

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 DN300 SN12
Outside diameter:	d_o 315,0 mm
Wall thickness:	s 11,30 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

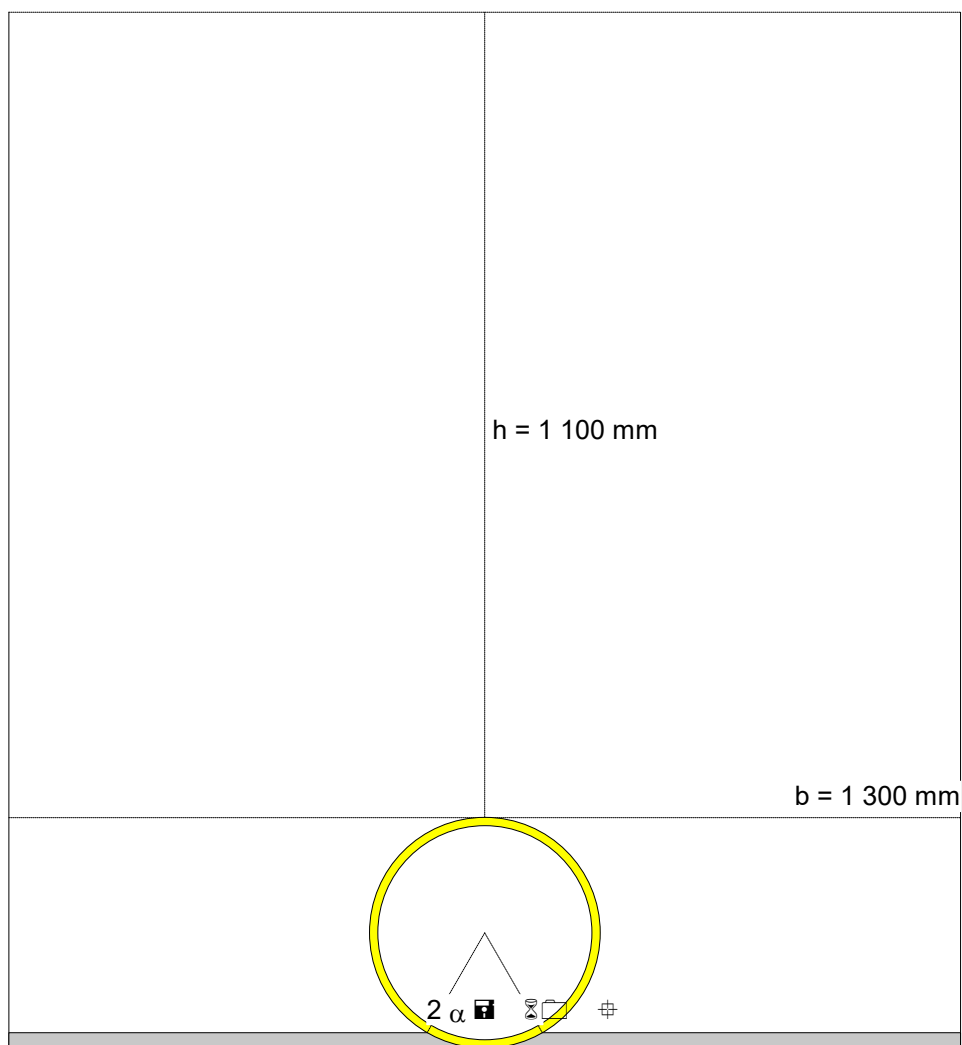
E1: Backfilling:	Soil group: G2
Value from Table 8 in ATV A127:	D_{PR1} 90,0 %
E20: Pipe zone:	Soil group: G2
Value from Table 8 in ATV A127:	D_{PR2} 90,0 %
E3: Native soil:	Soil group: G4
Proctor density:	D_{PR3} 95,0 %
E4: Below trench	$E4 = 10 * E1$

Installation

Trench width:	b	1 300	mm
Slope angle:	β	90,00	°
Cover condition:	A2		
Bedding condition:	B2		
Type of bedding:	loose		
Relative projection:	a	1,00	[1]
Bedding angle:	60°		

Load case combination 1

Description:	uložení v silnici III. třídy		
Cover depth:	h	1 100	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:		$\sigma_{\text{calc,BZ}}$	39,0	N/mm ²	
Calculated ultimate flexural compr. stress, soil/traffic load:		$\sigma_{\text{calc,BD}}$	39,0	N/mm ²	
Ultimate flexural tensile stress due to other loads:		$\sigma_{\text{all,BZ}}$	39,0	N/mm ²	
Ultimate flexural compressive stress due to other loads:		$\sigma_{\text{all,BD}}$	39,0	N/mm ²	
Internal:					
		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{\text{qv,qh,qh}^*,\text{i}}$	7,017	-7,308	12,683	N/mm ²
Stress due to other loads:	$\sigma_{\text{other,i}}$	0,229	-0,255	0,612	N/mm ²
Safety coefficient:	γ_{BTi}	5,38	---	2,93	[1]
Safety coefficient:	γ_{BCi}	---	5,16	---	[1]
External:					
		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{\text{qv,qh,qh}^*,\text{a}}$	-7,41	5,45	-13,04	N/mm ²
Stress due to other loads:	$\sigma_{\text{other,a}}$	-0,21	0,25	-0,55	N/mm ²
Safety coefficient:	γ_{BTe}	---	6,84	---	[1]
Safety coefficient:	γ_{BCe}	5,12	---	2,87	[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:	$I/(A_{\text{rad}} \cdot r_m^2)$	0,00046	[1]	
Ratio:	$I/(A_{\text{rad}} \cdot r_m^2) \cdot \kappa_q$	0,00055	[1]	
Resultant deflection coefficient:	c'_v	q_v -0,1053	q_h 0,0833	q_h^* 0,0640 [1]
Vertical diameter change:	Δd_v	8,0	mm	
Horizontal diameter change:	Δd_h	7,3	mm	
Relative vertical deformation:	δ_v	2,64	%	
Allowable deflection:	all d_v	6,00	%	

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Total vertical load	q_v	57,3	kN/m ²
Reduction factor for soil/traffic load:	κ_{v2}	0,86	[1]
Critical buckling load (soil/traffic load):	crit q_v	732,4	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}	12,78	[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:		$\sigma_{\text{calc,BZ}}$	31,3	N/mm ²	
Calculated ultimate flexural compr. stress, soil/traffic load:		$\sigma_{\text{calc,BD}}$	31,3	N/mm ²	
Ultimate flexural tensile stress due to other loads:		$\sigma_{\text{all,BZ}}$	17,0	N/mm ²	
Ultimate flexural compressive stress due to other loads:		$\sigma_{\text{all,BD}}$	17,0	N/mm ²	
Internal:					
		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{\text{qv,qh,qh}^*,\text{i}}$	5,666	-5,831	11,237	N/mm ²
Stress due to other loads:	$\sigma_{\text{other,i}}$	0,108	-0,121	0,490	N/mm ²
Safety coefficient:	γ_{BTi}	5,35	---	2,58	[1]
Safety coefficient:	γ_{BCi}	---	5,18	---	[1]
External:					
		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{\text{qv,qh,qh}^*,\text{a}}$	-6,20	4,07	-11,74	N/mm ²
Stress due to other loads:	$\sigma_{\text{other,a}}$	-0,10	0,12	-0,44	N/mm ²
Safety coefficient:	γ_{BTe}	---	7,31	---	[1]
Safety coefficient:	γ_{BCe}	4,91	---	2,50	[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:		$I/(A_{\text{rad}} \cdot r_m^2)$	0,00046	[1]
Ratio:		$I/(A_{\text{rad}} \cdot r_m^2) \cdot \kappa_q$	0,00055	[1]
Resultant deflection coefficient:	c'_v	q_v -0,1053	q_h 0,0833	q_h^* 0,0640 [1]
Vertical diameter change:		Δd_v	9,1	mm
Horizontal diameter change:		Δd_h	8,1	mm
Relative vertical deformation:		δ_v	3,00	%
Allowable deflection:		all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Total vertical load	q_v	56,3	kN/m ²
Reduction factor for soil/traffic load:	κ_{v2}	0,87	[1]
Critical buckling load (soil/traffic load):	crit q_v	631,5	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}	11,21	[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	5,35	-5,18	2,58	[1]
Safety coefficient (external):	γ_e	-4,91	7,31	-2,50	[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	3,00	%
Allowable deflection:	all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Buckling safety coefficient:	γ_{buckl}	11,21	[1]
Required buckling safety coefficient:	req γ_{buckl}	2,00	[1]

The buckling safety coefficients determined are sufficient.