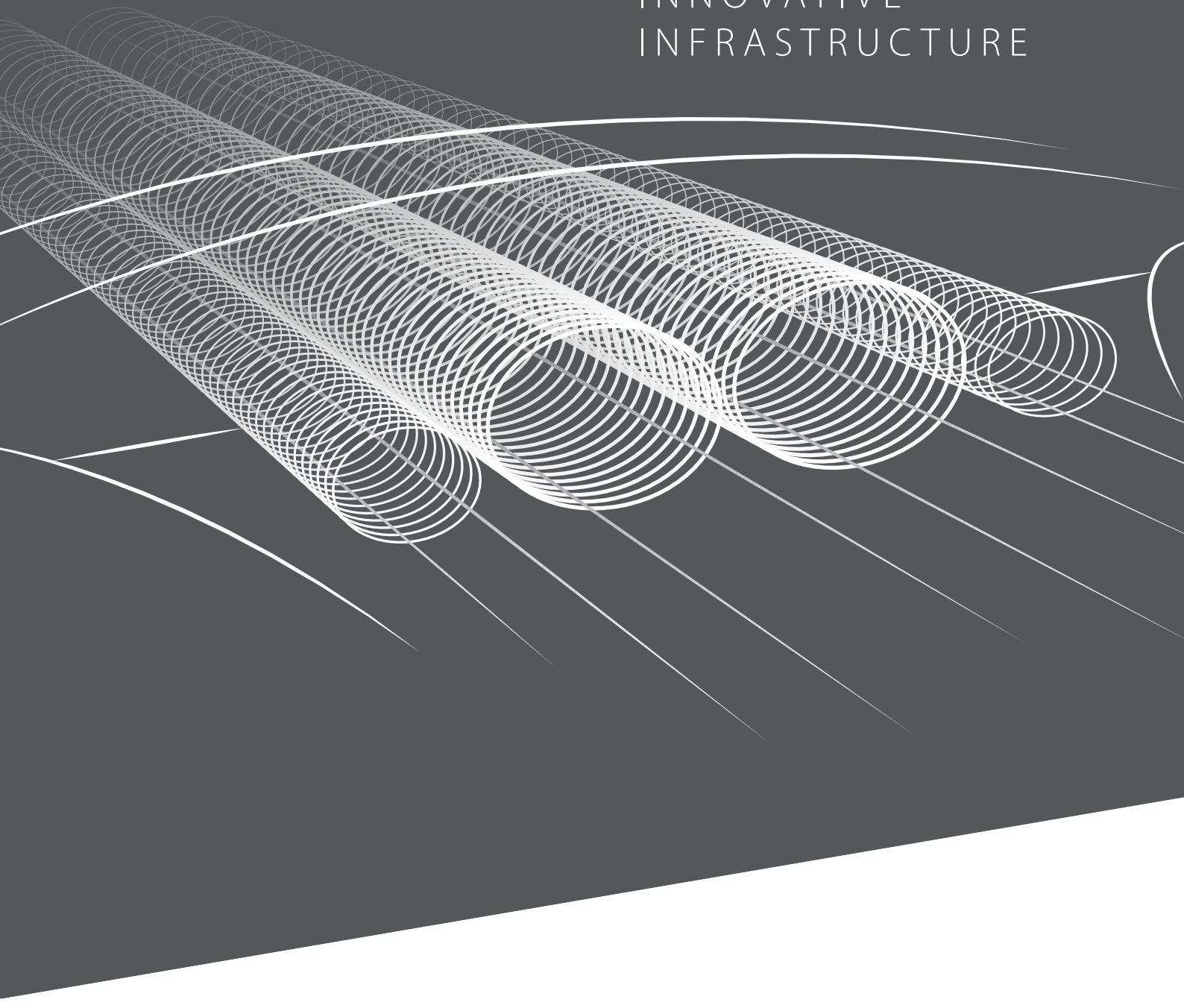
Product catalogue

INNOVATIVE
INFRASTRUCTURE



ViaCon

DIVERSE MARKETS

ROADS

RAILWAY

FORESTS

MELIORATIONS

MININGS

ARMY

OTHERS

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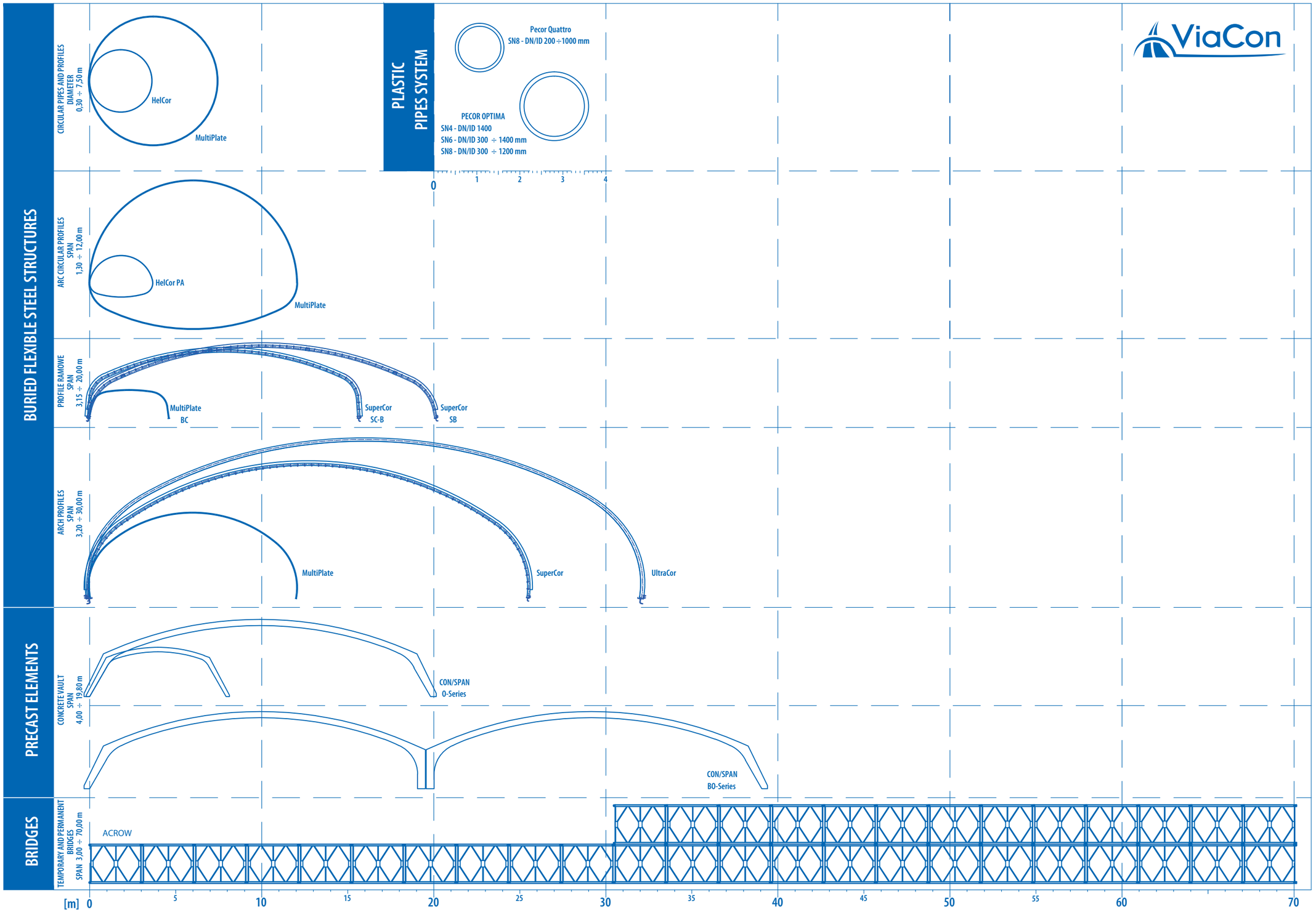
The scope of pipes and steel structures application to build engineering facilities



Culvert pipes
PECOR OPTIMA®

Culvert pipes
PECOR OPTIMA®

Sewage manholes
PECOR OPTIMA® M

PECOR OPTIMA®

QUALITY ASSURANCE

PECOR OPTIMA® pipes produced by ViaCon Sp. z o.o. are perfect for use in engineered structures:

- roads and railway culverts
- ecological passages (for animals)
- forestry culverts
- relining of existing old culverts
- ventilating system
- agro-ventilation

Application

PECOR OPTIMA® - exceptional, helically corrugated double wall pipes with smooth inside are used for building culverts and outdoor sewage pipelines system. The unique structure of PECOR OPTIMA® pipes is a result of Scandinavian long-term experience in culvert & sewage technology.

According to the latest PPI (Plastic Pipes Institute) corrugated pipes produced of polyethylene can be designed on the assumption of 100 years lifetime.

PECOR OPTIMA® system is widely used in civil engineering. Due to the fast assembly and very good strength and hydraulic parameters, the system has received wide recognition among designers and contractors. Unique spiral structural wall allows to get the optimal stress distribution on the whole pipe length and ensure the proper ring stiffness on each section. Smooth inside wall of PECOR OPTIMA® pipes allows to achieve good hydraulic parameters.

PECOR OPTIMA® pipes can be used as curved in plane and profile.

Broad range of fittings (elbows, T-pipes, reductions) make up complete system.

Advantages of using system PECOR OPTIMA®

- no needs to use heavy equipment for installation
- versatile system due to wide range of fittings
- fast and easy assembly (light-weighted)
- low transportation costs
- optimal strength and hydraulic parameters
- no corrosion concern

Technical approvals

PECOR OPTIMA® pipes have the following documents:

- Technical Approval issued by Polish Road and Bridge Research Institute IBDiM no AT/2007-03-0115/2
- positive opinion from Polish Central Mining Institute (GIG) for use of pipes on subsidence areas

Material

Raw material which is used for the production of PECOR OPTIMA® pipes is high density polyethylene (HDPE). Mechanical and physical characteristic properties are provided below:

- density: 0,942 [g/cm^3]
- Young modulus:
  - $E_{short\text{-}term}$ = 600 ÷ 1000 [MPa]
  - $E_{long\text{-}term}$ = 150 ÷ 300 [MPa]
- ultimate elongation: > 800 [%]
- melt flow index MFI: 0,15 ÷ 0,50 [g/10min] for loading 2,16 kg
- coefficient of linear thermal expansion: $\alpha = (1,5 \div 2,0) \times 10^{-4}$ [1/°C]
- working temperature range: -30 ÷ +75 [°C]

There is a mixture of polyethylene and black coloring dye stabilized on UV radiation used for PECOR OPTIMA® production.

Construction of pipe PECOR OPTIMA®

PECOR OPTIMA® pipes are produced with double wall, smooth inside and corrugated outside (Fig. 1).
The corrugation is stiff and can interact with surrounded soil. The corrugation size and the distance between corrugation depend on the diameter of the pipe (the bigger dimension, the larger corrugation).
Corrugation detail of PECOR OPTIMA® pipes is shown in Fig. 2. The dimensions and the tolerances are presented in table 1.

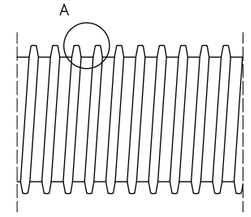


Fig. 1. View of PECOR OPTIMA®

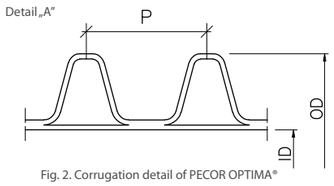


Fig. 2. Corrugation detail of PECOR OPTIMA®

Tab. 1

Item	Nominal diameter DN [mm]	Outside diameter OD [mm]	Inside diameter ID [mm]	Area [m²]	Period of corrugation P [mm]
1	300	357±2%	300±2%	0,07	55,5
2	400	477±2%	400±2%	0,13	74,0
3	500	593±2%	500±2%	0,20	92,0
4	600	724±2%	600±2%	0,28	108,0
5	700	824±2%	700±2%	0,38	108,0
6	800	970±2%	800±2%	0,50	140,0
7	900	1070±2%	900±2%	0,64	140,5
8	1000	1175±2%	1000±2%	0,79	142,0
9	1200	1375±2%	1200±2%	1,13	142,0
10	1400	1570±2%	1400±2%	1,54	142,0

Nominal diameter (DN) of PECOR OPTIMA® pipes refer to inside diameters (ID)

Strength

Standard PECO R OPTIMA® pipes are produced in the following classes of ring stiffness:

- SN 4 (4 kPa) - pipes 1400 mm
- SN 6 (6 kPa) - pipes from 300 mm to 1400 mm
- SN 8 (8 kPa) - pipes from 300 mm to 1200 mm
- there is a possibility to produce pipes in SN 10 on request

Standards length of PECOR OPTIMA® pipes

The standard lengths of PECOR OPTIMA® pipes are L=6 m, 7 m, 8 m (refer to SN 8) and L = 6 m (refer to SN 6 and SN 4).

The production process allows to make pipes with 12 m length.

Connection of PECOR OPTIMA®

PECOR OPTIMA® pipes are joined with coupling bands. There are three types of coupling bands: full ring (Fig.3a), in one connection (Fig.3b), in two connections (Fig.3c).

PECOR OPTIMA® pipes including coupling bands make up the sand tight system.

Fig. 3a Fig. 3b Fig. 3c

Fig. 3 Scheme of PECOR OPTIMA® connection

PECOR OPTIMA® culvert pipes

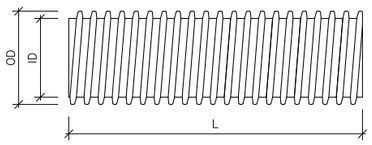


Fig. 4. PECOR OPTIMA® culvert pipe - SN 6 and SN 8

Item	Symbol	Diameter [mm]		Nominal length [m]
		ID	OD	L
1	PECOR OPTIMA 300	300	357	Standard lengths: 6, 7, 8 m (SN 8) 6 m (SN 6 and SN 4) Length of pipe (max. up to 12 m is available)
2	PECOR OPTIMA 400	400	477	
3	PECOR OPTIMA 500	500	593	
4	PECOR OPTIMA 600	600	724	
5	PECOR OPTIMA 700	700	824	
6	PECOR OPTIMA 800	800	970	
7	PECOR OPTIMA 900	900	1070	
8	PECOR OPTIMA 1000	1000	1175	
9	PECOR OPTIMA 1200	1200	1375	
10	PECOR OPTIMA 1400	1400	1570	

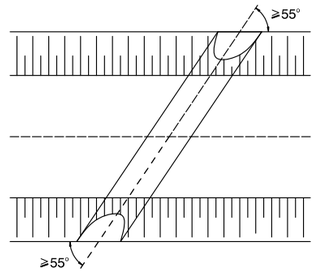


Fig. 5. Skew angle of the pipe

Pipe end finishing

Using PECOR OPTIMA® pipes enables an accurate adjustment of both ends slope and required angle.

Bevel cut can be done on one or both sides with full bevel or step bevel.

It is recommended to use vertical step of 1/3 the height of the pipe.

There are several possibilities of end finishing:

Vertical end:

- reinforced concrete head wall
- head wall made of gabions

Beveled end:

- slope paved with concrete or stone blocks placed on sand-cement
- slope paved with perforated concrete panels
- slope paved with stone rip rap
- reinforced concrete collar

It is recommended to pave bottom of the river. Concrete blocks, stone, gabions or other available material can be used.

Skewed (90°) end can be made for both vertical and beveled end. Minimum allowable skew angle is 55° (Fig. 5).

In special cases it is necessary to make additional reinforcement in the skewed area.

Please contact ViaCon Technical Department to get more information.

Fittings, coupling bands for PECOR OPTIMA® pipes

Complement system consists of:

- coupling bands (full ring, one-piece band, two-pieces band)
- elbow (30º , 45º , 60º , 75º , 90º)
- T-pipes (45º , 90º)

Fittings with other angles are available.

Hydraulic parameters of PECOR OPTIMA® pipes

Diameters of pipe should be determined on the basis of hydraulic calculation, depending on expected volume of flow. Figure 6 shows the reference water flow Q_m for PECOR OPTIMA® pipes with water flow at 75% height. Water-flow regulations may differ slightly depending on national standards.

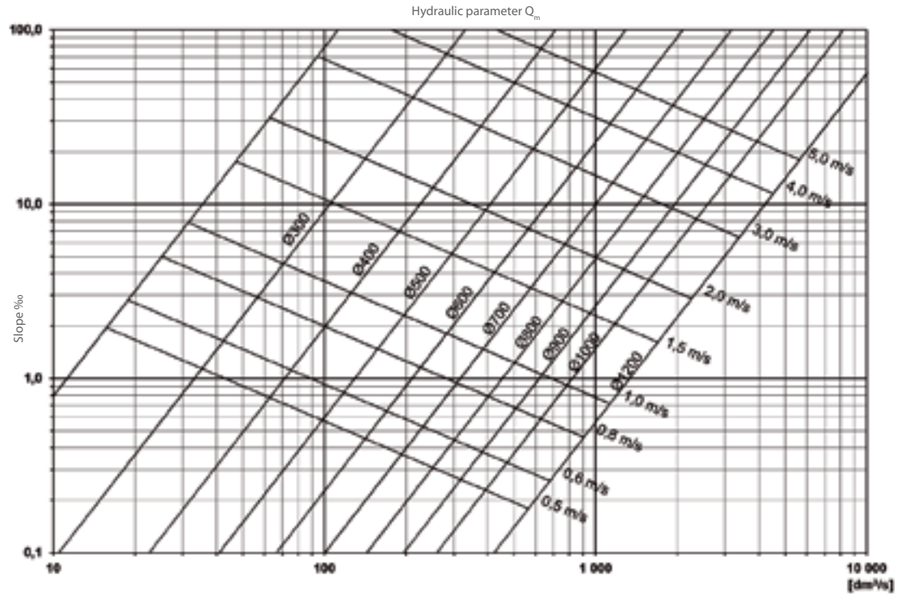


Fig. 6. Water flow Q_m for PECOR OPTIMA® pipes with water level 75% height

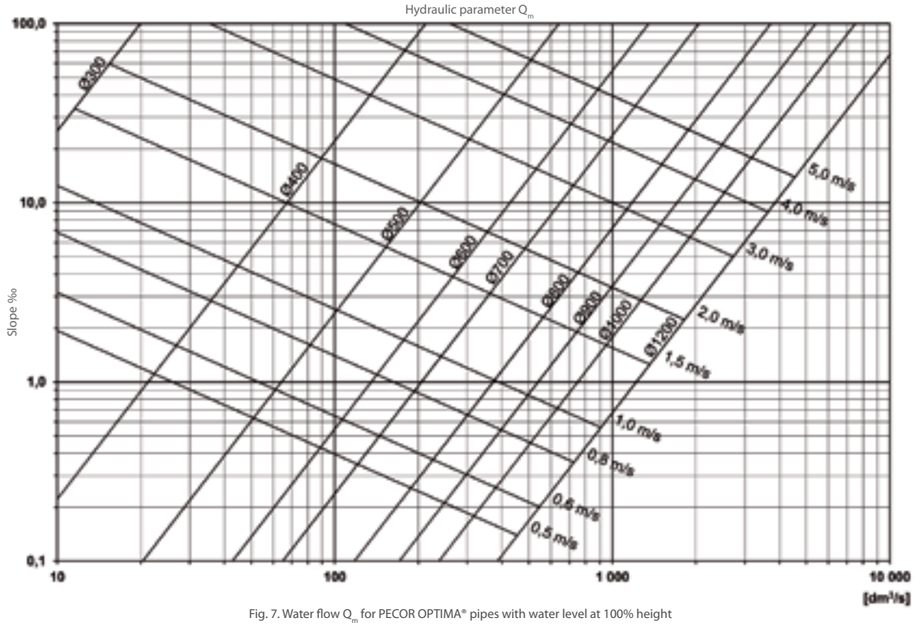


Fig. 7. Water flow Q_m for PECOR OPTIMA® pipes with water level at 100% height

PECOR OPTIMA® M sewage manholes – application

Manholes are used for:

- non-pressure sewage system
- roads dewatering
- parking places dewatering

PECOR OPTIMA® M manholes are produced in three types:

- three way pipe
- sedimentation tanks
- eccentric

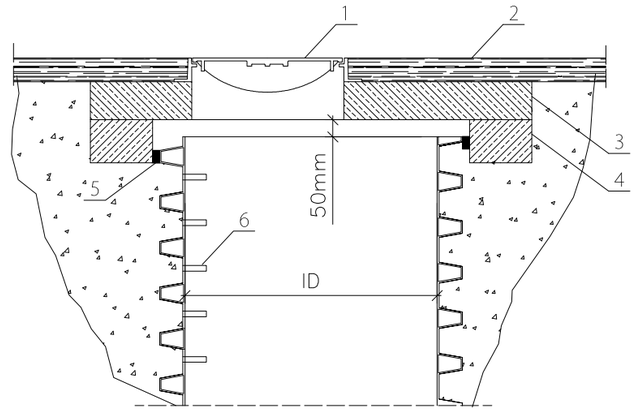
Manhole PECOR OPTIMA® M in dimensions ID=1000 mm, 1200 mm, 1400 mm are equipped with steps.

Sewage manholes PECOR OPTIMA® M are adopted to connect with cast iron or concrete cover in proper class. Figure 8 shows an example of PECOR OPTIMA® M manhole cover.

There are stud couplings on the bottom part of manhole made from PECOR OPTIMA® pipes or connector pipes made of HDPE adopted to connect sewage pipes.

The bottom of the manhole PECOR OPTIMA® M is made of HDPE plate.

The whole stub pipes & bottom are connected with main manhole body pipe by welding.



1 – manhole cover in proper class: A15÷D400
2 – surface
3 – concrete slab
4 – cover ring
5 – sealing (space between main pipe and reinforced plate)
6 – steps

Fig. 8. PECOR OPTIMA® M - manhole cover

Cover depth for PECOR OPTIMA® and Pecor Quattro

Definition of the cover depth for road structures

Cover depth can be described as a vertical distance between the top of the culvert and the road grade-line, including the road pavement.

Definition of the cover depth for railway structures

Cover depth for culvert under railway can be described as a vertical distance between the top of the culvert and the bottom of the railway sleeper, including the construction layers of the railroad.

In case of construction traffic the cover depth must be agreed with Technical Department of ViaCon company.

Tab. 1. Cover depth

Type of structure	Min. cover depth
cover depth for road structures	Hmin = { DN/ID 200 ÷ 500 – 0,3 [m] DN/ID 600 ÷ 1000 – 0,5 [m] DN/ID > 1000 – ½ × DN/ID [m]
cover depth for railway structures (for live load αk=+2)	*Hmin = { 0,6 [m]

* refer to SN 8

Material for bedding and backfill
for PECOR OPTIMA® and Pecor Quattro pipes

- gravel, sand -gravel mix, all-in aggregates and crushed stone can be used as bedding and backfill material
- aggregate grain size depends on size of corrugation profile
- aggregate size should have (0,3 m ÷ 0,5 m) 31,5 mm
- the use of cohesive soil, organic soil and soils included permafrost is not acceptable
- backfill material around the structure should be placed in un-compacted layers and then compacted:
  - un-uniformity coefficient $C_u \geq 4$
  - curvature coefficient $1 \leq C_c \leq 3$
  - permeability $k_{10} > 6$ m/day
  - backfill material should be compacted to minimum 0,95 of Standard Proctor Density, but 0,98 of Standard Proctor Density - in the pipe adjacent

Deviation from these principles requires consultation with the Technical Department of our company.

DOUBLE WALL POLYETHYLENE CORRUGATED PIPES PECOR OPTIMA®

Literature and standards
for PECOR OPTIMA® and Pecor Quattro pipes

[1] Regulation of the Minister of Transport and Maritime Economy of 30 May 2000 on the technical conditions to be met by road engineering objects and their location. Journal Laws: Dz.U. No. 63

[2] Design and technology guidelines for flexible engineering structures made of plastics. Annex to the Ordinance No. 30 of the General Directorate for National Roads and Motorways, dated 2 November 2006. Bridge and Road Research Institute (IBDiM), Branch in Wrocław

[3] Technical Approval issued by the Road and Bridge Research Institute (IBDiM), No. AT/2007-03-0115/2 „HDPE PECOR OPTIMA polyethylene pipes with fittings and connectors".

[4] Technical Approval issued by the Road and Bridge Research Institute (IBDiM), No. AT/2012-02-2815: „Pipes and fittings (polypropylene) for road culverts and drainage as well as for wire and cable protection".

[5] Technical opinion of the Central Mining Institute (GIG): „Opinion on the conditions for use of Pecor Optima structured-walls sewerage and culvert pipes in areas affected by mining", 2007.

[6] PN-EN 13476-3 Plastics piping systems for non-pressure underground drainage and sewerage. Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE). Part 3: Specifications for pipes and fittings with smooth internal and profiled external surface and the system, Type B.

Pecor Quattro

ADVANTAGE BY INNOVATION

Pecor Quattro pipes are used for building:

- gravity sewage system and storm water
- road and railway culverts
- culverts under forest roads
- ecological culverts for small animals
- retention tanks

Parameters

Pecor Quattro pipes are manufactured of polypropylene (PP) with double wall. Corrugated outside wall of pipes provides high stiffness SN 8 (8 kPa). Smooth inside wall allows to achieve optimal hydraulic parameters.

Pipes are produced according to norm PN-EN 13476-3 [6] and Technical Approval IBDIM No. AT/2012-02-2815 "Pipes and fittings made of polypropylene used for road culverts and drainage as well as for cable protection [4]."

Pipe bell is formed at the production stage and it is integrated part of pipe which allows fast assembly. The rubber sealing ring mounted on the end of pipe guarantees tightness.

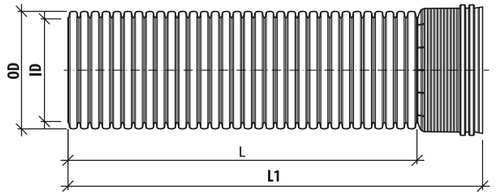
Pecor Quattro pipes are produced in two types of colors:

- outside black / inside grey – used for culvert pipes and storm water
- outside orange / inside grey – used for sewage system made on request.

Pecor Quattro system consists of:

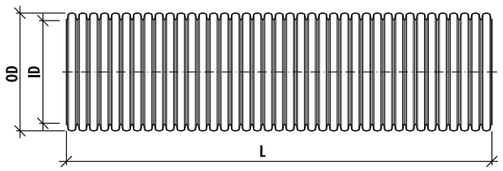
- pipe jointing sleeves
- double- bell couplings
- elbows: 15°, 30°,45°, 90°
- T-pipes: 45°, 90°
- reducers
- watertight connectors for concrete wells
- Pecor Quattro wells

Pecor Quattro SN 8 sewage pipe with bell



Symbol	Diameter [mm]			Length [mm]	
	DN/ID	ID	OD	L	L1
Pecor Quattro 200	200	196	224	6000	6150
Pecor Quattro 300	300	296	338	6000	6165
Pecor Quattro 400	400	394	451	6000	6185
Pecor Quattro 500	500	492	564	6000	6250
Pecor Quattro 600	600	591	674	6000	6290
Pecor Quattro 800	800	788	902	6000	6350
Pecor Quattro 1000	1000	988	1130	6000	6390

Pecor Quattro SN 8 sewage pipe without bell

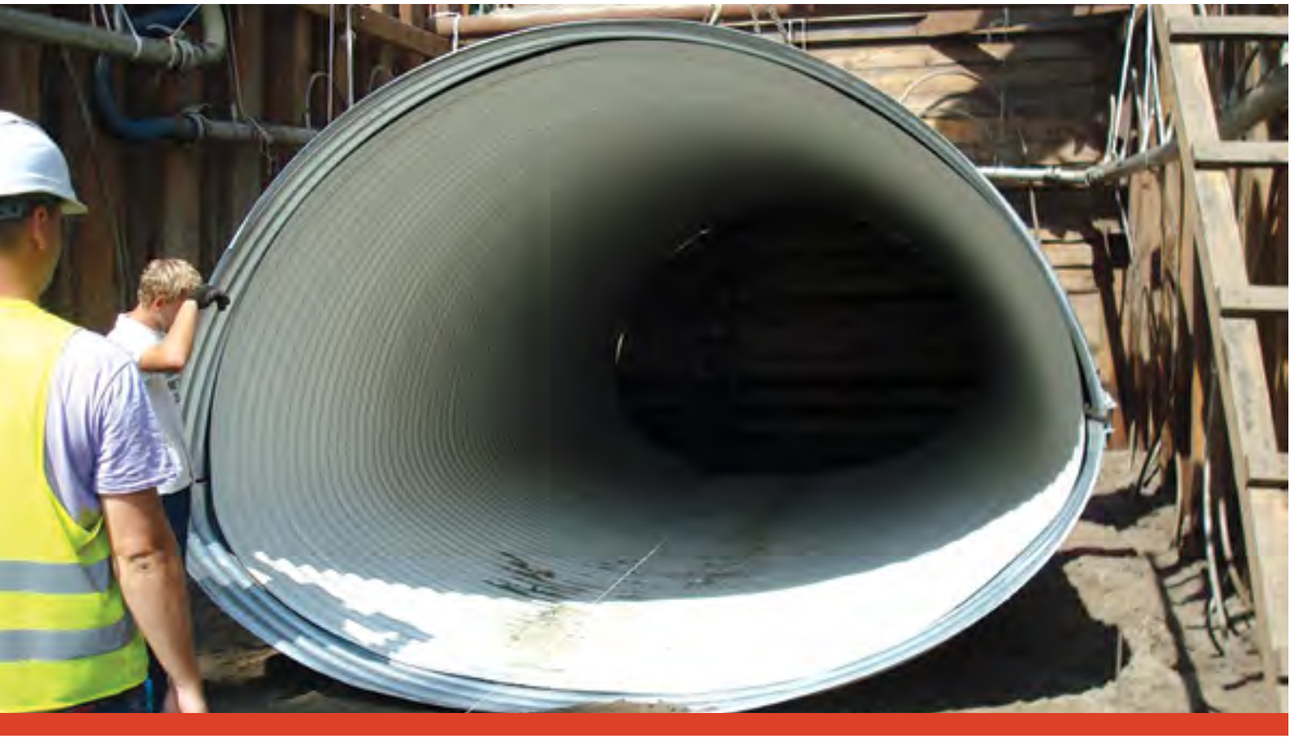


Symbol	Diameter [mm]			Length [mm]
	DN/ID	ID	OD	L*
Pecor Quattro 200	200	196	224	6000
Pecor Quattro 300	300	296	338	6000
Pecor Quattro 400	400	394	451	6000
Pecor Quattro 500	500	492	564	6000
Pecor Quattro 600	600	591	674	6000
Pecor Quattro 800	800	788	902	6000
Pecor Quattro 1000	1000	988	1130	6000

* Pipes in different lengths 7 and 8 m are possible.

HelCor® and HelCor PipeArch®

SPIRAL OF OPPORTUNITIES



Helically corrugated steel pipes HelCor® and pipe-arches HelCor PA produced by ViaCon make up complete systems used in civil engineering as:

- roads and railway culverts
- underground passages
- ecological passages
- hydro technical structures
- relining of existing old structures

Application

The history of corrugated steel pipes dates back to 1896, when its production was started in the United States. The first helically corrugated steel pipes were also produced at that time in Russia, where 1300 m of this product was used as culverts under the railway lines. In Poland, the pipes appeared at the end of the 1970s and since then they have been increasingly popular among designers and contractors.

Complete system of helically corrugated pipes includes elbows or T-connections and also additional elements such as manholes, inspection chambers etc.

According to the European Standard PN-EN 1991- 2:2007 HelCor® and HelCor PA pipes can be used as engineering structures for every class of road and railway (up to V=200km/h) load.

HelCor® and HelCor PA pipes have Technical Approval issued by Polish Road and Bridge Research Institute (IBDiM). HelCor® and HelCor PA pipes are approved by Polish Central Mining Institute (GIG) to be used on subsidence areas.

Installation time for HelCor® and HelCor PA is much shorter than for concrete pipes. Easy and quick assembly helps in limiting time for construction of culverts or other structures and allows to construct culvert in stages without stopping the traffic as well as during winter time. Construction of culverts with the use of HelCor® and HelCor PA is much cheaper than traditional concrete culverts.

Steel

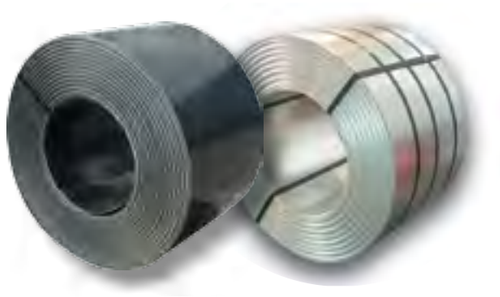
HelCor® and HelCor PA steel pipes mechanical properties				
Steel grade	Standard	Yield point R_e [MPa]	Tensile strength R_m [MPa]	Elongation A_{80min} [%]
DX51D	PN-EN 10346	-	270 - 500	22
S250GD		250	330	19

Steel used for the production of HelCor® and HelCor PA pipes, as well as coupling bands conform to the European Standards:

PN-EN 10346:2011 „Continuously hot-dip coated steel flat products – Technical delivery conditions"

Steel is delivered in coils, with a protection coating in accordance to a/m standards:

- 600 g/m^2 zinc coating both sides, equivalent to 42 µm on each side
- 1000 g/m^2 zinc coating both sides, equivalent to 70 µm on each side
- 600 g/m^2 zinc coating both sides, equivalent to 42 µm on each side, with an additional 300 µm polymer film (TrenchcoatTM or W-ProtectTM) on one or both sides



HelCor® and HelCor PA pipes are produced from steel coils with thickness ranging from 1,5 mm to 3,5 mm in two types of corrugation:

- D1 - 68 x 13 mm
- D3 - 125 x 26 mm

Production

HelCor® pipes are produced by cold forming of the steel coil into a round corrugated shape with diameters ranging from 300 mm to 3600 mm.

During forming of the pipe a lock-seam is performed to keep the pipe integrity.

HelCor Pipe Arches® (PA) are produced through controlled mechanical deformation of HelCor® pipes with the use of hydraulic jacks.

Section lengths and coupling bands

The standard lengths of HelCor® pipes are 6 m, 7 m and 8 m, however the production process allows the manufacturing of any length of pipe. The pipearches are produced up to 10 m long (6 m standard length).

Typically pipes are bevel cut in factory in accordance with the design to conform the slope and the skew angle.

Cut ends are protected against corrosion. In order to obtain the designed length of the pipe, several segments are joined with coupling bands.

The coupling bands are made out of flat or corrugated steel. Depending on the diameter and purpose of the pipe, different types and widths of coupling bands are used:

- **TYPE 1:** flat connected by bolts
- **TYPE 2:** helically corrugated connected by bolts
- **TYPE 3:** helically corrugated connected by bolts in tubes (for relining)
- **TYPE 4:** annular corrugated for connection of pipes with re-corrugated ends
- **TYPE 5:** flat with annular corrugation for connection of pipes with re-corrugated ends

Coupling band diameter for HelCor® pipes and dimensions for HelCor PA depend on pipe diameter or span/rise of pipe arch cross section.

TYPE 1 TYPE 2 TYPE 3 TYPE 4 TYPE 5

Geometric and hydraulic parameters

Thickness parameters for respective diameters/ dimensions of HelCor® and HelCor PA pipes are given in the table below.

Standard plate thickness is shown with bold, but it is possible to manufacture a pipe of a different plate thickness.

Diameter [mm]	Cross section [m²]	Corrugation	Zinc protection		Zinc coating + Trenchcoat layer	
			Plate thickness* [mm]	Weight [kg/m]	Plate thickness* [mm]	Weight [kg/m]
300	0,07	D1	**1,5**	**13,3**	**1,6**	**15,1**
400	0,12	D1	**1,5**	**17,7**	**1,6**	**20,1**
500	0,19	D1	**1,5**	**22,1**	**1,6**	**25,1**
600	0,28	D1	1,5 / **2,0**	**35,9**	1,6 / **2,0**	**36,5**
700	0,38	D1	1,5 / **2,0**	**41,8**	1,6 / **2,0**	**42,6**
800	0,50	D1	1,5 / **2,0**	**47,8**	1,6 / **2,0**	**48,6**
900	0,63	D1	1,5 / **2,0**	**53,8**	1,6 / **2,0**	**54,7**
1000	0,79	**D1** / D3	1,5 / **2,0** / 2,5	**59,8**	1,6 / **2,0** / 2,5 / 2,7	**60,8**
1100	0,95	**D1** / D3	**2,0** / 2,5	**65,8**	**2,0** / 2,5 / 2,7	**66,9**
1200	1,13	**D1** / D3	**2,0** / 2,5	**71,7**	**2,0** / 2,5 / 2,7	**73,0**
1300	1,32	**D1** / D3	**2,0** / 2,5	**77,7**	**2,0** / 2,5 / 2,7	**79,0**
1400	1,54	D1 / **D3**	2,0 / **2,5** / 3,0	**103,2**	2,0 / **2,5** / 2,7	**109,1**
1500	1,76	D1 / **D3**	2,0 / **2,5** / 3,0	**110,5**	2,0 / **2,5** / 2,7	**116,9**
1600	2,01	D1 / **D3**	2,0 / **2,5** / 3,0	**117,9**	2,0 / **2,5** / 2,7	**124,7**
1700	2,27	D1 / **D3**	2,0 / **2,5** / 3,0	**125,3**	2,0 / **2,5** / 2,7	**132,5**
1800	2,54	D1 / **D3**	2,5 / **3,0** / 3,5	**159,2**	2,5 / 2,7 / **3,0** / 3,5	**167,7**
1900	2,83	D3	2,5 / **3,0** / 3,5	**168,0**	2,5 / 2,7 / **3,0** / 3,5	**177,0**
2000	3,14	D3	2,5 / **3,0** / 3,5	**176,9**	2,7 / **3,0** / 3,5	**186,3**
2100	3,46	D3	2,5 / **3,0** / 3,5	**185,7**	2,7 / **3,0** / 3,5	**195,7**
2200	3,80	D3	2,5 / **3,0** / 3,5	**194,6**	2,7 / **3,0** / 3,5	**205,0**
2300	4,15	D3	2,5 / **3,0** / 3,5	**203,4**	2,7 / **3,0** / 3,5	**214,3**
2400	4,52	D3	2,5 / **3,0** / 3,5	**212,2**	2,7 / **3,0** / 3,5	**223,6**
2500	4,91	D3	3,0 / **3,5**	**257,9**	3,0 / **3,5**	**274,7**
2600	5,30	D3	3,0 / **3,5**	**268,3**	3,0 / **3,5**	**285,7**
2700	5,72	D3	3,0 / **3,5**	**278,6**	3,0 / **3,5**	**296,7**
2800	6,15	D3	3,0 / **3,5**	**288,9**	3,0 / **3,5**	**307,7**
2900	6,60	D3	3,0 / **3,5**	**299,2**	3,0 / **3,5**	**318,7**
3000	7,06	D3	3,0 / **3,5**	**309,5**	3,0 / **3,5**	**329,6**
3100	7,55	D3	**3,5**	**319,5**	**3,5**	**340,2**
3200	8,04	D3	**3,5**	**330,2**	**3,5**	**351,6**
3300	8,55	D3	**3,5**	**340,5**	**3,5**	**362,6**
3400	9,08	D3	**3,5**	**350,8**	**3,5**	**373,6**
3500	9,62	D3	**3,5**	**361,1**	**3,5**	**384,6**
3600	10,18	D3	**3,5**	**371,4**	**3,5**	**395,6**

For the same water level the pipe-arch shape has 65% - 100% better water flow capacity than a round pipe with the same rise.

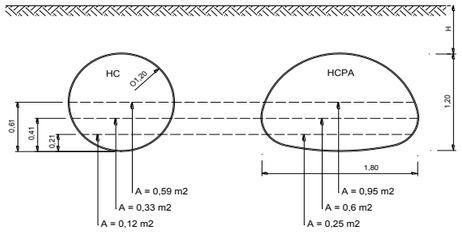


Fig. 1. Comparing water flow capacity of HelCor® and HelCor PA pipes

Type	Span/rise [m]	Cross section [m²]	Substitude dimeter** [mm]	Corrugation	Zinc protection		Zinc coating + Trenchcoat layer	
					Plate thickness* [mm]	Plate thickness* [mm]	Plate thickness* [mm]	Weight [kg/m]
HCPA-S1	**0,80/0,58**	0,38	700	D1	1,5 / **2,0**	**40,5**	1,6 / **2,0**	**41,7**
HCPA-S2	**0,91/0,66**	0,50	800	D1	1,5 / **2,0**	**46,2**	1,6 / **2,0**	**47,7**
HCPA-S3	**1,03/0,74**	0,63	900	D1	1,5 / **2,0**	**52,0**	1,6 / **2,0**	**53,6**
HCPA-S4	**1,15/0,82**	0,79	1 000	D1	1,5 / **2,0**	**57,8**	1,6 / **2,0**	**59,6**
HCPA-01	1,34/1,05	1,13	1 200	D1	2,0 / **2,5**	**88,4**	2,0 / **2,5** / 2,7	**88,8**
HCPA-02	1,44/0,97	1,10	1 210	D1	2,0 / **2,5**	**89,2**	2,0 / **2,5** / 2,7	**89,6**
HCPA-03	1,49/1,24	1,46	1 360	D1	2,0 / **2,5**	**99,7**	2,0 / **2,5** / 2,7	**100,7**
HCPA-04	1,62/1,10	1,42	1 350	D1	2,0 / **2,5**	**98,8**	2,0 / **2,5** / 2,7	**99,9**
HCPA-05	1,65/1,38	1,82	1 510	D1	2,0 / **2,5**	**110,5**	2,0 / **2,5** / 2,7	**111,8**
HCPA-06	1,80/1,20	1,70	1 510	D1	2,5 / **3,0**	**132,7**	2,5 / 2,7 / **3,0**	**133,6**
HCPA-07	1,80/1,50	2,15	1 650	D1	2,5 / **3,0**	**144,4**	2,5 / 2,7 / **3,0**	**146,0**
HCPA-08	1,84/1,39	2,04	1 620	D1	2,5 / **3,0**	**143,3**	2,5 / 2,7 / **3,0**	**143,3**
HCPA-09	1,84/1,48	2,16	1 660	D1	2,5 / **3,0**	**145,9**	2,5 / 2,7 / **3,0**	**146,9**
HCPA-10	1,89/1,55	2,32	1 720	D1	2,5 / **3,0**	**151,2**	2,5 / 2,7 / **3,0**	**152,2**
HCPA-11	1,91/1,46	2,23	1 700	D1	2,5 / **3,0**	**150,3**	2,5 / 2,7 / **3,0**	**150,4**
HCPA-12	1,95/1,32	2,04	1 640	D1	2,5 / **3,0**	**145,0**	2,5 / 2,7 / **3,0**	**145,1**
HCPA-13	2,01/1,59	2,55	1 810	D1	2,5 / **3,0**	**160,1**	2,5 / 2,7 / **3,0**	**160,1**
HCPA-14	2,04/1,49	2,41	1 770	D1	2,5 / **3,0**	**156,5**	2,5 / 2,7 / **3,0**	**156,6**
HCPA-15	2,10/1,45	2,42	1 810	D1	2,5 / **3,0**	**160,0**	2,5 / 2,7 / **3,0**	**160,1**
HCPA-16	2,10/1,55	2,59	1 830	D1	**3,0**	**161,6**	2,7 / **3,0**	**161,9**
HCPA-17	2,14/1,64	2,74	1 920	D1	**3,0**	**169,7**	2,7 / **3,0**	**169,9**
HCPA-18	2,16/1,62	2,80	1 920	D1	**3,0**	**169,7**	2,7 / **3,0**	**169,9**
HCPA-19	2,20/1,71	2,99	1 960	D1	**3,0**	**173,4**	2,7 / **3,0**	**173,4**
HCPA-20	2,23/1,68	2,93	1 960	D1	**3,0**	**173,4**	2,7 / **3,0**	**173,4**
HCPA-21	2,28/1,70	3,03	2 010	D3	**3,5**	**217,80**	**3,5**	**220,90**
HCPA-22	2,35/1,77	3,28	2 060	D3	**3,5**	**222,40**	**3,5**	**226,30**
HCPA-23	2,35/1,73	3,16	2 040	D3	**3,5**	**221,80**	**3,5**	**225,20**
HCPA-24	2,37/1,83	3,45	2 060	D3	**3,5**	**222,40**	**3,5**	**226,30**
HCPA-25	2,48/1,79	3,47	2 140	D3	**3,5**	**231,00**	**3,5**	**234,80**
HCPA-26	2,49/1,83	3,61	2 160	D3	**3,5**	**236,00**	**3,5**	**237,20**
HCPA-27	2,55/1,86	3,73	2 200	D3	**3,5**	**237,49**	**3,5**	**241,73**
HCPA-28	2,58/1,94	3,97	2 260	D3	**3,5**	**246,30**	**3,5**	**248,50**
HCPA-29	2,60/1,93	3,97	2 260	D3	**3,5**	**246,30**	**3,5**	**248,50**
HCPA-30	2,75/1,95	4,20	2 355	D3	**3,5**	**254,00**	**3,5**	**258,50**
HCPA-31	2,76/2,05	4,48	2 400	D3	**3,5**	**259,08**	**3,5**	**263,71**
HCPA-32	2,80/2,01	4,43	2 400	D3	**3,5**	**259,08**	**3,5**	**263,71**
HCPA-33	2,84/2,02	4,58	2 430	D3	**3,5**	**262,10**	**3,5**	**266,80**
HCPA-34	2,95/2,04	4,69	2 510	D3	**3,5**	**271,90**	**3,5**	**275,80**
HCPA-35	2,96/2,16	5,06	2 550	D3	**3,5**	**275,27**	**3,5**	**280,19**
HCPA-36	2,97/2,00	4,57	2 490	D3	**3,5**	**268,70**	**3,5**	**273,20**
HCPA-37	3,08/2,08	4,94	2 580	D3	**3,5**	**278,51**	**3,5**	**283,49**
HCPA-38	3,14/2,27	5,63	2 710	D3	**3,5**	**292,50**	**3,5**	**297,80**
HCPA-39	3,17/2,06	5,12	2 620	D3	**3,5**	**282,80**	**3,5**	**287,90**
HCPA-40	3,23/2,12	5,41	2 680	D3	**3,5**	**289,20**	**3,5**	**294,20**
HCPA-41	3,23/2,15	5,39	2 710	D3	**3,5**	**292,50**	**3,5**	**297,80**
HCPA-42	3,28/2,17	5,67	2 720	D3	**3,5**	**293,60**	**3,5**	**299,00**
HCPA-43	3,33/2,23	5,97	2 800	D3	**3,5**	**302,26**	**3,5**	**307,66**
HCPA-44	3,33/2,39	6,29	2 870	D3	**3,5**	**309,80**	**3,5**	**315,20**
HCPA-45	3,35/2,19	5,65	2 790	D3	**3,5**	**301,10**	**3,5**	**306,40**
HCPA-46	3,38/2,25	5,60	2 825	D3	**3,5**	**304,70**	**3,5**	**310,20**
HCPA-47	3,49/2,27	6,28	2 880	D3	**3,5**	**310,80**	**3,5**	**316,30**
HCPA-48	3,52/2,49	6,91	3 000	D3	**3,5**	**323,85**	**3,5**	**329,64**
HCPA-49	3,65/2,39	6,85	3 040	D3	**3,5**	**328,10**	**3,5**	**334,00**
HCPA-50	3,67/2,61	7,52	3 160	D3	**3,5**	**341,00**	**3,5**	**347,20**

* Plate thickness tolerances acc. to PN-EN 10143:2008
** Diameter of pipe before forming into pipe arch
Please contact Technical Department in case of different dimensions and plate thickness.

Tolerances

Manufacturing tolerance of HelCor® and HelCor PA length is ±0,5% of the designed length.

A gap between two pipes connected with a coupling band should not exceed 30 mm.

Manufacturing tolerances of HelCor® pipes		
Parameter	Unit	Acceptable tolerances
Diameter deviation	% of nominal diameter	± 1,5
Diameter deformation after backfilling	% of pipe diameter	± 2,0

Durability

Type of corrosion protection of HelCor® and HelCor PA pipes determines the durability of the culvert. ViaCon offers three types of corrosion protection, which allows the long term operation of the culvert in any given environmental condition in the most economical way.

Manufacturing tolerances of HelCor PA pipes		
Parameter	Unit	Acceptable tolerances
Dimensions deviation for pipe corrugation 68 x 13 (D1)	% of nominal equivalent diameter	± 2,0
Dimensions deviation for pipe corrugation 125 x 26 (D3)	% of nominal equivalent diameter	± 5,0
Dimensions deformation after backlling	% of pipe span	± 2,0

Additional corrosion protection by painting

Coating steel with a polymer film, called trenchcoating, is a technique invented, patented and used in USA since 1974 and in Europe since the beginning of 1998.

The zinc coated steel strip is covered with a polymer foil in a fully controlled in-house process. As a result a very smooth and highly adhesive layer of polymer film protects galvanized coating. Production process conforms to PN-EN 10169-1+A1:2012 (W-Protect™) and ASTM 742 (Trenchcoat™).

Trenchcoat™ film can be applied on either one or both sides of the pipe.

Protection obtained in such a process is the best way to prevent natural corrosion in zinc and steel, it also protects against mechanical damage and chemical corrosion. Research findings indicate that Trenchcoat™ film resists aggressive chemicals in excellent way.

This is the best corrosion protection that is available on the culvert market today. It guarantees over 100 years life-time in most environmental conditions.

Dielectric strength of Trenchcoat™ is 86,6 kV/mm which gives 25,9 kV for the thickness of 300 µm. This considerably outnumbers the value of the stray currents arising within the electrified railway lines sub grade.

Using Trenchcoat™ guarantees 100% protection against the corrosion that may be caused by stray currents.

In special cases it is possible to protect the galvanized pipes with the paint of the thickness up to 400µm. Please contact Technical Department of our company.

Pipe end finishing

Using HelCor® and HelCor PA pipes enables an accurate adjustment of both ends to fit the slope and in the required angle. Bevel cut can be done on one or both sides with full bevel or step bevel. It is recommended to use a vertical step of 1/3 the height of the pipe.
The embankment slopes in the in - and outlet areas can be reinforced in several ways:

Vertical end pipe:

- vertical reinforced concrete head wall
- vertical wall made of gabions

Bevel end pipe:

- reinforcement of the slope with concrete or stone blocks placed on sand-cement mix
- reinforcement with perforated concrete panels
- reinforcement with stone rip rap
- reinforcement with reinforced concrete collar

It is possible for both skewed inlet/outlet of the culvert (at the culvert and road axis intersection angle ≠ 90°) to be square or beveled. Minimum allowable skew angle is 55°.

In special cases it is necessary to make additional reinforcements in the skewed area.

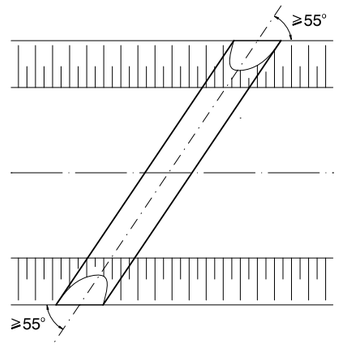


Fig. 2. Skew angle of the pipe

Cover depth

Definition of the cover depth for road structures
Cover depth can be described as a vertical distance between the top of the culvert and the road grade-line, including the road pavement.

Tab. 1. Cover depth

Type of structure	Min. cover depth
Cover depth for road structures	Hmin = max { (B/8)+0,2 [m]; B/6 [m]; 0,6 [m] }
Cover depth for railway structures	Hmin = max { B/4; 0,6 [m] }

B – diameter or pipe span [m]

Definition of the cover depth for railway structures
Cover depth for culvert under railway can be described as a vertical distance between the top of the culvert and the bottom of the railway sleeper, including the construction layers of the railroad.

In case of construction traffic occurring over the pipe the cover depth must me agreed with Technical Department of our company.

Material for bedding and backfill

- gravel, sand -gravel mix, all-in aggregates and crushed stone can be used as bedding and backfill material
- aggregate grain size depends on size of corrugation profile
- aggregate size should not exceed 31,5 mm, at the extend of (0,3 m ÷ 0,5 m) outside the pipe wall
- the use of cohesive soil, organic soil and soils included permafrost is not acceptable
- backfill material around the structure should be built in from layers of thickness 30 cm and then compacted symmetrically on both sides of the culvert
- un-uniformity coefficient $C_u \geq 4$
- curvature coefficient $1 \leq C_c \leq 3$
- permeability $k_{10} > 6$ m/day
- backfill material should be compacted to minimum 0,98 of Standard Proctor Density, but 0,95 of Standard Proctor Density - in the pipe adjacent is acceptable

Deviation from these principles requires consultation with the Technical Department of our company.

Underground detention tanks

Tanks made from HelCor® helically corrugated steel pipes manufactured by ViaCon can be used as:

- detention tanks in a gravity storm water drainage systems
- fire water tanks
- process water tanks (pH in the range from 3 to 12)
- settlement tanks for waste water pre-treatment (removal of suspended matter)
- coalescence separators for removal of petroleum derivatives from storm water

Application

As a part of the system there are also produced:
• pumping stations
• wells
• interceptors and pipelines

High strength parameters of HelCor® pipes allow building the system under a road or a car park — the minimum earth cover over the tank in vehicle traffic areas is 0.6 m, including structural layers off the pavement.

The maximum installation depth of tanks is a dozen or so meters.
A drainage system made from HelCor® pipes obtained a positive opinion of the Central Mining Institute in the scope of use in areas aff ected by mining damage of category I-IV.

Table of the chemical resistance of the Trenchcoating™ polymer coating.

Test	Test method	Result	
Resistance to 10% concentration of HCl	ASTM D1308	No reduction in the coating thickness	
Resistance to HNO_3	ASTM D1308	No reduction in the coating thickness	
Resistance to NH_4OH	ASTM D1308	No reduction in the coating thickness	
Resistance to NaOH	ASTM D1308	No reduction in the coating thickness	
Resistance to 30% concentration of H_2SO_4	ASTM D543, A742	No reduction in the coating thickness	
Resistance to NaOH	ASTM D543, A742	No reduction in the coating thickness	
Resistance to 10% concentration of NaCl	ASTM D543, A742	No reduction in the coating thickness	
Resistance to vapours SO_2	DIN 50018, 2.0L	No reduction in the coating thickness	
Resistance to chloroform (trichloromethane $CHCl_3$)	ISO 175, 28 days, 23°C	No reduction in the coating thickness	
Resistance to DMSO (dimethyl sulfoxide) $(CH_3)_2SO$	ISO 175, 28 days, 23°C	No reduction in the coating thickness	
Resistance to $MeCl_2$ (methylene chloride)	ISO 175, 28 days, 23°C	No reduction in the coating thickness	
Resistance to THF (tetrahydrofuran) C_4H_8O	ISO 175, 28 days, 23°C	No reduction in the coating thickness	
Resistance to 20% concentration of NaOH in water	ISO 175, 90 days	23°C	No reduction in the coating thickness
		80°C	8% reduction in the coating thickness
Resistance to 10% concentration of urea $CO(NH_2)_2$ in water	ISO 175, 90 days	23°C	No reduction in the coating thickness
		80°C	No reduction in the coating thickness
Resistance to 25% concentration of NH_4OH	ISO 175, 90 days	23°C	3% reduction in the coating thickness
		80°C	*
Resistance to 25% concentration of H_2SO_4	ISO 175, 90 days	23°C	No reduction in the coating thickness
		80°C	*
Resistance na 20% concentration of HNO_3	ISO 175, 90 days	23°C	No reduction in the coating thickness
		80°C	*
Resistance to isopropanol $(CH_3)_2CHOH$ (isopropyl alcohol)	ISO 175, 90 days	23°C	4% reduction in the coating thickness
		80°C	**
Resistance to acetone $CO(CH_3)_2$ (propanone)	ISO 175, 90 days	23°C	No reduction in the coating thickness
		80°C	**
Resistance to ethyl acetate $CH_3CO\text{-}O\text{-}C_2H_5$	ISO 175, 90 days	23°C	3% reduction in the coating thickness
		80°C	**
Resistance to toluene $C_6H_5(CH_3)$ (metylobenzen)	ISO 175, 90 days	23°C	4% reduction in the coating thickness
		80°C	Complete destruction of the coating
Resistance polyethylene glycol $C_{2n}H_{4n}+2O_{n+1}$	ISO 175, 90 days	23°C	No reduction in the coating thickness
		80°C	4% reduction in the coating thickness
Resistance to aircraft deicing fluid: - Clearway F1 -20% concentration of Nordway NA	ISO 175, 28 days	23°C	No reduction in the coating thickness

* – the test has not been carried out due to the emission of hazardous gases when heating NH_4OH, H_2SO_4, HNO_3 to the temperature of 80°C;
** – the test has not been carried out due to exceeding the boiling point when heating $(CH_3)_2CHOH$, $CO(CH_3)_2$, $CH_3CO\text{-}O\text{-}C_2H_5$ to the temperature of 80°C;

The tanks are manufactured with internal diameters to 3600 mm, while the maximum length of a single element is 16 m. This means that it is possible to manufacture a single tank with a volume of over 150 m^3 without a necessity of assembling it from elements at the construction site. In other arrangements, individual elements are joined together with the use of flange connections that ensure complete leak tightness of the system.

All tank elements are protected against corrosion in the factory through hot dip galvanizing with a coating thickness of 42 µm, and additionally by the Trenchcoating™ polymer coating with a minimum thickness of 300 µm. The protection ensures resistance of coatings to corrosive action of waste water in the pH range from 3 to 12. There is no need to make additional protection of the tank surface.

Detailed data are presented in the table showing the chemical resistance of the Trenchcoating™ polymer coating.

Production of the tanks includes manufacture of the tank body, bottoms, inspection shafts with ladders, inlet and outlet stub pipes, and connections between tanks. The tanks are manufactured in sections with a length up to 16 m and are joined at the construction site with the use of a flange connection with a gasket.

Tank bottoms are made of flat metal plates reinforced with ribs depending on the depth of tank foundation and the surcharge loads (earth pressure on the bottom). Both steel flanges and bottoms are made and welded to the pipe in the factory. After passing the leak tightness test, they are protected against corrosion by painting with high-zinc paint and additionally with a sealing agent. The anti-corrosion protection of welded joints allows obtaining the same durability as that of HelCor® pipes. The connection system guarantees 100-percent leak tightness of the tank.

Tanks should be installed on an aggregate foundation with a minimum thickness of 30 cm, on a 10 cm thick sand bed — in order to sink the pipe corrugation. In the case of a high level of groundwater, the state of equilibrium should be checked, considering the uplift of the tank caused by hydrostatic pressure of groundwater. If necessary, additional anchoring or loading of the tank should be provided for.

The backfill of the tank should be laid symmetrically on both its sides in layers with a thickness of 30 m, and then compacted to a degree of compaction Is ≥ 0.98 according to the standard Proctor test (Is ≥ 0.95 is allowed in close proximity of the tank).

Because of a low weight and large lengths of individual elements, as well as due to the fact that no reinforced concrete foundations are required, the proposed technology of building underground detention tanks from HelCor® pipes can significantly shorten the construction times, which is important in the case of a high level of groundwater. Thanks to high strength parameters and the proposed anticorrosion protection, tanks made from HelCor® pipes can be built practically in all groundwater conditions.

MultiPlate MP200

MULTIPURPOSE TECHNOLOGY

MultiPlate MP200 structures are used for road and railways and industrial applications such as:

- culverts
- bridges
- overpasses
- tunnels
- underpasses
- ecological crossing
- hangars
- shelters
- warehouses
- belt conveyor protection
- protection of pipes and heat-pipes
- sewage and liquid tanks
- storage bins

Application

The corrugated steel structures are used in civil engineering for over 100 years. The first application of this type of construction has taken place in North America and Russia, where the idea of using them in road and rail construction was born.
Today, buried corrugated steel structures are widely used in construction around the world. Structures of this type due to the nature of their work, are often referred to flexible structures.

Soil-steel interaction means that corrugated steel structure will interact with the surrounding backfill to the loads. They are cheap, easy and quick to build. The average installation time with a few people installation team takes few days.

MultiPlate MP200 structures are used in Poland since mid 90-ties, and the company ViaCon Sp. z o.o. producing them since 2005.

Approvals and Certificates:

- MultiPlate MP200 has the CE Certificate of Factory Production Control No. 1023-CPD-0447 F according to PN-EN 1090-1:2012
- AT/2012-02-2868
- AT/2007-03-0247/1
- Technical opinion of the Central Mining Institute (GIG):

Typical sequence for construction of MultiPlate MP200 structure consist of:

- foundations
- delivery
- assembly
- backfilling
- finishing work

MultiPlate MP200 structures have many advantages such as:

- simply design due to fewer details, drawings and calculations database for standard application
- easy and fast assembly
- possibility to assembly in temperature below zero
- possibility to assembly structures without stopping traffic
- possibility to assembly in total or partial prefabrication of the structures
- due to lightweight, corrugated steel plates can be delivered easily and economically to remote locations
- reduction in total time and cost of building the structures

Production

The process of MultiPlate MP200 production consists of mechanical forming of steel flat plates to the shape of corrugated curved plates which are later hot-dip galvanized.
Corrugated plates can be epoxy painted on request.
Whole process is located indoor.

Steel used for production of MultiPlate MP200 conforms to PN-EN 10025 and PN-EN 10149
Steel grade: S235JR, S355J2 or S355MC
Yield strength for this steel is 235 MPa and 355 MPa.

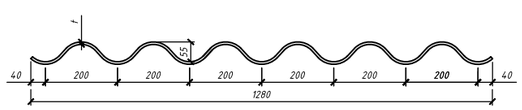


Fig.1. Cross section of MultiPlate MP200 plate

Standard length of plate is n × s + 130, where s=235 mm, and n= 4 ÷ 10. Standard width of plate is 1,2 m (m=6). Other plate widths are available upon request (Fig. 2.).

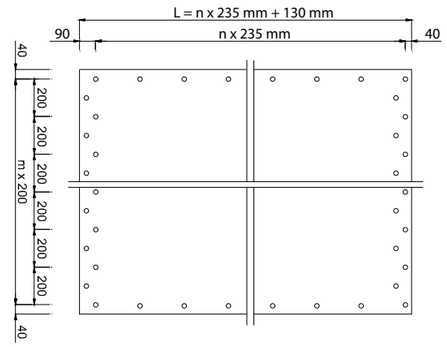


Fig. 2. Geometry of MultiPlate MP200 plate

Tab. 1. Geometrical parameters of MultiPlate MP200 plate

Plate thickness [mm]	Yield strength [MPa]	Area [mm²/mm]	Moment of inertia [mm⁴/mm]	Section modulus [mm³/mm]
3,00	235 / 355	3,55	1 356,36	46,77
4,00	235 / 355	4,74	1 813,80	61,49
5,00	235 / 355	5,93	2 316,15	77,20
6,00	235 / 355	7,11	2 787,57	91,40
7,00	235 / 355	8,29	3 213,20	103,65
8,00	235	9,37	3 616,77	114,82

Other plate configurations are available upon request. Selection of plate thickness depends on structure shape, span, depth of cover and live load. Please take the opportunity to consult with our Technical Department for advice and assistance on your project.

Bolts, nuts, anchor bolts

Corrugated steel plates are joined by bolts M20 class 8.8. or 10.9. The lengths of the bolts are related to thickness of connected plates and type of connection.

There are two types of bolt heads (Fig. 3) – oval-shaped and cone-shaped at dimensions: 32 mm, 37 mm, 45 mm, 50 mm, 63 mm, 70 mm.

Bolts diameter of 20 mm and nuts correspond to the requirements norm of PN-EN ISO 898-1 and PN-EN 20898-2.

Anchor bolts with a diameter of 20 mm and length of 225 mm or 365 mm made of steel corresponding to the requirements of PN-EN 10025-2.

All above mentioned elements are delivered together with corrugated plates as a complete structure.

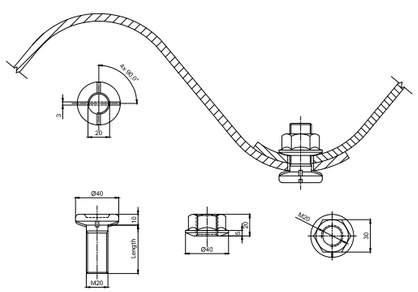


Fig. 3. Bolt connection of the structure

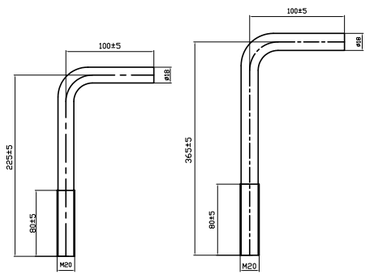


Fig. 4 Anchor bolts used to mount structure in foundation

Corrosion protection

Coatings applied by immersion, including hot-dip galvanizing are the most durable protection of steel surfaces, mainly due to produce a lasting connection of dip zinc coating with the steel surface. The protection of structures both by hot-dip galvanizing and epoxy paint creates ViaCoat system conformed to PN-EN ISO 12944-5. Standard use is epoxy paint, but surfaces exposed to UV rays should be painted with polyurethane paint as a top layer. It is recommended to use a coating thickness of 80÷200 µm. Coating thickness can be increased, if required by the assumed structures durability.

Tab. 2. Zinc layer

Characteristics	Requirements acc. PN-EN ISO 1461	
	Minimal local zinc coating thickness [µm]	Minimal average zinc coating thickness [µm]
Steel plate: >6 mm >3 mm to ≤6 mm ≥1,5 mm to ≤ 3 mm	 70 55 45	 85 70 55
Bolts, nuts, anchor bolts	40	50

Paint coat thickness is controlled by PN-EN ISO 2808. Minimum adhesion of the epoxy paint to the zinc base measured by pull - off method should not be less than 4 MPa, and control test is conducted according to the norm PN-EN ISO 4624. In order to obtain the right adhesion galvanized plates are sweep blast prior to application of paint. In order to obtain the proper protection effect, paint coatings are applied in special conditions.
Keeping a technological regime is crucial for successful performance of the protection system.

Design

Design process with using MultiPlate MP200 structure includes the following:

- design of MultiPlate MP200 structure (including assembly and backfilling procedure)
- design of engineered backfill
- design of foundation
- design of in and outlet fittings elements

MultiPlate MP200 structures are designed for all road and railway live load classes according to Eurocode EN 1991-2 or according to nationals standards. They also meet requirement of AASHTO and CHBDC and other national standards for corrugated steel structures in the world.

Dimensioning

MultiPlate MP200 structures are dimensioned using Swedish design method, developed by Prof. Sunquist and Prof. Pettersson.

They can also be designed with the use of the other methods like e.g. CHBDC, AASHTO. In complex cases finite element method (FEM) can be used.

Selection of structure cross section

In order to select a typical shape of a structure, please use tables provided on CD. These tables include standard shapes. Other shapes are available upon request.

A profile of a structure should fit to clearance box. Allow for tolerances of structure dimensions.

Cover depth

Definition of the cover depth for road structures

Vertical distance between top of a steel structure main barrel and top of the pavement including the pavement layer.

Tab. 3. Cover depth

Type of object	Min. cover depth
Structures under roads	Hmin = max { (Si/8)+0,2 [m]; Si/6 [m]; 0,6 [m] }
Structures under railway	Hmin = max { Si/4; 0,6 [m] }

Si – span of the structure [m]

In case of construction (technological) traffic is assumed over a structure the cover depth must be agreed with Technical Department of ViaCon.

Definition of the cover depth for rail structures

Vertical distance between top of a steel structure main barrel and bottom of railway sleeper.

Lover cover depth is permissible when appropriate static calculations are conducted. Maximum depth of a cover is always designed individually.

For high cover depth load reduction techniques are available.

Geometry of a structure in longitudinal direction

Bottom length of MultiPlate MP200 structures should conform to the following formula:

$$L_d = 40 + n \times 1200 + 40 \text{ [mm]}$$

where n – number of full rings alongside length

Top length of a structure is determined individually (in and outlets).

Ends of MultiPlate MP200 structures can be squared or beveled to match the embankment slope (Fig.5). For structure curved in plane use bends to align to designed curvature.

Depending on whether the structure is completed straight or bevel cut in accordance with the inclination of the slope, there are different finish solutions for inlet and outlet of the construction.

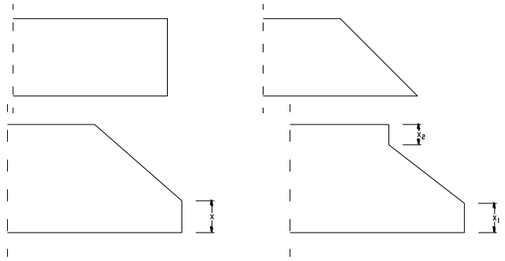


Fig. 5. End finishes for MultiPlate MP200 structures

If the structure is ended straight (square end) it is necessary to build headwalls constantly connected with the structure. For the construction of beveled ends in accordance with the inclination of the slope, it is necessary to finish the slope by paving the slopes or, natural grass finish or other erosion control methods, encased of gabions.

Skew angles

Minimum permissible angle for skewed ends is 55°. Concrete collars are used for large skews. Steel meshes attached to MultiPlate MP200 structure can be also used for skewed areas.

Please contact Technical Department for advice.

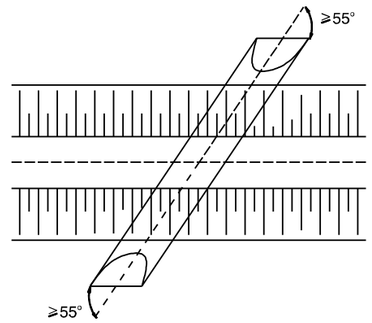


Fig. 6. Skewed structure

Concrete collar

Concrete collar is used:

- in order to stiffen inlet and outlet of MultiPlate structure with beveled ends
- as finishing element used as support of end treatment

Concrete collar is applied mostly in following cases:

- structures with skew angles to the road axis, when skew angle on outlet and inlet is ≤ 65° and span is > 3,5 m
- structures exceed 6,0 m span
- large skews

For smaller objects which do not meet the above criteria, stiffened collar or types of finish may also be used, depends on designer decision.

Multiple installation

For multiple structure installation, the smallest clear spacing between adjacent structures should be sufficient for the placement and compaction of soil. The minimum spacing requirement depends upon the shape and size of structures. When the required distance cannot be achieved, space between structures should be filled with C12/15 concrete or cement stabilized soil to the level where the distance between structures is not less than 10% of structure span. Exceptions to the above are possible after consultation with Technical Department of the company.

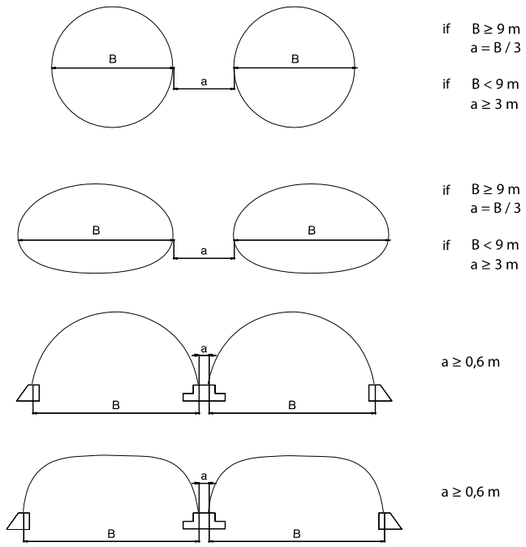


Fig. 7 Minimum clear spacing for multiple installations

Foundation

MultiPlate MP200 structures with closed shapes (round, elliptical, pipe-arch) are placed on soil bedding as follow:

- thickness of soil bedding – min. 30 cm
- top portion of the bedding should be shaped to fit to the bottom plates of a structure
- particular care should be exercised in compacting soil under haunches – about 5-15 cm layer of the bedding should be relatively loose material so that the corrugation can seat in it

MultiPlate MP200 structures with open shapes are placed on concrete (Fot. 2) or flexible (Fot. 3) footings.

For mounting the structure on the rock foundation a flat steel plate bolted to the plate is used (Fot. 1).

Deviation from these principles requires consultation with the Technical Department of our company.

Fot. 1. Flat steel mounting to the structure with an open cross-section

Fot. 2. Connection of MultiPlate MP200 structure with concrete footing

Fot. 3. Connection of MultiPlate MP200 structure with flexible footing

Material for bedding and backfill

- gravel, sand -gravel mix, all-in aggregates and crushed stone can be used as bedding and backfill material
- aggregate grain size depends on size of corrugation profile and for 200 x 55 corrugation should have max 42 mm size in the direct vicinity of structure
- the use of cohesive soil, organic soil and soils included permafrost is not acceptable
- backfill material around the structure should be placed in layers of 30 cm thick and then compacted symmetrically on both sides of the structure
- un-uniformity coefficient $Cu \geq 4$
- curvature coefficient $1 \leq Cc \leq 3$
- permeability k10 > 6 m/day
- backfill material should be compacted to minimum 0,98 of Standard Proctor Density, but 0,95 of Standard Proctor Density in the structure adjacent is acceptable

Deviation from these principles requires consultation with the Technical Department of our company.

End treatment (inlet/outlet)

End treatment depends on the way the ends of the structure are cut (Fig 5). For beveled ends, slopes can be finished by paving with stones blocks, etc. For bevel ends with gabion mattress, waterproof solutions must be applied.

As an alternative to concrete headwall MSE walls for instance ViaWall (retaining wall with the face from a reinforced concrete panel with galvanized steel reinforcing mesh or reinforced concrete panel with uniaxial PEHD geogrid) or ViaBlock® system (a retaining wall with the face from concrete blocks) or gabions can be applied.

The ground around the MultiPlate MP 200 construction can be reinforced with using steel or geosynthetic reinforcing meshes.

Construction protection against rainwater

In order to preserve structures against rain water that can infiltrate through backfilling it is necessary to make suitable protection. For that purpose a layer of 1,0 mm HDPE geomembrane enclosed by two layers of CBR>5KN non-woven should be placed over steel structures. For some overpasses this "umbrella" was made with the use of two layers of bentonite mat (geosynthetic clay layer).

Exceptions to the above are possible after consultation with Technical Department of our company. Placing the membrane directly on the structures is allowed with provisions for protection layers applied.

Durability

Following factors have an influence on structure's durability:

- aggressiveness of an environment
- abrasion
- corrosion protection
- plate thickness
- quality and frequency of maintenance of the structures in service

Procedure of calculating durability of MultiPlate MP 200 structures

- define the function of a structure
- define the required durability of a structure
- define the aggressiveness of the environment (water, backfill, air)
- select the type of a structure specify the plate thickness based on static calculations (acc. to Sundquist-Petterson method)
- specify the corrosion protection (thickness of zinc coating, paint coating, extend of painting, painting procedure)
- define annual loss of the protection layers in upper and lower part of a structure
- calculate the structure durability by considering corrosion progress over service lifetime

In cases, when the durability of MultiPlate MP200 structure is not enough, following measures can be taken:

- change the corrosion protection (thickness of zinc layer, paint coat)
- increase the plate thickness
- reduce the design effort (through, for example, a change of overburden)
- change the construction shape (example use oval shape)
- re-calculate the durability and compare with required

Durability of ViaCoat system is higher than sum of durability of the protection of each layers and can be calculated as:

$$S_D = \alpha (S_C + S_Z)$$

where:

- S_D – total durability of the protection layer
- S_C – durability of zinc coat
- S_Z – durability of paint coat
- α – synergy factor (from 1,5 to 2,0) for 200 µm thick paint layer α =1,5, for 400µm thick paint layer - α = 1,75

Relining

MultiPlate MP200 structures are also commonly used to repair old culverts or bridges where there are no possibilities to build a new one. The method is called relining. Corrugated steel structure is placed inside the existing structure (bridge/culvert/underpass) and space between an old facilities and a new structural plate is filled with concrete class of min. C16/20. This method allows to strengthen the structures without any traffic stops and eliminates the necessity to tear down the remaining the old structure.

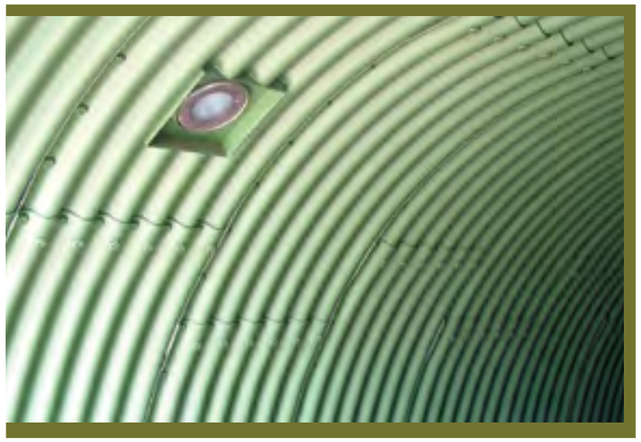
The control of pouring concrete between existing structure and new steel structure should be done by revision holes. During pouring concrete it is necessary to control deformation of MultiPlate MP200.

In case of open shapes structures, when relining will be used it is necessity to make footings which could be connected to existing one. Existing footings can be used also but it will require separate analysis or expertise.

Fittings

MultiPlate MP200 structures can be equipped with additional elements depending on function of the structure e.g.:

- lighting boxes
- ventilation
- niche
- skylight
- connector pipes
- shelves for animals
- technical hotels
- others



SuperCor®

A NEW GENERATION OF BRIDGES

Source: Autostrada Wielkopolska

SuperCor® versatile structures are used for roads and railways and industrial applications as well as for reinforcement and reconstruction of existing structures such us:

- bridges
- overpasses
- tunnels
- culverts
- underpasses
- pedestrian tunnels
- ecological crossings, hangars
- shelters
- underground storages
- belt conveyor protection

Application

SuperCor® structures are the new generation of flexible structures made of galvanized corrugated steel plates of a very high stiffness.

To take the loads, those structures use interaction with surrounding backfill soil. The load capacity of SuperCor® is far higher than traditional structures made of corrugated steel. SuperCor® structures are used for building engineering objects above and under roads and railways. Spans can reach 25 m.

Structures are simple and easy to assembly. Average assembly time takes a few days in assistance with small crew.

The beginning of SuperCor® use dates back to the middle of 80' in 20th century. Nowadays they have been used in many countries all over the world; in Poland ViaCon has been producing SuperCor® structures since 2008.

SuperCor® structures are designed for all road and railway live load classes according to Eurocode EN 1991-2:2003 or according to nationals standards.

Approvals and Certificates:

- SuperCor® has the CE Certificate of Factory Production Control No. 1023-CPD-0447 F according to PN-EN 1090-1:2012
- AT/2005-03-0879
- Technical opinion of the Central Mining Institute (GIG):

Typical sequence for construction of SuperCor® bridges:

- foundations
- delivery
- assembly
- backfilling
- finishing works

SuperCor® structures have many advantages over traditional bridge solutions:

- simple design due to fewer details, drawings and calculations database for standard application
- easy and fast assembly
- possibility to assemble in temperatures below zero
- possibility to assemble structures without stopping traffic
- possibility to assemble with partial or total prefabrication of structures
- due to lightweight, corrugated plates can be delivered easily and economically to remote locations
- reduction in total time and cost of building a bridge

The process of SuperCor® production consists of mechanical forming of steel flat plates to the shape of corrugated curved plates which are later hot-dip galvanized.
Producing of holes, cutting is done prior to galvanizing.

Corrugated plates can be epoxy painted on request. Whole process is located indoor. Steel used for production of SuperCor® conforms to PN-EN 10149-2 or PN-EN 10025-2, Steel grade S315MC, S355 MC, S420MC. Yield stress for this steel is min. 315 MPa.

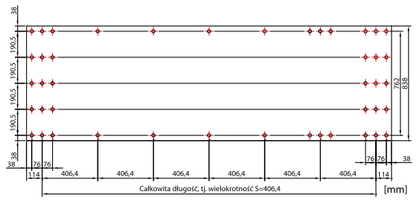


Fig. 1. Geometry of SuperCor® plate (total length, i.e. multiple S=406,4 mm)

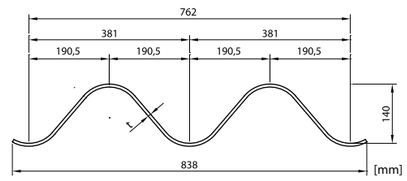


Fig. 2. Cross section of SuperCor® plate

Tab. 1. Geometrical parameters of SuperCor® plate.

Plate thickness [mm]	Area [mm2/mm]	Moment of interia [mm4/mm]	Section moduls [mm3/mm]
5,5	6,968	17 141,15	235,62
7,0	8,867	21 897,45	297,92
8,0	10,62	24 434,60	330,20

Other plate configurations are available upon request. Selection of plate thickness depends on structure shape, span, depth of cover and live load. Before you specify any of SuperCor® structures, please take the opportunity to consult with ViaCon Technical Department for advice and assistance on your project.

Bolts, nuts, anchor bolts, base channels

Corrugated steel plates are joined by bolts M20 (class 8.8).

The lengths of bolts are related to thickness of connected plates and type of connection.

There are two types of bolt heads oval – shaped and cone – shaped at dimensions of 50 mm, 63 mm, 70 mm.

All joint elements mentioned above are delivered in marked boxes together with the structure.

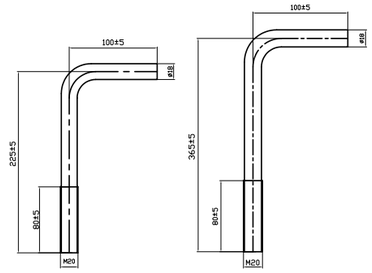


Fig. 3 Anchor bolts used to mount structure in foundation

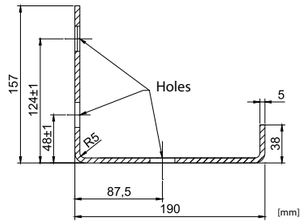


Fig. 4. Base channel used to connect structure to foundation

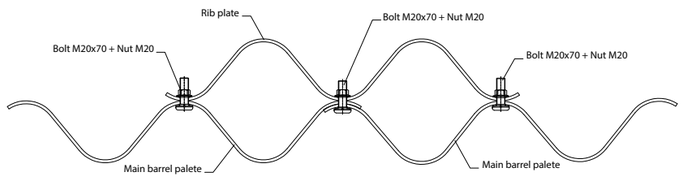


Fig. 5.Connection of ribs to main barrel plates

Corrosion protection

Hot –dip galvanizing is the most durable method of corrosion protection. In order to extend the durability of SuperCor® structures, especially in an aggressive environment, there is a possibility to apply an additional corrosion protection by applying epoxy paint.

Corrosion protection of SuperCor® structures is made in a production plant and consists of:

- hot-dip galvanizing of steel plates and additional fitting elements
- epoxy painting galvanized plates (if specified additionally)

SuperCor® structures are protected by hot-dip galvanizing as a standard, with zinc coating layer according to EN ISO 1461. Other thickness of zinc layer is possible on request. The protection of structures both by hot-dip galvanizing and epoxy paint creates ViaCoat system conformed to EN ISO 12944-5.
Paint coat thickness is controlled by EN ISO 2808. Minimum adhesion of the epoxy paint to the zinc base measured by pull - off method shouldn't be less than 4 MPa, and control test is conducted in acc. to the norm PN-EN ISO 4624.
In order to obtain right adhesion galvanized plates are sweep blasted prior to application of paint. In order to obtain the proper protection effect, paint coatings are applied in special conditions i.e. inside of closed halls with controlled temperature, humidity. Keeping a technological regime is crucial for successful performance of the protection system.

Tab. 2. Zinc layer

Characteristics	Requirements acc. to PN-EN ISO 1461	
	Minimal local zinc coating thickness [µm]	Minimal average zinc coating thickness [µm]
Steel plate: >6 mm >3 mm to ≤ 6 mm ≥1,5 mm to ≤ 3 mm	 70 55 45	 85 70 55
Bolts, nuts, anchor bolts	40	50
Base channel	55	70

Design

Design process includes the following:

- design of SuperCor® structure (including assembly and backfilling procedure)
- design of engineered backfill
- design of foundation
- design of in and outlet fitting elements

Design algorithm

SuperCor® structures are designed for all road and railway live load classes according to Eurocode EN 1991-2 or according to nationals standards. They also meet requirement of AASHTO and CHBDC and other national standards for corrugated steel structures in the world.

Selection of cross-section shape

In order to select a typical shape of a structure please use tables provided on request. These tables include standard shapes.

Other shapes are available on request. A profile of a structure should fit to a clearance box. Allow for tolerances of structure dimensions.

Cover depth

Definition of the cover depth for road structures
Vertical distance between top of a steel structure main barrel and top of the pavement including the pavement layer.

Definition of the cover depth for rail structures
Vertical distance between top of a steel structure main barrel and bottom of railway sleeper.
Lover cover depth is permissible when appropriate static calculations are conducted. Maximum depth of a cover is always designed individually.
For high cover depth load reduction techniques are available.

Tab. 3. Cover depth

Type of construction	Min. cover depth
Box structures	0,45 ≤ H ≤ 1,5 [m]
Other construction	H = 0,1 × B [m]

Minimum cover depth also depends on the thickness of the pavement layer (Gn) and should not be less than:

$$H = Gn + 0{,}15\ [m]$$

Lover cover depth is permissible when appropriate static calculations are conducted. Maximum depth of a cover is always designed individually. For high cover depth load reduction techniques are available.

In case of construction (technological) traffic is assumed over the structure the cover depth must be agreed with Technical Department of ViaCon company.

Geometry of a structure in longitudinal direction

Bottom length of SuperCor® structures should conform to the following formula:

$$L_d = 38 + n \times 762 + 38 \text{ [mm]}$$

where n – number of full rings alongside length

Ends of SuperCor® structures can be vertical or beveled to match the embankment slope (Fig. 6). For beveled ends minimum X-step is 0,16 m. For structures curved in plane use bends to align to designed curvature.

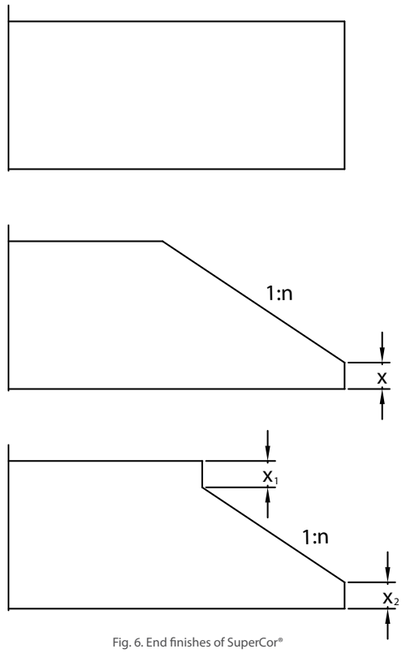


Fig. 6. End finishes of SuperCor®

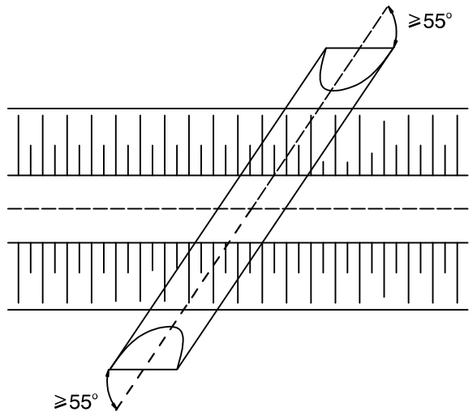


Fig. 7. Skewed structure

Skew angles

Minimum permissible angle for skewed ends is 55°. Concrete collars are used for large skews.
Steel meshes attached to SuperCor® structure can be also used for skewed areas.
Please contact Technical Department for advice.

Reinforcing ribs

Reinforcing ribs should be used when flexural capacity of the section is exceeded. Ribs can be used for all shapes of structures.

Reinforcing ribs:
in cross section (Fig. 8)

- in haunch and crown
- on whole perimeter

longitudinal section (Fig. 9)

- continuous –placed on the whole top length of the structure
- spaced at intervals of 762 mm, 1143 mm or 1524 mm

In order to get a bigger capacity, space between main barrel and reinforcing ribs can be filled with concrete (EC ribs).

The use of EC ribs can be necessary for large span structures. C25/30 concrete is used as filling acc. to EN 206-1:2000. Thanks to such a solution used for arch structures, bigger cross sectional area is achieved, which leads to decrease of compression stresses in steel wall.

For boxes, higher flexural capacity is reached by connecting ribs to the main barrel.

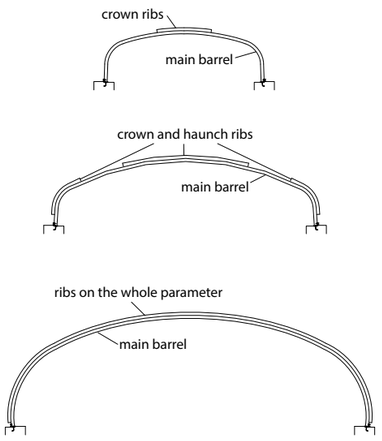


Fig. 8. Placement of the ribs in cross section of the structure

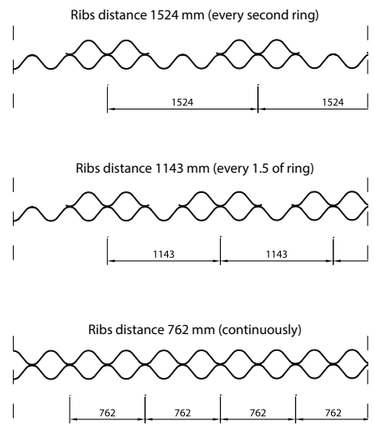


Fig. 9. Placement of the ribs in longitudinal direction of the structure

Multiple installation

For multiple structure installations, the smallest clear spacing between adjacent structures should be sufficient for the placement and compaction of soil (page 44 Fig. 7).

The minimum spacing requirement depends upon the shape and size of structures.

When the required distance cannot be achieved, space between structures should be filled with C10/15 concrete or cement stabilized soil to the level where the distance between structures is not less than 10% of structure span. Please contact Technical Department for advice.

Foundation

SuperCor® structures with closed shapes (round, elliptical, pipe-arch) are placed on soil bedding as follows:

- thickness of soil bedding – minimum 60 cm
- top portion of the bedding should be shaped to fit to the bottom plates of a structure
- particular care should be exercised in compacting soil under haunches
- upper 15 cm layer of the bedding should be relatively loose material so that the corrugation can seat in it

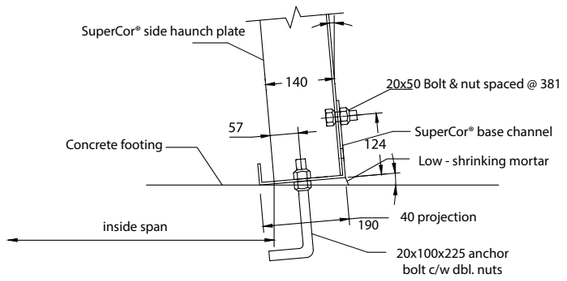


Fig. 10. Connection of SuperCor® structure with concrete footing

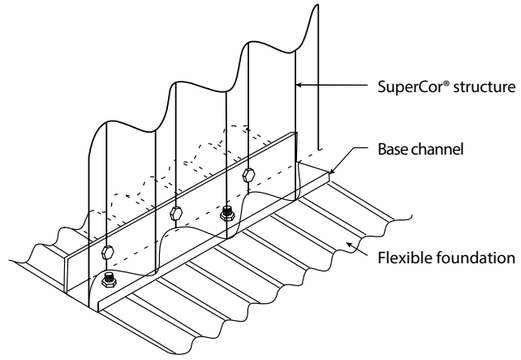


Fig. 11. Connection of SuperCor® structure with steel footer pads of a full steel invert

SuperCor® structures with open shapes (arches, boxes) are placed on concrete footings, steel footer pads or a full steel invert.
Connection of the structure to the concrete footings is realized by the means of anchor bolts, taking the following into account:

- anchor bolts for concrete foundations to be installed in concrete footings prior to delivery of a SuperCor® structure
- anchor bolts should not stick out from the top of the footing more than 40 mm
- placing of anchor bolts should conform to assembly drawing; the allowable tolerance is ±3 mm in longitudinal direction and ±2 mm in the transverse direction
- to minimize a risk of mistake, the location of each anchor should always be measured from the starting point (first anchor)
- parallel placement of anchor bolts on each footing and perpendicular placement of each pair of anchor bolts for individual rings are of great importance; better accuracy, easier assembly of the structure

Material for bedding and backfill

- gravel, sand -gravel mix, all-in aggregates and crushed stone can be used as bedding and backfill material
- aggregate grain size depends on size of corrugation profile and for 380 x 141 mm corrugation should have 0-120 mm grain size in the direct vicinity of the structures
- the use of cohesive soil, organic soil and soils included permafrost is not acceptable
- backfill material around the structure should be placed in layers of 30 cm thick and then compacted symmetrically on both sides of the structure
- un-uniformity coefficient Cu ≥ 4
- curvature coefficient 1 ≤ Cc ≤ 3
- permeability k10 > 6 m/day
- backfill material should be compacted to minimum 0,98 of Standard Proctor Density, but 0,95 of Standard Proctor Density in the adjacent to the structure is acceptable

Deviation from these principles requires consultation with the Technical Department of our company.

Rainwater protection of the structure

In order to protect the corrugated steel structure against rainwater which might penetrates embankment we recommend to use three layers "umbrella" (CBR>5KN nonwoven + 1 mm geomembrane + CBR>5KN nonwoven), 10-15 m above the structure, which will efficiently cut-off water penetration.

Geomembrane provides water isolation and non-woven above and under geo-membrane protect this geo-membrane against damages during backfilling and compaction process. Placing the membranes directly on the structures is allowed with provisions for protection layers applied.

In order dewater structures, we recommend to use drainage pipes in both ends, parallel to the axis of the structure.

End treatment (inlet/outlet)

End treatment depends on the way the ends of structure are cut.

For beveled ends, slopes can be finished by paving with stones blocks, etc.

For bevel ends with gabion mattresses, waterproof solutions must be applied.

As an alternative to concrete headwalls MSE like ViaWall or ViaBlock® system (look at page No 93) or gabions can be applied.

Concrete collar

Concrete collar is used:

- in order to stiffen inlet and outlet of SuperCor® structure with beveled ends
- as finishing element used as support of end treatment

Concrete collar is applied mostly in following cases:

- structures with skew angles to the road axis , when skew angle on outlet and inlet is ≤ 65° and span is > 3,5m
- structures exceed 6,0 m span
- large skews

In other cases concrete collar can be used as support for slope pavement.

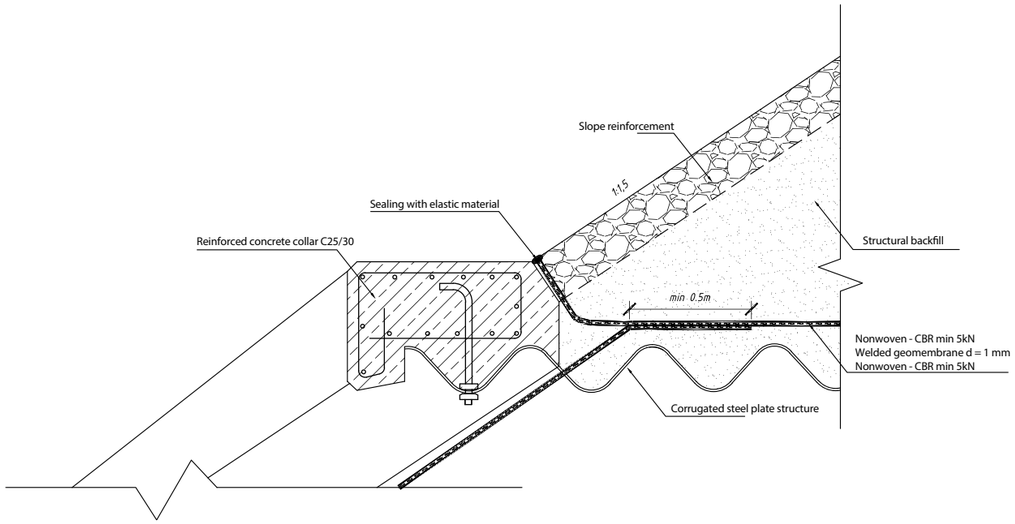


Fig. 12. Example of a concrete collar on inlet and outlet of the structure

Durability

Hot-dip galvanization is a basic anti-corrosion protection of SuperCor® structures. Durability of SuperCor® structures can extend over 100 years.

SuperCor® structures are hot-dip galvanized according to EN ISO 1461.

If necessary, SuperCor® structures can be provided with an extra layer of zinc or additional corrosion protection by epoxy coating called ViaCoat. These solutions are applied for aggressive environments.

In most cases the extend of corrosion protection by epoxy coating is as follows:

- inside and/or outside on the whole area of a structure
- at inlet and outlet of the structure (1,5 m inside the structure)
- inside up to 0,5 m above mean water level
- as a combination of above mentioned

Most common thickness of epoxy paint is 200 µm, however other thicknesses are possible.

Following factors have an influence on structure's durability:

- aggressiveness of an environment
- application of structure
- draining solutions
- abrasion
- installation damages
- corrosion protection
- plate thickness
- quality and frequency of maintenance of the structures in service

Procedure of calculating durability of SuperCor® structures:

- define the function of a structure
- define the required durability (lifetime) of a structure
- define the aggressiveness of the environment (water, backfill, air)
- select the type of a structure
- specify the plate thickness based on static calculations (acc. to Sundquist-Petterson method)
- specify the corrosion protection (thickness of zinc coating, paint coating, extend of painting, painting procedure)
- define annual loss of the protection layers in upper and lower part of a structure
- calculate the structure durability by considering corrosion progress over service lifetime
- compare calculated durability with the required
- adjust the anticorrosion solution and if required repeat the calculations

In cases, when the durability of SuperCor® structure is not enough, following measures can be taken:

- change corrosion protection (thickness of zinc layer, paint coat)
- increase the plate thickness
- adjust the shape of a structure and section stiffness to allow for more corrosion reserve

Durability of the ViaCoat system is higher than sum of durability of the protection layers and can be calculated as:

$$S_D = \alpha (S_C + S_Z)$$

where:

S_D – total durability of the protection layer [years]

S_C – durability of zinc coat [years]

S_Z – durability of the epoxy coat [years]

α – synergy factor (from 1,5 to 2,5) for 200 µm thick paint layer α = 1,5; for 400 µm thick paint layer α = 1,75

During the transportation and installation, the coating zinc layer may be damaged. The repair of such damage is done at site after structure is assembled.

Relining

SuperCor® structures are also commonly used to repair old bridges where there are no possibilities to build a new one. This method is called relining.

Corrugated steel structure is placed inside the existing structure (bridge /culvert / underpass) and space between an old bridge / culvert and new structural plate is filled with concrete C12/15. This method allows to strengthen the structures without any traffic stops and eliminates the necessity to tear down the remaining old structure.

The control of pouring concrete between existing structure and new steel structure should be done by revision holes. During pouring concrete it is necessary to control deformations of SuperCor®.

In a case where so called"open" shapes will be used for relining there is a need to make concrete footings which could be connected to existing one. Existing footings can be used also but it will require separate analysis or expertise.

Researches made in the years 2000-2007 confirmed increasing of capacity of relined structures.

Fittings

SuperCor® structures can be equipped with additional elements depending on function of the structure e.g.:

- lighting boxes
- ventilation
- niche
- shelves for animals
- technical holes
- skylight
- connector pipes
- others

UltraCor®

THE NEWEST GENERATION OF FLEXIBLE STRUCTURES

UltraCor® structures are used for roads and railways and industrial applications as well as for reinforcement and reconstruction of existing structures such us:

- bridges
- overpasses
- tunnels
- culverts
- underpasses
- pedestrian tunnels
- ecological crossings
- hangars
- shelters
- underground storages

Application

UltraCor® structures are the newest generation of flexible structures with the world's deepest corrugation profile. UltraCor® combines all the advantages of lightweight construction with previously unheard-of strength and durability to create the largest corrugated metal structures in the world today.

UltraCor® structures are used for building engineering objects above and under roads and railways.

Approvals and Certificates:

- CE Certificate according to norm PN-EN 1090-1.

Typical sequence for construction of SuperCor® bridges:

- foundations
- assembly
- backfilling
- finishing works

Depth (H) = 240 mm
Pitch (P) = 500 mm
Plate thickness (t) = 7 mm, 8 mm, 9,5 mm, 12,5 mm

Fig. 1. UltraCor parameters

Design features:

- The world's strongest corrugated steel plate
- Handles extreme loadings
- Spans can exceed 30 m (98')
- Available in: Box Culverts and Standard, Low, Medium, or High Profile Arches
- Easy and fast assembly

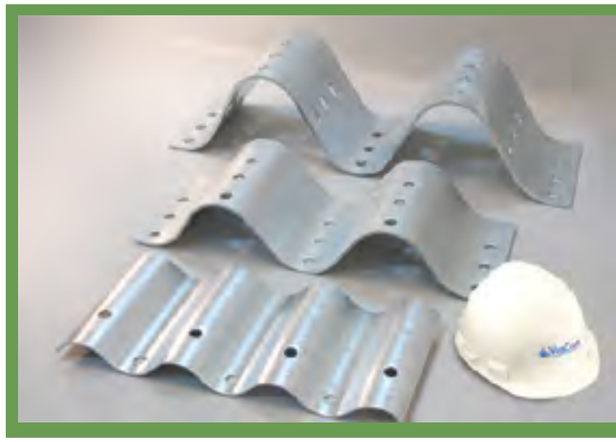
Benefits of installing UltraCor structures:

- Wider Spans
- Higher Covers
- Wider range of designing of backfilling height over the structure
- Lower installation costs

UltraCor®

SuperCor®

MultiPlate MP200



Fot. 1. Wave height comparison in the structures

Geosynthetics

RELIABLE MATERIALS
COMPLETE SOLUTIONS

GEOSYNTHETICS are perfect for use in construction of:

- roads and railway structures
- airport structures
- car parks
- reinforcement of steep slopes
- embankments
- steep slopes
- hydro engineering structures

Application

Geosynthetics are polymer products widely used in many geotechnical in civil engineering projects.
Geosynthetics application is very wide.

In order to fulfill different functions in the geotechnical design, ViaCon Sp. z o.o. offers a large number of geosynthetics: non-woven, woven, grids, erosion control products, geomembrane, GCL, drainage geocomposites as well as the fiberglass grids for asphalt reinforcement.

Non-woven geotextiles

Products are made of polypropylene or polyester fibres mechanically joined in the process of needle punching and thermal bonding.
They are generally used in the road and railway construction, hydro engineering, ground improvement, forestry and agriculture.

Applications:

- separation of soft subsoil under road and railway/road embankments
- increasing structure stability
- separating layer between soils or fill layers with a different aggregate size
- river banks protection, embankments and water reservoirs construction
- vertical and horizontal geosynthetics drains
- drainage systems protection
- cracks preventing layer under concrete pavements
- geomembranes protection against installation damages when building landfills, tunnels and water reservoirs

Polypropylene woven geotextiles

Woven geotextiles are made of high-quality polypropylene strips with tensile strength 20 kN/m to 110 kN/m.
These products are resistant to mechanical damage, UV radiation and chemical and biological corrosion.

Application:

- reinforcement and separation of low-bearing soils
- separation layer between soil and subbase layer
- railroads
- soil reinforcement
- geotubes

Geosynthetics AND BIODEGRADABLE PRODUCTS

Polyester woven geotextiles

Woven geotextiles are made of polyester multifilament yarn with a high tensile strength (up to 600 kN/m) and an elongation from 10 to 15%.
PES woven textiles expected service life is over 120 years. They are perfect for reinforcement of subsoil, separation, and construction of high embankments. They are resistant against mechanical damage, durability, low elongation and high tensile strength.

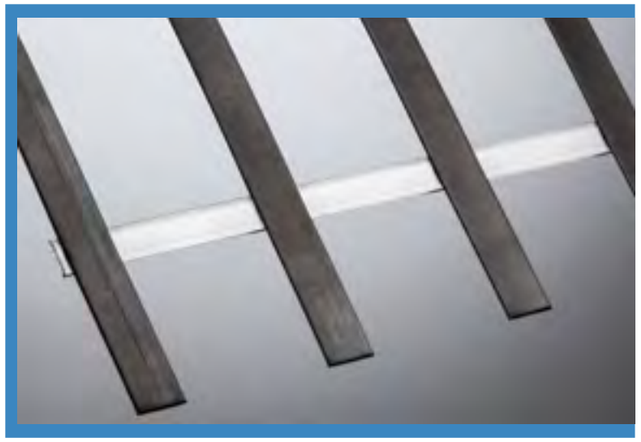
Applications:

- construction of roads and railways
- construction of storage yards, car parks
- construction of levees, wharfs
- reinforcement of retaining walls and construction of high embankments
- construction of river banks and water reservoirs
- mining damage areas

Geogrids for soil reinforcement

Geogrids are produced by welding PP or PES extruded strips. They are perfect for reinforcement of steep slopes of embankments. They are used also for construction of retaining walls with facing concrete blocks. Their expected service life is over 120 years and they are resistant to chemical and biological corrosion.

The product is CE certified.



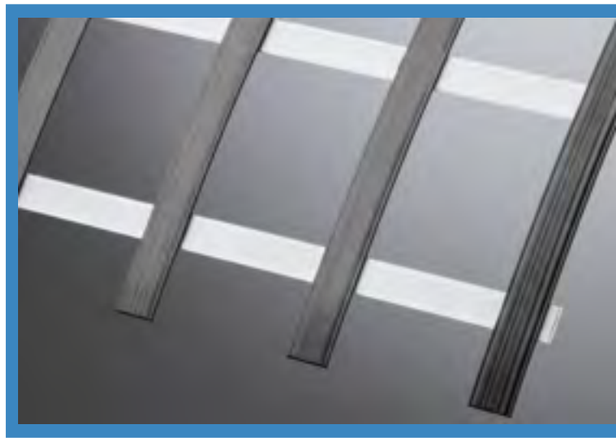
Applications:

- construction of steep slopes of road and railway embankments
- slope failures repair
- construction of retaining walls
- embankment extension works
- landfill embankments

Geogrids for soil stabilization

Biaxial geogrids are made of polypropylene or polyester strips welded in joints. They are characterized by a tensile strength from 20 to 60 kN/m. They guarantee a significant increase of ground bearing capacity. When using geogrids aggregate consolidation is more effective. Load is distributed to lower layers and deformations are reduced.

The product is CE certified



Applications:

- construction of roads, streets, railway lines, tramways, forest roads
- construction of airports, storage yards and car parks
- construction of embankments on soft soils
- reinforcement of subsoil under foundations

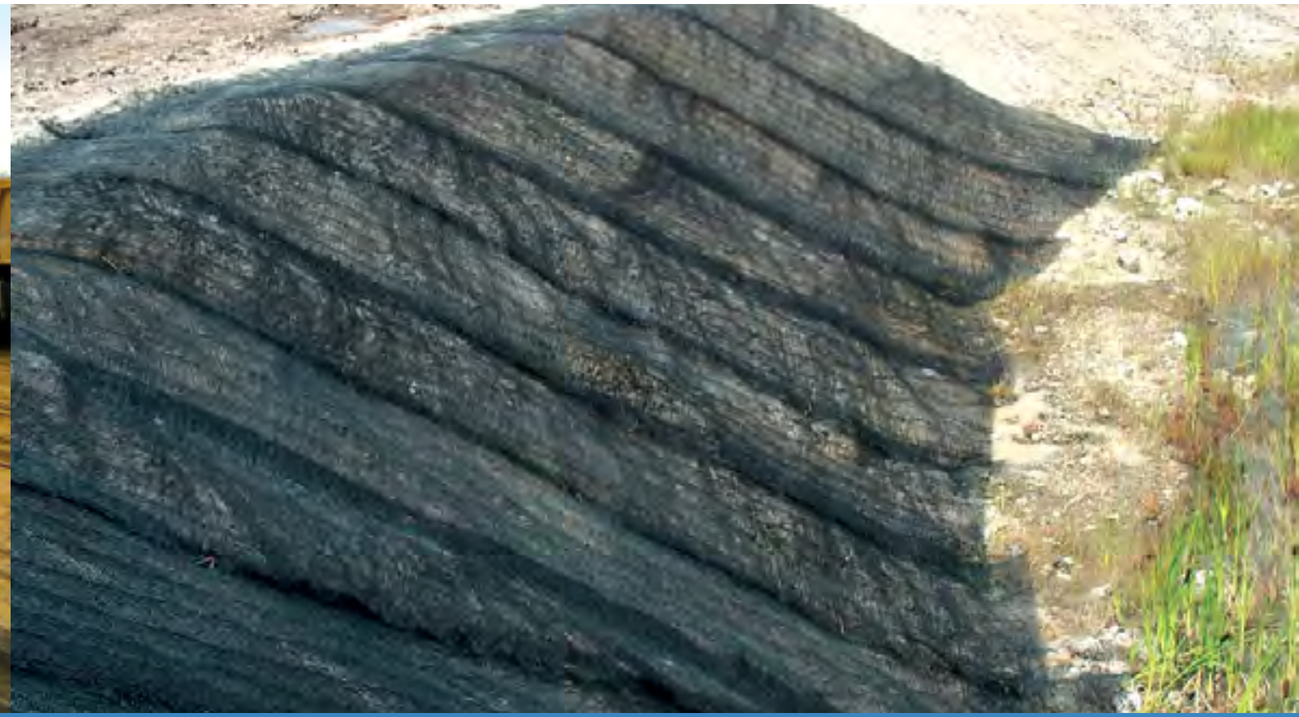
Woven polyester geogrids

Polyester woven geogrids are PVC coated. That is additional protection against UV. Their expected service life is over 120 years. They can be produced with over 900 kN/m tensile strength and elongation at break 10-12%.

The product is CE certified

Applications:

- reinforcing soft subsoil of embankments and banks
- construction of yards, car parks, temporary and forest roads
- reinforcement of the upper layer of the subsoil of roads and railways
- embankments reinforced, retaining structures and other structures



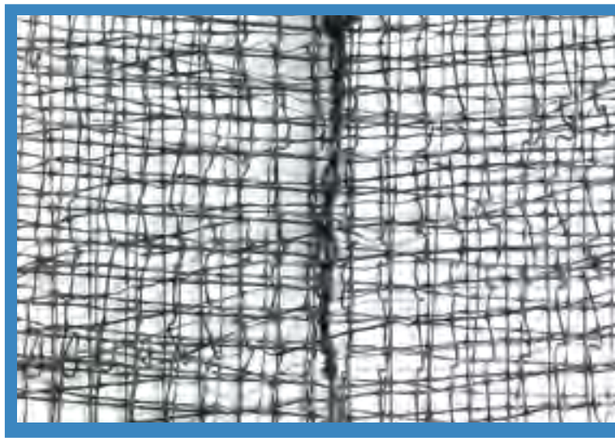
Erosion control geomats

Erosion control geomats are made of polypropylene fibres.
Thickness vary from 8 to 20 mm. They are perfect for protection against the degrading impact of rain, drain water, wind and waves.

The product is CE certified

Application:

- slopes to be covered with vegetation,
- slopes of trenches and canals,
- banks of canals, ponds and artificial reservoirs, as well as covering for landfills,
- rock fall protection



Biodegradable erosion control products

Erosion control mats are made of natural biodegradable fibres. They are produced from straw, coir and jute. They are used for protection of slopes of an angle up to 70°. Erosion control mats prevent slope degradation and ensure vegetation of plants during their initial rooting.

Embankments and river banks secured with the biomats ensure protection of the slope face against wind and storm water runoff.

Greenfields - erosion control mats	
Product	Composition
Greenfields S-100-P S-100-J	100% straw, interwoven polypropylene mesh interwoven jute mesh
Greenfields SK-50-P SK-50-J	50% straw, 50% kokosa, interwoven polypropylene mesh interwoven jute mesh
Greenfields K-100-P K-100-J	100% kokosa, interwoven polypropylene mesh interwoven jute mesh
Greenfields Quickie SM 800	100% coir, plus coir base and fertilizer
Greenfields K-100-M	100% coir, with textured foil 2+
Greenfields BioMat	Hastec KGW 700, from 300g of coir
Greenfields Waterlogs	100% coir, with coir or polypropylene mesh

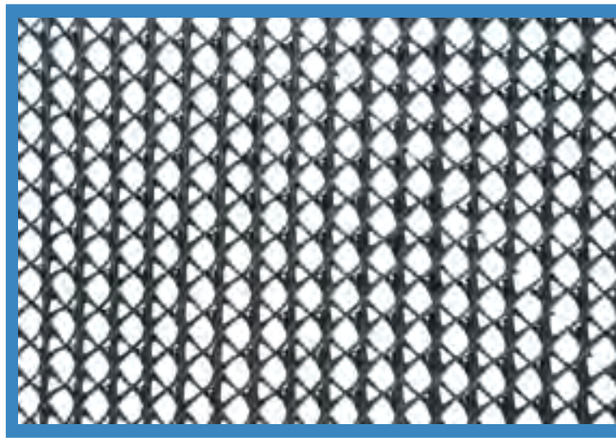
Hastec – erosion control fabrics	
Product	Composition
HasTec KGW 400	Coir fabric, 100% coir
HasTec KGW 700	Coir fabric, 100% coir
HasTec KGW 900	Coir fabric, 100% coir
HasTec KSM	Coir loop mat
HasTec akoBond	Multi-purpose textile strips, 100% coir
HasTec JG 500	Jute fabric 100% jute
HasTec JG 200	Jute fabric 100% jute

Drainage geocomposites

Drainage geocomposites are made of three dimensional HDPE core and non-woven on one or both sides. Geocomposites are characterized by a low compressibility and allow discharging very large amounts of water at a high load. This is the most efficient surface drainage system. Drainage geocomposite is very durable and resistant to silting up.

Application:

- drainage of runways, roads and railways
- drainage of car parks and storage yards
- gas discharge and landfills drainage
- drainage of bridge abutments, walls



Geomembranes

Geomembranes are watertight materials made of HDPE and PVC. They are produced in rolls with the width of 5.0 - 11.0 m and the thickness of 0.5 mm - 3.0 mm. They are joined by thermal bonding or welding and always provide tight and durable connection. Geomembranes are resistant to UV radiation, chemical and biological corrosion, acids and alkali.

Application:

- construction of landfills and waste dumps
- waste dumps sealing
- construction of canals, levees and artificial water reservoirs
- reinforced concrete and steel tanks sealing
- hazardous substance handling yards and fuel stations sealing
- yards at scrap vehicle recycling establishments sealing

Grids for road pavements

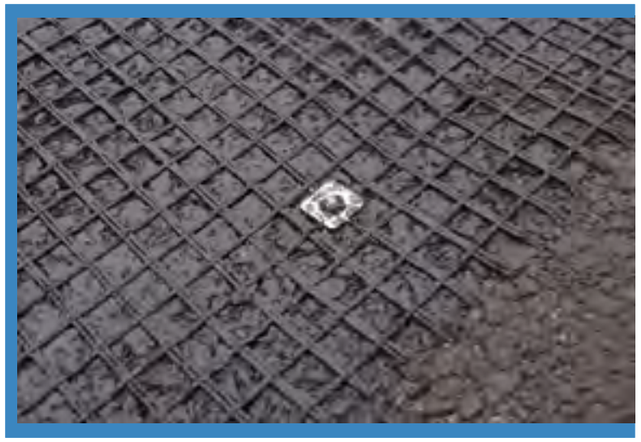
Fiberglass geogrids and fiberglass geocomposites are produced from glass fibers knitted in a bioriented structure and bituminous coated. In the geocomposites, glass fibre grid is bonded with non-woven polypropylene geotextile. Geogrids are characterized by low elongation (up to 3%) and a high tensile strength (up to 200 kN/m) they are resistant to high temperatures up to 240°C.

Application:

- prevention of reflective cracking
- reinforcement of asphalt layers, e.g. areas with heavy load traffic (airports, car parks)
- reinforcement of connections between two different structures or new and old structures
- ruts prevention
- reinforcement of connections when widening roads

The product is CE certified

Geogrids properties	Tests	Unit	50/50	80/80	100/100	120/120	120/200
Tensile strength (along/across)	EN ISO 10319	kN/m	50/50	80/80	100/100	120/120	120/200
Elongation (along/across)	EN ISO 10319	%	3/3	3/3	3/3	3/3	3/3
Mesh size	EN ISO 10319	mm × mm			12,5 x 12,5 25,4 x 25,4 40 x 40		



Geosynthetics installation

Stage I: Preparation of the subsoil

Geosynthetic should be placed on smooth subsoil. All protruding roots and large sharp stones sticking out which might cause damage to the material during its installation should be removed.

Stage II: Installation of geosynthetics

The direction of laying the geosynthetics should be in accordance with the technical design and installation guide. The longitudinal and transverse overlap must not be less than 0.3 m. Its value should be selected depending on the bearing capacity of the subsoil expressed by CBR from table below.

Geomembranes, where the connection should be tight, thermal bonding and welding are used. Uniaxial geogrids for reinforcement of high embankments can be joined with one another with botkin connections.

CBR	Typical width of overlap [m]
>3	0,30
1÷3	0,50
< 1	0,75

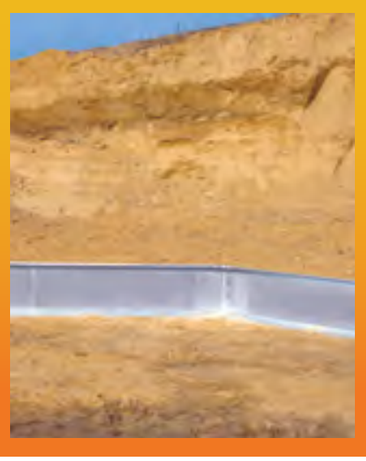
Geosynthetics can be anchored with the use of steel pins or U shaped wire.

Stage III. Backfilling and compacting

The aggregate should be laid in layers with a thickness of 0.3 m. It should be remembered that the equipment used in the process should not move directly on the geosynthetic – the minimum thickness of the aggregate layer, on which the equipment can move, should be 0.15 m.

When using geogrids it is very important to comply with the specific parameters of the aggregate (fraction of the aggregate, with which the geogrid must be covered up).

Proper installation of geosynthetic materials guarantee proper behavior of such materials and the engineering structure, in which they are installed. Apart from a wide range of geosynthetic materials, ViaCon Sp. z o.o. offers also full installation service at the construction site starting from geomembrane welding at petrol stations or water tanks and landfills, to laying and stitching of geosynthetics.



ViaFence

AN AMPHIBIAN PROTECTION
AND DIRECTING SYSTEM

The protection and directing system for amphibians and other small animals was developed with the participation of Ecologists who for many years have performed studies on the mortality rate of amphibians on roads and in their vicinity. ViaCon Sp. z o.o. included in its offer a protection system, which is most developed one among such systems available so far in Poland, in order to meet the ever increasing market requirements.

Materials

Steel fences in the standard version are made of steel with a thickness of 1.0 - 2.0 mm protected against corrosion by hot dip galvanizing in accordance with PN-EN ISO1461:2011. Depending on the needs, they can also be coated with epoxy paint, epoxy-polyurethane paint, or polyester paint in any colour. Each element of the system can be permanently marked with the name and location of the project or the name of the investor.

Parameters

Fences consist of basic modules with a length of 4 m and a height of 0.49 m. An additional vertical flange, which prevents amphibians from getting through to the other side of the fence, increases their height to 0.52 m. Each module has a 20 cm raceway ended with a flange with a width of 10 cm, which is sunk in the ground (Fig. 1). It is also possible to make a fence with longitudinal corrugation (Fig. 2), which performs the function of an additional protection that prevents amphibians from climbing up.

Installation

Installation of fences does not require the use of heavy equipment. The system was designed in such a way, so that it is possible to install it regardless of the terrain conditions. Among other things, the following solutions were developed: the manner of connecting the fence with engineering structures, the manner of installing the fences at newly built and existing embankments, fences in a free-standing version.
Mounting posts are designed to be placed with a spacing of 4 m. On the sections, which require to be bent in the plane and in the profile, additional masking elements are used to ensure the tightness of the fence.

Advantages:

- a wide raceway to prevent the growth of vegetation, on which amphibians could climb up
- the raceway is ended in such a way, as to prevent digging a tunnel under the fence
- the height of the fence prevents even small animals from getting through it
- a wide flange ended with a drip edge
- a smooth surface prevents amphibians from climbing up
- the tightness of the fence eliminates the risk of confining animals in it
- the stability of the fence is ensured through the use of metal sheet with an adequate thickness and the development of a proper installation system
- corrosion resistance
- low cost of construction and maintenance of fences
- long-term durability

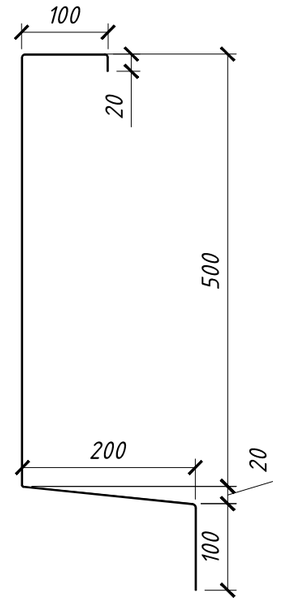


Fig. 1. Cross section of a steel fence

Acrow® 700XS®

ENGINEERING IDEAS
WORLDWIDE SOLUTIONS

Acrow bridge system is:

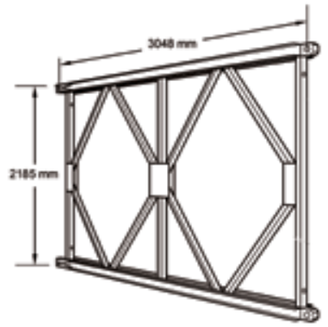
- Pre-engineered, modular and prefabricated
- Used for permanent, temporary or emergency applications
- Offered for sale or rental
- No field welding or fabrication
- Supporting light pedestrian loads or vehicular loads or trucks exceed 250 tonnes
- Rapidly deployed and assembled very quickly
- Versatility that allows for assembly in any length or width and any load combination
- Good economy
- Compliant with many world standards

Application

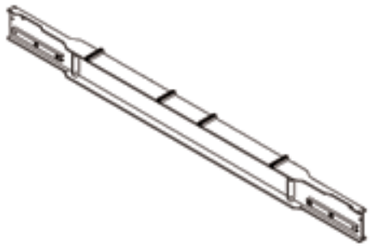
The Acrow® 700XS® truss bridge system is based on the Bailey bridge system, which is well known around the globe.

Acrow® 700XS® bridges have been used for many years on construction sites all over the world. Simplicity in the design and ease of assembly make them very popular.

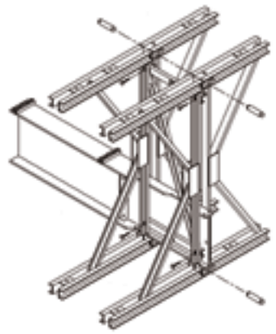
Main elements of the system



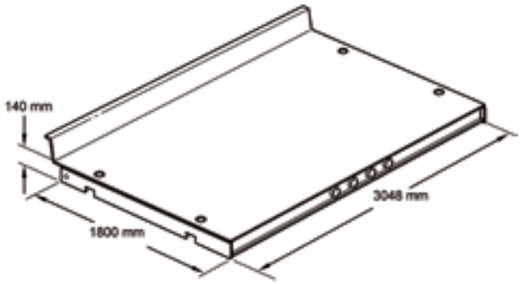
- Truss panels with the dimensions of 218.50 cm x 304.80 cm joined together with the use of bolts



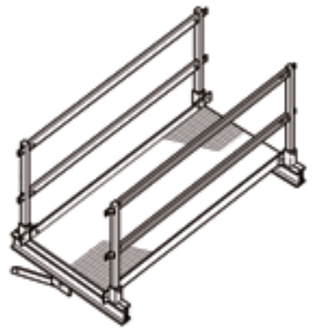
- I-profile crossbars allow building a bridge with six standard widths: 3.65m, 4.14 m, 5.48 m, 7.31 m, 9.14 m, and 10.96 m (width of the deck between curbs). The crossbars are placed every 3.048 m.



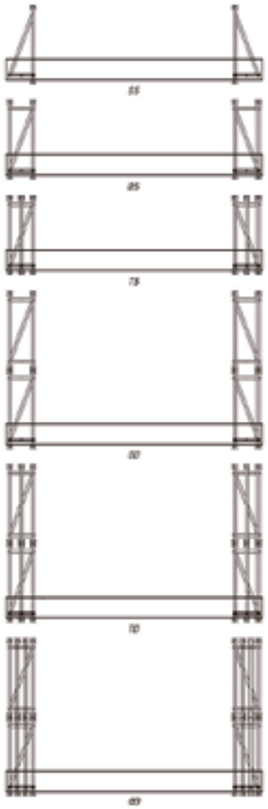
- Bracing and fasteners



- Steel decks placed on the crossbars ensure the possibility of vehicular traffic. Surface of the bridge deck in the form of steel plate or steel plate with epoxy coating applied in the factory. It is also possible to make a wooden deck. Fixing the decks to crossbars is very simple and takes place from the level of the deck with the use of bolts



- Cantilevered walkways with the width of 1.5 m, located outside the truss panels ensure separation of pedestrian traffic from the vehicular traffic, which increases the safety of pedestrians.



Panels can be installed in various ways to create a structure that will be adapted to any specific design requirements - it is enough to modify the configuration of the panels to change the span or enable carrying higher/lower loads. In order to provide a greater efficiency, these trusses can use light or heavy reinforcing bands.

The bridges can be built as single-span or multi-span structures. The latter can be designed as continuous structures on intermediate piers or in the form of simply supported structures, consisting of a number of individual spans.

Structural elements of the bridges are made of high-strength steel and are protected against corrosion by hot dip galvanizing (coating thickness: 610 g/m²).

A short time needed to make a crossing is the reason why Acrow® 700XS® bridges are perfect for use in the event of sudden failures of existing facilities, during implementation of road and bridge investment projects, or in areas aff ected by natural disasters.

Features and Benefits:

- Diverse applications
- Multifunctional
- Easily customized to desired length, width and strength
- Fast assembly and disassembly
- Flexible launch methods with minimal equipment needed
- Durable
- Galvanized steel for no maintenance
- Easy to transport worldwide
- Reusable
- Time-tested technology exceeds most rigorous quality standards
- Certified:
  - ISO 9001
  - AISC for Major Bridge Structures
  - CE of Europe

Installation methods

The most popular methods include:

- Cantilevered sliding method - it consists in assembling bridge elements on one side of an obstacle and then systematically pulling out the bridge towards an intermediate support or an abutment. Pulling out takes place with the use of installation rollers supplied with the structure.
- Structure lifting method - it consists in assembling a bridge and lifting its entire structure onto the prepared abutments. In such a case, it is recommended to leave the structure without placing the deck and making the deck after placing the span on the target supports.

Gabions

GABION BOXES AND MATTRESSES

> **Gabions are construction products made of steel wire protected against corrosion.**

The use of gabions

- gabion boxes are used for construction of retaining structures,
- strengthening the banks of water reservoirs or transport facilities adjacent to these reservoirs
- construction or strengthening bridge abutments
- retaining structures from reinforced soil
- mattresses used for the construction of fords and structures which limit the erosion of the river bottoms and riverbanks, water reservoirs and watercourses near bridge supports, earth structures
- temporary structures which increase the height or strengthen floodbanks
- trapezoidal baskets are used for construction of free-standing walls, screens, partitions.

Woven gabions

Woven gabions (baskets and mattresses) are made of hexagonal double twisted steel mesh. Gabion mattresses are elements up to 30 cm height. The elements over 30 cm are called gabion boxes. There are two types of gabion boxes: rectangular and with an anchoring mesh. The wire used for gabion production is available in diameters from 2.0 mm to 4.0 mm and can have the following anti-corrosive coatings: Zn; ZnAL; Zn+PCV; ZnAL+PCV. The ZnAL coating is also known under the names: Bezinal, Crapal, Galfan. It is possible to coat the basic wire with grey or green PVC material.

The woven gabions are used for road and rail infrastructure, as well as water engineering, mainly for the construction of retaining structures and slope protection.

Also mesh cylinders are available, used for river and water reservoir banks and bottoms protection. Steel hexagonal mesh is used for protecting steep rocky slopes against degradation. It prevent rocks from falling down.

Welded gabions

Welded gabions are made of steel grid with rectangular or square mesh. Typical wire spacing is 50 mm, 75 mm, 100 mm or mixed. the wires can be coated against corrosion by: zinc coating Zn, zinc coating + PVC coating, zinc-aluminium called galfan (ZnAL) or galfan (ZnAL) + PVC.

Grids are made of wire with diameters of: 2.5 mm, 2.7 mm, 3.0 mm, 3.5 mm, 3.8 mm, 4.0 mm, 4.5 mm or 5.0 mm.

The grids coated with PVC are used with wire with diameter of: 2.7 – 5.0 mm.

Welded gabions are supplied to construction sites as a set of panels assembled directly on site with C-rings, spirals, hooks or tie wire.

ViaWall A®

ViaWall B®

ViaBlock®

ViaWall

RETAINING WALL SYSTEMS

> **Retaining walls of ViaWall are offered in four systems:**
>
> - ViaWall A® (type 1-4) - a retaining wall with the face from a reinforced concrete panel
> - ViaWall B - a retaining wall with the face from a steel mesh
> - ViaBlock® (type 1 and 2) - a retaining wall with the face from concrete blocks

Application

Retaining walls are used for:

- construction of bridges abutment
- protection of embankment bevels

In the scope of retaining structures, ViaCon Sp. z o.o. offers:

- design support
- preparation of an engineering design for each implementation
- installation or installation instructions on the construction site

Structural elements of retaining wall systems

System	Retaining wall face	Reinforcing mesh
ViaWall A® type 1	reinforced concrete panel C30/37	galvanized steel mesh
ViaWall A® type 2	reinforced concrete panel C30/37	uniaxial HDPE geogrid
ViaWall A® type 3	reinforced concrete panel C30/37	steel strip geogrid
ViaWall A® type 4	reinforced concrete panel C30/37	polymer strip geogrid
ViaWall B®	galvanized steel reinforcing mesh, stone 80/250	galvanized steel mesh
ViaBlock® type 1	vibropressed concrete block 15 x 20 x 4,1 cm	uniaxal HDPE geogrid
ViaBlock® type 2	vibropressed concrete block 20 x 39,8 x 24 cm	uniaxial PES or HDPE geogrid

ViaWall A®

The system has obtained Technical Approval of the Road and Bridge Research Institute, AT/2010-02-2611/4

ViaWall A® is a retaining wall system, in which reinforced concrete panels form the facing part of the wall, while galvanized steel reinforcing mesh, uniaxial HDPE geogrid, steel or polymer strip is the reinforcing part in the embankment.

Elements of the system

Reinforced concrete panel

The panel is made of concrete (class C30/37) reinforced with steel (class A-IIIN). The system consists of typical panels with the following dimensions: 150 x 150 or 150 x 75 (width x height) and thickness 14, 15 or 18 cm. It is possible to form panels with non-standard dimensions.

It is possible to make panels with any texture, for example:

- occasional patterns
- imitations of stone
- rustication
- checkering, etc.

Additional elements

- EPDM rubber bearing pads are placed between rows of panels; the thickness of pads is approx 20 mm
- filter cloth (non-woven geotextile): belts with a width of min. 305 mm
  are laid from the side of the backfill in such a way as to cover all panel joints; its function is to prevent fine particles from being washed out from the embankment material
- alignment rods - galvanized steel rods threaded at one side, which align the panels of the upper layer in relation to the bottom layer and facilitate proper installation of panels
- bodkin HDPE rods is used to connect reinforcing mesh with the panel
- bolts are used to connect steel belt with the panel
- U-bolt is used to connect steel mesh with the panel

Earth reinforcement

ViaWall A type 1 – Reinforcing meshes are made of steel bars (class A-IIIN), ribbed or smooth, with standard diameters from 6 to 20 mm. Mesh is protected against corrosion by a zinc layer with a coating weight of min. 600 g/m^2.

ViaWall A® type 2 – connecting elements of polyethylene (HDPE) is used.

ViaWall A type 3 – soil reinforcement made of galvanized steel strips with ribs on both sides.

ViaWall A type 4 – soil reinforcement made of polymeric strips.

Inseparable elements of the system are connection elements that fasten soil reinforcement to panels.

ViaWall A type 1 – systems bars protected against corrosion by a zinc layer with coating weight of min. 600 g/m^2.

ViaWall A® type 2 – HDPE flat bar is used as connecting element.

ViaWall A® type 3 – bolt is used as connecting element.

ViaWall A type 4 – connection is made by interleaving straps through the system connector.

Panel properties		
Concrete	Absorbability	Frost resistance
C30/37	≤ 5%	F150

Backfill

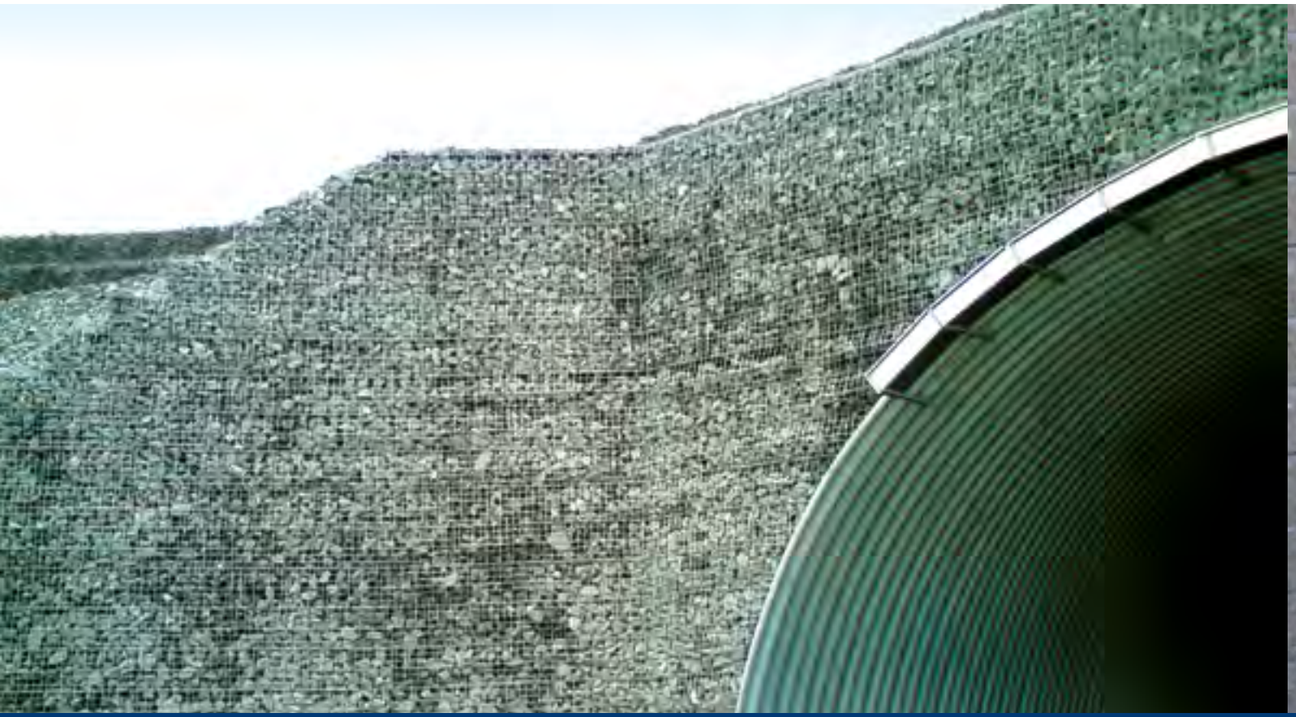
Non-cohesive soil with the following parameters* is used as backfill:

- min. internal friction angle $\varphi = 34°$,
- cohesion c = 0 kPa,
- weight = 20.0 kN/m3
- coefficient of uniformity Cu ≥ 5 (according to PN-86/B-02480)
- coefficient of curvature 1 ≤ Cc ≤ 3 (according to PN-86/B-02480)

* there is a possibility of using backfill with other parameters

Advantages of using the ViaWall A® system

- possibility of forming any geometric shapes
- easy to install and impervious to weather conditions (dependent only on the possibilities of compacting the backfill)
- installed with the use of light equipment only (the heaviest element: up to 1500 kg)
- possibility of using panel faces with various architectural textures



ViaWall B

The system has obtained Technical Approval of the Road and Bridge Research Institute, AT/2010-02-2611/4

ViaWall B is a retaining wall system, in which steel reinforcing meshes form the face and reinforcement part of the embankment.

Elements of the system

Meshes

ViaWall B system includes two types of reinforcing meshes:

- main L-shaped mesh, which acts both as the face and the anchoring element
- auxiliary mesh
- crowning mesh

Main and auxiliary meshes are made of welded steel bars. Standard diameters of ribbed bars ranging from 6 to 20 mm.

In order to protect the mesh against corrosion, all elements of the system are covered with a zinc layer with a coating weight of min. 600 g/m^2.

Facing sone:

Natural or crushed aggregate with a grain size of 80/250 is used in the facing part.

Between the backfill in the facing part of the wall and the backfill in the reinforcing part is used a separating geotextile.

Backfill

Non-cohesive soil with the following parameters* is used as backfill:

- min. internal friction angle $\varphi = 34°$,
- cohesion c = 0 kPa,
- weight = 20.0 kN/m3
- coefficient of uniformity Cu ≥ 5 (according to PN-86/B-02480)
- coefficient of curvature 1 ≤ Cc ≤ 3 (according to PN-86/B-02480)

* there is a possibility of using backfill with other parameters

Advantages of using the ViaWall B system

- quick and economical retaining wall system
- easy to install
- thanks to the use of natural stone in the facing part, the system perfectly integrates with the natural environment, e.g. in mountainous areas

ViaBlock®

Type 1

The system has obtained Technical Approval of the Road and Bridge Research Institute, No AT/2016-02-3212

ViaBlock® type 1 is a retaining wall system, in which the face of the wall is made from ViaBlock® concrete blocks combined with uniaxial HDPE geogrid.

Elements of the system

ViaBlock® retaining wall system consists with:

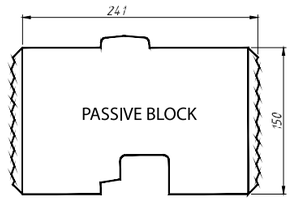
- modular blocks with diameters 15x20x24,1cm (active, passive)
- blocks crowning the wall
- uniaxial HDPE geogrid
- connectors (T-clip)

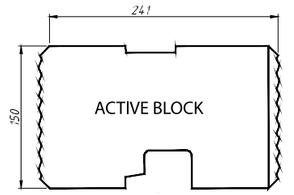
The retaining wall can be finished at the top with a crowning precast element, a monolithic cover or a concrete rim.

Block properties		
Concrete	Absorbability	Frost resistance
min. C25/C30	≤ 5%	F150

Additional elements

- polyethylene connector (T-Clip) for connecting blocks with the geogrid the connector has a specifically designed shape and therefore it should not be replaced with other elements
- bodkins (HDPE rods - 6x20x1050 mm) are used to transversely connect two geogrids.





ViaBlock®

Type 2

ViaBlock® type 2 is a retaining wall system, in witch the face of the wall is made from concrete blocks combined with uniaxial geogrid. In this system we can use HDPE or polyester geogrids.

ViaBlock type 2 have only one type of block.

Elements of the system

ViaBlock® retaining wall system consists with:

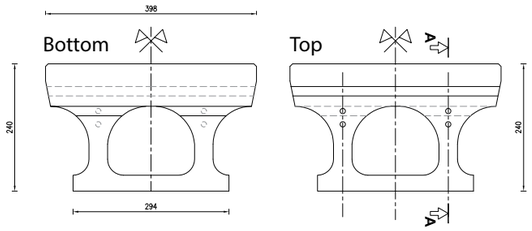
- modular blocks with diameters 20x39,8x24cm
- blocks crowning the wall
- uniaxial polyester geogrid with protective polymer coating or uniaxial HDPE geogrids
- pins
- bodkin

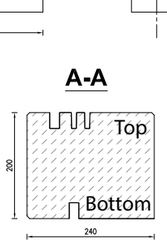
Additional elements:

- polymer pins
- bodkins are used for connecting blocks with the mesh

Advantages of using the ViaBlock® system

- low cost of building a retaining wall
- quick and easy installation
- possibility of forming walls with various shapes (concave or convex arch)
- possibility of making blocks in different colours





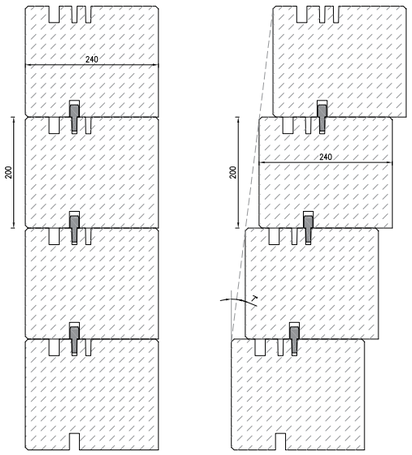


Fig 3. Erection drawing of ViaBlock type 2

Currently available colours

CON/SPAN

ENGINEERING STRUCTURES MADE
OF PRECAST ELEMENTS

ENGINEERING STRUCTURES MADE OF PRECAST ELEMENTS CON/SPAN

Engineering structures made of precast elements of CON/SPAN are used for roads, railways and industrial applications:

- bridges
- overpasses
- tunnels
- culverts
- underpasses
- pedestrian tunnels
- ecological crossings
- shelters
- underground storages

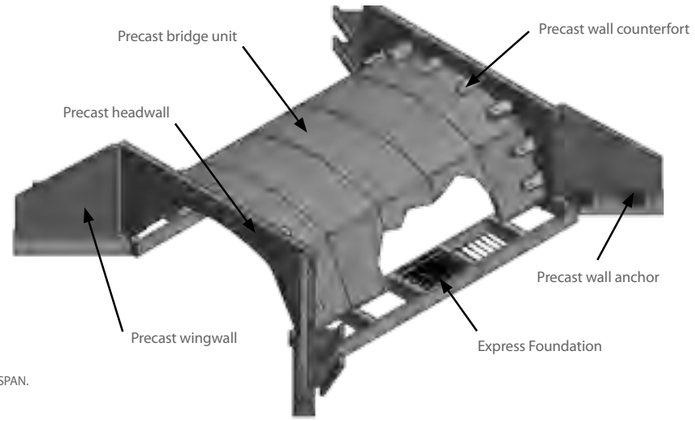


Fig. 1 Elements consists of precast buried bridge system CON/SPAN.

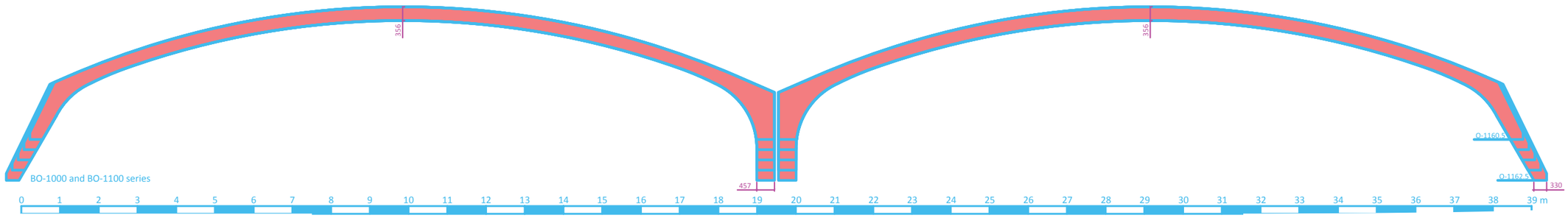
Benefits of CON/SPAN system:

- designed for all road and railway live load classes according to norm PN-85/S-10030 and PN-EN 1991-2. All system conform to AASHTO LRFD Bridge Specification
- provides ease and speed of installation
- minimal reinforcement to be placed on site
- no need to use formwork
- no connection in cross section – installation without the use of scaffolding
- possibility to make bend in plan view
- complete system, unification of design and production
- wide scope of applications
- a wide range of cross sections
- possibility of installing the CON/SPAN system after the Express Foundations are done – reduction of installation time
- possibility of using only certain elements of the system

CON/SPAN construction process:

- excavate and prepare foundation subgrade
- unload and place precast foundation sections
- place minimal reinforcing at joints to provide foundation continuity
- set precast bridge units, headwalls and wingwalls
- fill cells with cast-in-place concreto
- seal joints, grout wingwalls and backfill

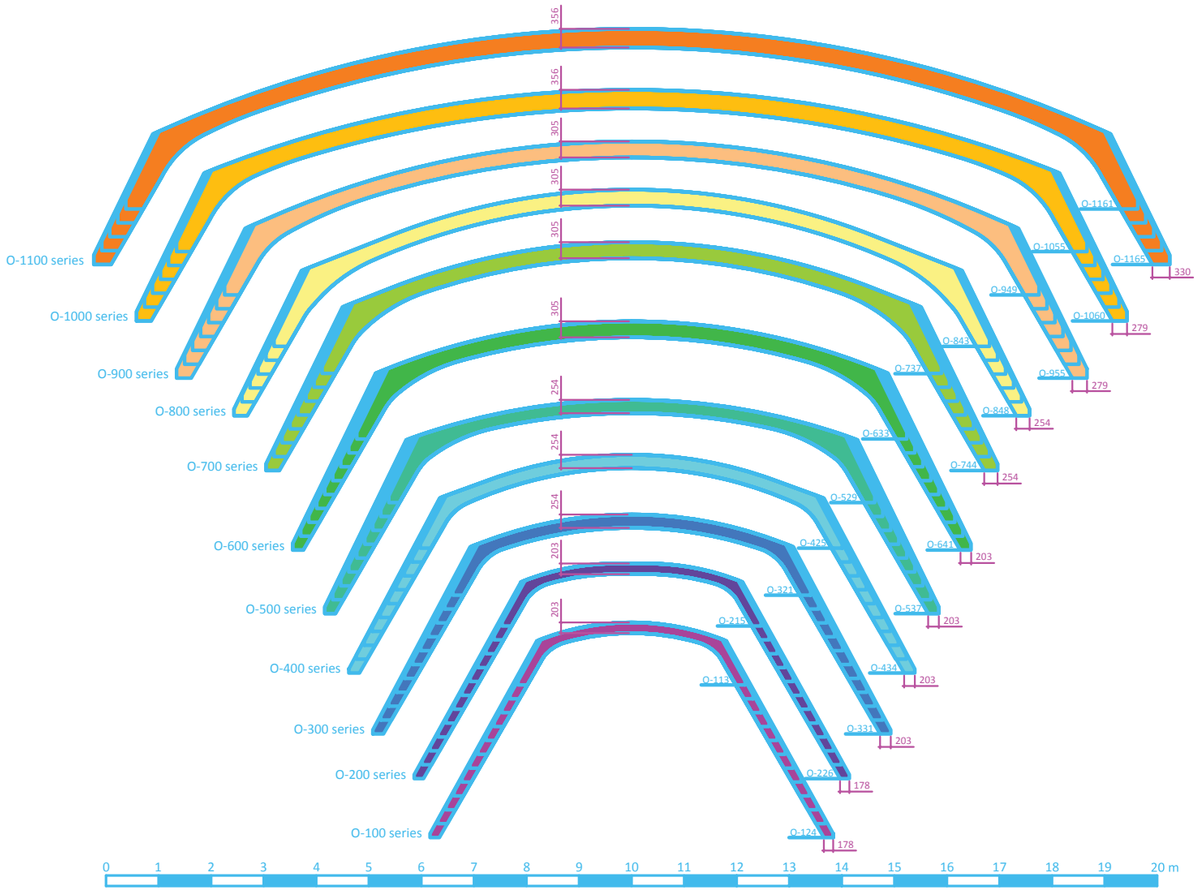
Profiles of precast buried bridge systems – spans from 3,96 m to 19,80 m:



O-100 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-113	3962	985	3,07
0-114	4267	1250	4,18
0-115	4572	1513	5,30
0-116	4877	1777	6,60
0-117	5182	2041	7,90
0-118	5486	2305	9,29
0-119	5791	2569	10,78
0-120	6096	2833	12,36
0-121	6401	3097	14,03
0-122	6706	3361	15,79
0-123	7010	3625	17,56
0-124	7315	3889	19,42

O-200 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-215	4572	986	3,72
0-216	4877	1249	4,92
0-217	5182	1513	6,22
0-218	5486	1777	7,71
0-219	5791	2041	9,20
0-220	6096	2305	10,68
0-221	6401	2569	12,36
0-222	6706	2833	14,12
0-223	7010	3097	15,89
0-224	7315	3361	17,84
0-225	7620	3625	19,79
0-226	7925	3889	21,83

O-300 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-321	6401	1280	6,41
0-322	6706	1544	8,18
0-323	7010	1808	9,94
0-324	7315	2072	11,89
0-325	7620	2336	13,84
0-326	7925	2600	15,89
0-327	8230	2864	18,02
0-328	8534	3128	20,25
0-329	8839	3392	22,58
0-330	9144	3656	24,90
0-331	9449	3920	27,31



O-400 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-425	7620	1523	8,83
0-426	7925	1787	10,87
0-427	8230	2050	13,01
0-428	8534	2315	15,24
0-429	8839	2579	17,56
0-430	9144	2842	19.88
0-431	9449	3106	22,39
0-432	9754	3370	24,90
0-433	10058	3634	27,50
0-434	10363	3899	30,19

O-500 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-529	8839	1701	11,89
0-530	9144	1964	14,31
0-531	9449	2229	16,72
0-532	9754	2492	19,23
0-533	10059	2756	21,83
0-534	10636	3021	24,53
0-535	10668	3284	27,31
0-536	10973	3549	30,19
0-537	11278	3812	33,17

O-600 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-633	10058	1935	15,14
0-634	10363	2199	17,84
0-635	10668	2463	20,62
0-636	10973	2727	23,50
0-637	11278	2990	26,48
0-638	11582	3254	29,45
0-639	11887	3518	32,52
0-640	12192	3782	35,77
0-641	12497	4047	39,02

O-700 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-737	11278	2192	18,95
0-738	11582	2456	21,93
0-739	11887	2720	25,08
0-740	12192	2984	28,24
0-741	12497	3247	31,49
0-742	12802	3512	34,84
0-743	13106	3775	38,28
0-744	13411	4039	41,71

BO-1100 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
BO-1160.5	18428	3069	43,25
BO-1161	18593	3335	48,17
BO-1161.5	18745	3600	53,09
BO-1162	18898	3865	58,06
BO-1162.5	19050	4130	63,08

BO-1000 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
BO-1054.5	16599	2722	35,25
BO-1055	16764	2984	39,62
BO-1055.5	16916	3249	44,08
BO-1056	17069	3514	48,59
BO-1056.5	17221	3780	53,09
BO-1057	17374	4042	57,65

O-1100 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-1161	18563	3072	43,20
0-1162	18898	3335	48,22
0-1163	19202	3599	53,23
0-1164	19507	3863	58,34
0-1165	19812	4127	63,55

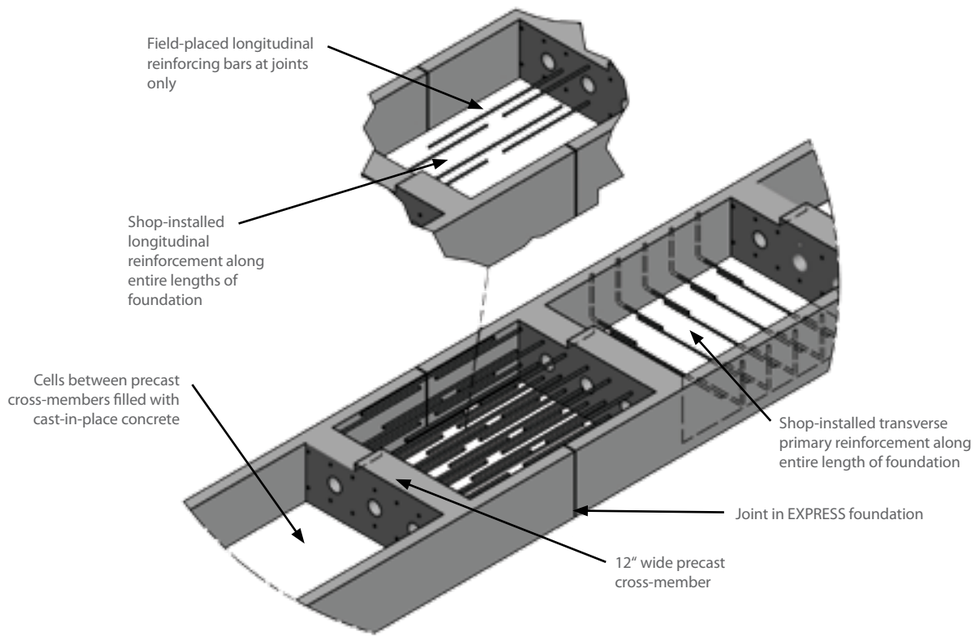
O-1000 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-1055	16764	2722	35,30
0-1056	17069	2985	39,76
0-1057	17374	3249	44,31
0-1058	17678	3514	48,96
0-1059	17983	3778	53,61
0-1060	18288	4041	58,44

O-900 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-949	14935	2615	29,73
0-950	15240	2878	33,72
0-951	15545	3142	37,72
0-952	15850	3406	41,90
0-953	16154	3670	46,08
0-954	16459	3934	50,45
0-955	16764	4198	54,81

O-800 series			
Section	Dimentions		Cross section area [m²]
	Span [mm]	Height [mm]	
0-843	13106	2676	26,29
0-844	13411	2940	29,82
0-845	13716	3204	33,35
0-846	14021	3468	37,07
0-847	14326	3732	40,78
0-848	14630	3996	44,59

Express Foundations system

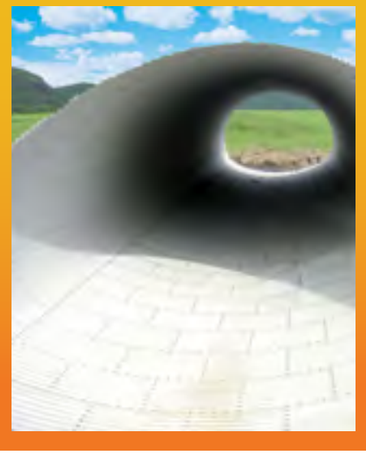
A precast foundation system that blends the speed of precast with the economy of cast-in-place.



Technical support from ViaCon Sp. z o.o.

Cross section of engineering structure is selected according to clearance box and required load capacity. Each time characteristic parameters for individual project are defined such us; span, height, cross section area, thickness element, precast element, width, reinforcement.

ViaCon offers full support for designing of CON/SPAN precast bridge system and well qualified assembly teams will take a comprehensive system installation on site.



A2 Motorway

ROAD TO SUCCES

> **The A2 motorway is one of the most strategic parts of the Polish motorway construction plan. By direct connection to the network of German motorways it became the key transport route between Poland and Western Europe.**

The newly opened section, which connects in Świecko with the A12 German motorway: Berlin - Frankfurt (Oder), has become a part of a strategic European transport route: Berlin - Warszawa - Minsk - Moscow. The Świecko - Nowy Tomyśl section of the A2 motorway was opened on 1 December 2011. The contractor for this investment was STRABAG Sp. z o.o., while the main concessionaire was Autostrada Wielkopolska S.A. In connection with the fact that this section of the motorway runs in 85% through forest areas, including Natura 2000 protected sites, it was an engineering challenge to carry out the project with the utmost care for the environment.
Nowadays, there is no need to convince anyone that it is necessary to build wildlife crossings, as many animal species are endangered by progressive fragmentation of habitats. Modernization of old roads and construction of new ones become increasingly important barriers to animal migrations. In order to ensure the survival of animals, the most important issue is to try to maintain and even gradually improve the continuity of forest habitats and provide opportunities for animal migration by designating ecological corridors and protecting them.
Thanks to the fact that already in the design phase it was assumed that all European environmental standards would be addopted, the opened section of the motorway is one of the most environmentally friendly infrastructure projects in Europe. Expenditure related to the environmental protection accounted for 25% of the entire investment costs. Nearly 200 wildlife crossings and underpasses for large and small animals have been built along the 106 km long section of the motorway.

SuperCor® and MultiPlate MP200 corrugated steel structures

ViaCon Sp. z o.o. had a very large contribution to the construction of the A2 motorway. Our company delivered and assembled corrugated steel structures for construction of 13 wildlife overpasses.

11 of them have two spans, one has three spans and one four spans. SuperCor® and MultiPlate MP200 corrugated steel structures were used for this purpose.
SuperCor® structures are arch-shaped and have a span of 17.67 m and a height of 5.46 m. They are placed on reinforced concrete supports. The motorway runs under these structures. The bottom length of SuperCor® steel structures ranges from 39.70 m to 75.51 m.
MultiPlate MP200 structures are used to pass service roads. They have a closed shape with a span of 8.66 m and a height of 7.54 m. Their length ranges from 39.70 m to 54.94 m.

One of important requirements set forth by the investor was to ensure a minimum 100-year durability of the animal overpasses.

This was achieved by protecting the steel structures by hot-dip galvanizing with average thickness of the coating: 105 µm (a minimum thickness of 90 µm), and additionally, from the surface exposed to air was painted. Total thickness of paint was min 200 µm and this coating was performed in two layers – 120 µm of the epoxy and 80 µm of polyurethane paint. The colour of the coatings was selected in such a way as to make the colour of the inner surface fully consistent with RAL 1013 in order to light up the interior and at the same time improve the safety of the travellers. The colour of the epoxy and polyurethane coatings was selected in such a way as to make the colour of the inner surface fully consistent with RAL 1013 in order to light up the interior and at the same time improve the safety of the travellers.

Steel structures were assembled using the plate-by-plate method combined with and the partial preassembly. The corrugated steel plate structures were covered with a gravel and sand mix. The height of the cover over the SuperCor® structures ranges from approx. 1.80 m to 2.35 m.

Over the steel structures there was laid an „umbrella" that protects them against possible penetration of storm water into the interior. Width of the overpasses measured in the axis of motorway between fences varies from approx. 38 m to over 63 m and reaches 120 m in the base of embankment.

MSE walls with reinforced concrete panels have been foreseen for facilities with square ends. Slopes of facilities with bevelled ends were finished with a rip-rap on a cement and sand bed. Inlets and outlets of all structures were strengthened with reinforced concrete collars. The facilities were fitted with screening greenery and antiglare screens were built on edges of passes.

In the most intense period, the assembly was performed by 5 assembly crews. Assembly crews consisted of 7 people, the average time of assembly of one structure was 4 weeks, and the entire task was completed in just 14 months (from April 2010 to May 2011).

HelCor®

In the period from 2009 to 2011 ViaCon Sp. z o.o. manufactured HelCor® and HelCor PA helically corrugated pipes, protected against corrosion with zinc coating with a thickness of 42 µm and additionally with polymer coating with a thickness of 250 µm, and delivered them to the construction site of the Świecko - Nowy Tomyśl section. HelCor® and HelCor PA pipes were designed as culverts and wildlife underpasses under the motorway and under access and service roads.

Parameters and the total number of HelCor® pipes:

- diameter: O600 mm, 2.0 mm sheet metal – 87.0 m
- diameter: O800 mm, 2.0 mm sheet metal – 316.0 m
- diameter: O1000 mm, 2.0 mm sheet metal – 294.0 m
- diameter: O1200 mm, 2.0 mm sheet metal – 266.5 m

Parameters and the total number of HelCor PA pipes:

- dimensions 1440x970 mm, sheet metal 2,0 mm – 1 374,84 m
- dimensions 1950x1320 mm, sheet metal 2,7 mm – 2 211,41 m

Geosynthetics

Geosynthetics, apart from other materials, were used for construction of the concrete pavement. Under the concrete pavement layer, a lean concrete base course with a thickness of 20 cm was laid on the prepared frostprotection layer with a thickness of 32 cm.

Non-woven polypropylene geotextile with a mass weight of 450 g/m^2, performing the role of a separating layer, was laid on the lean concrete base course The non-woven geotextile separates the rigid lean concrete base course from the pavement and prevents the propagation of possible cracks on the base course layer to upper layers of the pavement.

In total, 2.5 million m^2 of Bonar VNW450 PP-K non-woven geotextile and Geo&tex2000 GEO RPPAG 450 nonwoven geotextile were laid in the entire Świecko - Nowy Tomyśl section of the A2 motorway. This geosynthetic is resistant to alkalis. Additionally, it is characterized by high hydraulic and mechanical performance.

ViaWall A® type 1

ViaWall A® type 1 MSE retaining walls were used in the WD-69a, WD-65a, and WD-10a animal overpasses. Vertical retaining walls were built on both sides of the passages between the SuperCor® and MultiPlate MP200 corrugated structures. Approx. 3000 m^2 of walls were built in these three facilities, and their maximum height reached 10.5 m.

The walls were covered with non-cohesive soil with an internal friction angle of at least 34°, compacted to the degree of compaction Is = 0.98 (according to the standard Proctor test).
Panels were made of reinforced concrete, class C 30/37, with dimensions of 1.5 x 1.5 x 0.15 m.

Soil reinforcing grids were made from steel bars with diameters ranging from 8 to 12 mm, welded and hot galvanized. The lengths of the grids varied from 4.55 to 8.15 m. Additional elements necessary for the assembly included EPDM bearings, as well as non-woven separating geotextile in the form of belts with a width of 40 cm, which covered the gaps between panels from the side of the cover.

The walls were painted and topped with a monolithic cornice.

ViaCon Sp. z o.o. is a member of ViaCon Group established in Sweden and Norway in 1986. At present, ViaCon Group operates in a 18 European countries and belongs to SAFEROAD® Group. ViaCon is currently the largest European group in the field of flexible pipes and structures.

All companies share Group experience to their customers worldwide.

ViaCon has been operating in the Polish market since 1997. At present, ViaCon has subsidiary companies in the Czech Republic, Slovakia, Austria, Hungary, Romania, Bulgaria and Turkey.

The company owes its success to people. The people in the company, as well as those who put their trust in us and for many years have been changing the world for better and creating a better future together with us.

People from ViaCon are well educated, loyal, professional and friendly. Many of them are young, and therefore our strength lies in the ability to combine experience with the continuous development and the desire to be better.

Our customers are not only large multinational corporations, but also small local companies. We cooperate with road and railway administration centres, universities and research institutes. We treat seriously all of them and promote good cooperation.

ViaCon introduced a system of steel flexible pipes and structures as the first company in the Polish market. This system has strongly contributed to reducing the construction costs of roads and motorways and accelerated the process of their construction.

ViaCon has a comprehensive offer for infrastructure markets. Products and solutions offered by the company are used in construction ofroads and railways around the world. Systems manufactured by ViaCon are exported to over twenty five countries throughout the continent. Our products are used for constructing, strengthening and reconstruction of culverts, bridges, tunnels, underpasses, as well as for assembly temporary bridges. We produce, design and install underground detention systems.

Corrugated steel structures manufactured by ViaCon are used also in the industrial construction sector and in the mining sector as belt conveyors protection and protection of pipes and heat-pipes. The offer of products includes also the Pecor Quattro system manufactured from polypropylene, which is intended, inter alia, for construction of gravity sewage systems, storm-water drainage systems and sanitary sewage systems, as well as very popular HDPE culvert pipes PECOR OPTIMA®. ViaCon designs, manufactures and installs the manufactured products, thanks to which it can implement tasks in a comprehensive manner.

Over the last 19 years, ViaCon has become a European leader in this field. Our production plant in Rydzyna near Leszno (Wielkopolskie Province) is the largest in Europe and one of the largest in the world.

The company cooperates closely with the state administration, suppliers, as well as scientific and research centres in Europe, the United States and Canada.

This results in a whole range of innovative solutions offered by ViaCon, including underground detention systems, advanced corrosion protection systems, and comprehensive system solutions for storm-water drainage systems and sanitary sewage systems.

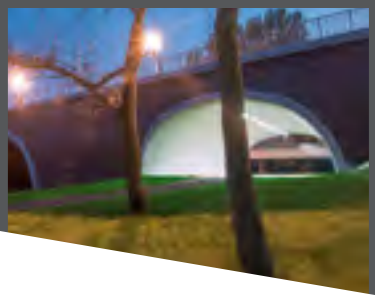
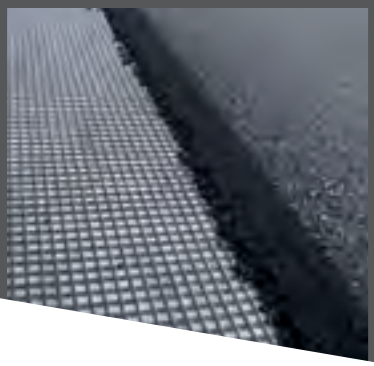
ViaCon Group is a pioneer in the production of SuperCor® flexible structures in the European market. Solutions of corrugated plate structures on flexible foundations constitute another example of the innovative approach to implementation and allow reducing the cost and time of construction.

Our company, as the first in Poland, placed double-wall HDPE pipes (PECOR OPTIMA®) on the market. They are used as plastic culverts. ViaCon also produces four MSE retaining walls systems called ViaWall® and ViaBlock®.

The company offers a wide range of geosynthetics, such as non-woven geotextiles, geotextiles, woven geotextiles, geogrids, geomembranes, and bentonite mats. Geosynthetics are polymer products characterized by high durability. Such products can be built in the subsoil to improve its mechanical and hydraulic parameters. They are widely used in hydraulic engineering, drainage, construction and forestry.

ViaCon has certified its Integrated Quality Assurance System according to ISO 9001:2008 and ISO 14001:2004, as well as OHS Management System according to the OHSAS 18001 standard. The offered products: MultiPlate MP200, HelCor® i HelCor PA, SuperCor®, and geosynthetics bear the CE mark.

ViaCon continuously strives to introduce new ideas and technologies that could improve the production system. To this end, we develop a Lean Manufacturing culture. We implement the following elements in accordance with this concept: 6S, Kaizen, Process standardization, TPM. Doing so, we use a number of tools, such as: 5W, Ishikawa, OEE, Mapping, PDCA and Pareto principle. The integrated knowledge management system, which functions in ViaCon, is unique in our industry.

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