

## 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 600; 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<sub>Pr,E3</sub> 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 1.30 m  
γ 20.0 kN/m<sup>3</sup>  
No  
p<sub>0</sub> 0.0 kN/m<sup>2</sup>  
h<sub>W,max</sub> 0.00 m  
h<sub>W,min</sub> 0.00 m  
P<sub>I,K</sub> 0.00 bar  
P<sub>I,L</sub> 0.00 bar  
Yes  
γ<sub>F</sub> 10.0 kN/m<sup>3</sup>  
HLC 60 (road)  
α<sub>qHT,dyn</sub> 0.00 %

#### 1.1.4 Installation

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

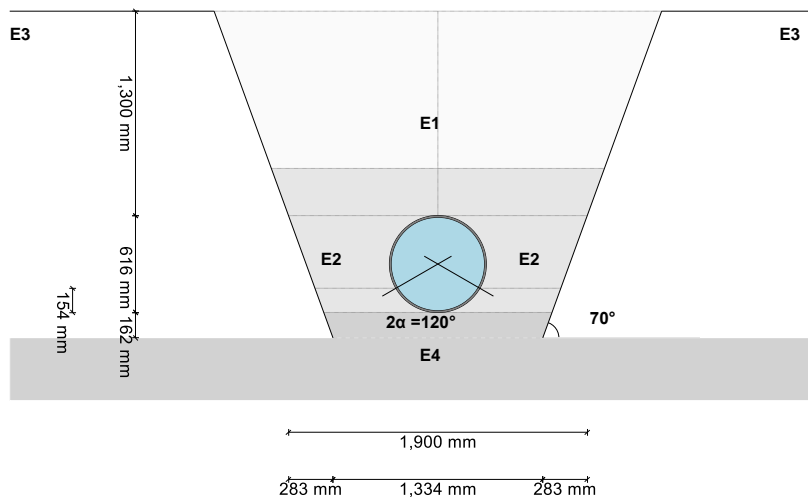
Trench  
b 1.90 m  
Yes  
β 70 °  
A1

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:	Do - s		
Outer diameter:	$d_a$	616	mm
Wall thickness:	$t$	14.0	mm
Local deformation:	$\delta_{v, \text{lokal}}$	0.0	%
Nominal stiffness:	SN	10,000	N/m <sup>2</sup>
Nominal pressure:	PN	1.0	bar
Deformation at failure to Table 3 ATV:	Yes		
Creep ratio:	$f_{\text{Kriech}}$	2.00	[-]
Reduction factor due to temperature effect:	$A_{1, \text{Temp}}$	1.00	[-]
Reduction factor due to media attack:	$A_{2, \text{Medium}}$	1.00	[-]
Reduction factor due to dynamic loading:	$A_{3, \text{dyn}}$	1.00	[-]
Specific gravity:	$\gamma_R$	18.00	kN/m <sup>3</sup>
Poissons ratio:	$\nu$	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 <sup>2</sup>
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 <sup>2</sup>

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	$\gamma$	-9.361	13.659	-7.789	[-]
Safety coefficient Inside	$\gamma$	10.067	-10.584	8.251	[-]
(Safety coefficients for flexural compressive stress are marked with a minus sign)					
Required security coefficient, tensile stress by bending:			erf $\gamma_{RBZ}$	2.00	[-]
Required security coefficient, compressive stress by bending:			erf $\gamma_{RBD}$	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):	$\delta_{v,Ges}$	3.05	%
Allowable deflection:	zul $\delta_v$	6.00	%

The deflection determined is less than the allowable deflection.

##### 1.2.2.3 Stability proof, linear

Safety coefficient stability:	$\gamma$	12.42	[-]
Required security coefficient, failure by instability (buckling):	erf $\gamma_{stab}$	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	$\gamma$	-7.031	10.973	-5.566	[-]
Safety coefficient Inside	$\gamma$	7.688	-8.229	5.913	[-]
(Safety coefficients for flexural compressive stress are marked with a minus sign)					
Required security coefficient, tensile stress by bending:			erf $\gamma_{RBZ}$	2.00	[-]
Required security coefficient, compressive stress by bending:			erf $\gamma_{RBD}$	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):	$\delta_{v,Ges}$	3.20	%
Allowable deflection:	zul $\delta_v$	6.00	%

The deflection determined is less than the allowable deflection.

##### 1.2.3.3 Stability proof, linear

Safety coefficient stability:	$\gamma$	11.23	[-]
Required security coefficient, failure by instability (buckling):	erf $\gamma_{stab}$	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 $\sigma_{pV}$	12.819	-13.379	13.485	N/mm <sup>2</sup>
Safety coefficient external:	dyn $\gamma$	3.042	---	2.892	[-]
Necessary safety coefficient:			erf $\gamma$	1.000	[-]
outside					
Dynamic stress portion external	dyn $\sigma_{pV}$	-12.407	12.233	-13.094	N/mm <sup>2</sup>
Safety coefficient external:	dyn $\gamma$	---	3.188	---	[-]
Necessary safety coefficient:			erf $\gamma$	1.000	[-]

The determined safety coefficients are sufficient.

All necessary proofs are ok.