

# How to use the ACO Link Type Causeway Flow File



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## 1.0 Introduction

ACO Linear Drainage Channels can be modelled in Causeway Flow using the ACO Link Type File “ACO Causeway Flow Channel Link Types V1.3.pfd.” Modelling linear channels as part of an overall site drainage network can often provide significant value engineering opportunities, especially when using larger capacity systems, typically resulting in reduced attenuation requirements or even eliminating the need for separate attenuation altogether.

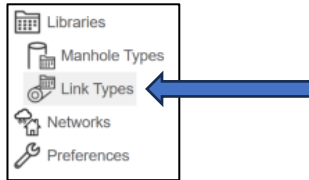
Linear channels by their nature take continuous lateral inflow along their length, which is very different from point drainage systems where surface water runoff enters the system at specific points or nodes.

Catchment area intake into a linear drainage channel can be modelled in Flow in two ways. Firstly, for a simplistic analysis the contributing catchment area draining into the channel along its length can be entered as single lateral inflow, by setting the insertion point to 50% (i.e. on average the inflow entering the channel travels along 50% of its length). If the catchment area draining to the channel is not uniformly distributed along its length, the insertion point can be altered accordingly. This can give a reasonable approximation within the model, although it is limited in terms of fully utilising the benefits of a linear drainage channel.

However, a more detailed analysis can be undertaken by splitting the channel length (Link) into a number of smaller sections and assigning the relevant proportion of contributing catchment area to each Link. Whilst this is more complex to model, it will provide a better representation of the proposed drainage network, spreading the flow more evenly across the channel, and better utilising all the available capacity within the channels for optimisation and maximise efficiencies.

## 2.0 Viewing the ACO Link Types, Properties and Groups

The ACO Link Type file contains the profiles of all ACO Civils and Infrastructure Linear Drainage Channels and Combined Kerb Drainage systems. These can be viewed by clicking on the “Link Types” tree heading, under “Libraries” on the left-hand side menu:



Once selected, you will see the full product range of all ACO Channel types and sizes displayed with a scroll bar to the right:

Name
● ACO H Range RD150V 10.0
● ACO H Range RD150V 20.0
● ACO H Range RD200V 0.0
● ACO H Range RD200V 20.0
● ACO H Range RD300V
● ACO MultiDrain M100D 0100
● ACO MultiDrain M100D 0.0
● ACO MultiDrain M100D 10.0
● ACO MultiDrain M100D 20.0
● ACO MultiDrain M100D 30.0
● ACO MultiDrain M150D 0100
● ACO MultiDrain M150D 0.0
● ACO MultiDrain M150D 10.0
● ACO MultiDrain M150D 20.0
● ACO MultiDrain M200D 0100
● ACO MultiDrain M200D 0.0
● ACO MultiDrain M200D 10.0
● ACO MultiDrain M200D 20.0
● ACO MonoDrain PD100D 0.0
● ACO MonoDrain PD100D 10.0
● ACO MonoDrain PD100D 20.0
● ACO MonoDrain PD100D 30.0
● ACO MonoDrain PD150D 0.0
● ACO MonoDrain PD150D 10.0
● ACO MonoDrain PD150D 20.0
● ACO RoadDrain PD100F 10.1
● ACO RoadDrain PD100F 20.1
● ACO RoadDrain PD100F 30.1
● ACO RoadDrain PD100F 40.1
● ACO RoadDrain PD100F 50.1
● ACO RoadDrain PD200F 10.1
● ACO RoadDrain PD200F 20.1
● ACO RoadDrain PD200F 30.1
● ACO BridgeDeck HB100 (125mm upstand)
● ACO BridgeDeck HB160 (125mm upstand)

Selecting any of the specific channel sizes will display its properties including cross section, for example clicking on ACO Qmax 900 shows the following:

The screenshot displays a software interface for configuring channel properties. On the left, a list of settings is shown, including Shape (Closed User Defined), Barrels (1), Height (mm), Width (mm), Side Slope (1:X) (n/a), Auto Increment (mm) (10), Preferred Cover (m) (0.253), Steep Slope (1:X), Follow Ground (checked), Velocity (Manning), and ks (mm) / n (0.018). In the center, a table titled 'Cross-section' provides data for various depths and widths. On the right, a graph shows the cross-section of the channel, which is a semi-elliptical shape.

Depth / Total	Width / Total
0.000	0.000
0.010	0.114
0.020	0.158
0.030	0.191
0.040	0.217
0.050	0.238
0.060	0.256
0.070	0.272
0.080	0.286
0.090	0.301
0.100	0.315
0.110	0.328
0.120	0.341
0.130	0.354
0.140	0.367
0.150	0.379
0.160	0.391
0.170	0.403
0.180	0.414
0.190	0.425
0.200	0.436
0.210	0.446
0.220	0.456
0.230	0.466
0.240	0.475
0.250	0.485
0.260	0.494
0.270	0.503
0.280	0.511
0.290	0.519
0.300	0.527
0.310	0.535
0.320	0.543
0.330	0.550

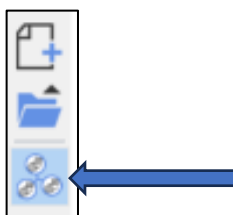
All settings have been defined to match the specific ACO channel selected.

You will note that a **“Preferred Cover (m)”** has been set, which allows for the appropriate channel grating/slot depth above the open conduit profile.

**“Follow Ground”** has also been checked, which means the channel will always be laid at the same gradient as the ground level, irrespective of the velocity that it produces.

The **“ks (mm) / n”** values have been populated based on the channel material properties using appropriate Mannings n value for either polymer concrete or polyethylene (as appropriate).

The ACO channels have been further arranged into **“Link Type Groups.”** When a specific Link Type Group is selected for a Link, the software will assess each of the channel sizes within the group until it finds a channel size that can take the required flow, based on the design settings. The ACO channel Link Type Groups can be viewed by clicking on the **“Display Link Type Groups”** button, just to the left of the channel list:



From here it will display all of the Link Type Groups and when a Group is selected you will also see all of the Link Types that are contained within that Group:

Name
● ACO H Range RD 150V
● ACO H Range RD 200V
● ACO MultiDrain M100D
● ACO MultiDrain M150D
● ACO MultiDrain M200D
● ACO MonoDrain PD100D
● ACO MonoDrain PD150D
● ACO RoadDrain PD100F
● ACO RoadDrain PD200F
● ACO KerbDrain HB D400 - E600 (High Capacity)
● ACO KerbDrain SP D400
● ACO KerbDrain HB E600
● ACO BridgeDeck HB (125mm upstand)
● ACO BridgeDeck HB (100mm upstand)
● ACO BridgeDeck SP (100mm upstand)
● ACO BridgeDeck SP (75mm upstand)
● ACO S Range S100
● ACO S Range S150
● ACO Qmax

**Link Types in group**


- ACO Qmax 150
- ACO Qmax 225
- ACO Qmax 350
- ACO Qmax 550
- ACO Qmax 700
- ACO Qmax 900

### 3.0 Adding the ACO Link Types in a network model

Ideally you should start by opening the ACO Link Type file and use this file to create your network model from. If you want to use ACO Link Types in an existing network model you’ve already created, you should copy and paste the specific channel(s) parameters from the master Link Type file into the Link Types of your existing Flow model file.

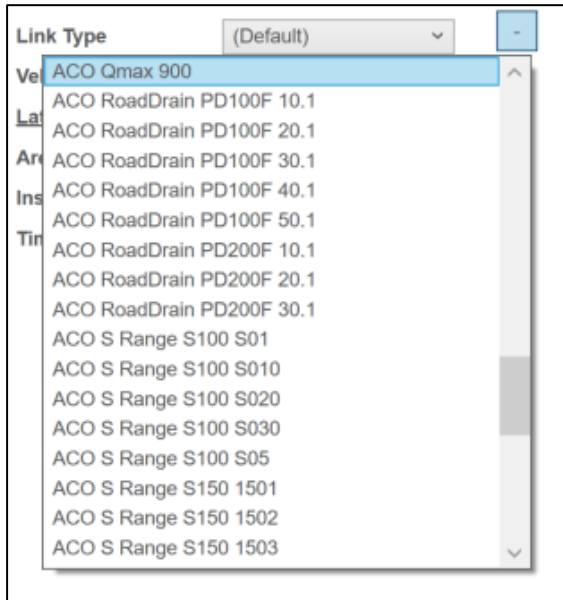
It is recommended that you create your network model with all other elements first (e.g. pipes, manholes, junctions etc), and then add the linear channels at the end. The main reason for this is that linear channels are typically installed flat or with minimal gradients, and will follow the ground level, therefore it is helpful to switch off “Enforce best practice design rules” in the design settings to ensure the software doesn’t treat them in the same way as a pipe:

<b>Rainfall Methodology</b>	FSR	<b>Note:</b> FSR rainfall parameters are available from the surface water storage volume estimation tool at <a href="http://www.uksuds.com">www.uksuds.com</a>
<b>Return Period (years)</b>	1	
<b>Additional Flow (%)</b>	0	
<b>FSR Region</b>	England & Wales	
<b>M5-60 (mm)</b>	20.000	
<b>Ratio-R</b>	0.430	
<b>CV</b>	0.750	
<b>Time of Entry (mins)</b>	5.00	
<b>Maximum Time of Concentration (mins)</b>	30.00	
<b>Maximum Rainfall (mm/hr)</b>	50.0	
<b>Minimum Velocity (m/s)</b>	1.00	
<b>Connection Type</b>	Level Soffits	
<b>Minimum Backdrop Height (m)</b>	0.200	
<b>Preferred Cover Depth (m)</b>	1.200	
<b>Include Intermediate Ground</b>	<input checked="" type="checkbox"/>	
<b>Enforce best practice design rules</b>	<input type="checkbox"/>	

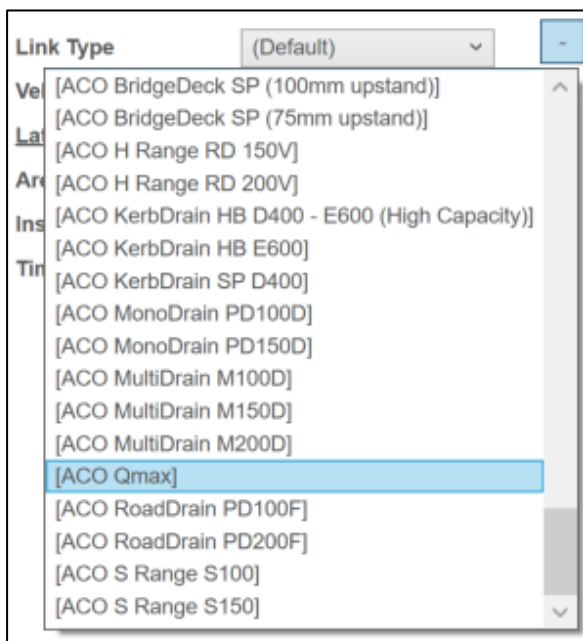
Linear channels are defined in a similar way to the rest of the network in a model using Nodes and Links. When you create the Link for a channel, clicking on the  button in the top left-hand corner of the Links page opens up the Extended Properties menu:

<b>Link Type</b>	(Default)
<b>Velocity</b>	(Default)
<b>Lateral Inflow</b>	
<b>Area (ha)</b>	
<b>Insertion Point (%)</b>	50
<b>Time of Entry (mins)</b>	

Clicking in the “Link Type” selector will then allow you to choose from any of the available Link Types from the file. The first part of the list contains the individual channel Link Types, enabling a specific ACO channel type and size to be selected, e.g. ACO Qmax 900 for example:



As you scroll further down the list you can select from the Link Type Groups, which are shown in square brackets [ ], allowing you to choose the ACO channel range without specifying a specific channel size, e.g. ACO Qmax Range. (Note: When choosing the Link Type Group, the software will select the smallest channel size that can take the required flow, based on the design settings – this will likely need to be reviewed and modified later when analysing the network for storm criteria such as 1 in 30 and 1 in 100 year return periods).

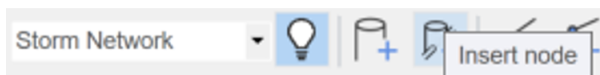


Once a channel Link Type or Group is selected you can then add the catchment area (ha) that will be draining into the channel section, as well as insertion point (%) and Time of Entry (mins) if required (Note: Velocity should be left as “Default” as this value will be taken from the Channel Link Type properties already defined):

Link Type	ACO Qmax 900
Velocity	(Default)
<b>Lateral Inflow</b>	
Area (ha)	<input type="text"/>
Insertion Point (%)	50
Time of Entry (mins)	<input type="text"/>

As mentioned within the Introduction section, splitting each channel length into smaller sections with associated catchment area inflows will result in a more optimal analysis that best utilises the full capacity of the proposed channel system.

If using Sketch you can split a Link down into smaller sections by clicking the Insert Node button in the ribbon bar at the top.

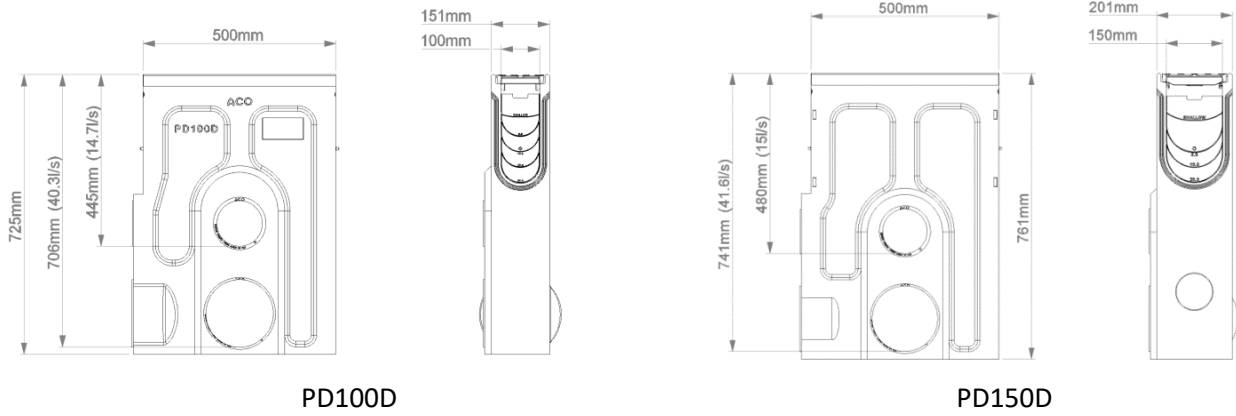


This then allows you to select an existing Link and insert additional Nodes within it to subdivide it down into smaller sections.

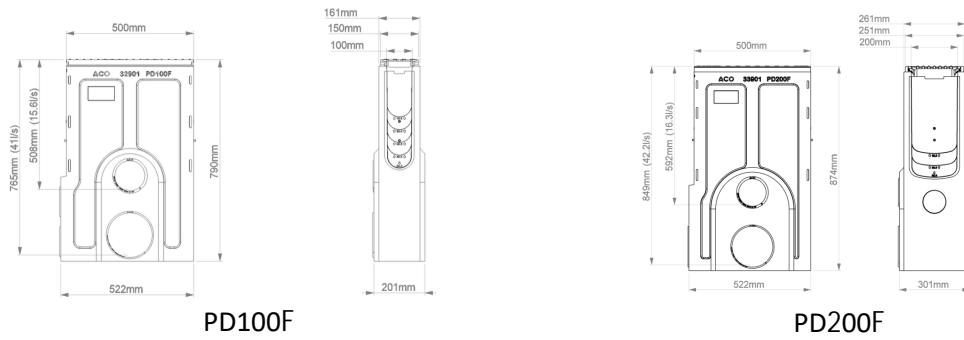
For linear channels we suggest that Nodes are defined as Manholes, as these are allowed to flood in Flow, whereas Junctions between Closed Link Types cannot. For channel connections, the Manhole Nodes should be sized to match the channel widths, lengths and depths in order to avoid the introduction of any additional storage. For channel outlets (sumps and gullies) the Manholes should be sized accordingly to match the dimensions of the specific outlet based on the ACO Channel Outlet Diagrams that follow.

## 4.0 ACO Channel Outlet Diagrams

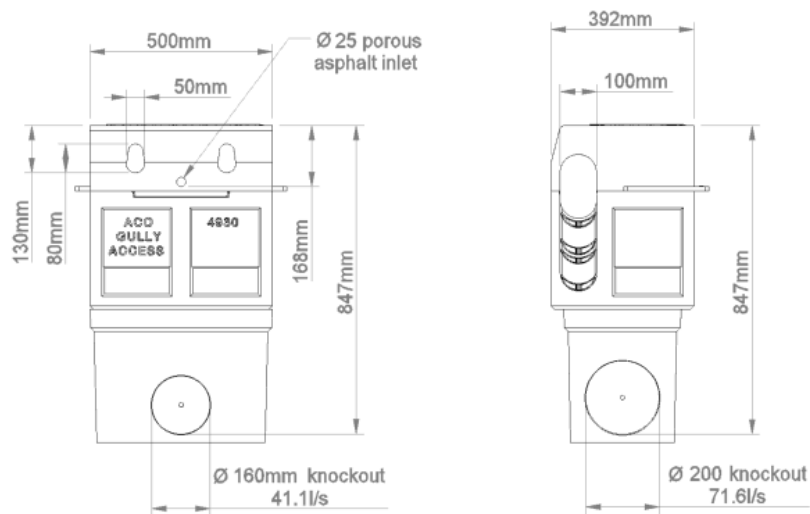
### ACO MonoDrain



### ACO RoadDrain

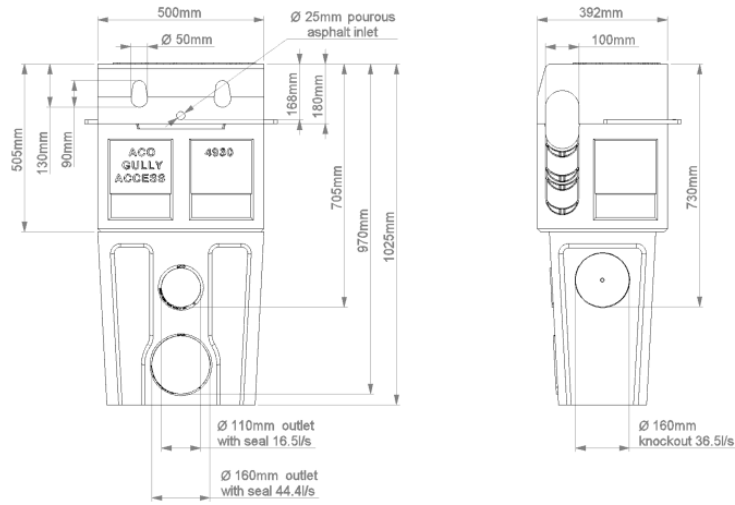


### ACO KerbDrain D 400

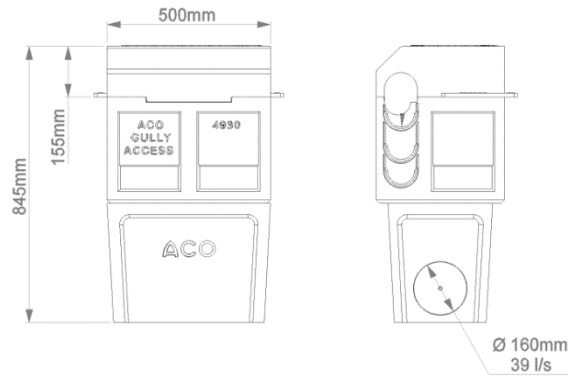


HB Shallow Base

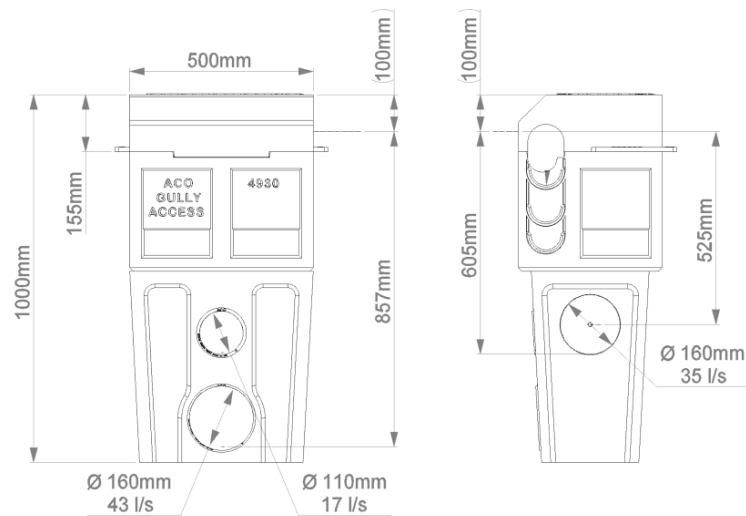
### ACO KerbDrain D 400



HB Deep Base

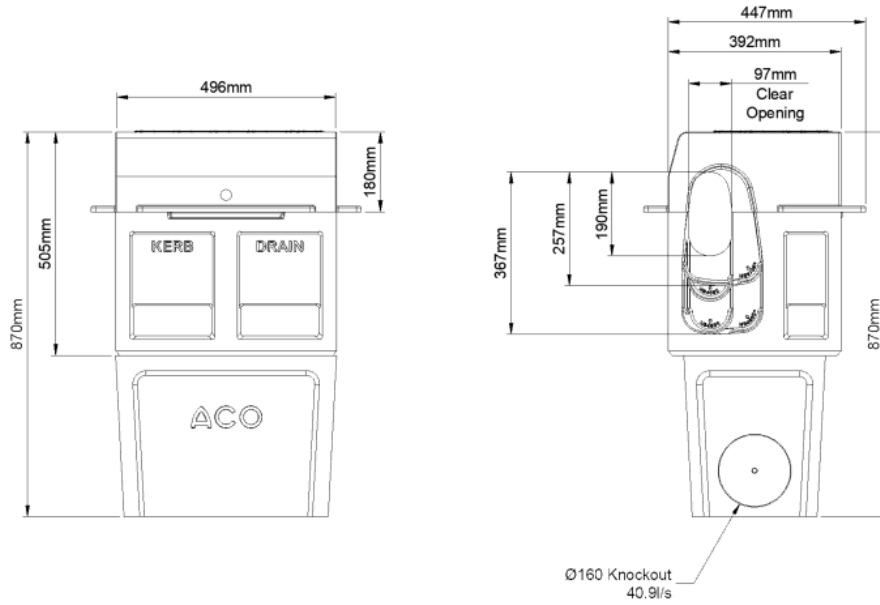


SP Shallow Base

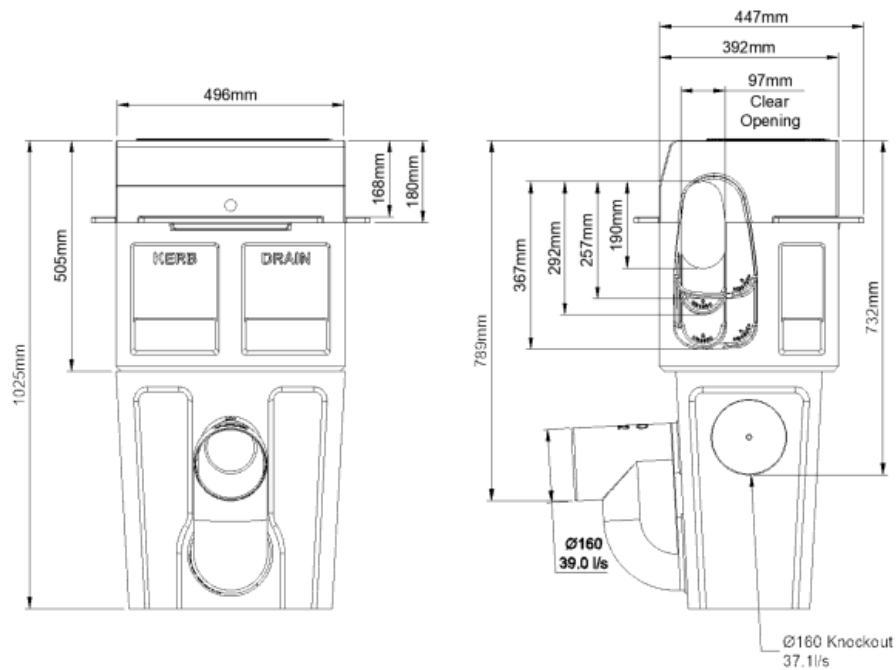


SP Deep Base

### ACO KerbDrain E 600

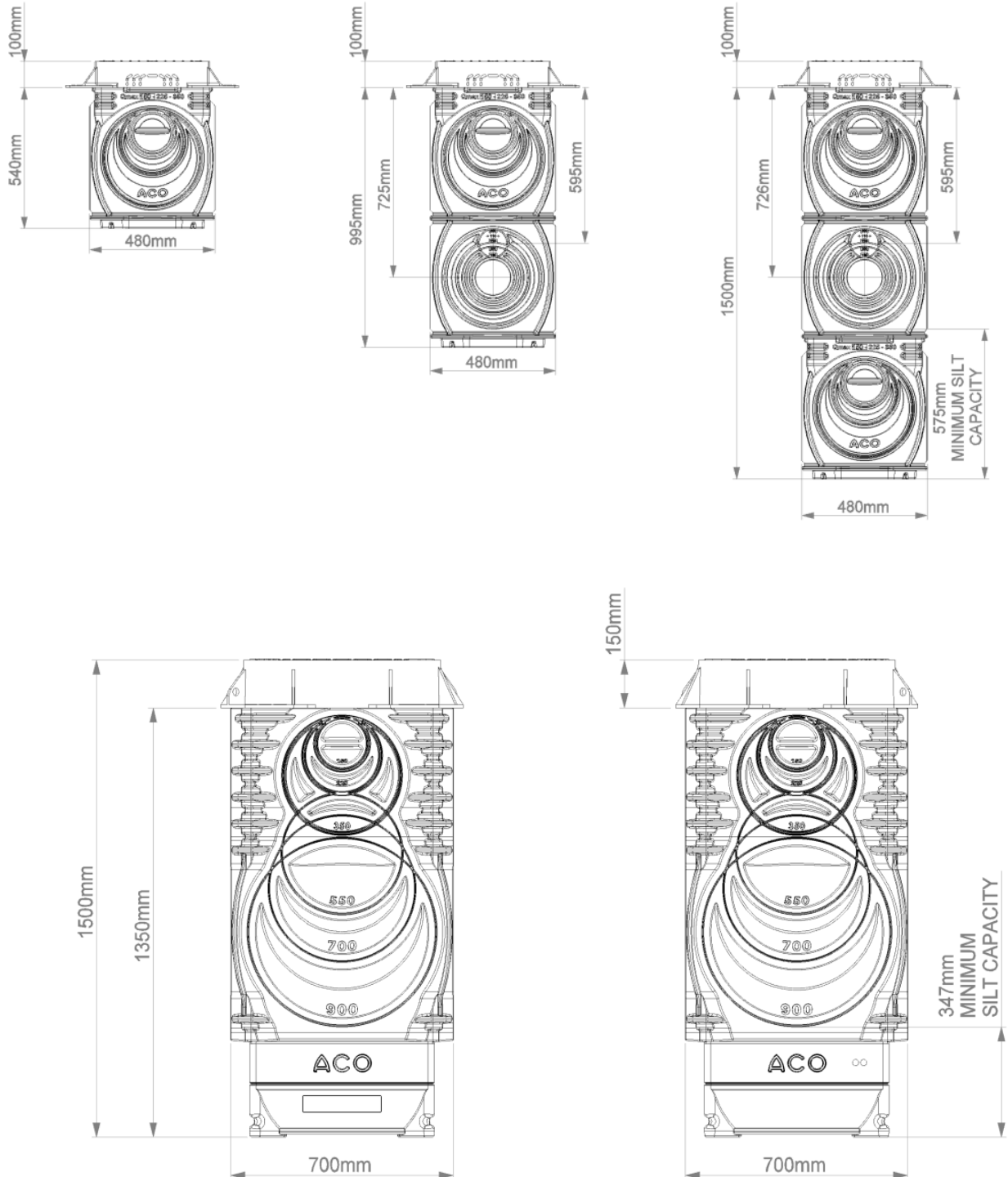


HB Shallow Base

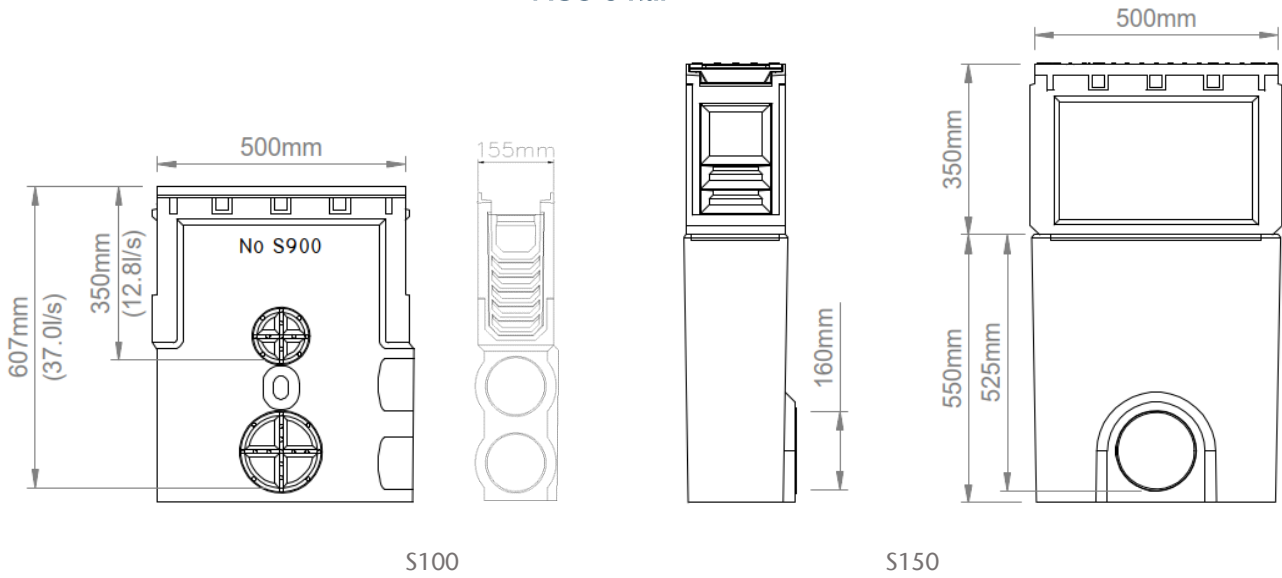


HB Deep Base

### ACO Qmax



### ACO S Ranae



### ACO MultiDrain

