

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

Project: Letkov u Plzně
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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 DN400 SN12
Outside diameter:	d_o 400,0 mm
Wall thickness:	s 14,40 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

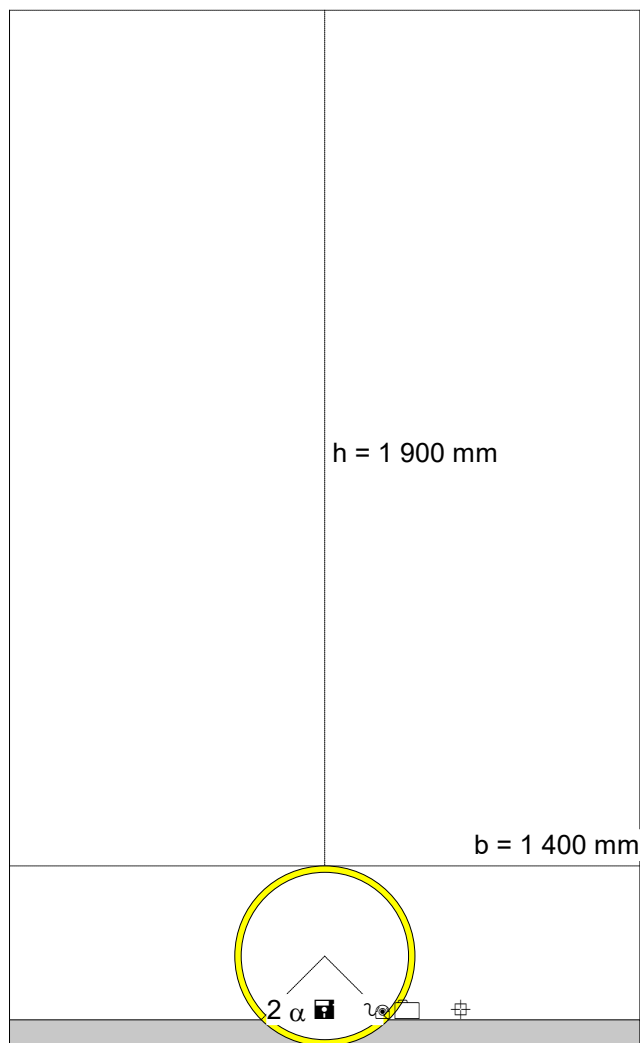
E1: Backfilling:	Soil group: G2
Value from Table 8 in ATV A127:	D_{PR1} 90,0 %
E20: Pipe zone:	Soil group: G2
Value from Table 8 in ATV A127:	D_{PR2} 90,0 %
E3: Native soil:	Soil group: G4
Proctor density:	D_{PR3} 95,0 %
E4: Below trench	$E4 = 10 * E1$

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	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:	$\sigma_{qv,qh,qh^*,i}$	7,047	-7,475	9,640	N/mm ²
Stress due to other loads:	$\sigma_{other,i}$	0,285	-0,320	0,574	N/mm ²
Safety coefficient:	γ_{BTi}	5,32	---	3,82	[1]
Safety coefficient:	γ_{BCi}	---	5,00	---	[1]
External:		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{qv,qh,qh^*,a}$	-7,51	5,52	-10,14	N/mm ²
Stress due to other loads:	$\sigma_{other,a}$	-0,25	0,31	-0,50	N/mm ²
Safety coefficient:	γ_{BTe}	---	6,69	---	[1]
Safety coefficient:	γ_{BCe}	5,02	---	3,67	[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:		$I/(A_{rad} \cdot r_m^2)$	0,00046	[1]
Ratio:		$I/(A_{rad} \cdot r_m^2) \cdot \kappa_q$	0,00056	[1]
Resultant deflection coefficient:	c'_v	q_v -0,0966	q_h 0,0833	q_h^* 0,0640 [1]
Vertical diameter change:		Δd_v	9,3	mm
Horizontal diameter change:		Δd_h	8,8	mm
Relative vertical deformation:		δ_v	2,42	%
Allowable deflection:		all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Total vertical load	q_v	60,7	kN/m ²
Reduction factor for soil/traffic load:	κ_{v2}	0,86	[1]
Critical buckling load (soil/traffic load):	crit q_v	706,4	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}	11,63	[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:		$\sigma_{calc,BZ}$	26,7	N/mm ²	
Calculated ultimate flexural compr. stress, soil/traffic load:		$\sigma_{calc,BD}$	26,7	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:	$\sigma_{qv,qh,qh^*,i}$	4,756	-4,989	7,241	N/mm ²
Stress due to other loads:	$\sigma_{other,i}$	0,145	-0,165	0,434	N/mm ²
Safety coefficient:	γ_{BTi}	5,35	---	3,37	[1]
Safety coefficient:	γ_{BCi}	---	5,08	---	[1]
External:		Crown	Springline	Bottom	
Stress due to soil and traffic loads:	$\sigma_{qv,qh,qh^*,a}$	-5,44	3,22	-7,97	N/mm ²
Stress due to other loads:	$\sigma_{other,a}$	-0,13	0,16	-0,38	N/mm ²
Safety coefficient:	γ_{BTe}	---	7,67	---	[1]
Safety coefficient:	γ_{BCe}	4,72	---	3,12	[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:		$I/(A_{rad} \cdot r_m^2)$	0,00046	[1]	
Ratio:		$I/(A_{rad} \cdot r_m^2) \cdot \kappa_q$	0,00056	[1]	
Resultant deflection coefficient:		c'_v	q_v -0,0966	q_h 0,0833	q_h^* 0,0640 [1]
Vertical diameter change:		Δd_v	11,4	mm	
Horizontal diameter change:		Δd_h	10,5	mm	
Relative vertical deformation:		δ_v	2,95	%	
Allowable deflection:		all d_v	6,00	%	

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Total vertical load	q_v	58,2	kN/m ²
Reduction factor for soil/traffic load:	κ_{v2}	0,87	[1]
Critical buckling load (soil/traffic load):	crit q_v	540,8	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}	9,29	[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	-5,08	3,37	[1]
Safety coefficient (external):	γ_e	-4,72	7,67	-3,12	[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	2,95	%
Allowable deflection:	all d_v	6,00	%

The deflection determined is less than the allowable deflection.

Stability proof (linear):

Buckling safety coefficient:	γ_{buckl}	9,29	[1]
Required buckling safety coefficient:	req γ_{buckl}	2,00	[1]

The buckling safety coefficients determined are sufficient.