ACO has an established Technical Services Department with experienced engineers and support staff offering free advice on surface water management.

This service is offered with no obligation and is supported with comprehensive, high quality literature and project specific technical documentation.

ACO provides assistance with the following four areas.

Selection, design and installation

1 Application

Trench drains are designed to collect and remove surface water and a failure to do so will require early replacement of the drainage system with the associated remediation costs.

Early failure of the drainage system is usually due to an inappropriate choice of grate and/or channel for the application.

To ensure a long service life of the drainage system, consider the following application requirements.

Loading requirements

A B C D E F G

Loads influence pavement design and as the trench system is an integral part of the pavement, the correct installation detail is critical to product longevity.

ACO provides the following:

- **Advice on the most appropriate load class**
- **Load test certificates**
- **Detailed technical installation drawings**

See page 104 for more information.

Site requirements

The specific site requirements will influence the material selected for the trench drain and grate.

ACO supplies channels and grates in a variety of materials. The correct material choice ensures longevity.

ACO can provide advice and supply drainage systems for chemical corrosion resistance and non-metallic environments.

ACO provides the following:

- **Advice on suitable trench drain and grate material**
- **Material test reports**
- **Detailed specification information sheets**

See page 110 for more information.

User requirements

ACO provides recommendations on the most suitable grate for a project based on legislative and specific user requirements

ACO provides the following:

- **Information on the industry standards**
- **Information on goverment compliance**
- **Detailed technical information**

See page 114 for more information.

2 Hydraulics

Hydraulic performance refers to the amount of liquid a drain collects and discharges in a given time period. The amount of liquid determines the size of channel and the optimum slot size for the grate.

An undersized or oversized trench drain may have cost and liability expenses especially when flood damages property or personal risk is of concern.

ACO provides project specific hydraulic information to accurately determine the safest and most cost effective trench drainage system.

ACO provides the following:

- **Site specific hydraulic simulations showing the performance of the channel and grate**
- **Hydraulic simulations showing the effect of temporary ponding**

See page 116 for more information.

3 Trench layout

When multiple trench runs are involved, determining what pieces go where can be a challenge when the products are delivered to site.

To ensure this part of the process runs as smoothly and efficiently as possible, ACO offers several services.

ACO provides the following:

- **Trench run layouts in plan**
- **Elevation layout of the trench runs showing the numbered sequence of the modular channels**
- **Bill of Materials (BOM) showing all products itemised**

See page 122 for more information.

4 Installation

Installing the drainage system correctly the first time ensures the trench drain will perform as expected.

ACO has a team of experienced engineers to offer advice on the most suitable installation to ensure the longevity of the trench drain.

Advice includes the various methods of installing the trench drain and suggestions about the concrete encasement suitable for the site.

ACO provides the following:

- **Detailed installation guide**
- **Consultation on specific installation concerns**
- **Installation drawings showing detailed sections**

See page 124 for more information.

5 All-inclusive service

ACO can offer a comprehensive solution where the above services are combined to assist designers at the preliminary and detailed design stages of the project with an emphasis on:

- Minimising earthworks and pipework.
- Utilising existing pavement levels and drainage infrastructure.
- Integrating other water management requirements, for example OSD, rainwater harvesting and other WSUD initiatives.

ACO recommendations include professional documentation, CAD drawings and product data sheets.

1 Application

Loading requirements

Load standards

There is no current Australian Standard that specifically deals with trench drains.

AS 3996 specifies the requirements for access covers and grates for use in vehicular and pedestrian areas for a clear opening up to 1,300mm.

The only standard written specifically for grated trench drains that is internationally recognised is EN 1433. This standard includes different grate widths and different channel sizes.

The Standard EN 1433 specifies test methods with loads up to 900kN for both the grate and channel body. The test accounts for both serviceability and ultimate loading.

Factors affecting load on a trench drain

There are a number of key factors that affect a trench drain's resistance to load:

a) **Type of traffic** – for example pedestrians, cars, trucks and forklifts crossing the drain. For trolleys and forklifts, consider the weight of the loads being carried.

b) **Frequency of traffic** – more frequent traffic may require a heavier duty drain.

c) **Speed of traffic** – fast moving traffic can intensify the load effect on the drain.

d) **Location of the drain** – if the drain is positioned where traffic will be turning, braking, or if it is installed at the bottom of a ramp, the drain will be subjected to dynamic forces.

e) **Wheel type** – solid tyres exert loads through smaller contact areas than pneumatic tyres. A heavier duty drain may be required.

Selecting the right trench drain is essential for a durable long lasting installation.

Certification

ACO's policy is to continuously improve and develop its products to the highest quality.

ACO has a NATA accredited testing facility operated by fully trained technicians.

NATA accreditation number 15193.

ACO is authorised to conduct tests and prepare documentation to meet AS 3996 and EN 1433 requirements.

ACO can provide the following:

- Certificate of Compliance or Conformance
- NATA endorsed load test report to AS 3996 and EN 1433

AS 3996 table of load classification

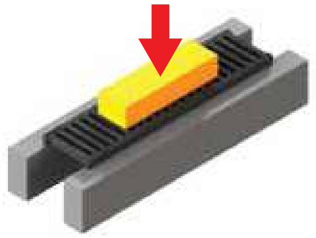
A	B	C	D	E	F	G
10kN *Extra light duty*	**80kN** *Light duty*	**150kN** *Medium duty*	**240kN** *Heavy duty*	**400kN** *Extra heavy duty*	**600kN** *Extra heavy duty*	**900kN** *Extra heavy duty*
Typical Uses						
Footpaths and areas accessible to pedestrians and cyclists	Residential properties and footpaths suitable for light vehicles	Malls and pedestrian areas open to slow moving commercial vehicles	Major roads, freeway shoulders and loading docks	Carriageways of freeways and heavy industrial areas	Docks and aircraft pavements subjected to high wheel loads	Docks and aircraft pavements subjected to very high wheel loads
Approximate Nominal Wheel Load						
330 kg	**2,670 kg**	**5,000 kg**	**8,000 kg**	**13,700 kg**	**20,000 kg**	**30,000 kg**
EN 1433 Equivalent						
Class A 15kN	**Class B 125kN**	**Class C 250kN**		**Class D 400kN**	**Class E 600kN**	**Class F 900kN**

Load testing

AS 3996

The diagrams below show the test load applied to typical grates through an AS 3996 specified test block size.

Grate for 100mm clear opening trench drain



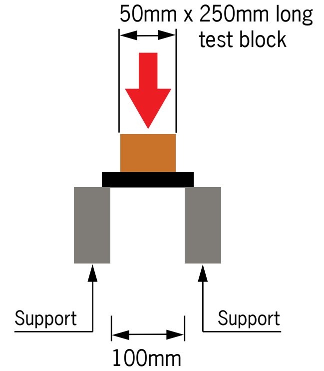
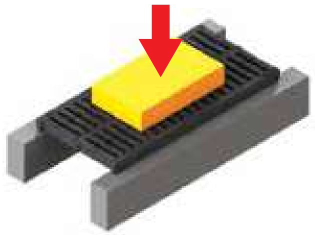


Diagram shows test block positioned centrally on grate.

The Standard prescribes a minimum clearance of 25mm to the supports.

Grate for 200mm clear opening trench drain



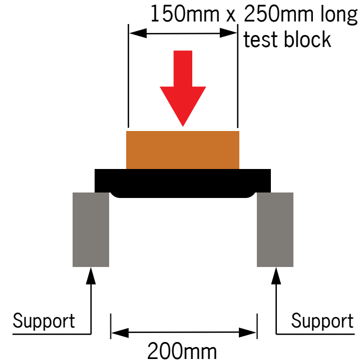
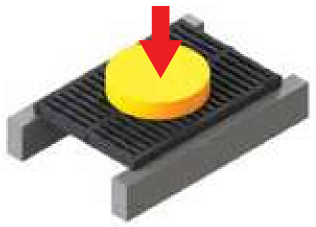


Diagram shows test block positioned centrally on grate.

The Standard prescribes a minimum clearance of 25mm to the supports.

Grate for 300mm and over clear opening trench drain



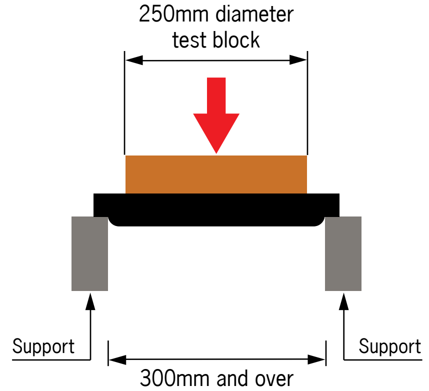


Diagram shows test block positioned centrally on grate.

For clear opening of 390mm and over, a 240mm x 240mm square test block can be used as an alternative to the circular test block.

EN 1433

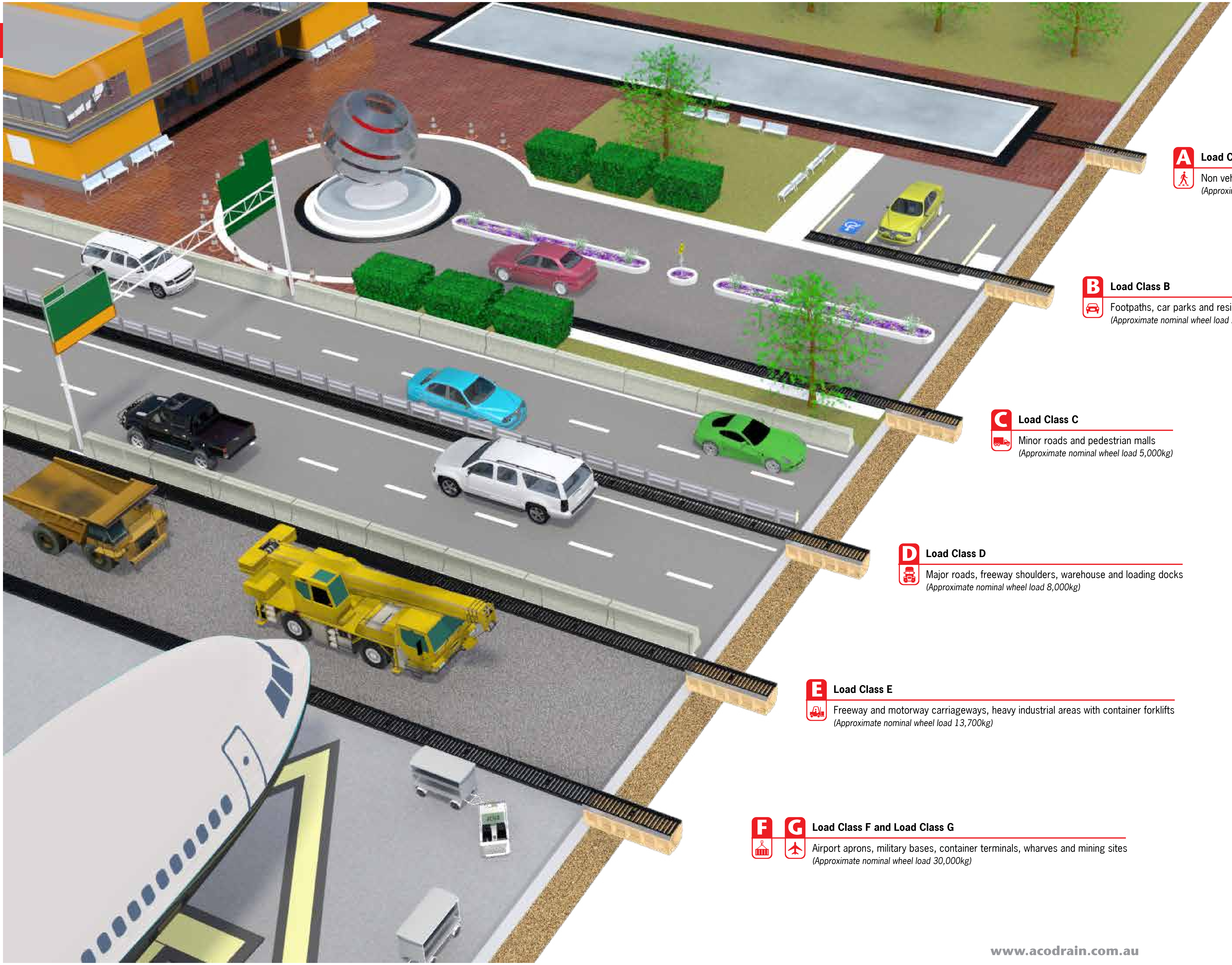
The only standard written specifically for trench drains and internationally recognised is EN 1433 *Drainage channels for vehicles and pedestrian areas.* EN 1433 accounts for different widths of grates and channels.

For grates less than 200mm wide, the test block for load testing is 250mm long by 75mm wide. For grates 200mm to 300mm wide, the test block is 250mm long by 150mm wide; for grates over 300mm, the test block is 250mm diameter.

EN 1433 also prescribes methods for testing the complete trench drain and grate and accounts for both proof loading and catastrophic failure.

EN 1433 also outlines testing for monolithic trench drains with grate and body manufactured as a single unit. Contact ACO for information on monolithic trench drains.

LOAD CLASSES
AS 3996 Table 3.1



A **Load Class A**
Non vehicular traffic pavements
(Approximate nominal wheel load 330kg)

B **Load Class B**
Footpaths, car parks and residential properties
(Approximate nominal wheel load 2,670kg)

C **Load Class C**
Minor roads and pedestrian malls
(Approximate nominal wheel load 5,000kg)

D **Load Class D**
Major roads, freeway shoulders, warehouse and loading docks
(Approximate nominal wheel load 8,000kg)

E **Load Class E**
Freeway and motorway carriageways, heavy industrial areas with container forklifts
(Approximate nominal wheel load 13,700kg)

F **G** **Load Class F and Load Class G**
Airport aprons, military bases, container terminals, wharves and mining sites
(Approximate nominal wheel load 30,000kg)

Factors affecting load on a trench drain

Loading

Loading is often referred to as traffic and is any weight that will rest on or travel over a trench drain. Traffic may come from pedestrians, machinery or vehicles.

Traffic is the most important factor to consider in pavement design and a trench drain is an integral part of the pavement.

The type of trench drainage system and the surrounding concrete encasement requires careful consideration.

Contact area

The contact area between the load and the grate in a trench drain determines the force per unit area, referred to as 'stress'.

Usually the stress relates to the size and type of tyre, but can include anything that may rest permanently or periodically on the drain.

Large tyres and pneumatic tyres spread the load over a larger contact area beyond the grate width, which exerts a lower stress on the trench drain.

Small tyres and solid tyres concentrate load onto a small contact area, which exerts a higher stress. This application requires a drainage system with a higher load rating.

Wheel load

A wheel load is combined with contact area to determine loading.

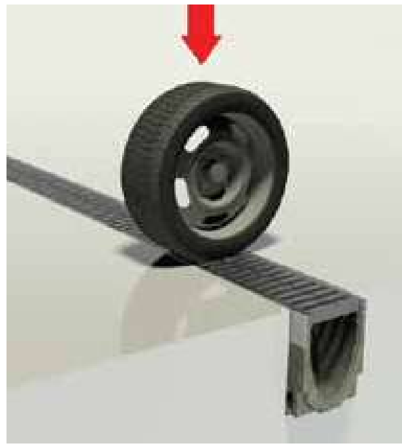
- Weight of vehicle/cart and its typical load, e.g. forklift and weight of typical loaded pallet.
- Number of wheels and axles that load is distributed over affects individual wheel load.
- Unusual traffic going over the trench, for example industrial trolleys, pallet jacks or skip bins.

Load frequency

It is important to consider how often a load will be applied to the drainage system. Frequent and continuous loads will require a heavy-duty trench drain and a stronger concrete encasement than occasional loads of the same weight.

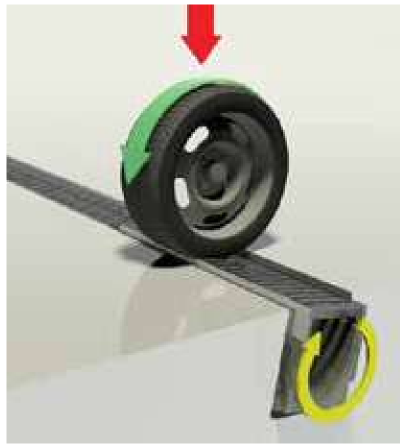
Static loads compared to dynamic loads

Static loads



Static loads are the weight applied vertically onto a trench drain with no other movement. Static loads are used in load testing a grate or trench drain, as they provide an objective measure to rate products. They are not typically found in real-life scenarios.

Dynamic loads



Forces created by dynamic or moving loads tend to twist trench drains and grates out of position. The more movement the greater the dynamic load. Forces also rise rapidly as the traffic speed increases.

Factors that intensify dynamic loads include:

- Vehicles travelling across or along the trench drain.
- Traffic braking, accelerating or turning on the trench drain.
- The speed of traffic.
- A trench drain located at the top or the bottom of a ramp.

The trench body, type of grate, quality of installation and locking mechanism are all important factors to consider when addressing dynamic loads.

Note: During the construction phase, it will be necessary to protect the modular trench from the site traffic. See page 126 for more information.

ACO Technical Services – Structurally fit for purpose

Load categories

To assist product selection, ACO can provide NATA endorsed test reports for each channel and grate to load standards, AS 3996 and EN 1433. Ratings are categorised into classes from light duty 10kN to heavy duty 900kN.

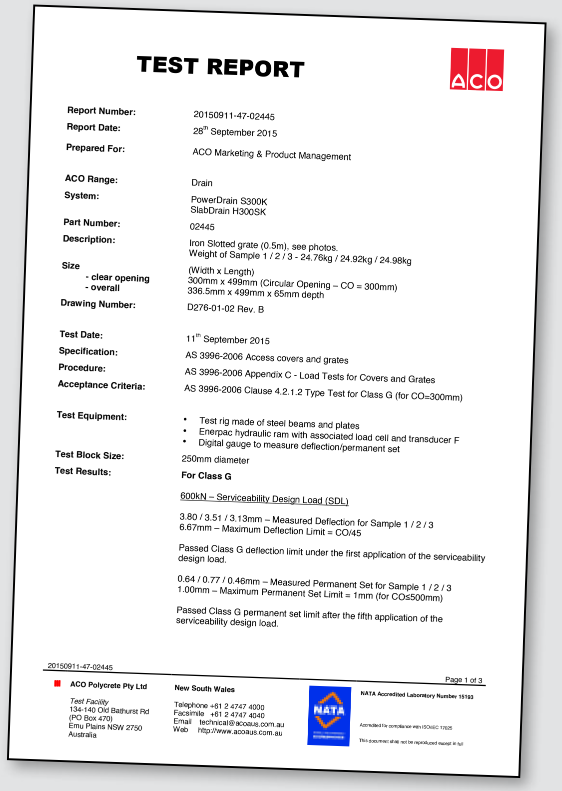
An overview and comparison of AS 3996 and EN 1433 is provided on page 104.

The following information is required for ACO to provide advice on the most appropriate load class for the specific application:

- Weight of vehicle (including load hauled).
- Type and direction of traffic moving over the trench drain.
- Wheel type and size.
- Typical vehicle speed.
- Vehicles turning or braking on the trench drain.
- The location of the trench drain, for example at the bottom of a ramp or alongside a building.
- Unusual traffic, for example skip bins.

ACO can supply the relevant load test report and a Certificate of Compliance or Conformance on request.

ACO's NATA Accredited Testing Machine



TEST REPORT

Report Number:	20150911-47-02445
Report Date:	28th September 2015
Prepared For:	ACO Marketing & Product Management
ACO Range:	Drain
System:	PowerDrain S300K SlabDrain H300SK
Part Number:	02445
Description:	Iron Slotted grate (0.5m), see photos. Weight of Sample 1 / 2 / 3 - 24.76kg / 24.92kg / 24.98kg
Size - clear opening - overall	(Width x Length) 300mm x 499mm (Circular Opening – CO = 300mm) 336.5mm x 499mm x 65mm depth
Drawing Number:	D276-01-02 Rev. B
Test Date:	11th September 2015
Specification:	AS 3996-2006 Access covers and grates
Procedure:	AS 3996-2006 Appendix C - Load Tests for Covers and Grates
Acceptance Criteria:	AS 3996-2006 Clause 4.2.1.2 Type Test for Class G (for CO=300mm)
Test Equipment:	• Test rig made of steel beams and plates • Enerpac hydraulic ram with associated load cell and transducer F • Digital gauge to measure deflection/permanent set
Test Block Size:	250mm diameter
Test Results:	**For Class G** 600kN – Serviceability Design Load (SDL) 3.80 / 3.51 / 3.13mm – Measured Deflection for Sample 1 / 2 / 3 6.67mm – Maximum Deflection Limit = CO/45 Passed Class G deflection limit under the first application of the serviceability design load. 0.64 / 0.77 / 0.46mm – Measured Permanent Set for Sample 1 / 2 / 3 1.00mm – Maximum Permanent Set Limit = 1mm (for CO≤500mm) Passed Class G permanent set limit after the fifth application of the serviceability design load.

20150911-47-02445

Page 1 of 3

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NATA Accredited Laboratory Number 15193

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Concrete encasement

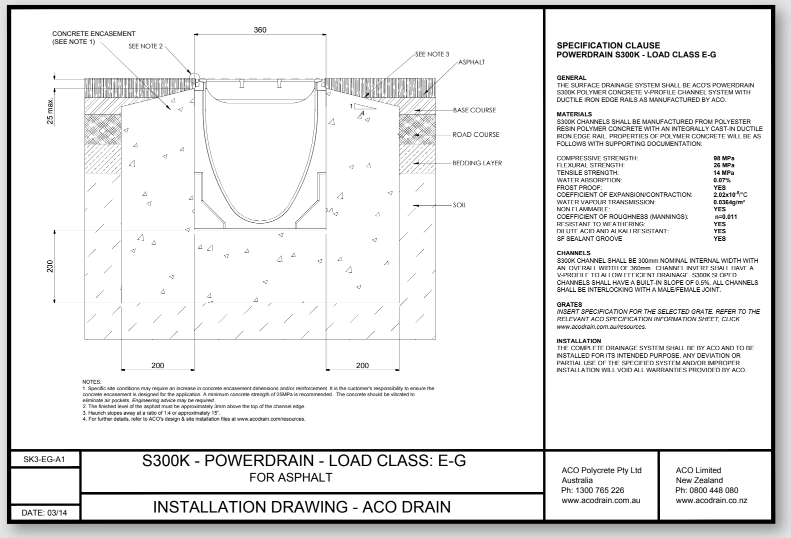
Loading will also impact the size of concrete encasement required. It is recommended that the cement concrete encasement be durable and conform to minimum strength requirements shown in ACO's recommended installation details.

Poor site conditions and low load bearing pavements may require an increase in the size of concrete encasement to meet both vertical and lateral loads.

Some applications may require steel reinforcement. Always seek engineering advice for specific applications.

The following information is required for ACO to provide advice on the correct concrete encasement section detail:

- Load class required.
- Product type and width e.g. PowerDrain S300K.
- Pavement type.



Download installation details for all products and pavements at: www.acodrain.com.au/resources/site-installation.htm

Site requirements

Trench materials

Modular trench drain systems are generally manufactured from either polymer concrete, GRC (Glass fibre Reinforced Concrete) or HDPE (High Density Polyethylene).

ACO Drain comprise **Polycrete®** *Channels*, trench bodies manufactured from polymer concrete. Other materials do not meet the compressive strength and thermal expansion properties required in commercial and industrial applications.

Cement concrete

Cement concrete is Portland cement mixed with aggregates. Generally used for large cast-in-situ slab applications, where mass is required for structural rigidity.

Complex formwork is required to construct cast-in-situ trench drains, which adds to installation time and labour costs.

Plastic

Plastic is commonly used in trench drains. It is a readily available economical material that is easy to mould.

When directly exposed, plastic has poor thermal properties. A trench drain of 30m in length, with an ambient temperature change of 24°C, can expand or contract up to 330mm more than the surrounding concrete slab.

The concrete encasement will expand and contract minimally, causing the trench to buckle or pull away from the concrete.

When installed beneath the surface where only a metallic inlet slot is visible, the drain bodies should be designed with moulded features to key into the concrete.

Polymer concrete

Polymer concrete is a versatile composite material produced by mixing mineral aggregates with a resin binding agent. The finished material has excellent mechanical and thermal properties and offers good corrosion resistance to many chemicals, see chemical resistance chart on page 113. A maximum working temperature of 82°C is recommended.

Due to their structural rigidity, polymer concrete trench drains, when installed properly, can be used in a variety of pavement types such as concrete, asphalt and brick pavers.

GRC

Glass fibre reinforced concrete (GRC) is a mixture of cement, fine aggregate, water, chemical admixtures and alkali resistant glass fibres. GRC is predominantly used for building cladding panels.

GRC is a porous material that absorbs liquids which is not ideal for drainage.

Channel edge

The exposed edge of the trench helps hold the grate in position and is subject to the same loads as the grate. In addition to the effect of climate and weight of vehicles, it may be exposed to impact from items being dropped or pulled across it (e.g. skips). If an edge fails, the grate will move and cause catastrophic failure.

Metal edges are used to withstand the abuse of traffic and are commonly made from galvanised steel, stainless steel and ductile iron. Edge protection rails should be integrally cast-in to the trench body.

Edge rails also provide some protection during installation, particularly if the wearing course of the pavement is not applied immediately. Appropriate edge protection is particularly important in asphalt situations where rolling machines can damage edge rail, leading to premature failure of the trench drain.

See page 126 for more information.

Grate materials

Grates are manufactured from a variety of materials. The most common are ductile iron, mild steel, stainless steel and plastic.

Grates need higher tensile properties than the trench body to withstand direct loads. Grates can be removed, changed or easily replaced after installation, unlike the trench drain body.

ACO Technical Services – Trench drain material comparison

The performance properties of trench materials

Different materials offer different surface and physical performance properties which may affect their suitability of use in various applications. These charts provide a side by side comparison. ACO can provide documentation to support these findings.

	Cement Concrete	Plastic (HDPE)	Polymer Concrete	GRC
Mechanical Properties				
Compressive strength The trench body is subject to compressive loads in use and needs to withstand the specified load.	25MPa	58MPa D-695	98MPa C-579	50MPa
Flexural strength Affects site handling and when trench body is in areas where encasement and soils are suspect.	3MPa	15MPa D-790	26MPa C-580	12MPa
Tensile strength Not generally required in trench bodies, but relevant to grates. Used as material measurement.	2MPa	14MPa D-638	14MPa C-307	5.5MPa
Thermal Properties				
Water absorption The trench is designed to carry and collect liquids without contaminating surrounding soil/encasement.	<3%	+0.31% D-570	+0.07% C-97	12%
Freeze-thaw Inability to withstand freeze-thaw cycles causes surface spoiling and leads ultimately to trench failure.	300 cycles maintain 80% structural integrity	223 cycles FAILED modulus of elasticity test C666	300 cycles modulus of elasticity 95.1% C666	modulus of elasticity unchanged
Coefficient of expansion/contraction Excessive movement between trench and encasement materials creates unwanted stresses which may lead to failure.	10 x 10^{-6} per °C	209.8 x 10^{-6} per °C E831	45.6 x 10^{-6} per °C E831	20 x 10^{-6} per °C
Water vapour transmission WVT is measurement of water vapour flow through a material. Passage of water vapour may be critical in some instances.	See water absorption test	WVT - 0.1392g/m^2 1,592hrs E96	WVT 0.0364g/m^2 1,592hrs E96	1 x 10^{-4} gm/s.MN
Surface Properties				
Surface burning Trench systems are often used around petrol stations, chemical processing and interior applications and may be subject to fire. They should be non-flammable and not give off fumes or smoke.	Non-combustible	After flame time : 390 seconds - fail UL-94	Flame spread : 0 Smoke density : 5 E84	Non combustible Ignitability : P Fire propagation : 0 Flame spread : 1 BS476
Weathering The majority of trench drains are used in exterior applications. The ability to withstand adverse weather conditions will ensure long service life, for example erosion, UV degradation etc.	Good depending upon proper curing	1000hr exposure no change G-154 FAILED TEST	2000hr exposure no change G-153	Similar to cement concrete. UV stable
Coefficient of friction (Manning's) Any degree of friction will affect liquid flow to some extent, therefore the lowest value is desirable.	n=0.013	n=0.010	n=0.011	n= 0.012
Chemical resistance Trench may be used for liquids other than water and in such circumstances, needs to be resistant to a variety of mediums. See page 113 for details.	Poor	Good	Good	Poor - better than cement concrete

Key: Good Acceptable Poor

Note:
1. Cement concrete values obtained from AS 3600 and SA HB 64 Guide to Concrete Construction (Cement & Concrete Assoc. of Australia).
2. HDPE values obtained from experimental data using ASTM testing procedures.
3. Polymer concrete values obtained from experimental data using ASTM testing procedures.
4. GRC values obtained from Design, Manufacture & Installation of Glass Reinforced Concrete (GRC Industry Group of NPCAA).

Sustainable drainage

In a perfect world, permeable landscapes would be everywhere allowing nature to work as intended. However, this is not possible and hard landscapes are common.

Sustainable drainage is the collection of rainwater for reuse. Water Sensitive Urban Design (WSUD) is a land planning and engineering design approach that integrates the urban water cycle including stormwater and groundwater to minimise environmental degradation and improve natural and recreational areas.

WSUD involves collecting water runoff that may or may not contain pollutants, cleaning the water, storing the water for future use or discharging the water in a controlled manner to receiving waterways with minimal impact to the environment.

Cost effective water management drainage solutions can be used to assist the 'collect' part of this process.

Trench drainage solutions are ideal as they enable maximum liquid collection and can form a barrier to prevent runoff flowing onto sensitive environmental areas and soft landscapes.

Trench drains are also very effective where there is a high risk of toxic pollutants entering the environment, for example highways and petrol stations.

EPA requirements

Stormwater runoff is generated from heavy rainfall flowing over land or impervious surfaces which has not infiltrated into the ground.

In urban areas such as pedestrian pavements, roads, car parks and building rooftops, the runoff can accumulate debris, chemicals, sediment and other pollutants that could adversely affect the water quality if discharged untreated.

Trench drains in high risk areas, for example petrol stations and airports, should drain into oil-water separators to remove hydrocarbons and other pollutants. For more information, contact ACO.

Retention, detention and infiltration

Sustainable surface water management goes beyond simply the collection of runoff.

Plastic geocellular systems with flow control devices can effectively influence the negative impact of stormwater, such as flooding to downstream catchments.

These systems can also harvest water for parklands, sports fields, agriculture and gardens. For more information, contact ACO.

Chemical resistance

ACO Drain channel bodies are highly resistant to chemical attack and with the appropriate grate can be used in most environments where everyday acids and diluted alkalis are encountered.

Different materials have different surface and performance properties which may affect their suitability for various applications. Refer to the chemical resistance chart on the opposite page.

Contact ACO for information on ACO's stainless steel or monolithic range of channels if the standard product range does not meet the required chemical resistance for the project.

Important considerations for chemical environments

When reviewing potential applications of trench drains in chemical environments, consider the following issues:

1. Type and mixture of chemicals.
2. Concentration percentages.
3. Contact time with the trench drain.
4. The temperature of chemicals constantly flowing into the trench drain (82°C maximum for polymer concrete).
5. Flushing system employed to clear chemicals from the system.
6. Cleaning agents should be checked for compatibility with trench drain material.
7. Polymer concrete samples can be provided to test the chemical resistance of the material.
8. Grate, locking mechanism, edge rail, outlet and rubbish basket should be checked for chemical resistance.
9. Check sealant for compatibility with trench drain, if applicable.

ACO Technical Services – Chemical resistance chart

The recommendations below are a guide only. Customers are advised to test a sample of polymer concrete to ensure its suitability for the intended application. Samples of polymer concrete are available for testing free of charge from ACO.

Chemical	Maximum Concentration	Short Exposure 72 Hours	Long Exposure 42 Days
Acetic Acid	30%	✓	✗
Acetone	10%	✓	✗
Ammonia	10%	✓	✗
Aniline	100%	✓	✗
Aniline in Ethyl Alcohol	10%	✓	✓
Benzene	100%	✓	✗
Boric Acid	100%	✓	✓
Butyric Acid	25%	✓	✓
Butyl Alcohol	100%	✓	✓
Calcium Chloride	100%	✓	✓
Calcium Hydroxide	100%	✓	✗
Caster Oil	100%	✓	✓
Chloric Acid	5%	✓	✗
Chromic Acid	5%	✓	✓
Citric Acid	100%	✓	✓
Diesel Fuel	100%	✓	✓
Ethanol	100%	✓	✗
Ethlendiamine	100%	✓	✓
Ethyl Acetate	100%	✓	✗
Ferrous Sulfate	30%	✓	✓
Fluorallic Acid	10%	✓	✓
Formaldehyde	35%	✓	✓
Formic Acid	10%	✓	✗
Fuel Oil	100%	✓	✓
Gasoline	100%	✓	✓
n-Heptane	100%	✓	✓
n-Hexane	100%	✓	✓
Hydraulic Oil	100%	✓	✓
Hydrochloric Acid	10%	✓	✓
Hydrofluoric Acid	5%	✓	✗
JP4	100%	✓	✓
JP8	100%	✓	✓
Lactic Acid	10%	✓	✓
Methanol	5%	✗	✗
Methyl Amine	100%	✓	✗
Methyl Ethyl Ketone	100%	✓	✗
Mineral Oil SAE5W50	100%	✓	✓
Monochlor Benzene	0.05%	✗	✗
Monochloroacetic Acid	10%	✓	✓
Nitric Acid	10%	✓	✗
n-Nonane	100%	✓	✓
Iso-Octane	100%	✓	✗
Oxalic Acid	100%	✓	✓
Phenol	100%	✓	✗
Phosphoric Acid	10%	✓	✓
Potassium Hydroxide	10%	✗	✗
Sodium Acetate	100%	✓	✗
Sodium Carbonate	20%	✓	✓
Sodium Chloride	100%	✓	✓
Sodium Hydroxide	15%	✓	✗
Sodium Hypochloric	5%	✓	✓
Sulfuric Acid	40%	✓	✓
Tetrafluoroborsaure	20%	✓	✗
Toluene	100%	✓	✗
Trichloroethylene	100%	✗	✗
Triethylamine	100%	✓	✓
Xylene	100%	✓	✗

Note: Maximum operating temperature of 82°C

User requirements

End user requirements and legislative obligations need to be considered once the type, size, load class and durability criteria of the trench drain have been chosen.

ACO can provide product guidance based on current industry standards and requirements. Test certificates are also available where testing has been carried out.

Accessibility

Trench drains are commonly used in public spaces where accessibility legislation is required. ACO supplies a variety of grates that are wheelchair and walking cane compliant without compromising on aesthetics or performance.

Heel and bicycle tyre safety

ACO has categorised grate safety into:

- Inlet size restrictions – complies with AS 3996.
- Bicycle safe – complies with AS 3996.

Grate security

ACO recommends that grates should be secured to prevent movement by vehicular traffic. If unsecured, the movement can cause damage to the trench channel and grate.

Aesthetics

The grate is the most visible part of the trench drain and aesthetically the most important component.

Grates can be selected to blend into the pavement or used as a feature or border.

For more information, see page 13.

Slip resistance

Slip resistance is crucial for user safety. Ideally, the slip resistance of the grate should be similar to the slip resistance of the surrounding pavement to minimise slip and trip hazards.

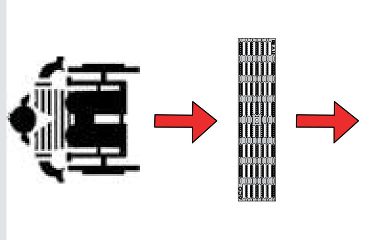
ACO Technical Services – Selection guidance and test data

Wheelchair and walking cane compliance

AS 1428.2 Clause 9 *Ground and floor surfaces*, specifies grate requirements.

'If gratings are located in a walking surface, they shall have spaces no more than 13mm wide and no more than 150mm long. If gratings have elongated openings, they shall be placed so that the long dimension is transverse to the dominant direction of travel.'

The diagram shows the slots perpendicular to the flow of traffic. This prevents the wheelchair and walking aids from becoming trapped or slipping on the grate surface.



Pedestrian heel resistance

AS 3996 Clause 3.3.6 *Surface openings in pedestrian areas.*

Inlet sizes must be kept to a minimum to prevent heels from becoming wedged in the grate slots. A grate's inlet size has a significant effect on its hydraulic performance and must be considered as grate inlets clog up with silt and debris over time. ACO believes a 10mm slot is the optimum size for grates in pedestrian areas.

Bicycle tyre safety

AS 3996 Clause 3.3.7 *Bicycle tyre penetration resistance.*

AS 3996 Clause 3.3.7 specifies the maximum slot length dependent on slot width for grates that are deemed Bicycle Tyre Penetration Resistant.

Grate security and locking options

ACO provides a number of locking options:

Boltless locking – mechanisms that secure the grate without the use of bolts. They are quick to install and remove, making installation and maintenance easier. Boltless locking is suitable for most applications.

Bolt and other locking – bolts hold grates in place by fastening into either the frame or locking bar that straddles the trench. Occasionally, other types of locking devices are required such as tamper resistant bolts. Contact ACO for more information.

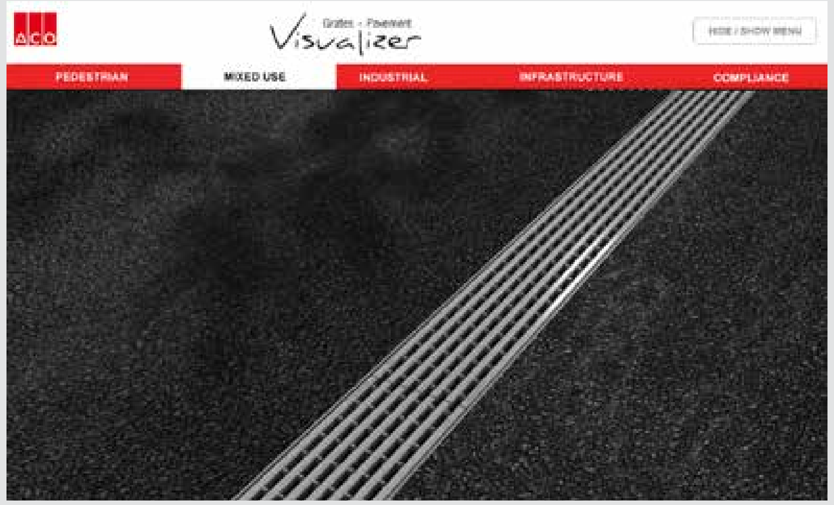
Aesthetic options

Consider the following options:

Grate materials – stainless steel, ductile iron and plastic can all provide excellent aesthetic design options. Monolithic trench drains are constructed from polymer concrete where the grate and trench channel is constructed from the same material.

Grate slot patterns – longitudinal, transverse and decorative patterns are available from ACO's grate range.

ACO offers an online grate **'Visualizer'** program that enables pavement and grate combinations to be viewed.



Slip resistance

AS 4586 *Slip resistance classification of new pedestrian surface materials.*

With an increase in litigation for injuries caused by slips, trips and falls, designers need to specify grates and floor surfaces that comply with AS 4586. A trip hazard may occur when a grate has a higher slip resistance rating than the surrounding floor surface. A slip hazard may occur when a grate has a lower slip resistance than the surrounding floor surface.

ACO grates are tested according to the methods outlined in AS 4586. The tests include: wet pendulum, wet-barefoot inclining platform and oil-wet inclining platform.

Catchment hydraulics

Calculating run-off

The catchment run-off must be accurately calculated to determine the correct size of the trench drain.

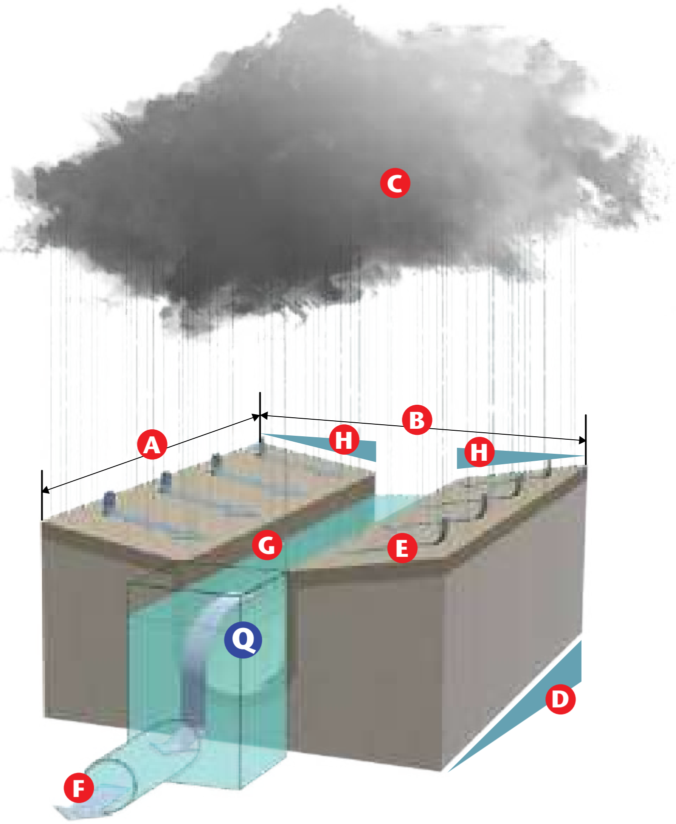
- Pavement length **(A)** x width **(B)** = Catchment area (m^2)
- Rainfall intensity **(C)** (mm/hr)

Once catchment run-off **(Q)** is calculated, other inflows can be added.

Factors that affect trench drain hydraulics:

- Ground fall **(D)**
- Pavement material as some materials absorb liquids such as brick pavers **(E)**
- Position and size of outlet pipe **(F)**
- The roughness of the surface of the trench material. For Manning's roughness coefficient, see page 111 **(G)**
- Crossfall to the trench drain can affect grate hydraulics. For example steep slopes may cause bypass in ramp applications **(H)**

$$Q\ (L/s) = \frac{\text{Area (AxB) x Rainfall intensity (C)}}{\text{60 (minutes) x 60 (seconds)}}$$



Non-uniform flow

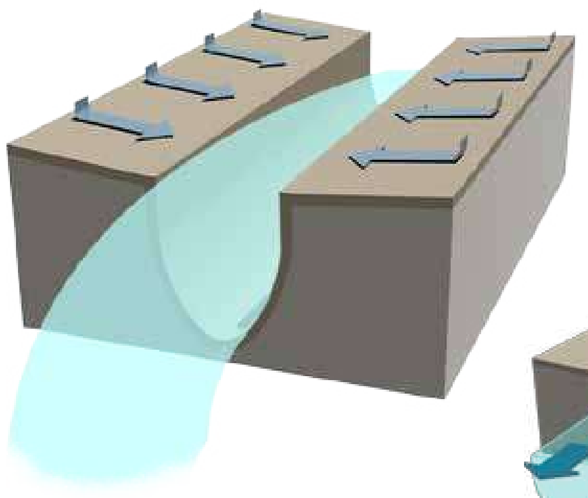
Non-uniform flow accounts for liquid being carried in a trench plus the constant addition of liquid collected through the grates (lateral intake) along the trench run. This resulting buildup of liquid means that a trench's run length will influence its hydraulic capacity.

A characteristic of non-uniform flow is the change of liquid velocity and height at successive cross-sections along the trench. Differential calculus and computer modelling is required to simulate this. **'Hydro'** is a purpose written hydraulic design program modelled on differential calculus for non-uniform flow in open channels.

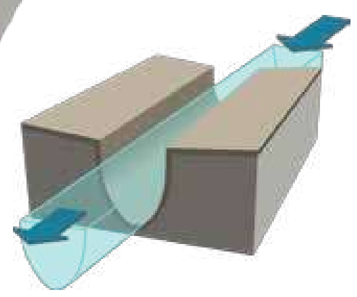
The program has been calibrated by empirical data from a series of experiments, modelling lateral intake into trenches. Analysis on the effect of slope, run length and trench cross section profiles are included in the program. It can also model complex scenarios and optimum outlet positions along trench runs.

For more information, see page 117.

$$\frac{dy}{dx} = \frac{S_0 - S_1 - 2\alpha Qq / gA^2}{1 - \alpha Q / gA^2 D}$$



Non-uniform flow



Steady uniform flow

ACO Technical Services – Modelling channel hydraulics

To generate results from the **'Hydro'** program, the following information is required:

- Length of trench run (metres).
- Length and width of catchment area (metres).
- Surrounding pavement material, for example concrete, asphalt or pavers.
- Rainfall intensity (mm/hr).
- Ground fall along the trench run (%).
- Crossfall perpendicular to the trench run (%).
- Preferred position of outlets along trench drain and any outlet size restrictions.
- Any slab depth restrictions.

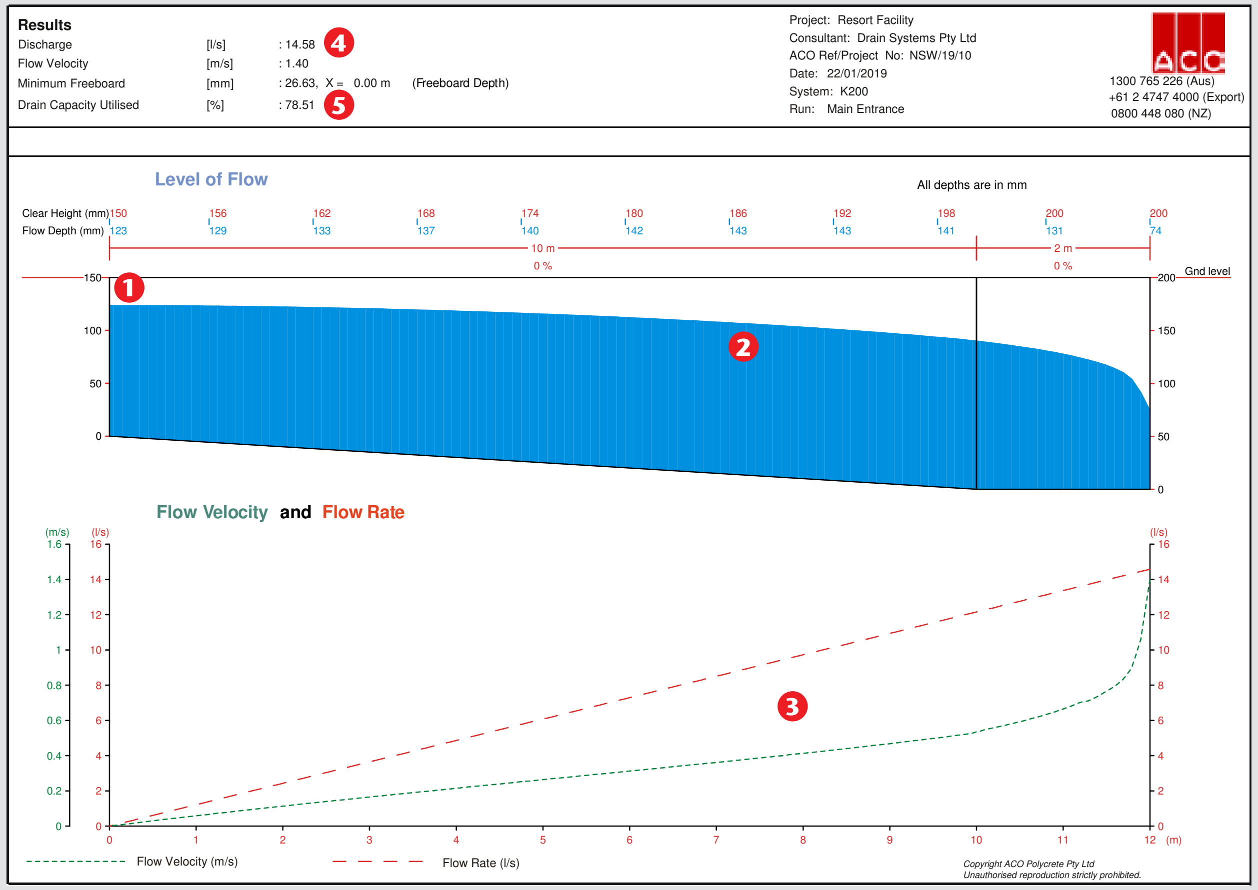
The electronic request form can be found at **www.acodrain.com.au/technical-support.htm**
Results are provided either electronically or as a printout.

Hydraulic results

The **'Hydro'** program calculates the following information:

Key

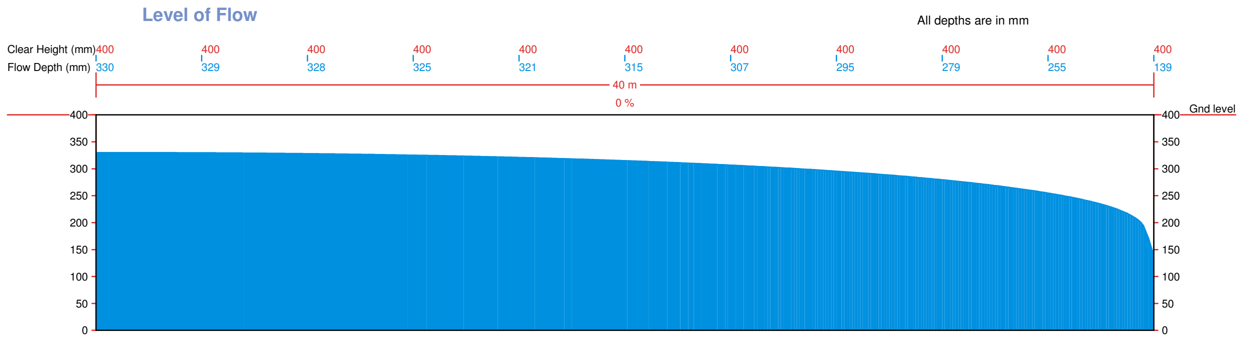
1. Position and size of minimum freeboard (gap between underside of grate and top of liquid in trench).
2. Hydraulic profile of liquid.
3. Flow velocity and flow rate at all points along the trench.
4. Maximum discharge capacity of trench run.
5. The percentage (%) of the hydraulic utilisation of the trench drain. If the hydraulic utilisation is over 100%, ponding occurs. The example below shows a hydraulic utilisation of 78.51%.

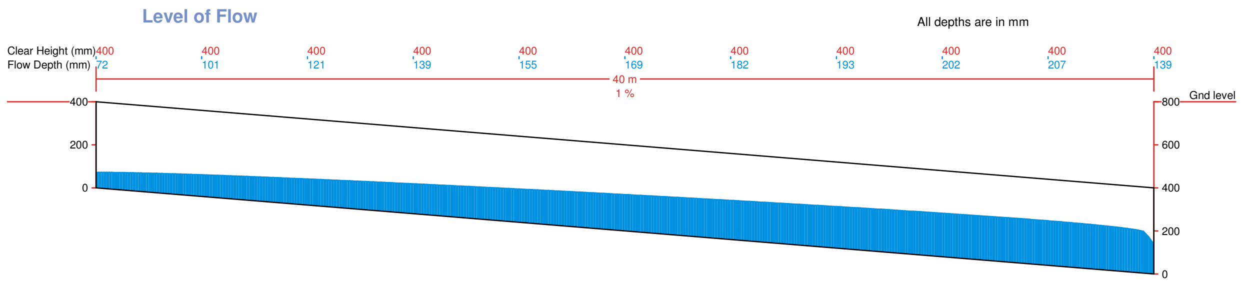


Effect of slope on trench drain hydraulics

Hydraulic capacity

Slope increases the hydraulic capacity of the trench drain because flow velocity is increased. This increase in capacity may result in larger areas being drained, outlets spaced further apart or a narrower and/or shallower trench system being specified that will result in product and installation cost savings.The drawings below highlight the water profile in the trench. The channel and flows are the same in both examples except the lower image has a 1% slope added. Note the difference in flow depth.





Position of outlet

Trench drains connect to underground pipes and the outlet position can dramatically affect the size and length of the trench drain required.

End outlet

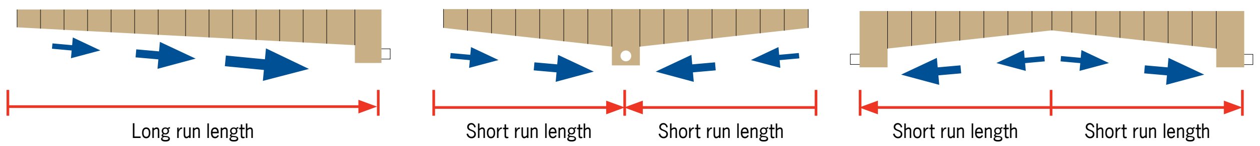
With a single end outlet, water may build up along the trench and cause ponding before reaching the outlet.

Central outlet – two directions

A central outlet enables a smaller trench drain as the central outlet reduces the build up of water, reducing the risk of ponding.

Double end outlet – two directions

An outlet at either end of the trench run enables a smaller trench drain but requires more outlets and additional pipework.



Size and type of outlet

Designers need to ensure the outlet and pipe infrastructure is not undersized restricting the outflow of the trench drain.

Horizontal end outlet

A pipe is connected horizontally at the end of the trench. This minimises excavation but offers the lowest outlet capacity.

Vertical end outlet

A pipe is connected vertically at the bottom of the trench. This option improves the outlet capacity due to gravity.

In-line pit

The pit is the same width as the trench, but deeper. It offers superior outlet capacity as large pipes can be connected and the increased depth gives increased head of water pressure.

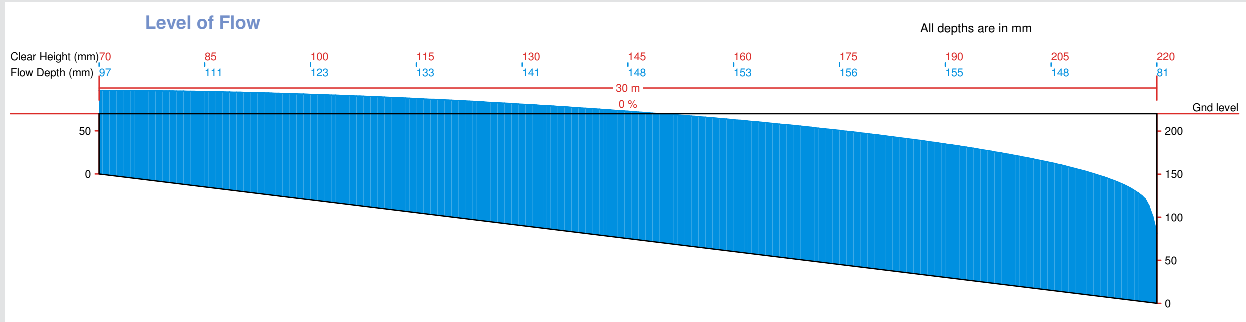
ACO Technical Services – Modelling catchment hydraulics

Temporary ponding refers to a brief flood situation that is acceptable with an undersized trench drain to enable a more cost effective drainage solution. The drain is designed to work effectively under average weather conditions, but will be slightly undersized during heavy storms.

Temporary ponding should only be considered where buildings and property are not in close proximity to the drainage system to minimise risk of damage. It is an ideal option for outer areas such as large car parks and distribution yards. A risk analysis should be carried out when temporary ponding is considered.

In order to produce a ponding analysis map, the following information is required:

- The same information required for the **'Hydro'** program, see page 117.
- Plan of site showing elevations.
- Location of buildings near the drain.



The **'Hydro'** result above indicates that flooding and ponding will occur and the situation requires a re-evaluation of the drainage size (width, depth, run length) or if temporary ponding can be tolerated, a ponding analysis, see below.

Ponding analysis results

The ponding analysis map shows the size and location of the ponding.

Key

1. Run-off scenario.
2. Catchment geometry showing width and depth of temporary ponding.
3. Visual map of worst ponding scenario.
4. Trench drain length an length of temporary ponding.
5. Project notes.

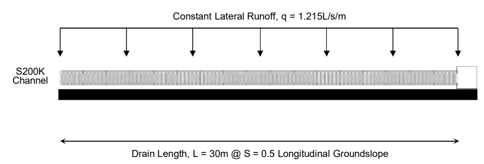
Ponding Analysis

Based on the results from ACO's 'Hydro' hydraulic design program

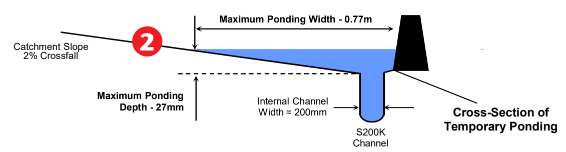
PROJECT: Resort Facility
Contact: James Smith
Company: JBD Constructions

Tel. No: 04011315527
Fax No:
email: James.Smith@JBDConstructions.com

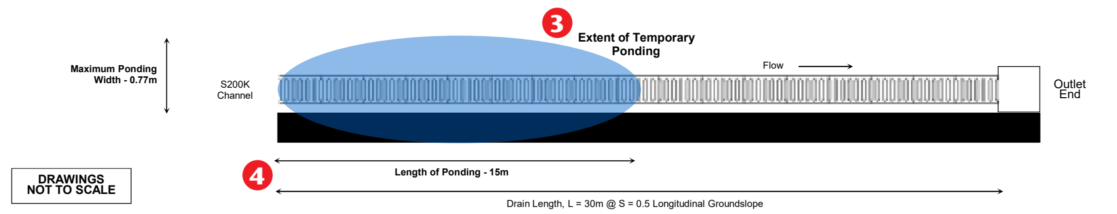
Runoff Scenario 1



Catchment Geometry (Cross Section)



Ponding Map



General Information

Date: 22/01/19 **ACO Contact:** Jarred Taylor **Ref. No:** NSW/19/10

Note: 5
1. The hydraulics of the ACO Drain System were calculated based on the assumed Runoff Scenario above.
2. The extent of ponding, depth and width, were determined from the Catchment Geometry (Cross-Section).

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ACO Pty Ltd

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Website: www.acoaus.com.au

Grate hydraulics

In typical conditions, a trench drain reaches hydraulic capacity before the grate. When there are concentrated flows running down a steep slope for example, the grate may not be capable of capturing all the flow, even if the trench is correctly sized.

Correctly located drains position grates in the direct path of surface runoff. A grate has a finite capacity to capture the surface run-off from the catchment area. When the grate's hydraulic capacity has exceeded, bypass occurs.

A grate's hydraulic performance can be greatly influenced by subtle changes in the design of the grate and catchment characteristics.

When liquid moves over a grate, the following two scenarios may occur:

- **Weir** occurs when liquid depths are minimal and the speed of liquid is high.
- **Drowned orifice** occurs when there is an accumulation of liquid above the grate.

Drains positioned in sag or valley locations allow for more liquid to accumulate. This gives rise to higher flow rates due to the increased pressure of the liquid depth being pushed through the grate openings.

Hydraulic performance is affected by the characteristics of the grate and catchment.

1. Grate characteristics

- Intake area.
- Width of grate.
- Design features such as the direction of bars, slots and slip resistance features.

2. Catchment characteristics

- Catchment slope determines the liquid velocity.
- Catchment roughness determines the liquid velocity and head of liquid.
- Flow direction – one direction requires a barrier drain, two or more directions requires a sag or valley drain.
- Type of liquid.
- Debris within the liquid.

No bypass

100% Capture
All the liquid flows through the grate opening.

Bypass

Less than 100% Capture
Bypass occurs when not all of the liquid flows through the grate openings.
Reasons for bypass include:

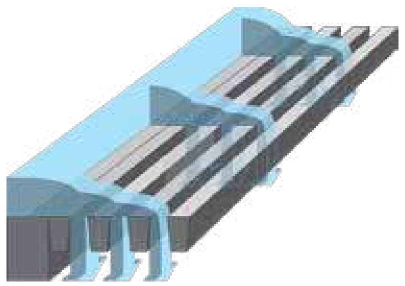
- Not enough grate open area.
- Too much runoff.
- Too much slope perpendicular to grate.

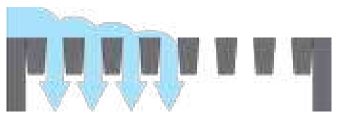
Types of inlet grates

Grate with longitudinal openings

When comparing grates of equal intake area and width, grates with longitudinal openings offer the highest water intake and the maximum flow evacuation. See image below.

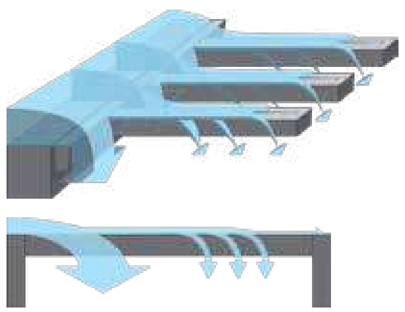
- Four bars interrupt and slow down the flow before a weir is produced.
- Slots 1, 2 and 3 are drowned orifices.
- Slot 4 acts as a weir.





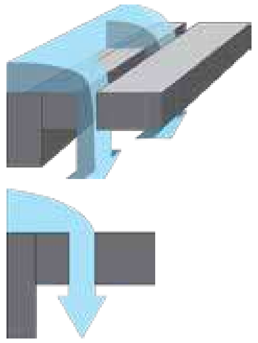
Grate with transverse openings

When comparing grates of equal intake area and width, grates with transverse openings offer moderate water intake. The bars create a bridge across both sides of the drain with minimal flow interruption, this can result in early (low volume) bypass.



Grate with a slot opening

When comparing grates of equal intake area and width, grates with slot openings provide minimal flow interruption as a weir is produced. The water intake is the lowest and the minimal depth above the slot will have negligible drowned orifice effect.



Note: Designers need to be aware of the trade-off between small inlets for heel safety and large inlets for optimum grate hydraulics. For more information, see page 115.

ACO Technical Services – Modelling grate hydraulics

Grate intake experiments

Due to the complex nature of fluids in relation to grate inlet hydraulics, testing is the only way to accurately predict how a grate will intercept surface water run-off.

ACO commissioned the UNSW Water Research Laboratory to research and test grate hydraulics. Three studies were carried out in 1998, 2004 and 2016 to investigate the water intake performance of ACO grates.

The tests were carried out under varying flow rates and catchment approach slopes. Each grate was tested until bypass occurred, which is the point where liquids pass across the grate.

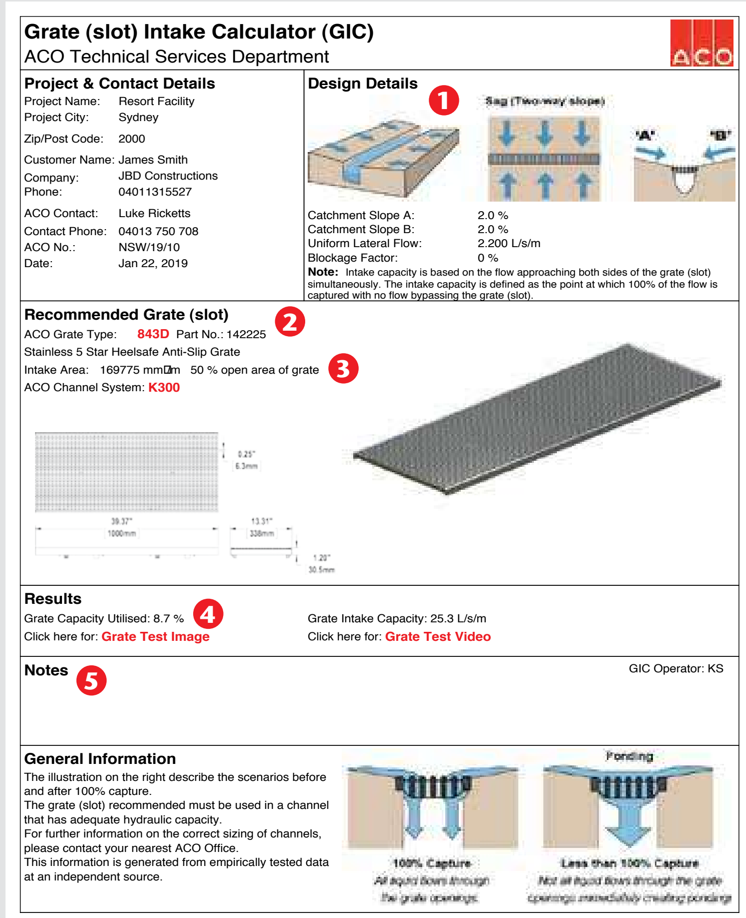
The hydraulic grate test results enable ACO to accurately recommend grates for specific projects based on their catchment hydraulics.

Grate intake calculator

Grate Intake Calculator (GIC) provides valuable information on the performance of a grate during design conditions.

To generate results from the **'GIC'** program the following information is required:

- Preferred grate type.
- Length of grate (metres).
- Length and width of catchment area (metres).
- Position of trench in catchment area.
- Surrounding pavement material for example concrete or asphalt.
- Rainfall intensity in (mm/hr).
- Crossfall perpendicular to the trench drain (%).



Grate (slot) Intake Calculator (GIC)
ACO Technical Services Department

Project & Contact Details
Project Name: Resort Facility
Project City: Sydney
Zip/Post Code: 2000
Customer Name: James Smith
Company: JBD Constructions
Phone: 04011315527
ACO Contact: Luke Ricketts
Contact Phone: 04013 750 708
ACO No.: NSW/19/10
Date: Jan 22, 2019

Design Details 1
Sag (Two-way slope)
'A' 'B'
Catchment Slope A: 2.0 %
Catchment Slope B: 2.0 %
Uniform Lateral Flow: 2.200 L/s/m
Blockage Factor: 0 %
Note: Intake capacity is based on the flow approaching both sides of the grate (slot) simultaneously. The intake capacity is defined as the point at which 100% of the flow is captured with no flow bypassing the grate (slot).

Recommended Grate (slot) 2
ACO Grate Type: 843D Part No.: 142225
Stainless 5 Star Heelsafe Anti-Slip Grate
Intake Area: 169775 mm²/m 50 % open area of grate 3
ACO Channel System: K300
0.25" 6.3mm
39.37" 1000mm
13.31" 338mm
1.20" 30.5mm

Results
Grate Capacity Utilised: 8.7 % 4
Click here for: Grate Test Image
Grate Intake Capacity: 25.3 L/s/m
Click here for: Grate Test Video

Notes 5
GIC Operator: KS

General Information
The illustration on the right describe the scenarios before and after 100% capture.
The grate (slot) recommended must be used in a channel that has adequate hydraulic capacity.
For further information on the correct sizing of channels, please contact your nearest ACO Office.
This information is generated from empirically tested data at an independent source.
Ponding
100% Capture
Less than 100% Capture

Grate analysis results

ACO's grate analysis program calulates the following information.

Key

1. Catchment design and hydraulics.
2. Recommended grate information.
3. Total intake area per metre of trench run.
4. Hydraulic utilisation of the grate – 100% indicates that all the grate intake capacity is used.
5. Additional notes relating to the grates performance.

For a quick result, an online version of the **'GIC'** program is available.

Grate Intake Calculator (GIC)
Every grate on the ACO Drain website has a link to the **'GIC'** program.
Go to **www.acodrain.com.au**
Click the symbol to go to the **'GIC'** input page.

ACO Technical Services – Run layouts

CAD design services

For complex projects, ACO can provide a custom trench drain layout using CAD to illustrate required positions and layouts of trench runs.

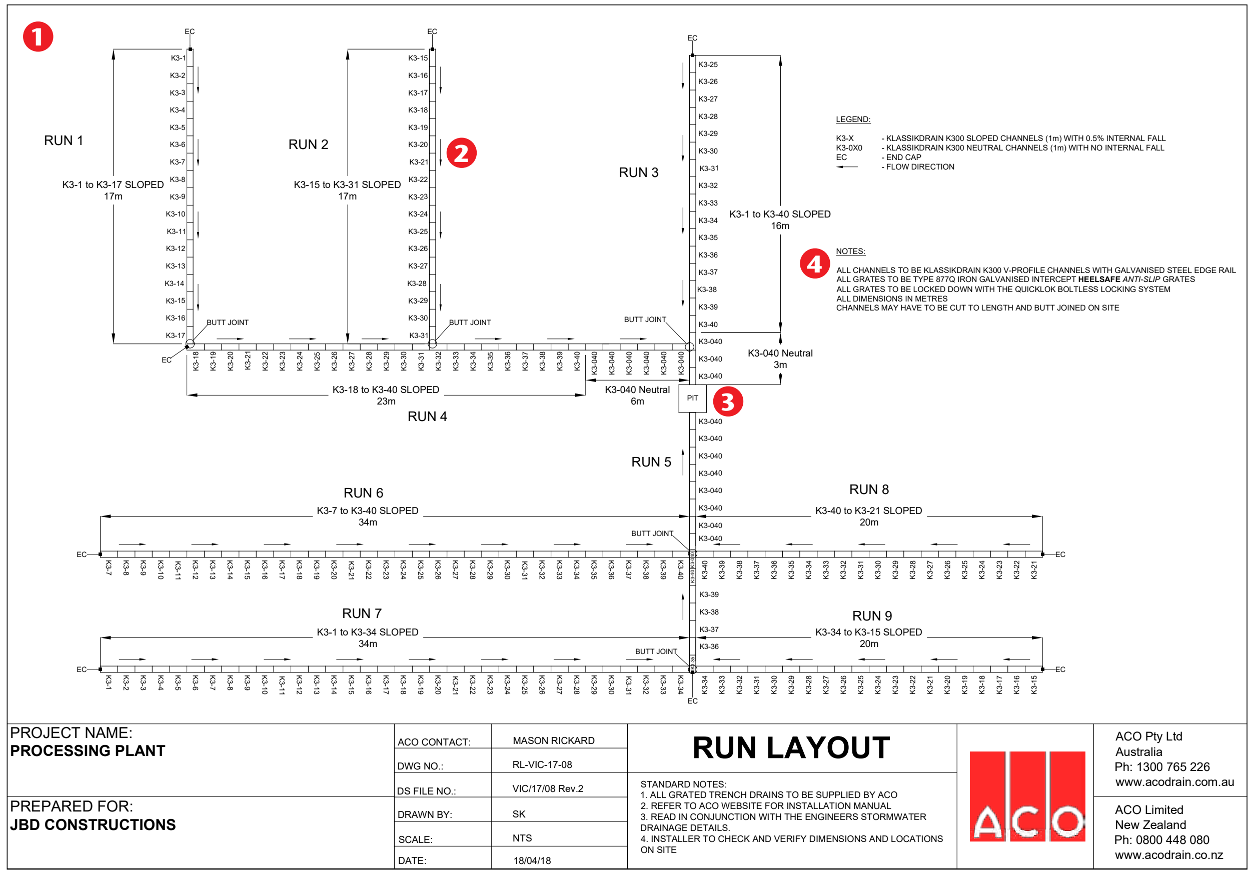
In order to produce a plan layout, the following information is required:

- Plan of site showing elevations.
- Existence of any depth restrictions.
- Position and type of any plumbing fixtures/outlets.
- Position of any permanent structures.
- Liquid flow pattern and type of traffic (including traffic flow).

CAD layout results

Key

1. Plan view of trench run layout.
2. Direction of liquid flow.
3. Position and type of outlet.
4. Trench and grate selected.



ACO Technical Services – Product parts and pieces

Scheduler

'Scheduler' is a purpose written software program that shows trench drain run layouts in plan and elevation views including the position of outlets and accessories.

The program also calculates the Bill of Materials for each run and totals all the runs to ensure the correct parts and pieces are ordered. This service is very useful for onsite installers.

Key

1. Elevation view of trench run.
2. Direction of liquid flow.
3. Position and type of outlet.
4. Detailed bill of materials.
5. Hyperlinks to specification information sheets on products drawn.

Scheduler – Parts Schedule
ACO Technical Service Department

Project Details
Name: Building Entrance
Address: George Street
City: Sydney State/Region: NSW
Country: Australia

Customer Details
Name: Darren Chan
Company: ACO
Phone: 02 4747 4000
Email: dchan@acoaus.com.au

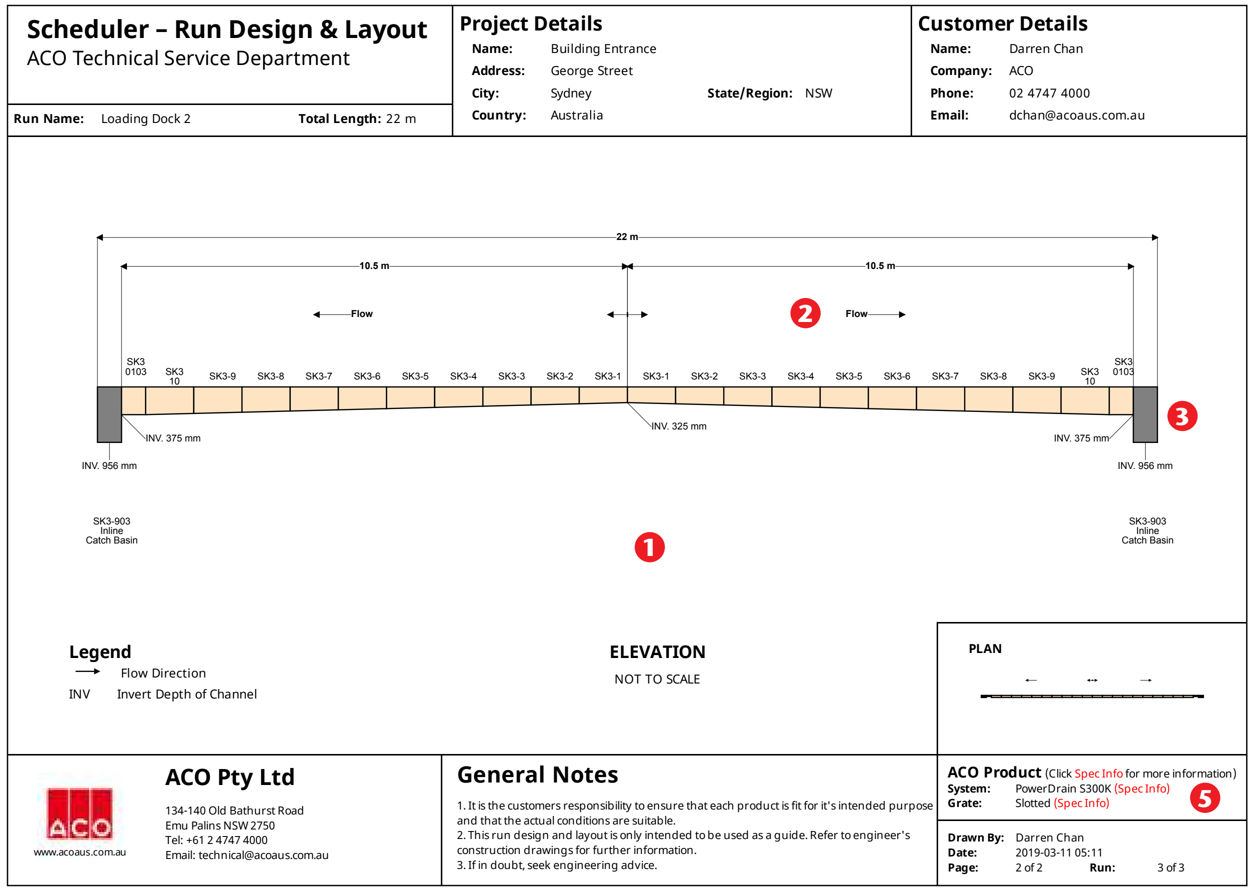
Run Details
Run Name: Loading Dock 2
Length: 22 m

ACO Product (Click Spec Info for more information)
System: PowerDrain S300K (Spec Info)
Grate: Slotted (Spec Info)
5

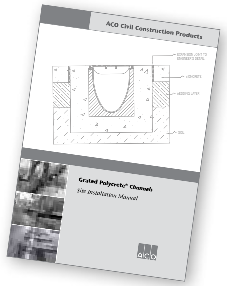
Part Number	Product Description	Quantity
142549	SK3-903 In-line pit - (0.5m)	2
69045	SK3-0103 Neutral channel - (0.5m)	2
69010	SK3-10 Sloped channel - (1m)	2
69009	SK3-9 Sloped channel - (1m)	2
69008	SK3-8 Sloped channel - (1m)	2
69007	SK3-7 Sloped channel - (1m)	2
69006	SK3-6 Sloped channel - (1m)	2
69005	SK3-5 Sloped channel - (1m)	2
69004	SK3-4 Sloped channel - (1m)	2
69003	SK3-3 Sloped channel - (1m)	2
69002	SK3-2 Sloped channel - (1m)	2
69001	SK3-1 Sloped channel - (1m)	2
02445	S300K Iron Slotted - (0.5m)	44
97479	300 Installation device	25

4

For simple trench drains, customers can schedule their own ACO Drain runs.
Go to **www.acodrain.com.au**



Installation support

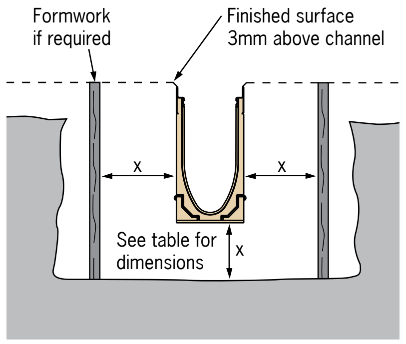


Channel units are installed in a continuous trench, and are encased with concrete. Full installation instructions are available in the Site Installation Manual. Contact ACO or visit www.acodrain.com.au

1. Trench excavation

Excavate trench to accommodate trench drain. Excavation should be around centre line of trench. Excavation must be sufficient enough to accommodate each of the following:

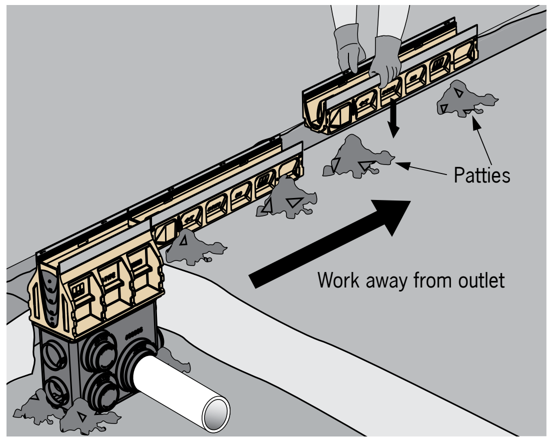
- Channel and inline pit width and depth dimensions.
- Concrete encasement dimensions – 100mm to 200mm. Specific loading and ground conditions will increase the excavation size. See page 128 for further guidelines.
- For sloped systems, excavate base to follow the fall of the trench run.



Dimension for:	X
AS 3996 Class A–B	100mm
AS 3996 Class C–D	150mm
AS 3996 Class E–G	200mm

2. Outlet installation

- Determine type of outlet and position.
- Install outlet or inline pit.
- Install channels starting at the outlet, then working away from the deepest (highest channel number) to shallowest channel.

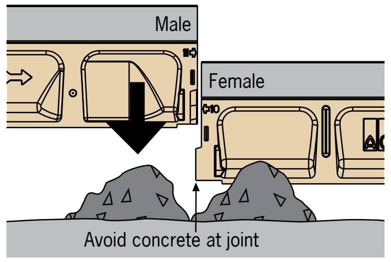


3. Trench drain installation

Channel units need to be supported at correct height and held securely in place to avoid movement during concrete pour. There are a number of options available.

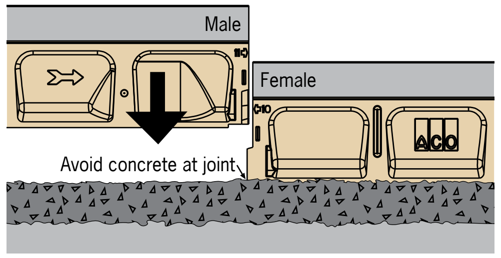
Patty method

Channels are set up on concrete patties with a stiff, low slump to support the weight of the channel.



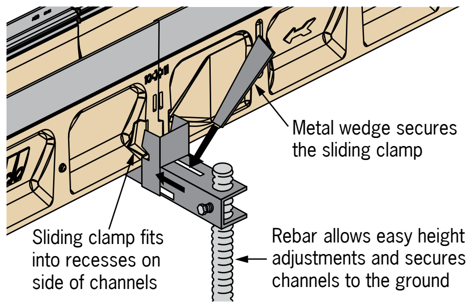
Continuous wet base method

A wet concrete base suitable to support the weight of the channel.



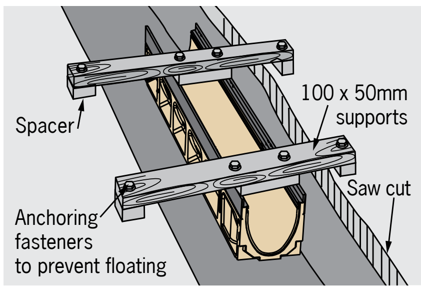
Installation device for KlassikDrain and PowerDrain

A clamping system that fits around the channel joints, supported on rebars to achieve correct height. One device per joint is required. This allows for a single concrete pour.



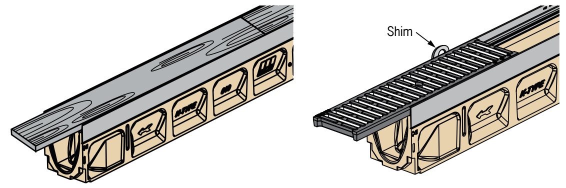
Hanging method for PowerDrain and SlabDrain HSK

Channels can be hung from existing slab or formwork.



4. Channel bracing

To prevent channel walls and joints being distorted by pressure of concrete, grates (or plywood cut to a snug fit) should be installed in channel prior to concrete pour. Shims or washers placed along each side allow easy removal of the grates. Grates should be suitably wrapped to protect from concrete splash.



5. Concrete pour

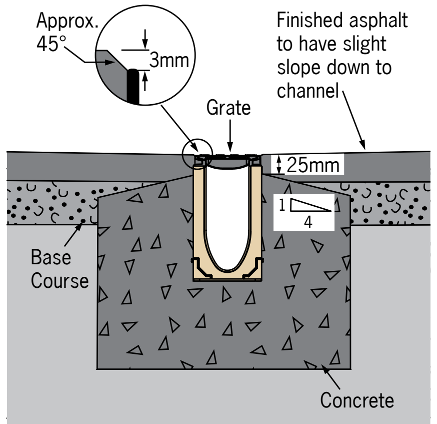
Concrete should have compressive strength of minimum 25MPa to provide the encasement for the channel. Concrete should be poured evenly (both sides of channel) and carefully to avoid dislodging channels. A wand-type vibrator should be used to ensure concrete distributes evenly underneath and around channels.

6. Pavement finishing

The top of the adjacent pavement or concrete encasement must be above the top of the grate by approximately 3mm.

Brick pavers should be set approximately 3mm above the trench edge with the first paver course set on mortar or concrete.

Care should be taken with asphalt rolling machines to avoid damage to trench edge.



7. Complete the installation

- Remove grates and remove protective wrapping.
- Remove any debris in channel and grate rebate. Ensure outlet pipes are clear.
- Install the rubbish baskets into inline pits, if required.
- Flush trench drain to check for pipe blockages; unblock if required.
- Empty rubbish baskets and clean out pipe connections. Re-install rubbish baskets.
- Install grates ensuring they are securely locked down.

Drainage system is now ready for use.

Maintenance

Regular inspections of the trench drain system are recommended. Frequency will depend on local conditions and environment, but should be carried out at least annually.

Inspections should cover:

- Grates and locking devices.
- In-line pits and rubbish baskets.
- Concrete encasement and adjacent paving.

All items should be inspected for damage, blockage or movement. Compare with site drawings if necessary.

Maintenance guidelines

1. Remove grates and clear slot openings of dirt and debris.
2. Remove debris from channel either by shovelling, water jetting or vacuum pump.
3. Flush channels with water or pressure washer.
4. Repair damaged channel surfaces, if necessary, with ACO repair kit (Part No. 02163).
5. Renew joint seals as required.
6. Empty rubbish baskets and clean out pipe connections.
7. Re-install rubbish baskets.
8. Re-install grates, ensuring they are securely locked down.

Oxidation of iron grates over time

Most ductile iron grates have a black coating applied to protect the grate for a short period after manufacture. It is not intended to be either a long term or architectural finish.

Oxidation on the surface of ductile iron products is a natural process that does not affect the structural integrity of the product and produces a rustic look, see pages 90 to 91.

If a black finish is required, it would be recommended to paint the grates with a black rust inhibitor from time to time.

Product design life

If properly maintained, ACO products installed in the correct application and according to ACO's installation instructions, will hold their integrity for as long as the adjacent pavement will.

For example, if the pavement is designed for 30 years and is not damaged during this time, the ACO product will last for 30 years.

Unforeseen and adverse conditions out of ACO's control may affect the life of the product.

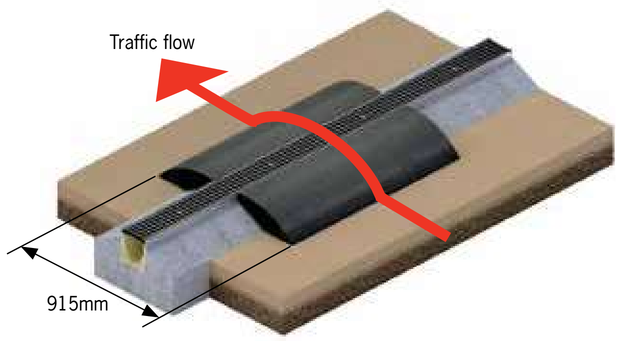
Site specific solutions

Ground conditions

Specific ground conditions or contaminated ground may require a deeper and/or wider concrete encasement than the minimum recommendations. If in doubt, seek engineering advice.

Temporary installation

During site work and after trench run is laid, the trench top can be vulnerable to damage. Site traffic should be routed away from the trench. If temporary crossings are required, a base course of minimum width 915mm should be installed either side of the trench for protection. Loose boards or plates are inadequate.

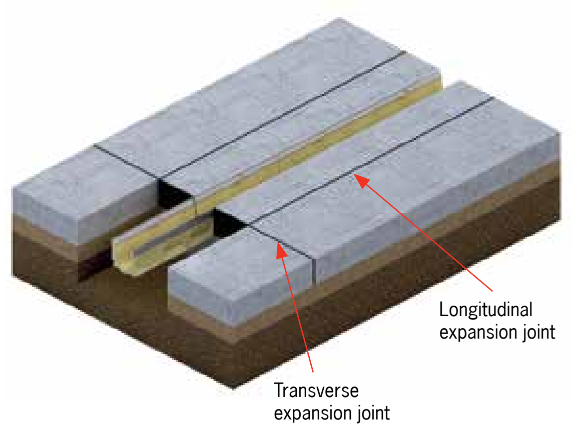


Thermal movement

Longitudinal expansion joints, which for some slabs may be dowelled horizontally and de-bonded, will isolate the trench and concrete encasement from thermal movement from adjacent large concrete slabs.

Transverse expansion joints in the concrete slab should be positioned to coincide with channel-to-channel joints. Alternatively the channel may be cut to align with the slab joint and resealed with a suitable flexible sealant.

Engineering advice should be sought for specifying expansion and/or isolation joints.



Shrinkage movement / cracking

A good curing regime along with the addition of control joints will ensure concrete provides adequate support and protection for the channel run. Engineering advice should be sought for specifying shrinkage control provisions.

Joint sealing

ACO's channels are installed with a concrete encasement, which will provide a basic seal around the channel. If required, all channel-to-channel and channel-to-fitting joints can be further sealed.

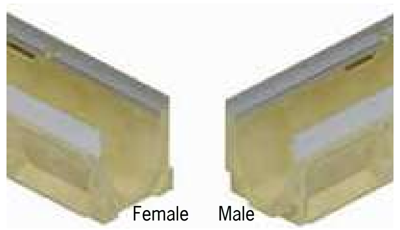
ACO channels are supplied with a Sealant Groove as standard. This provides a groove that can be filled with an appropriate flexible sealant to create a watertight joint. This is particularly important with elevated slabs and where liquids may contain chemicals or oils.

Sealant should be resistant to the same chemicals that are in contact with the trench material and be flexible to allow for any slab movement from temperature changes. Surfaces should be correctly prepared prior to applying sealant to ensure good adhesion.

Connection options

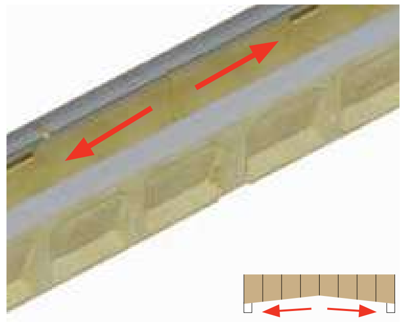
Male-female connection

Interconnecting end details allow easy and effective joining of channels. It also helps with height and sideways alignment between channels. A groove provides positive placement for appropriate sealant.



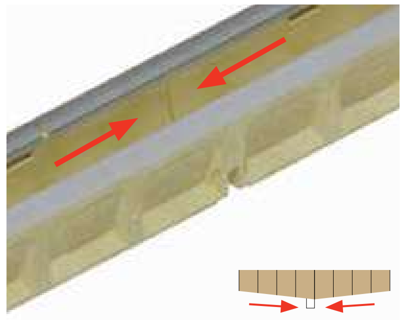
Female-female connection

Creation of a direction change and high point, requires an outlet at start and end of run. To create, grind off female end details and butt channels together and mortar in place.



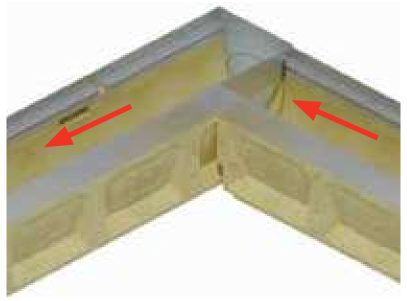
Male-male connection

Enables a creation of a low point that is usually installed with a bottom outlet where an in-line pit is not required. To create, butt male channel ends together, fill gaps and mortar in place.



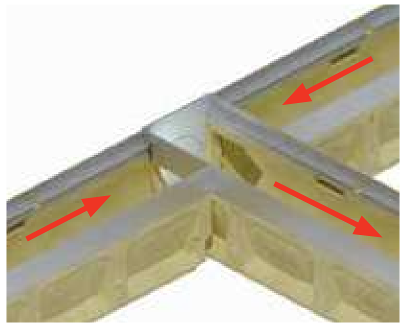
Corner

Junction details on sides of half metre neutral channels allow on-site creation of corners. Edge rails and grate seats remain intact for structural integrity.



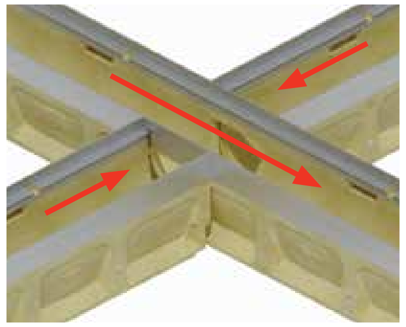
Tee junction

Junction details on sides of half metre neutral channels allow on-site creation of tees. Edge rails and grate seats remain intact for structural integrity.



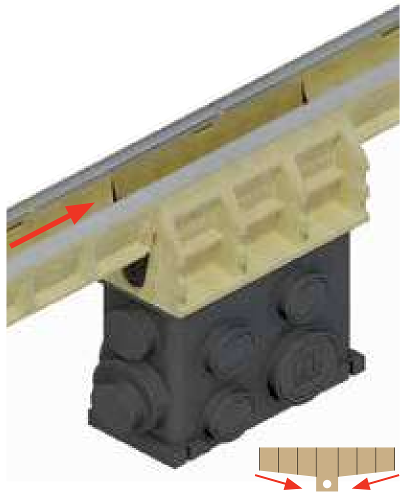
X–cross

Junction details on sides of half metre neutral channels allow on-site creation of x-cross. Edge rails and grate seats remain intact for structural integrity.



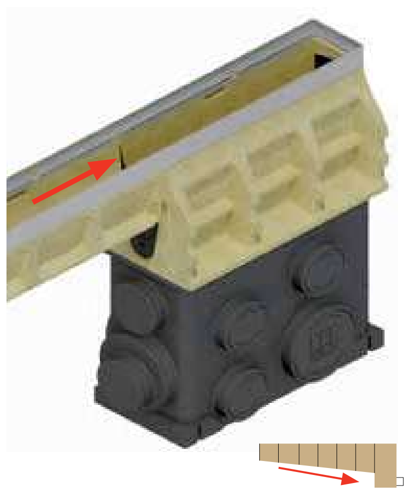
In-line pits

The in-line pit is typically the low point and has female connections at each side for easy connection to the deeper male channel end.



Blanking end plates

For in-line pits a blanking end plate is supplied to prevent concrete ingress during concrete pour. It also provides an aesthetic finish at the end of the channel.



Cutting, drilling and grinding

ACO strongly recommends wet cutting, wet drilling and/or wet grinding of polymer concrete products in a well ventilated area with the use of personal protective equipment including masks, gloves and eye protection.

Note: → Arrow depicts direction of channel slope and flow.

Installation sections

An installed ACO Drain System will incorporate the following:

- Correct grate type.
- Correct channel type and size.
- A minimum grade 25MPa compressive strength cement concrete encasement.

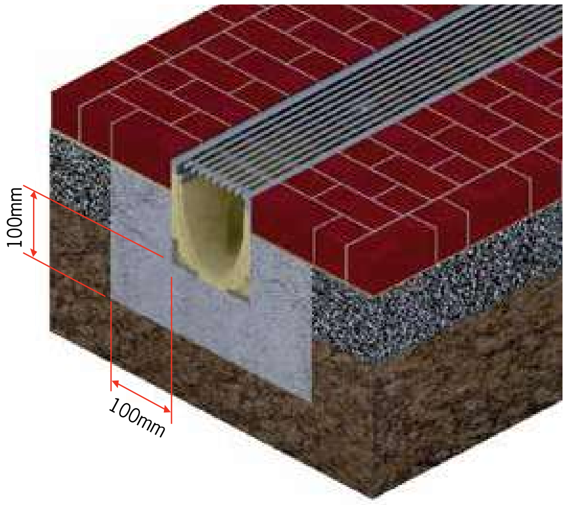
It is recommended that the cement concrete encasement be durable and conform to minimum strength requirements.

Poor site conditions and low load bearing pavements will require an increase in the dimensions shown in the illustrations to meet both the vertical and lateral loads. It is the customer's responsibility to ensure that the complete design and construction of the encasement is suitable for the application. If in doubt, seek engineering advice.

The following illustrations are a guide only.
A complete library is downloadable from www.acodrain.com.au

Class A to B

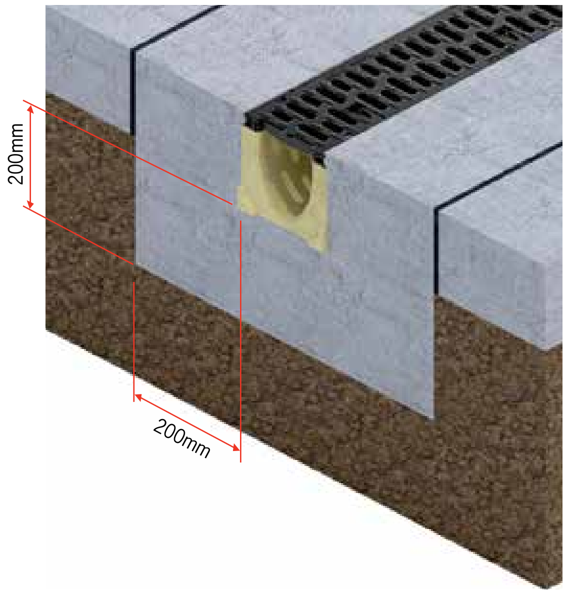
100mm channels for BLOCK PAVER installation
(Maximum 2,670kg approximate wheel load)



Note:
1. Grate should be 3mm below pavement surface.

Class E to G

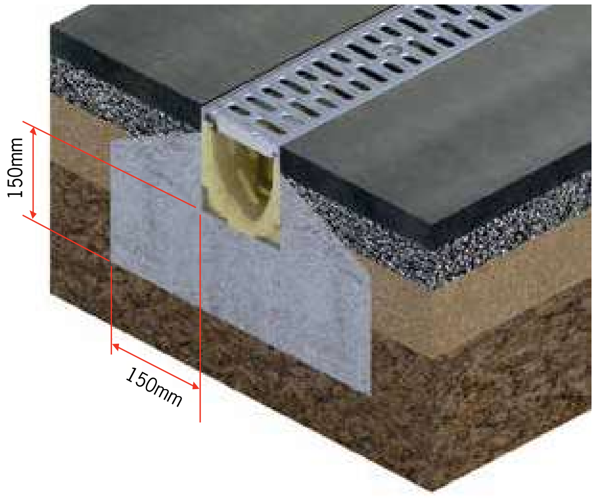
100mm channels for CONCRETE installation
(Maximum 30,000kg approximate wheel load)



Note:
1. Grate should be 3mm below pavement surface.

Class C to D

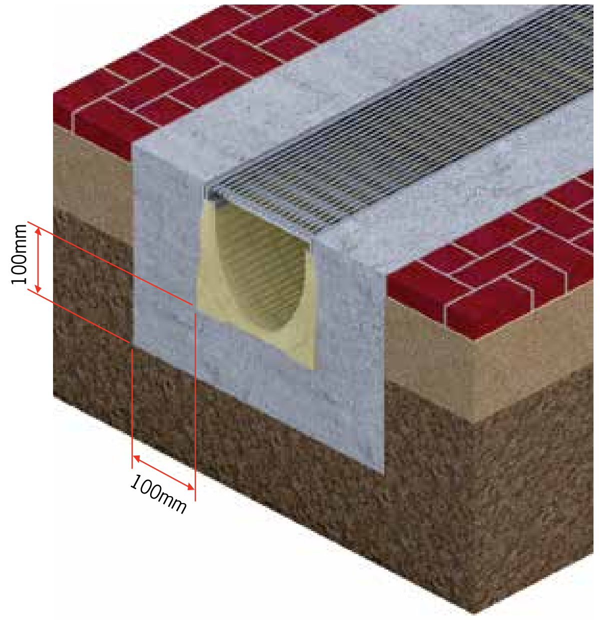
100mm channels for ASPHALT to edge installation
(Maximum 8,000kg approximate wheel load)



Note:
1. Grate should be 3mm below pavement surface.
2. Care should be taken with asphalt rolling machines to avoid damage to channel edge and grate.

Class A to B

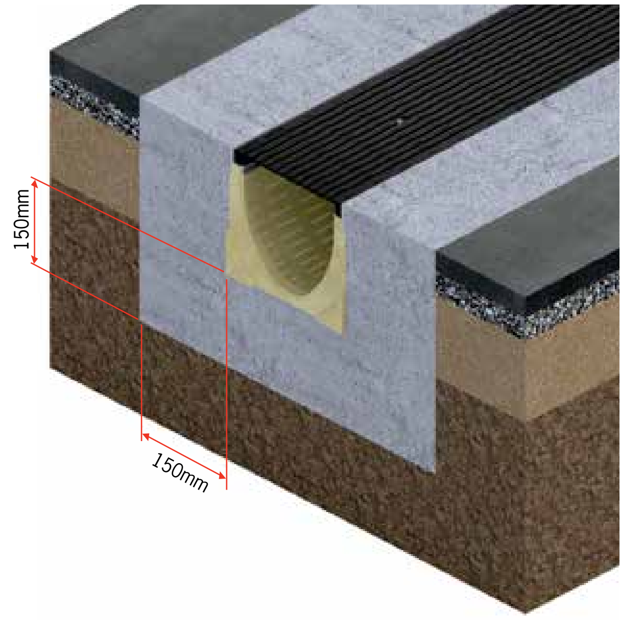
200mm channels for BLOCK PAVER installation
(Maximum 2,670kg approximate wheel load)



Note:
1. Grate should be 3mm below pavement surface.
2. Paver to edge option, refer to previous page.

Class C to D

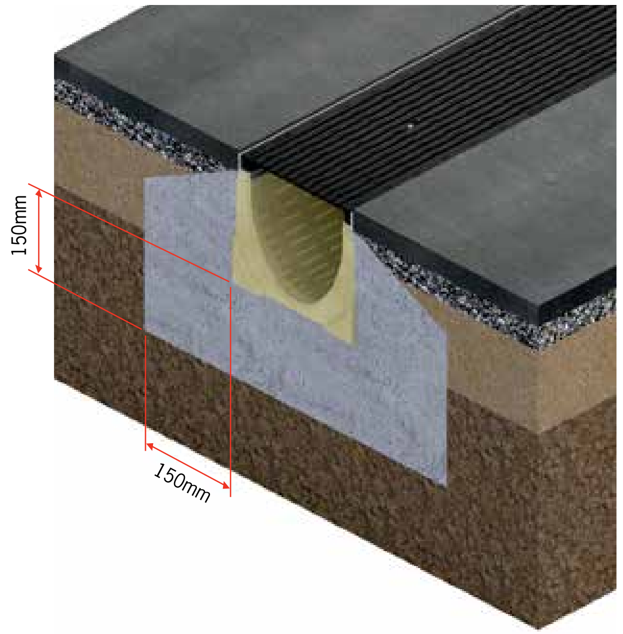
200mm channels for ASPHALT installation
(Maximum 8,000kg approximate wheel load)



Note:
1. Grate should be 3mm below pavement surface.

Class C to D

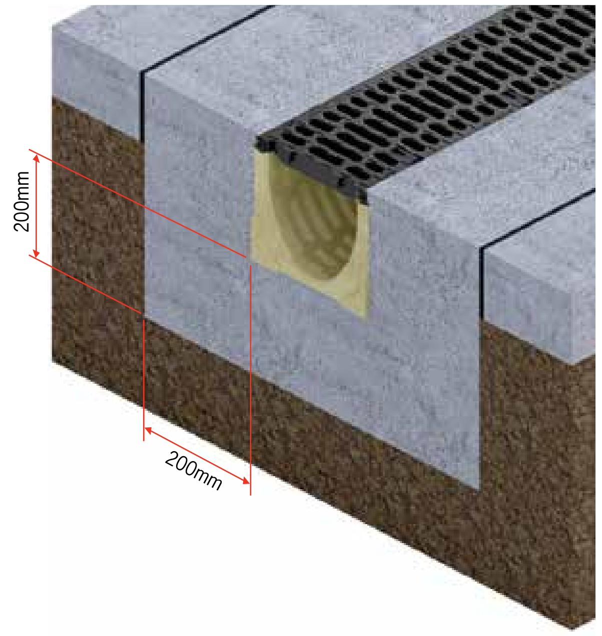
200mm channels for ASPHALT to edge installation
(Maximum 8,000kg approximate wheel load)



Note:
1. Grate should be 3mm below pavement surface.
2. Care should be taken with asphalt rolling machines to avoid damage to channel edge and grate.

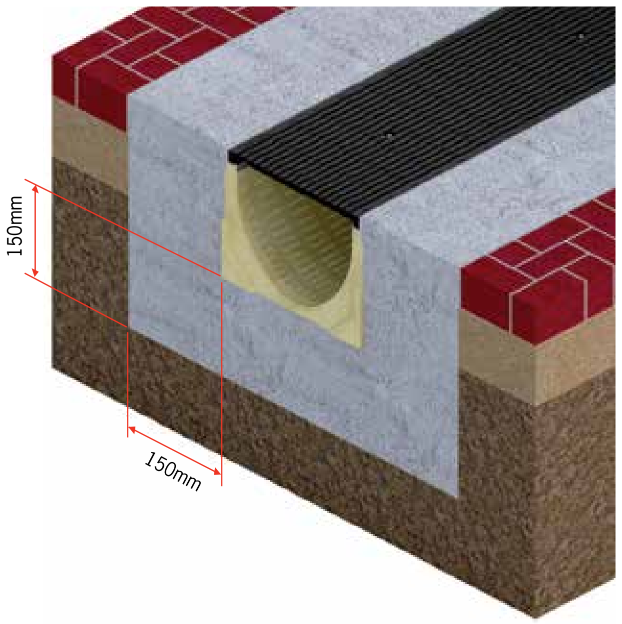
Class E to G

200mm channels for CONCRETE installation
(Maximum 30,000kg approximate wheel load)



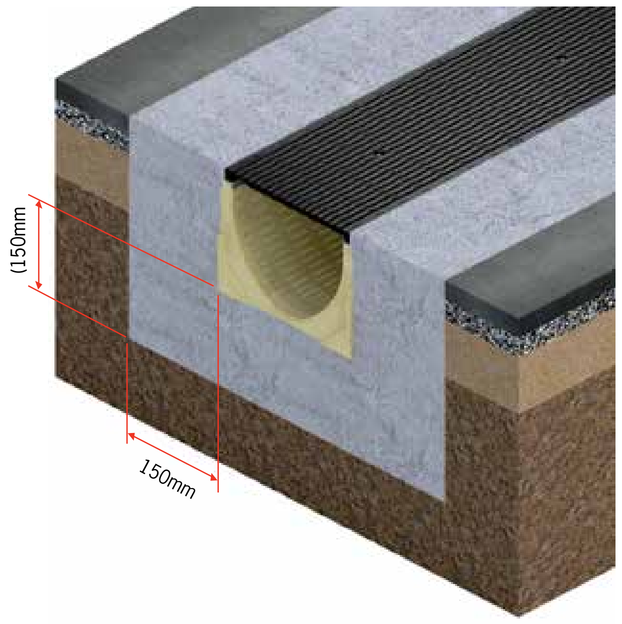
Note:
1. Grate should be 3mm below pavement surface.

Class C to D
300mm channels for BLOCK PAVER installation
(Maximum 8,000kg approximate wheel load)



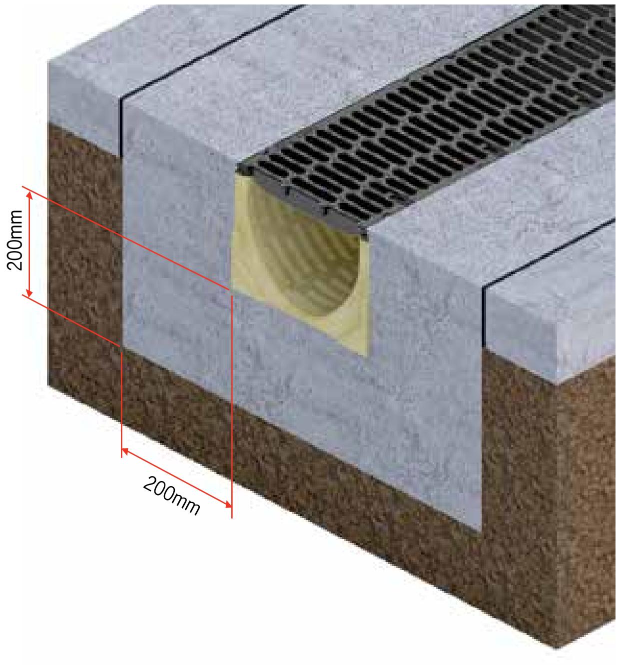
Note:
1. Grate should be 3mm below pavement surface.

Class C to D
300mm channels for ASPHALT installation
(Maximum 8,000kg approximate wheel load)



Note:
1. Grate should be 3mm below pavement surface.

Class E to G
300mm channels for CONCRETE installation
(Maximum 30,000kg approximate wheel load)



Note:
1. Grate should be 3mm below pavement surface.

Glossary

Anti-shunt lugs – interlocking mechanism on grate and edge rail of channel to prevent longitudinal movement of the grates.

AS 1428.2 – Australian Standard for the *Design for Access and Mobility* requirements for buildings.

AS 3996 – Australian Standard for *Access Covers and Grates.*

AS 4586 – Australian Standard for *Slip Resistance Classification of New Pedestrian Surface Materials.*

Bicycle safe – grates with slot sizes that are safe for bicycle wheels.

Cast-in-situ – a trench drain that is constructed during a concrete pour with removable formwork.

Catchment area – paved area that will collect liquids.

Channel – individual modular unit.

Chemical resistance – ability to withstand specified chemicals.

Corrosion resistance – ability to withstand weathering.

Cut-outs – shaped plastic inserts cast in the ends of polymer concrete channels to enable easy removal of material for channel connection.

DrainLok – ACO's patented barless and boltless locking system for KlassikDrain and SlabDrain HK Series.

Drill-outs – shaped recesses in a polymer concrete unit to enable easy removal of material for pipe or channel connection.

Ductile iron – pig iron with magnesium added to provide durability and strength is also referred to as spheroidal graphite (SG) iron.

Edge protection – metal edge rail to protect the edge of the trench body from general impact or damage.

EN 1433 – European Standard for *Drainage Channels for Vehicular and Pedestrian Areas.*

Female – the end of a channel with a rebate to interconnect with the protrusions of a male end of a channel to enable a tight connection.

Free area – area for water flow, calculated by clear opening width and space beneath the grate.

Freestyle – ACO's semi-custom iron grates.

Galvanised steel – black steel with protective galvanised coating.

GIC – ACO's proprietary software program to calculate grate intake performance.

Grade – angle of pavement slope.

Grated pit – large basin to collect liquid into underground pipe work.

Grate hydraulics – performance of liquid entering grate openings.

Groundslope – percentage of surface slope.

Heelsafe® *Anti-slip* grates – ACO's trademark for pedestrian friendly grates.

Hydro – ACO's proprietary software program to accurately calculate trench drain performance.

Hydrological cycle – cycle of water from oceans to rainfall and back to the ocean.

In-line pit – same width basin connected to trench drain that acts as an exit point to the underground pipe work.

Invert depth – depth from top of grate to inside base of channel.

kN – kilonewton – measurement of force, 1kN = 102kg of force.

Lateral intake – liquid entering the trench drain from surrounding paved area.

Male – the end of a channel with protrusions to interconnect with the rebate of a female end of a channel to enable a tight connection.

Manning's equation – an equation for calculating steady and uniform flow in pipes or culverts. Does not account for lateral intake of liquids.

Manning's roughness coefficient – the hydraulic measure of a material's surface roughness.

Non-uniform flow – changing flow velocity in a trench due to continuous lateral intake.

Overall depth – depth from top of grate to underside/bottom of channel.

Pavement – the hard surface material of a road or street surrounding a trench drain.

Polycrete® – ACO's trademark for polymer concrete products.

Polymer concrete – material created with mineral aggregates mixed with resin binding agents used to produce channels.

Ponding analysis – computer calculations to ascertain the temporary ponding in a short lived flood situation, which is deemed acceptable for certain projects.

PowerLok – ACO's patented barless and boltless locking system consisting of a sliding clip that locks onto the edge rail.

QuickLok – ACO's patented boltless locking system consists of a shaped stud and spring clip that locks to a bar inserted in the channel.

R rating – classification defined by AS 4586 for the Oil-Wet Inclining platform test to be applied in commercial and industrial areas where surfaces are contaminated with oil and grease, for example commercial kitchens.

SA HB 198 – Australian Standard Handbook: *Guide to the Specification and Testing of the Slip Resistance of Pedestrian Surfaces.*

Scheduler – ACO's proprietary software program to illustrate trench layouts.

Sealant groove – void at channel joint to allow application of a sealant if required.

Slip resistance – measure of coefficient of friction of grate surface.

Spoon drain – cast-in-situ dish in a pavement with little depth and no grate.

Stainless steel – a mild steel with a minimum of 11% chromium added to provide enhanced corrosion resistance. There are a wide number of stainless steels available, each with differing properties. ACO grates are Grade 304 austenitic stainless steel. Grade 316 available on request.

Steady uniform flow – constant flow velocity in a trench and pipe based on Manning's Equation.

Sustainable drainage – Water Sensitive Urban Drainage (WSUD) is the design for the collection, treatment and reuse of rainwater for low environmental impact.

Trench drain – a long, narrow ditch for the collection of liquid.

Wet pendulum test – prescribed in AS 4586 for pedestrian areas that can become wet with rainwater. This test is designed to be applied to urban stormwater grates. P rating classification is used.