ACO. creating the future of drainage

The ACO Group

Founded in 1946, the ACO Group is a world leader in drainage technology. Climate change sets us a challenge to react effectively with innovative solutions to new environmental conditions. With its integrated approach, ACO provides systems for professional surface water drainage, efficient cleaning, and the controlled discharge or reuse of water.

Products include:

- surface water drainage
- oil, sediment, heavy metal and grease separators
- detention, retention and infiltration systems
- flow control release products

Major innovative strengths of the ACO Group are its continuous research & development and technical expertise in the processing of polymer concrete, plastics, cast iron, stainless steel and cement concretes.

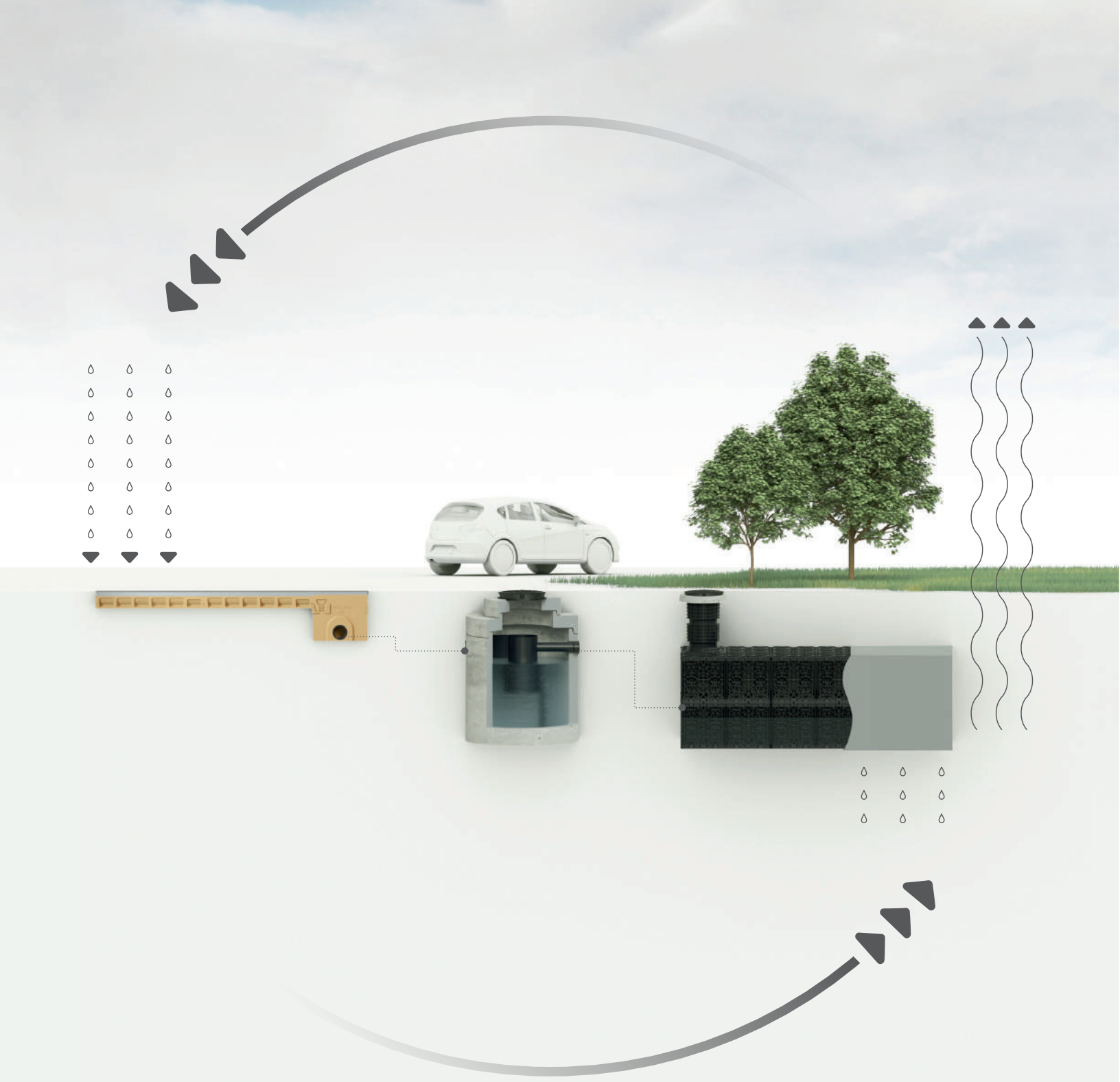
ACO in the USA

ACO, Inc. was founded in Ohio, 1978. Since then, continuous growth in the USA has seen the company expand and build manufacturing facilities in Mentor, OH, and Casa Grande, AZ. The company has further locations in Phoenix, AZ, and Fort Mill, SC. Today, ACO USA has sales personnel across the country and an extensive distribution network through all states, the Caribbean and Central America.

ACO Drain®

ACO Drain is the market leading modular trench drain system manufactured at the company's modern facilities in Arizona and Ohio.

ACO Drain offers the most comprehensive range of trench drain solutions for every application. ACO Drain products are offered in a variety of widths, depths, and load ratings, with grates to suit. In conjunction with a comprehensive, quality product range, ACO supports its business with extensive stocking distributors, technical sales support and world-class customer service.



COLLECT CLEAN HOLD RELEASE

The Hydrological Cycle is the natural cycle of water from rainfall to evaporation. The ACO System Chain provides products that **Collect** water from impervious surfaces, which is transmitted to other products which help **Clean** solids and liquids from the collected water. **Hold** and **Release** require products that can hold and return this water back to nature in a controlled manner. These products can be used in conjunction with water reuse programs.

COLLECT

Surface water collection from paved areas is a critical element of managing the hydrological cycle effectively. The increase of impermeable surfaces reduces the opportunity for natural infiltration back into the ground water.

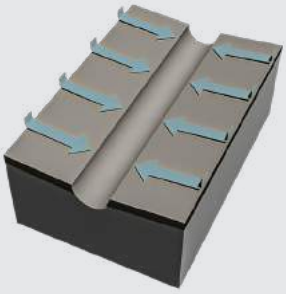
BENEFITS OF SURFACE WATER DRAINAGE

- Effectively collects water to be transferred into an underground infiltration tank used to recharge groundwater with a good utilization of space.
- Provides an efficient way of moving water off of paved areas, preventing potential injury and/or property damage. When combined with an underground detention/retention tank, outflow back into watercourses can be managed.
- When contaminated surface water is present, an efficient surface water drainage system can capture polluted liquids and transfer them to an appropriate cleaning facility before allowing clean water back into groundwater or watercourses.

METHODS TO COLLECT SURFACE WATER

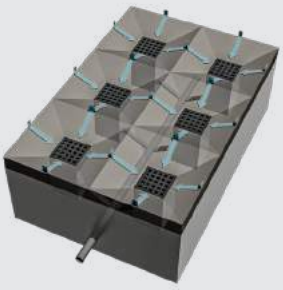
A TRENCH DRAINS

Trench drains benefit from continuous inlets along the entire length of the trench to allow for maximum water capture. For safety, trench drains allow for 100% liquid containment when required.



B SWALES

Swales can be used to direct surface water from impervious surfaces to point drains, but offer poor performance in extreme weather events and are potentially dangerous to people.



C CATCH BASINS

Catch basins are pits with gratings on top. They are connected to an underground sewer system. Catch Basins evacuate water from paved surfaces, but are difficult to install correctly on graded, impervious surfaces.

D NO DRAINAGE

In extreme weather events, the lack of surface drainage creates flooding and property damage, as the impervious nature of pavement prevents infiltration back into groundwater.

1

Introduction

Selecting the Right Product

Once the decision is made to drain an impermeable surface, there are two options:

1. **Linear Drains -** Surface drains are surface mounted and provide continuous water interception.
2. **Catch Basins -** Point drains with underground, connecting pipework.

The decision to proactively drain the surface is just one of a number of decisions that have to be made by the stakeholder, designer, engineer and installer to give a long-lasting, and safely performing system.

ACO provides professional advice to ensure correct products are used that will give an economic and efficient solution to every application.

1. **Linear Drains** - Typical example of a correct, well-installed linear drain.

2. **Catch Basins -** Common example of a catch basin and underground pipework installation.

A typical situation where surface drainage was not considered and installed, leading to pavement damage and user inconvenience.

Benefits of Modular Trench Drains vs. Cast-in-Place and Catch Basins

Trench Drains

A trench drain is a continuous line of surface drainage that removes liquid from impermeable/semi-permeable surfaces. It has a continuous inlet along the entire length ensuring maximum liquid capture. Trench drains allow simple one-way grading of surfaces to be drained. The two most popular forms of trench drains are modular systems and cast-in-place.

A. MODULAR TRENCH DRAIN

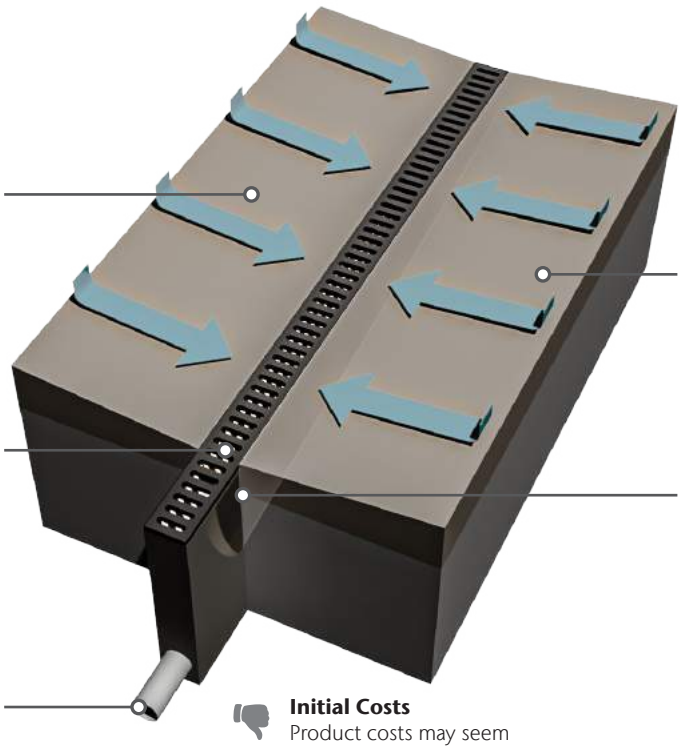
Factory produced units offer consistent quality and are created with advanced shape profiles and built-in slope, providing additional benefits and savings.

Safety
Superior liquid capture minimizes slip hazards to pedestrians and vehicles, reducing risk of litigation.

Pavement Longevity
Reduced standing water extends service life (especially in freeze-thaw environments) and pavement aesthetics.

Narrow Grates
Typically narrow grates are significantly cheaper, particularly in high load class applications.

Pipe Savings
Minimal underground pipe, related excavation and site work required.



Initial Costs
Product costs may seem high, but can be offset by lower installation and pipe costs.

Maintenance
Easy access to system. Increased flow velocity = less sediment build-up and maintenance.

Grading
Simple one-way slopes; easy and quick to construct.

Hydraulics
A narrower system with built-in slope creates increased velocity and system efficiency, and can result in lower material costs.

Environmental/Health
Standing water attracts insects and bacteria. Trench drains can provide collection of rainwater for reuse (LEED) or liquids for treatment (EPA).

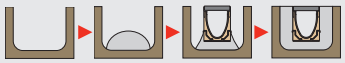
B. CAST-IN-PLACE TRENCH DRAIN

Boxed out trench formed on-site before concrete pour. Some benefit and cost savings when compared to modular trench drains with the following exceptions:

- **Deterioration** - Concrete surface deteriorates, especially in freeze-thaw environments, resulting in lower performing hydraulics and hard to clean surfaces.
- **Wider grates** - Typically wider grates are significantly more expensive - particularly in higher load class applications.
- **Site work** - Excavation, formwork construction, creation of slope and 'U' or 'V' profile can be costly and time consuming. Tees/corners are difficult and time consuming to create.
- **Quality** - Can vary greatly and be inconsistent depending upon the contractor. Difficult to achieve level grate and frame with good concrete support resulting in the common cause of many future problems.

a. Modular Trench Drain

Quick, simple installation:



1. Excavate
2. Pour concrete patties or use ACO Installation Device
3. Set ACO channels
4. Pour concrete fill

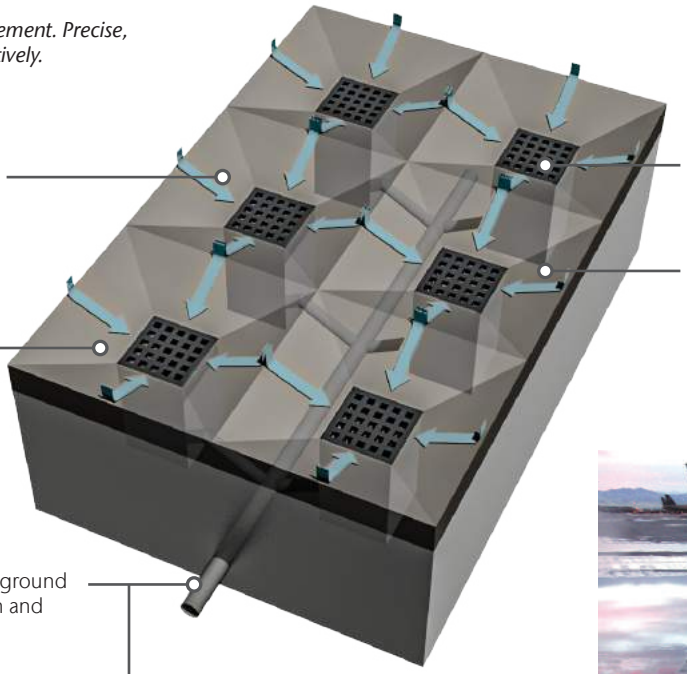
b. Cast-In-Place Trench Drain

Slow, inefficient installation:

1. Excavate; widen trench to account for former removal
2. Form & pour trench foundation
3. Form & pour trench sides
4. Strip formers from trench
5. Grout over base to create slopes
6. Install grating

Catch Basins

Series of catch basins located in pavement. Precise, exact grading needed to drain effectively.



- **Grading** - Complex 4-way slopes are difficult and time consuming to create.
- **Quality** - Inconsistent pavement quality and settlement creates ponding.
- **Pipe Cost** - Extensive underground pipework; related excavation and site work required.
- **Maintenance** - Pipes are easily blocked by build-up of debris and require frequent maintenance.
- **Product Costs** - Initial cost may be less, usually offset by high installation and pipe cost.
- **Pavement Longevity** - Ponding and undulating surface deteriorates and results in reduced life (especially in freeze-thaw environments).

Product Selection Factors

When selecting trench drains, the following questions should be answered to ensure long service life:

1. **Application** - Installed location factors; loading, site and user requirements
2. **Hydraulics** - Amount of liquid to collect and drain

A summary of the two factors are outlined below; additional supporting information is provided on pages 161–180.

1. Application

A number of issues relating to where the drain is used are critical to address. Incorrect product choice can lead to product failure, remediation costs, possible litigation, or over-engineered solutions.

See page 161

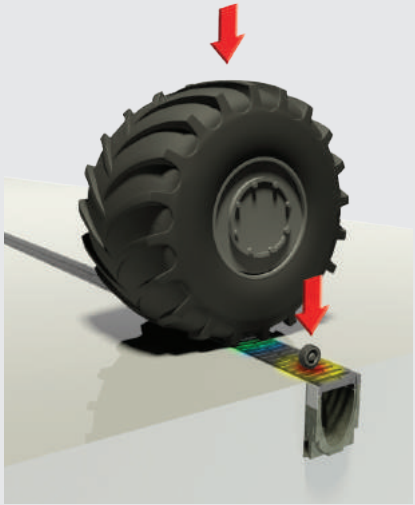
A) LOADING

Required Load Ratings - page 161

Loading refers to any kind of traffic or load being applied to the trench and grate. There are several US Load Standards relating to larger catch basin grates. ACO uses the EN 1433 standard which is specifically written for trench drains of different widths.

Loading is categorized into several load classes (light, medium and heavy). Choosing the correct solution is determined by:

- **Type of traffic** - Pedestrians, cars, trucks, forklift, aircraft, etc.
- **Wheel loads** - Include vehicle, weight of load being carried and type of tire (solid or pneumatic).
- **Unusual traffic** - E.g. dumpsters/snow plows being dragged across trench etc.
- **Frequency** - Occasional versus frequent use may also affect product choice.



B) SITE REQUIREMENTS

Non-Metallic Options
page 170

EPA, LEED, LID, Sustainable Drainage
page 171

Chemical Resistance
page 172

Specifics of the installed environment may drive, or limit, the choice of trench drain and grate.

- **Installation restrictions** such as limited down times may require trench drains that are quick to install.
- **Limited construction depth** may demand a shallow trench drain system.
- **Corrosive liquids** may influence channel and grate material choices.
- **Non-metallic trench drains** may be required for factors other than chemical resistance - non-magnetic explosive environments (sparking) may be required in certain industrial applications.

- **Environmental needs** such as Sustainable Drainage, Low Impact Development (LID) or Leadership in Energy & Environmental Design (LEED) qualification may be a determining factor in certain applications.
- **Sloped trench drains** may be required to eliminate standing water, which can provide a breeding ground for mosquitoes and potential health concerns - Malaria, SARS, West Nile virus, Zika, etc.

C) USER REQUIREMENTS

ADA Compliant

Bicycle-safe

Heel-resistant 0.31"
(< 8.0 mm) opening

Aesthetic Options

Heel-Safe 0.25"
(< 6.5 mm) opening

Slip-Resistant
Grates

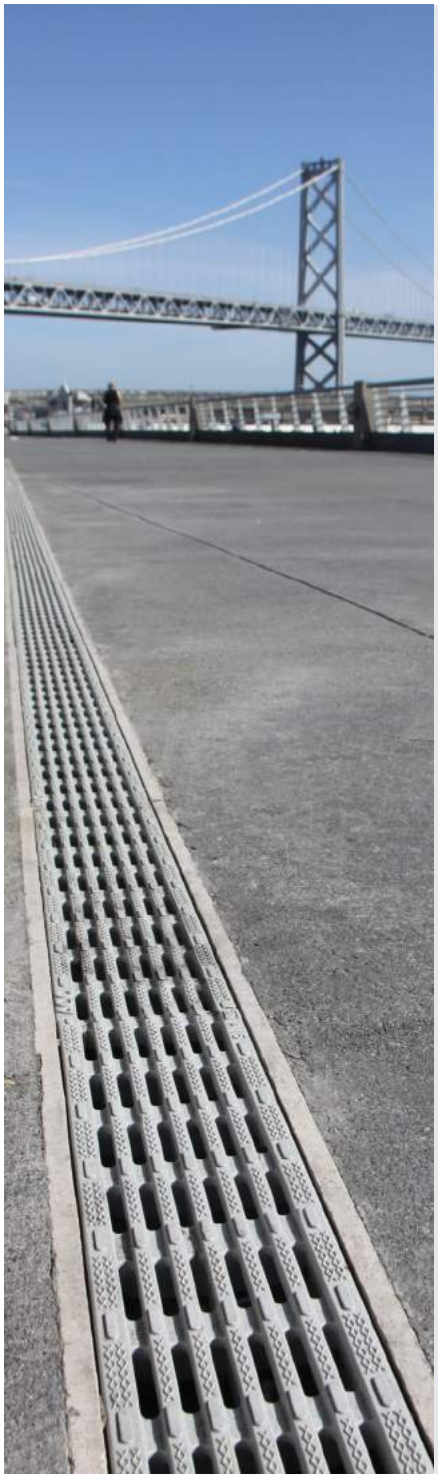
See page 174

User requirements typically affect the grate, as that is the exposed part once trench drain is installed.

Requirements are project specific and once loading requirements are met, grate choice typically relates to aesthetics, legal or safety concerns.

- **Aesthetics** - Intake shape (slots, holes or other shapes) and material (iron, stainless, plastic) can be chosen to complement surrounding landscape.
- **Legal requirements** typically relate to ADA compliance, heel safety and bicycle safety needs.

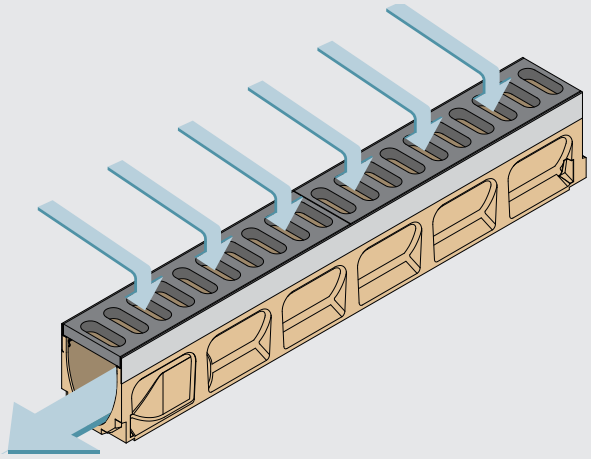
- **Safety requirements** typically refer to grate lockings and special surfaces (slip-resistance). ACO recommends all grates are locked in place, especially in high load areas. Some applications may require multiple locks per grate or security lockings. On occasion, monolithic trench drains may be required for maximum grate security - See ACO Infrastructure product line.



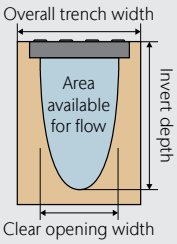
2. Hydraulics

The amount of liquid a trench drain needs to collect and discharge in a given time period determines size.

See page 175

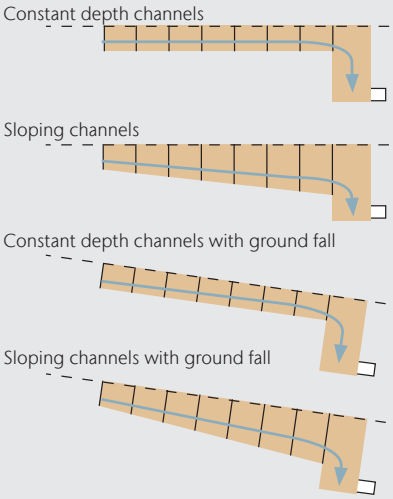


Low flow capacity  High flow capacity



The following factors must be taken into consideration:

- Area available for flow (channel width AND depth) - Right combination avoids unnecessary costs and/or flooding.
- Slope increases velocity providing a more efficient trench. Slope is added in 3 ways:
  - Sloping invert channels
  - Constant depth channels and ground slope
  - Combination of both
- Outlet size AND position
  - Avoid restricting flow with small pipes.
  - Central outlets may enable fewer outlets.
- Grate intake - Open area (calculated by size and quantity of the openings) and slot design affect how much water gets into trench, and rate of bypass (water flowing straight over grate).



Trench System Selector

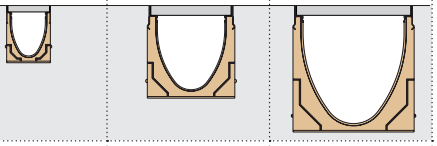
1. Application

A) LOADING

Loading is the pressure (pounds per square inch) a trench drain needs to withstand. ACO products are independently certified to EN 1433, and relevant US load standards - full details and comparison to US load standards are provided on page 161.

Required load rating - page 161

*EN 1433 suggests monolithic systems for Load class D due to dynamic loading of fast moving vehicles. See ACO Infrastructure MonoBloc for product solutions.
**H100 is rated Load Class C. H100K, H200K & H300K is rated Load Class E. H100SK, H200SK and H300SK are rated Load Class F.

	KLASSIKDRAIN		
	K100	K200	K300
			
	page 23	page 43	page 65
Load Class A	✓	✓	✓
Load Class B	✓	✓	✓
Load Class C	✓	✓	✓
Load Class D*	✓	✓	✓
Load Class E	✓	✓	✓
Load Class F	×	×	×
200000 lb proof	×	×	×
ASHTO HS20	C & E grates only	C & E grates only	C & E grates only
ASHTO HS25	C & E grates only	E grates only	E grates only

B) SITE REQUIREMENTS

Project environment may drive, or limit, the choice of trench drain and grate material.

Non-metallic options page 170

Chemical resistance page 172

EPA, LEED, LID, Sustainable Drainage page 171

For chemical and application requirements not met by standard products, ACO's Aquaduct line offers a range of different fiberglass resins and can be customized to suit. Stainless steel channels are also available. Contact ACO for details.

Features			
Channel material	polymer concrete	polymer concrete	polymer concrete
Edge rail material	galvanized or stainless	galvanized or stainless	galvanized or stainless
Ductile iron grates	✓	✓	✓
Galvanized steel grates	✓	✓	✓
Stainless steel grates	✓	✓	✓
Non-metallic grates	✓	×	×

C) USER REQUIREMENTS

Typically project-led criteria based on design preference or legislation compliance. See page 174.

ADA-compliant

Bicycle-safe

Aesthetic options

Heel-resistant 0.31" (<8.0 mm) opening

Slip-resistant grates

Heel-safe 0.25" (<6.5 mm) opening

Features			
Locking options	QuickLok® DrainLok	QuickLok® DrainLok	QuickLok® DrainLok
Aesthetic options			
Safety			

2. Hydraulics

Width, depth and slope of trench drain determines amount of liquid a trench can collect and drain in a given time period - if unsure, ACO can use software to determine the right size for specific projects. See pages 175–180.

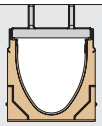
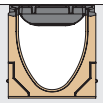
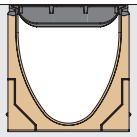
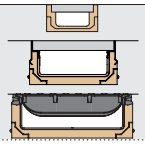
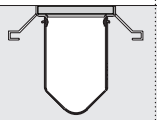
Low flow capacity — High flow capacity

Features			
Channel width	4" (100 mm)	8" (200 mm)	12" (300 mm)
Slope			

Sloped fall channels (page 177); catch basin(s) available

Constant depth channels; catch basin(s) available

Constant depth channels; catch basin(s) unavailable

MINIKLASSIK	BRICKSLOT		POWERDRAIN			SLABDRAIN	FLOWDRAIN
K50	Brickslot 100	Brickslot 200	S100K	S200K	S300K	SlabDrain	FG200
							
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✓	✓	✓	✓	✓	✓	✓	✓
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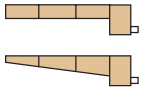
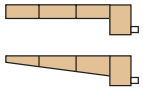
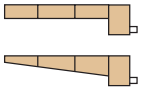
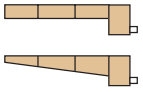
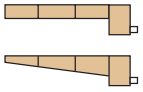
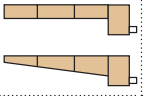
×	×	×	✓	✓	✓	✓**	✓
×	×	×	✓	✓	✓	✓**	✓
×	×	×	✓	✓	✓	✓**	×
×	×	×	✓	✓	F grates only	F grates only	E grates only
C grates only	✓	✓	✓	✓	✓	C, E, F grates only	✓
C grates only	×	×	✓	✓	✓	E & F grates only	E grates only
polymer concrete	polymer concrete	polymer concrete	polymer concrete	polymer concrete	polymer concrete	polymer concrete	fiberglass
galvanized or stainless	galvanized or stainless	galvanized or stainless	ductile iron	ductile iron	ductile iron	polymer concrete, steel, or iron	galvanized, stainless, or coated steel
✓	×	×	✓	✓	✓	✓	✓
✓	✓	✓	×	×	×	✓	✓
✓	✓	✓	×	×	×	✓	✓
✓	×	×	×	×	×	100 mm only	×
DrainLok	Non-locking	Non-locking	PowerLok® Bolted	PowerLok® Bolted	PowerLok® Bolted	Various	Bolted
			×	×	×		×
	Paver-dependent	Paver-dependent					
2" (50 mm)	4" (100 mm)	8" (200 mm)	4" (100 mm)	8" (200 mm)	12" (300 mm)	4"/8"/12" (100/200/300 mm)	8" (200 mm)
							

Grate Selection

A drainage grate's primary function is to let water enter the trench system efficiently. Grates have to remove the quantity of water specified and be strong enough to withstand traffic without collapsing.

The visual importance of drain systems is now more prominent.

ACO has introduced many different sized patterns and materials, including discreet drainage concepts such as Brickslot and EcoPanel.

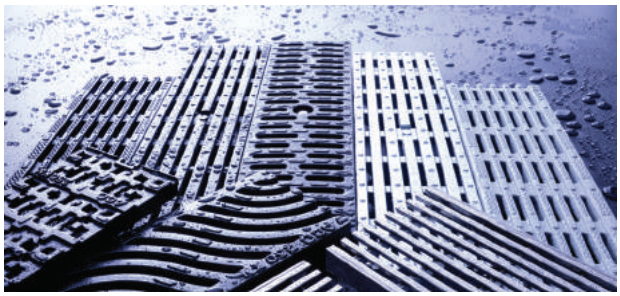
Another innovative option is Freestyle - an easy and cost effective way to design your own iron grate.

ACO offers a surface and grate Visualizer; an online tool for designers to imagine each ACO Drain grate against a number of different surface types.
Visit at: https://askaco.us/visualizer/

When choosing a grate, the following should be considered:

- Water intake capacity
- Loading
- Material - durability and aesthetics
- Slot style
- Locking
- Legal requirements:
  - ADA compliance
  - Slip-resistance
  - Heel and bicycle safety

Options:



Standard Grates — Ready-made

ACO Drain provides a wide selection of standard grates for all sizes and types of channels. These offer the most economic option and encompass popular styles and materials. Details for standard grates can be found in each associated ACO Drain product section.

Freestyle Grates — Custom Decorative Tops

ACO offers a semi-custom option with the opportunity to design the top surface look of an iron grate to complement your project design (see page 15).

Brickslot — Slot Drains

When discreet drainage is desired for pavement design, a continuously slotted inlet is available in stainless or galvanized steel. Brickslot is also offered in a single or twinslot option as well as ADA-compliant (see pages 39 and 57).

EcoPanel — Linear Permeable Pavers

EcoPanel is a trench drain cover consisting of a permeable, UV stable, resin-bonded aggregate infill available in a range of colors. The unique construction provides a durable load bearing surface. It's enclosed in an engineered frame, enabling water to infiltrate into the channeln (see page 61).

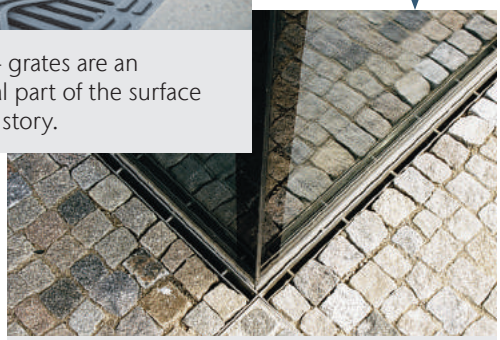
Decision Tree for Grate Selection

Purpose of a grate - to remove water from surface

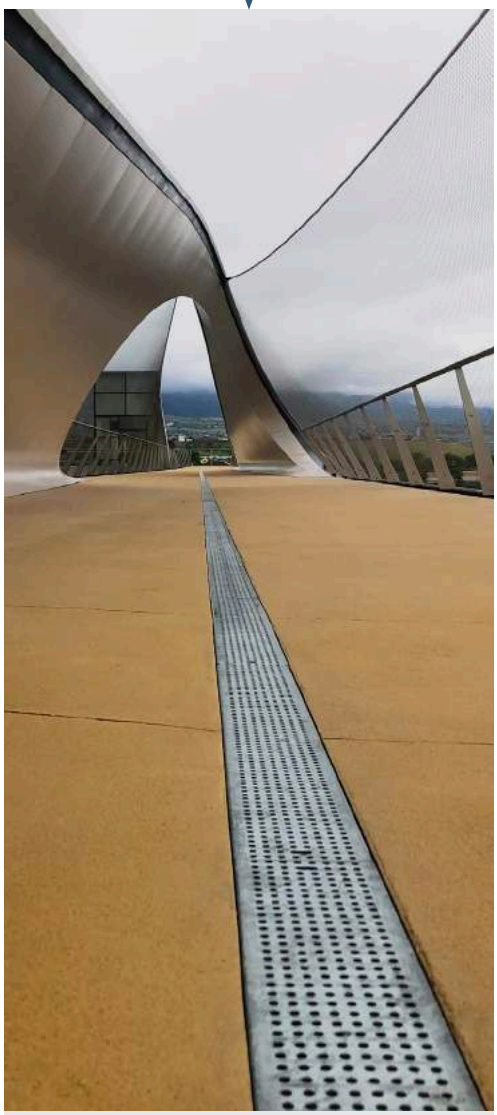
WHAT IS THE PRIORITY?

Aesthetics - grates can be used either as an intended and integral part of the surface design or an intentionally contrasting element.

Design pavement - grates are an intended and integral part of the surface design, or help tell a story.



Discreet - water intake can be intentionally inconspicuous.



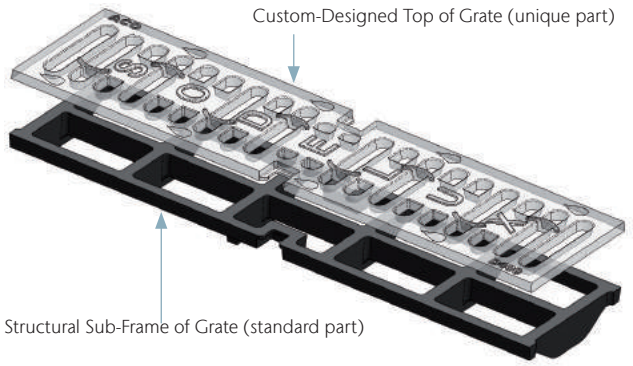
Functionality - water removal/resisting loads while grates contrast or blend in with the surrounding surface.

FREESTYLE GRATES — CUSTOM DECORATIVE TOPS

Architectural features such as entrances, promenades, courtyards and landscaped areas, whether public or private, can all have their appearance significantly enhanced through the creative use of ACO Freestyle grates.

Flexible production tools with ACO's own foundries make it possible to create unique grate designs for projects with a custom surface design on a standard KlassikDrain DrainLok grate.

The two-part tool consists of a standard lower part to provide the structural support of the grate and a customizable top section where the designers unique patterns can be created.



A minimum order of 400 half-meter length grates is required for this option.

Grate Design

The designer starts by envisioning the pattern they want on the grate. This is submitted to ACO who will advise on the feasibility of converting the design into a physical product.

Features

- Load Class D
- Available for 4", 8" and 12" KlassikDrain systems
- Manufactured from ductile iron
- ACO DrainLok locking system

Examples:

PITT STREET MALL

Sydney
Australia

In Pitt Street Mall, Sydney, architects designed a Freestyle grate to harmonize with the surrounding urban elements and historical context of the area. The major refurbishment of the public domain accommodated a central trench drain system where the pattern on the grates visually imitates the trickling of water to remind us of the original underlying Tank Stream. The grates, illuminated from beneath at night, are fit for foot traffic, emergency and maintenance vehicles, as well as functioning to collect stormwater from the pavement and adjacent awnings. The underlying ACO channel then diverts the water into surrounding vegetation.

PORTFOLIO