The Automatic Sprinkler Program

The Automatic Sprinkler Program (The-ASP) is a Windows based sprinkler performance estimation program. It calculates the estimated hydraulic demand of a sprinkler system based on its configuration, and compares that demand to the available water supply to produce the estimated sprinkler performance. Calculations are based on the algorithm published in EPANet 2.0 — a public domain program produced by the United States Environmental Protection Agency (https://19january2017snapshot.epa.gov/water-research/epanet_.html)

Program Definitions

Term	Definition
C factor:	A unit-less property of pipe that defines its roughness coefficient.
Fixed Flow Point	A specialized node that emits a fixed volume of flow regardless of the pressure at the point (usually a hose allowance). These nodes are shown on the schematic as two concentric circles.
Fixed Loss Device	A physical item that connects two points that has a fixed pressure loss not related to the flow through the device. This is shown on the schematic as a dotted line.
Flow Direction	Positive and negative flow designations show the flow direction in a pipe. The program has an option for reversing the flow points of a pipe.
Graph	A graphic representation of the supply and demand curves of the calculated system.
K factor	A unit-less property of a sprinkler head that is proportional to the flow/pressure relationship.
Node (Hydraulic Point)	This is a point in the system where there is the opportunity for a change is flow. This may be a sprinkler head, or a pipe junction.
Pipe	A physical item that connects two points that has friction loss proportional to the flow.
Riser Nipple	A short piece of pipe that elevates the branch line from the main.
Schematic	A non-scaled drawing showing the layout of the sprinkler system.
Shortcut (node)	A placeholder node on the schematic that represents an actual node. This is used to "clean up" a schematic with a number of pipes crowding the same area – it has no effect on calculations. Shortcut nodes have their IDs labeled in italics and boxed.
Source	The node at which the demand is calculated for the sprinkler system. Every system must have a Source Point designated.
Sprig	A short piece of pipe that extends a sprinkler head away from the branch line.
Sprinkler Head	A specialized node that emits flow proportional to the pressure at the point. These nodes are shown on the schematic as open circles.

Button Definitions

	**New File**	**Erases all data and creates a blank page**
	Open File	Opens a previously saved file
	Save File	Saves the current data in a disk file
	Cover Page	Enter or edit data to be printed in the standard report
	Report	Print a standard report
	Undo	Undo previous editor action
	Select Mode	Put the editor in the mode for selecting and editing the schematic
	Node Mode	Put the editor in the mode for adding Nodes to the schematic
	Pipe Mode	Put the editor in the mode for adding Pipes to the schematic
	QuicKalc	Run the routines for generating a simple grid or tree system
	Water Supply	Enter data for the water supply at the Source
	Calculations	Run the calculation routine.
	Schematic	Select the mode to view the schematic
	Graph	View the hydraulic graph of the calculations

Mode Button Definitions

IDs	IDs	Display the ID tags of the Nodes and Pipes
	Head Flow	Display the flow from the open heads
	Head and Pipe Flow	Display the flow from the heads and pipes
	Head Pressure	Display the effective pressure at open heads
	Pipe Diameter	Display the pipe diameters
	Pipe Length	Display the pipe lengths
	Pipe Flow	Display the Flow in the pipes
	Pipe Friction Loss	Display the friction,or, fixed loss in the pipe
	Pipe Velocity	Display the water velocity in the pipes

Editor Modes

The on screen editor has three modes, Selection, Add Node, and Add Pipe. To enter, or change to, a mode click on the corresponding button on the button bar.

Selection Mode : In selection mode you can select previously draw items, either by clicking on them, or dragging a box around them. Selection of multiple items is accomplished by holding down the Shift key while clicking.

Selected nodes can be moved, deleted, or have their attributes changed while in the Selection mode. Note that you cannot delete a node that has a connect pipe. You must first delete the pipe.

Pipes can be deleted, or have their attributes changed in the Selection mode.

Selected items can be edited by entering data in the attributes bar and clicking on the red check box for either the nodes, or the pipes.

Add Node Mode : In Node mode nodes (hydraulic points and operating sprinkler heads) are placed on the screen.

First enter the attributes of the node into the appropriate boxes on the node attribute bar, and then click on the screen where you want the node to appear.

Symbol	Node Type
	Operating Sprinkler Head
	Hydraulic Point
	Fixed Flow Point
	Shortcut to a real hydraulic point
	Source Node

Add Pipe Mode : In Pipe Mode pipes are drawn connecting existing nodes.

First enter the attributes of the pipe into the appropriate boxes on the pipe attribute bar. Next drag a line between the two nodes to be connected with the pipe.

Note you cannot draw a pipe unless a diameter, a length, and a C factor are entered in the attributes bar.

Lengths

Lengths may be entered in decimal format (e.g 10.5), or in feet and inch format (e.g. 10-6). Lengths are stored and displayed in decimal format

Example:

Enter	Resulting Length
10-1 (10 feet 1 inch)	10.08
10-4 (10 feet 4 inches)	10.33
10-11 (10 feet 11 inches	10.88
10.5 (10.5 feet)	10.5

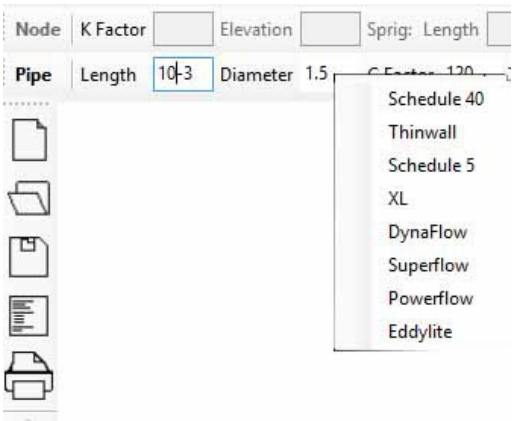
Diameters

Diameters may be entered as an actual inch dimension, or entered as a nominal followed by a suffix (e.g. to enter 1.5 inch thinwall enter 1.5T. An actual value of 1.682 will be displayed).

Allowable suffixes

S	Schedule 40
T	Thinwall
L	Schedule 5
X	XL
D	DynaFlow
U	Superflow
P	Powerflow
E	Eddylite

As an alternative, the nominal diameter can be entered, and the context menu brought up (right-click) to get the actual diameter.



This shortcut does **not** work in the table editor.

Cut, Copy, & Paste

The Windows shortcut keys work in the graphic editor
Control- C - copy the selected to the clipboard without affecting the original
Control- X - copy he selected to the clipboard discarding the original
Control- V - Past the clipboard to the cursor posistion

Note you cannot paste a pipe without end nodes. If you try to paste a single pipe it the pipe's metrics will be copied into the pipe metric bar and the edit mode will change to Pipe Mode. You can then do a normal drag betwee two nodes to add a pipe with the smae metrics asthe copied pipe.

For consistancy this same action holds true if you copy a single sprinkler/hydraulic point, The points metrics will be placed in the node metic bar and the edit mode change to Node Mode.

Grouping Elements (Pipes and Hydraulic Points)

Pipes, heads, and hydraulic points are grouped by selecting the elements, right clicking, and choosing "Select Group". After elements are grouped the group can be selected by selecting any element in the group

Once groups are created they may be aligned (left/right or top/bottom) to each other. Note that groups can only be aligned to other groups and not to individual nodes.

Grouping elements has no effect on the calculations.

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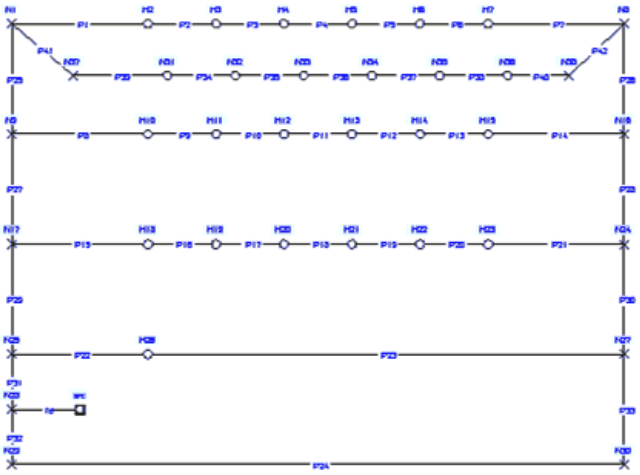
Shortcuts

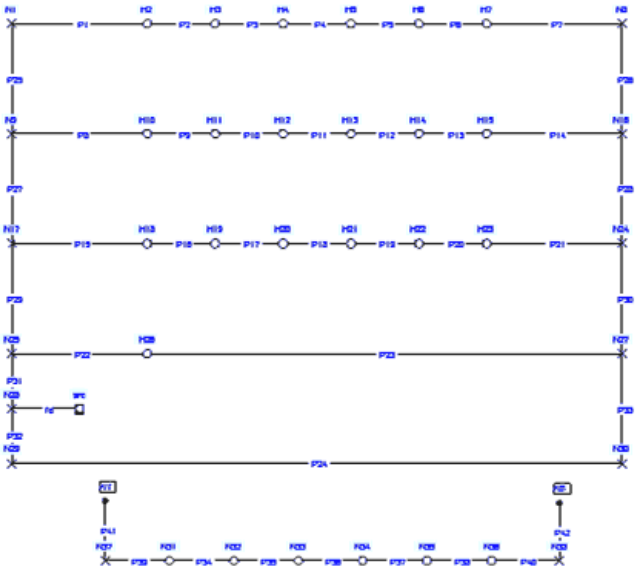
Shortcuts are specialized nodes that point to a normal node in the system. They serve no hydraulic purpose, and are provided as a mechanism to clean up a crowded schematic.

To create a shortcut first place a normal node on the screen. Next select it, and then right click to bring up the context menu and select "Node to shortcut". A dialog box will appear asking the ID of the node to be linked.. That is it.

Example: A grid with one level of looped in-racks calculated



Can be displayed like this with shortcuts to N7 and N8



Merge Nodes

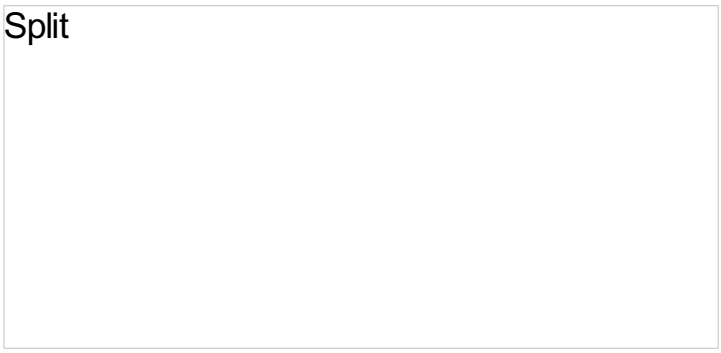
Two nodes may be merged into one node by simply selecting a node to be merged, and dragging it on top of another (target) node.

The merge node will be retained and the target node will be eliminated. All connections to the merge and the target node will be retained.

Splitting a Pipe

A pipe may be split adding a new hydraulic point. This action by itself will not affect the hydraulic calculations.

To split a pipe, select the pipe and right click to bring up the context menu. Select Split Pipe, this dialog will be displayed.



In this example Pipe P33, connecting nodes N5 and N34, will be split into two pipes and a new hydraulic point added.

Fixed Pressure Loss Device

Pipes may be edited to account for fixed pressure loss devices such as valves and backflow preventers.

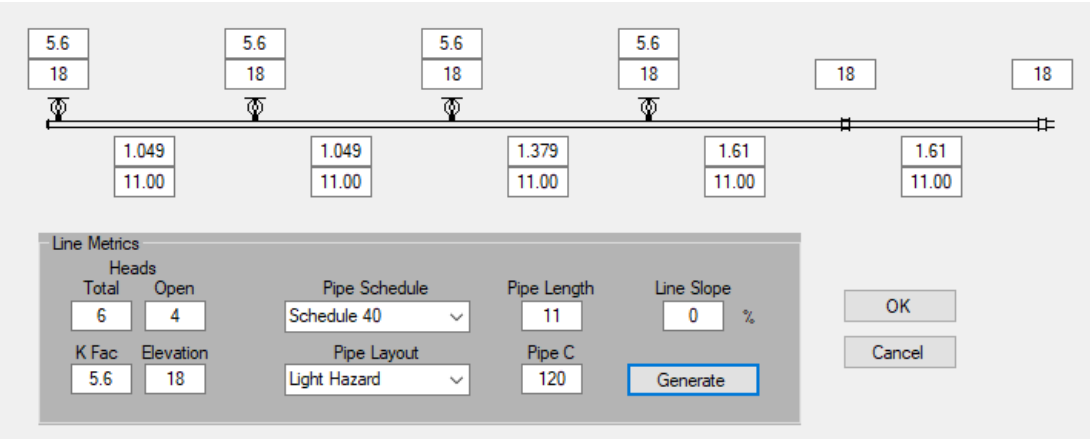
To change a pipe to a fixed pressure loss device select it, enter the pressure loss in the fixed pressure loss box and click on the red check mark  .

Note the program will set a diameter of 99 to all fixed pressure loss devices. This is neccessary for some internal error checking - DO NOT CHANGE IT.

Line of Pipes

Enter Line of Pipes

This dialog allows the entry of a formatted branch line of pipes. When the data is entered clicking on "Generate" will display the line of pipes, and thier attributes. These attributes an then be edited to tailor the final result. Clicking "OK" will copy the pipes to the editor.

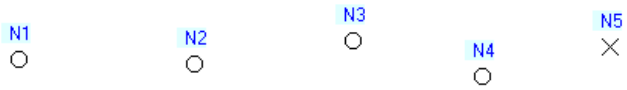


Drawing a System Example

To draw a system on the screen first place nodes (heads) on the screen, then connect the nodes with pipes, and finally designate a node as the Source.

Example: First click on the node mode button â€“ this will darken to indicate you are in the node mode

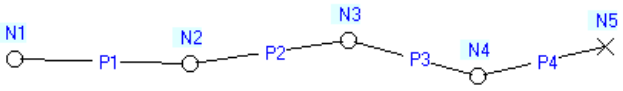
To place an open sprinkler head first enter the data into the Head K and Head Elevation boxes before clicking on the screen. An open sprinkler head will be shown as a circle, a hydraulic point will be shown as an X. To enter a hydraulic point (or non-operating sprinkler head) set the Head K to 0 before placing it on the screen. A sprinkler line with four (4) operating heads would be entered like this



This shows 4 operating heads (N1, N2, N3, & N4) and a hydraulic point (N5).

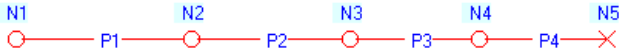
To next connect the nodes with pipes first click on the pipe mode button. This will darken to indicate you are in the pipe mode.

Enter the pipe metrics into the boxes. If you do not enter a pipe diameter, length and C factor the program will not allow you to draw a pipe. Next click on a node and drag a line to the connecting node.

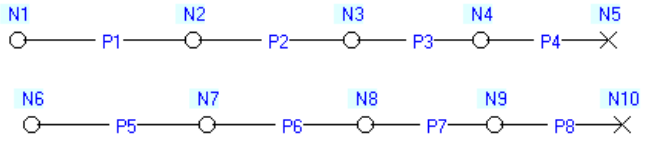


It is preferable, although not necessary, to draw the pipe in the direction of flow. In this example drawing from N5 to N4, N4 to N3, N3 to N2, and N2 to N1 would be the preferred order. Not drawing in the direction of flow *does not affect the calculations*, but will show a negative flow on the schematic.

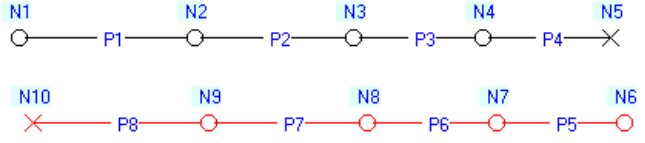
To align the nodes drag a box around the desired nodes, they will indicate they are selected by displaying in red. Next bring up the context (popup) menu by right clicking on the screen. Select "Align Nodes - Bottoms" and the nodes will be aligned.



It is, of course, possible to keep dropping heads on the page and connecting them with pipes, and if you have a non-symmetrical system it may be the only way to complete it. However, most systems are generally symmetrical, and it is easier to copy and paste the line of heads to create a system. For the example assume this is a center feed symmetrical system. First make a copy of the sprinkler line - In Select Mode drag a box around the pipes/nodes you want to copy and press Control-C. Click on the screen where you want to drop the new line and press Control-V.

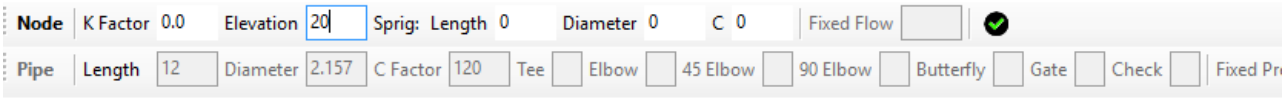


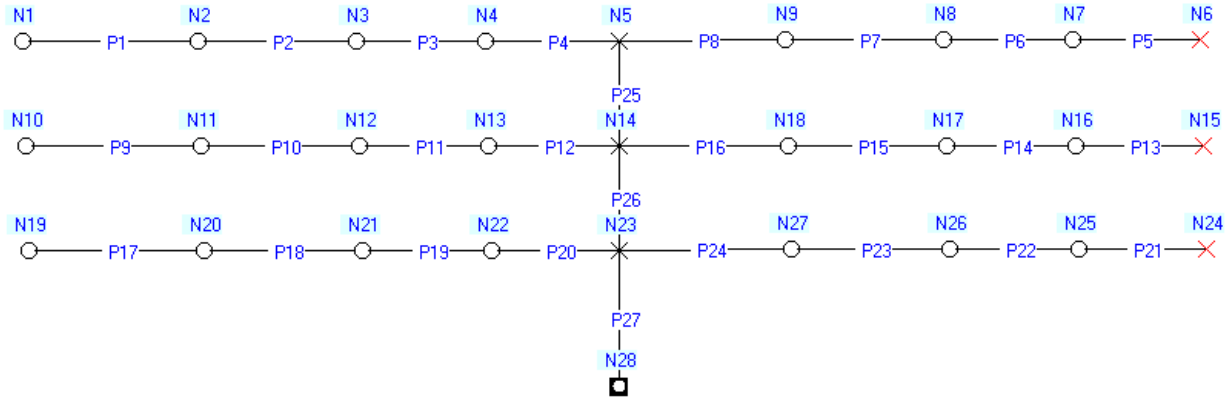
If this was a side feed system the process could be continued until the desired number of branch lines were created. This example is a center feed system and the right side of the branch line needs to be created. Again, it would be simple to add the nodes and pipes manually, but in a symmetrical system it is easier, and faster, to simply flip one of the lines of pipes to make a mirror image. To do this select the desired line, right click for the context menu, and select Flip Line (horizontal).



The last step in creating the center feed branch line is to drag the selected line to connect to the other side. With the line selected, drag node N10 on top of N5. The nodes will merge forming a center feed line.

To complete the system, use Using the Select, Copy and Paste methods to duplicate the line two times. Then connect the center hydraulic points with pipes, and add a hydraulic point for the source node.





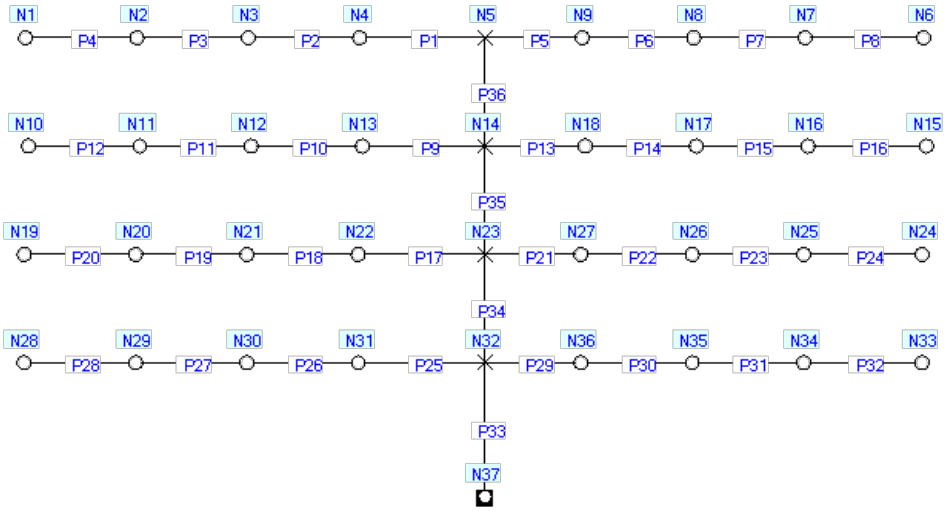
The system can then is edited to add fittings to pipes, turn off sprinkler heads, add sprigs, etc. See the Editing a System section for more information.

Editing a System Example

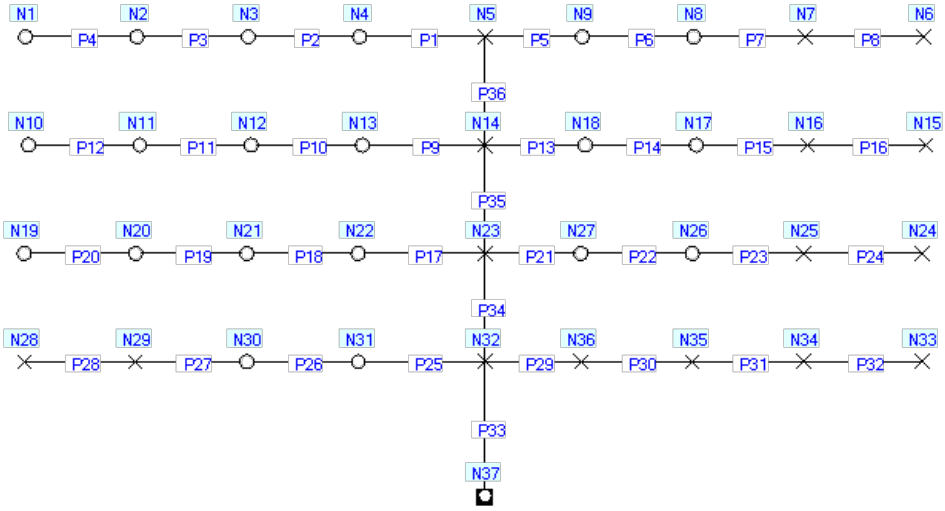
The editor has many functions to allow fine tuning of an entered system

Example

For an example start with this created system



The first thing to be edited is the number of open heads. In this example we want to open 20 heads (3 lines of 6 and 1 line of 2). To do this will take 3 edits. First drag a box around the 2 heads to the far right on each line (N6, N7; N15, N16; N24, N25; N33, N34). In the K factor box enter a zero(0). Click on the red check box on the node line and the heads will be “turned off”. Repeat this procedure selecting nodes N35 and N36, and again Nodes N28 and N29. The resulting schematic should look like this.

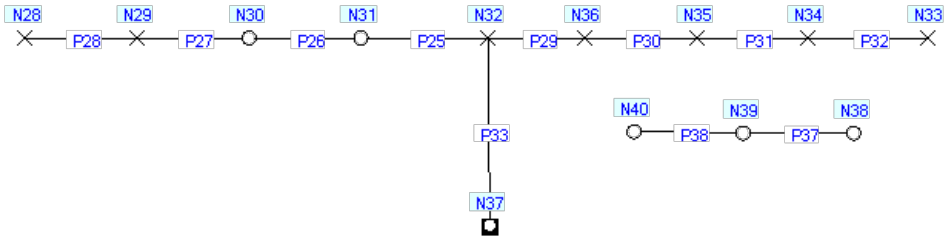


The next issues in this example are the “tail pieces” pipes P1, P5, P9, P17, P25, & P29. I entered them as having the same length as the other pipes, and they are only half the length, plus they have a Tee fitting that I neglected to add (this edit would not be necessary if the pipes had been entered correctly).

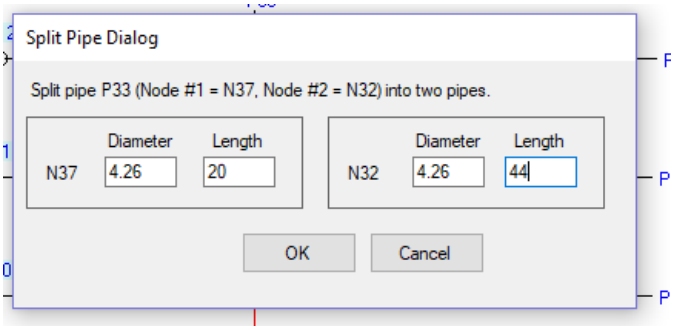
To make this edit select pipe P1, and holding the Shift key down click on each of the other desired pipes. Enter the new length in the Pipe length box, and enter a 1 in the Tee box.

Click on the red check and the edit will be complete.

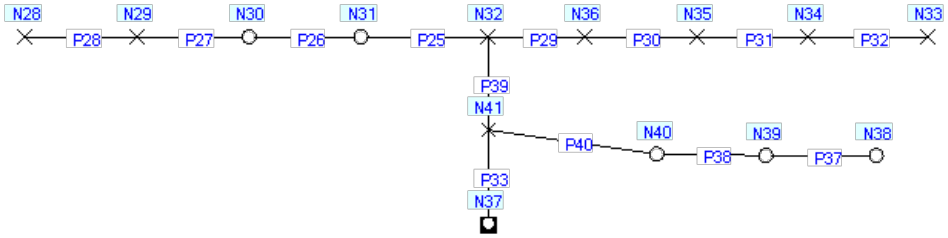
The last edit in this example is to add a line of in-rack sprinklers. First draw the line of in racks – for the example/brevity only three heads are being entered.



The next step is to add a connection point on pipe P33. To add a connection point split the pipe. Select the pipe, bring up the context menu, and select split pipe, and enter the correct metrics for the two pipes.



The last step is to connect the in-rack sprinklers to the new connection point.



Important things to remember are:

- This is not a scaled drawing – moving a point does not affect the dimension of the system

- When editing, boxes left blank in the attributes bar will be ignored, but entering a zero will change the attribute of the selected item(s) to zero.

Program Calculations

Calculation can be accomplished with or without a water supply. If a water supply is provided the program will compare the demand to the supply iterating to within 1 gpm at the supply point.

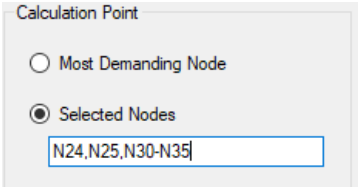
Calculation to a density is provided in the QuicKalc calculations. this is possible becasue the generated system has a known area per head of coverage. The main calculation box does not have this information and provides only calculation to an end head pressure, or a minimum flow. However, a minimum pressure can be calculated from a density by right clicking on the pressure box and useing the "Density to Pressure" tool.

Calculation to the Water supply can be done with the Hose Allowance included, or without it. this calculation returns the intersection of the demand curve and the supply curve (with, or without hose allowance).

Calculation to Selected Nodes

By default calculation determine the most demanding node (sprinkler head) and compare the desired flow/pressure to that node. Sometimes it is desirable to ignore the most demanding node and compare the design to a specific node. This most often occurs when calculating in-rack sprinklers. Occasionally the minimum design for the overhead sprinklers will not provide enough flow to meet the in-rack sprinkler design. To calculate at a specific point choose the Selected Nodes option as the Calculation Point, and enter the node(s) to be verified.

This example will check nodes N24, N25, and the nodes in the range N30 to N35.



Grid Peaking

Generated grids place the operating sprinkler heads in the center of the grid. To have the program peak the calculations, and move the area to the most demanding point, check the "Peak" checkbox either in QuicKalc, or in the calculation dialg box.

Note that peaking is only available for generated system. The program cannot determine which pipes to adjust in a manually entered system.

QuicKalc

The QuicKalc routine can be used to generate a symetrical tree or grid system. Calculations may be run from within QuicKalc, or the generated system can be modified in the editor to provide for more exact system metrics and calculations..

The screen is broken into a number of panels; System Metrics, Tree/Grid, C Factor, Design Factor, and Feed Pipe. Required data is as follows

System Generation

System Metrics

Head/Line distance: The horizontal distance between sprinkler heads and sprinkler lines

Head Elevation: The vertical distance between the sprinkler heads and the Source Node.

Head K Factor: The operating heads K factor

Branch Line Count: The total number of sprinkler branches between the end of the system and the Feed Pipe (inclusive).

Tree

System Layout: QuicKalc can only generate tree systems that are laid out using one of the NFPA standard layout schedules. A drop down selection is provided to choose the correct schedule.

Heads Left/Right Side: Enter the TOTAL heads on each side of the branch line. Do NOT try to calculate the number of open heads - enter the total heads. QuicKalc will open the proper number of heads based on the design area.

Riser Nipple: If a riser nipple is provided to elevate the branch line above the cross main enter the length of the riser nipple

Grid

Near/Far/Branch Line Diameters: Enter the NOMINAL diameter of each component. The actual diameter will be calculated from the Schedule drop down selection box.

Heads Per Branch: Enter the TOTAL number of heads on a single branch line. . Do NOT try to calculate the number of open heads - enter the total heads. QuicKalc will open the proper number of heads based on the design area.

Feed Entry: The program numbers the branch lines internally starting at 0. Enter the number of the branch line just above the feeed entry into the grid (e.g. if the feed enters between lines 8 and 9 enter 8). If you do not make an entry into this box the program will automatically assume the feed enters in the bottom corner of the near side.

Riser Nipple: If a riser nipple is provided to elevate the branch line above the mains, enter the length and nominal diamter of the riser nipple.

CMSA/ESFR Layouts: Selecting one of these will adjust the open head layout to meet the NFPA requirements.

Pipe Schedule: Select the type of pipe used in the system. The 10/40 split schedule will use Schedule 40 pipe for all pipe 2" and less in diameter and Schedule 10 pipe for all other.

Feed Pipe

Enter the lengths of the feed pipe to the Source node. For a tree system this is the main pipe from the last branch line to the base of the riser. For a grid system it is the pipe from the grid to the base of the riser. The program accepts multiple entries so you can make entries in all 4 pipe sizes. Note that at least one entry must be made for the system to generate/calculate.

Area Factor

NFPA 13 specifies that an area design factor of 1.2 be used to design the operating area. However, some specifying entites require a more conservative, 1.4, factor be used. QuicKalc gives you the option of either

factor.

Calculations

Design

For "standard" spray sprinkler control mode designs the screen will ask for a design area and either, a design density, or a minimum end head pressure. For a CMSA, or ESFR systems the design will ask for the number of open heads and a minimum end head pressure.

Water Supply

This entry is optional. To enter a hydrant test enter the static pressure and the flow data in Point #1. To enter a pump test enter the discharge data from the pump test in the Static, Point #1 and Point #2 boxes.

Results

The results will include a calculated demand point and, if a water supply is provided, a pressure safety factor. Also, if a water supply is entered, it will return an estimate of how the system will perform with the available water supply.

Warnings are provided for designs that have pipe velocities greater than 32 fps, and head pressures less than 7 psi.

Hydraulic Graph

The hydraulic graph is generated by the calculation routine and is not editable in The-ASP. It can be copied to the clipboard (Cntrl-A, Cntrl-C) and edited in any program that will edit vector based drawings (Paint, Word, Visio, Gimp, etc).

The graph automatically scales to fit the data. If this produces an unaceptable presentation, right click to bring up the context menu and change the scaling of the graph.

Version 6

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