

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:	PP Master DN500 SN16
Outside diameter:	d_o 500,0 mm
Wall thickness:	s 19,70 mm

Pipe material

Material class:	Thermoplastic
Description:	Multilyer PP- PP Master
Density of pipe material:	γ_P 10,50 kN/m ³
Transv. contr. coeff.:	ν 0,38 [1]
E-Modulus, short:	E_{st} 2 900,00 N/mm ²
E-Modulus, long:	E_{lt0} 725,00 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

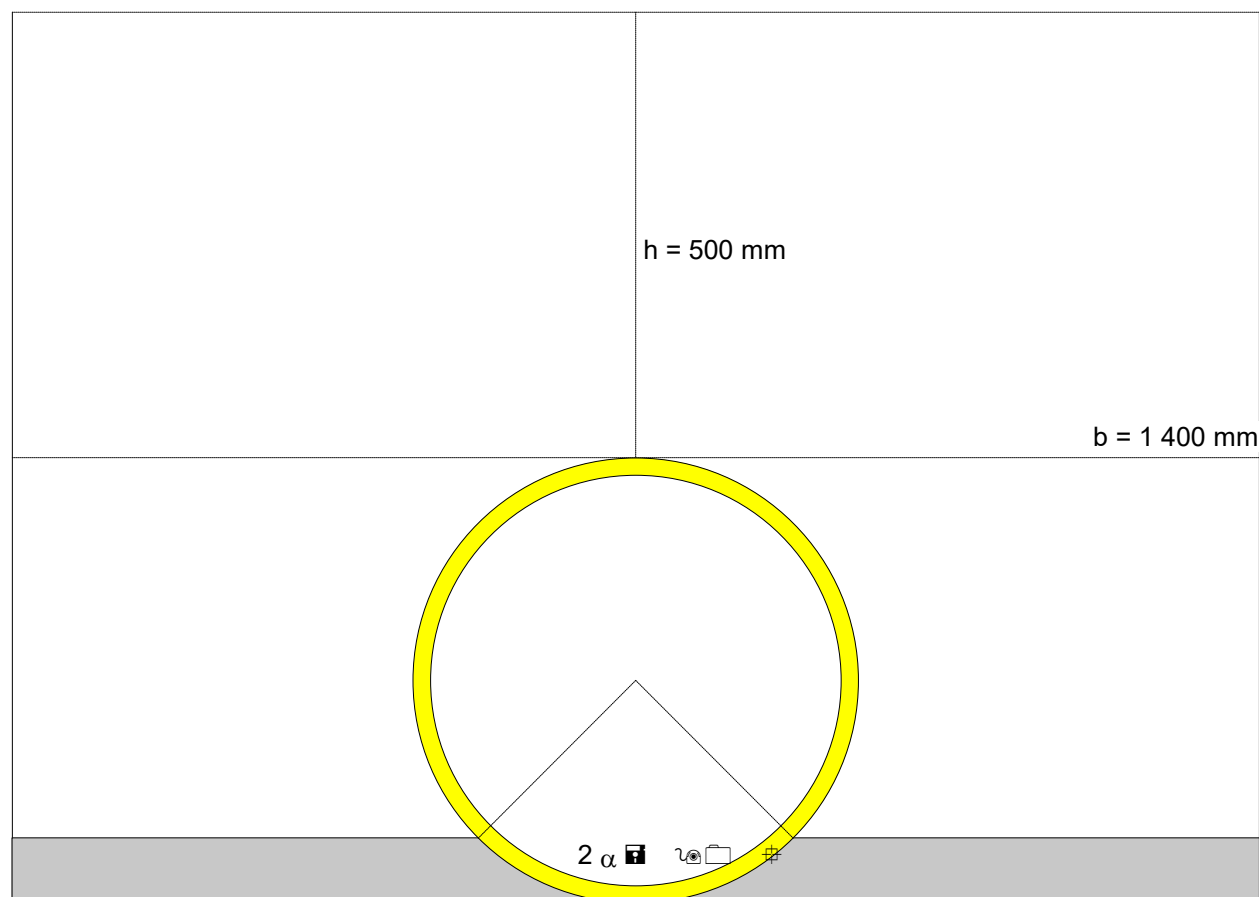
E1: Backfilling:	Soil group: G2
Value from Table 8 in ATV A127:	D_{PR1} 90,0 %
E20: Pipe zone:	Soil group: G2
Value from Table 8 in ATV A127:	D_{PR2} 90,0 %
E3: Native soil:	Soil group: G4
Proctor density:	D_{PR3} 95,0 %
E4: Below trench	$E4 = 10 * E1$

Installation

Trench width:	b	1 400	mm
Slope angle:	β	90,00	°
Cover condition:	A2		
Bedding condition:	B2		
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	500	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:	$\sigma_{qv,qh,qh^*,i}$	10,855	-11,363	13,664	N/mm ²
Stress due to other loads:	$\sigma_{other,i}$	0,352	-0,393	0,656	N/mm ²
Safety coefficient:	γ_{BTi}	3,48	---	2,72	[1]
Safety coefficient:	γ_{BCi}	---	3,32	---	[1]
External:		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{qv,qh,qh^*,a}$	-10,92	8,87	-13,78	N/mm ²
Stress due to other loads:	$\sigma_{other,a}$	-0,31	0,38	-0,56	N/mm ²
Safety coefficient:	γ_{BTe}	---	4,22	---	[1]
Safety coefficient:	γ_{BCe}	3,47	---	2,72	[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:		$I/(A_{rad} \cdot r_m^2)$	0,00056	[1]
Ratio:		$I/(A_{rad} \cdot r_m^2) \cdot \kappa_q$	0,00067	[1]
Resultant deflection coefficient:	c'_v	q_v -0,0966	q_h 0,0833	q_h^* 0,0640 [1]
Vertical diameter change:		Δd_v	15,5	mm
Horizontal diameter change:		Δd_h	15,0	mm
Relative vertical deformation:		δ_v	3,24	%
Allowable deflection:		all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Total vertical load	q_v	79,5	kN/m ²
Reduction factor for soil/traffic load:	κ_{v2}	0,86	[1]
Critical buckling load (soil/traffic load):	crit q_v	770,5	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}	9,70	[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:		$\sigma_{calc,BZ}$	36,3	N/mm ²	
Calculated ultimate flexural compr. stress, soil/traffic load:		$\sigma_{calc,BD}$	36,3	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:	$\sigma_{qv,qh,qh^*,i}$	10,390	-10,851	13,197	N/mm ²
Stress due to other loads:	$\sigma_{other,i}$	0,193	-0,218	0,497	N/mm ²
Safety coefficient:	γ_{BTi}	3,36	---	2,54	[1]
Safety coefficient:	γ_{BCi}	---	3,21	---	[1]
External:		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{qv,qh,qh^*,a}$	-10,52	8,39	-13,37	N/mm ²
Stress due to other loads:	$\sigma_{other,a}$	-0,17	0,21	-0,43	N/mm ²
Safety coefficient:	γ_{BTe}	---	4,10	---	[1]
Safety coefficient:	γ_{BCe}	3,33	---	2,54	[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:		$I/(A_{rad} \cdot r_m^2)$	0,00056	[1]
Ratio:		$I/(A_{rad} \cdot r_m^2) \cdot \kappa_q$	0,00067	[1]
Resultant deflection coefficient:	c'_v	q_v -0,0966	q_h 0,0833	q_h^* 0,0640 [1]
Vertical diameter change:		Δd_v	16,4	mm
Horizontal diameter change:		Δd_h	15,8	mm
Relative vertical deformation:		δ_v	3,42	%
Allowable deflection:		all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Total vertical load	q_v	79,4	kN/m ²
Reduction factor for soil/traffic load:	κ_{v2}	0,86	[1]
Critical buckling load (soil/traffic load):	crit q_v	734,7	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}	9,25	[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	3,36	-3,21	2,54	[1]
Safety coefficient (external):	γ_e	-3,33	4,10	-2,54	[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	3,42	%
Allowable deflection:	all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Buckling safety coefficient:	γ_{buckl}	9,25	[1]
Required buckling safety coefficient:	req γ_{buckl}	2,00	[1]

The buckling safety coefficients determined are sufficient.