

# Box Culverts



**BISON PRECAST**

a Forterra brand

# Box Culverts

**Easy to install,  
suitable for very  
shallow or deep fill,  
ideal for use in a  
wide variety of  
civil engineering  
applications.**



## Bison Precast is one of the largest producers of box culverts in the UK.

Bison Precast Box Culverts are designed and manufactured for each individual project to meet the specific scheme requirements.

Our in-house design team are on hand to provide immediate guidance and information where required to optimise the design to provide the most economical solution.

In its simplest form the box culvert system will comprise of straight units with no access or pipe openings.

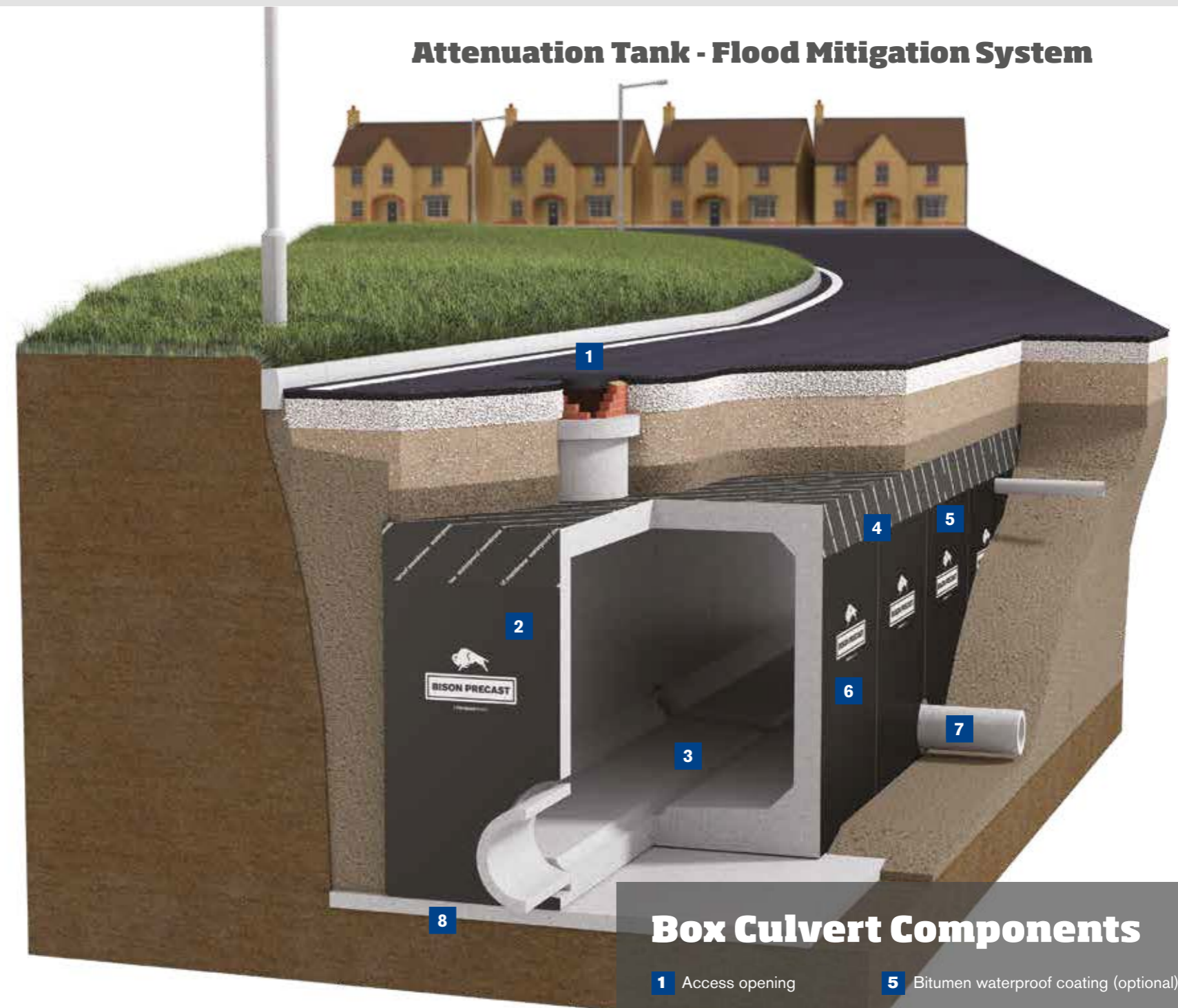
For longer runs of culvert, special units can be included which incorporate access openings and pipe openings. The system can be further adapted with special units with end walls to create attenuation tanks. In addition to the above, gradual changes in direction can be incorporated with skewed units.

Box Culverts are available in a wide and extensive range of sizes from 1000mm x 600mm to 6000mm x 3600mm. Nonstandard sizes and internal profiles can also be provided including shaped inverts, dry weather flow channels and units with cross over channels.

### Box Culvert Applications

- |                                |                     |
|--------------------------------|---------------------|
| Watercourse Diversions         | Escape Tunnels      |
| Attenuation Tanks              | Service Tunnels     |
| Road Crossings                 | Pumping Stations    |
| Multi-cell Construction        | Channels            |
| Pipe Replacement               | Portals             |
| Pedestrian and Vehicle Subways | CSO Chambers        |
| Sea Outfalls                   | Mammal Crossings    |
| Shafts                         | Conveyor Protection |
|                                | Basement Solutions  |

## Attenuation Tank - Flood Mitigation System



### Box Culvert Components

- |                                   |  |
|-----------------------------------|--|
| <b>1</b> Access opening           | <b>5</b> Bitumen waterproof coating (optional) |
| <b>2</b> End wall                 | <b>6</b> Standard unit                         |
| <b>3</b> Dry weather flow channel | <b>7</b> Pipe opening                          |
| <b>4</b> Joint material           | <b>8</b> Bedding material                      |

# Box Culverts Benefits



## Design specific

Box culvert design is specific to client requirement and can be designed for highways, airport, rail, pedestrian or field loading

## Ease of installation

Can be laid as singles or in multiple runs

## Quality Service

Available nationwide on a supply only basis

Complies with all relevant standards and manufactured in accordance with ISO 9001 and 14001

CE marked against BS EN 14844

## Flexibility of range

Accommodates almost any size requirement

Availability of multi-cell sections

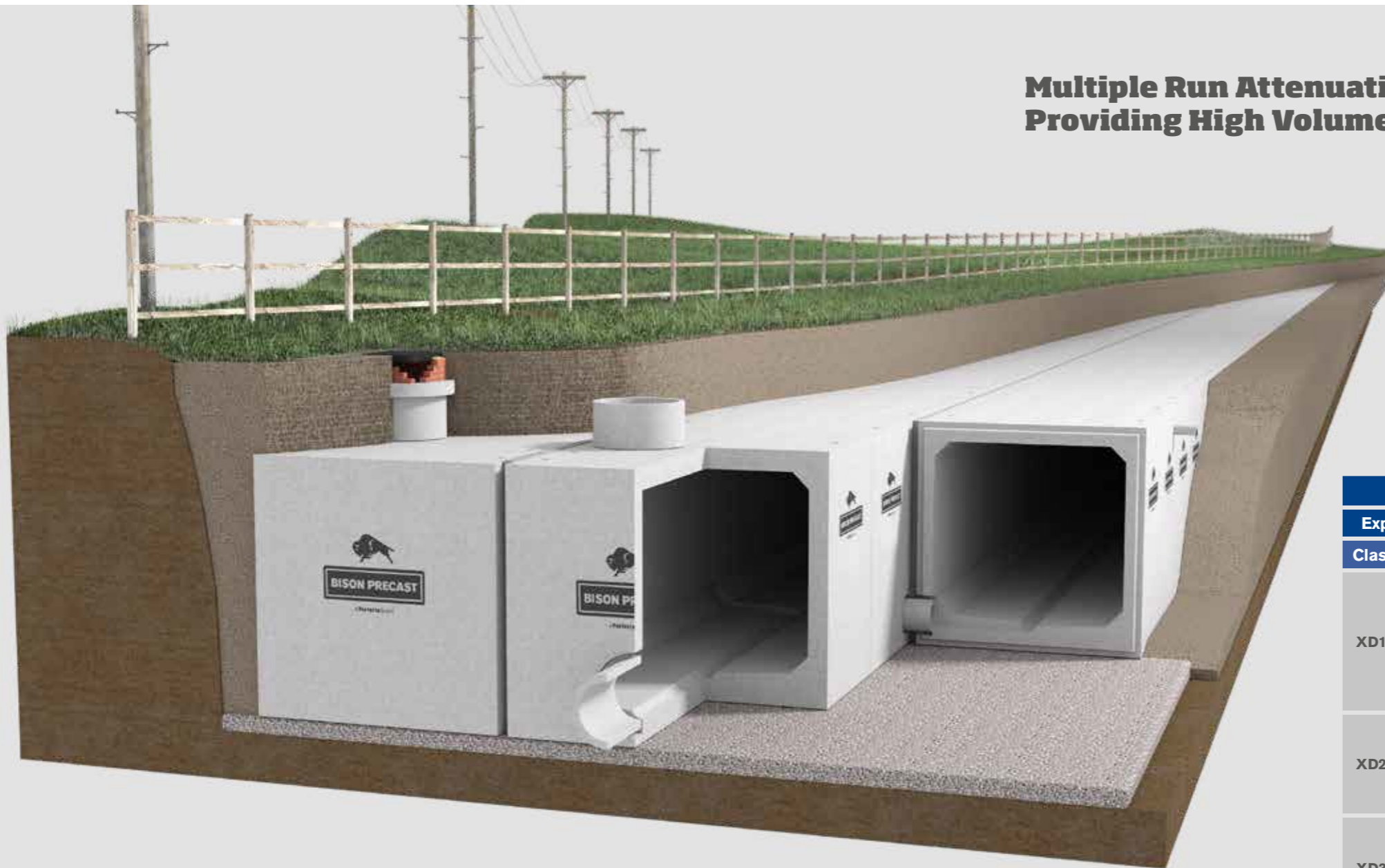
Use with shaped invert for dry weather flow situations eg. sloping vee and half round

## Long term durability

With 120 year design life



## Multiple Run Attenuation Tank - Providing High Volume Storage



Bison Precast can accommodate a variety of specialist manufactured components to satisfy scheme design requirements.



**DWF CHANNELS**



**ANIMAL CROSSING LEDGE**



**TWIN CELL CONSTRUCTION**



**ACCESS UNITS**



**CAST ON END WALLS**

Table 1		
Exposure & cover requirements		
Class	Description	Cover
XD1	Concrete structures more than 10 metres away from a carriageway and exposed to occasional chlorides	30
XD2	Buried highway structure more than 1 metre below adjacent carriageway	40
XD3	Buried highway structure less than 1 metre below adjacent carriageway	45

## Design & detailing

Bison Precast Box Culverts are designed in accordance with BS EN 14844, Eurocodes, PD6694, BS EN 13369, BS EN 206, BS 8500 and BRE Special Digest 1.

## Exposure & cover requirements

Depending on the depth of fill, proximity to a highway and the environmental conditions the units will be designed in accordance with Table 1. Minimum concrete grade used is C45/55 with a maximum aggregate size of 20mm. Please refer to BS8500 Table A.1 for further details.

## Breaking & acceleration

In accordance with Eurocodes the breaking and acceleration force generated from traffic loading needs to be considered.

## Surface loading & fill depth

Loading applied at the ground surface and weight of fill material produce a combination of vertical and horizontal forces on the box culvert.

Surface loading may be specified as a standard loading type, equivalent uniform loading or individual wheel loads. The critical load on a culvert can occur at minimum or maximum fill.

Each enquiry for a culvert should state the minimum and maximum fill depth and the amount or type of surface loading.

It is recommended that the minimum fill depth should be not less than 200mm or one fifteenth of the internal width of the culvert if this is greater.

Please size by span x height. All dimensions are internal.

## Dimensions, flow area & discharge rates

		Width mm (internal span)																	
		1000	1200	1500	1800	2100	2400	2700	3000	3300	3600	3900	4200	4500	4800	5100	5400	5700	6000
Height mm (internal span)	600	0.53 0.50	0.65 0.64	0.83 0.86	1.01 1.07	1.19 1.29	x	x	x	x	x	x	x	x	x	x	x	x	x
	800	0.73 0.77	0.89 0.99	1.13 1.33	1.37 1.67	1.61 2.01	1.85 2.36	2.09 2.71	2.33 3.06	x	x	x	x	x	x	x	x	x	x
	1000	0.93 1.07	1.13 1.37	1.43 1.84	1.73 2.32	2.03 2.80	2.33 3.29	2.63 3.79	2.93 4.29	3.23 4.79	3.53 5.29	3.83 5.80	4.13 6.30	4.43 6.81	4.73 7.32	x	x	x	x
	1200	x	1.37 1.76	1.73 2.37	2.09 3.00	2.45 3.64	2.81 4.29	3.17 4.95	3.53 5.61	3.89 6.28	4.25 6.95	4.61 7.62	4.97 8.29	5.33 8.97	5.69 9.64	6.02 10.28	6.38 10.96	6.74 11.64	7.09 12.32
	1500	x	x	2.18 3.21	2.63 4.08	3.08 4.98	3.53 5.89	3.98 6.81	4.43 7.74	4.88 8.68	5.33 9.62	5.78 10.57	6.23 11.52	6.68 12.48	7.13 13.44	7.55 14.37	8.00 15.33	8.45 16.30	8.90 17.27
	1800	x	x	x	3.17 5.21	3.71 6.38	4.25 7.57	4.79 8.78	5.33 10.00	5.87 11.24	6.41 12.48	6.95 13.74	7.49 15.00	8.03 16.26	8.57 17.54	9.08 18.79	9.62 20.07	10.16 21.35	10.70 22.64
	2100	x	x	x	x	4.34 7.83	4.97 9.31	5.60 10.82	6.23 12.36	6.86 13.92	7.49 15.49	8.12 17.07	8.75 18.67	9.38 20.27	10.01 21.88	10.61 23.48	11.24 25.11	11.87 26.74	12.50 28.37
	2400	x	x	x	x	x	5.69 11.11	6.41 12.94	7.13 14.81	7.85 16.70	8.57 18.61	9.29 20.55	10.01 22.50	10.73 24.46	11.45 26.43	12.14 28.40	12.86 30.40	13.58 32.40	14.30 34.41
	2700	x	x	x	x	x	x	7.22 15.11	8.03 17.32	8.84 19.56	9.65 21.84	10.46 24.14	11.27 26.46	12.08 28.80	12.89 31.15	13.67 33.52	14.48 35.90	15.29 38.29	16.10 40.70
	3000	x	x	x	x	x	x	x	8.93 19.88	9.83 22.49	10.73 25.14	11.63 27.82	12.53 30.53	13.43 33.27	14.33 36.02	15.20 38.80	16.10 41.59	17.00 44.40	17.90 47.22
	3300	x	x	x	x	x	x	x	x	10.82 25.48	11.81 28.52	12.80 31.59	13.79 34.71	14.78 37.85	15.77 41.02	16.73 44.22	17.72 47.44	18.71 50.68	19.70 53.93
	3600	x	x	x	x	x	x	x	x	x	12.89 31.95	13.97 35.43	15.05 38.96	16.13 42.53	17.21 46.13	18.26 49.77	19.34 53.43	20.42 57.11	21.50 60.81

Flow area m<sup>2</sup> Discharge rate m<sup>3</sup>/s



### Hydraulic design

The discharge rates are based on a flat invert culvert unit with a 1 in 1000 gradient and roughness coefficient of 0.3mm. Please contact our design team for alternative discharge rates.

**1** Bison Precast Concrete Wing Walls

**2** Bison Precast Concrete Head Beam

### Notes

- 1** The standard range of box culverts generally have flat inverts and 190mm corner splays up to 4800mm span and 225mm splays from 5100mm to 6000mm span and a maximum length of 2m.
- 2** Sizes other than those stated can be manufactured to suit customer requirements.
- 3** Special internal profiles, shaped inverts and dry weather flow channels can be produced and are available on request.

- 4** Tapered units for bends, units with manhole openings and pipe access holes are available on request.
- 5** All box culverts are manufactured to order and to the specific required design criteria, the external loading conditions will govern the wall, roof and floor thickness, unit length and reinforcement content.
- 6** Joints are a standard rebate within the wall of the unit and the box culverts can be jointed using sealant strip to provide a seal and flexible joint if required.
- 7** Special insert pins are cast in to each box culvert to enable them to be lifted.

## Bedding, laying & backfilling

Excavation can be kept to a minimum with only nominal working space required on each side of the box culvert. When working in trenches the normal requirements for health and safety must always be observed.

The base of the trench should be uniformly prepared before laying a 200mm bedding of compacted granular material over the full width of the trench. A surface blinding of the fine material will assist levelling. Local packings are subject to settlement and should not be used.

As an alternative to granular bedding a concrete blinding layer is sometimes preferred to protect the formation or to allow a faster rate of laying the culverts.

A layer of unreinforced concrete approximately 75mm thick, on a trench bottom which has been well prepared to provide a uniform support, is generally sufficient.

A culvert line is usually laid directly on the bedding starting from the downstream end with the sockets facing upstream, to receive the next culvert.

The trench should be backfilled as soon as possible after the culvert has been laid and it should be filled evenly on each side of the trench. Backfilling should continue in 200mm compacted layers to reach the required depth of cover.

**Where loads from construction plant may exceed the design load of the box culvert, protective measures will be required. This is particularly relevant at shallow fill depths.**

## Jointing

The culvert sections generally have rebated joints and can be laid open or sealed using preformed strips and/or pointing materials. Reference should be made to the jointing material manufacturer's specification and recommendation for use of the product.

A system using preformed strip within the joint is most commonly used. When the strip is bitumen based the joint faces should be cleaned, primed and allowed to dry. The strip is then applied to the internal corner of the socket just before the culvert is laid in the trench.

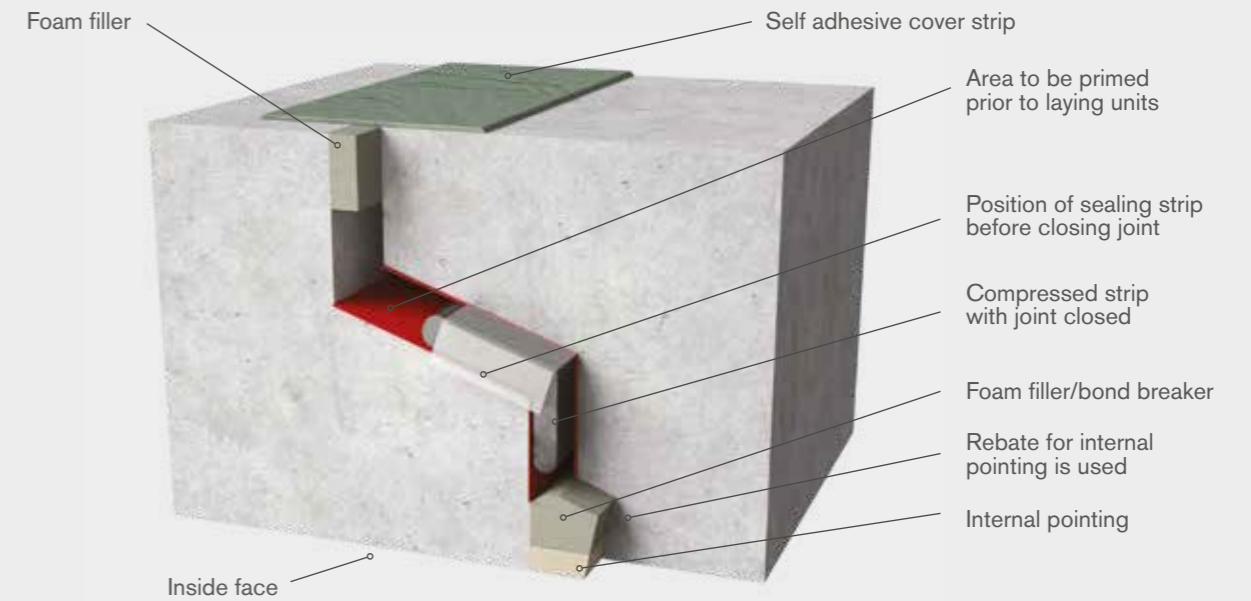
Joints are closed to a nominal gap by pulling against previously laid culverts

with an applied load of approximately one tonne per metre of strip plus about half of the weight of the culvert unit to overcome base friction, less if the unit is suspended from the crane whilst jointing.

Heat may be required to soften the strip when working at low temperature.

When the box culvert is of sufficient size for access, it can be pointed internally with an elastomeric or bitumen based material using a suitable primer.

Not all methods of jointing, however, should be expected to be completely watertight.



# Delivery & Offloading

It is the contractors responsibility to offload the box culverts on delivery. A hard level access area should be provided which can be used safely by standard articulated delivery vehicles.

The contractor should provide a suitable crane of adequate capacity for lifting the culvert.

For reasons of safety and economy certain box culverts are delivered to site on end rather than as laid, and will require a safe method of turning during offloading.

A data sheet giving guidance of lifting and turning is available and is issued to clients prior to the first delivery.

The offloaded box culverts should be placed carefully on a firm level base away from the edge of the trench, and if any further movement is required it should be by lifting; the culvert should never be dragged or dropped.







**Forterra is a leading manufacturer of a diverse range of clay and concrete building products, used extensively within the construction sector, and employs over 1,900 people across 18 manufacturing facilities in the UK.**

**It is the second largest brick and aircrete block manufacturer in the country, and the only producer of the iconic London Brick. Other trusted brands from Forterra include Thermalite, Conbloc, Ecostock, Butterley, Cradley, Red Bank, Bison Precast, Jetfloor and Formpave.**

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