

Calculations to ATV-DVWK-A 127, third edition, August 2000

Project: Letkov u Plzne
Client: Zdenek Bláha
Statics No.: 20241104v1
Date: 04.11.2024
Contact: Zdenek Bláha
Tel: +420 724 966 620
E-mail: zdenek@ipkblaha.cz

Nemáme autorizaci pro statické posouzení, výsledky platí pouze pro zadané hodnoty !

Input:

Safety factors

Safety class:	A (normal case)	
Allowable deflection:	6% (normal case)	
A type predeformation:	$\delta_{v,TypeA}$	1,00 %
Local predeformation:	$\delta_{v,local}$	0,00 %

Pipe

Description:	PRAGMA+ID DN600 SN16		
Inside diameter:	d_i	604,3	mm
Profile height:	h	43,35	mm
Profile surface:	A_{rad}	9,28	mm ² /mm
Moment of inertia:	J	1 573,02	mm ⁴ /mm
Distance of inertia:	e	16,94	mm
Surface ratio Kappa Q:	κ_Q	2,43	[1]

Pipe material

Material class:	Thermoplastic		
Description:	Polypropylene		
Density of pipe material:	γ_P	9,00	kN/m ³
Transv. contr. coeff.:	ν	0,38	[1]
E-Modulus, short:	E_{st}	1 200,00	N/mm ²
E-Modulus, long:	E_{lt0}	350,00	N/mm ²
Ultimate flexural tensile stress, short-term:	$\sigma_{BT,st}$	39,00	N/mm ²
Ultimate flexural compressive stress, short-term:	$\sigma_{BC,st}$	39,00	N/mm ²
Ultimate flexural tensile stress, long-term:	$\sigma_{BT,lt}$	17,00	N/mm ²
Ultimate flexural compressive stress, long-term:	$\sigma_{BC,lt}$	17,00	N/mm ²

Soil

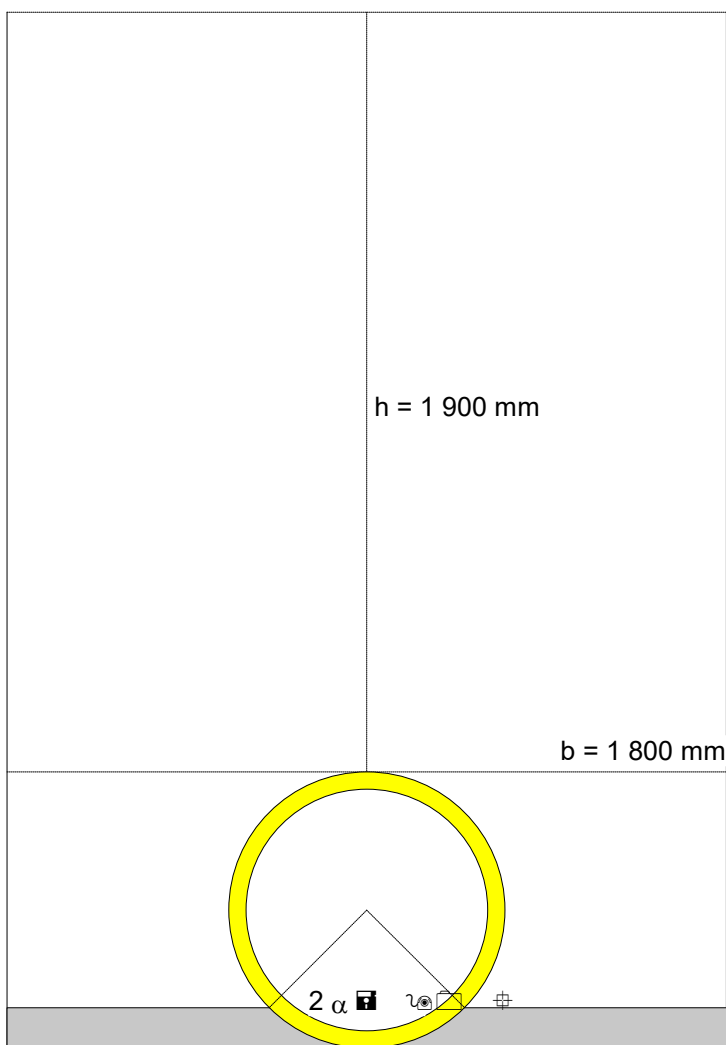
E1: Backfilling:	Soil group: G2		
Value from Table 8 in ATV A127:	D_{PR1}	90,0	%
E20: Pipe zone:	Soil group: G1		
Value from Table 8 in ATV A127:	D_{PR2}	90,0	%
E3: Native soil:	Soil group: G4		
Proctor density:	D_{PR3}	95,0	%
E4: Below trench	$E4 = 10 * E1$		

Installation

Trench width:	b	1 800	mm
Slope angle:	β	90,00	°
Cover condition:	A2		
Bedding condition:	B2		
Lining below pipe taken into account as per ATV Work Group 1.5.5 report.			
Lining depth below pipe:	t_s	0	mm
Type of bedding:	loose		
Relative projection:	a	1,00	[1]
Bedding angle:	90°		

Load case combination 1

Description:	uložení v silnici III. třídy		
Cover depth:	h	1 900	mm
Soil density:	γ	20,00	kN/m ³
Additional surface load:	P ₀	0,00	N/mm ²
Maximum groundwater level above pipe bed:	h _{W,max}	0	mm
Minimum groundwater level above pipe bed:	h _{W,min}	0	mm
Internal pressure:	P _i	0,00	bar
Water fill (e.g. damming channel)	Yes		
Density of medium:	γ_F	10,00	kN/m ³
Traffic load:	HLC 60 (road)		



Proof for load case combination 1, Short term

Stress proof:

Calculated ultimate flexural tensile stress, soil/traffic load:		$\sigma_{calc,BZ}$	39,0	N/mm ²	
Calculated ultimate flexural compr. stress, soil/traffic load:		$\sigma_{calc,BD}$	39,0	N/mm ²	
Ultimate flexural tensile stress due to other loads:		$\sigma_{all,BZ}$	39,0	N/mm ²	
Ultimate flexural compressive stress due to other loads:		$\sigma_{all,BD}$	39,0	N/mm ²	
Internal:		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{qv,qh,qh^*,i}$	2,508	-4,891	5,012	N/mm ²
Stress due to other loads:	$\sigma_{other,i}$	0,291	-0,296	0,789	N/mm ²
Safety coefficient:	γ_{BTi}	13,93	---	6,72	[1]
Safety coefficient:	γ_{BCi}	---	7,52	---	[1]
External:		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{qv,qh,qh^*,a}$	-7,02	2,02	-11,11	N/mm ²
Stress due to other loads:	$\sigma_{other,a}$	-0,36	0,47	-0,90	N/mm ²
Safety coefficient:	γ_{BTe}	---	15,69	---	[1]
Safety coefficient:	γ_{BCe}	5,28	---	3,25	[1]
Required flexural tensile safety coefficient:		req γ_{BT}	2,50	[1]	
Required flexural compressive safety coefficient:		req γ_{BC}	2,50	[1]	

The stress safety coefficients determined are sufficient.

Deflection proof:

Calculation method:		linear		
Ratio:		$I/(A_{rad} \cdot r_m^2)$	0,00166	[1]
Ratio:		$I/(A_{rad} \cdot r_m^2) \cdot K_q$	0,00405	[1]
		q_v	q_h	q_h^*
Deflection coefficient for bending moments:	c_v	-0,0966	0,0833	0,0640 [1]
Deflection coefficient for axial forces:	cN_v	-0,697	-0,681	-0,247 [1]
Deflection coefficient for lateral forces:	cQ_v	-0,389	0,335	0,243 [1]
Resultant deflection coefficient:	c'_v	-0,1021	0,0859	0,0663 [1]
Vertical diameter change:		Δd_v	16,1	mm
Horizontal diameter change:		Δd_h	12,0	mm
Relative vertical deformation:		δ_v	2,52	%
Allowable deflection:		all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Total vertical load	q_v	59,3	kN/m ²
Reduction factor for soil/traffic load:	κ_{v2}	0,87	[1]
Critical buckling load (soil/traffic load):	crit q_v	654,6	kN/m ²
The buckling proof for water pressure does not apply, as there is neither groundwater nor a vacuum.			
Buckling safety coefficient:	γ_{buckl}	11,03	[1]
Required buckling safety coefficient:	req γ_{buckl}	2,00	[1]

The buckling safety coefficients determined are sufficient.

Non linear stability proof:

- n/a -

Proof for load case combination 1, Long term

Stress proof:

Calculated ultimate flexural tensile stress, soil/traffic load:		$\sigma_{calc,BZ}$	26,6	N/mm ²	
Calculated ultimate flexural compr. stress, soil/traffic load:		$\sigma_{calc,BD}$	26,6	N/mm ²	
Ultimate flexural tensile stress due to other loads:		$\sigma_{all,BZ}$	17,0	N/mm ²	
Ultimate flexural compressive stress due to other loads:		$\sigma_{all,BD}$	17,0	N/mm ²	
Internal:		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{qv,qh,qh^*,i}$	1,238	-3,546	3,690	N/mm ²
Stress due to other loads:	$\sigma_{other,i}$	0,160	-0,159	0,659	N/mm ²
Safety coefficient:	γ_{BTi}	17,86	---	5,63	[1]
Safety coefficient:	γ_{BCi}	---	7,01	---	[1]
External:		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{qv,qh,qh^*,a}$	-5,41	0,21	-9,42	N/mm ²
Stress due to other loads:	$\sigma_{other,a}$	-0,20	0,27	-0,74	N/mm ²
Safety coefficient:	γ_{BTe}	---	42,11	---	[1]
Safety coefficient:	γ_{BCe}	4,64	---	2,51	[1]
Required flexural tensile safety coefficient:		req γ_{BT}	2,50	[1]	
Required flexural compressive safety coefficient:		req γ_{BC}	2,50	[1]	

The stress safety coefficients determined are sufficient.

Deflection proof:

Calculation method:		linear		
Ratio:		$I/(A_{rad} \cdot r_m^2)$	0,00166	[1]
Ratio:		$I/(A_{rad} \cdot r_m^2) \cdot K_q$	0,00405	[1]
		q_v	q_h	q_h^*
Deflection coefficient for bending moments:	c_v	-0,0966	0,0833	0,0640 [1]
Deflection coefficient for axial forces:	cN_v	-0,697	-0,681	-0,247 [1]
Deflection coefficient for lateral forces:	cQ_v	-0,389	0,335	0,243 [1]
Resultant deflection coefficient:	c'_v	-0,1021	0,0859	0,0663 [1]
Vertical diameter change:		Δd_v	19,8	mm
Horizontal diameter change:		Δd_h	12,9	mm
Relative vertical deformation:		δ_v	3,10	%
Allowable deflection:		all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Total vertical load	q_v	58,1	kN/m ²
Reduction factor for soil/traffic load:	κ_{v2}	0,87	[1]
Critical buckling load (soil/traffic load):	crit q_v	507,1	kN/m ²
The buckling proof for water pressure does not apply, as there is neither groundwater nor a vacuum.			
Buckling safety coefficient:	γ_{buckl}	8,73	[1]
Required buckling safety coefficient:	req γ_{buckl}	2,00	[1]

The buckling safety coefficients determined are sufficient.

Non linear stability proof:

- n/a -

Proof for load case combination 1, Long term

Stress proof:

		Crown	Springline	Bottom	
Safety coefficient (internal):	γ_i	17,86	-7,01	5,63	[1]
Safety coefficient (external):	γ_e	-4,64	42,11	-2,51	[1]
(Safety coefficients for flexural compressive stress are marked with a minus sign)					

Required flexural tensile safety coefficient:	req γ_{BT}	2,50	[1]
Required flexural compressive safety coefficient:	req γ_{BC}	2,50	[1]

The stress safety coefficients determined are sufficient.

Deflection proof:

Relative vertical deformation:	δ_v	3,10	%
Allowable deflection:	all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Buckling safety coefficient:	γ_{buckl}	8,73	[1]
Required buckling safety coefficient:	req γ_{buckl}	2,00	[1]

The buckling safety coefficients determined are sufficient.