

Pipe Sizing

The **Pipe Auto Size option** allows a network of Pipes and or Channels to be given an initial sizing to ensure that they meet the requirements specified in the Pipe Sizing Criteria.

Note: Use of Auto Size is optional, if the levels and sizes are known they can be entered directly.

The auto size process is completed based on the **Pipe Sizing Criteria** specified for the phase. Some aspects, such as Minimum Cover Depth, Velocity and Slope are optional and will only be used if turned on. However the auto sizing engine will always look to ensure that a pipe/channel has sufficient capacity to take the calculated flow. Equally the Design Level will be applied to align pipe/channels to one another.

Initiating a Pipe Sizing

An Auto sizing is completed along a **Flow Path** using the **Network** that is constructed. This is initiated in one of two ways:

- Right-Click on the Flow Path on the Tree view and select 'Auto Size'.
or
- Select the desired Flow Path on the Connections form and select 'Auto Size'.

Note: The use of the Auto Size on the Connections form will not be committed until the 'Apply' or 'OK' button are pressed to confirm the changes. This can be useful if you wish to see the effects of Auto Size without changing the model. i.e. Click on 'Cancel'.

Auto Size Calculations

Pipe sizing will begin at the head of the Flow path selected, which acts as the mainline. Typically the head of a Flow Path will normally be an Inflow (Area or Hydrograph). It will then move down each Pipe /Channel in the network sizing the pipe/channel in turn. This is completed as follows:

1. **Set Initial dimensions for Pipes/Channels** - To ensure that the smallest possible size is considered the dimensions of the pipe/channel will be set to a suitable minimum before starting:
 - a. **Pipe** - The diameter is set to the Smallest pipe size in the Pipe Size Library.
 - b. **Rectangular/Trapezoidal Channel** - The Base Width is set to 600mm.
 - c. **Triangular Channel** - The Height is set to 0.2m as this is the dimension that is adjustedNote: These are the dimensions that are adjusted to increased when up-sizing the pipe/channel.
2. **Establish Total Area & Base Flow** - The Inflows contributing to each connection will be summed as the calculation moves down the network to establish the totals used for sizing:
 - a. **Area/Roof Area** - Depending on which Runoff Method the contributing area will be established as:
 - i. **Area Inflow:**
 1. **Time of Concentration** - Area * Runoff Coefficient
 2. **Time Area Diagram** - Total Area of Time Area Diagram
 3. **FSR/FEH/SCS/Laurenson** - Area
 - ii. **Roof Area:**
 1. **Time of Concentration** - Area * Proportion Drained
 2. **Time Area Diagram** - Total Area of Time Area Diagram
 3. **Green Roof** - Area * Proportion Drained
 - iii. **Hydrograph** - The peak flow of the Hydrograph will be considered as a base flow.

Note: Where there are multiple upstream branches the totals of all branches will be combined for the downstream pipe/channel totals.
3. **Determine Travel Time & Rainfall Intensity** - The Travel Time is calculated as the Min. Time of Concentration from the **Pipe Sizing Criteria** + The Travel Time through the Upstream connections. The time of travel for a given connection is calculated using the Velocity of flow under full bore conditions and the length of the connection. The travel time is then restricted to the Max. Travel Time from the Pipe Sizing Criteria which helps to prevent intensities dropping too low in a large network.
The Rainfall Intensity is determined from the IDF data, specified on the **Pipe Sizing Criteria**, based on the Travel Time for the given connection.
4. **Determine Flow** - The selected Calculation Method on the Pipe Sizing Criteria will then be used to establish the flow that the pipe/channel must have capacity to convey.
 - a. **Rational Method:** Flow = Rainfall Intensity x Total Area + Total Base Flow
 - b. **(UK) Modified Rational Method:** Flow = Rainfall Intensity x Total Area * Cr(1.3) + Total Base Flow
5. **Adjust dimensions to ensure Capacity and Min. Velocity/Slope (if needed)** - The auto size calculation will then adjust the pipe/channel dimensions to ensure that it has sufficient capacity to take the calculated flow. If the Pipe/Channel does not have capacity it will be up-sized:
 - a. **Pipe** - The next pipe size from the entered Pipe Size library will be selected. if the largest pipe in the file is not big enough for the flow then the program will continue



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Workflow - What's next...?



Connect Inflows to your **Stormwater Control**, specify **Inlets** or **Outlets** or connect to another Stormwater Control or **Junction**.

based on the Additional Increment specified (75mm by default) until sufficient capacity is reached.

b. Rectangular/Trapezoidal Channel - the base width is increased by 100mm.

c. Triangular Channel - The Height is increased by 20mm.

If the **Minimum Slope** is being used the software will set the slope of each pipe/channel to the minimum selected and will then adjust the slope to try and find a slope that gives enough capacity. If the connection gets too steep (>1:10) the software will then up-size the pipe and start again.

If the **Minimum velocity** is being used the software will ensure that the pipe/channel has at least that velocity during the sizing. This will prevent the software selecting a wide flat section instead of increasing the slope to generate a suitable velocity on a smaller pipe/channel.

6. Apply Design Level and Min. Cover Depth (if needed) - Once the pipes/channels have been sized the Auto Size calculation will then look to adjust the levels of the connections so that they meet the design level options selected:

a. Level Inverts - The calculation will align the Upstream Invert Level of the connection being sized to the Downstream Invert level of the upstream connection.

b. Level Soffits (Pipes only) - The calculation will align the Upstream Soffit Level of the connection being sized to the Downstream Soffit Level of the upstream connection. This will result in 'steps' in the sections as the pipe sizes increase, but can be desired in some circumstances.

Note: Where there are multiple upstream connections, i.e. branch lines, the software will use the lowest upstream level.

If the **Minimum Cover Depth** is being used the calculation will ensure that the depth from the cover level to the soffit is at least the value entered. However this only applies to Pipes as Channel "soffits" are seen as aligned to the surface.

Note: It is therefore important to ensure that the cover level for each connection is present to avoid the whole network being dropped to suit an invalid level. 0m is considered a valid level for the purposes of sizing.

Locked Pipe/Channels

it is possible to lock a Pipe/Channel to prevent it being sized, by toggling the Auto Size setting (hidden by default) on the Connections form for a given connection(s). When the Auto Size calculation encounters this it will not adjust the dimensions of that connection. The Area and Base flow totals will still be determined and passed downstream and the downstream connections will still be aligned to the locked connection.

Connections without dimensions

The Auto Size calculation cannot size a connection if it does not have dimensions so it will be bypassed. In the same way as a Locked pipe/channel the software will still establish the total area and base flow so that this can be carried forward. It is however not possible to align the downstream connections against it so the previous upstream connection will be used instead.