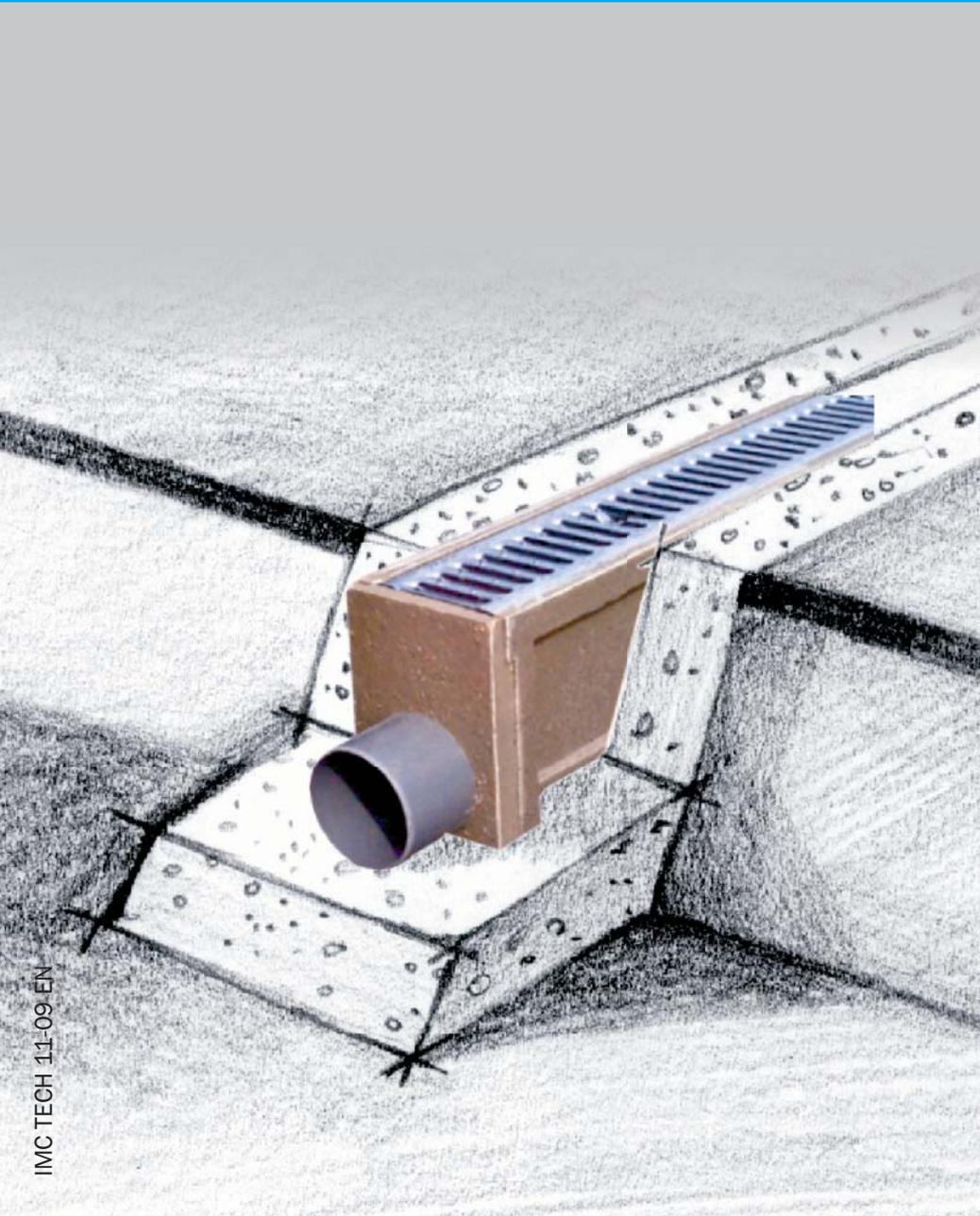


STORA DRAIN

TECHNICAL MANUAL

Storage & transport | Installation | Maintenance | Capacity calculation | Standards | Chemical resistance



1.1 Point drainage - line drainage

Point drainage:

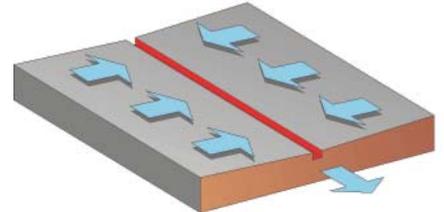
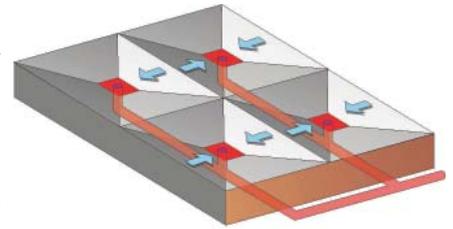
A terrain is brought into slope by means of breaking surfaces to several catchment points in order to convey precipitation from road drains to an underground sewerage.

Line drainage:

The underground sewerage is partially replaced by channels or trenches at the surface. This way the terrain can be laid out with less breaking surfaces and can be integrated in the design. Installation becomes easier for the contractor.

Advantages of channels over traditional line drainage with trenches:

- no sudden bumps in the terrain; a channel is easier to drive on
- optimum use of the terrain
- faster and more efficient drainage



1.2 Choice of material

1.2.1 Presentation of polyester concrete

Origin - Composition:

Polyester concrete is an all-round and modern product with greater mechanical and chemical properties than traditional concrete. It is manufactured from an improved composition of polyester resin, quartz sand and quartz granules.

Mechanical properties:

Compressive strength: 100 N/mm²
 Flexural strength: 30 N/mm²
 Water absorption: less than 0,5 %
 Expansion coefficient: 0,018 mm/m/°C
 High vibration absorption

Chemical resistance:

Standard polyester concrete is generally resistant to: saline solutions, ground acids, mineral oils, fuel oil, petrol, waste water, a.o. For applications in very aggressive environments, a special resin with a higher chemical resistance is available on request.

Temperature resistance:

Polyester concrete is resistant to temperatures of -60°C to maximum 80°C (for water evacuation).

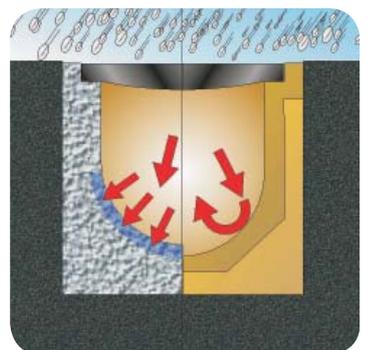
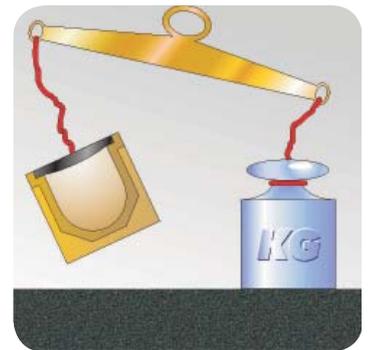
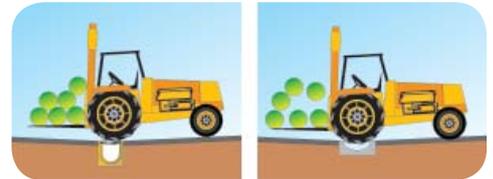
1.2.2 Benefits of polyester concrete

Light weight: Polyester concrete offers a very hard structure with better mechanical and chemical properties than conventional concrete. This way it is possible to manufacture a channel with relatively thin walls, which means the channel has a considerably lower weight. This makes the installation a lot easier and results in time gain, as the building site does not require a crane.

Higher mechanical and chemical resistance than conventional concrete, thus ensuring a higher durability.

Resistance to frost: Due to low water absorption and a smooth surface it is unaffected by frost damage.

Dense structure and smooth surface reduce sediments and vegetation growth in the channel.



POLYESTER CONCRETE CHEMICAL RESISTANCE LIST

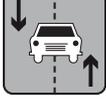
This list is only an aid. The composition of a product is subject to changes and particular circumstances. This information cannot give cause to liability or guarantee from the supplier.

Resistant= x / Not resistant= -

Product	Conc.	Resist.	Temp.	Product	Conc.	Resist.	Temp.	Product	Conc.	Resist.	Temp.
acetic acid	50	-	-	epichlore hydrine	-	-	-	nitric acid	10	x	25
acetone	10	-	-	epoxy resins (without solvent)	-	x	30	nitric acid	40	-	-
acidity of wine	all	x	30	epoxyharsen (zonder oplosmiddel)	-	x	30	nitrohydrochloric acid	-	-	-
active chlorine	12-15	-	-	ethanol	until 20	x	30	octane	-	x	30
adipic acid	-	x	30	ethanol aq. up to 20% iq.	-	x	30	oils, animal + vegetable	-	x	30
alcohol (ethanol, 96%)	-	x	30	ethanol aq. up to 50% iq.	-	x	30	oleic acid	-	x	50
alcoholic drinks	-	x	30	ethanol comm.	-	x	30	oleic acid	all	x	30
alkylbenzene sulphonate	-	-	-	ethanol, denaturated	-	-	-	oxalaldehyd 40%	-	x	30
alum aq.	-	x	30	+ 2% tannol	96	-	-	oxalic acid	all	x	30
aluminium salts (n.n.s.) aq.	-	x	30	ether	-	-	-	palmitic acid	-	x	30
ammonia watery solution	25	-	-	ethylbenzene	-	-	-	paraffin	-	x	30
ammonium bromate	-	x	30	ethylene diamine	-	-	-	paraffin oil	-	x	50
ammonium bromide w.sol.	-	x	30	ethylhexanol	-	-	-	P3 cold detergent	20	x	30
ammonium chlorate w.sol.	-	x	30	fats and fatty acids	-	x	30	perchloroethylene	-	x	30
ammonium chloride w.sol.	-	x	30	ferrous trichloride	-	x	30	perchloric acid	20	x	30
ammonium nitrate w.sol.	-	x	30	fixing baths (photo)	-	x	30	petrol	-	x	30
ammonium phosphate w.sol.	-	x	30	formaldehyde	30 w.sol.	-	-	petroleum	-	x	30
ammonium sulphate w.sol.	-	x	30	formic acid	10	x	30	petroleum oil	-	x	30
amyl acetate	100	-	-	frigen 119	-	x	30	petrolic ether	-	x	30
apple juice	-	x	30	fruit acids	-	x	30	phenol	-	-	-
aqua dest.	-	x	30	fruit juices	-	x	30	phosphates, inorganic w.sol.	-	x	30
arsenic acid	-	x	40	glucose w.sol.	-	x	30	phosphoric acid	10,85	x	30
barium salt w.sol.	-	x	30	glycerol	-	x	30	phthalic acid	-	-	-
battery acid	32	x	30	glycol	-	x	40	phthalic ester	-	x	30
beer	-	x	30	hard coco oil	-	x	30	pickle	-	x	30
benzene	-	-	-	heavy petrol	-	x	30	pitric acid	-	x	30
benzene acid	-	x	30	heptane	-	-	-	pot ash solution	10,20,50	-	-
benzene aldehyde	-	-	-	herring pickle	-	x	30	potassium bichromate aq.	10	-	-
benzoyl chloride	-	x	30	hexane	-	-	-	potassium cyanide	-	x	40
benzoyl peroxide	-	-	-	humic acid	-	x	30	potassium permanganate w.sol.	10	-	-
benzyl alcohol	-	x	30	humid chlorine gas	-	-	-	potassium salts	-	x	30
benzyl chloride	-	-	-	humus	-	x	30	propanol	-	-	-
borax	-	x	30	hydrobromic acid	-	x	30	propyl alcohol	-	x	30
boric acid	all	x	30	hydrochloric acid	-	x	30	propylene glycol	-	x	30
brine	-	x	30	hydrochloric acid	conc.	x	30	salicylaldehyde	-	x	30
brine (NaCl)	-	x	30	hydrocyanic acid	-	x	30	salicylic acid	-	x	30
budandiol	-	-	-	hydrofluoric acid	40	-	-	salicylic acid aq.	-	x	40
butanol	100	-	-	hydrofluosilicic acid	34	x	30	saturated chlorine gas	-	-	-
butyl acetate	-	-	-	hydrogen chloride (anhydrous)	-	x	30	sea water	-	x	30
butyl glycol	-	-	-	hydrogensulphide	-	x	30	silicone grease	-	x	30
butyric acid	100	x	30	hydrozine w.sol.	50	-	-	silicone oil	-	x	40
calcium chloride aq.	-	x	40	iodine, solid	-	x	30	silver nitrate aq.	-	x	30
calcium formate aq.	-	x	30	isopropyle alcohol	100	-	-	sodium carbonate aq.	-	-	-
calcium hydroxide aq.	-	x	30	joiner glue	-	x	30	sodium hydroxide	10,20,40	-	-
calcium salt w.sol.	-	x	30	kerosene	-	x	30	sodium hypochlorite	-	-	-
capryl acid	-	-	-	lactic acid w.sol.	80	x	30	with 15% active chlore	-	-	-
caprylic acid	-	x	30	lake water	-	x	30	sodium salts	-	x	30
carbon tetrachloride	100	-	-	lemonade	-	x	30	sorbite	-	x	30
chloroform	-	-	-	lime, aqueous slurry	-	x	30	starch w.sol.	-	x	30
chromate bath	-	-	30	linseed oil	-	x	30	stearic acid	-	x	30
chrome sulphate aq.	-	x	30	linseed oil fatty acid	100	x	30	styrol	-	-	-
chromic acid	6,12,36	x	30	lithium chloride aq.	-	x	50	succinic acid w.sol.	-	x	30
chromic acid aq. 10% iq.	-	-	-	lubricating oil	-	x	30	sugar beet oil	-	x	30
chromic acid aq. 40% iq.	-	x	30	lubrication oil, grease	-	x	30	sugar w.sol.	-	x	30
cinnamon aldehyde	-	x	30	lye (caustic soda)	-	-	-	sulphamic acid	-	x	30
citric acid	all	x	30	lysol	-	x	30	sulphite liquor	-	x	40
cobalt acid aq. (n.n.s.)	-	x	40	magnesium salts	-	x	30	sulphur dioxide gas conc.	-	x	30
cobalt salts	-	x	30	maleic acid	-	x	30	sulphuric acid	10,30,70	x	30
cod-liver oil	-	x	30	malic acid	100	x	30	table glue	-	x	30
copper salts	-	x	30	manganese salts	-	x	30	tannic acid	-	x	40
crude oil	-	x	30	margarine	-	x	30	tetrachlore ethylene	100	x	25
cyclohexane	100	-	-	melamine resin aq.	-	x	30	tetrahydrofurane	-	-	-
cyclohexanone	100	-	-	mercury	-	x	50	thermal oil	-	x	30
dedocyl-ether sulphate aq.	-	x	30	mercury salts w.sol.	-	x	30	thioglycolic acid	100	-	-
detergent, commercial	-	x	30	methanol	-	-	-	tin salts	-	x	30
di-ethanolame	-	x	30	methyl acrylic acid	-	-	-	toluene	-	-	-
di-ethylamus	-	-	-	methyl ester	-	-	-	trichloroacetic acid	-	x	30
di-isobutane	-	x	30	methyl amine	-	-	-	trichloroethane	-	-	-
dibutyl phthalate	-	x	30	methyl bethylene keton	-	-	-	trichloroethylene	-	-	-
dichloroacetic acid	20	x	30	methylated spirit	-	x	30	turpentine	-	x	30
diesel fuel	-	x	30	methylene chloride	-	-	-	urea w.sol.	-	x	30
diesel oil	-	x	30	milk	-	x	30	water (sea, drinking, mineral)	-	x	30
diethtyl phthalate	100	-	-	mineral oil	-	x	30	water: deionisated	-	x	30
diethylene glycol	-	x	50	mineral water	-	x	30	water: demineralised	-	x	30
dimethylaniline	100	-	-	molasses	-	x	30	water: distilled	-	x	30
dodecylbenzene sulphonic acid	-	x	30	monochlore acetic acid	5	x	30	wine	-	x	30
drinking water	-	x	30	nickel salts	-	x	30	xylene	-	-	-
engine oil	-	x	30					zinc salts w.sol.	-	x	30

STORA-DRAIN PRODUCT RANGE

The STORA-DRAIN product range is subdivided in several groups. This subdivision has been mainly based on the expected loading class. The loading classes have been defined in the EN1433 standard as follows.

		Loading class	Max. Load	Use and Application
		A15	1,5 Tons	Pedestrian and cyclist areas Occasional car in green areas and domestic driveways
		B125	12,5 Tons	Cars and light vehicles on car parks and pedestrian ways
		C250	25,0 Tons	Cars, vans and lorries at low speed in shopping streets, car parks and kerb sides
		D400	40,0 Tons	Public roads, motorways, petrol stations and car parks for all types of vehicles, lorry loading and unloading points
		E600	60,0 Tons	Industrial areas with heavy vehicle loads, forklift trucks, heavy slow speed industrial traffic
		F900	90,0 Tons	Areas with exceptionally heavy loads, e.g. airports, container and boarding quays

The overview below will help you in choosing the optimum system for your application. Both the maximum load and other factors such as the type of load (occasional, fast or slow, ...), the capacity, the grating types available, etc.... determine this choice. For further specific information and characteristics we refer to the product sheets concerned.

Load class range	Field of application	Channel type	Short code	Available widths
 A15	Garden and terrace, pedestrian areas only	 Light	SA	100
 A15 - B125	Garden, terrace and domestic driveway with occasional car traffic	 Self	SB	100-150-200
 A15 - C250	Domestic driveway, playground, parking area with light traffic	 Top	SCB	100
 A15 - C250	Regular and medium traffic	 Parking	SC	100-150-200-300
 D400 - F900	Heavy load, fast traffic, industrial areas, lorry traffic	 Super	SF	100-150-200-300

STORAGE AND TRANSPORT

Polyester concrete drainage channels are very strong and hard-wearing when installed properly (also see installation instructions). Nevertheless the channels must be handled with care during transport and installation. The drainage channels are supplied on pallets. They are piled up crosswise in layers. STORA-DRAIN channels are delivered without grating. STORA-SUPER channels are delivered with grating.

		UNITS PER STANDARD PALLET		W100	W150	W200	W300
Stora-Light		channel + grating	height 80 + grating height 110 + grating	96 72	-	-	-
Stora-Self		channel + grating		108	-	-	-
		channel only		90	45	35	-
Stora-Top		channel with level invert	height 100/150/200	44	-	-	-
			height 65	66	-	-	-
Stora-Parking		channel without/with built-in fall		52	45	35	20
Stora-Super		width 100	S1	30	-	-	-
			S2	24	-	-	-
			S3	24	-	-	-
			with built-in fall	24	-	-	-
		width 150	height 170	-	25	-	-
			height 220	-	20	-	-
			height 270	-	20	-	-
		width 200	height 130	-	-	20	-
			height 180	-	-	16	-
			height 240	-	-	16	-
			height 300	-	-	12	-
		width 300	height 245	-	-	-	12
			height 305	-	-	-	6
height 365	-		-	-	6		



The trench is excavated, taking into account the thickness of the foundation, the height of the channel and possibly the thickness of an onlay grating or kerb top.

The foundation concrete is poured in the trench. The quality and thickness of the concrete depends on the expected load. The table below indicates the minimum dimensions and quality of the concrete, as required by the EN1433 standard. The STORA-DRAIN channels are of the M-type in accordance with article 3.3 of the EN1433 standard.

Table 1: Minimum requirements for the foundation and surrounding overlay for M-type channels in accordance with EN1433 art. 3.3

Load class	Concrete quality according to EN 206-1	Lateral support X(mm)	Y (mm)	Underlying foundation Z (mm)
A15	C12/15	80	1/2 Channel height	80
B125	C12/15	100	1/2 Channel height	100
C250	C20/25	150	1/2 Channel height	150
D400	C20/25	200	Channel height (*)	200
E600	C20/25	200	Channel height (*)	200
F900	C25	250	Channel height (*)	250

(*) : For class D400-E600-F900 the channels must be entirely supported laterally by the surrounding concrete.

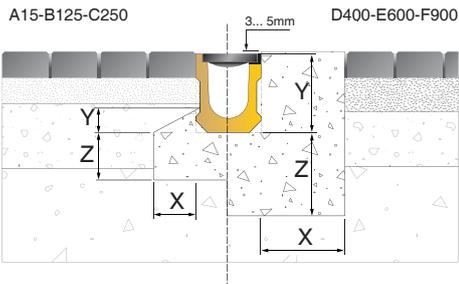
The channels are assembled against each other by means of a tongue and groove joining system.

Starting from the outlet the channel ends are fit into each other. The arrow on the channel elements indicates the direction of the water. The channel elements must be kept clean while installing. To obtain an impermeable finish the security joints must be filled up with an adapted building sealant (please contact our technical department for advice).

The gratings must be installed and secured in the channel before pouring the surrounding concrete. Both gratings and edge profile are best protected with a synthetic foil that is removed after finishing the works. This prevents the profiles and gratings from being damaged and prevents concrete from ending up in the channels. The top of the edge profile and the gratings must be installed 3 to 5mm below the overlay to ensure an optimum evacuation of the surface water and to protect the channel edges.

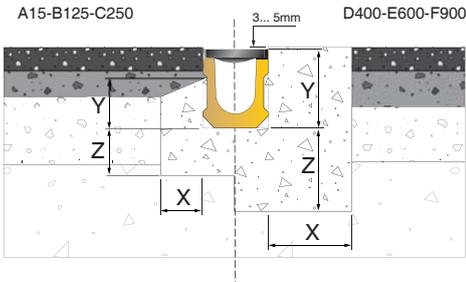


INSTALLATION EXAMPLES



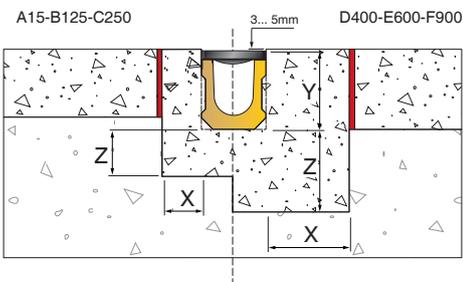
Flag paving, tiles, clinker brick and block paving

In case of a low load the flag paving, tiles or clinker brick and block paving can be installed against the channel. However we advise to fix the clinker bricks or blocks, that lean against the channel, in a mortar bed. With higher loads the clinker bricks or blocks are installed against the concrete surrounding.



Asphalt

With lower load classes the asphalt can be placed against the channel. Obviously the compaction of the asphalt after rolling must be taken into account. The asphalt must come out 3 to 5mm above the grating and the edge profile after rolling. Be careful to prevent the channels from being damaged while rolling.

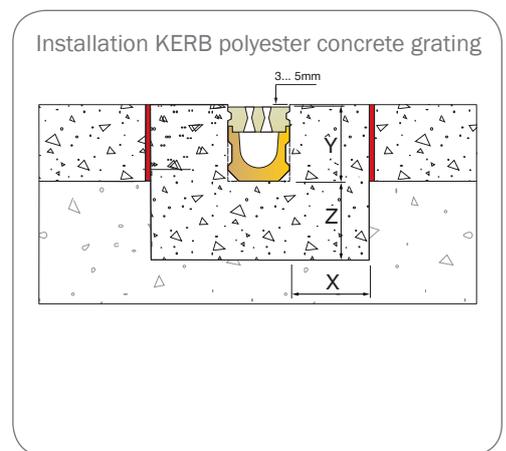
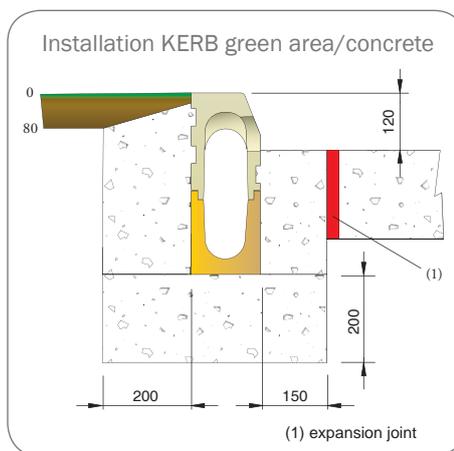
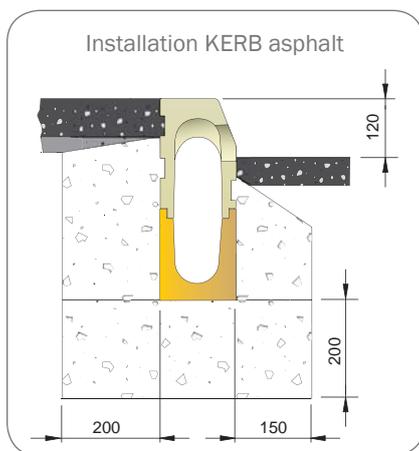


Concrete

With concrete paving the necessary expansion joints will be provided. The channel is fitted with the expansion joints in its full length and on both sides. These must prevent the channels from being pressed up as a result of expansion of the surrounding concrete slabs. The exact location and dimensions of the expansion joints depend on the project as well as the site, and will be stipulated by the architect or leading engineer.

STORA-KERB, polyester concrete grating and other top units

When installing polyester concrete gratings or other polyester concrete top units you should always make sure that the complete top unit is secured in the surrounding concrete along with the underlying channel. When installed in green areas, asphalt concrete or clinker brick and block paving, you must ensure that the surrounding concrete is raised as highly as possible. The clinker brick or block paving that leans against the channel or STORA-KERB must be pressed down in a mortar bed.



For other situations please contact us for further advice.

REPAIRS

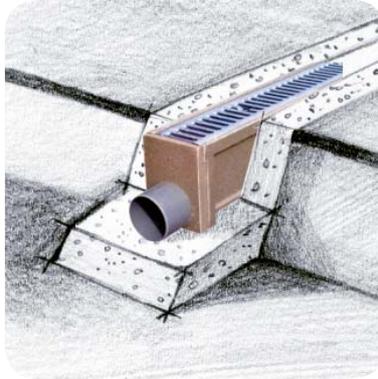
With channel repairs and replacements we will always make sure that the installation is carried out in accordance with the installation instructions of a new channel run. The channels must at all times be reinstalled in a surrounding concrete along all sides. Please contact us for advice.

HOW DO YOU CONNECT TO THE SEWER SYSTEM ?

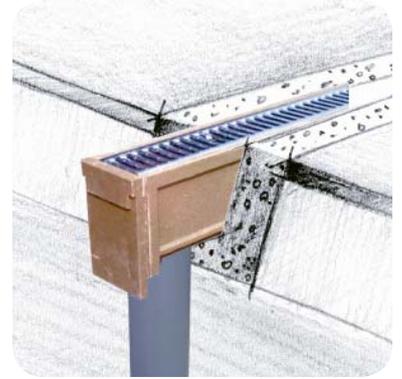
Connecting to the sewer system can be done in different ways: by means of a sump unit, a vertical or horizontal outlet. The channel run can be closed by means of an endcap.



connection by means of a sump unit



connection by means of a horizontal outlet



connection by means of an endcap

PREFORMED KNOCKOUT:

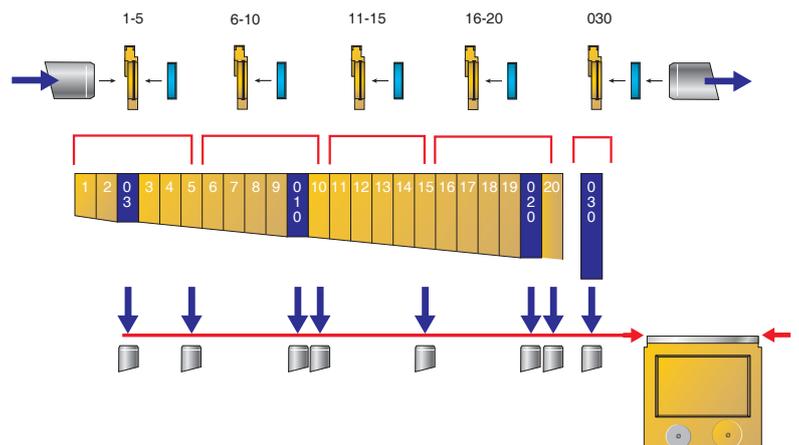


Certain drainage channels are fitted with a preformed knockout to create a vertical outlet.

The knockout is easily knocked open with hammer and chisel. Be careful to knock it out from the inside towards the outside to avoid damaging the inside of the channel.



The standard connection possibilities with the various STORA products are presented in the product catalogues. For example STORA-PARKING with built-in fall:



MAINTENANCE

It is recommended to check the channel run regularly and to clean it, if necessary. The channel system has to be inspected at regular intervals. The frequency of the inspection will depend upon the location and the environment. Next items have to be inspected: gratings, channels and sump units.

1. The gratings should be inspected on the locking. Loose gratings may cause injuries and may cause damages to both channels and surrounding surfaces.
2. The channels should be cleaned at regular intervals to remove all silt and the gratings can be easily removed to clear away the dirt. For this purpose a cleaning shovel (Art.N° S0000036) is used, which is specially designed to fit in channel width 100.
3. The sump unit should be emptied periodically. The use of boiling water or cleaning agents for cleaning the polymer concrete channels is prohibited at all times.

It is advisable to install a sump unit at the end of a channel run. Both sump units and gullies can be provided with removable galvanised (or stainless) steel buckets. After cleaning the gratings must be relocked. Not fastening the gratings may cause serious damages when the gratings are driven on.

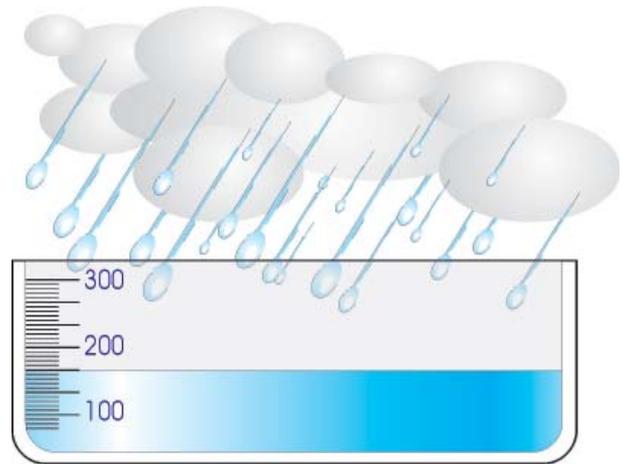


CAPACITY DETERMINATION

Depending on the site location the catchment area is provided with one or several channel runs. It is very important to know what channel runs are possible from which specific channel type in function of the catchment area width or the terrain depth and the likely rainfall intensity ($n = L/\text{sec}/\text{ha}$). It may be necessary to integrate several outlet points or to choose a wider channel type.

RAINFALL INTENSITY

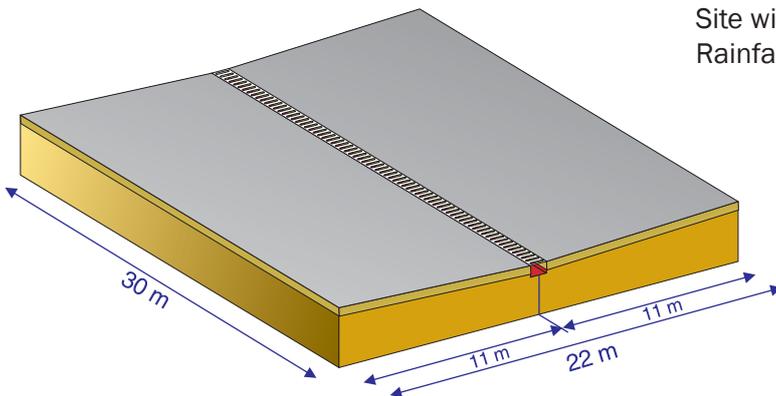
In meteorological institutes the rainfall on a specific surface during a certain time span is measured with pluviometers (these meteorological data must NOT be compared by dividing or multiplying the units !). The average precipitation of the heaviest rainfalls in Belgium amounts to about one litre per minute and per m^2 horizontal surface. However this quantity is often exceeded locally during relatively short time spans. Therefore you should take into account a maximum precipitation of $3 \text{ l}/\text{min}/\text{m}^2$ (NBN 306) for the calculation of drainage from roofs. This standard prescribes a high value as gutters may get partially obstructed (thaw, leaves, ...). Public sewers on the other hand are submitted to a maximum precipitation intensity of $125 \text{ l}/\text{sec}/\text{ha}$ ($\Delta t = 15'$ $T=2\text{y}$). As for the capacity determination of drainage channels this value can be increased (e.g. $300 \text{ l}/\text{sec}/\text{ha}$) if an unfavourable location or a possible pollution of the channels should be taken into account.



Calculation example:

Information needed for the calculation:

Given: Site length: 30m
Site width: 22m
Rainfall intensity $n = 300 \text{ l}/\text{sec}/\text{ha}$

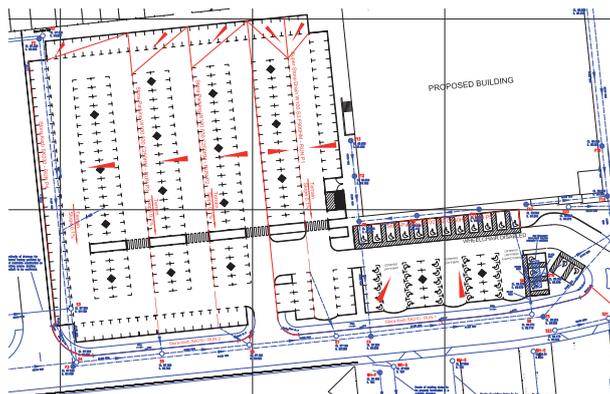
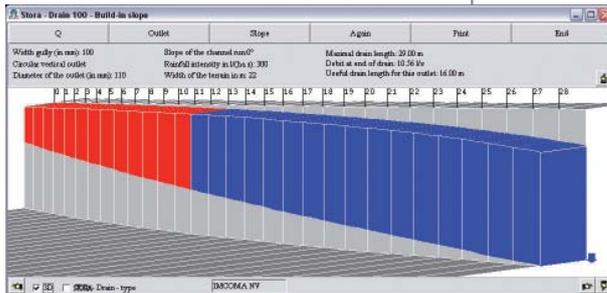
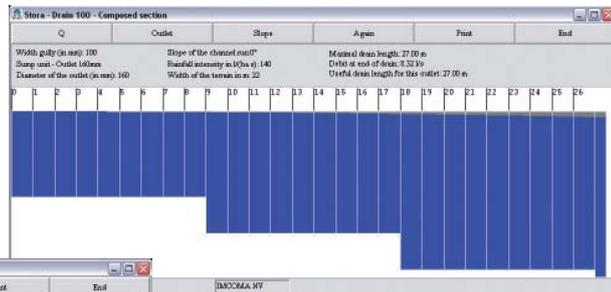
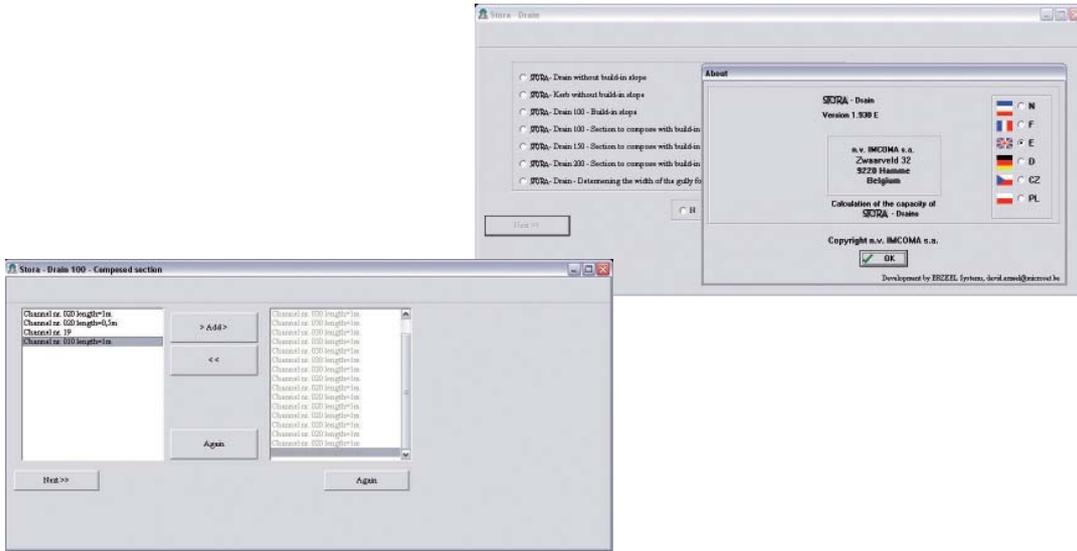


Location of the channels: one channel run parallel to the longest side of the site

STORA-DRAIN CALCULATION PROGRAM

Based on the information on the previous page, our engineering service can assist you at any time to work out the most efficient solution for your evacuation problem. A computer program simulates the evacuation inside the channel as well as the results under changing conditions.

Our engineering service also offers advice with regard to the most optimum design for the evacuation of surface water using CAD (see bottom drawing).





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