Helix Technologies Pty Ltd

Project	Helix QA	Client	Helix QA
Project No.	4567	Design Date	14/03/2017
Category	Demo Liquid QA	Atmos. Press	100.19 kPa
Network Type	Liquid	Calc. Method	Darcy
Description	QA Continuity of flow at junction		

Junction Flow Continuity Worked Example, ref. 2500 Solved Problems in Fluid Mechanics and Hydraulics, Jack B. Evett et.al. Example 13.23 on pg 339.

Assumed Water at 20 dg C. Build model with 4 tanks and set the pressure at each tank to the values specified for the node. Set pipe roughness to 0.262mm to get friction factor of 0.029437 which is close to the 0.0294 used in the published results. Solve network, flow rates and Head losses are calculated. Note sum of flows into junction equals sum of flows out of juntion.

Calculation Results	Published Data	Helix Calculation
Pipe to 800kPa	0.0181 m3/s	0.0181 m3/s
Pipe to 400kPa	0.0104 m3/s	0.0104 m3/s
Pipe to 600kPa	0.0104 m3/s	0.0104 m3/s
Pipe to 200kPa	0.0181 m3/s	0.0181 m3/s

Results are the same. Continuity of flow at the junction is maintained.

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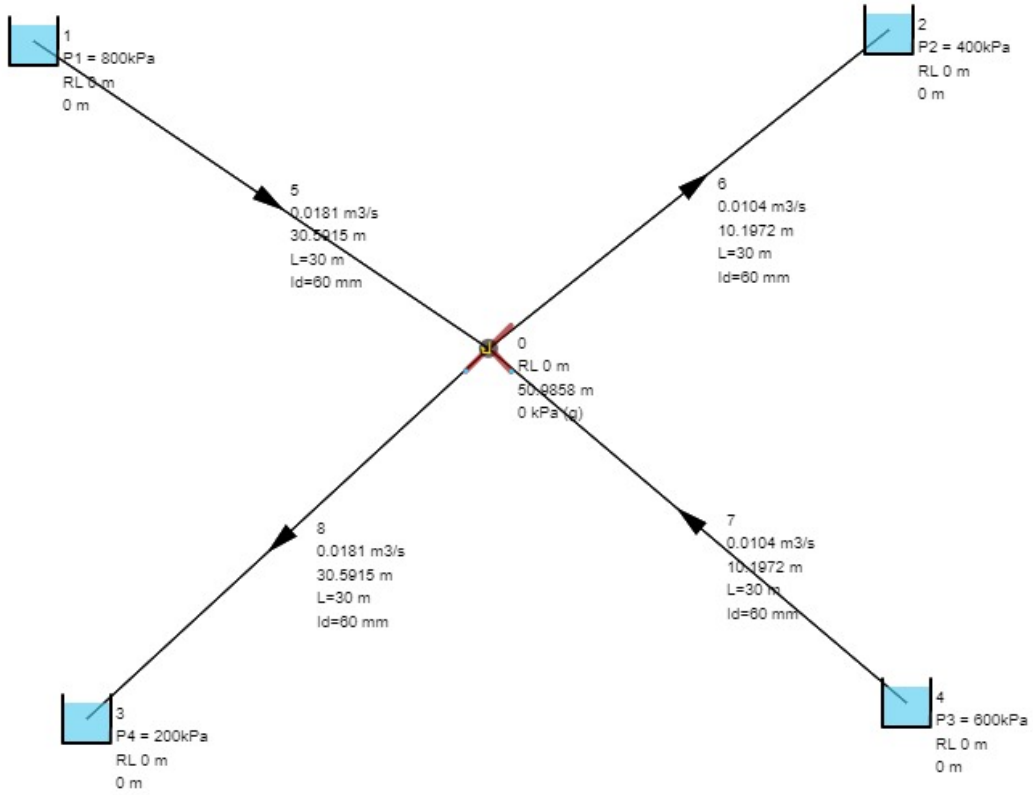

QA Continuity of flow at junction

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Project No.	4567	Design Date	14/03/2017
Category	Demo Liquid QA	Atmos. Press	100.19 kPa
Description	QA Continuity of flow at junction		

Pipe No	5	From node to node	0 - 1
Description		Equipment No	
Liquid	Water	Viscosity	1 cp
Temperature	20 C	Density	1000 kg/m3
Vapour Pressure	2.34 kPa		
Pipe Description	Cast Iron	Pipe Class	
Nominal Diameter	60 mm	Inside Diameter	60 mm
Outside Diameter	70 mm	Pipe Length	30 m
Pipe Roughness	0.262 mm	Allowable Press.	2500 kPa
Orifice Plate Dia	-	Non Return Valve	No
Total Fittings k	0	Total Fittings kf	0
Flow Rate	0.0181 m3/s	Velocity	6.3846 m/s
Friction Loss	30.5915 m	Fitting Losses	0 m
Slurry Losses	0 m	Orifice Losses	0 m
Fixed Head Loss	0 m	Booster Pump Head	0 m
Total Head Loss	30.5915 m	Total Pressure Drop	300 kPa
Entry Total Head	81.5773 m	Exit Total Head	50.9858 m
Entry Gauge Head	50.9858 m	Exit Gauge Head	20.3943 m
Reynolds No.	383075.6414	Friction Factor	0.0294371 (Darcy f)

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Pipe No	6	From node to node	0 - 2
Description		Equipment No	
Liquid	Water	Viscosity	1 cp
Temperature	20 C	Density	1000 kg/m3
Vapour Pressure	2.34 kPa		
Pipe Description	Cast Iron	Pipe Class	
Nominal Diameter	60 mm	Inside Diameter	60 mm
Outside Diameter	70 mm	Pipe Length	30 m
Pipe Roughness	0.262 mm	Allowable Press.	2500 kPa
Orifice Plate Dia	-	Non Return Valve	No
Total Fittings k	0	Total Fittings kf	0
Flow Rate	0.0104 m3/s	Velocity	3.6736 m/s
Friction Loss	10.1972 m	Fitting Losses	0 m
Slurry Losses	0 m	Orifice Losses	0 m
Fixed Head Loss	0 m	Booster Pump Head	0 m
Total Head Loss	10.1972 m	Total Pressure Drop	100 kPa
Entry Total Head	50.9858 m	Exit Total Head	40.7886 m
Entry Gauge Head	50.9858 m	Exit Gauge Head	40.7886 m
Reynolds No.	220417.815	Friction Factor	0.0296372 (Darcy f)

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Category	Demo Liquid QA	Atmos. Press	100.19 kPa
Description	QA Continuity of flow at junction		

Pipe No	7	From node to node	0 - 4
Description		Equipment No	
Liquid	Water	Viscosity	1 cp
Temperature	20 C	Density	1000 kg/m3
Vapour Pressure	2.34 kPa		
Pipe Description	Cast Iron	Pipe Class	
Nominal Diameter	60 mm	Inside Diameter	60 mm
Outside Diameter	70 mm	Pipe Length	30 m
Pipe Roughness	0.262 mm	Allowable Press.	2500 kPa
Orifice Plate Dia	-	Non Return Valve	No
Total Fittings k	0	Total Fittings kf	0
Flow Rate	0.0104 m3/s	Velocity	3.6736 m/s
Friction Loss	10.1972 m	Fitting Losses	0 m
Slurry Losses	0 m	Orifice Losses	0 m
Fixed Head Loss	0 m	Booster Pump Head	0 m
Total Head Loss	10.1972 m	Total Pressure Drop	100 kPa
Entry Total Head	61.183 m	Exit Total Head	50.9858 m
Entry Gauge Head	50.9858 m	Exit Gauge Head	40.7886 m
Reynolds No.	220417.815	Friction Factor	0.0296372 (Darcy f)

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Category	Demo Liquid QA	Atmos. Press	100.19 kPa
Description	QA Continuity of flow at junction		

Pipe No	8	From node to node	0 - 3
Description		Equipment No	
Liquid	Water	Viscosity	1 cp
Temperature	20 C	Density	1000 kg/m3
Vapour Pressure	2.34 kPa		
Pipe Description	Cast Iron	Pipe Class	
Nominal Diameter	60 mm	Inside Diameter	60 mm
Outside Diameter	70 mm	Pipe Length	30 m
Pipe Roughness	0.262 mm	Allowable Press.	2500 kPa
Orifice Plate Dia	-	Non Return Valve	No
Total Fittings k	0	Total Fittings kf	0
Flow Rate	0.0181 m3/s	Velocity	6.3846 m/s
Friction Loss	30.5915 m	Fitting Losses	0 m
Slurry Losses	0 m	Orifice Losses	0 m
Fixed Head Loss	0 m	Booster Pump Head	0 m
Total Head Loss	30.5915 m	Total Pressure Drop	300 kPa
Entry Total Head	50.9858 m	Exit Total Head	20.3943 m
Entry Gauge Head	50.9858 m	Exit Gauge Head	20.3943 m
Reynolds No.	383075.6414	Friction Factor	0.0294371 (Darcy f)

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Node No	0	Node Type	Junction
Description		Equipment No	
Rel. Level (RL)	0 m	Pressure Input	0 kPa
Nozzle K value	-	Ext Flow (+In/-Out)	0 m3/s
Int.(Gauge) Head	50.9858 m	Int.(Gauge) Pressure	0 kPa
Total Node Head	50.9858 m		

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Node No	1	Node Type	Tank
Description	P1 = 800kPa	Equipment No	
Rel. Level (RL)	0 m	Pressure Input	800 kPa
Nozzle K value	-	Ext Flow (+In/-Out)	-
Int.(Gauge) Head	-	Int.(Gauge) Pressure	-
Total Node Head	0 m		

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Node No	2	Node Type	Tank
Description	P2 = 400kPa	Equipment No	
Rel. Level (RL)	0 m	Pressure Input	400 kPa
Nozzle K value	-	Ext Flow (+In/-Out)	-
Int.(Gauge) Head	-	Int.(Gauge) Pressure	-
Total Node Head	0 m		

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Node No	3	Node Type	Tank
Description	P4 = 200kPa	Equipment No	
Rel. Level (RL)	0 m	Pressure Input	200 kPa
Nozzle K value	-	Ext Flow (+In/-Out)	-
Int.(Gauge) Head	-	Int.(Gauge) Pressure	-
Total Node Head	0 m		

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Category	Demo Liquid QA	Atmos. Press	100.19 kPa
Description	QA Continuity of flow at junction		

Node No	4	Node Type	Tank
Description	P3 = 600kPa	Equipment No	
Rel. Level (RL)	0 m	Pressure Input	600 kPa
Nozzle K value	-	Ext Flow (+In/-Out)	-
Int.(Gauge) Head	-	Int.(Gauge) Pressure	-
Total Node Head	0 m		