

Structural analysis

Project: Preplastitev regionalne ceste R3-675

Description: Odsek1481 Mokrice-Obrežje-Slovenska vas na delu med km 1.555 do km 2.687
DN 400; SN 10.000; PN1; HGV60

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1 Statics according to ATV-DVWK-A 127, 3rd edition

Kind of calculation:
Add sketch to print:

Nominal stiffness
Yes

1.1 Input

1.1.1 Safety factors

Safety class:
Allowable deflection:
Treatment of internal pressure:

Lower safety factors for flexural compression:
Proof for not predominantly static loading:
Consideration of dyn pvh*:
Consideration of Type A 'predeformation' in the deformation proof:
Proof of minimum ring stiffness:

A (normal case)
6% (standard)
In accordance with Footnote 39 in
ATV-DVWK-A 127
No (ATV-DVWK-A 127)
According to standard
According to standard
Yes
No

1.1.2 Soil

Soil group backfill:
Calculation E1:
Soil group pipe zone:
Calculation E20:
Soil group native soil:
Calculation E3:
Proctor density E3:
E4 = 10 · E1:
Application of silo theory:

G1
Table 8 (A127)
G2
Table 8 (A127)
G3
Proctor density
D_{Pr,E3} 90.0 %
Yes
Automatic

1.1.3 Load

Cover depth:
Soil density:
Manual input of buoyant weight of soil:
Additional surface load:
Maximum groundwater level above pipe bed:
Minimum groundwater level above pipe bed:
Inner pressure, short term:
Inner pressure, long term:
Water fill (e.g. damming channel):
Density of medium:
Traffic load:
Including horizontal loads due to traffic in the fatigue proof:

h 0.80 m
γ 20.0 kN/m³
No
p₀ 0.0 kN/m²
h_{W,max} 0.00 m
h_{W,min} 0.00 m
P_{I,K} 0.00 bar
P_{I,L} 0.00 bar
Yes
γ_F 10.0 kN/m³
HLC 60 (road)
α_{qHT,dyn} 0.00 %

1.1.4 Installation

Installation:
Trench width at pipe crown level:
Automatic consideration of bedding layer:
Slope angle:
Cover condition:

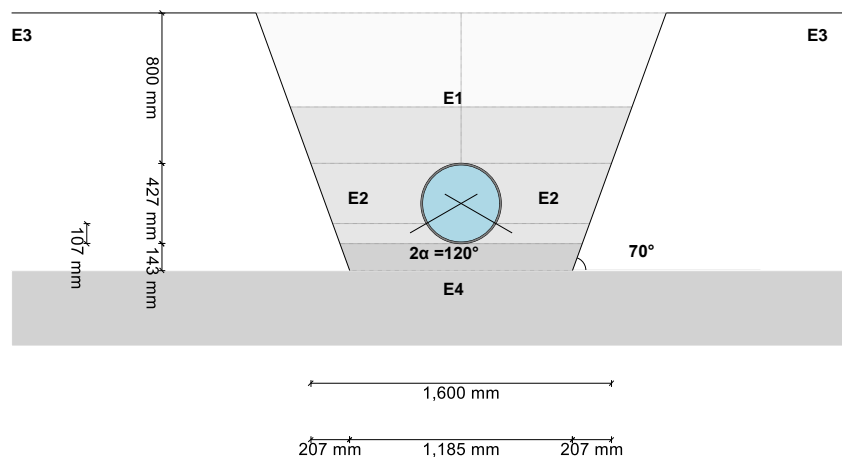
Trench
b 1.60 m
Yes
β 70 °
A1

Installation condition:	B1		
Type of bedding:	Loose		
Bedding angle:	120°		
Calculate bedding automatically:	Yes		
Height base:	h_s	0.00	m

1.1.5 Pipe with nominal stiffness

Choice of input:	$D_o - s$		
Outer diameter:	d_a	427	mm
Wall thickness:	t	11.0	mm
Local deformation:	$\delta_{v, lokal}$	0.0	%
Nominal stiffness:	SN	10,000	N/m ²
Nominal pressure:	PN	1.0	bar
Deformation at failure to Table 3 ATV:	Yes		
Creep ratio:	f_{Kriech}	2.00	[-]
Reduction factor due to temperature effect:	$A_{1, Temp}$	1.00	[-]
Reduction factor due to media attack:	$A_{2, Medium}$	1.00	[-]
Reduction factor due to dynamic loading:	$A_{3, dyn}$	1.00	[-]
Specific gravity:	γ_R	18.00	kN/m ³
Poissons ratio:	ν	0.30	[-]
Amplitude with $1 \cdot 10^6$ tests is known:	Yes		
Amplitude with $1 \cdot 10^6$ tests:	$2\sigma_{a, 2E6}$	39.00	N/mm ²
Amplitude with $1 \cdot 10^8$ tests is known:	Yes		
Amplitude of the pipe with $1 \cdot 10^8$ tests:	$2\sigma_{a, 1E8}$	24.00	N/mm ²

Traffic load: HLC 60 (road)



1.2 Results

1.2.0.1 Minimum trench width according to DIN EN 1610

The minimum trench width at trench sole level according DIN EN 1610 is met.

1.2.1 Section forces

1.2.2 Short term load case

1.2.2.1 Strain proof

		crown	springline	invert	
Safety coefficient outside	γ	-7.675	13.317	-6.393	[-]
Safety coefficient Inside	γ	8.462	-9.363	6.937	[-]
(Safety coefficients for flexural compressive stress are marked with a minus sign)					
Required security coefficient, tensile stress by bending:			erf γ_{RBZ}	2.00	[-]
Required security coefficient, compressive stress by bending:			erf γ_{RBD}	2.00	[-]

All calculated safety coefficients of the strain proof are sufficient.

1.2.2.2 Deformation proof

Total vertical deformation (Type A + Type B):	$\delta_{v,Ges}$	3.47	%
Allowable deflection:	zul δ_v	6.00	%

The deflection determined is less than the allowable deflection.

1.2.2.3 Stability proof, linear

Safety coefficient stability:	γ	10.85	[-]
Required security coefficient, failure by instability (buckling):	erf γ_{stab}	2.00	[-]

The buckling safety coefficients determined are sufficient.

1.2.3 Long term load case

1.2.3.1 Strain proof

		crown	springline	invert	
Safety coefficient outside	γ	-6.696	12.058	-5.415	[-]
Safety coefficient Inside	γ	7.443	-8.314	5.867	[-]
(Safety coefficients for flexural compressive stress are marked with a minus sign)					
Required security coefficient, tensile stress by bending:			erf γ_{RBZ}	2.00	[-]
Required security coefficient, compressive stress by bending:			erf γ_{RBD}	2.00	[-]

All calculated safety coefficients of the strain proof are sufficient.

1.2.3.2 Deformation proof

Total vertical deformation (Type A + Type B):	$\delta_{v,Ges}$	3.55	%
Allowable deflection:	zul δ_v	6.00	%

The deflection determined is less than the allowable deflection.

1.2.3.3 Stability proof, linear

Safety coefficient stability:	γ	10.36	[-]
Required security coefficient, failure by instability (buckling):	erf γ_{stab}	2.00	[-]

The buckling safety coefficients determined are sufficient.

1.2.3.4 stability proof, nonlinear

The nonlinear stability proof is not applicable because of $VRB > 1.0$ (rigid pipe) or relative vertical deformation $< 6\%$.

1.2.3.5 Proof of safety against failure with not predominantly static loading

Inside					
Dynamic stress portion external	dyn σ_{pV}	14.011	-14.678	14.737	N/mm ²
Safety coefficient external:	dyn γ	2.783	---	2.646	[-]
Necessary safety coefficient:			erf γ	1.000	[-]
outside					
Dynamic stress portion external	dyn σ_{pV}	-13.501	13.256	-14.251	N/mm ²
Safety coefficient external:	dyn γ	---	2.942	---	[-]
Necessary safety coefficient:			erf γ	1.000	[-]

The determined safety coefficients are sufficient.

All necessary proofs are ok.