction with three legs of equal area.

The head loss by friction in the inlet and outlet piping is not taken into account in this component.

Model formulation:

Cross-sectional area of the three branches (m^2):

$$A_1 = \pi \cdot \frac{D_1^2}{4}$$

$$A_2 = \pi \cdot \frac{D_2^2}{4}$$

$$A_3 = \pi \cdot \frac{D_3^2}{4}$$

with $D_1 = D_2 = D_3$

Volume flow rate in the common branch (m^3/s):

$$Q_3 = Q_1 + Q_2$$

Mean velocity in the left branch (m/s):

$$U_1 = \frac{Q_1}{A_1}$$

Mean velocity in the right branch (m/s):

$$U_2 = \frac{Q_2}{A_2}$$

Mean velocity in the common branch (m/s):

$$U_3 = \frac{Q_3}{A_3}$$

Mass flow rate in the left branch (kg/s):

$$G_1 = Q_1 \cdot \rho$$

Mass flow rate in the right branch (kg/s):

$$G_2 = Q_2 \cdot \rho$$

Mass flow rate in the common branch (kg/s):

$$G_3 = Q_3 \cdot \rho$$

Reynolds number in the left branch:

$$\mathrm{Re}_1 = \frac{U_1 \cdot D_1}{\nu}$$

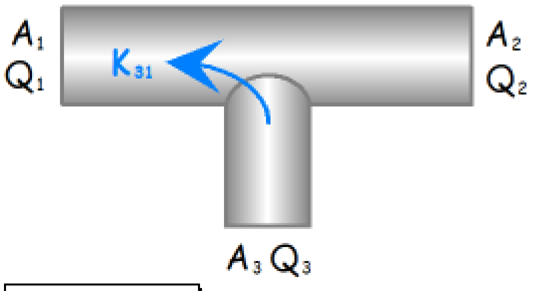
Reynolds number in the right branch:

$$\mathrm{Re}_2 = \frac{U_2 \cdot D_2}{\nu}$$

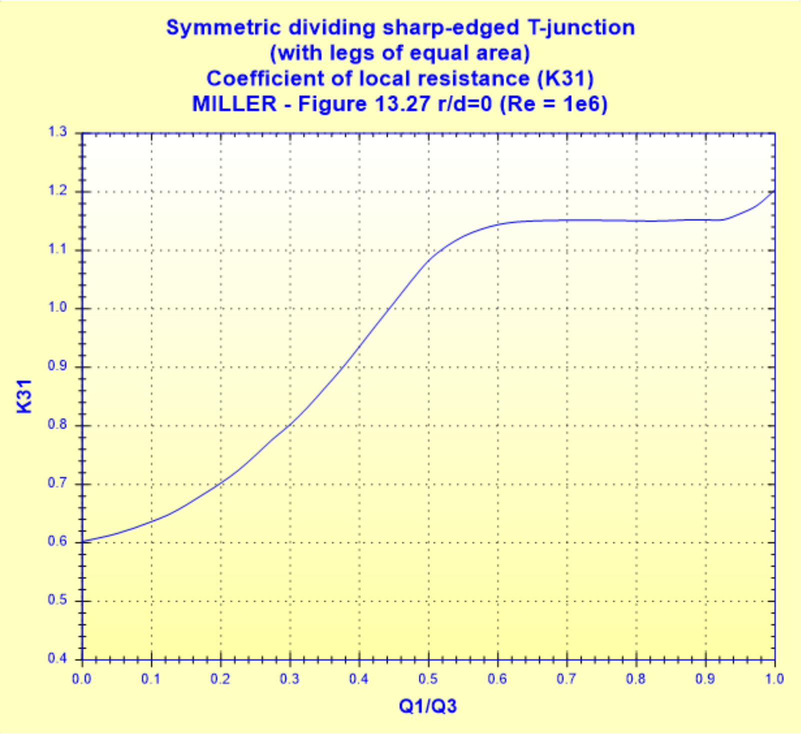
Reynolds number in the common branch:

$$\mathrm{Re}_3 = \frac{U_3 \cdot D_3}{\nu}$$

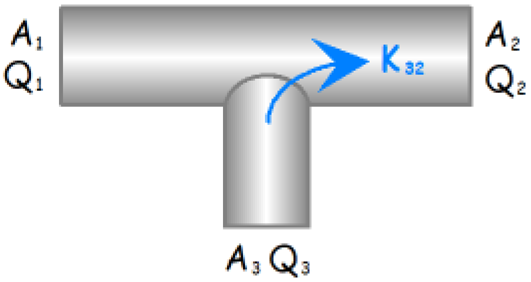
Pressure loss coefficient of the left branch (based on mean velocity in the common branch):



$$K_{31} = f\left(\frac{Q_1}{Q_3}\right)$$ ([1] figure 13.27 with r/d = 0)

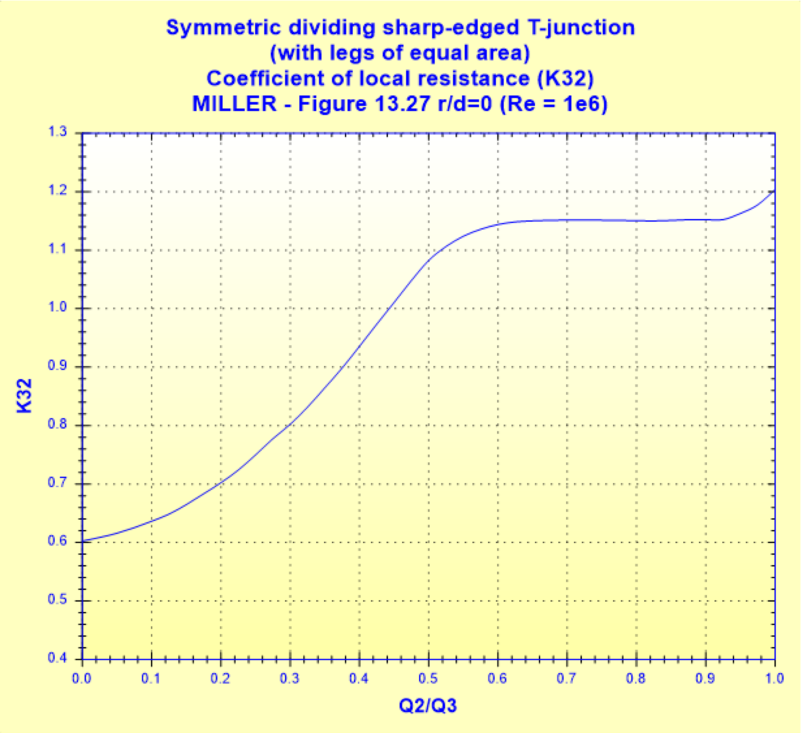


Pressure loss coefficient of the right branch (based on mean velocity in the common branch):



$$K_{32} = f\left(\frac{Q_2}{Q_3}\right)$$

([1] figure 13.27 with r/d = 0)



Pressure loss in the left branch (Pa):

$$\Delta P_{31} = K_{31} \cdot \frac{\rho \cdot U_3^2}{2}$$

([1] equation 13.3)

Pressure loss in the right branch (Pa):

$$\Delta P_{32} = K_{32} \cdot \frac{\rho \cdot U_3^2}{2}$$

([1] equation 13.4)

Head loss of fluid in the left branch (m):

$$\Delta H_{31} = K_{31} \cdot \frac{U_3^2}{2 \cdot g}$$

Head loss of fluid in the right branch (m):

$$\Delta H_{32} = K_{32} \cdot \frac{U_3^2}{2 \cdot g}$$

Hydraulic power loss in the left branch (W):

$$Wh_{31} = \Delta P_{31} \cdot Q_1$$

Hydraulic power loss in the right branch (W):

$$Wh_{32} = \Delta P_{32} \cdot Q_2$$

Symbols, Definitions, SI Units:

D_1	Diameter of the left branch (m)
D_2	Diameter of the right branch (m)
D_3	Diameter of the common branch
A_1	Cross-sectional area of the left branch (m^2)
A_2	Cross-sectional area of the right branch (m^2)
A_3	Cross-sectional area of the common branch (m^2)
Q_1	Volume flow rate in the left branch (m^3/s)
U_1	Mean velocity in the left branch (m/s)
Q_2	Volume flow rate in the right branch (m^3/s)
U_2	Mean velocity in the right branch (m/s)
Q_3	Volume flow rate in the common branch (m^3/s)
U_3	Mean velocity in the common branch (m/s)
G_1	Mass flow rate in the left branch (kg/s)
G_2	Mass flow rate in the right branch (kg/s)
G_3	Mass flow rate in the common branch (kg/s)
Re_1	Reynolds number in the left branch ()
Re_2	Reynolds number in the right branch ()
Re_3	Reynolds number in the common branch ()

K_{31} Pressure loss coefficient of the left branch (based on mean velocity in the common branch) ()

K_{32} Pressure loss coefficient of the right branch (based on mean velocity in the common branch) ()

ΔP_{31} Pressure loss in the left branch (Pa)

ΔP_{32} Pressure loss in the right branch (Pa)

ΔH_{31} Head loss of fluid in the left branch (m)

ΔH_{32} Head loss of fluid in the right branch (m)

Wh_{31} Hydraulic power loss in the left branch (W)

Wh_{32} Hydraulic power loss in the right branch (W)

ρ Fluid density (kg/m^3)

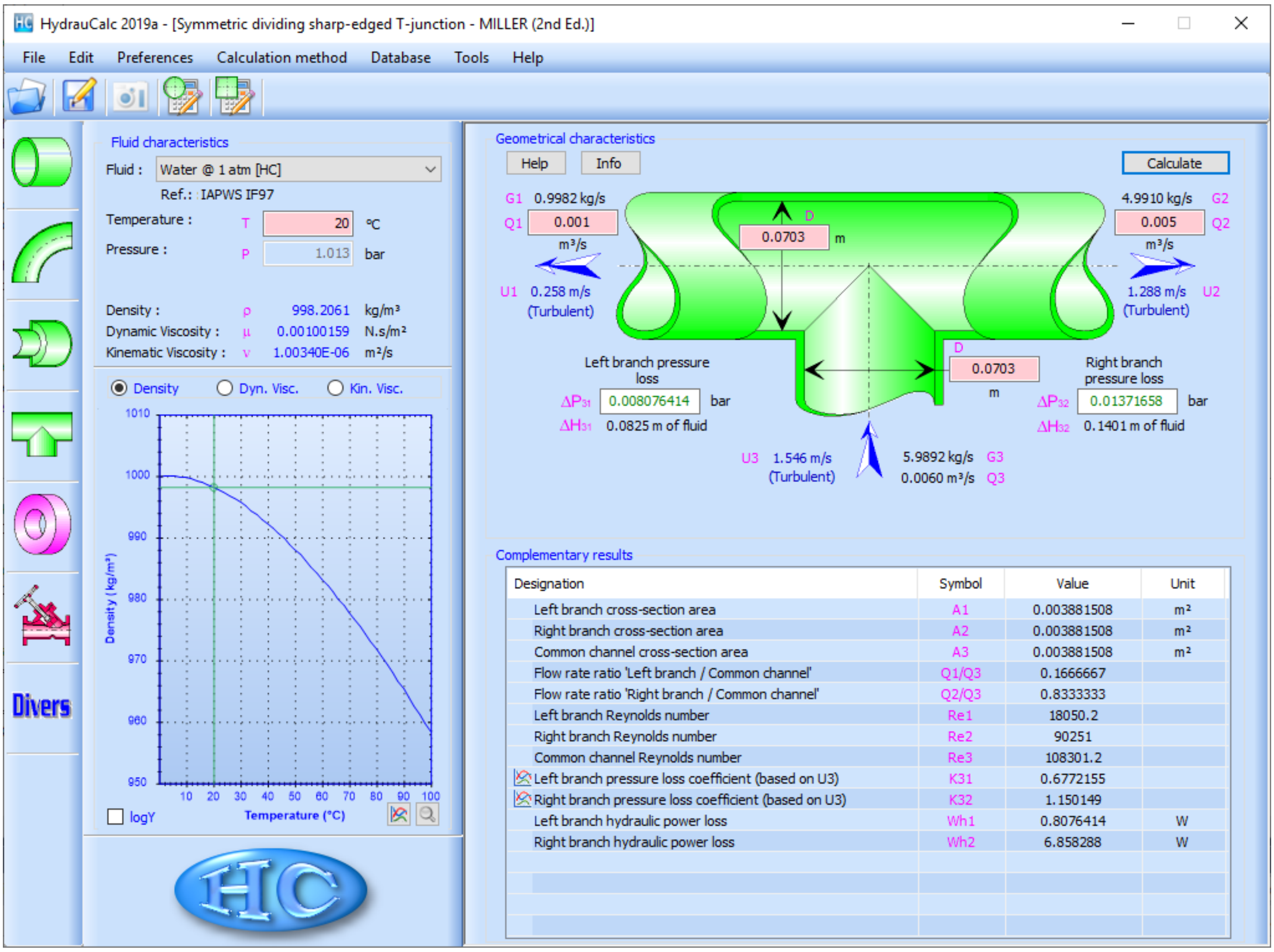
ν Fluid kinematic viscosity (m^2/s)

g Gravitational acceleration (m/s^2)

Validity range:

- turbulent flow regime ($Re_3 \geq 10^5$)
- three legs of equal area

Example of application:



References:

[1] Internal Flow System, Second Edition, D.S. Miller (1990)