Water Reticulation Benchmark

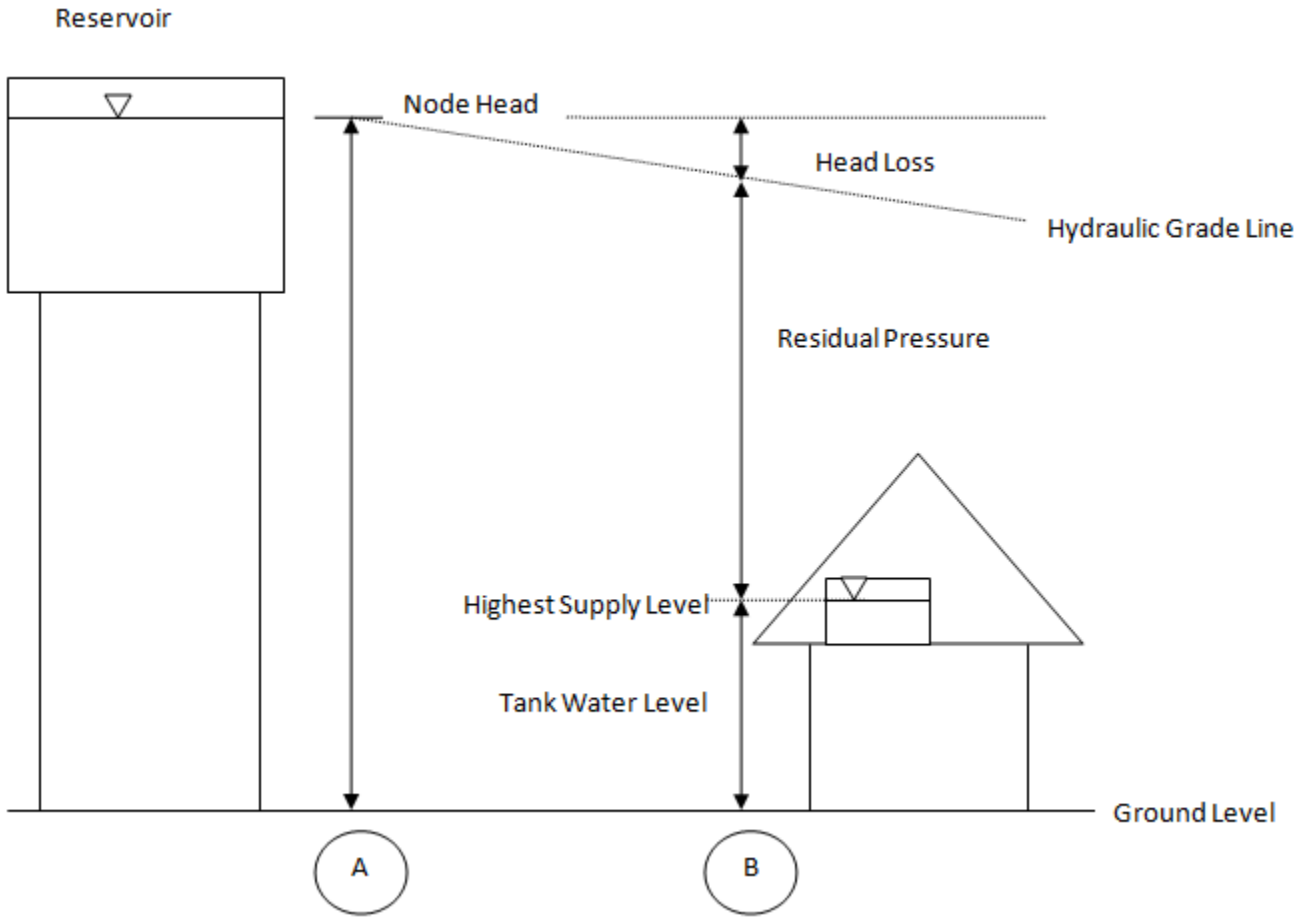
Water · https://mes100.com/docs/water-reticulation-benchmark/

Water reticulation is water distribution network which is delivered to the consumers. The distribution came from the pressure created from the source and delivered to its destination. Below is an example of the calculation and benchmark with MiTS software.

Project File

Provided a **project file** and the **spreadsheet** as your reference.

Diagram below displays the common terms used in water reticulation.



Hydraulic Grade Line (HGL)

= Fix Head - Head Loss

Residual Pressure

= Hydraulic Grade Line - Highest Supply Level

Tank Water Level

= Height from Ground Level to Tank Water Level

Highest Supply Level

= Ground Level + Tank Water Level

Head Loss

= Using Hazen William equation
(Manual Headloss Calculation Benchmark)

Peak Flow

Peak flow or also known as domestic flow. It is calculated for water distribution for domestic uses (residential, school, commercial etc.). Water demand is multiplied with peak factor (2.5) to determine the flow.

i. Example on Pipe 3 in Nodes for Peak Calculation

Flow (LPS) = Water Demand x Peak Factor

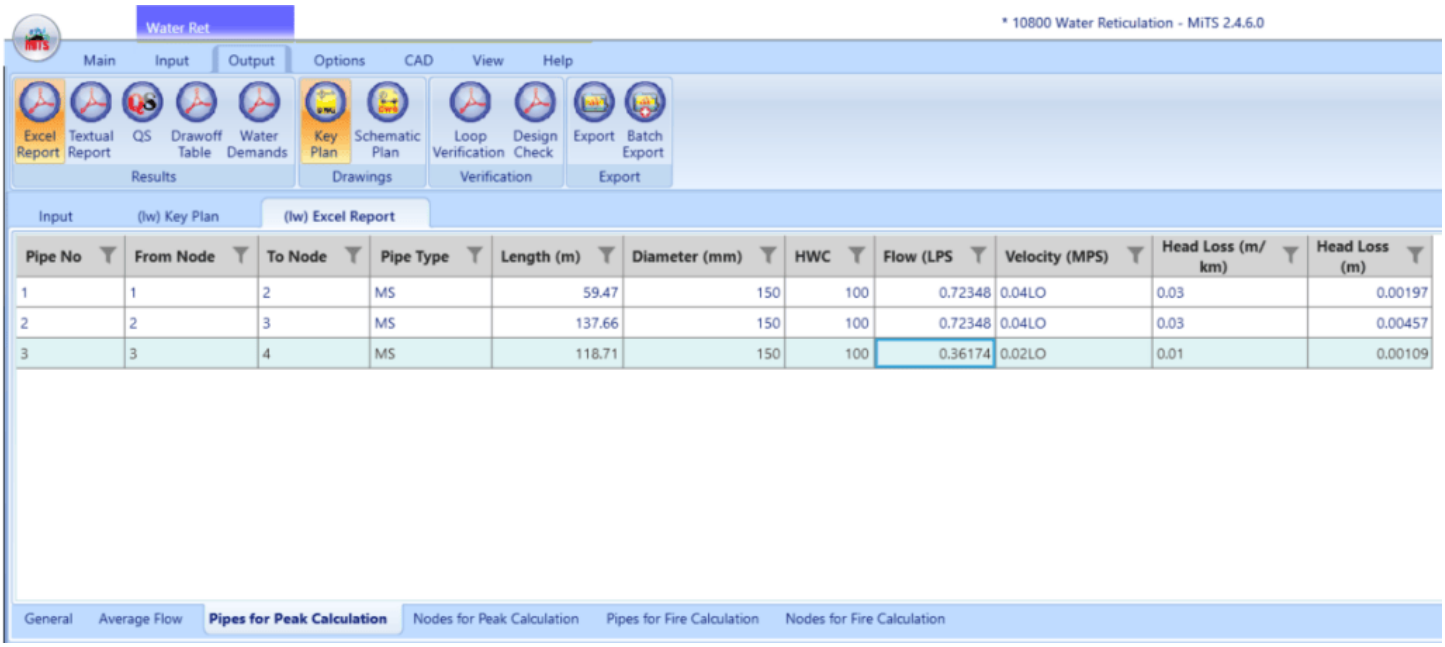
= |--0.144696211458333| x 2.5

= 0.3617 LPS

Pipe Type	Length (m)	Diameter (mm)	HWC	Flow (LPS) [Water Demand x Peak Factor]	Velocity (MPS) [Q/A]	Head Loss (m/km) [Hazen-Williams Equation]	Head Loss (m) [Sf x L]
MS	59.4665	150.0000	100.0000	0.7235	0.0409	0.033154952	0.0020
MS	137.6580	150.0000	100.0000	0.7235	0.0409	0.033154952	0.0046
MS	118.7105	150.0000	100.0000	0.3617	0.0205	0.009185133	0.0011

General | Average Flow | Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire Calcula

Calculation of Flow in Pipes for Peak Calculation in Spreadsheet



Pipe No	From Node	To Node	Pipe Type	Length (m)	Diameter (mm)	HWC	Flow (LPS	Velocity (MPS)	Head Loss (m/ km)	Head Loss (m)
1	1	2	MS	59.47	150	100	0.72348	0.04LO	0.03	0.00197
2	2	3	MS	137.66	150	100	0.72348	0.04LO	0.03	0.00457
3	3	4	MS	118.71	150	100	0.36174	0.02LO	0.01	0.00109

Calculation of Flow in Pipes for Peak Calculation in MiTS

Velocity (m/s) = Q/A

$$ =\frac{\displaystyle\frac{0.3617}{1000}}{\mathrm\pi0.075^2} $$

= 0.0205 m/s

	E	F	G	H	I	J	K
	Length (m)	Diameter (mm)	HWC	Flow (LPS) [Water Demand x Peak Factor]	Velocity (MPS) [Q/A]	Head Loss (m/km) [Hazen-Williams Equation]	Head Loss (m) [Sf x L]
	59.4665	150.0000	100.0000	0.7235	0.0409	0.033154952	0.0020
	137.6580	150.0000	100.0000	0.7235	0.0409	0.033154952	0.0046
	118.7105	150.0000	100.0000	0.3617	0.0205	0.009185133	0.0011

General | Average Flow | Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for

Velocity calculation in spreadsheet



Velocity calculation in MiTS

$$ \mathbf{Energy}\boldsymbol\;\mathbf{Slope}\boldsymbol\;\boldsymbol(\mathbf m\boldsymbol/\mathbf{km}\boldsymbol)\boldsymbol\;=\;\sqrt[27]{\frac{\mathrm V}{\mathrm k\;\mathrm C\;{({\displaystyle\frac{\mathrm D}4})}^{0.63}}}^{50}\;\times\;1000 $$

(you may refer here)

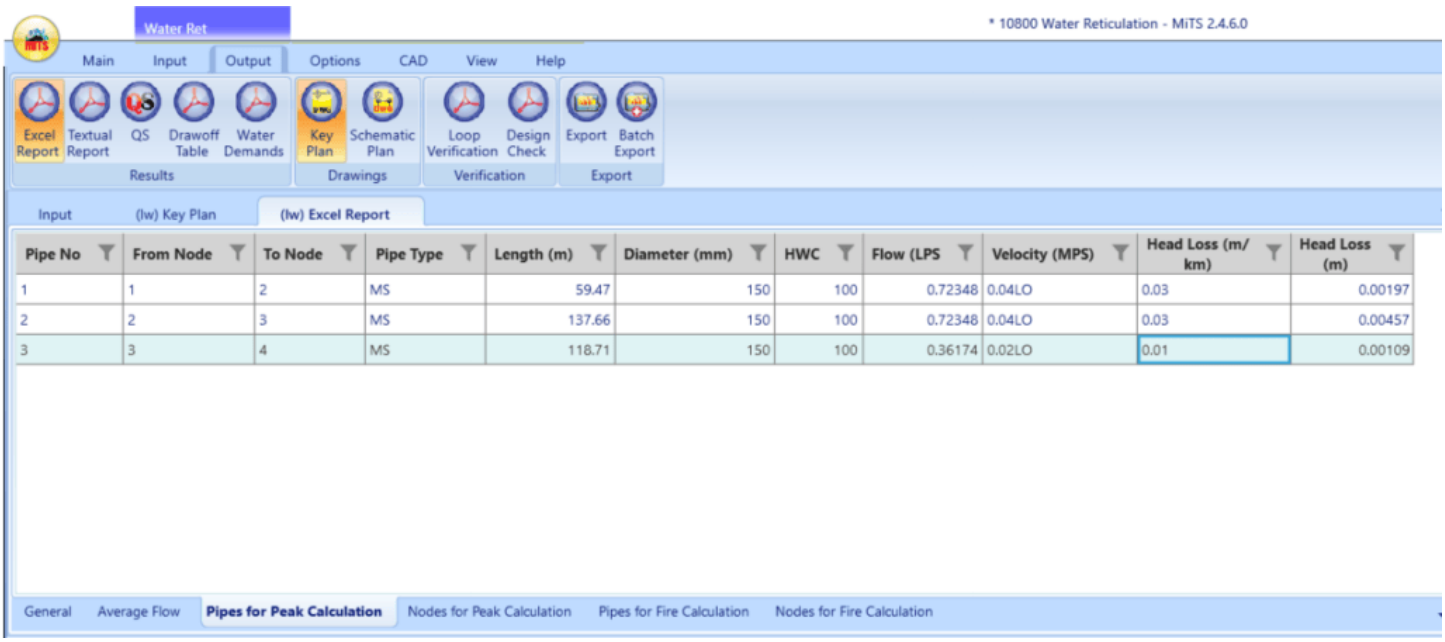
$$
=\sqrt[27]{\frac{0.0204703}{0.85\;\times\;100\;\times\;{({\displaystyle\frac{0.15}4})}^{0.63}}}^{50}$$

= 0.009185 m/km

E	F	G	H	I	J	K	L
Length (m)	Diameter (mm)	HWC	Flow (LPS) [Water Demand x Peak Factor]	Velocity (MPS) [Q/A]	Head Loss (m/km) [Hazen-Williams Equation]	Head Loss (m) [Sf x L]	
59.4665	150.0000	100.0000	0.7235	0.0409	0.033154952	0.0020	
137.6580	150.0000	100.0000	0.7235	0.0409	0.033154952	0.0046	
118.7105	150.0000	100.0000	0.3617	0.0204703	0.009185133	0.0011	

General | Average Flow | Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire

Energy Slope (m/km) calculation in spreadsheet



Head Loss (m) = Sf x L

$$ =\frac{0.009185\;\times\;118.7105}{1000} $$

= 0.00109 m

E	F	G	H	I	J	K
Length (m)	Diameter (mm)	HWC	Flow (LPS) [Water Demand x Peak Factor]	Velocity (MPS) [Q/A]	Head Loss (m/km) [Hazen-Williams Equation]	Head Loss (m) [Sf x L]
59.4665	150.0000	100.0000	0.7235	0.0409	0.033154952	0.0020
137.6580	150.0000	100.0000	0.7235	0.0409	0.033154952	0.0046
118.7105	150.0000	100.0000	0.3617	0.0204703	0.009185133	0.0011

General | Average Flow | Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for

Headloss calculation in Spreadsheet

Input | (lw) Key Plan | (lw) Excel Report

Pipe No	From Node	To Node	Pipe Type	Length (m)	Diameter (mm)	HWC	Flow (LPS	Velocity (MPS)	Head Loss (m/ km)	Head Loss (m)
1	1	2	MS	59.47	150	100	0.72348	0.04LO	0.03	0.00197
2	2	3	MS	137.66	150	100	0.72348	0.04LO	0.03	0.00457
3	3	4	MS	118.71	150	100	0.36174	0.02LO	0.01	0.00109

General | Average Flow | Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire Calculation | Nodes for Fire Calculation

Headloss calculation in MiTS

ii. Example on Pipe 1 in Pipes for Peak Calculation

HGL = Fix Head - Head Loss

= 60 - 0.002

= 59.998 m

Node No	Flow (LPS)	Ground Level (m)	HGL (m) [Fix Head - Head Loss]	Tank Water Level (m)	Highest Supply Level (m) [Ground Level + Tank Water Level]	Residual Pressure (m) [HGL - HSL]
1 R	0.72	32.76	60.00			
2	0.00	33.22	60.00	0.00	33.22	26.78
3	-0.36	35.31	59.99	7.50	42.81	17.18
4	-0.36	33.52	59.99	7.50	41.02	18.98

Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire Calcu

HGL calculation in Spreadsheet

Input | (lw) Key Plan | (lw) Excel Report

Node No	Flow (LPS)	Ground Level (m)	HGL (m)	Highest Supply Level (m)	Residual Pressure (m)
1 R	0.72348	32.76	60.00	-	-
2	0.00000	33.22	60.00	33.22	26.78
3	-0.36174	35.31	59.99	42.81	17.18
4	-0.36174	33.52	59.99	41.02	18.98

General | Average Flow | Pipes for Peak Calculation | **Nodes for Peak Calculation** | Pipes for Fire Calculation | Nodes for Fire Calculation

HGL calculation in MiTS

HSL = Ground Level + Tank Water Level

= 33.22 + 0

= 33.22 m

Node No	Flow (LPS)	Ground Level (m)	HGL (m) [Fix Head - Head Loss]	Tank Water Level (m)	Highest Supply Level (m) [Ground Level + Tank Water Level]	Residual Pressure (m) [HGL - HSL]
1 R	0.72	32.76	60.00			
2	0.00	33.22	60.00	0.00	33.22	26.78
3	-0.36	35.31	59.99	7.50	42.81	17.18
4	-0.36	33.52	59.99	7.50	41.02	18.98

Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire Calcu

HSL calculation in Spreadsheet

Input | (lw) Key Plan | (lw) Excel Report

Node No	Flow (LPS)	Ground Level (m)	HGL (m)	Highest Supply Level (m)	Residual Pressure (m)
1 R	0.72348	32.76	60.00	-	-
2	0.00000	33.22	60.00	33.22	26.78
3	-0.36174	35.31	59.99	42.81	17.18
4	-0.36174	33.52	59.99	41.02	18.98

General | Average Flow | Pipes for Peak Calculation | **Nodes for Peak Calculation** | Pipes for Fire Calculation | Nodes for Fire Calcula

HSL calculation in MiTS

Residual Pressure = HGL - HSL

= 59.998 - 33.22

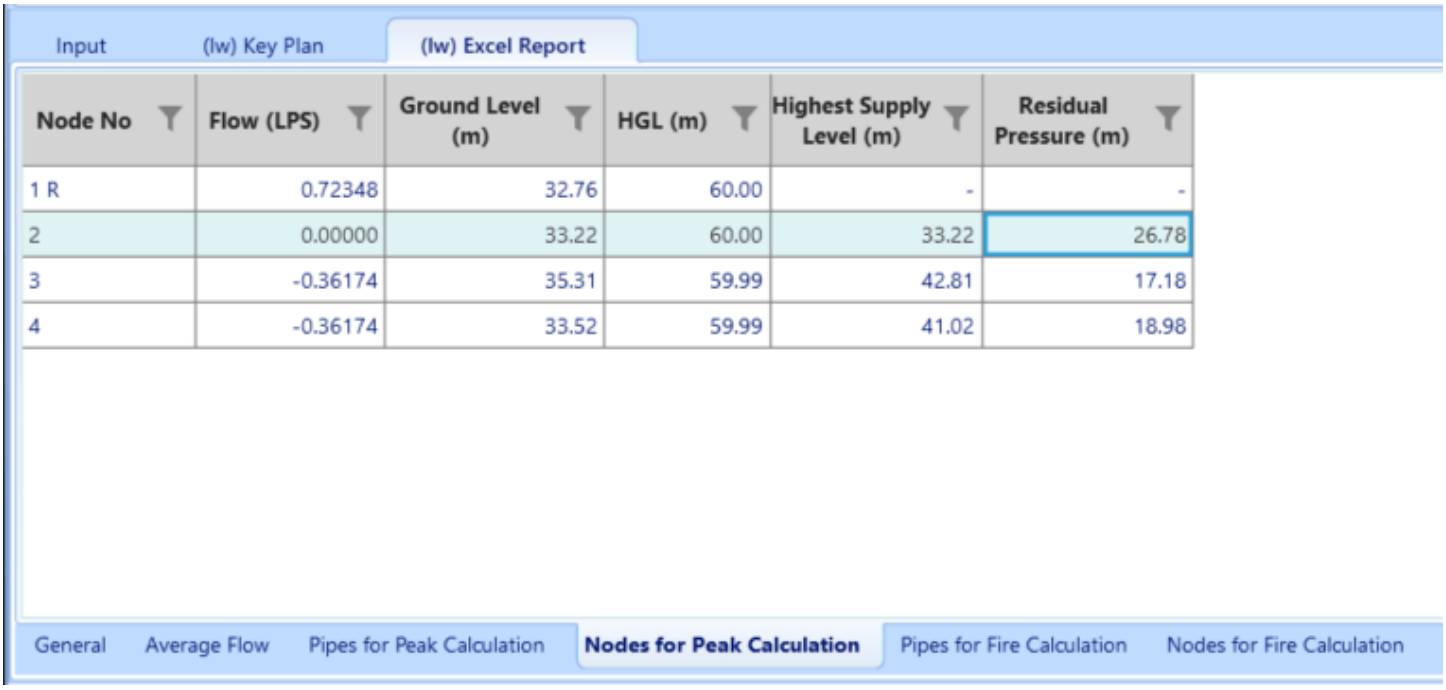
= 26.778 m

=D3-F3

Node No	Flow (LPS)	Ground Level (m)	HGL (m) [Fix Head - Head Loss]	Tank Water Level (m)	Highest Supply Level (m) [Ground Level + Tank Water Level]	Residual Pressure (m) [HGL - HSL]
1 R	0.72	32.76	60.00			
2	0.00	33.22	60.00	0.00	33.22	26.78
3	-0.36	35.31	59.99	7.50	42.81	17.18
4	-0.36	33.52	59.99	7.50	41.02	18.98

Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire Calculatio

Residual Pressure calculation in Spreadsheet



Input (lw) Key Plan (lw) Excel Report

Node No	Flow (LPS)	Ground Level (m)	HGL (m)	Highest Supply Level (m)	Residual Pressure (m)
1 R	0.72348	32.76	60.00	-	-
2	0.00000	33.22	60.00	33.22	26.78
3	-0.36174	35.31	59.99	42.81	17.18
4	-0.36174	33.52	59.99	41.02	18.98

General Average Flow Pipes for Peak Calculation **Nodes for Peak Calculation** Pipes for Fire Calculation Nodes for Fire Calculation

Residual Pressure calculation in MiTS

Fire Calculation

Fire calculation is the calculation with hydrant assigned in the design. The purpose of it is to make sure whether the water distribution is sufficient to cater during fire breakout, even at the lowest pressure. The value usually used for water demand in fire calculation is 22.7 LPS.

i. Example on Pipe 3 in Nodes for Fire Calculation

Flow (LPS) = (Water Demand x Fire Factor) + Average Flow

= (22.7 x 1) + 0.145

= 22.845 LPS

Pipe No	From Node	To Node	Pipe Type	Length (m)	Diameter (mm)	HWC	Flow (LPS) [Water Demand x Peak Factor]	Velocity (MPS) [Q/A]	Head Loss (m/km) [Hazen-Williams Equation]	Head Loss (m) [Sf x L]
1	1	2	MS	59.47	150.00	100.00	22.99	1.300933491	20.05467761	1.19
2	2	3	MS	137.66	150.00	100.00	22.99	1.300933491	20.05467761	2.76
3	3	4	MS	118.71	150.00	100.00	22.84	1.29274536	19.82155445	2.35

Average Flow | Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire Calculation

Flow calculation in Spreadsheet

Results | Drawings | Verification | Export

Input | (lw) Key Plan | (lw) Excel Report

Pipe No	From Node	To Node	Pipe Type	Length (m)	Diameter (mm)	HWC	Flow (LPS	Velocity (MPS)	Head Loss (m/ km)	Head Loss (m)
1	1	2	MS	59.47	150	100	22.98939	1.30	20.08HI	1.19429
2	2	3	MS	137.66	150	100	22.98939	1.30	20.08HI	2.76465
3	3	4	MS	118.71	150	100	22.84470	1.29	19.85HI	2.35640

General | Average Flow | Pipes for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire Calculation | Nodes for Fire Calculation

Flow calculation in MITS

Velocity (m/s) = Q/A

$$ =\frac{\displaystyle\frac{22.84}{1000}}{\mathrm\pi0.075^2} $$

= 1.292 m/s

Pipe No	From Node	To Node	Pipe Type	Length (m)	Diameter (mm)	HWC	Flow (LPS) [Water Demand x Peak Factor]	Velocity (MPS) [Q/A]	Head Loss (m/km) [Hazen-Williams Equation]	Head Loss (m) [Sf x L]
1	1	2	MS	59.47	150.00	100.00	22.99	1.300933491	20.05467761	1.19
2	2	3	MS	137.66	150.00	100.00	22.99	1.300933491	20.05467761	2.76
3	3	4	MS	118.71	150.00	100.00	22.84	1.29274536	19.82155445	2.35

s for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire Calculation | Nodes for Fire Calculation

Velocity calculation in Spreadsheet

Input | (lw) Key Plan | (lw) Excel Report

Pipe No	From Node	To Node	Pipe Type	Length (m)	Diameter (mm)	HWC	Flow (LPS	Velocity (MPS)	Head Loss (m/ km)	Head Loss (m)
1	1	2	MS	59.47	150	100	22.98939	1.30	20.08HI	1.194
2	2	3	MS	137.66	150	100	22.98939	1.30	20.08HI	2.764
3	3	4	MS	118.71	150	100	22.84470	1.29	19.85HI	2.356

General | Average Flow | Pipes for Peak Calculation | Nodes for Peak Calculation | **Pipes for Fire Calculation** | Nodes for Fire Calculation

Velocity calculation in MiTS

$$ \mathbf{Energy}\boldsymbol\;\mathbf{Slope}\boldsymbol\;\boldsymbol(\mathbf m\boldsymbol/\mathbf{km}\boldsymbol)\boldsymbol\;=\;\sqrt[27]{\frac{\mathrm V}{\mathrm k\;\mathrm C\;{({\displaystyle\frac{\mathrm D}4})}^{0.63}}}^{50}\;\times\;1000 $$

$$ =\sqrt[27]{\frac{1.292}{0.85\;\times\;100\;\times\;{({\displaystyle\frac{0.15}4})}^{0.63}}}^{50}$$

= 19.80 m/km

	C	D	E	F	G	H	I	J	K
1	To Node	Pipe Type	Length (m)	Diameter (mm)	HWC	Flow (LPS) [Water Demand x Peak Factor]	Velocity (MPS) [Q/A]	Head Loss (m/km) [Hazen-Williams Equation]	Head Loss (m) [Sf x L]
2	2	MS	59.47	150.00	100.00	22.99	1.300933491	20.05467761	1.19
3	3	MS	137.66	150.00	100.00	22.99	1.300933491	20.05467761	2.76
4	4	MS	118.71	150.00	100.00	22.84	1.29274536	19.82155445	2.35

s for Peak Calculation | Nodes for Peak Calculation | Pipes for Fire Calculation | Nodes for Fire Calculation

Headloss (m/km) calculation in spreadsheet

Headloss (m/km) calculation in MITS

Head Loss (m) = Sf x L

= 19.80 x 118.71 / 1000

= 2.35 m

Headloss calculation in Spreadsheet

Headloss calculation in MiTS

ii. Example on Pipe 1 in Pipes for Fire Calculation

HGL = Fix Head - Head Loss

= 60 - 1.19

= 58.81 m

HGL calculation in Spreadsheet

HGL calculation in MiTS

Residual Pressure = HGL - GL

= 58.81 - 33.22

= 25.59 m

Residual Pressure calculation in Spreadsheet

Residual Pressure calculation in MiTS

Related



Ngu Soon Hui

I’m the Benevolent Dictator for Life for MiTS Software cum Editor of this website. Read more here.

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