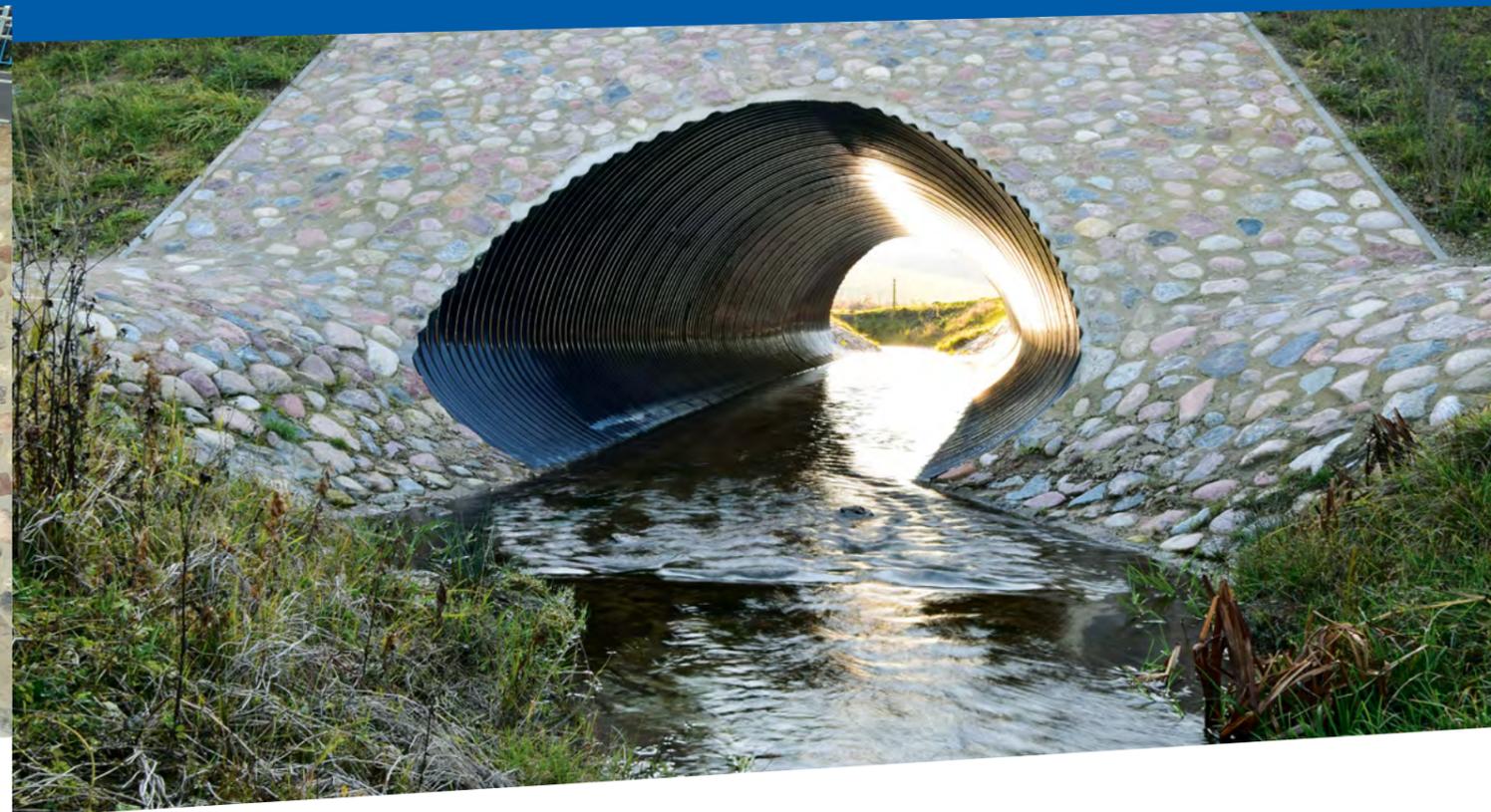


HELICALLY CORRUGATED STEEL PIPES

HelCor®

SPIRAL OF OPPORTUNITIES





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



- roads and railway culverts
- underground passages
- ecological passages
- hydrotechnical structures
- relining of deteriorated structures

Introduction

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, T-connections and additional elements such as manholes, inspection chambers etc.

Installation time of HelCor® and HelCor PA is much shorter than for concrete pipes. Easy and quick assembly helps to limit the construction time of culverts or other structures and allows construction of the pipe culvert in stages without stopping the traffic. Construction of culverts with the use of HelCor® and HelCor PA is much more economical than traditional concrete culverts. Construction can also take place during the winter time or cold weather conditions.

Steel

Tab. 1. HelCor® and HelCor PA steel pipes mechanical properties

| HelCor® and HelCor PA steel pipes mechanical properties | | | | |
|---|-------------|-------------------------------------|--|--------------------------------------|
| Steel grade | Standard | Yield point R _e [MPa] | Tensile strength R _m [MPa] | Elongation A _{50min} [%] |
| 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:

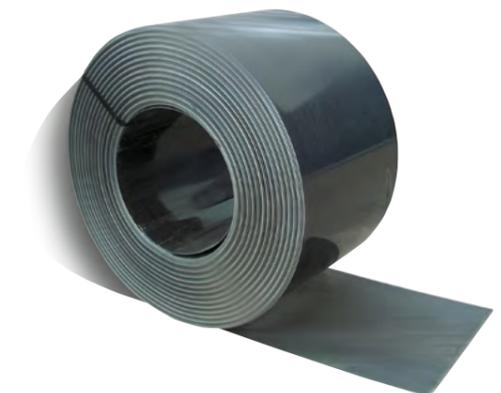
PN-EN 10346:2011 „Continuously hot-dip coated steel flat products – Technical delivery conditions”

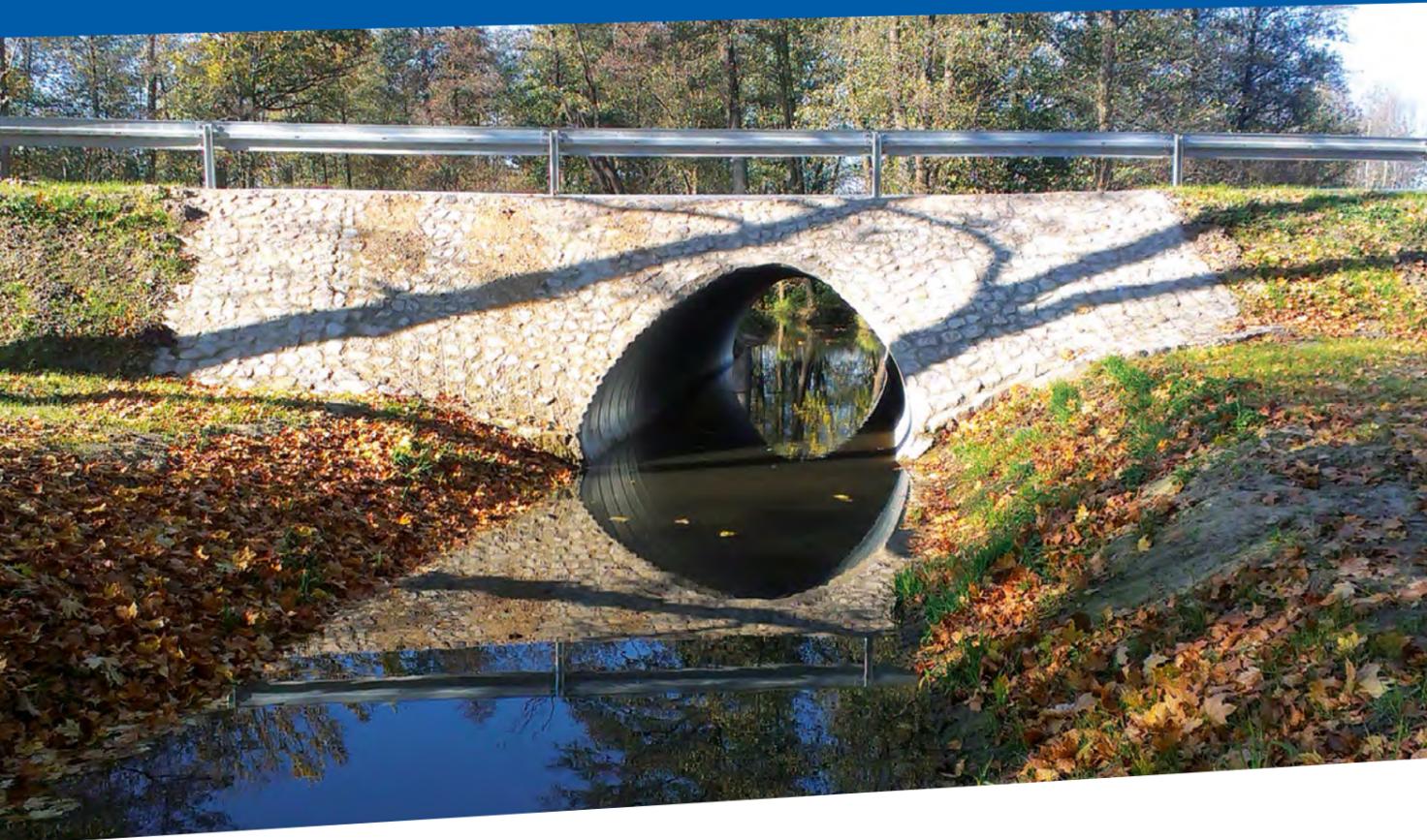
Steel is delivered in coils, with a protection coating in accordance to a/m standards:

- 600 g/m zinc coating total both sides, equivalent to 42 µm on each side
- 1000 g/m zinc coating total both sides, equivalent to 70 µm on each side
- 600 g/m zinc coating both sides, equivalent to 42 µm on each side, with an additional 300 µm polymer film (Trenchcoat™ or W-Protect™) 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 corrugations:

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





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 manufacture of pipes in any length. The pipearches are produced up to 10 m long (6 m standard length).

Pipes can be bevel cut in the factory in accordance with the design to conform the slope and the skew angle of the embankment.

Cut ends of the pipe are protected against corrosion by painting the cut sections. In order to obtain the designed length of the pipe, several lengths can be joined together with coupling bands.



TYPE 1

TYPE 2

TYPE 3

TYPE 4

TYPE 5

The coupling bands are made of flat or corrugated steel sheets. 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:
annularly corrugated for connection of pipes
with re-corrugated ends

TYPE 5:
flat with annular corrugation for connection of pipes with
recorrugated ends

Geometric properties of coupling bands are adjusted to the geometry of HelCor® pipes.





Tab.2. Technical specification for HelCor® pipes

| Type | Span/rise [m] | Cross section [m ²] | Substitute diameter** [mm] | Corrugation | Zinc protection | | Zinc coating + Trenchcoat layer | |
|---------|---------------|---------------------------------|----------------------------|-------------|-----------------------|---------------|---------------------------------|---------------|
| | | | | | Plate thickness* [mm] | Weight [kg/m] | 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 | 2,0 / 2,5 | 57,8 | 2,0 / 2,5 | 59,6 |
| HCPA-01 | 1,34/1,05 | 1,13 | 1 200 | D1 | 2,0 / 2,5 | 86,7 | 2,0 / 2,5 / 2,7 | 88,8 |
| HCPA-02 | 1,44/0,97 | 1,10 | 1 210 | D1 | 2,0 / 2,5 | 87,4 | 2,0 / 2,5 / 2,7 | 89,6 |
| HCPA-03 | 1,49/1,24 | 1,46 | 1 360 | D1 | 2,0 / 2,5 | 98,3 | 2,0 / 2,5 / 2,7 | 100,7 |
| HCPA-04 | 1,62/1,10 | 1,42 | 1 350 | D1 | 2,0 / 2,5 | 97,5 | 2,0 / 2,5 / 2,7 | 99,9 |
| HCPA-05 | 1,65/1,38 | 1,82 | 1 510 | D1 | 2,0 / 2,5 | 109,1 | 2,0 / 2,5 / 2,7 | 111,8 |
| HCPA-06 | 1,80/1,20 | 1,70 | 1 510 | D1 | 2,5 / 3,0 | 130,9 | 2,5 / 2,7 / 3,0 | 133,6 |
| HCPA-07 | 1,80/1,50 | 2,15 | 1 650 | D1 | 2,5 / 3,0 | 143,0 | 2,5 / 2,7 / 3,0 | 146,0 |
| HCPA-08 | 1,84/1,39 | 2,04 | 1 620 | D1 | 2,5 / 3,0 | 140,4 | 2,5 / 2,7 / 3,0 | 143,3 |
| HCPA-09 | 1,84/1,48 | 2,16 | 1 660 | D1 | 2,5 / 3,0 | 143,9 | 2,5 / 2,7 / 3,0 | 146,9 |
| HCPA-10 | 1,89/1,55 | 2,32 | 1 720 | D1 | 2,5 / 3,0 | 149,1 | 2,5 / 2,7 / 3,0 | 152,2 |
| HCPA-11 | 1,91/1,46 | 2,23 | 1 700 | D1 | 2,5 / 3,0 | 147,4 | 2,5 / 2,7 / 3,0 | 150,4 |
| HCPA-12 | 1,95/1,32 | 2,04 | 1 640 | D1 | 2,5 / 3,0 | 142,2 | 2,5 / 2,7 / 3,0 | 145,1 |
| HCPA-13 | 2,01/1,59 | 2,55 | 1 810 | D1 | 2,5 / 3,0 | 156,9 | 2,5 / 2,7 / 3,0 | 160,1 |
| HCPA-14 | 2,04/1,49 | 2,41 | 1 770 | D1 | 2,5 / 3,0 | 153,5 | 2,5 / 2,7 / 3,0 | 156,6 |
| HCPA-15 | 2,10/1,45 | 2,42 | 1 810 | D1 | 2,5 / 3,0 | 156,9 | 2,5 / 2,7 / 3,0 | 160,1 |
| HCPA-16 | 2,10/1,55 | 2,59 | 1 830 | D1 | 3,0 | 158,7 | 2,7 / 3,0 | 161,9 |
| HCPA-17 | 2,14/1,64 | 2,74 | 1 920 | D1 | 3,0 | 166,5 | 2,7 / 3,0 | 169,9 |
| HCPA-18 | 2,16/1,62 | 2,80 | 1 920 | D1 | 3,0 | 166,5 | 2,7 / 3,0 | 169,9 |
| HCPA-19 | 2,20/1,71 | 2,99 | 1 960 | D1 | 3,0 | 169,9 | 2,7 / 3,0 | 173,4 |
| HCPA-20 | 2,23/1,68 | 2,93 | 1 960 | D1 | 3,0 | 169,9 | 2,7 / 3,0 | 173,4 |
| HCPA-21 | 2,28/1,70 | 3,03 | 2 010 | D3 | 3,5 | 214,1 | 3,5 | 217,8 |
| HCPA-22 | 2,35/1,77 | 3,28 | 2 060 | D3 | 3,5 | 219,4 | 3,5 | 223,3 |
| HCPA-23 | 2,35/1,73 | 3,16 | 2 040 | D3 | 3,5 | 217,3 | 3,5 | 221,1 |
| HCPA-24 | 2,37/1,83 | 3,45 | 2 060 | D3 | 3,5 | 219,4 | 3,5 | 223,3 |
| HCPA-25 | 2,48/1,79 | 3,47 | 2 140 | D3 | 3,5 | 227,9 | 3,5 | 231,9 |
| HCPA-26 | 2,49/1,83 | 3,61 | 2 160 | D3 | 3,5 | 230,1 | 3,5 | 234,1 |
| HCPA-27 | 2,55/1,86 | 3,73 | 2 200 | D3 | 3,5 | 234,3 | 3,5 | 238,4 |
| HCPA-28 | 2,58/1,94 | 3,97 | 2 260 | D3 | 3,5 | 240,7 | 3,5 | 244,9 |
| HCPA-29 | 2,60/1,93 | 3,97 | 2 260 | D3 | 3,5 | 240,7 | 3,5 | 244,9 |
| HCPA-30 | 2,75/1,95 | 4,20 | 2 355 | D3 | 3,5 | 250,8 | 3,5 | 255,2 |
| HCPA-31 | 2,76/2,05 | 4,48 | 2 400 | D3 | 3,5 | 255,6 | 3,5 | 260,1 |
| HCPA-32 | 2,80/2,01 | 4,43 | 2 400 | D3 | 3,5 | 255,6 | 3,5 | 260,1 |
| HCPA-33 | 2,84/2,02 | 4,58 | 2 430 | D3 | 3,5 | 258,8 | 3,5 | 263,4 |
| HCPA-34 | 2,95/2,04 | 4,69 | 2 510 | D3 | 3,5 | 267,3 | 3,5 | 272,0 |
| HCPA-35 | 2,96/2,16 | 5,06 | 2 550 | D3 | 3,5 | 271,6 | 3,5 | 276,4 |
| HCPA-36 | 2,97/2,00 | 4,57 | 2 490 | D3 | 3,5 | 265,2 | 3,5 | 269,9 |
| HCPA-37 | 3,08/2,08 | 4,94 | 2 580 | D3 | 3,5 | 274,8 | 3,5 | 279,6 |
| HCPA-38 | 3,14/2,27 | 5,63 | 2 710 | D3 | 3,5 | 288,6 | 3,5 | 293,7 |
| HCPA-39 | 3,17/2,06 | 5,12 | 2 620 | D3 | 3,5 | 279,1 | 3,5 | 284,0 |
| HCPA-40 | 3,23/2,12 | 5,41 | 2 680 | D3 | 3,5 | 285,4 | 3,5 | 290,5 |
| HCPA-41 | 3,23/2,15 | 5,39 | 2 710 | D3 | 3,5 | 288,6 | 3,5 | 293,7 |
| HCPA-42 | 3,28/2,17 | 5,67 | 2 720 | D3 | 3,5 | 289,7 | 3,5 | 294,8 |
| HCPA-43 | 3,33/2,23 | 5,97 | 2 800 | D3 | 3,5 | 298,2 | 3,5 | 303,5 |
| HCPA-44 | 3,33/2,39 | 6,29 | 2 870 | D3 | 3,5 | 305,7 | 3,5 | 311,1 |
| HCPA-45 | 3,35/2,19 | 5,65 | 2 790 | D3 | 3,5 | 297,2 | 3,5 | 302,4 |
| HCPA-46 | 3,38/2,25 | 5,60 | 2 825 | D3 | 3,5 | 300,9 | 3,5 | 306,2 |
| HCPA-47 | 3,49/2,27 | 6,28 | 2 880 | D3 | 3,5 | 306,8 | 3,5 | 312,1 |
| HCPA-48 | 3,52/2,49 | 6,91 | 3 000 | D3 | 3,5 | 319,5 | 3,5 | 325,1 |
| HCPA-49 | 3,65/2,39 | 6,85 | 3 040 | D3 | 3,5 | 323,8 | 3,5 | 329,5 |
| HCPA-50 | 3,67/2,61 | 7,52 | 3 160 | D3 | 3,5 | 336,6 | 3,5 | 342,5 |



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

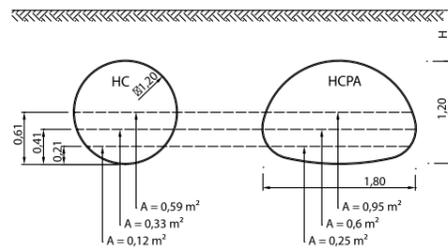


Fig. 1. Comparing water flow capacity of HelCor® and HelCor PA pipes



* Plate thickness tolerances acc. to EN 10143:1997

** Diameter of pipe before forming into pipe arch

In case of necessity of customized shape or plate thickness, please contact Technical Department.



Additional corrosion protection by painting

Coating steel with a polymer film, called Trenchcoat™, 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 film in a fully controlled in-house process. As a result, a very smooth and highly adhesive layer of polymer film protects the galvanized coating. The 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 process is the best way to protect against natural corrosion in zinc and steel, and it can also protect against mechanical damage due to abrasion and chemical corrosion. Research findings indicate that the Trenchcoat™ film is very effective in resisting aggressive chemicals.

Trenchcoat™ is the best corrosion protection available on the culvert market today. It can provide over 100 years lifetime in most environmental conditions.

The dielectric strength of Trenchcoat™ is 86,6 kV/mm which gives 25,9 kV for the thickness of 300 µm. This greatly outweighs the voltage of the stray currents arising within the electrified railway lines subgrade.

Using Trenchcoat™ provides absolute protection against the corrosion potentially caused by stray currents.

In special cases additional corrosion protection can be applied to the galvanized pipe with additional paint with thickness up to 400 µm. Please contact the ViaCon Technical Department for further information.



Pipe end finishing

Using HelCor® and HelCor PA pipes enables accurate adjustment of both ends to fit the slope and required angle. A 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 of the height of the pipe.

The embankment slopes in the inlets and outlets areas may 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 riprap
- stiffening with reinforced cast-in-place concrete collar

Culverts with an intersection angle other than 90 degrees may be manufactured with square or beveled ends. The minimum allowable skew angle is 55°.

In special cases additional reinforcement of the skewed area of the pipe may be necessary.

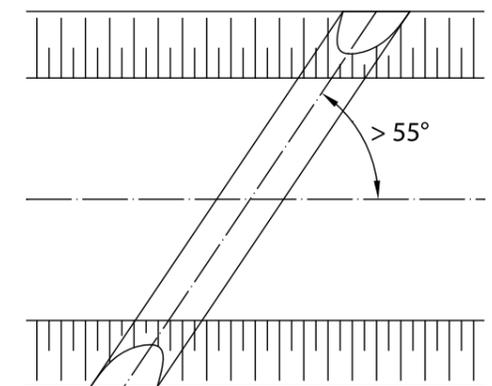
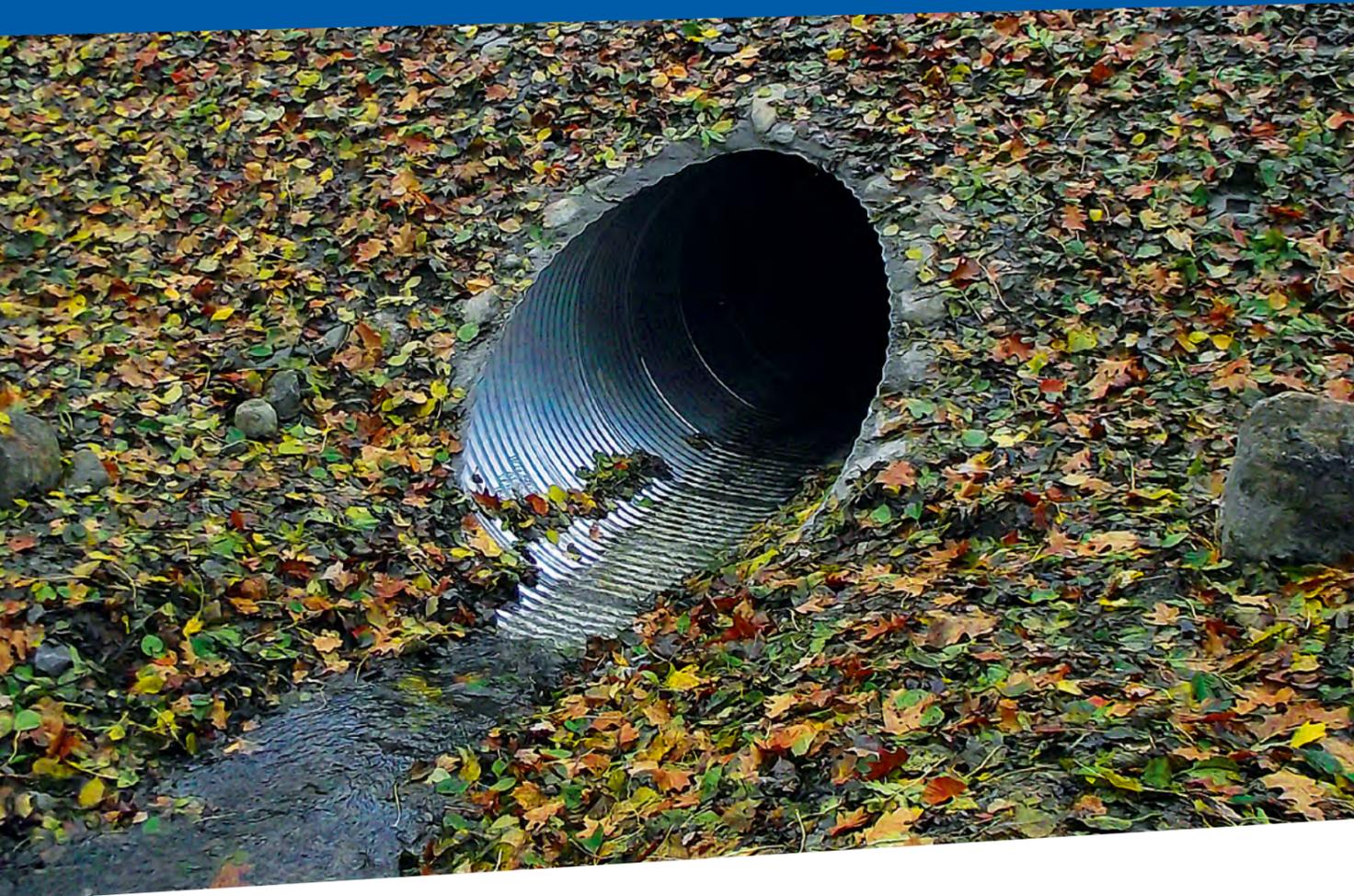


Fig. 2. Skewed structure





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 gradeline, including the road pavement.

Tab. 3. Cover depth

| Type of structure | Minimum cover depth |
|------------------------------------|--|
| Cover depth for road structures | $H_{min} = \max \begin{cases} (B/8)+0,2 \text{ [m]} \\ B/6 \text{ [m]} \\ 0,6 \text{ [m]} \end{cases}$ |
| Cover depth for railway structures | $H_{min} = \max \begin{cases} B/4 \\ 0,6 \text{ [m]} \end{cases}$ |

B – diameter or pipe span [m]

Definition of the cover depth for railway structures

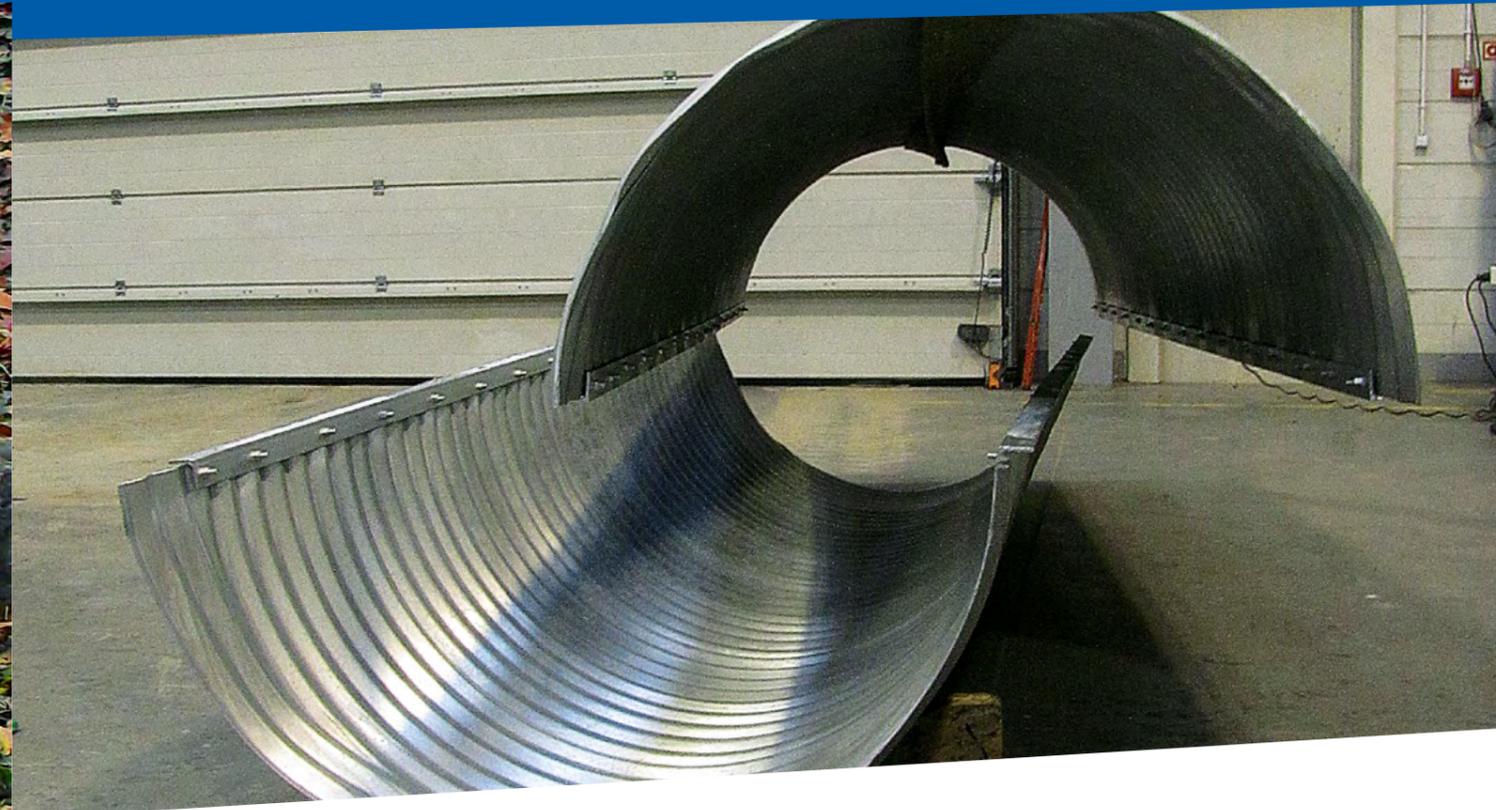
Cover depth for culvert under railway can be described as a vertical distance between the top of the culvert and the bottom of the railway sleeper, including the construction layers of the railroad.

In case of construction traffic occurring over the pipe, the cover depth must be checked by the ViaCon's Technical Department.

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 the 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 including frozen material is not acceptable
- backfill material around the structure should be built in layers of thickness 30 cm and then compacted symmetrically on both sides of the culvert
- uniformity coefficient $C_u \geq 4$
- curvature coefficient $1 \leq C_c \leq 3$
- permeability $k_{10} > 6 \text{ m/day}$
- backfill material should be compacted to minimum 0,98 Standard Proctor Density, (0,95 of Standard Proctor Density is acceptable in the zone directly adjacent to the pipe)

Deviation from these principles requires consultation with ViaCon Technical Department.



New helically corrugated steel pipes HelCor® Bi Pipes



Flexible, cold formed helically corrugated steel pipes, produced as bifid pipes (half pipes), bolted together with L-shape steel elements and longitudinally connected with couplings, can be used in as a steel-soil structures under road and railways loads.

Parameters

- produced diameters – Ø400 mm - Ø1200 mm
- recommended lengths – 6 m
- two types of corrugations – D168x13 mm and 125x26 mm

Three types of corrosion protection

- 42 µm zinc layer (600g/m²)
- 70 µm zinc layer (1000g/m²)
- 42 µm zinc layer (600g/m²) + 300 µm polymer layer Trenchcoating™(TC) or W-Protect™



INNOVATIVE INFRASTRUCTURE

SuperCor®



MultiPlate MP200



UltraCor®



HelCor®



HelCor PA®



PECOR OPTIMA®



PECOR QUATTRO



ViaWaterTank



Geogrids



Woven and nonwoven geotextiles



Gabions



HelCor® wells



Temporary and permanent
Acrow bridges



ViaWall A®



ViaWall B®



ViaBlock®



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