

HelCor®

Helically corrugated steel pipes



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HelCor®



Helically (spirally) 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. In Europe, the pipes appeared at 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. HelCor® and HelCor PA may be designed for all road and railway live load classes according to norm Eurocode EN 1991-2 or according to the relevant national standards dedicated for corrugated steel.

SUSTAINABILITY

By using lightweight corrugated steel pipe instead of concrete, both energy consumption in manufacturing and installation as well as CO2 emissions can be reduced. A comparative life cycle analysis study of corrugated steel structures



and reinforced concrete pipes confirms this. This was commissioned by the Canadian Corrugated Steel Pipe Institute (CSPI). The study concludes that corrugated steel pipes cause 77 per cent less CO₂ emissions in their entire life cycle compared to reinforced concrete pipes. The greatest advantage of corrugated steel pipes over concrete pipes is their significantly lower mass.

STEEL

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

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 on one or both sides



HelCor® and HelCor PA pipes are produced from steel coils with various thickness and various types of corrugations:

HelCor® and HelCor PA can be also produced from a special Aluminium (Al)

More technical information about raw material parameters and product parameters is available on the Technical Data Sheet (TDS) connected to production unit.





SECTION LENGTHS AND COUPLING BANDS

The typical lengths of HelCor® pipes are 6 m, 7 m and 8 m, however the production process allows the manufacture of pipes in any 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.

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:

Not each type of coupling are available in each ViaCon production unit. Please check this in Technical Data Sheet connected to production unit.

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 re-corrugated ends



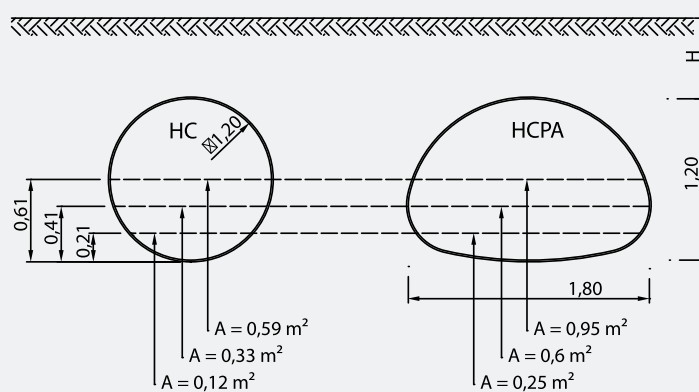
Geometric properties of coupling bands are adjusted to the geometry of HelCor® pipes.





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





ADDITIONAL CORROSION PROTECTION BY POLYMER FILM

Coating steel with a polymer film, 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 EN 10169-1+A1:2012 and ASTM 742.

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

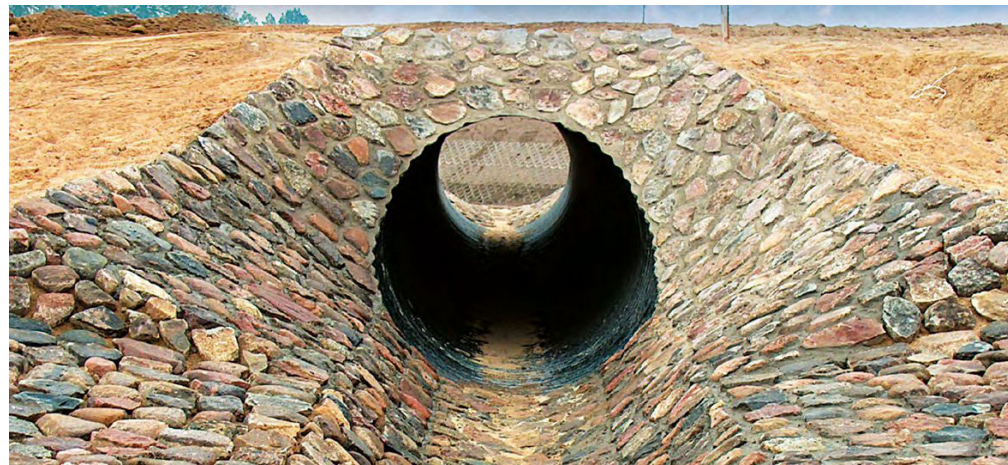
Protection obtained in such process is the best way to protect against natural corrosion in zinc and steel, and it can also protect against mechanical damage due to abrasion and chemical corrosion. Research findings indicate that the polymer film is very effective in resisting aggressive chemicals.

Polymer film is the best corrosion protection available on the steel culvert today. It can provide over 100 years life-time in most environmental conditions.

The dielectric strength of Polymer Film 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 Polymer Film provides absolute protection against the corrosion potentially caused by stray currents.

Nowadays ViaCon produce pipes with several types of polymer films coating, for instance: Trenchcoat®, Isofilm®. Each of them are tested to fulfill corrosion resistance, adhesion and abrasion requirements.

Long-term studies from the USA – where corrugated steel pipes with film-coating have been used for culverts for over 40 years – confirm the long possible service life above 100 years even under the most adverse conditions (moisture from wastewater, drought, salt, chemicals, or UV radiation).





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:

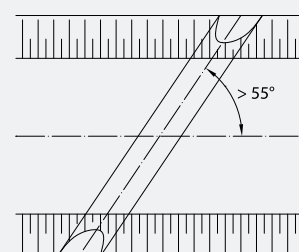
- Reinforcement of the slope with concrete or stone blocks placed on sand-cement mix
- Reinforcement with perforated concrete panels
- Reinforcement with stone riprap
- Stiffening with reinforced cast-in-place concrete collar

Culverts with an intersection angle other than 90 degrees may be manufactured with square or beveled ends. The recommended minimum skew angle is 55° fig.2.

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 pipe and the road gradeline, 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.

Minimum cover depth could be calculate as follows:

Tab. 3. **Minimum** Cover depth

Type of structure	Minimum. cover depth	
Cover depth for road structures	$H_{\min} = \max$	$(D/8)+0,2$ [m] $D/6$ [m] $0,6$ [m]
cover depth for railway structures	$*H_{\min} = \max$	$D/4$ $0,90$ (1,50 in Germany) [m]

D – diameter or pipe [m]

Minimum cover depth could be defined differently from country to country. Anyway optimal cover depth should be always design individually for a given project.

RECOMMENDED 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 and needs to be defined by the designer.
- 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 $k_{10} > 6$ 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)

Each project specification could define backfilling material with some deviation from above. Consulting of backfilling parameters with ViaCon expert is recommended.





HELICALLY CORRUGATED STEEL PIPES HelCor®Bi

Optionally ViaCon can produce HelCor® pipes as bifid pipes HelCor®Bi

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 –
68x13 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

NOTES



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