



Appendix G - Drainage Strategy

Langstone FCERM

Drainage Strategy

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1. Introduction

AECOM has been commissioned by Coastal Partners to assist in the design and implementation of the Langstone Flood and Coastal Erosion Risk Management (FCERM) Scheme. The scheme, which will introduce new defences, is required to provide improved protection against tidal flooding in Langstone village and the A3023 road link to Hayling Island. The tidal flood defences will consist of a mix of earth bunds and reinforced concrete sea walls. For ease of reference and reporting, the scheme has been split into frontages, as can be seen in Figure 1-1.

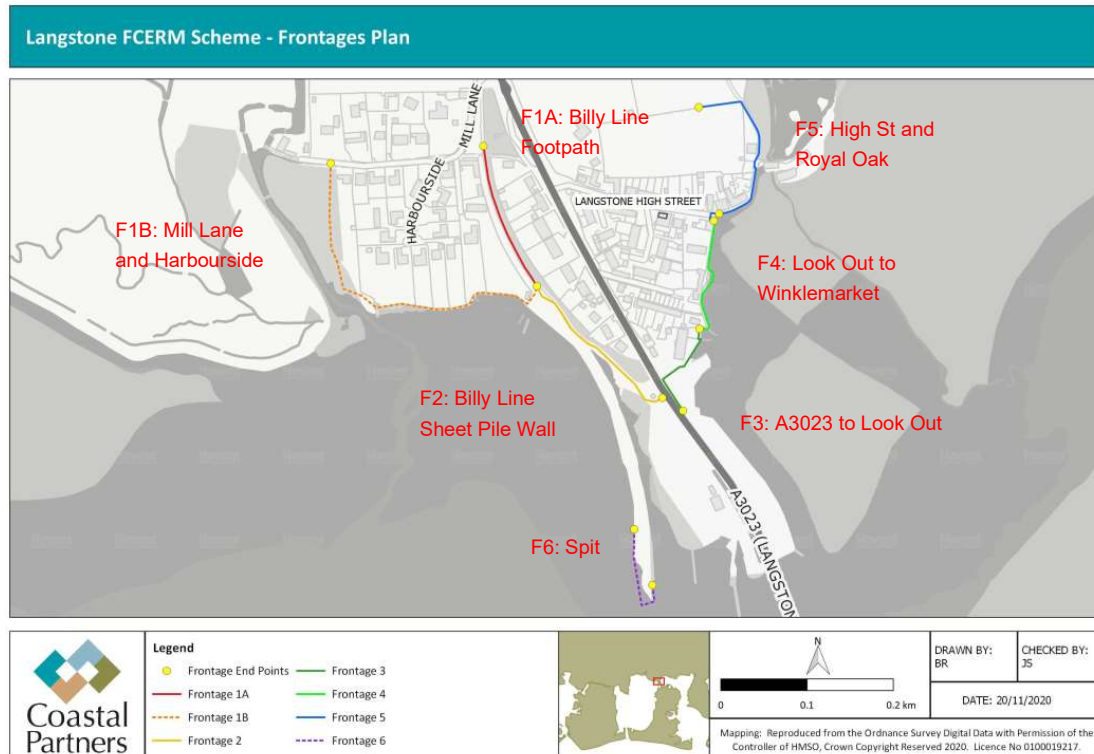


Figure 1-1: Scheme alignment split by frontages. The core scheme is represented by solid lines and the additional scheme represented by dotted lines. (Coastal Partners, 2020)

The proposed tidal flood defences will prevent the drainage of rainwater and wave overtopping water from land areas that previously freely discharged into the sea. Therefore, surface water drainage is proposed to be installed in conjunction with the defences.

In summary:

- Frontage 1a: No formalised drainage is installed along frontage 1a; the surface water is to drain to either side of the raised embankment.
- Frontage 1b: The existing drainage outlets are to be extended through Frontage 1b and fitted with a flap non-return valve on the seaward end. Filter drain is provided at the bottom of the embankment to facilitate drainage.
- Frontage 2: Along the northern section of the defence, a filter drain collects the runoff from the cycle path and is discharged through outlet pipe located within an ACO SuDS swale inlet unit. Along the southern section of the defence, a channel drain is to be provided to collect the runoff from the cycle path and is discharged through the outlet pipe located within an ACO SuDS swale inlet unit to reduce the footprint on the saltmarsh in the creek.

- Frontage 3: A new elevated vehicle ramp is proposed adjacent to the Ship Inn and the raising of the existing wall fronting the Ship Inn porch. The construction of a new elevated ramp will impede the free drainage of water. The drainage will consist of a mix of channel drains, gullies and surface water sewers and outfalls.
- Frontage 4: The existing drainage outlets are to be extended through Frontage 4 and fitted with a flap non-return valve on the seaward end. The existing surface drainage runoff in this frontage remains unchanged, where the surface water on the footpath will be directed seaward. A crossfall of 1 in 40 (2.5%) is to be provided for the new footpath. This provides a good balance between the need to remove surface water and the needs of footpath users. A new filter drain is to be provided around the Green Cottage front garden to remove any excessive surface runoff.
- Frontage 5: The new coastal defence wall will trap rainwater and wave overtopping water. At present, water freely drains off the walkways along Frontage 5. As such, adequate drainage of the collected water will be installed landward of the coastal defence and the collected water directed seaward.
- Frontage 6: No new formalised drainage along frontage 6.

This design report is concerned with proposed drainage for the tidal flood defences along Frontage 3 and Frontage 5. The remainder of the drainages are detailed on the design drawings (see Table 4-1. Drawing list related to the drainage).

2. Drainage philosophy

Assumptions and Design Criteria

The proposed coastal flood defences along frontages 3 and 5 require drainage of surface water and any residual overtopping water on the landward side of the new defence structure. The drainage required must be able to convey the water on the landward side of the defences to discharge points on the seaward side. It is assumed that:

- All drainage will be free draining (i.e. no pumping solutions are considered). However, catch pits are provided where a submersible pump can be employed by Hampshire Highways or coastal management authority personnel.
- Standing water will occur temporarily when the drainage outfalls are tidally locked (blocked from draining freely by a higher downstream seawater level). Drainage will commence as soon as the tidal water level drops to a level below the outfall.
- The drainage will be installed with the coastal defence structures. It is assumed that the existing ground levels will be retained unless otherwise amended as part of the design works.
- The existing drainage along Langstone Road is assumed sufficient for draining Langstone Road. Therefore, additional drainage due to the proposed coastal wall along the road is not necessary.
- Drainage and storage have been designed to provide efficient removal of water behind the defences following tide-locking situations as far as is reasonable and practical. It is recognised that in certain extreme conditions water may pond behind defences at high tide leading to localised potential flood risk. This will be focussed around areas which currently experience regular tidal flooding and already have property-level protection installed to manage the risks. In addition to the scheme protection, it is recommended that when high rainfall coincides with extreme tidal events, or when potential residual risk from wave overtopping is expected under the most extreme events the properties behind defences should continue to install PLP measures to manage the transitory residual risk due to tide locking of drainage within the scheme.

Drainage Scenarios

Various scenarios will occur that will need drainage of water from the frontages.

- i. Regular seasonal rainfall: summer and winter rainfall
This scenario will experience minimal standing water, with possible localised shallow pooling, runoff to the main catchment drains.
- ii. Regular storm conditions: Annual winter storms associated with heavy rainfall and possible elevated tidal water levels due to storm surge, prohibiting free draining of the drainage outfalls causing some standing water behind the flood defences; and
- iii. Future projected extreme storms: The resulting wave overtopping² from high tidal water levels and extreme wave events might cause extreme flooding if the coastal protection structures are overtopped.

The drainage design is based on regular storm conditions and not extreme flooding and overtopping conditions. In the case of extreme flooding, the flood waters will free-drain over time.

² The wave overtopping and extreme events are reported in AECOM, (2022), Joint Probability and Wave Overtopping Report, Langstone FCERM, June 2022

3. Drainage design

Materials

Various drainage solutions are offered by an array of suppliers. For this design, drainage solutions manufactured by ACO³ (Multidrain MD range) are used in the design. The drainage design is based on:

- Frontage 2: The drainage along the northern section comprises a filter drain. Along the southern section, the drainage comprises a channel drain with a width of 200mm and a depth of 265mm (ACO M200DS No.0.0) drainage channel and proprietary small headwall outfall (ACO SuDS swale unit).
- Frontage 3: The drainage area upstream of the Ship Inn parking area using channel drains with a width of 200mm and a depth of 365mm (ACO M200DS No.20.0 drainage channel) and reduced in cross-sectional area for areas of lower flow along the Ship Inn porch area (ACO M200DS No. 0.0 drainage channel with a width of 200mm and a depth of 265mm).
- Frontage 5: The drainage area along the Royal Oak frontage consists of ACO M150DS No. 10.0 drainage channels with a width of 150mm and a depth of 260mm.
- Filter drains (all frontages): Subsurface drainage will comprise a 150mm filter drainpipe⁴ with type B filter material wrapped with a non-woven geotextile.

Alternative drainage solutions and/or products proposed by the contractor must be able to channel and drain the flow at an equivalent flow rate or better.

Tidal Water Levels

The usual tidal levels at Portsmouth range between -2.17m AOD (Above Ordnance Datum Newlyn) and +2.31m ODN for 90% of the time since monitoring began at the site⁵. The highest recorded tidal level was recorded on 6th Dec 2013 at +2.82m AOD.

The tidal profile is given in Table 3-1 and is based on the Portsmouth profile in the Admiralty Tide Table with corrections applied for Langstone Harbour (AECOM, 2022)⁶.

Table 3-1. Tidal Levels for Langstone Harbour Entrance

	LAT	MLWS	MLWN	MSL	MHWN	MHWS	HAT
Metres above Ordnance Datum (mODN) ⁽¹⁾	-2.63 ⁽²⁾	-1.93	-0.83	0.2	1.17	2.07	2.67

1) The Chart Datum (mCD) is -2.73 relative to the Ordnance Datum for Langstone Harbour (Entrance)

(2) Admiralty Tide Tables do not provide LAT for Secondary Ports. LAT is taken as LAT at Portsmouth subtract Tide Level Difference at Langstone Harbour for MLWS

The vertical level of the seaward drainage is dependent mainly on two factors:

- The upstream surface level and practical location of the stormwater channels and/or pipes; and
- The tidal water levels on the sea (drainage) side, i.e. the surface water cannot be discharged if the tidal water level is at a level above the drainage outlet and no sufficient head for opening the flap valve and allowing the water to free drain exists. As such, the MHWS level of +2.07m AOD, read from Table 3-1, is assumed as the minimum drainage outlet invert level for design purposes.

During a typical year, the mean high water springs (MHWS) level of +2.07 AOD is exceeded for 1 hour at an average of 63 times per year, for 2 hours at an average of 18 times per year and exceeded for 3 hours, less than

³ <https://www.aco.co.uk/products/multidrain-md>

⁴ To comply with the requirements of filter drain pipes in table 5/1 OD The Specification for Highway Works

⁵ River Levels: Tide at Portsmouth, available online: <https://riverlevels.uk/tide-portsmouth>

⁶ AECOM, 2022, Langstone Flood and Coastal Erosion Management Scheme, Basis of Design (BoD) Report, Havant Borough Council, September 2022

five times per year⁷. This means that if a heavy storm downpour occurs at the same time as a tidal water level greater than the designed drainage level, the surface water might not be able to free drain until the tidal water has level receded to a sufficient level below the designed drainage invert level.

Frontage 3

Site Topography

The latest site topographical survey⁸ was used to determine the local catchment areas and the general drainage directions. Figure 3-1 indicates the general direction of drainage (blue arrows) derived from the topographical survey, taking into account the proposed bund ramp that forms part of the coastal protection strategy. Naturally, the raised slope will impede the flow of drainage water which, at present, runs off towards the sea across the informal parking lot.

Existing road drainage is installed along Langstone Road and around the Ship Inn parking area. The drainage gullies are shown as red rectangles in Figure 3-1. As such, a design for drainage along Langstone Road is not deemed necessary. The drainage direction of the existing drainage around the Ship Inn parking area is not known nor where the collected water discharges. Also, note that the new ramp will be constructed over the existing drainage gully closest to the Ship Inn. As such, a new drainage network is needed for water collecting and running off the Ship Inn parking lot.

In addition, surface water drainage for water collecting along the Ship Inn porch area and from the roof needs to be discharged. As seen in Figure 3-1, the porch area drains towards the southern and northern points of the seating area. The new coastal defence wall needs to allow for adequate drainage in these areas.

⁷ Averages calculated from seven years of historical tide record between 2000 and 2006.

⁸ Coastal Partners, Drawing A0/003 Rev A, 29/03/2021, Topographical Survey, Langstone, Havant

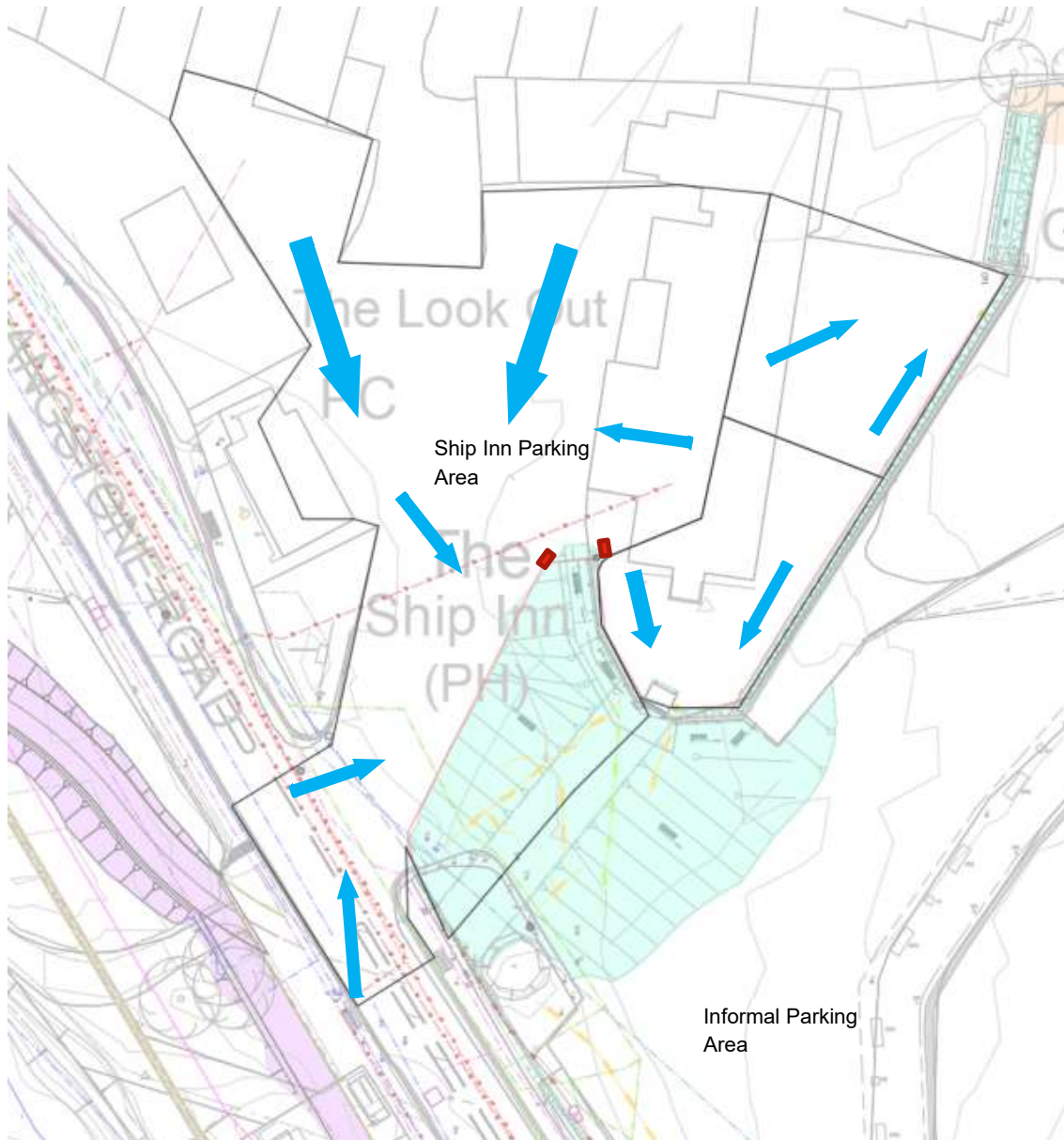


Figure 3-1: Drainage directions (blue arrows) derived from the latest topographical survey. Existing subsurface drainage catchment pits are shown in red.

Drainage Areas and Peak Discharge

The drainage area for Frontage 3 can be divided into three sectors as shown in Figure 3-2 following from the general drainage directions (shown in Figure 3-1).

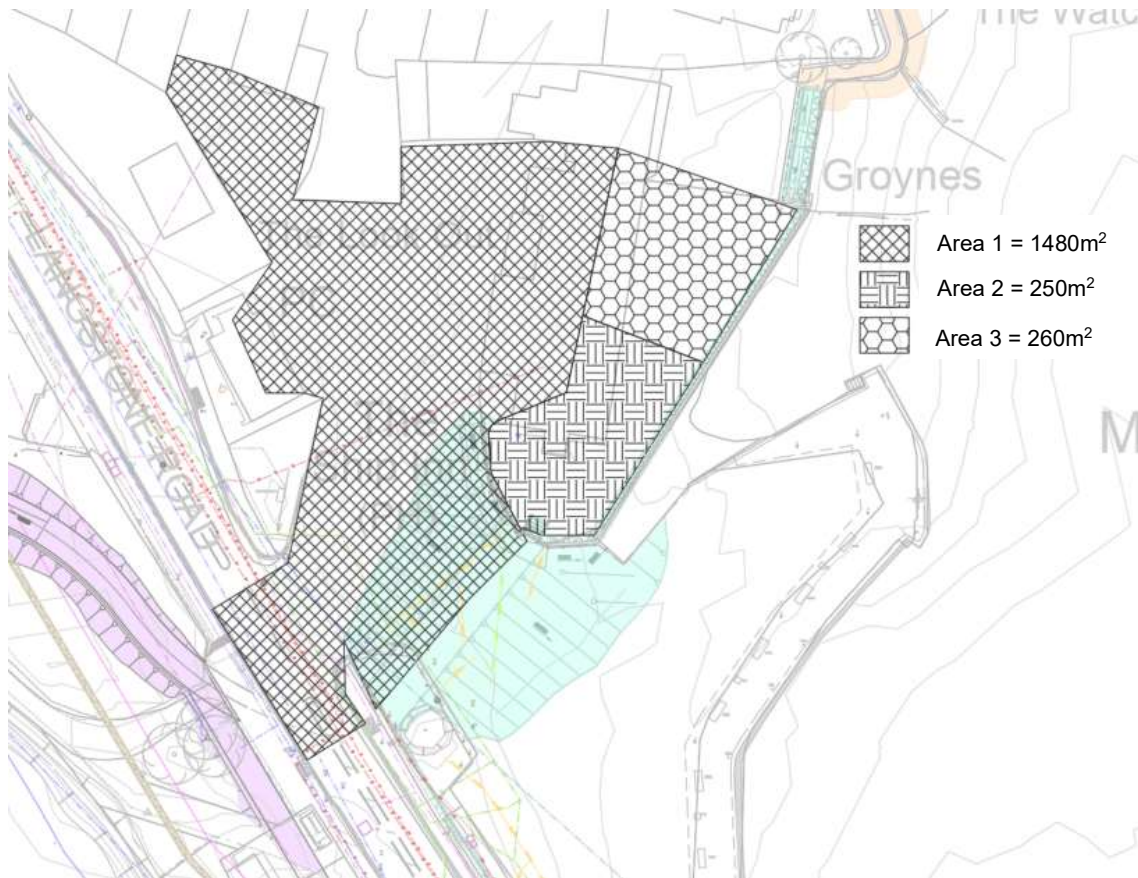


Figure 3-2: Drainage areas identified for Frontage 3

The peak discharges for the drainage areas were calculated using the Modified Rational Method⁹. The M5-60min value for Langstone is 20mm and $r = 0.37$. Using these values, the average point rainfall intensity (mm/hr) and peak discharge (l/s) are calculated based on the extent of the drainage areas. The calculated rainfall intensities and peak discharges for Area 1 (Ship Inn parking lot) and for Areas 2 and 3 (Ship Inn porch seated areas)¹⁰ are given in Table 3-2 and Table 3-3 respectively.

⁹ Design and Analysis of Urban Storm Drainage, The Wallingford Procedure, Volume 4, The Modified Rational Method, Department of the Environment National Water Council, Standing Technical Committee Reports No 31.

¹⁰ The drainage areas for Area 2 and Area 3 are equal in size and thus only a single table is presented.

Table 3-2. Calculated rainfall intensity and peak discharge for Area 1

Area 1 Duration	Rainfall Intensity (mm/hr)			Peak Discharge (l/s)		
	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)
5min	70.2	91.5	164.3	36.1	47.1	84.5
15min	41.6	53.6	103.5	21.4	27.6	53.2
30min	25.6	33.0	64.0	13.2	17.0	32.9
1hour	16.2	20.6	40.6	8.3	10.6	20.9
2hours	9.8	12.4	24.1	5.1	6.4	12.4
4hours	6.6	8.2	15.8	3.4	4.2	8.1
24hours	2.0	2.4	4.2	1.0	1.2	2.2

Table 3-3. Calculated rainfall intensity and peak discharge for Areas 2 and Area 3¹¹

Area 2 and 3 Duration	Rainfall Intensity (mm/hr)			Peak Discharge (l/s)		
	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)
5min	70.2	91.5	164.3	6.3	8.2	14.6
15min	41.6	53.6	103.5	3.7	4.8	9.2
30min	25.6	33.0	64.0	2.3	2.9	5.7
1hour	16.2	20.6	40.6	1.4	1.8	3.6
2hours	9.8	12.4	24.1	0.9	1.1	2.2
4hours	6.6	8.2	15.8	0.6	0.7	1.4
24hours	2.0	2.4	4.2	0.2	0.2	0.4

¹¹ Areas 2 and 3 have the same surface areas, the figures in Table 3.3 refer to the flow rates for each area individually.

Table 3-2 and Table 3-3, it can be seen that a maximum rainfall intensity of 164.3mm/hr was calculated for the 5 minute 1 in 100 year return period storm, reducing to 64.0 mm/hr for the 30 minute 1 in 100 year intensity for the drainage of the Ship Inn parking area upstream of the new protection ramp/bund wall.

Peak discharges of 84.5 l/s for the 5 minute 1 in 100 year rainfall intensity and 32.9 l/s for the 30 minute 1 in 100 year rainfall intensity are calculated for the Ship In parking lot area 1. For areas 2 and 3 peak discharges of 14.l/s and 5.7l/s are calculated for the 5 minute and 30 minute 1 in 100 year rainfall events respectively.

Drainage Layout and Discharge

Calculations are based on the calculated rainfall intensities and drainage gradients calculated from the topographical measurements on-site. Refer to Appendix A for the hydraulic calculation sheets¹².

Drainage for Frontage 3 is through two primary subsurface conduits (channels) and discharge outlets:

1. The layout of the new coastal defences and the fall of the drainage area tends towards linearly connected drainage channels that collect water from area 1 and 2 for a combined drainage area of 1560m². With the new ramp across the parking area, this area drains to a low point adjacent to the proposed stairs descending from the top of the stairs. However, at this low point, no sufficient discharge point to the sea is immediately available due to the ground levels downstream of the new coastal defence. As such, the water must be conveyed to a point where it can be discharged to the Langstone Harbour waters above the mean high-water springs (MHWS) water level. A subsurface pipe of 300mm OD and approximately 25m in length is installed and discharged above the MHWS level. The drainage paths along the new coastal defence are shown in red arrows in Figure 3-3.

The combined drainage area (area 1 and 2) of 1730m² (Figure 3-2) is drained with 46m of channel drain at a 1 in 100 (1% slope). The flow rate that the channel drain can accept without surcharging (i.e. no standing water on top) is 60.5l/s, at a velocity of 1.4m/s. This is equivalent to a 5 minute 1 in 100 year rainfall intensity calculated in Table 3-3. The outfall level was set above MHWS as this will allow for a free discharge for the majority of the time (see section Tidal Water Levels). The velocity through the outfall at peak design flow (above) is 1m/s.

2. The drainage area of 260m² (Figure 3-2) is drained with 30m of channel drain at a 0.6 in 100 (0.6% slope). The flow rate that the channel drain can accept without surcharging is 30.0 l/s, at a velocity of 1.1m/s. The outfall level was set above MHWS as this will allow for a free discharge for the majority of the time (see section Tidal Water Levels). The velocity through the outfall at peak design flow (above) is 1m/s. The drainage paths along the new coastal defence are shown in yellow arrows in Figure 3-3.

¹² The calculations are produced using the ACO Hydraulic Channel Analysis Design software: Quad Hydraulic Design 2.0 (available online at <https://www.aco.co.uk/quadr-hydraulic-design-2.0>)

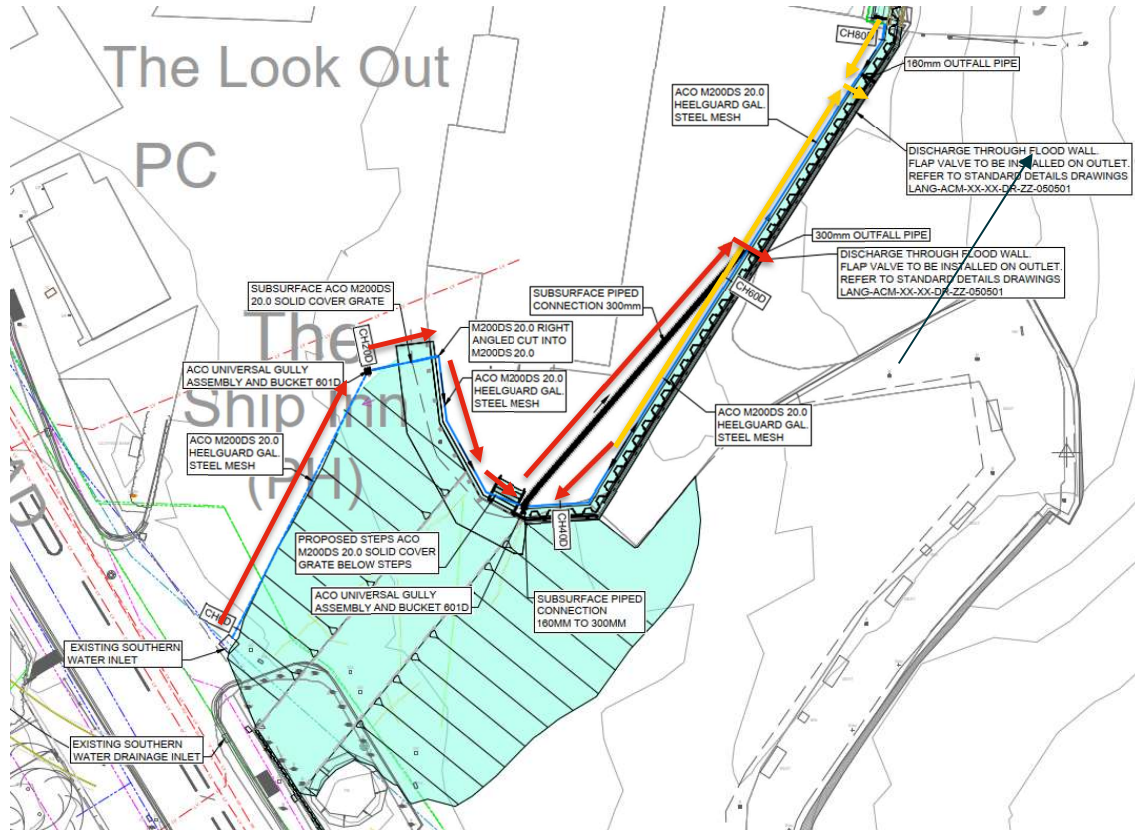


Figure 3-3: Drainage conduit flow directions for Frontage 3

Drainage: Extreme Events

During extreme events (see Section: Drainage Scenarios), when the tidal level exceeds the drainage outlet levels and a significant amount of drainage water is trapped in the upstream area of the coastal protection, the discharge of the stormwater will be delayed until the tidal level on the downstream side has receded sufficiently.

The time to drain the accumulated stormwater is dependent on the level (and volume) of stormwater build-up behind the defences. Assuming that, in the unlikely event that the upstream area is flooded to the height of the coastal defence (+3.8m AOD), it will take approximately 260 minutes, after the sea level is below the invert of the outfall pipes, to drain the flood waters to a level of +2.90m AOD, which is the average natural ground level around the Ship Inn. Figure 3-4 shows the relationship between the drainage time and the upstream inundation water depth.

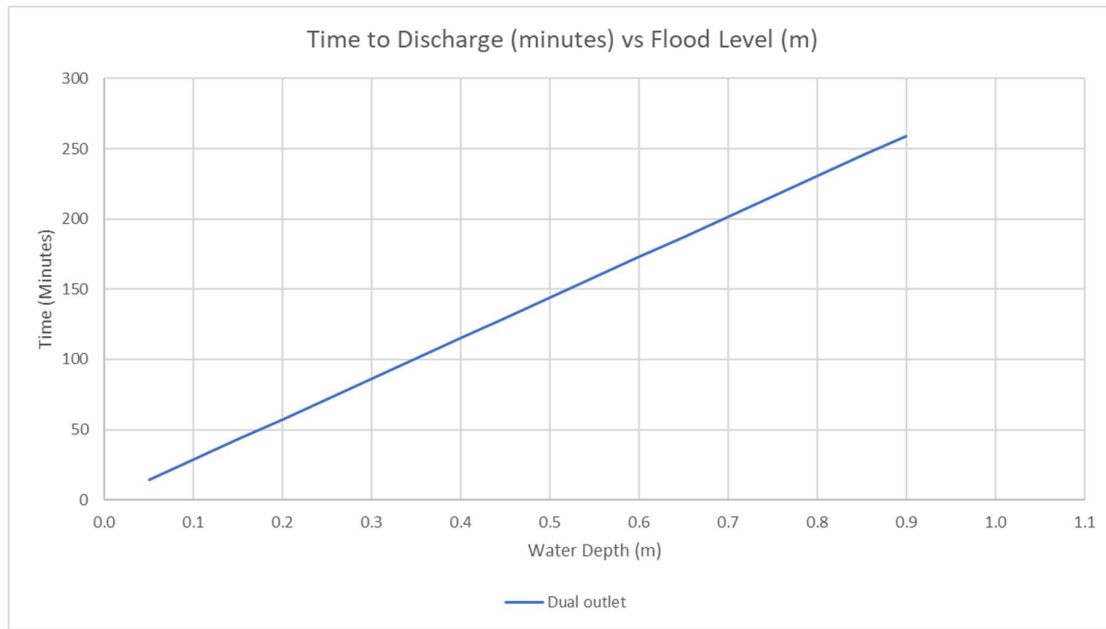


Figure 3-4: Graph of inundation water level vs. time to discharge of storm water¹³

Drainage: Oil Interceptors

Consideration was given to whether oil interceptors were required for the carpark (Meeting between AECOM and the Client on 15th June 2023). The design rationale for the drainage scheme is to maintain a like-for-like arrangement to the current car-park drainage. There is no current guidance on when oil interceptors are required. The risk from oil contamination is considered low given the size of the car park and that no fuel oil refuelling or delivery activities are expected in the area. Providing oil interceptors and the associated drainage system is also likely to significantly increase the construction cost as well as the operational and maintenance requirements. Given these reasons, a decision was made by the Client to not include oil interceptors in the design (Email dated 21/06/2023). Instead, the design has included for a trapped gully pot to be included in Area A (in line with Environment Agencies withdrawn PPG3 guidance for small car parks).

¹³ Dual outfalls for Frontage 3

Frontage 5

Site Topography

The latest site topographical survey was used⁸ to determine the local catchment areas and the general drainage directions. Figure 3-5 indicates the general direction of drainage (blue arrows) derived from the topographical survey and the resulting drainage areas (hatched areas).



Figure 3-5: Drainage areas and drainage directions identified for Frontage 5

At present, runoff from the downpipes and along the frontage runs into the sea without a vertical wall restricting the runoff. The installation of the new coastal defence will impede the natural drainage paths. As such, drainage along the frontage must be installed and existing drainage behind boundary walls extended through the new coastal defence. Figure 3-6 shows an example of an existing drainage conduit from a walled property along Frontage 5.



Figure 3-6: Example of an existing drainage conduit from behind a boundary wall (Frontage 5)

The drainage area for Frontage 5 can be divided into two sectors and the general drainage directions are shown in Figure 3-5.

Peak Discharge

The peak discharges for the drainage areas are calculated using the Modified Rational Method. The M5-60min value for Langstone is 20mm and $r = 0.37$. Using these values, the average point rainfall intensity (mm/hr) and peak discharge (l/s) are calculated based on the extent of the drainage areas. The calculated rainfall intensities and peak discharges for Area 1 and Area 2 are given in Table 3-4 and Table 3-5 respectively.

Table 3-4. Calculated rainfall intensity and peak discharge for Area 1

Area 1 Duration	Rainfall Intensity (mm/hr)			Peak Discharge (l/s)		
	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)
5min	70.2	91.5	164.3	6.5	8.5	15.2
15min	41.6	53.6	103.5	3.9	5.0	9.6
30min	25.6	33.0	64.0	2.4	3.1	5.9
1hour	16.2	20.6	40.6	1.5	1.9	3.8
2hours	9.8	12.4	24.1	0.9	1.1	2.2
4hours	6.6	8.2	15.8	0.6	0.8	1.5
24hours	2.0	2.4	4.2	0.2	0.2	0.4

Table 3-5. Calculated rainfall intensity and peak discharge for Area 2

Area 2 Duration	Rainfall Intensity (mm/hr)			Peak Discharge (l/s)		
	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)
5min	70.2	91.5	164.3	13.0	16.9	30.4
15min	41.6	53.6	103.5	7.7	9.9	19.2
30min	25.6	33.0	64.0	4.7	6.1	11.9
1hour	16.2	20.6	40.6	3.0	3.8	7.5
2hours	9.8	12.4	24.1	1.8	2.3	4.5
4hours	6.6	8.2	15.8	1.2	1.5	2.9
24hours	2.0	2.4	4.2	0.4	0.4	0.8

From Table 3-4 and Table 3-5, it can be seen that, as for Frontage 3, a maximum rainfall intensity of 164.3mm/hr is calculated for the 5 minute 1 in 100 year rainfall intensity and reduced to 64.0 mm/hr for the 30 minutes 1 in 100 year rainfall intensity. The peak 1 in 100-year 5-minute discharge for area 1 is calculated to be 15.2 l/s and 30.4 l/s for area 2 with a drainage area of 540m².

Drainage Layout and Discharge

Calculations are based on the calculated rainfall intensities and drainage gradients calculated from the topographical measurements on-site. Refer to Appendix A for the hydraulic calculation sheets¹⁴.

Free drainage for Frontage 5, as indicated in Figure 3-7 by the arrows, is through two primary discharge outlets:

1. The draining of area 1, with a drainage area of 270m² (Figure 3-5) is calculated with surface-level drains over a length of 21m. The direction of drainage is indicated by yellow arrows in Figure 3-7. The area is drained at a 0.74 in 100 (0.74% slope). The flow rate that the channel drain can accept without surcharging is 21.0 l/s, at a velocity of 1.1m/s. The outfall level was set above MHWS as this will allow for a free discharge for the majority of the time (see section Tidal Water Levels). The velocity through the outfall at peak design flow is 1m/s.
2. The draining of Area 2 (drainage area of 540m² as shown in Figure 3-5) is calculated with surface level drains over a length of 63m. The drainage paths along the new coastal defence are shown in red arrows in Figure 3-7. At an average slope of 0.6% (0.6 in 100), the flow rate that the channel drain can accept without surcharging is 23.0 l/s, at a velocity of 1.1m/s. The outfall level was set above MHWS as this will allow for a free discharge for the majority of the time (see section Tidal Water Levels). The velocity through the outfall at peak design flow is 1m/s. The spare capacity of the Area 1 drainage can function as an overflow for the draining of Area 2.
3. Additional drainage is provided along the flood wall in property No.21. The existing surface runoff in this area drains into the permeable ground naturally. The new proposed drainage comprises a combination of channel and filter drains and is intended to remove excessive surface runoff and discharge through the existing quay wall by the allotment.

¹⁴ The calculations are produced using the ACO Hydraulic Channel Analysis Design software: Quad Hydraulic Design 2.0 (available online at <https://www.aco.co.uk/quad-hydraulic-design-2.0>)

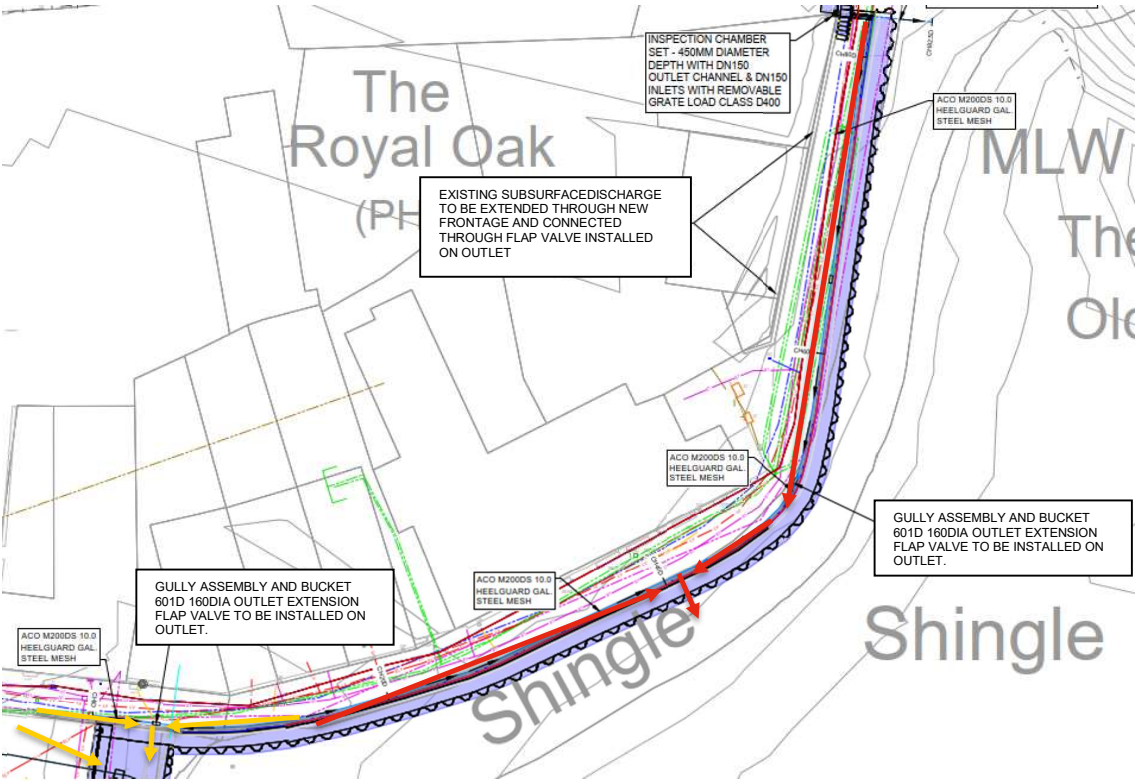


Figure 3-7: Drainage conduit flow directions for Frontage 5

Drainage: Extreme Events

Once the tidal water level recedes to below the base level of the High Street flood gate (at Frontage 5), the barriers of the gate can be removed and free draining of excess water around the Royal Oak will be channelled via the High Street flood gate.

4. Design Details

Drawing List

The drawing list related to the drainage design is listed in Table 4-1

Table 4-1. Drawing list related to the drainage design.

Drawing Number	Sheet Title	Revision
LANG-ACM-SW-F2-DR-ZZ-011041	FRONTAGE 2 SURFACE WATER DRAINAGE PLAN	P01
LANG-ACM-SW-F2-DR-ZZ-021042	FRONTAGE 2 DRAINAGE LONG SECTION SHEET 1	P01
LANG-ACM-SW-F2-DR-ZZ-021043	FRONTAGE 2 DRAINAGE LONG SECTION SHEET 2	P01
LANG-ACM-SW-F2-DR-ZZ-051044	FRONTAGE 2 DRAINAGE DETAILS	P01
LANG-ACM-SW-F3-DR-ZZ-011045	FRONTAGE 3 SURFACE WATER DRAINAGE PLAN	P01
LANG-ACM-SW-F3-DR-ZZ-021046	FRONTAGE 3 DRAINAGE LONG SECTION SHEET 1	P01
LANG-ACM-SW-F3-DR-ZZ-051048	FRONTAGE 3 DRAINAGE DETAILS	P01
LANG-ACM-SW-F4-DR-ZZ-011049	FRONTAGE 4 SURFACE WATER DRAINAGE PLAN	P01
LANG-ACM-SW-F4-DR-ZZ-021050	FRONTAGE 4 DRAINAGE LONG SECTION AND DETAILS	P01

LANG-ACM-SW-F5-DR-ZZ-011051	FRONTAGE 5 SURFACE WATER DRAINAGE PLAN	P01
LANG-ACM-ZZ-F5-DR-ZZ-021052	FRONTAGE 5 DRAINAGE LONG SECTION	P01
LANG-ACM-ZZ-F5-DR-ZZ-051054	FRONTAGE 5 DRAINAGE DETAILS	P01
22000	ACO Universal Gully D400 Concrete Pavement Installation	B
21999	ACO Universal Gully D400 Asphalt Pavement Installation	B
21828	ACO Multidrain M200D 0.0 Channel Installation Detail	F
21830	ACO Multidrain M200D 20.0 Channel Installation Detail	F
21848	ACO MultiDrain M200D Universal Sump Installation Detail	E
21825	ACO Multidrain M150D 10.0 Channel Installation Detail	F

5. Conclusions

AECOM was commissioned by Coastal Partners to assist in the design and implementation of the Langstone Flood and Coastal Erosion Risk Management (FCERM) Scheme. Drainage of excess rainwater accumulating behind the proposed coastal defence structures must be installed in areas where, in the past, free drainage occurred in the absence of coastal defences.

This design report discusses the drainage arrangement for the scheme. The drainage strategy for the following frontage remains similar to the existing, where the current drainage arrangement is to be maintained.

- Frontage 1a - Surface water for F1A is to drain to either side of the raised embankment.
- Frontage 1b - Existing arrangement for F1B is to be maintained where existing outlets are to be extended through the new structure. New filter drain provided on the landward of the earth embankment to remove any excessive runoff. This will discharge into the existing outfall around Chainage 150.
- Frontage 3 – Existing outfalls are to be extended. A cross fall of 1 in 40 is to be provided to the new footpath along Ship Inn Annex to drain surface water seaward effectively. New filter drain is to be provided in the Ship Inn Annex garden to remove any excessive runoff. This will discharge to the quay through a new outfall fitted with a flap valve.
- Frontage 4 – Existing drainage outlet through the existing walls is to be extended. A cross fall of 1 in 40 is to be provided to the new footpath to drain surface water seaward effectively. New filter drain is to be provided in the Green Cottage front garden to remove any excessive runoff. This will discharge to the quay through a new outfall fitted with a flap valve.
- Frontage 6- No new formalised drainage is provided along Frontage 6 as there are no impermeable surfaces in this area.

The drainage design consists of subsurface drains detailed in the design relevant design drawings. Additional drainage infrastructure elements are detailed as follows:

- Frontage 2: Filter drain is to be provided to one side of the cycle path/footpath for the northern section and channel drain is to be provided for the southern section to collect surface water and discharge through 2 new outlet pipes located within small headwalls (ACO SuDS swale unit).
- Frontage 3: A new elevated vehicle ramp is proposed adjacent to the Ship Inn and raising the existing wall fronting the Ship Inn porch. The construction of a new elevated ramp will impede the free drainage of water and adequate drainage of the collected stormwater is needed along the elevated vehicle ramp. The drainage design discharges into the harbour via 2 new outlets.

- Frontage 5: The new coastal defence wall will trap upstream stormwater. At present, the water free drains off the walkways along Frontage 5. As such, adequate drainage of the collected stormwater is needed along the frontage. The drainage design discharges into the harbour via 4 new outlets.

From the design calculations, it is concluded that:

- Frontage 3 – Area 1 and 2: The combined drainage area (area 1 and 2) of 1560m² is drained with 46m of channel drain at a 1 in 100 (1% slope). The flow rate that the channel drain can accept without surcharging (i.e. no standing water on top) is 60.5l/s, at a velocity of 1.4m/s. This is equivalent to a 5-minute 1 in 100 year rainfall intensity. The outfall level was set above MHWS as this will allow for a free discharge for the majority of the time. The velocity through the outfall at peak design flow (above) is 1m/s.
- Frontage 3 – Area 3 (Ship Inn porch area): The drainage area of 250m² is drained with 30m of channel drain at a 0.6 in 100 (0.6% slope). The flow rate that the channel drain can accept without surcharging is 30.0 l/s, at a velocity of 1.1m/s. The outfall level was set above MHWS as this will allow for a free discharge for the majority of the time. The velocity through the outfall at peak design flow is 1m/s.
- For Frontage 5 – Area 1: The draining of area 1, with a drainage area of 270m² is calculated with surface level drains over a length of 21m. The area is drained at a 0.74 in 100 (0.74% slope). The flow rate that the channel drain can accept without surcharging is 21.0 l/s, at a velocity of 1.1m/s. The velocity through the outfall at peak design flow is 1m/s.
- For Frontage 5 – Area 2: The draining of Area 2 (drainage area of 540m²) is calculated with surface level drains over a length of 63m. At an average slope of 0.6% (0.6 in 100), the flow rate that the channel drain can accept without surcharging is 23.0 l/s, at a velocity of 1.1m/s. The velocity through the outfall at peak design flow is 1m/s.
- Existing drainage conduits originating from behind local property boundary walls must be extended through the new coastal defence.
- A load class of D400 is to be used in all drainage units.
- No specific calculation is undertaken where the existing arrangement drains naturally into the adjacent permeable ground, for example in Frontage 1a, 1B (on the rear of the embankment) Frontage 2, Frontage 4 (Green Cottage front garden) and Frontage 5 (property No.21 and the Allotment). Nominally sized filter drain (perforated pipe) and channel drain are provided in these areas to remove any excessive surface runoff in extreme conditions.

Drainage and storage have been designed to provide efficient removal of water behind the defences following tide-locking situations as far as is reasonable and practical. It is recognised that in certain extreme conditions water may pond behind defences at high tide leading to localised potential flood risk. This will be focussed around areas which currently experience regular tidal flooding and already have property-level protection installed to manage the risks. In addition to the scheme protection, it is recommended that when high rainfall coincides with extreme tidal events, or when potential residual risk from wave overtopping is expected under the most extreme events the properties behind defences should continue to install PLP measures to manage the transitory residual risk due to tide locking of drainage within the scheme.



Figure 3-6: Example of an existing drainage conduit from behind a boundary wall (Frontage 5)

The drainage area for Frontage 5 can be divided into two sectors and the general drainage directions are shown in Figure 3-5.

Peak Discharge

The peak discharges for the drainage areas are calculated using the Modified Rational Method. The M5-60min value for Langstone is 20mm and $r = 0.37$. Using these values, the average point rainfall intensity (mm/hr) and peak discharge (l/s) are calculated based on the extent of the drainage areas. The calculated rainfall intensities and peak discharges for Area 1 and Area 2 are given in Table 3-4 and Table 3-5 respectively.

Table 3-4. Calculated rainfall intensity and peak discharge for Area 1

Area 1	Rainfall Intensity (mm/hr)			Peak Discharge (l/s)		
	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)
5min	70.2	91.5	164.3	6.5	8.5	15.2
15min	41.6	53.6	103.5	3.9	5.0	9.6
30min	25.6	33.0	64.0	2.4	3.1	5.9
1hour	16.2	20.6	40.6	1.5	1.9	3.8
2hours	9.8	12.4	24.1	0.9	1.1	2.2
4hours	6.6	8.2	15.8	0.6	0.8	1.5
24hours	2.0	2.4	4.2	0.2	0.2	0.4

Table 3-5. Calculated rainfall intensity and peak discharge for Area 2

Area 2 Duration	Rainfall Intensity (mm/hr)			Peak Discharge (l/s)		
	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)	1 in 2 year (M2)	1 in 5 year (M5)	1 in 100 year (M100)
5min	70.2	91.5	164.3	13.0	16.9	30.4
15min	41.6	53.6	103.5	7.7	9.9	19.2
30min	25.6	33.0	64.0	4.7	6.1	11.9
1hour	16.2	20.6	40.6	3.0	3.8	7.5
2hours	9.8	12.4	24.1	1.8	2.3	4.5
4hours	6.6	8.2	15.8	1.2	1.5	2.9
24hours	2.0	2.4	4.2	0.4	0.4	0.8

From Table 3-4 and Table 3-5, it can be seen that, as for Frontage 3, a maximum rainfall intensity of 164.3mm/hr is calculated for the 5 minute 1 in 100 year rainfall intensity and reduced to 64.0 mm/hr for the 30 minutes 1 in 100 year rainfall intensity. The peak 1 in 100-year 5-minute discharge for area 1 is calculated to be 15.2 l/s and 30.4 l/s for area 2 with a drainage area of 540m².

Drainage Layout and Discharge

Calculations are based on the calculated rainfall intensities and drainage gradients calculated from the topographical measurements on-site. Refer to Appendix A for the hydraulic calculation sheets¹⁴.

Free drainage for Frontage 5, as indicated in Figure 3-7 by the arrows, is through two primary discharge outlets:

1. The draining of area 1, with a drainage area of 270m² (Figure 3-5) is calculated with surface-level drains over a length of 21m. The direction of drainage is indicated by yellow arrows in Figure 3-7. The area is drained at a 0.74 in 100 (0.74% slope). The flow rate that the channel drain can accept without surcharging is 21.0 l/s, at a velocity of 1.1m/s. The outfall level was set above MHWS as this will allow for a free discharge for the majority of the time (see section Tidal Water Levels). The velocity through the outfall at peak design flow is 1m/s.
2. The draining of Area 2 (drainage area of 540m² as shown in Figure 3-5) is calculated with surface level drains over a length of 63m. The drainage paths along the new coastal defence are shown in red arrows in Figure 3-7. At an average slope of 0.6% (0.6 in 100), the flow rate that the channel drain can accept without surcharging is 23.0 l/s, at a velocity of 1.1m/s. The outfall level was set above MHWS as this will allow for a free discharge for the majority of the time (see section Tidal Water Levels). The velocity through the outfall at peak design flow is 1m/s. The spare capacity of the Area 1 drainage can function as an overflow for the draining of Area 2.
3. Additional drainage is provided along the flood wall in property No.21. The existing surface runoff in this area drains into the permeable ground naturally. The new proposed drainage comprises a combination of channel and filter drains and is intended to remove excessive surface runoff and discharge through the existing quay wall by the allotment.

¹⁴ The calculations are produced using the ACO Hydraulic Channel Analysis Design software: Quad Hydraulic Design 2.0 (available online at <https://www.aco.co.uk/quad-hydraulic-design-2.0>)

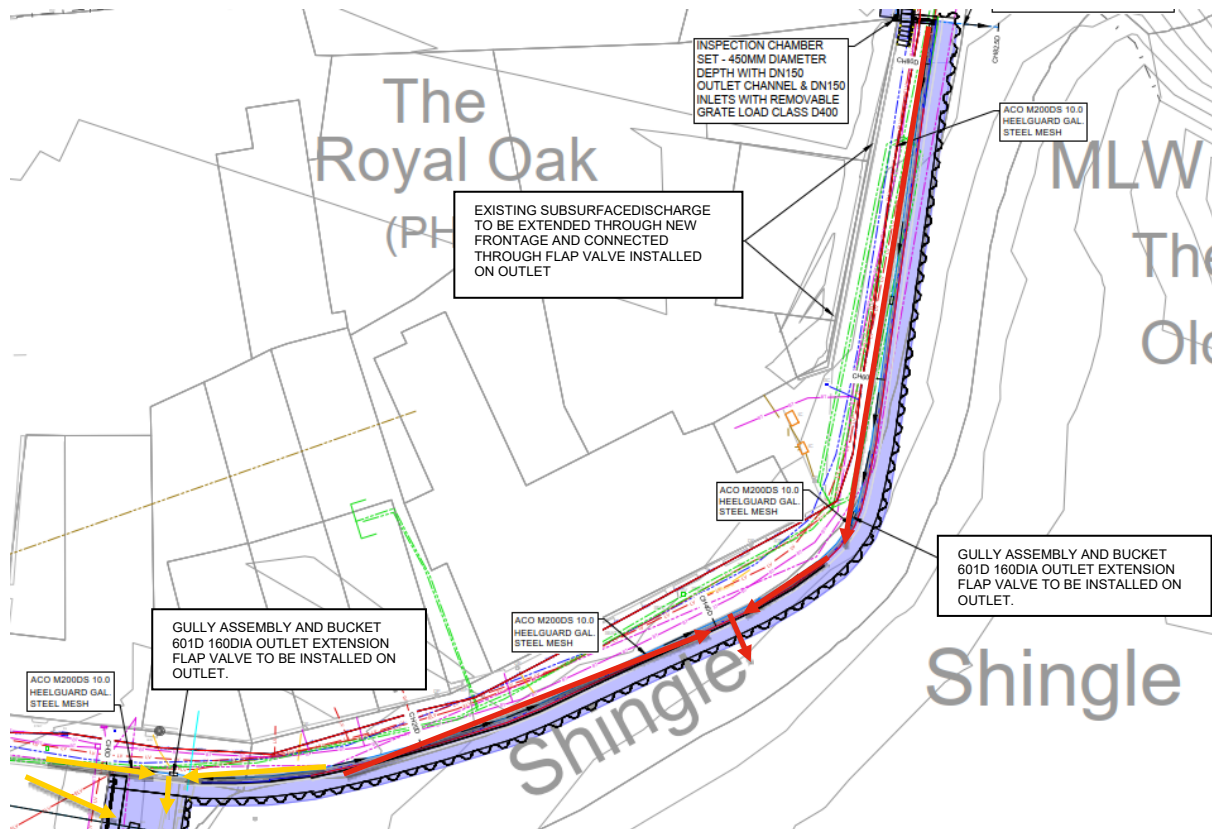


Figure 3-7: Drainage conduit flow directions for Frontage 5

Drainage: Extreme Events

Once the tidal water level recedes to below the base level of the High Street flood gate (at Frontage 5), the barriers of the gate can be removed and free draining of excess water around the Royal Oak will be channelled via the High Street flood gate.

4. Design Details

Drawing List

The drawing list related to the drainage design is listed in Table 4-1

Table 4-1. Drawing list related to the drainage design.

Drawing Number	Sheet Title	Revision
LANG-ACM-SW-F2-DR-ZZ-011041	FRONTAGE 2 SURFACE WATER DRAINAGE PLAN	P01
LANG-ACM-SW-F2-DR-ZZ-021042	FRONTAGE 2 DRAINAGE LONG SECTION SHEET 1	P01
LANG-ACM-SW-F2-DR-ZZ-021043	FRONTAGE 2 DRAINAGE LONG SECTION SHEET 2	P01
LANG-ACM-SW-F2-DR-ZZ-051044	FRONTAGE 2 DRAINAGE DETAILS	P01
LANG-ACM-SW-F3-DR-ZZ-011045	FRONTAGE 3 SURFACE WATER DRAINAGE PLAN	P01
LANG-ACM-SW-F3-DR-ZZ-021046	FRONTAGE 3 DRAINAGE LONG SECTION SHEET 1	P01
LANG-ACM-SW-F3-DR-ZZ-051048	FRONTAGE 3 DRAINAGE DETAILS	P01
LANG-ACM-SW-F4-DR-ZZ-011049	FRONTAGE 4 SURFACE WATER DRAINAGE PLAN	P01
LANG-ACM-SW-F4-DR-ZZ-021050	FRONTAGE 4 DRAINAGE LONG SECTION AND DETAILS	P01

LANG-ACM-SW-F5-DR-ZZ-011051	FRONTAGE 5 SURFACE WATER DRAINAGE PLAN	P01
LANG-ACM-ZZ-F5-DR-ZZ-021052	FRONTAGE 5 DRAINAGE LONG SECTION	P01
LANG-ACM-ZZ-F5-DR-ZZ-051054	FRONTAGE 5 DRAINAGE DETAILS	P01
22000	ACO Universal Gully D400 Concrete Pavement Installation	B
21999	ACO Universal Gully D400 Asphalt Pavement Installation	B
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- Frontage 3 – Area 3 (Ship Inn porch area): The drainage area of 250m² is drained with 30m of channel drain at a 0.6 in 100 (0.6% slope). The flow rate that the channel drain can accept without surcharging is 30.0 l/s, at a velocity of 1.1m/s. The outfall level was set above MHWS as this will allow for a free discharge for the majority of the time. The velocity through the outfall at peak design flow is 1m/s.
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- For Frontage 5 – Area 2: The draining of Area 2 (drainage area of 540m²) is calculated with surface level drains over a length of 63m. At an average slope of 0.6% (0.6 in 100), the flow rate that the channel drain can accept without surcharging is 23.0 l/s, at a velocity of 1.1m/s. The velocity through the outfall at peak design flow is 1m/s.
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Appendix A Hydraulic Calculations

Frontage 3: Drainage Calculations



Project Name: Langstone Drainage Design

Designer: Frans Van Eeden

Project Date: 6th July 2023

Location:

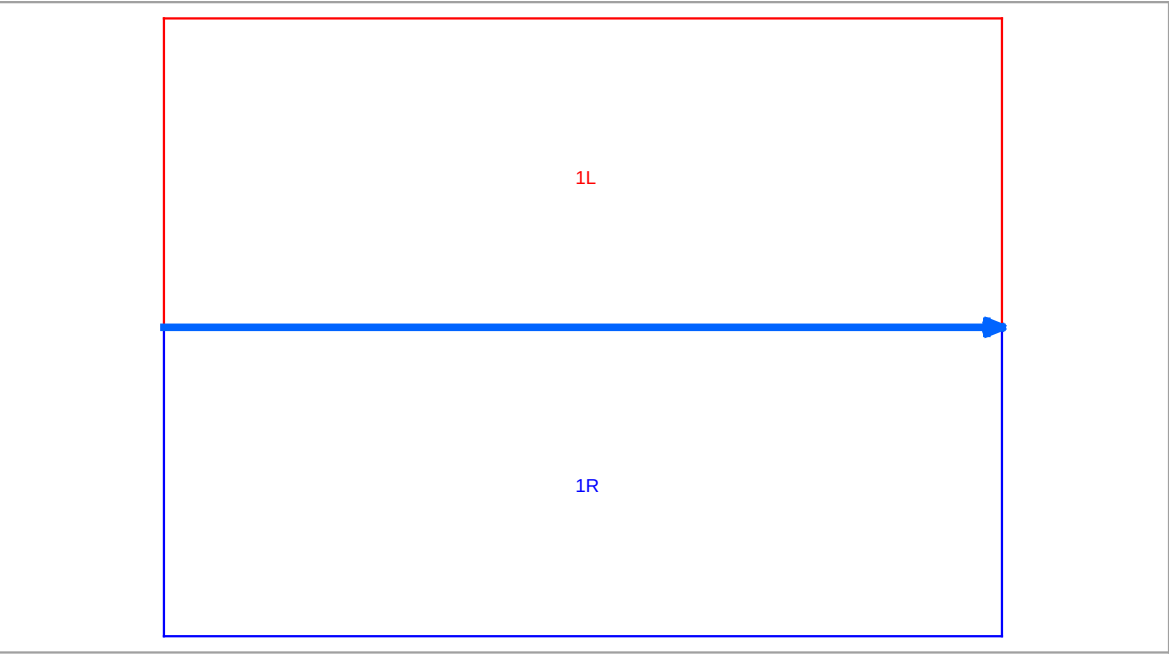
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+ CHANNEL LAYOUT



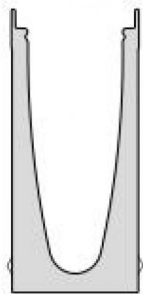
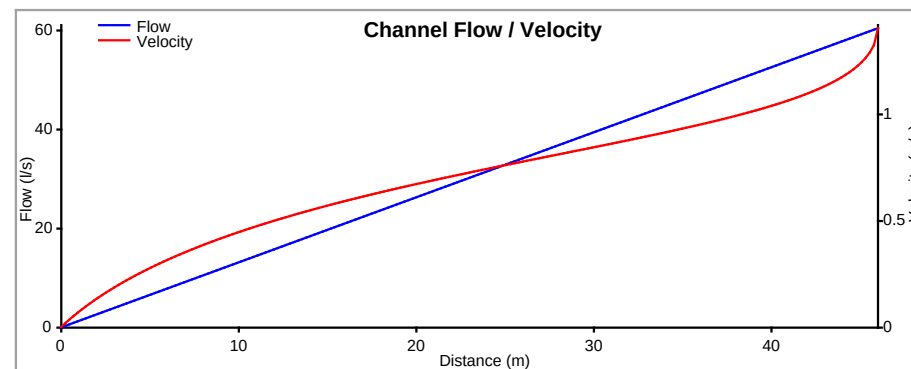
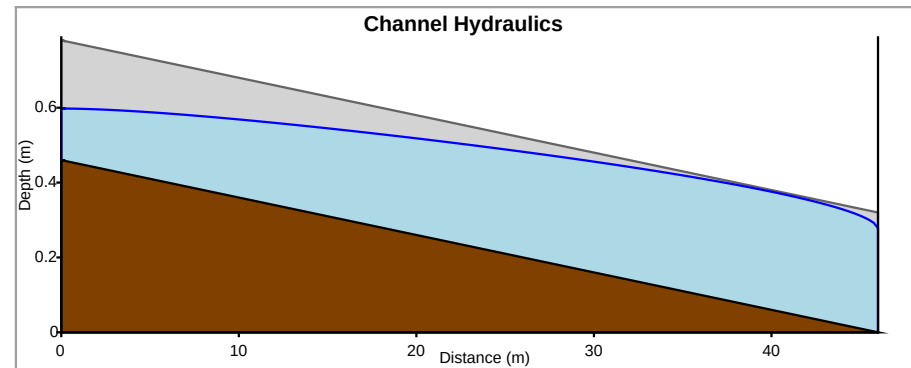
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15 mins	53.44
30 mins	33.61
1 hour	20.60
2 hours	12.30
4 hours	7.24
6 hours	5.36
10 hours	3.67
24 hours	1.89
48 hours	1.09



OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
60.47	98.27	1.40	0.00	16.61	12.65

1	
System	M200D 20.0
W - Width (mm)	200
H - Invert (mm)	340
Length (m)	46.00





Project Name: Langstone Drainage Design

Designer: Frans Van Eeden

Project Date: 6th July 2023

Location:

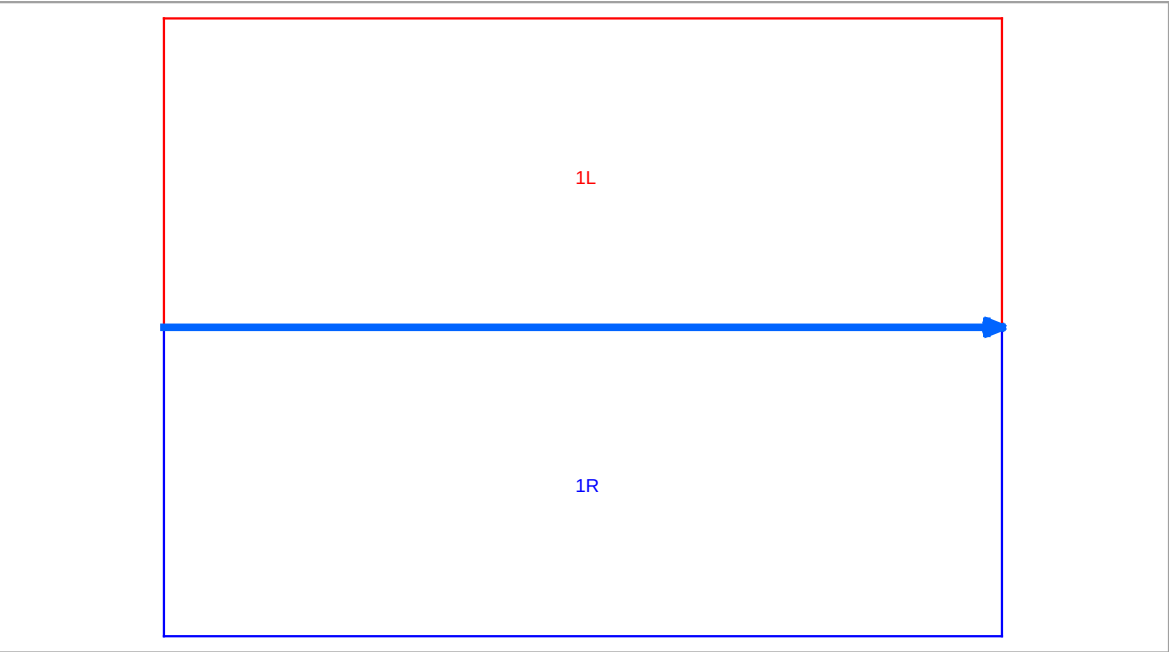
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Project Notes:

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46.00	1,560.04	1.00	0.85	SVF	0	0.00	-	64.00	None	None	0.00

+ CHANNEL LAYOUT



+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	85.68
10 mins	66.24
15 mins	53.44
30 mins	33.61
1 hour	20.60
2 hours	12.30
4 hours	7.24
6 hours	5.36
10 hours	3.67
24 hours	1.89
48 hours	1.09



+ DETAILED RUN REPORT - Page 2

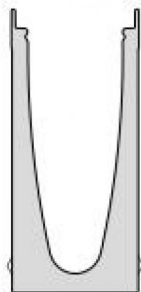
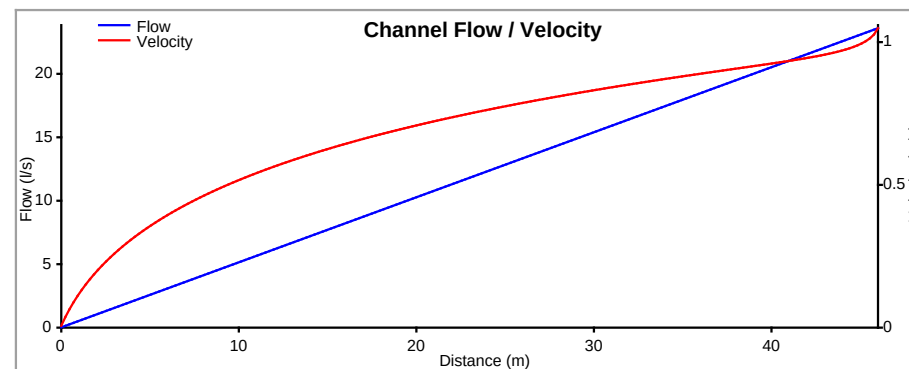
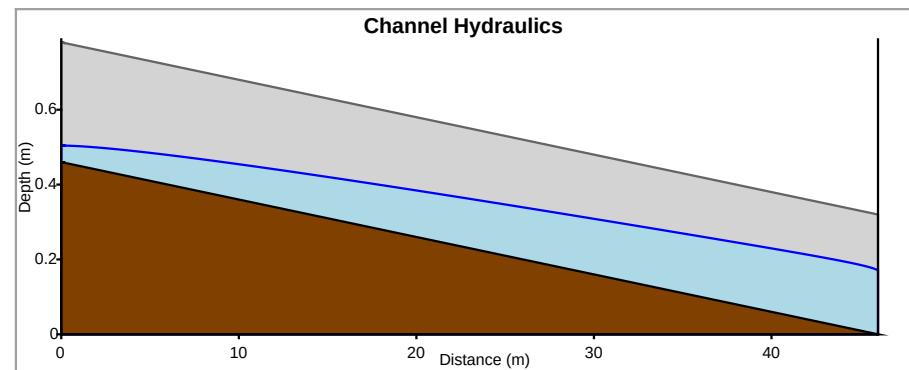


Project Date: 6th July 2023

Print Date: 6th July 2023

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23.60	45.25	1.05	0.14	16.61	12.65

1	
System	M200D 20.0
W - Width (mm)	200
H - Invert (mm)	340
Length (m)	46.00





Project Name: Langstone Drainage Design

Designer: Frans Van Eeden

Project Date: 6th July 2023

Location:

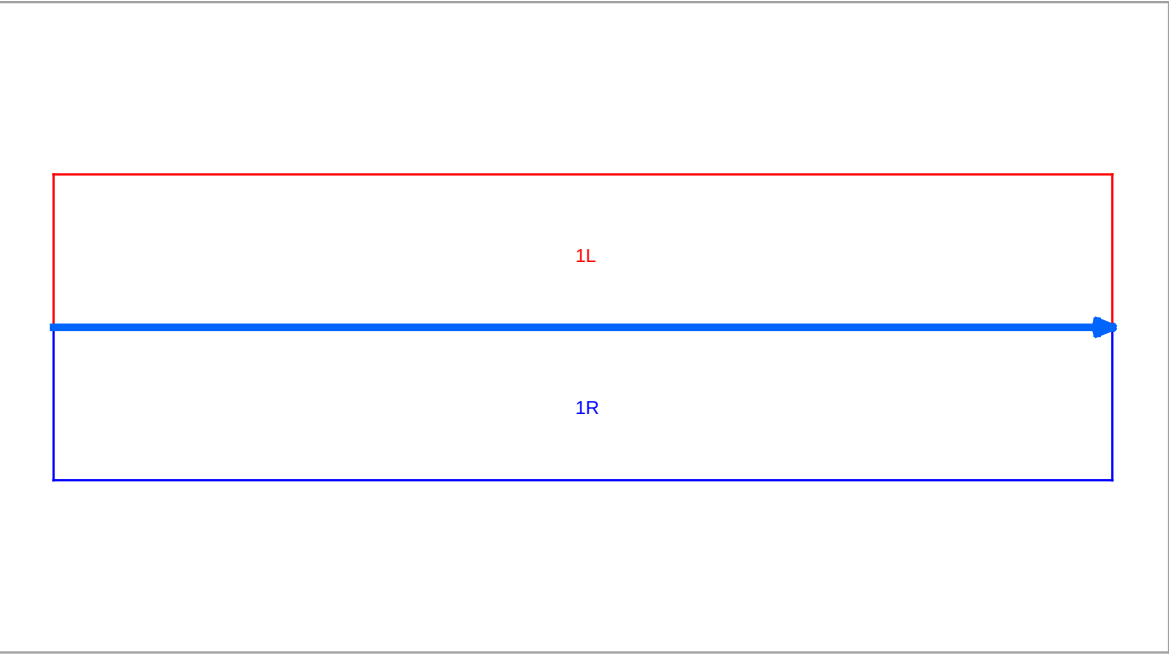
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Project Notes:

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+ CHANNEL LAYOUT



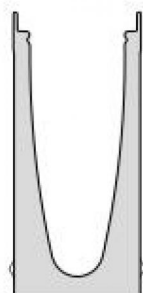
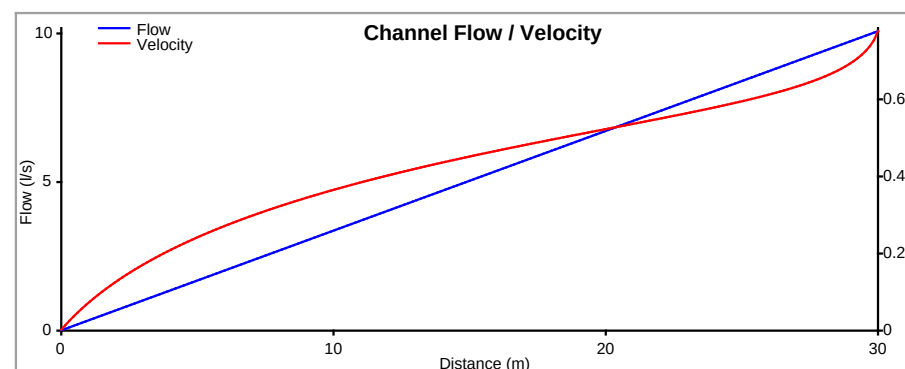
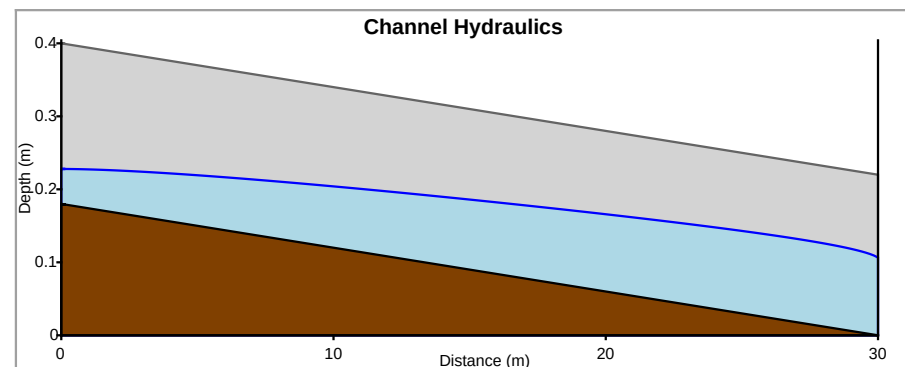
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Duration	Intensity (mm/h)
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10 mins	66.24
15 mins	53.44
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1 hour	20.60
2 hours	12.30
4 hours	7.24
6 hours	5.36
10 hours	3.67
24 hours	1.89
48 hours	1.09



OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
10.08	40.99	0.78	0.11	8.91	7.05

1	
System	M200D 0.0
W - Width (mm)	200
H - Invert (mm)	240
Length (m)	30.00





Project Name: Langstone Drainage Design

Designer: Frans Van Eeden

Project Date: 6th July 2023

Location:

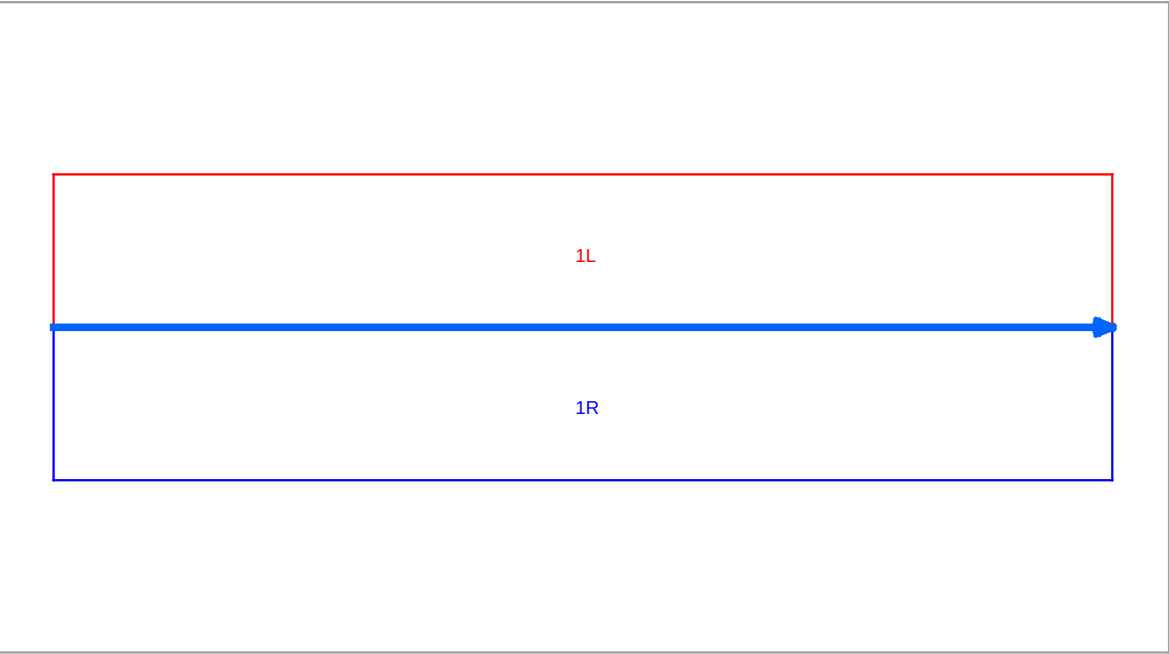
Print Date: 6th July 2023

Project Notes:

+ INPUT DATA:- Run 1: 'Frontage 3', Option C 'Ship_Inn_64'

M5-60: 20mm/hr		Ratio R: 0.4									
LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERM. FACTOR	CALC. EQUATION	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
30.00	259.98	0.60	0.85	SVF	0	0.00	-	64.00	None	None	0.00

+ CHANNEL LAYOUT



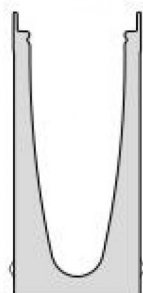
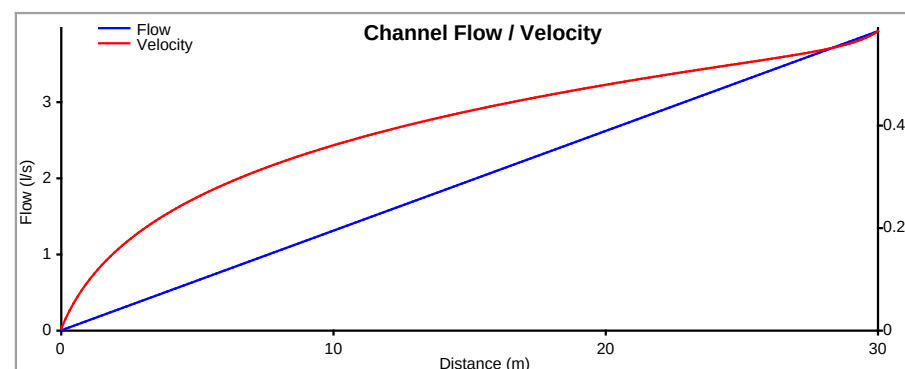
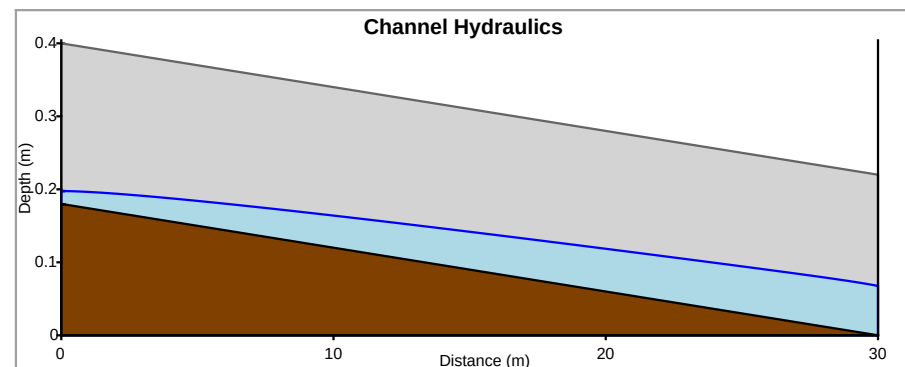
+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	85.68
10 mins	66.24
15 mins	53.44
30 mins	33.61
1 hour	20.60
2 hours	12.30
4 hours	7.24
6 hours	5.36
10 hours	3.67
24 hours	1.89
48 hours	1.09



OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
3.93	19.40	0.58	0.15	8.91	7.05

1	
System	M200D 0.0
W - Width (mm)	200
H - Invert (mm)	240
Length (m)	30.00



Frontage 5: Drainage Calculations

Project Name: Langstone Drainage Design

Designer: Frans Van Eeden

Project Date: 7th July 2023

Location:

Print Date: 7th July 2023

Project Notes:

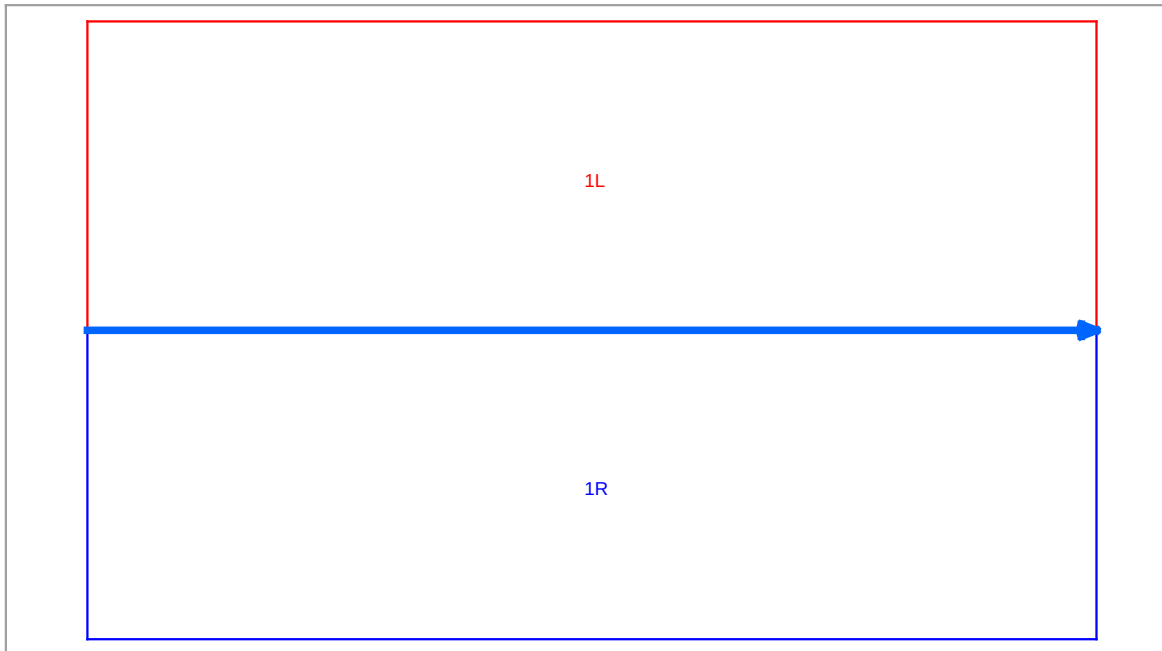
+ INPUT DATA:- Run 2: 'Frontage 5', Option A 'Royal Oak 164mm/hr'

M5-60: 20mm/hr

Ratio R: 0.4

LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERM. FACTOR	CALC. EQUATION	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
21.00	270.02	0.74	0.85	SVF	0	0.00	-	164.00	None	None	0.00

+ CHANNEL LAYOUT



+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	85.68
10 mins	66.24
15 mins	53.44
30 mins	33.61
1 hour	20.60
2 hours	12.30
4 hours	7.24
6 hours	5.36
10 hours	3.67
24 hours	1.89
48 hours	1.09





Project Name: Langstone Drainage Design

Designer: Frans Van Eeden

Project Date: 7th July 2023

Location: nbsp;nbsp;

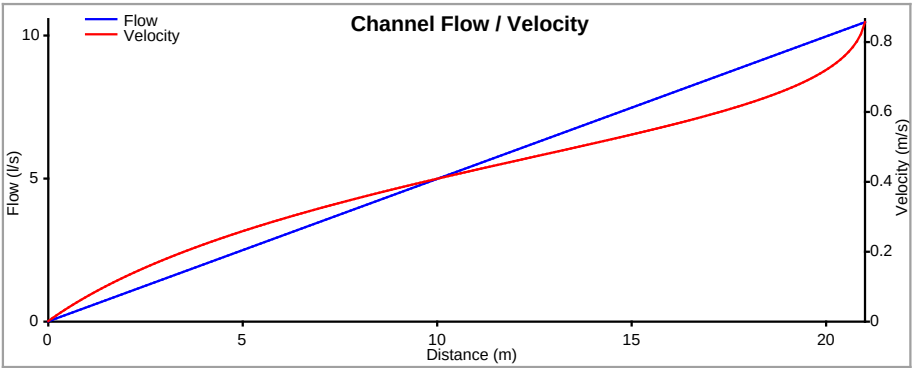
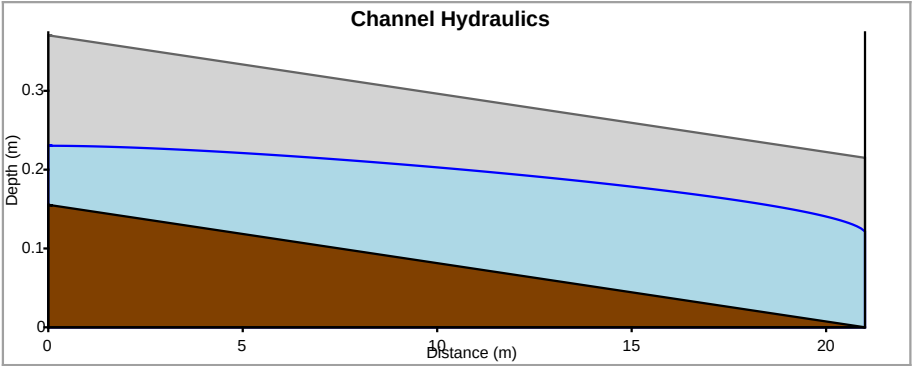
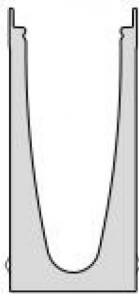
Print Date: 7th July 2023

+ OUTPUTS:- Run 2: 'Frontage 5', Option A 'Royal Oak 164mm/hr'

OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
10.47	55.26	0.86	0.08	5.69	4.68

MultiDrain MD

1	
System	M150D 10.0
W - Width (mm)	150
H - Invert (mm)	235
Length (m)	21.00





Project Name: Langstone Drainage Design

Designer: Frans Van Eeden

Project Date: 7th July 2023

Location:

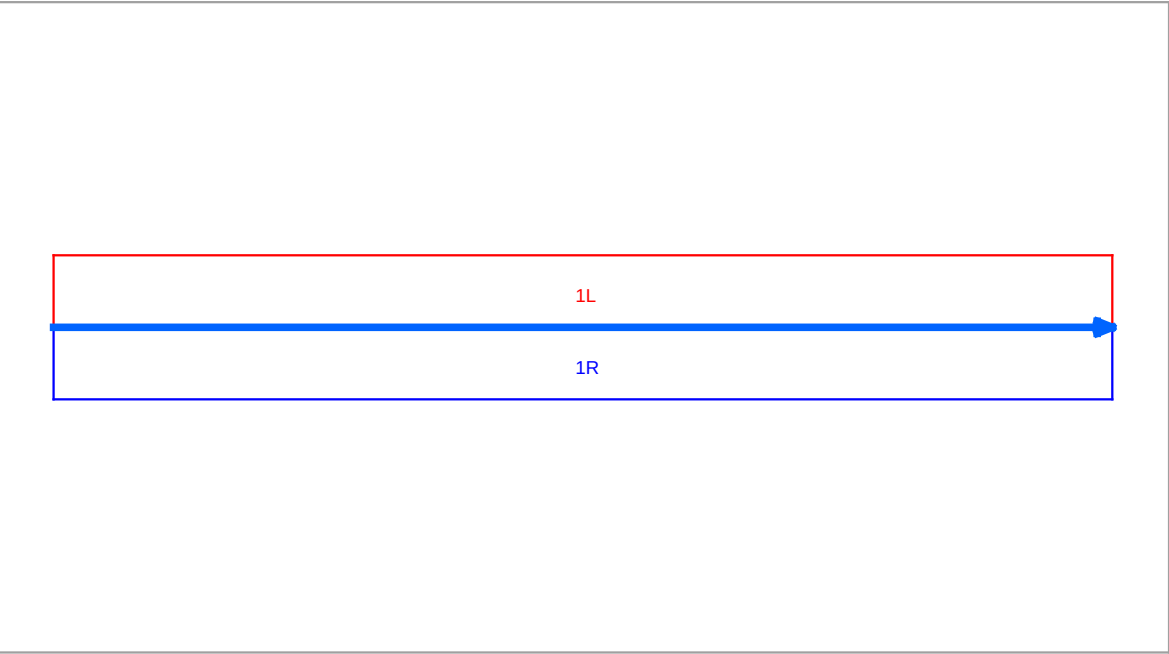
Print Date: 7th July 2023

Project Notes:

+ INPUT DATA:- Run 2: 'Frontage 5', Option B 'Royal Oak 2 164mm/hr'

M5-60: 20mm/hr		Ratio R: 0.4									
LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERM. FACTOR	CALC. EQUATION	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
63.00	540.04	0.60	0.85	SVF	0	0.00	-	164.00	None	None	0.00

+ CHANNEL LAYOUT



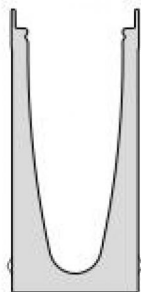
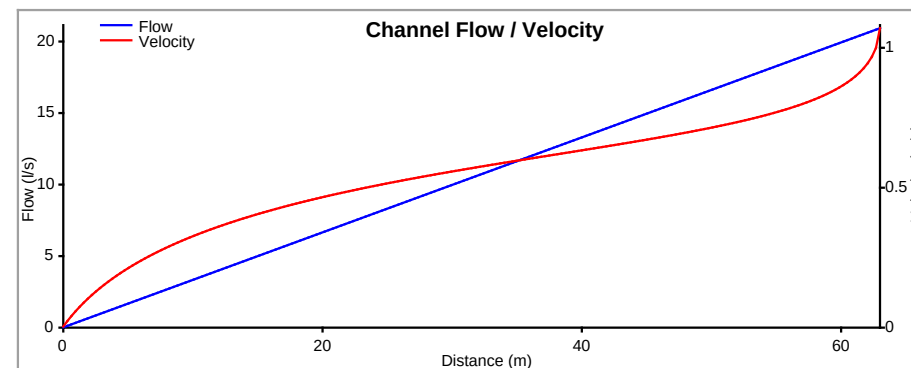
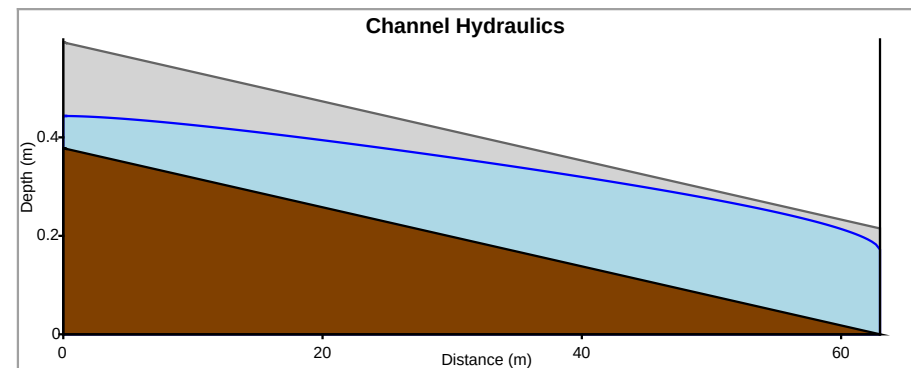
+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	85.68
10 mins	66.24
15 mins	53.44
30 mins	33.61
1 hour	20.60
2 hours	12.30
4 hours	7.24
6 hours	5.36
10 hours	3.67
24 hours	1.89
48 hours	1.09



OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
20.93	91.37	1.07	0.01	17.07	14.05

	1
System	M150D 10.0
W - Width (mm)	150
H - Invert (mm)	235
Length (m)	63.00





Project Name: Langstone Drainage Design

Designer: Frans Van Eeden

Project Date: 7th July 2023

Location:

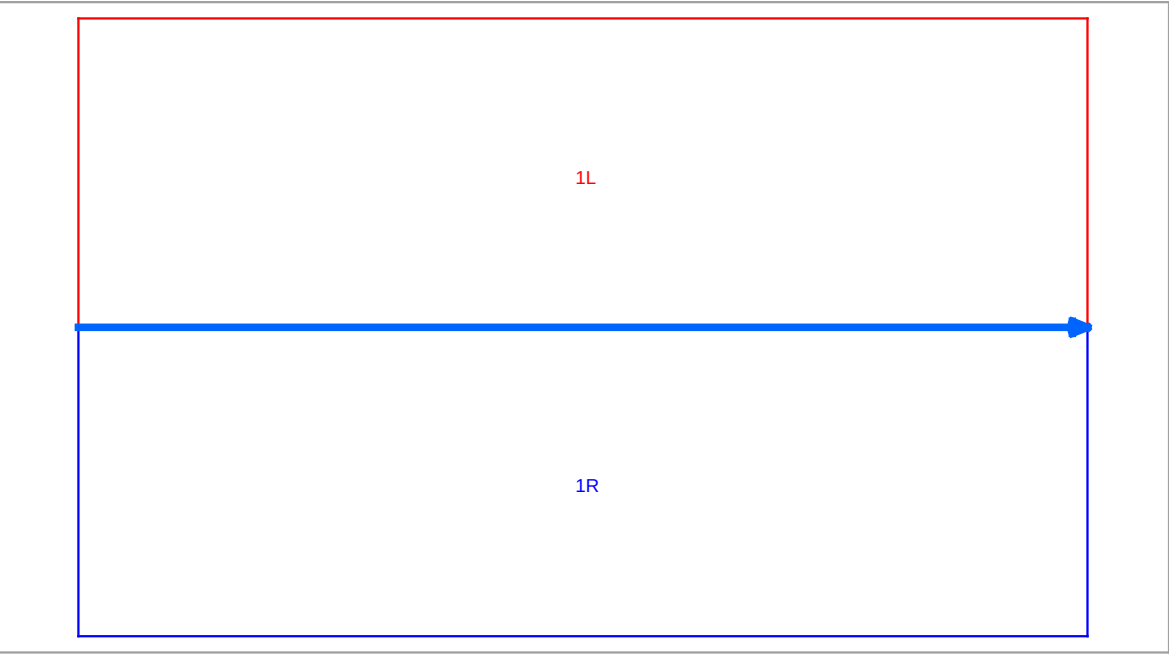
Print Date: 7th July 2023

Project Notes:

+ INPUT DATA:- Run 2: 'Frontage 5', Option C 'Royal Oak 64mm/hr'

M5-60: 20mm/hr		Ratio R: 0.4									
LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERM. FACTOR	CALC. EQUATION	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
21.00	270.02	0.74	0.85	SVF	0	0.00	-	64.00	None	None	0.00

+ CHANNEL LAYOUT



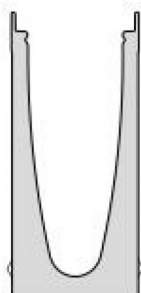
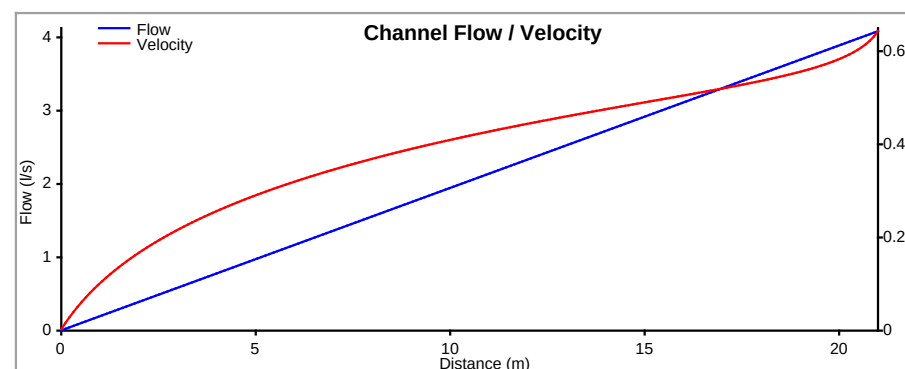
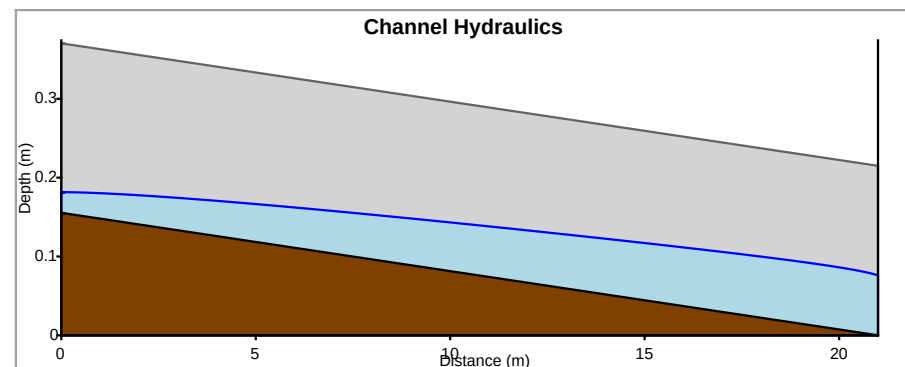
+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	85.68
10 mins	66.24
15 mins	53.44
30 mins	33.61
1 hour	20.60
2 hours	12.30
4 hours	7.24
6 hours	5.36
10 hours	3.67
24 hours	1.89
48 hours	1.09



OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
4.08	25.70	0.64	0.14	5.69	4.68

1	
System	M150D 10.0
W - Width (mm)	150
H - Invert (mm)	235
Length (m)	21.00





Project Name: Langstone Drainage Design

Designer: Frans Van Eeden

Project Date: 7th July 2023

Location:

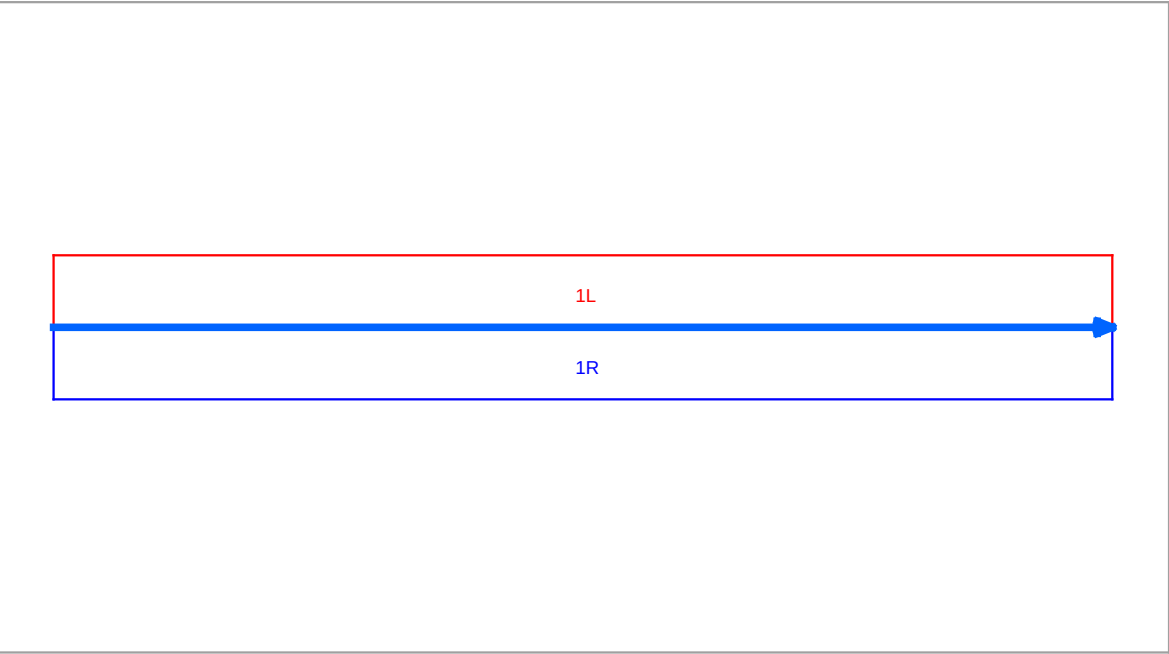
Print Date: 7th July 2023

Project Notes:

+ INPUT DATA:- Run 2: 'Frontage 5', Option D 'Royal Oak 2 64mm/hr'

M5-60: 20mm/hr			Ratio R: 0.4								
LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERM. FACTOR	CALC. EQUATION	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
63.00	540.04	0.60	0.85	SVF	0	0.00	-	64.00	None	None	0.00

+ CHANNEL LAYOUT



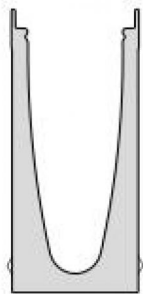
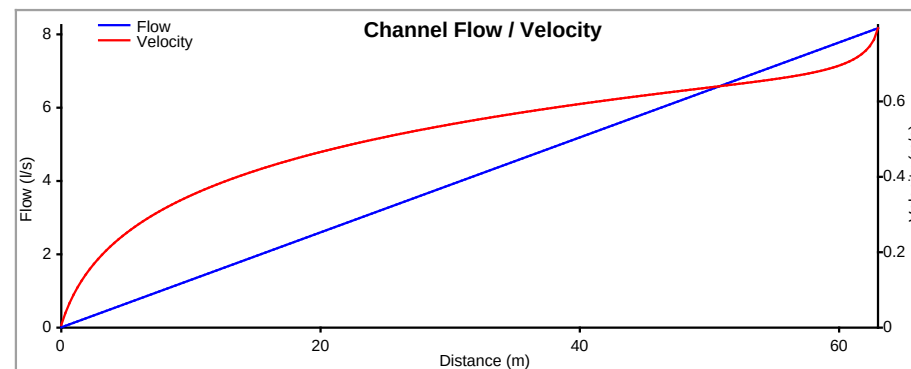
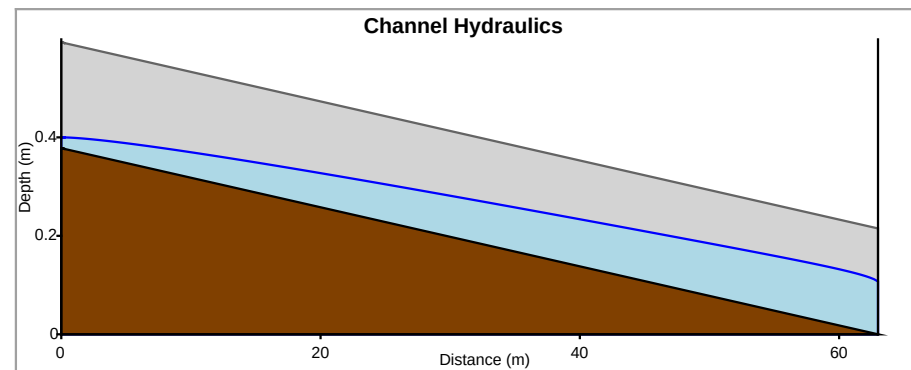
+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	85.68
10 mins	66.24
15 mins	53.44
30 mins	33.61
1 hour	20.60
2 hours	12.30
4 hours	7.24
6 hours	5.36
10 hours	3.67
24 hours	1.89
48 hours	1.09



OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
8.17	43.06	0.79	0.10	17.07	14.05

	1
System	M150D 10.0
W - Width (mm)	150
H - Invert (mm)	235
Length (m)	63.00



Appendix B Drainage Details

Load Class	A 15	B 125	C 250	D 400*
Minimum	X	150	150	150
Dimensions (mm)	Y	Full Gully Height (Less Y2 where applicable)	150	300
	Z	150	150	300

* e.g. parking areas for all types of road vehicle.

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NBS Specification:
ACO Universal Gully should be specified in section Q10:180. Assistance in completing this clause can be found in ACO Technologies product entries in NBS Plus, or a model specification can be downloaded from www.aco.co.uk. For further assistance, contact the ACO Water Management Design Services Team.

Best Practice and Workmanship:
ACO can give guidance with respect to the most suitable methods of installation for each of the products in the ACO Universal Gully range. ACO Universal Gully should be installed using levels of workmanship that accord with the National Code of Practice (UK: BS8000: Part 14: 1989) and in keeping with EN 1433 (Drainage channels for vehicular and pedestrian areas).

Detailed installation statements and methodologies will vary for all sites as each will have different aspects deserving particular consideration, consequently the relevant approvals should be sought from the consulting engineer and/or the installer.

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1.0 Load Class
Installation recommendations shown are ACO minimum recommendations for BS EN 1433:2002 load class requirements.

2.0 Ground Conditions
The long term performance of a gully installation to sustain vertical and lateral loads depends upon A) ground conditions B) stability of the adjacent pavement and C) a durable concrete bed and surround. The recommended installation detail may require the minimum dimensions to be revised to achieve site specific load class requirements (referred to in 1.0 above).

3.0 Location and Connection with Sub Surface Drainage Guidance
The sump or gully should be positioned at the lowest channel invert point. With the base level, connect pipework, locate gully top if required and concrete the complete assembly in position. Any channels knockouts should remain until channel connection. The channels should then be selected (in numerical order from deepest to shallowest where sloping invert channels are specified) starting from the outlet, to make up the length of channel required and lay out. Install channels in order from the outlet with the arrow on each unit pointing to the outlet (flow direction) and ensure the channels butt together so that the male and female details locate positively.
Note: For any channel system, sump/gully unit end plates will need to be cut to match the invert depth of adjacent channel units.

4.0 Cutting and Joining
Cut out knockouts on gully frame and profile of the channel from the inside of the unit to match the desired adjacent unit. Use an appropriate sealant to create watertight joint between intermediate unit and desired channel face.

5.0 Isolation Joints
The gully must be isolated from the surrounding environment. An isolation joint must be positioned up to 1500mm from the gully wall. Any dowel bars must be located no nearer than 150mm from the gully wall. Other isolation joints in surrounding slab must be continued through the gully. Additional crack control may be required to comply with specifier requirements.

6.0 Temporary Installation
A gully installation is not complete until the final surfacing is laid. In any temporary condition, i.e. with the gully frame projecting above adjacent ground, site traffic should not cross gullies. Loose boards, stone fill or cover plates will not protect the gully frame. A temporary gully crossing should be formed by raising the ground level locally, to 3 - 6mm above top of frame, either side of a gully for a distance of 750 to 1000mm, to form ramps. Note that the gully load class should be adequate to carry the site traffic.

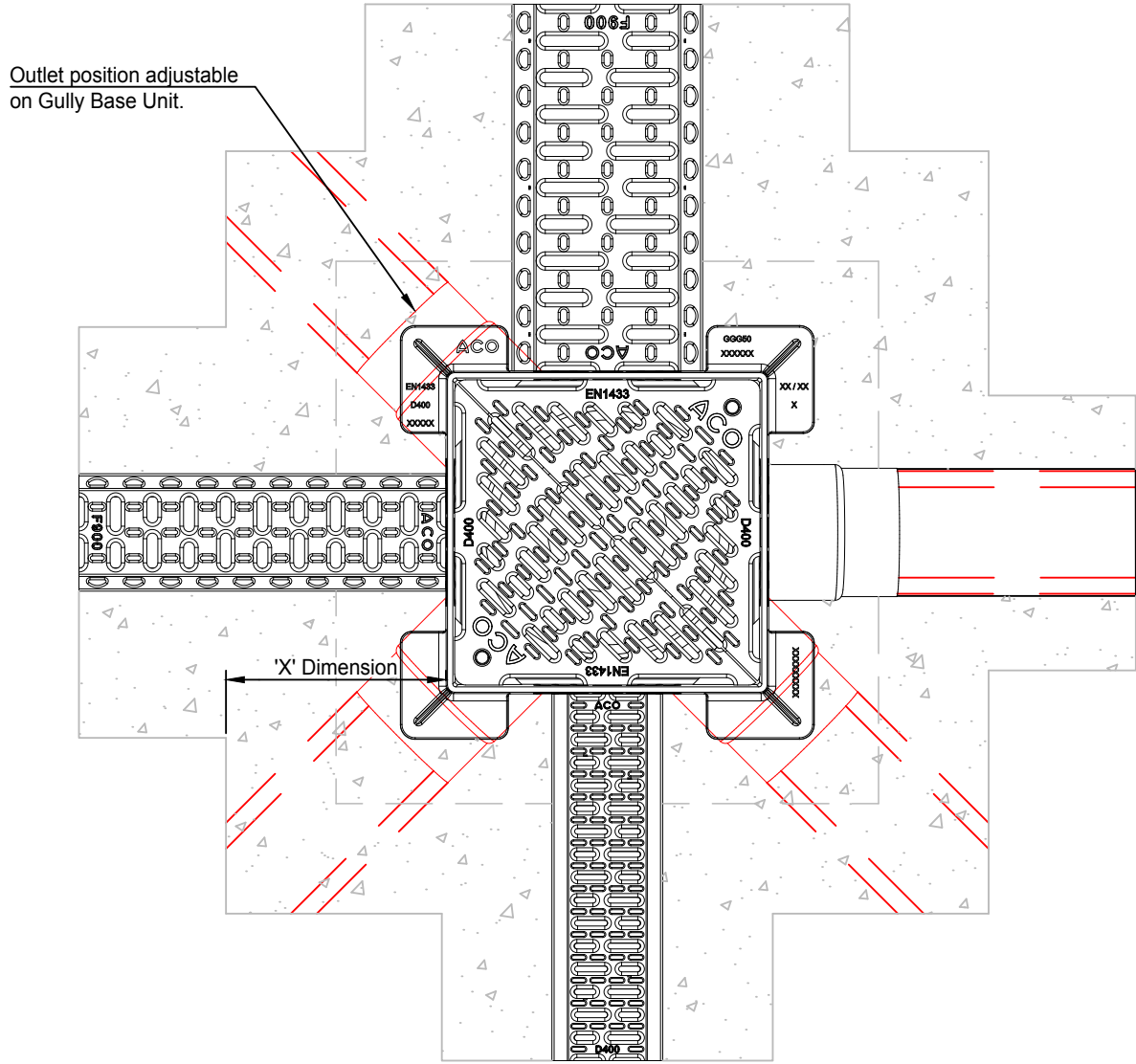
7.0 Concrete Surround and Reinforcement
Ensure that the gully assembly does not float while pouring the concrete.

8.0 Grate Locking System
Gratings should be securely fixed to the gully, where required, using an appropriate grate lock system (where available).

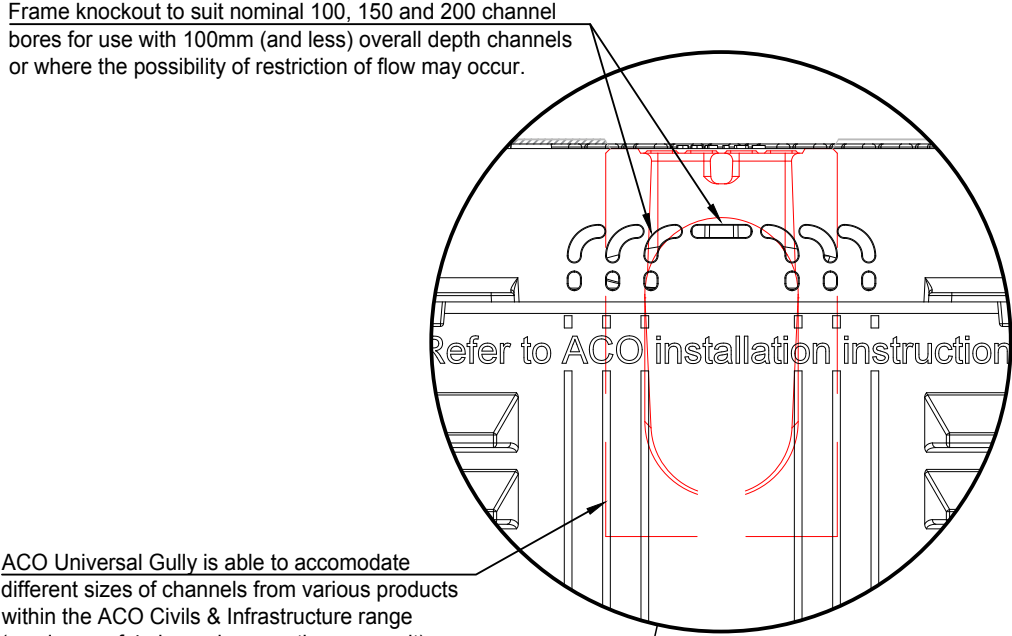
9.0 Channel Protection
Avoid contact between compaction equipment and top of ACO gully frame. The installer must ensure that the finished surface level lies above the top of the frame (by at least 3-6mm). Covering or protecting the frame, before concreting the haunch, removes the time and cost associated with cleaning the gully and frame of cement material and embedded stones.

10.0 Watertight Installation to BS EN 1433:2002
Where ACO Universal Gullies are to be installed with watertight joints, the adjoining channel units must be checked for cleanliness prior to any sealant application. ACO Universal Gullies are tested to confirm compliance with the watertightness requirements of BS EN 1433 when filled with water to the top of the gully frame. Installation must be in accordance with ACO's recommendations and the recommendations of the sealant manufacturer. It is envisaged that the channel joints would not be subject to movement, but any movement of the joint might compromise the watertightness.

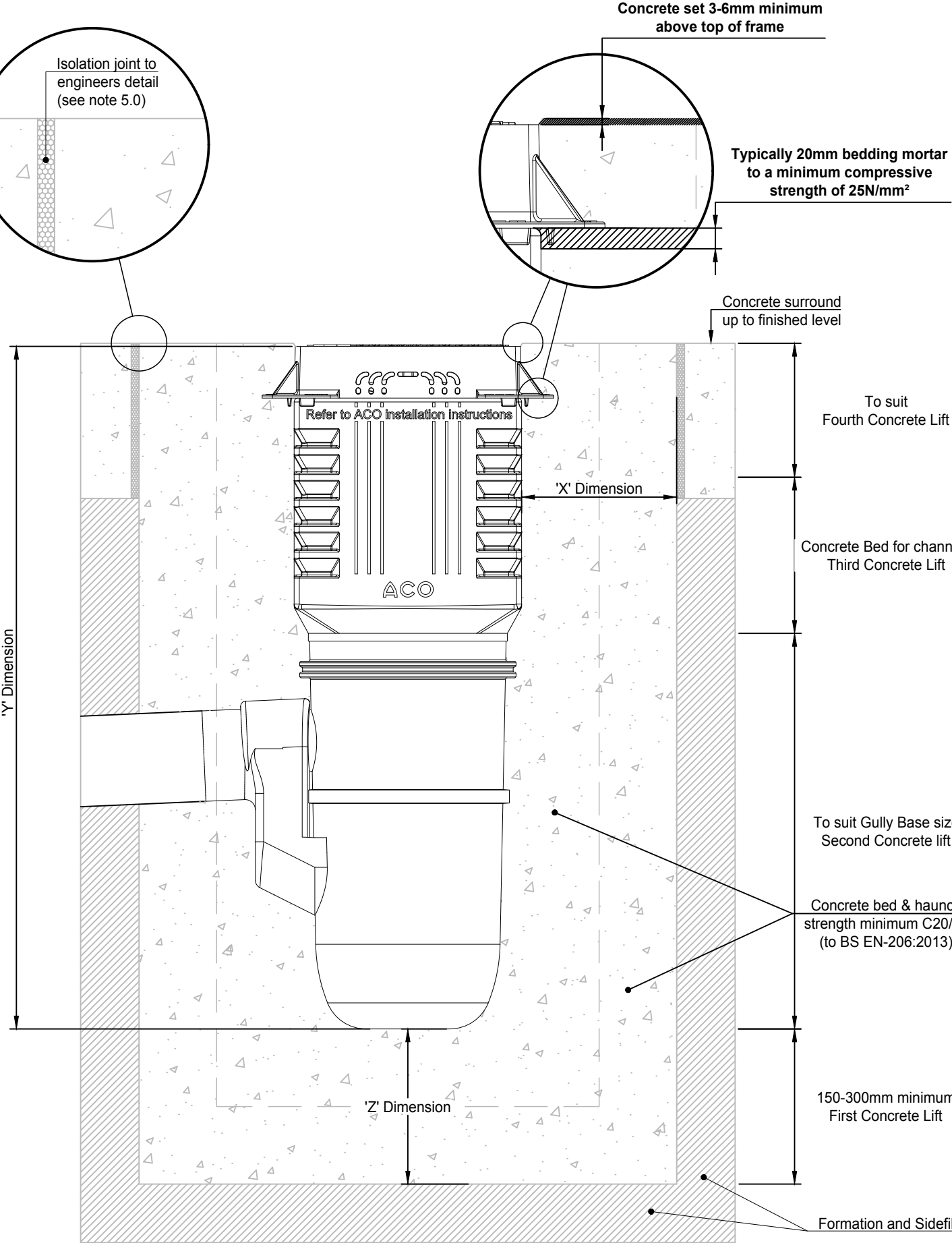
Note: Galvanised steel and iron products have good corrosion resistance to concrete and mortar products but may experience corrosion if high chloride and/or sulphate content is present. Use only good quality concrete and consider using corrosion inhibitors where necessary. The use of protective coatings, such as paint, can minimise the risk of corrosion.



1 : 10 ACO Universal Gully Installation with Various Channels and Outlet Connection



1 : 10 ACO Universal Gully Concrete Pavement with Channel and Outlet Connection



1 : 10 ACO Universal Gully Concrete Pavement

B	12.8.2016	NBS specification amended	TS
Version	Date	Description	Name
	ACO Business Park Hitchin Road Sheffield Bedfordshire SG17 5TE, UK Tel: 01462 816666 www.aco.co.uk	Drawing Number: 22000	Revision: B
		Title: ACO UNIVERSAL GULLY D400 CONCRETE PAVEMENT INSTALLATION DETAIL DRAWING	
Created by: IM	Released by: TS	Projection: ISO-A	Units: mm
Created at: 14.1.2016	Released at: 12.8.2016		Format: A3
Replacement for: E1-E01-019-3	Replaced by:	Information contained in this drawing is copyright property of ACO Technologies plc. Any reproduction in part or whole without written permission of ACO Technologies plc is prohibited.	Scale: 1 : 10
			Sheet: 1 of 1

Load Class		A 15	B 125	C 250	D 400*
Minimum	X	150	150	150	300
Dimensions (mm)	Y	Full Gully Height (Less Y2 where applicable)			
	Z	150	150	150	300
Maximum	Y2	35	35	35	35
Dimensions (mm)	Y3	100	60	60	60

* e.g. parking areas for all types of road vehicle.

A

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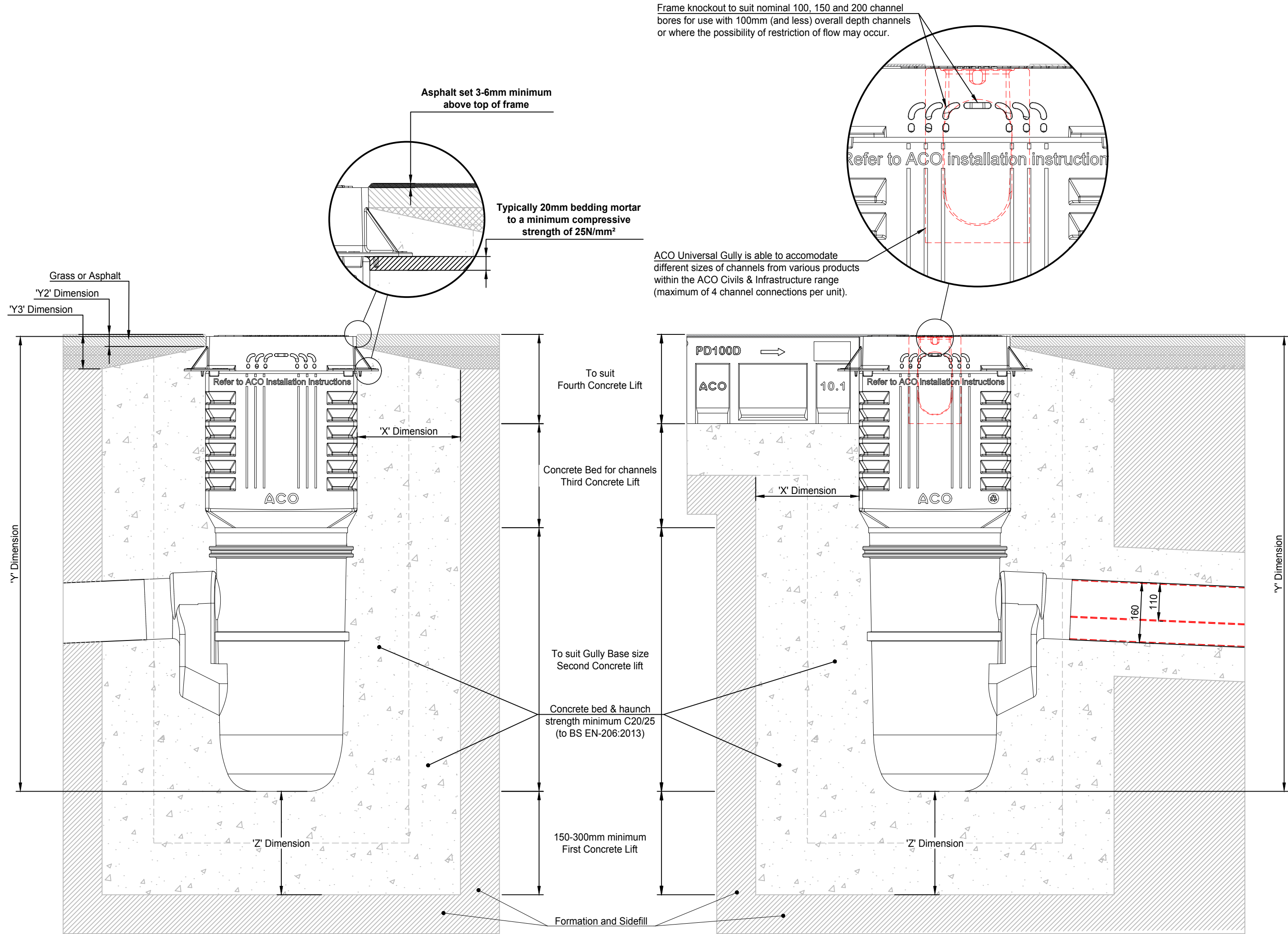
G

H

NBS Specification:
ACO Universal Gully should be specified in section Q10:180. Assistance in completing this clause can be found in ACO Technologies product entries in NBS Plus, or a model specification can be downloaded from www.aco.co.uk. For further assistance, contact the ACO Water Management Design Services Team.

Best Practice and Workmanship:
ACO can give guidance with respect to the most suitable methods of installation for each of the products in the ACO Universal Gully range. ACO Universal Gully should be installed using levels of workmanship that accord with the National Code of Practice (UK: BS8000: Part 14: 1989) and in keeping with EN 1433 (Drainage channels for vehicular and pedestrian areas).

Detailed installation statements and methodologies will vary for all sites as each will have different aspects deserving particular consideration, consequently the relevant approvals should be sought from the consulting engineer and/or the installer.



1 : 10 ACO Universal Gully Grass or Asphalt Pavement

1 : 10 ACO Universal Gully Grass or Asphalt Pavement with Channel and Outlet Connection

1.0 Load Class
Installation recommendations shown are ACO minimum recommendations for BS EN 1433:2002 load class requirements.

2.0 Ground Conditions
The long term performance of a gully installation to sustain vertical and lateral loads depends upon A) ground conditions B) stability of the adjacent pavement and C) a durable concrete bed and surround. The recommended installation detail may require the minimum dimensions to be revised to achieve site specific load class requirements (referred to in 1.0 above).

3.0 Location and Connection with Sub Surface Drainage Guidance
The sump or gully should be positioned at the lowest channel invert point. With the base level, connect pipework, locate gully top if required and concrete the complete assembly in position. Any channels knockouts should remain until channel connection. The channels should then be selected (in numerical order from deepest to shallowest where sloping invert channels are specified) starting from the outlet, to make up the length of channel required and lay out. Install channels in order from the outlet with the arrow on each unit pointing to the outlet (flow direction) and ensure the channels butt together so that the male and female details locate positively.
Note: For any channel system, sump/gully unit end plates will need to be cut to match the invert depth of adjacent channel units.

4.0 Cutting and Joining
Cut out knockouts on gully frame and profile of the channel from the inside of the unit to match the desired adjacent unit. Use an appropriate sealant to create watertight joint between intermediate unit and desired channel face.

5.0 Isolation Joints
The gully must be isolated from the surrounding environment. An isolation joint must be positioned up to 1500mm from the gully wall. Any dowel bars must be located no nearer than 150mm from the gully wall. Other isolation joints in surrounding slab must be continued through the gully. Additional crack control may be required to comply with specifier requirements.

6.0 Temporary Installation
A gully installation is not complete until the final surfacing is laid. In any temporary condition, i.e. with the gully frame projecting above adjacent ground, site traffic should not cross gullies. Loose boards, stone fill or cover plates will not protect the gully frame. A temporary gully crossing should be formed by raising the ground level locally, to 3 - 6mm above top of frame, either side of a gully for a distance of 750 to 1000mm, to form ramps. Note that the gully load class should be adequate to carry the site traffic.

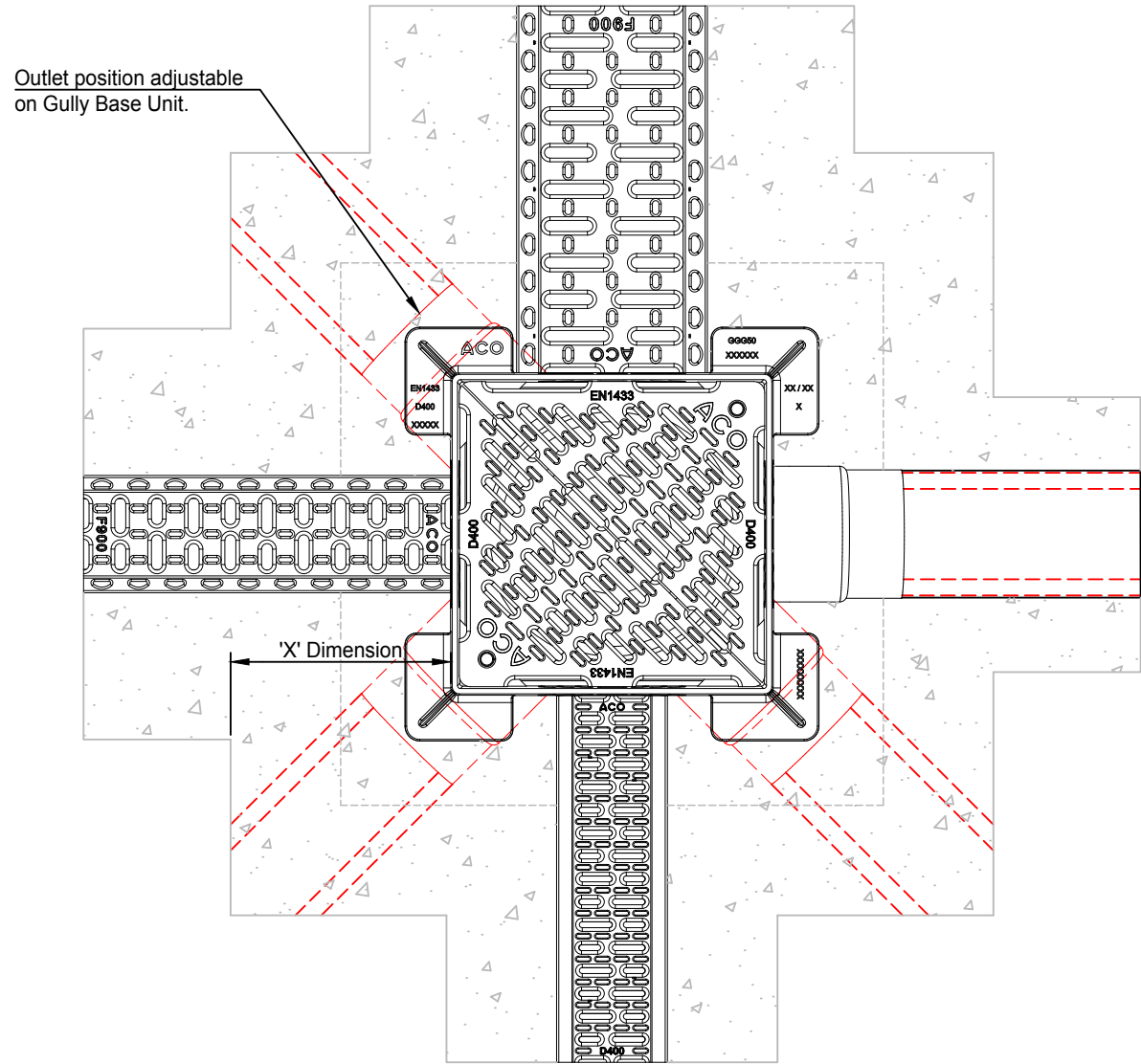
7.0 Concrete Surround and Reinforcement
Ensure that the gully assembly does not float while pouring the concrete. The combined depth of the asphalt pavement must not exceed the Y2 and Y3 dimensions given in the table.

8.0 Grate Locking System
Gratings should be securely fixed to the gully, where required, using an appropriate grate lock system (where available).

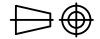
9.0 Channel Protection
Avoid contact between compaction equipment and top of ACO gully frame. The installer must ensure that the finished surface level lies above the top of the frame (by at least 3-6mm). Covering or protecting the frame, before concreting the haunch, removes the time and cost associated with cleaning the gully and frame of cement material and embedded stones.

10.0 Watertight Installation to BS EN 1433:2002
Where ACO Universal Gullies are to be installed with watertight joints, the adjoining channel units must be checked for cleanliness prior to any sealant application. ACO Universal Gullies are tested to confirm compliance with the watertightness requirements of BS EN 1433 when filled with water to the top of the gully frame. Installation must be in accordance with ACO's recommendations and the recommendations of the sealant manufacturer. It is envisaged that the channel joints would not be subject to movement, but any movement of the joint might compromise the watertightness.

Note: Galvanised steel and iron products have good corrosion resistance to concrete and mortar products but may experience corrosion if high chloride and/or sulphate content is present. Use only good quality concrete and consider using corrosion inhibitors where necessary. The use of protective coatings, such as paint, can minimise the risk of corrosion.



1 : 10 ACO Universal Gully Installation with Various Channels and Outlet Connection

B	12.8.2016	NBS specification amended	TS
Version	Date	Description	Name
	ACO Business Park Hitchin Road Sheffield Bedfordshire SG17 5TE, UK Tel: 01462 816666 www.aco.co.uk	Drawing Number: 21999	Revision: B
		Title: ACO UNIVERSAL GULLY D400 ASPHALT PAVEMENT INSTALLATION DETAIL DRAWING	
Created by: IM	Released by: TS	Projection: ISO-A 	Units: mm
Created at: 14.1.2016	Released at: 12.8.2016		Format: A3
Replacement for: E1-E01-019-3	Replaced by:	Information contained in this drawing is copyright property of ACO Technologies plc. Any reproduction in part or whole without written permission of ACO Technologies plc is prohibited.	Scale: 1 : 10
			Sheet: 1 of 1

A

B

C

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H

Load Class		A 15	B 125	C 250	D 400*
Minimum	X	100	150	150	200
Dimensions (mm)	Y	Full Channel Height (Less Y2 where applicable)			
	Z	100	150	150	200
Maximum	Y2	35	35	35	35
Dimensions (mm)	Y3	100	60	60	60

* e.g. parking areas for all types of road vehicle.
Not suitable for carriageway of roads or industrial areas.

A

B

C

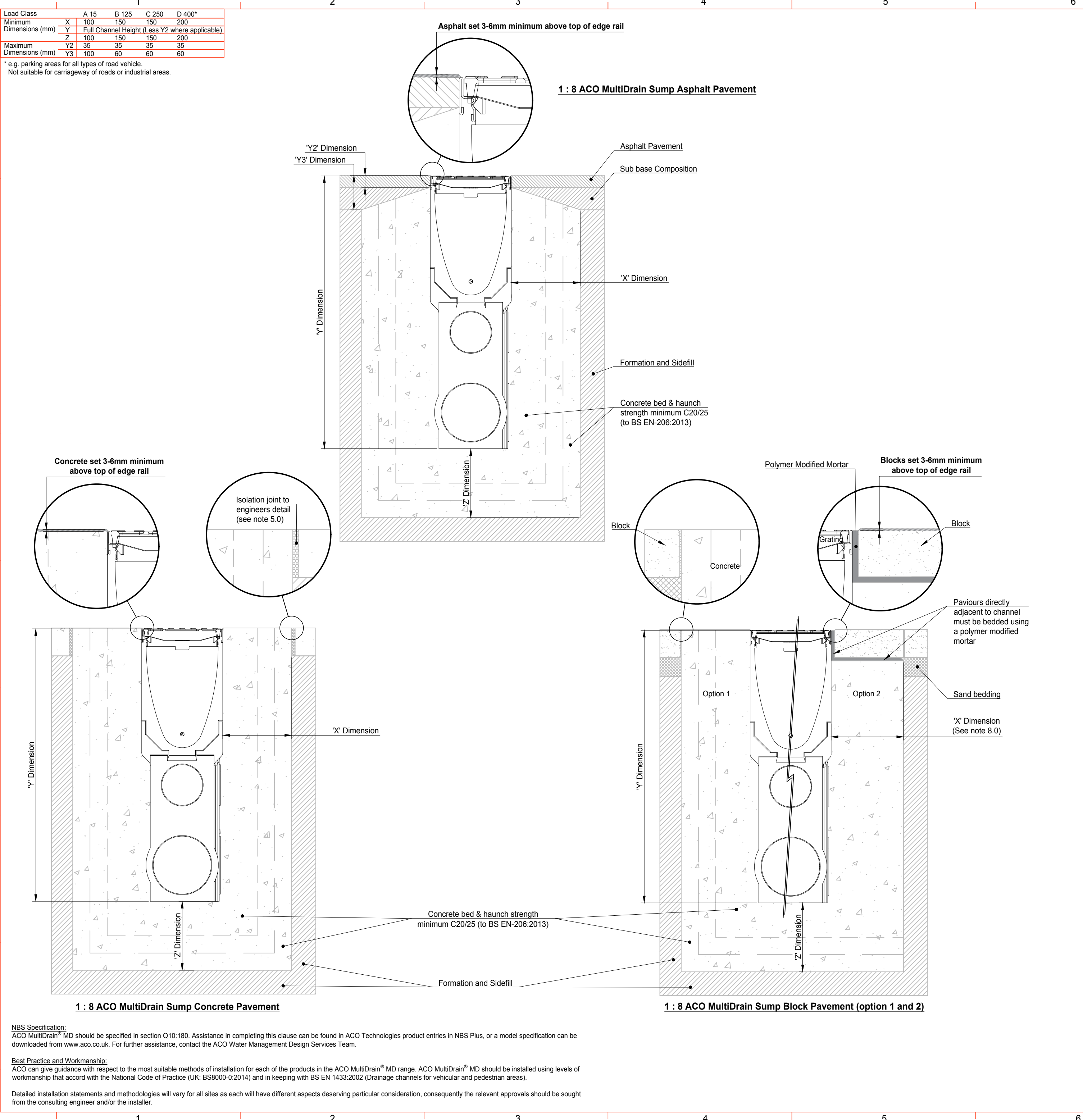
D

E

F

G

H



1.0 Load Class
Installation recommendations shown are ACO minimum recommendations for BS EN 1433:2002 load class requirements.

2.0 Ground Conditions
The long term performance of a channel installation to sustain vertical and lateral loads depends upon A) ground conditions B) stability of the adjacent pavement and C) a durable concrete bed and surround. The recommended installation detail may require the minimum dimensions to be revised to achieve site specific load class requirements (referred to in 1.0 above).

3.0 Location and Connection with Sub Surface Drainage Guidance
The sump or gully should be positioned at the lowest channel invert point. With the base level, connect pipework, locate gully top if required and concrete the complete assembly in position. Any channels knockouts should remain until channel connection. The channels should then be selected (in numerical order from deepest to shallowest where sloping invert channels are specified) starting from the outlet, to make up the length of channel required and lay out. Install channels in order from the outlet with the arrow on each unit pointing to the outlet (flow direction) and ensure the channels are butt together so that the male and female details locate positively.
Note: For any channel system, sump/gully unit end plates will need to be cut to match the invert depth of adjacent channel units.

4.0 Cutting and Joining
Mitre joints are formed by cutting the channels to the required angle and butting them together with appropriate sealant (e.g. Sikaflex 11FC or similar) or ACO Repair Kit. Where possible 90° joints and T's should be formed so that gratings do not have to be cut. Angles can be formed by connecting them using proprietary PVCu pipework attached to ACO inlet/outlet endcaps. For further details please contact ACO Design Services Team.
Note: For Load Classes higher than C 250, mitred joints are not recommended in vehicular areas. Where requested ACO can custom manufacture angled junctions to order.

5.0 Isolation Joints
The channel must be isolated from the surrounding environment. An isolation joint must be positioned up to 1500mm from the channel wall. Any dowel bars must be located no nearer than 150mm from the channel wall. Other isolation joints in surrounding slab must be continued through the channel. Additional crack control may be required to comply with specifier requirements.

6.0 Installation into in-situ Slab
Where a channel is to be installed into an existing concrete slab it is necessary to cut a suitably sized pocket in the slab. The channel will then need to be bedded in polymer modified mortar of 25mm minimum thickness (this may vary depending on the type of mortar used). Engineering advice may be necessary.

7.0 Temporary Installation
A channel installation is not complete until the final surfacing is laid. In any temporary condition, i.e. with the channel walls projecting above adjacent ground, site traffic should not cross channels. Loose boards, stone fill or cover plates will not protect the channel walls or grating. A temporary channel crossing should be formed by raising the ground level locally, to 3 - 6mm above top of edge rail, either side of a channel for a distance of 750 to 1000mm, to form ramps. Note that the channel load class should be adequate to carry the site traffic.

8.0 Block Pavements
The channel must be supported laterally. Blocks laid directly against a channel must be laid as a soldier course and restrained from movement by bedding securely on the concrete haunch e.g. by using a polymer modified mortar for bed and perpendicular joints (e.g. RONAFIX mortar mix C or similar). Blocks or slabs bedded on sand remote from the channel should be set at a higher level to compensate for possible settlement of the paving in service.

9.0 Grate Locking System
Brickslot insert tray should be securely fixed to the channel, where required, using an appropriate grate lock system (where available).

10.0 Channel Protection
Avoid contact between compaction equipment and top of ACO channel edge rail. The installer must ensure that the finished surface level lies above the top of the edge rail (by at least 3-6mm). Covering or protecting the grating, before concreting the haunch or laying blocks, removes the time and cost associated with cleaning the channel and grating of cement material and embedded stones. (Please note that ACO channels must be installed with the grating in place to prevent deformation of the channel).

11.0 Watertight Installation to BS EN 1433:2002
Where ACO channel joints/fittings and channel/pavement interfaces are to be sealed, an appropriate sealant should be used (e.g. Sikaflex 11FC or similar). Guidance on the necessary surface preparation and/or priming should be sought from the sealant manufacturer.

- For Guidance a typical method of application follows:
- The end faces of the channels are to be sound and free from dust, oil, and grease, with any loose material or dirt removed, e.g. by mechanical wire brush. No water drops should be evident.
 - Using a standard cartridge gun, apply the sealant evenly and with no flaws. The detail on the ends of a channel varies from one product to another:
 - Products with a basically flat face - apply the sealant in a layer approximately 5mm thick to one face of the joint.
 - Products with a sealing groove within the end face - apply the sealant in a bead of approximately 10mm diameter into the sealing groove.
 - Products with a sealing groove following the inside shape of the channel - apply the sealant to the end face of the channel and to the sealant groove, such that when the joint is completed, the sealant will both cover the end face and fill the groove.
 - The channel unit should be placed on the prepared concrete bedding and pressed against the previously placed channel unit. A sealed joint of approximately 1-2mm width should be formed between adjacent channel units.
 - Excess sealant should be wiped from the inside face of the channel to leave a smooth finish.
 - The sealant is to be left to cure for 24 hours, during which time the sealant should be kept as dry as possible.

Note: Galvanised steel and iron products have good corrosion resistance to concrete and mortar products but may experience corrosion if high chloride and/or sulphate content is present. Use only good quality concrete and consider using corrosion inhibitors where necessary. The use of protective coatings, such as paint, can minimise the risk of corrosion.

E	24.6.2016	Updated title block	TS
D	22.6.2016	Revised to comments 15/03/16	TS
C	2.3.2016	General revisions	TS
B	8.2.2016	Revision of standard text	TS
Version	Date	Description	Name
		Drawing Number: 21848 Title: ACO MULTIDRAIN M200D/DS UNIVERSAL SUMP INSTALLATION DETAIL DRAWING	Revision: E
Created by: IM	Released by: TS	Projection: ISO-A 	Units: mm
Created at: 11.12.2015	Released at: 24.6.2016		Format: A2
Replaced for: E1-E01-036-3-c	Replaced by:	Information contained in this drawing is copyright property of ACO Technologies plc. Any reproduction in part or whole without written permission of ACO Technologies plc is prohibited	Scale: 1 : 8
			Sheet: 1 of 1

Load Class		A 15	B 125	C 250	D 400*
Minimum	X	100	150	150	200
Dimensions (mm)	Y	Full Channel Height (Less Y2 where applicable)			
	Z	100	150	150	200
Maximum	Y2	35	35	35	35
Dimensions (mm)	Y3	100	60	60	60

* e.g. parking areas for all types of road vehicle.
Not suitable for carriageway of roads or industrial areas.

A

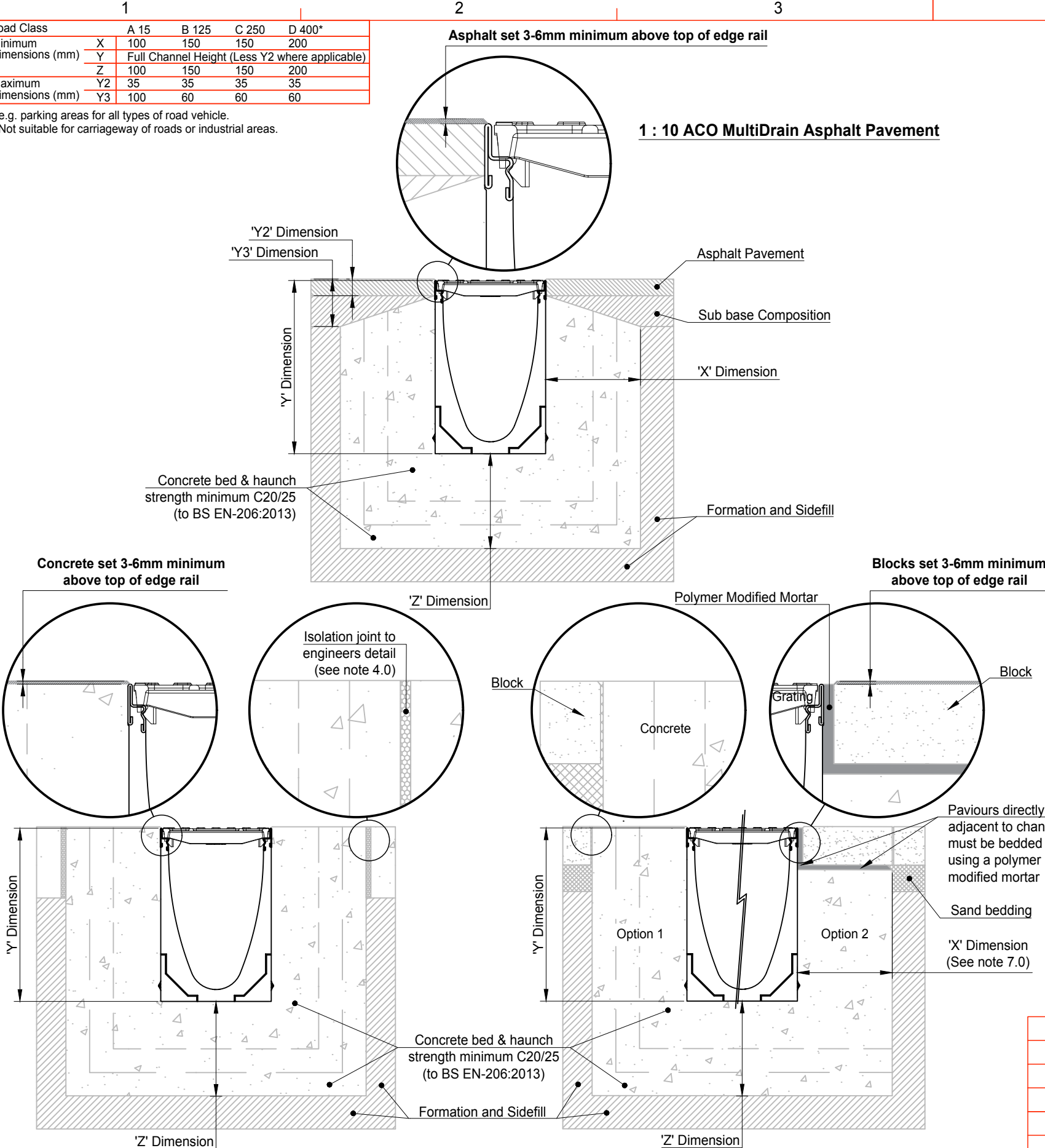
B

C

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F



NBS Specification:
ACO MultiDrain® MD should be specified in section Q10:180. Assistance in completing this clause can be found in ACO Technologies product entries in NBS Plus, or a model specification can be downloaded from www.aco.co.uk. For further assistance, contact the ACO Water Management Design Services Team.

Best Practice and Workmanship:
ACO can give guidance with respect to the most suitable methods of installation for each of the products in the ACO MultiDrain® MD range. ACO MultiDrain® MD should be installed using levels of workmanship that accord with the National Code of Practice (UK: BS8000-0:2014) and in keeping with BS EN 1433:2002 (Drainage channels for vehicular and pedestrian areas).

Detailed installation statements and methodologies will vary for all sites as each will have different aspects deserving particular consideration, consequently the relevant approvals should be sought from the consulting engineer and/or the installer.

1.0 Load Class
Installation recommendations shown are ACO minimum recommendations for BS EN 1433:2002 load class requirements.

2.0 Ground Conditions
The long term performance of a channel installation to sustain vertical and lateral loads depends upon A) ground conditions B) stability of the adjacent pavement and C) a durable concrete bed and surround. The recommended installation detail may require the minimum dimensions to be revised to achieve site specific load class requirements (referred to in 1.0 above).

3.0 Cutting and Jointing
Mitre joints are formed by cutting the channels to the required angle and butting them together with appropriate sealant (e.g. Sikaflex 11FC or similar) or ACO Repair Kit. Where possible 90° joints and T's should be formed so that gratings do not have to be cut. Angles can be formed by connecting them using proprietary PVCu pipework attached to ACO inlet/outlet endcaps. For further details please contact ACO Design Services Team.
Note: For Load Classes higher than C 250, mitred joints are not recommended in vehicular areas. Where requested ACO can custom manufacture angled junctions to order.

4.0 Isolation Joints
The channel must be isolated from the surrounding environment. An isolation joint must be positioned up to 1500mm from the channel wall. Any dowel bars must be located no nearer than 150mm from the channel wall. Other isolation joints in surrounding slab must be continued through the channel. Additional crack control may be required to comply with specifier requirements.

5.0 Installation into in-situ Slab
Where a channel is to be installed into an existing concrete slab it is necessary to cut a suitably sized pocket in the slab. The channel will then need to be bedded in polymer modified mortar of 25mm minimum thickness (this may vary depending on the type of mortar used). Engineering advice may be necessary.

6.0 Temporary Installation
A channel installation is not complete until the final surfacing is laid. In any temporary condition, i.e. with the channel walls projecting above adjacent ground, site traffic should not cross channels. Loose boards, stone fill or cover plates will not protect the channel walls or grating. A temporary channel crossing should be formed by raising the ground level locally, to 3 - 6mm above top of edge rail, either side of a channel for a distance of 750 to 1000mm, to form ramps. Note that the channel load class should be adequate to carry the site traffic.

7.0 Block Pavements
The channel must be supported laterally. Blocks laid directly against a channel must be laid as a soldier course and restrained from movement by bedding securely on the concrete haunch e.g. by using a polymer modified mortar for bed and perpendicular joints (e.g. RONAFIX mortar mix C or similar). Blocks or slabs bedded on sand remote from the channel should be set at a higher level to compensate for possible settlement of the paving in service.

8.0 Grate Locking System
Gratings should be securely fixed to the channel, where required, using an appropriate grate lock system (where available).

9.0 Channel Protection
Avoid contact between compaction equipment and top of ACO channel edge rail. The installer must ensure that the finished surface level lies above the top of the edge rail (by at least 3-6mm). Covering or protecting the grating, before concreting the haunch or laying blocks, removes the time and cost associated with cleaning the channel and grating of cement material and embedded stones. (Please note that ACO channels must be installed with the grating in place to prevent deformation of the channel).

10.0 Watertight Installation to BS EN 1433:2002
Where ACO channel joints/fittings and channel/pavement interfaces are to be sealed, an appropriate sealant should be used (e.g. Sikaflex 11FC or similar). Guidance on the necessary surface preparation and/or priming should be sought from the sealant manufacturer.

- For Guidance a typical method of application follows:**
- The end faces of the channels are to be sound and free from dust, oil, and grease, with any loose material or dirt removed, e.g. by mechanical wire brush. No water drops should be evident.
 - Using a standard cartridge gun, apply the sealant evenly and with no flaws. The detail on the ends of a channel varies from one product to another:
 - Products with a basically flat face - apply the sealant in a layer approximately 5mm thick to one face of the joint.
 - Products with a sealing groove within the end face - apply the sealant in a bead of approximately 10mm diameter into the sealing groove.
 - Products with a sealing groove following the inside shape of the channel - apply the sealant to the end face of the channel and to the sealant groove, such that when the joint is completed, the sealant will both cover the end face and fill the groove.
 - The channel unit should be placed on the prepared concrete bedding and pressed against the previously placed channel unit. A sealed joint of approximately 1-2mm width should be formed between adjacent channel units.
 - Excess sealant should be wiped from the inside face of the channel to leave a smooth finish.
 - The sealant is to be left to cure for 24 hours, during which time the sealant should be kept as dry as possible.

Note: Galvanised steel and iron products have good corrosion resistance to concrete and mortar products but may experience corrosion if high chloride and/or sulphate content is present. Use only good quality concrete and consider using corrosion inhibitors where necessary. The use of protective coatings, such as paint, can minimise the risk of corrosion.

F	24.6.2016	Updated title block	TS
E	18.4.2016	Revised to comments 12/04/16	TS
D	23.3.2016	Revised to comments 15/03/16	TS
C	2.3.2016	General revisions	TS
Version	Date	Description	Name
 ACO Technologies plc		Drawing Number: 21830	Revision: F
		Title: ACO MULTIDRAIN M200D/DS 20.0 CHANNEL INSTALLATION DETAIL DRAWING	
Created by: IM	Released by: TS	Projection: ISO-A 	Units: mm
Created at: 10.12.2015	Released at: 24.6.2016		Format: A3
Replacement for: E1-E01-036-3-c	Replaced by:	Information contained in this drawing is copyright property of ACO Technologies plc. Any reproduction in part or whole without written permission of ACO Technologies plc is prohibited	
			Scale: 1 : 10
			Sheet: 1 of 1

Load Class		A 15	B 125	C 250	D 400*
Minimum	X	100	150	150	200
Dimensions (mm)	Y	Full Channel Height (Less Y2 where applicable)			
	Z	100	150	150	200
Maximum	Y2	35	35	35	35
Dimensions (mm)	Y3	100	60	60	60

* e.g. parking areas for all types of road vehicle.
Not suitable for carriageway of roads or industrial areas.

A

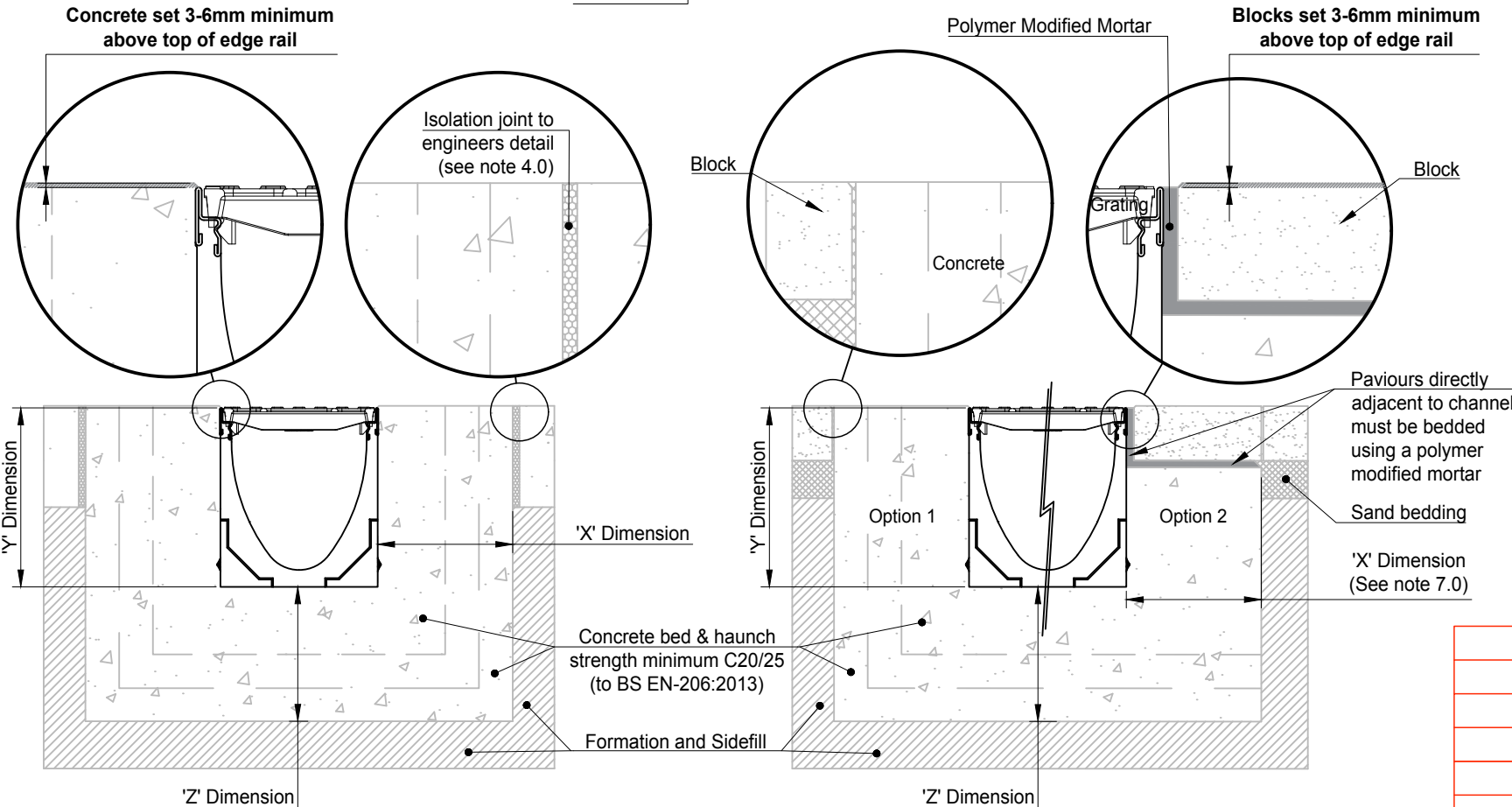
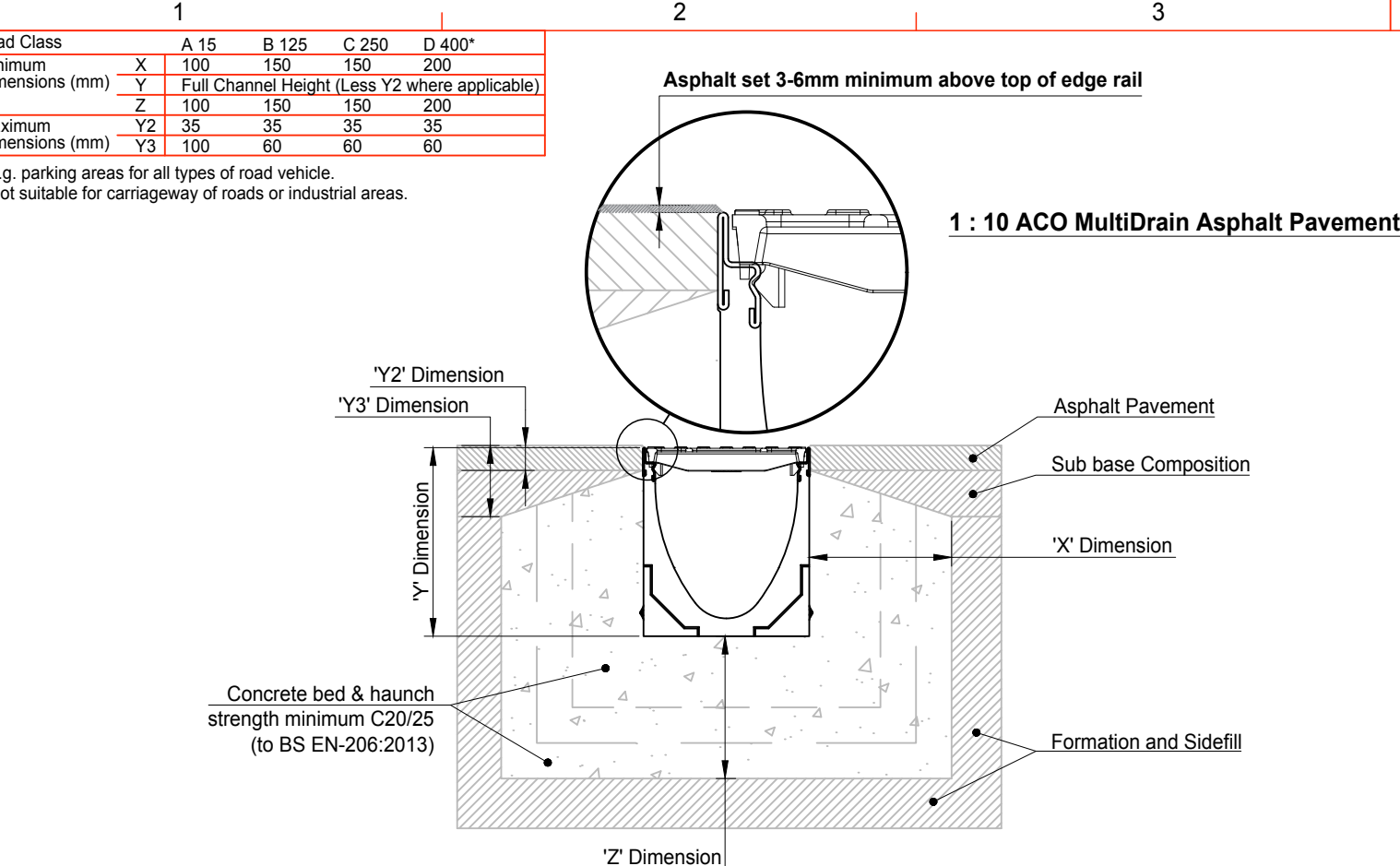
B

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F



1 : 10 ACO MultiDrain Concrete Pavement **1 : 10 ACO MultiDrain Block Pavement (Option 1 and 2)**

NBS Specification:
ACO MultiDrain® MD should be specified in section Q10:180. Assistance in completing this clause can be found in ACO Technologies product entries in NBS Plus, or a model specification can be downloaded from www.aco.co.uk. For further assistance, contact the ACO Water Management Design Services Team.

Best Practice and Workmanship:
ACO can give guidance with respect to the most suitable methods of installation for each of the products in the ACO MultiDrain® MD range. ACO MultiDrain® MD should be installed using levels of workmanship that accord with the National Code of Practice (UK: BS8000-0:2014) and in keeping with BS EN 1433:2002 (Drainage channels for vehicular and pedestrian areas).

Detailed installation statements and methodologies will vary for all sites as each will have different aspects deserving particular consideration, consequently the relevant approvals should be sought from the consulting engineer and/or the installer.

1.0 Load Class
Installation recommendations shown are ACO minimum recommendations for BS EN 1433:2002 load class requirements.

2.0 Ground Conditions
The long term performance of a channel installation to sustain vertical and lateral loads depends upon A) ground conditions B) stability of the adjacent pavement and C) a durable concrete bed and surround. The recommended installation detail may require the minimum dimensions to be revised to achieve site specific load class requirements (referred to in 1.0 above).

3.0 Cutting and Jointing
Mitre joints are formed by cutting the channels to the required angle and butting them together with appropriate sealant (e.g. Sikaflex 11FC or similar) or ACO Repair Kit. Where possible 90° joints and T's should be formed so that gratings do not have to be cut. Angles can be formed by connecting them using proprietary PVCu pipework attached to ACO inlet/outlet endcaps. For further details please contact ACO Design Services Team.
Note: For Load Classes higher than C 250, mitred joints are not recommended in vehicular areas. Where requested ACO can custom manufacture angled junctions to order.

4.0 Isolation Joints
The channel must be isolated from the surrounding environment. An isolation joint must be positioned up to 1500mm from the channel wall. Any dowel bars must be located no nearer than 150mm from the channel wall. Other isolation joints in surrounding slab must be continued through the channel. Additional crack control may be required to comply with specifier requirements.

5.0 Installation into in-situ Slab
Where a channel is to be installed into an existing concrete slab it is necessary to cut a suitably sized pocket in the slab. The channel will then need to be bedded in polymer modified mortar of 25mm minimum thickness (this may vary depending on the type of mortar used). Engineering advice may be necessary.

6.0 Temporary Installation
A channel installation is not complete until the final surfacing is laid. In any temporary condition, i.e. with the channel walls projecting above adjacent ground, site traffic should not cross channels. Loose boards, stone fill or cover plates will not protect the channel walls or grating. A temporary channel crossing should be formed by raising the ground level locally, to 3 - 6mm above top of edge rail, either side of a channel for a distance of 750 to 1000mm, to form ramps. Note that the channel load class should be adequate to carry the site traffic.

7.0 Block Pavements
The channel must be supported laterally. Blocks laid directly against a channel must be laid as a soldier course and restrained from movement by bedding securely on the concrete haunch e.g. by using a polymer modified mortar for bed and perpendicular joints (e.g. RONAFIX mortar mix C or similar). Blocks or slabs bedded on sand remote from the channel should be set at a higher level to compensate for possible settlement of the paving in service.

8.0 Grate Locking System
Gratings should be securely fixed to the channel, where required, using an appropriate grate lock system (where available).

9.0 Channel Protection
Avoid contact between compaction equipment and top of ACO channel edge rail. The installer must ensure that the finished surface level lies above the top of the edge rail (by at least 3-6mm). Covering or protecting the grating, before concreting the haunch or laying blocks, removes the time and cost associated with cleaning the channel and grating of cement material and embedded stones. (Please note that ACO channels must be installed with the grating in place to prevent deformation of the channel).

10.0 Watertight Installation to BS EN 1433:2002
Where ACO channel joints/fittings and channel/pavement interfaces are to be sealed, an appropriate sealant should be used (e.g. Sikaflex 11FC or similar). Guidance on the necessary surface preparation and/or priming should be sought from the sealant manufacturer.

- For Guidance a typical method of application follows:**
- The end faces of the channels are to be sound and free from dust, oil, and grease, with any loose material or dirt removed, e.g. by mechanical wire brush. No water drops should be evident.
 - Using a standard cartridge gun, apply the sealant evenly and with no flaws. The detail on the ends of a channel varies from one product to another:
 - Products with a basically flat face - apply the sealant in a layer approximately 5mm thick to one face of the joint.
 - Products with a sealing groove within the end face - apply the sealant in a bead of approximately 10mm diameter into the sealing groove.
 - Products with a sealing groove following the inside shape of the channel - apply the sealant to the end face of the channel and to the sealant groove, such that when the joint is completed, the sealant will both cover the end face and fill the groove.
 - The channel unit should be placed on the prepared concrete bedding and pressed against the previously placed channel unit. A sealed joint of approximately 1-2mm width should be formed between adjacent channel units.
 - Excess sealant should be wiped from the inside face of the channel to leave a smooth finish.
 - The sealant is to be left to cure for 24 hours, during which time the sealant should be kept as dry as possible.

Note: Galvanised steel and iron products have good corrosion resistance to concrete and mortar products but may experience corrosion if high chloride and/or sulphate content is present. Use only good quality concrete and consider using corrosion inhibitors where necessary. The use of protective coatings, such as paint, can minimise the risk of corrosion.

F	24.6.2016	Updated title block	TS
E	9.6.2016	Revised to comments 12/04/16	TS
D	23.3.2016	Revised to comments 15/03/16	TS
C	2.3.2016	General revisions	TS
Version	Date	Description	Name
 ACO Technologies plc	ACO Business Park Hitchin Road Shefford Bedfordshire SG17 5TE, UK Tel: 01462 816666 www.aco.co.uk	Drawing Number: 21828	Revision: F
		Title: ACO MULTIDRAIN M200D/DS 0.0 CHANNEL INSTALLATION DETAIL DRAWING	
Created by: IM	Released by: TS	Projection: ISO-A 	Units: mm
Created at: 10.12.2015	Released at: 24.6.2016		Format: A3
Replacement for: E1-E01-036-3-c	Replaced by:	Information contained in this drawing is copyright property of ACO Technologies plc. Any reproduction in part or whole without written permission of ACO Technologies plc is prohibited	
		Scale: 1 : 10	
		Sheet: 1 of 1	

Load Class		A 15	B 125	C 250	D 400*
Minimum	X	100	150	150	200
Dimensions (mm)	Y	Full Channel Height (Less Y2 where applicable)			
	Z	100	150	150	200
Maximum	Y2	35	35	35	35
Dimensions (mm)	Y3	100	60	60	60

* e.g. parking areas for all types of road vehicle.
Not suitable for carriageway of roads or industrial areas.

2

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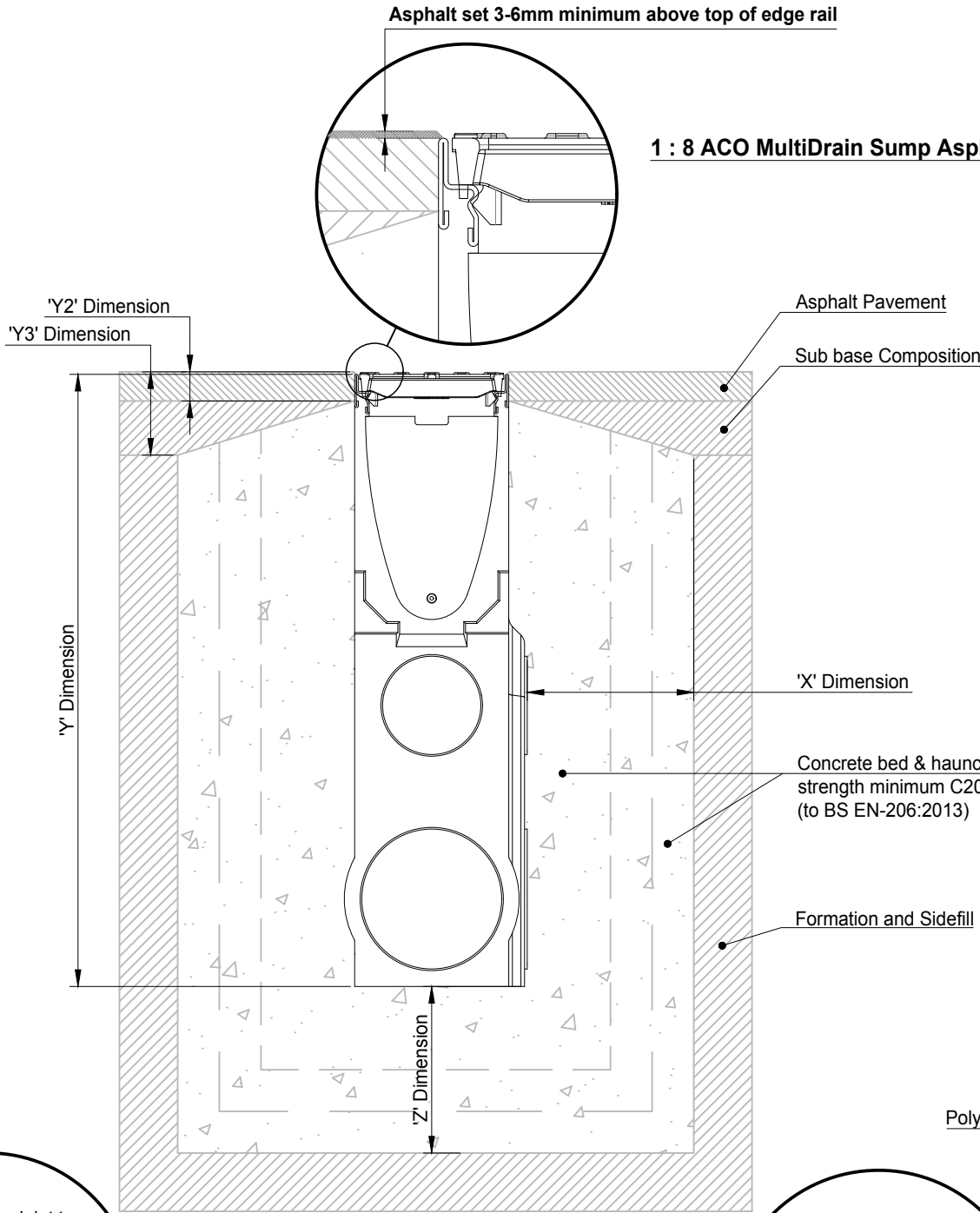
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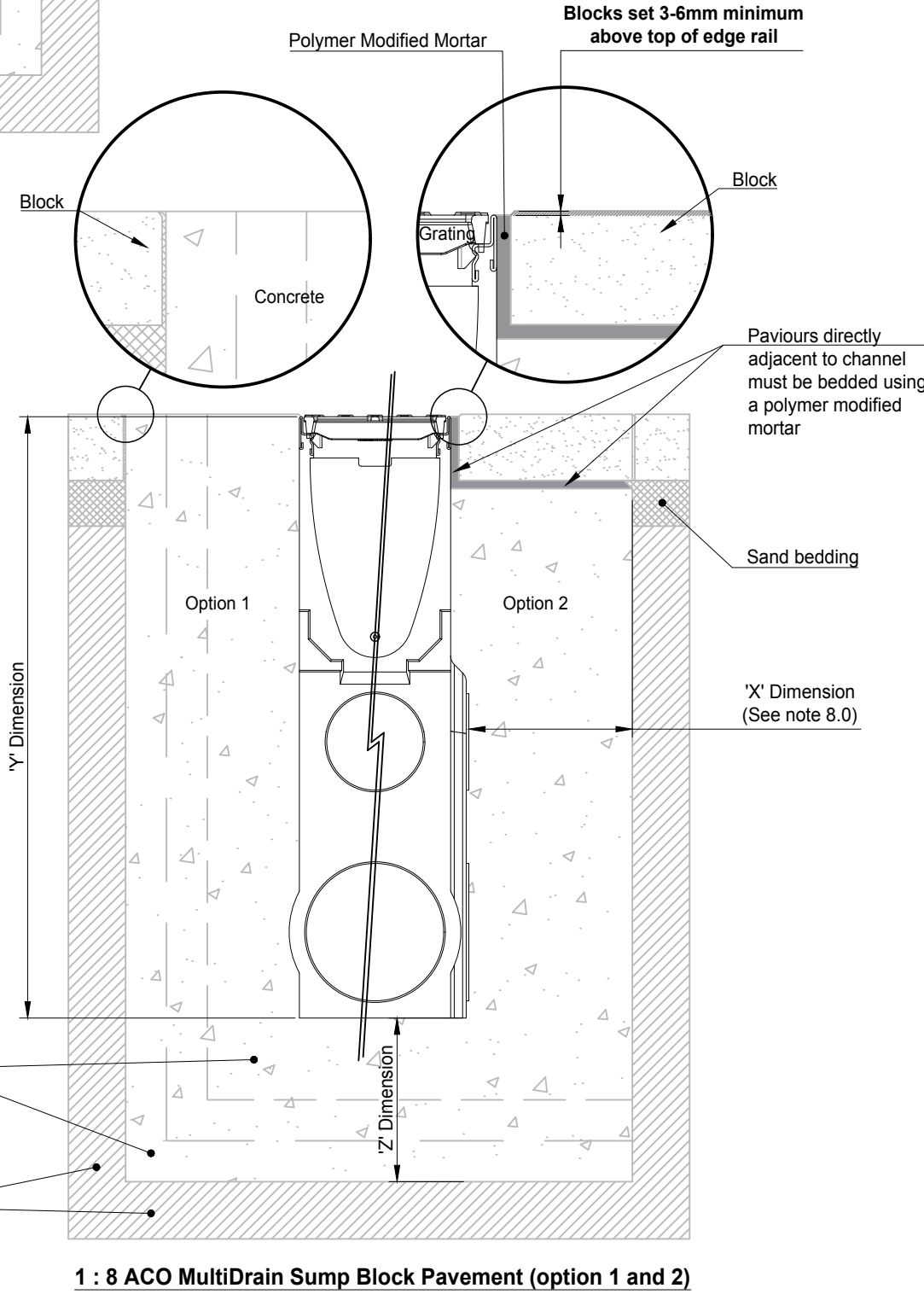
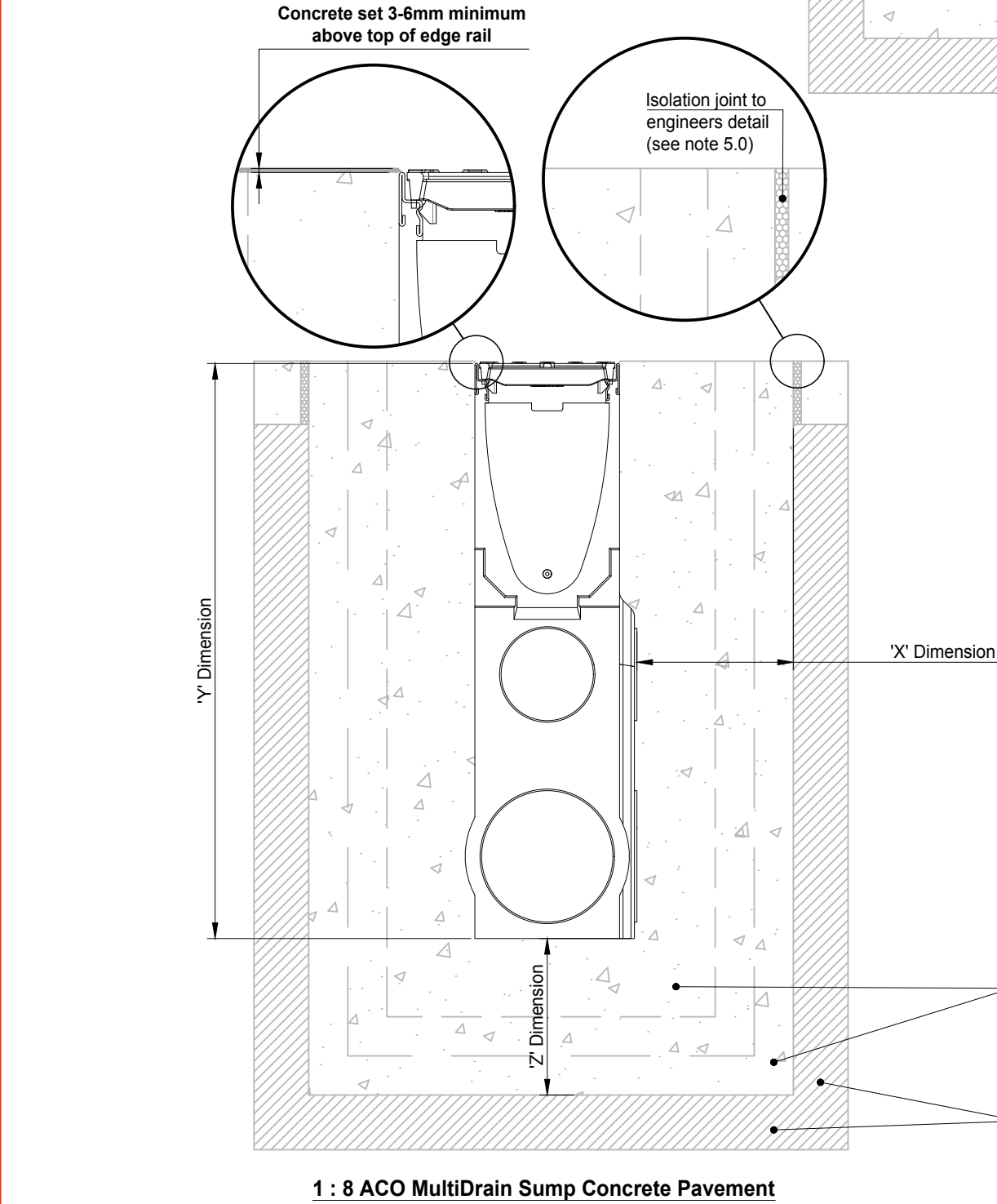
7

8

1 : 8 ACO MultiDrain Sump Asphalt Pavement



- 1.0 Load Class
Installation recommendations shown are ACO minimum recommendations for BS EN 1433:2002 load class requirements.
- 2.0 Ground Conditions
The long term performance of a channel installation to sustain vertical and lateral loads depends upon A) ground conditions B) stability of the adjacent pavement and C) a durable concrete bed and surround. The recommended installation detail may require the minimum dimensions to be revised to achieve site specific load class requirements (referred to in 1.0 above).
- 3.0 Location and Connection with Sub Surface Drainage Guidance
The sump or gully should be positioned at the lowest channel invert point. With the base level, connect pipework, locate gully top if required and concrete the complete assembly in position. Any channels knockouts should remain until channel connection. The channels should then be selected (in numerical order from deepest to shallowest where sloping invert channels are specified) starting from the outlet, to make up the length of channel required and lay out. Install channels in order from the outlet with the arrow on each unit pointing to the outlet (flow direction) and ensure the channels are butt together so that the male and female details locate positively.
Note: For any channel system, sump/gully unit end plates will need to be cut to match the invert depth of adjacent channel units.
- 4.0 Cutting and Joining
Mitre joints are formed by cutting the channels to the required angle and butting them together with appropriate sealant (e.g. Sikaflex 11FC or similar) or ACO Repair Kit. Where possible 90° joints and T's should be formed so that gratings do not have to be cut. Angles can be formed by connecting them using proprietary PVCu pipework attached to ACO inlet/outlet endcaps. For further details please contact ACO Design Services Team.
Note: For Load Classes higher than C 250, mitred joints are not recommended in vehicular areas. Where requested ACO can custom manufacture angled junctions to order.
- 5.0 Isolation Joints
The channel must be isolated from the surrounding environment. An isolation joint must be positioned up to 1500mm from the channel wall. Any dowel bars must be located no nearer than 150mm from the channel wall. Other isolation joints in surrounding slab must be continued through the channel. Additional crack control may be required to comply with specifier requirements.
- 6.0 Installation into in-situ Slab
Where a channel is to be installed into an existing concrete slab it is necessary to cut a suitably sized pocket in the slab. The channel will then need to be bedded in polymer modified mortar of 25mm minimum thickness (this may vary depending on the type of mortar used). Engineering advice may be necessary.
- 7.0 Temporary Installation
A channel installation is not complete until the final surfacing is laid. In any temporary condition, i.e. with the channel walls projecting above adjacent ground, site traffic should not cross channels. Loose boards, stone fill or cover plates will not protect the channel walls or grating. A temporary channel crossing should be formed by raising the ground level locally, to 3 - 6mm above top of edge rail, either side of a channel for a distance of 750 to 1000mm, to form ramps. Note that the channel load class should be adequate to carry the site traffic.
- 8.0 Block Pavements
The channel must be supported laterally. Blocks laid directly against a channel must be laid as a soldier course and restrained from movement by bedding securely on the concrete haunch e.g. by using a polymer modified mortar for bed and perpendicular joints (e.g. RONAFIX mortar mix C or similar). Blocks or slabs bedded on sand remote from the channel should be set at a higher level to compensate for possible settlement of the paving in service.
- 9.0 Grate Locking System
Brickslot insert tray should be securely fixed to the channel, where required, using an appropriate grate lock system (where available).
- 10.0 Channel Protection
Avoid contact between compaction equipment and top of ACO channel edge rail. The installer must ensure that the finished surface level lies above the top of the edge rail (by at least 3-6mm). Covering or protecting the grating, before concreting the haunch or laying blocks, removes the time and cost associated with cleaning the channel and grating of cement material and embedded stones. (Please note that ACO channels must be installed with the grating in place to prevent deformation of the channel).
- 11.0 Watertight Installation to BS EN 1433:2002
Where ACO channel joints/fittings and channel/pavement interfaces are to be sealed, an appropriate sealant should be used (e.g. Sikaflex 11FC or similar). Guidance on the necessary surface preparation and/or priming should be sought from the sealant manufacturer.
- For Guidance a typical method of application follows:
- The end faces of the channels are to be sound and free from dust, oil, and grease, with any loose material or dirt removed, e.g. by mechanical wire brush. No water drops should be evident.
 - Using a standard cartridge gun, apply the sealant evenly and with no flaws. The detail on the ends of a channel varies from one product to another:
 - Products with a basically flat face - apply the sealant in a layer approximately 5mm thick to one face of the joint.
 - Products with a sealing groove within the end face - apply the sealant in a bead of approximately 10mm diameter into the sealing groove.
 - Products with a sealing groove following the inside shape of the channel - apply the sealant to the end face of the channel and to the sealant groove, such that when the joint is completed, the sealant will both cover the end face and fill the groove.
 - The channel unit should be placed on the prepared concrete bedding and pressed against the previously placed channel unit. A sealed joint of approximately 1-2mm width should be formed between adjacent channel units.
 - Excess sealant should be wiped from the inside face of the channel to leave a smooth finish.
 - The sealant is to be left to cure for 24 hours, during which time the sealant should be kept as dry as possible.
- Note: Galvanised steel and iron products have good corrosion resistance to concrete and mortar products but may experience corrosion if high chloride and/or sulphate content is present. Use only good quality concrete and consider using corrosion inhibitors where necessary. The use of protective coatings, such as paint, can minimise the risk of corrosion.



NBS Specification:
ACO MultiDrain® MD should be specified in section Q10:180. Assistance in completing this clause can be found in ACO Technologies product entries in NBS Plus, or a model specification can be downloaded from www.aco.co.uk. For further assistance, contact the ACO Water Management Design Services Team.

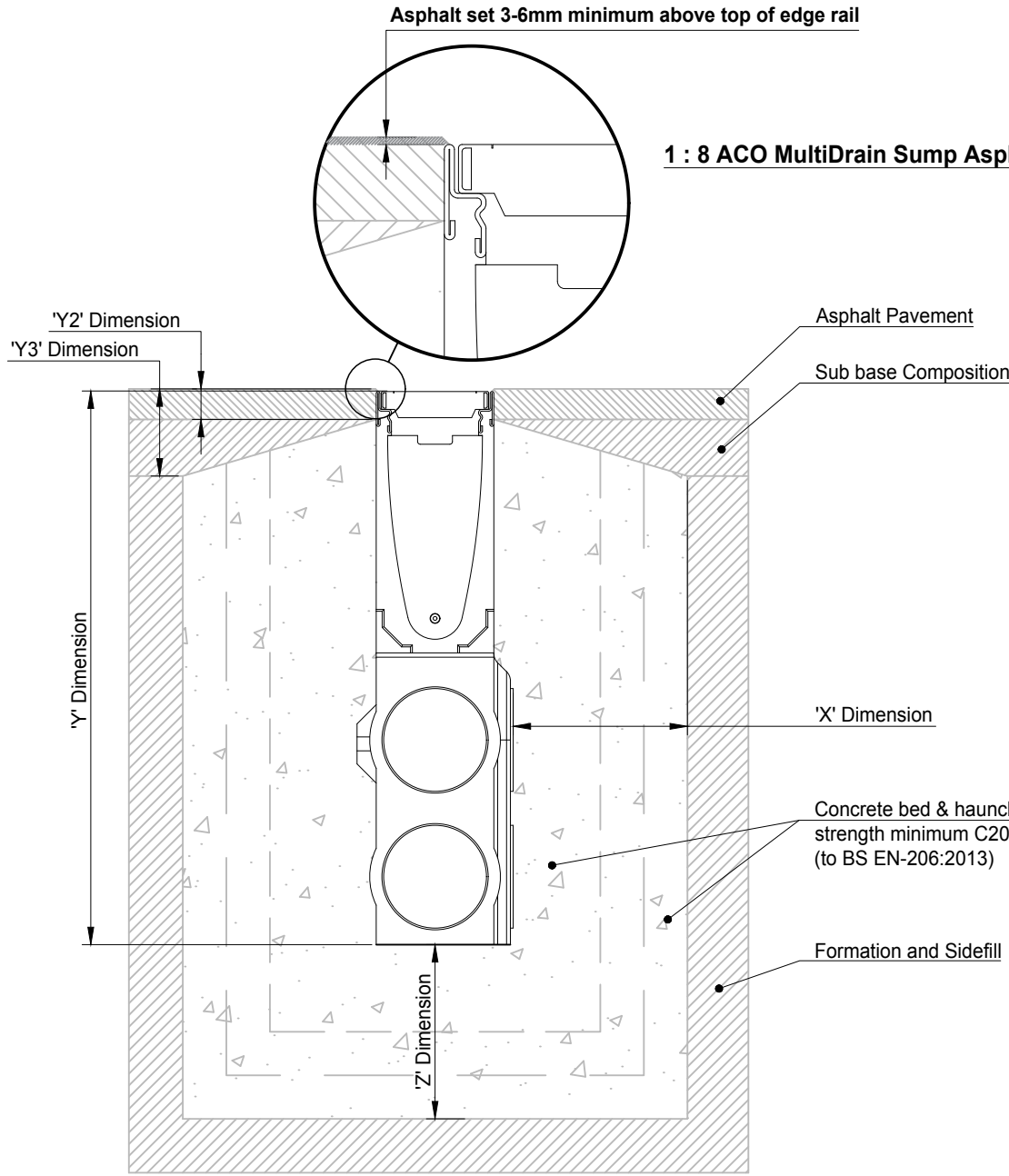
Best Practice and Workmanship:
ACO can give guidance with respect to the most suitable methods of installation for each of the products in the ACO MultiDrain® MD range. ACO MultiDrain® MD should be installed using levels of workmanship that accord with the National Code of Practice (UK: BS8000-0:2014) and in keeping with BS EN 1433:2002 (Drainage channels for vehicular and pedestrian areas).

Detailed installation statements and methodologies will vary for all sites as each will have different aspects deserving particular consideration, consequently the relevant approvals should be sought from the consulting engineer and/or the installer.

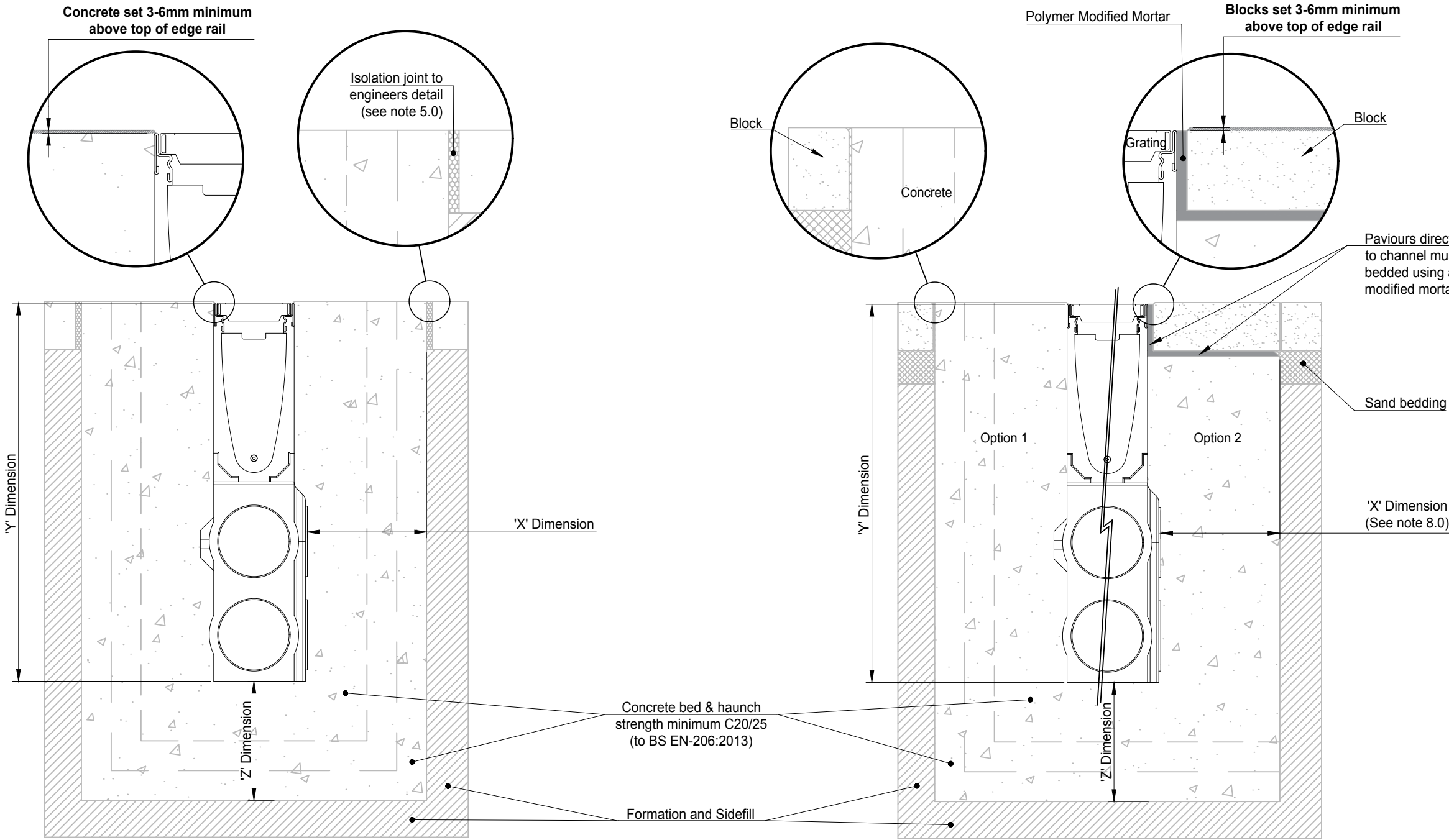
E	24.6.2016	Updated title block	TS
D	15.6.2016	Revised to comments 15/03/16	TS
C	2.3.2016	General revisions	TS
B	8.2.2016	Revision of standard text	TS
Version	Date	Description	Name
		Drawing Number: 21847	Revision: E
		Title: ACO MULTIDRAIN M150D/DS UNIVERSAL SUMP INSTALLATION DETAIL DRAWING	
Created by: IM	Released by: TS	Projection: ISO-A	Units: mm
Created at: 11.12.2015	Released at: 24.6.2016		Format: A2
Replaced for: E1-E01-036-3-c	Replaced by:	Information contained in this drawing is copyright property of ACO Technologies plc. Any reproduction in part or whole without written permission of ACO Technologies plc is prohibited	
			Scale: 1 : 8
			Sheet: 1 of 1

Load Class		A 15	B 125	C 250	D 400*
Minimum	X	100	150	150	200
Dimensions (mm)	Y	Full Channel Height (Less Y2 where applicable)			
	Z	100	150	150	200
Maximum	Y2	35	35	35	35
Dimensions (mm)	Y3	100	60	60	60

* e.g. parking areas for all types of road vehicle.
Not suitable for carriageway of roads or industrial areas.



1 : 8 ACO MultiDrain Sump Asphalt Pavement



1 : 8 ACO MultiDrain Sump Concrete Pavement

1 : 8 ACO MultiDrain Sump Block Pavement (option 1 and 2)

NBS Specification:
ACO MultiDrain® MD should be specified in section Q10:180. Assistance in completing this clause can be found in ACO Technologies product entries in NBS Plus, or a model specification can be downloaded from www.aco.co.uk. For further assistance, contact the ACO Water Management Design Services Team.

Best Practice and Workmanship:
ACO can give guidance with respect to the most suitable methods of installation for each of the products in the ACO MultiDrain® MD range. ACO MultiDrain® MD should be installed using levels of workmanship that accord with the National Code of Practice (UK: BS8000-0:2014) and in keeping with BS EN 1433:2002 (Drainage channels for vehicular and pedestrian areas).

Detailed installation statements and methodologies will vary for all sites as each will have different aspects deserving particular consideration, consequently the relevant approvals should be sought from the consulting engineer and/or the installer.

1.0 Load Class
Installation recommendations shown are ACO minimum recommendations for BS EN 1433:2002 load class requirements.

2.0 Ground Conditions
The long term performance of a channel installation to sustain vertical and lateral loads depends upon A) ground conditions B) stability of the adjacent pavement and C) a durable concrete bed and surround. The recommended installation detail may require the minimum dimensions to be revised to achieve site specific load class requirements (referred to in 1.0 above).

3.0 Location and Connection with Sub Surface Drainage Guidance
The sump or gully should be positioned at the lowest channel invert point. With the base level, connect pipework, locate gully top if required and concrete the complete assembly in position. Any channels knockouts should remain until channel connection. The channels should then be selected (in numerical order from deepest to shallowest where sloping invert channels are specified) starting from the outlet, to make up the length of channel required and lay out. Install channels in order from the outlet with the arrow on each unit pointing to the outlet (flow direction) and ensure the channels are butt together so that the male and female details locate positively.
Note: For any channel system, sump/gully unit end plates will need to be cut to match the invert depth of adjacent channel units.

4.0 Cutting and Joining
Mitre joints are formed by cutting the channels to the required angle and butting them together with appropriate sealant (e.g. Sikaflex 11FC or similar) or ACO Repair Kit. Where possible 90° joints and T's should be formed so that gratings do not have to be cut. Angles can be formed by connecting them using proprietary PVCu pipework attached to ACO inlet/outlet endcaps. For further details please contact ACO Design Services Team.
Note: For Load Classes higher than C 250, mitred joints are not recommended in vehicular areas. Where requested ACO can custom manufacture angled junctions to order.

5.0 Isolation Joints
The channel must be isolated from the surrounding environment. An isolation joint must be positioned up to 1500mm from the channel wall. Any dowel bars must be located no nearer than 150mm from the channel wall. Other isolation joints in surrounding slab must be continued through the channel. Additional crack control may be required to comply with specifier requirements.

6.0 Installation into in-situ Slab
Where a channel is to be installed into an existing concrete slab it is necessary to cut a suitably sized pocket in the slab. The channel will then need to be bedded in polymer modified mortar of 25mm minimum thickness (this may vary depending on the type of mortar used). Engineering advice may be necessary.

7.0 Temporary Installation
A channel installation is not complete until the final surfacing is laid. In any temporary condition, i.e. with the channel walls projecting above adjacent ground, site traffic should not cross channels. Loose boards, stone fill or cover plates will not protect the channel walls or grating. A temporary channel crossing should be formed by raising the ground level locally, to 3 - 6mm above top of edge rail, either side of a channel for a distance of 750 to 1000mm, to form ramps. Note that the channel load class should be adequate to carry the site traffic.

8.0 Block Pavements
The channel must be supported laterally. Blocks laid directly against a channel must be laid as a soldier course and restrained from movement by bedding securely on the concrete haunch e.g. by using a polymer modified mortar for bed and perpendicular joints (e.g. RONAFIX mortar mix C or similar). Blocks or slabs bedded on sand remote from the channel should be set at a higher level to compensate for possible settlement of the paving in service.

9.0 Grate Locking System
Brickslot insert tray should be securely fixed to the channel, where required, using an appropriate grate lock system (where available).

10.0 Channel Protection
Avoid contact between compaction equipment and top of ACO channel edge rail. The installer must ensure that the finished surface level lies above the top of the edge rail (by at least 3-6mm). Covering or protecting the grating, before concreting the haunch or laying blocks, removes the time and cost associated with cleaning the channel and grating of cement material and embedded stones. (Please note that ACO channels must be installed with the grating in place to prevent deformation of the channel).

11.0 Watertight Installation to BS EN 1433:2002
Where ACO channel joints/fitings and channel/pavement interfaces are to be sealed, an appropriate sealant should be used (e.g. Sikaflex 11FC or similar). Guidance on the necessary surface preparation and/or priming should be sought from the sealant manufacturer.

- For Guidance a typical method of application follows:
- The end faces of the channels are to be sound and free from dust, oil, and grease, with any loose material or dirt removed, e.g. by mechanical wire brush. No water drops should be evident.
 - Using a standard cartridge gun, apply the sealant evenly and with no flaws. The detail on the ends of a channel varies from one product to another:
 - Products with a basically flat face - apply the sealant in a layer approximately 5mm thick to one face of the joint.
 - Products with a sealing groove within the end face - apply the sealant in a bead of approximately 10mm diameter into the sealing groove.
 - Products with a sealing groove following the inside shape of the channel - apply the sealant to the end face of the channel and to the sealant groove, such that when the joint is completed, the sealant will both cover the end face and fill the groove.
 - The channel unit should be placed on the prepared concrete bedding and pressed against the previously placed channel unit. A sealed joint of approximately 1-2mm width should be formed between adjacent channel units.
 - Excess sealant should be wiped from the inside face of the channel to leave a smooth finish.
 - The sealant is to be left to cure for 24 hours, during which time the sealant should be kept as dry as possible.

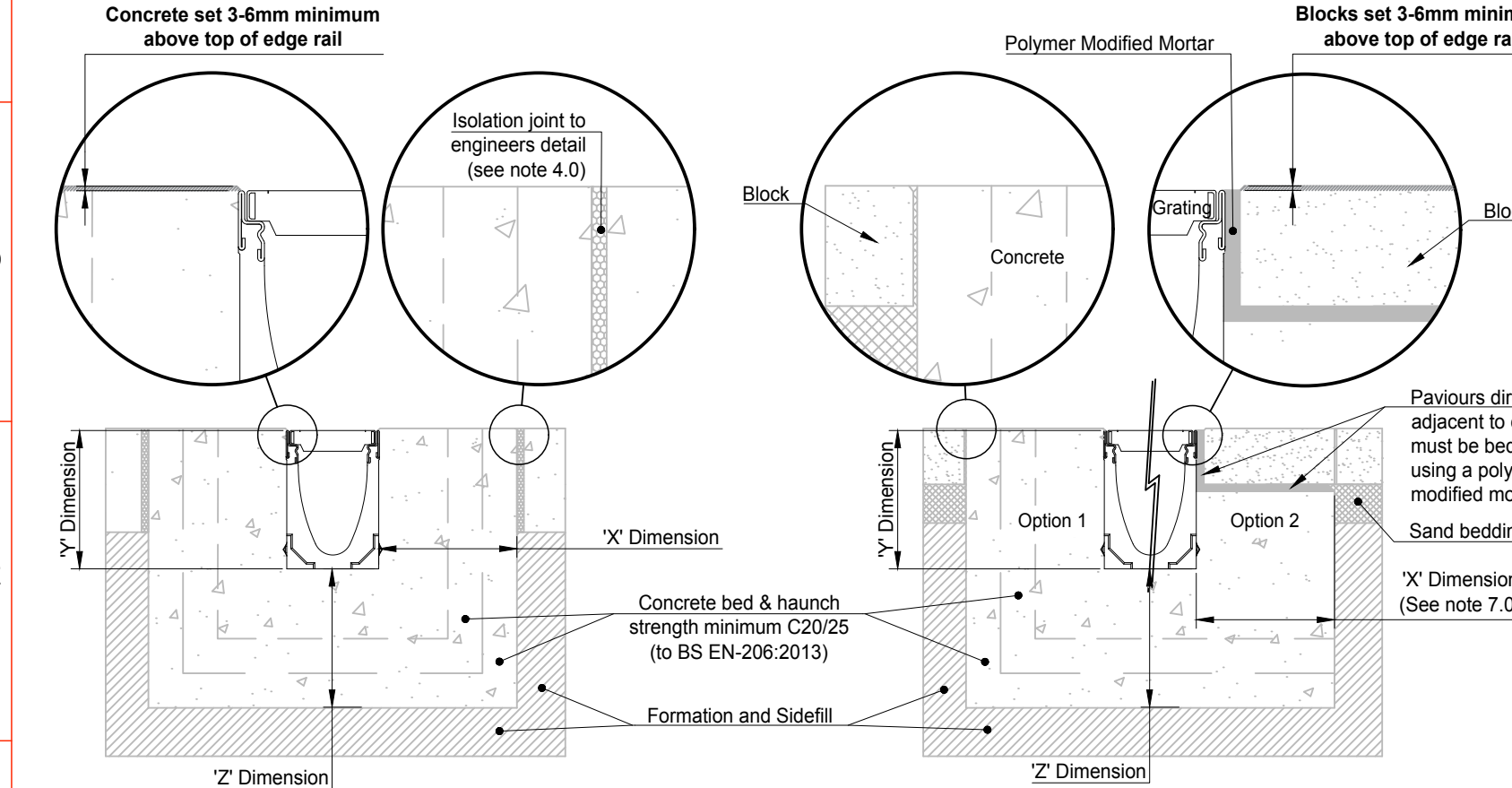
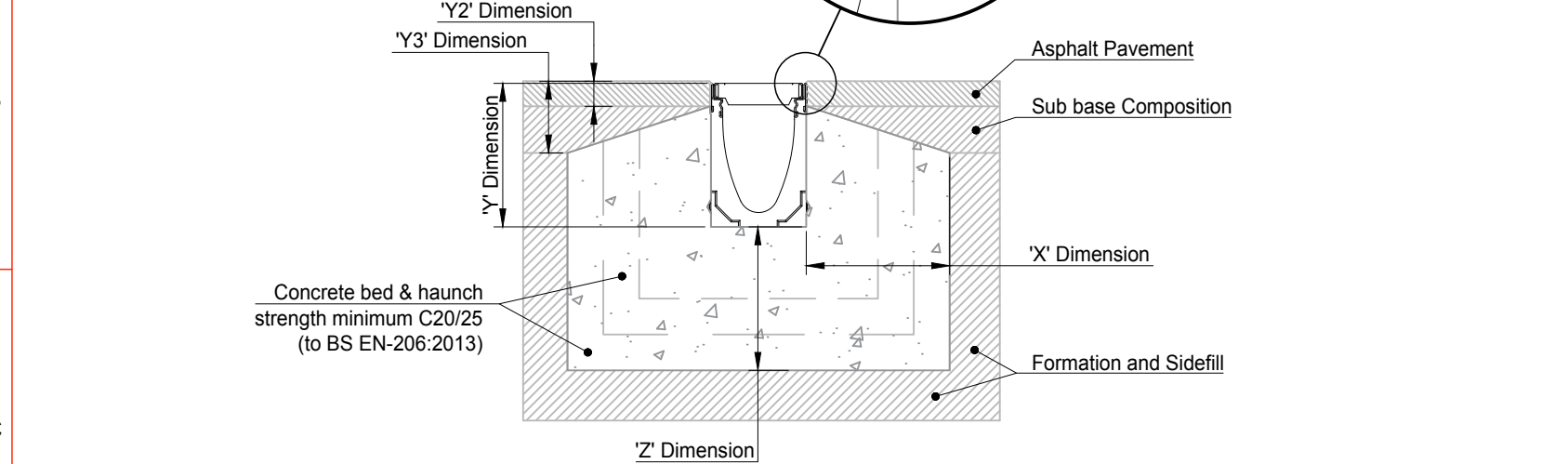
Note: Galvanised steel and iron products have good corrosion resistance to concrete and mortar products but may experience corrosion if high chloride and/or sulphate content is present. Use only good quality concrete and consider using corrosion inhibitors where necessary. The use of protective coatings, such as paint, can minimise the risk of corrosion.

E	24.6.2016	Updated title block	TS
D	15.6.2016	Revised to comments 15/03/16	TS
C	2.3.2016	General revisions	TS
B	8.2.2016	Revision of standard text	TS
Version	Date	Description	Name
		Drawing Number: 21846	Revision: E
		Title: ACO MULTIDRAIN M100D/DS UNIVERSAL SUMP INSTALLATION DETAIL DRAWING	
Created by: IM	Released by: TS	Projection: ISO-A	Units: mm
Created at: 11.12.2015	Released at: 24.6.2016		Format: A2
Replacement for: E1-E01-036-3-c	Replaced by:	Information contained in this drawing is copyright property of ACO Technologies plc. Any reproduction in part or whole without written permission of ACO Technologies plc is prohibited	
			Scale: 1 : 8
			Sheet: 1 of 1

		1			
Load Class		A 15	B 125	C 250	D 400*
Minimum Dimensions (mm)	X	100	150	150	200
	Y	Full Channel Height (Less Y2 where applicable)			
	Z	100	150	150	200
Maximum Dimensions (mm)	Y2	35	35	35	35
	Y3	100	60	60	60

* e.g. parking areas for all types of road vehicle.
Not suitable for carriageway of roads or industrial areas.

1 : 10 ACO MultiDrain Asphalt Pavement



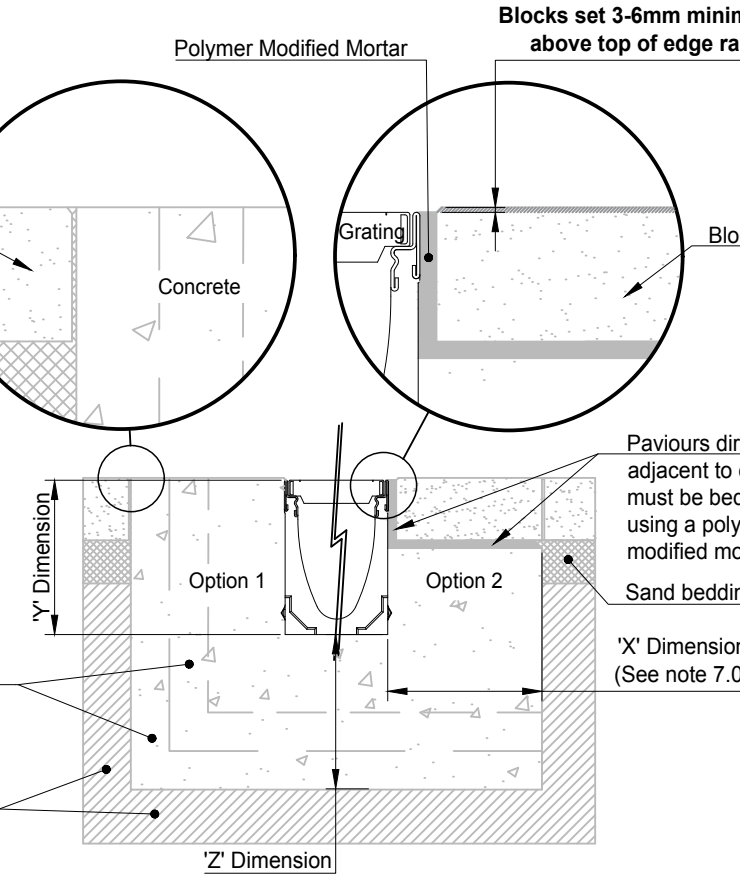
1 : 10 ACO MultiDrain Concrete Pavement

NBS Specification:
ACO MultiDrain® MD should be specified in section Q10:180. Assistance in completing this clause can be found in ACO Technologies product entries in NBS Plus, or a model specification can be downloaded from www.aco.co.uk. For further assistance, contact the ACO Water Management Design Services Team.

Best Practice and Workmanship:
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Detailed installation statements and methodologies will vary for all sites as each will have different aspects deserving particular consideration, consequently the relevant approvals should be sought from the consulting engineer and/or the installer.

1 : 10 ACO MultiDrain Block Pavement (Option 1 and 2)



1.0 Load Class

Installation recommendations shown are ACO minimum recommendations for BS EN 1433:2002 load class requirements.

2.0 Ground Conditions

The long term performance of a channel installation to sustain vertical and lateral loads depends upon A) ground conditions B) stability of the adjacent pavement and C) a durable concrete bed and surround. The recommended installation detail may require the minimum dimensions to be revised to achieve site specific load class requirements (referred to in 1.0 above).

3.0 Cutting and Jointing

Mitre joints are formed by cutting the channels to the required angle and butting them together with appropriate sealant (e.g. Sikaflex 11FC or similar) or ACO Repair Kit. Where possible 90° joints and T's should be formed so that gratings do not have to be cut. Angles can be formed by connecting them using proprietary PVCu pipework attached to ACO inlet/outlet endcaps. For further details please contact ACO Design Services Team.

Note: For Load Classes higher than C 250, mitred joints are not recommended in vehicular areas. Where requested ACO can custom manufacture angled junctions to order.

4.0 Isolation Joints

The channel must be isolated from the surrounding environment. An isolation joint must be positioned up to 1500mm from the channel wall. Any dowel bars must be located no nearer than 150mm from the channel wall. Other isolation joints in surrounding slab must be continued through the channel. Additional crack control may be required to comply with specifier requirements.

5.0 Installation into in-situ Slab

Where a channel is to be installed into an existing concrete slab it is necessary to cut a suitably sized pocket in the slab. The channel will then need to be bedded in polymer modified mortar of 25mm minimum thickness (this may vary depending on the type of mortar used). Engineering advice may be necessary.

6.0 Temporary Installation

A channel installation is not complete until the final surfacing is laid. In any temporary condition, i.e. with the channel walls projecting above adjacent ground, site traffic should not cross channels. Loose boards, stone fill or cover plates will not protect the channel walls or grating. A temporary channel crossing should be formed by raising the ground level locally, to 3 - 6mm above top of edge rail, either side of a channel for a distance of 750 to 1000mm, to form ramps. Note that the channel load class should be adequate to carry the site traffic.

7.0 Block Pavements

The channel must be supported laterally. Blocks laid directly against a channel must be laid as a soldier course and restrained from movement by bedding securely on the concrete haunch e.g. by using a polymer modified mortar for bed and perpendicular joints (e.g. RONAFIX mortar mix C or similar). Blocks or slabs bedded on sand remote from the channel should be set at a higher level to compensate for possible settlement of the paving in service.

8.0 Grate Locking System

Gratings should be securely fixed to the channel, where required, using an appropriate grate lock system (where available).

9.0 Channel Protection

Avoid contact between compaction equipment and top of ACO channel edge rail. The installer must ensure that the finished surface level lies above the top of the edge rail (by at least 3-6mm). Covering or protecting the grating, before concreting the haunch or laying blocks, removes the time and cost associated with cleaning the channel and grating of cement material and embedded stones. (Please note that ACO channels must be installed with the grating in place to prevent deformation of the channel).

10.0 Watertight Installation to BS EN 1433:2002

Where ACO channel joints/fittings and channel/pavement interfaces are to be sealed, an appropriate sealant should be used (e.g. Sikaflex 11FC or similar). Guidance on the necessary surface preparation and/or priming should be sought from the sealant manufacturer.

For Guidance a typical method of application follows:

- The end faces of the channels are to be sound and free from dust, oil, and grease, with any loose material or dirt removed, e.g. by mechanical wire brush. No water drops should be evident.
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- Products with a sealing groove following the inside shape of the channel - apply the sealant to the end face of the channel and to the sealant groove, such that when the joint is completed, the sealant will both cover the end face and fill the groove.
- The channel unit should be placed on the prepared concrete bedding and pressed against the previously placed channel unit. A sealed joint of approximately 1-2mm width should be formed between adjacent channel units.
- Excess sealant should be wiped from the inside face of the channel to leave a smooth finish.
- The sealant is to be left to cure for 24 hours, during which time the sealant should be kept as dry as possible.

Note: Galvanised steel and iron products have good corrosion resistance to concrete and mortar products but may experience corrosion if high chloride and/or sulphate content is present. Use only good quality concrete and consider using corrosion inhibitors where necessary. The use of protective coatings, such as paint, can minimise the risk of corrosion.

F	24.6.2016	Updated title block	TS
E	18.4.2016	Revised to comments 12/04/16	TS
D	23.3.2016	Revised to comments 15/03/16	TS
C	2.3.2016	General revisions	TS
Version	Date	Description	Name
		Drawing Number: 21820	Revision: F
ACO Business Park Hitchin Road Shefford Bedfordshire SG17 5TE, UK Tel: 01462 816666 www.aco.co.uk		Title: ACO MULTIDRAIN M100D/DS 10.0 CHANNEL INSTALLATION DETAIL DRAWING	
Created by: TS	Released by: TS	Projection: ISO-A 	Units: mm
Created at: 9.12.2015	Released at: 24.6.2016		Format: A3
Replacement for: E1-E01-036-3-c	Replaced by:	Information contained in this drawing is copyright property of ACO Technologies plc. Any reproduction in part or whole without written permission of ACO Technologies plc is prohibited	
		Scale: 1 : 10	
		Sheet: 1 of 1	

Appendix C Summary of New Outfalls

Frontage	New Outfalls
1B	New filter drain to discharge using existing outfalls. Additional drainage pipes installed at 1m centres (181 total) within the concrete apron to maintain flow of groundwater.
2	2 New Drainage Outfalls
3	3 New Drainage Outfalls
4	1 New Drainage Outfall
5	4 New Drainage Outfalls

