POSITION 23: SCHNEIDER BT 8.25

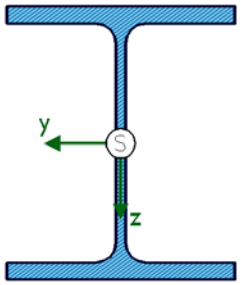
1. Input parameters

1.1. General statements

results acc. to DIN EN 1993:2010, Germany
verification of classification of the cross-section (width to thickness ratio)
flexural buckling by the method of fictitious bars

1.2. Cross-section

material: S235 (St37)
section: HE360B
section scale 1:10



1.3. Section properties (refering to centroid S)

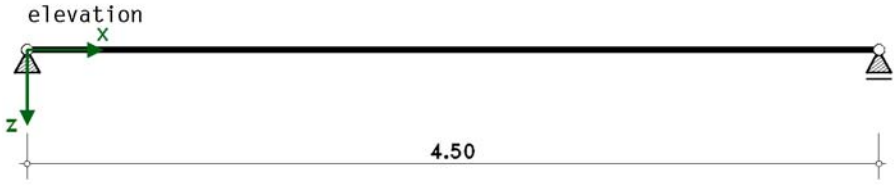
I_y = 43190 cm^4, I_z = 10140 cm^4, I_w = 2883000.0 cm^6, I_t = 293.00 cm^4
W_y = 2400.00 cm^3, W_z = 676.00 cm^3, $W_{pl,y}$ = 2683.00 cm^3, $W_{pl,z}$ = 1030.00 cm^3
$z_{m,y}$ = 0 mm, $z_{m,z}$ = 0 mm, A = 18100 mm^2, cross-section is susceptible to torsional deformations

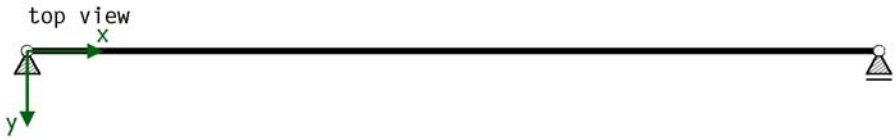
1.4. Load application point (refering to centroid S)

z_{load} = -180 mm (top edge of cross-section),

1.5. Structural system

all supports with fork conditions, beam length 4.500 [m]
no support in z-direction, no support in y-direction





1.6. Buckling factors

about the y-axis: β_z = 1.000, about the z-axis: β_y = 1.000
warping restraint intensity β_0 = 1.000

1.7. Combinations of design internal forces

Nr	N_d kN	A
1	2500.00	

moment diagram types

2. Verifications acc. to DIN EN 1993, Germany

DIN EN 1993-1-1 (EC 3)

chapter	value	definition
6.1(1)	permanent/transient sit.	partial factors for structural steel
	γ_{M0} = 1.00	Cross-section failure
	γ_{M1} = 1.10	instability
	γ_{M2} = 1.25	fracture cross-sections in tension
	accidental situation	partial factors for structural steel
	γ_{M0} = 1.00	Cross-section failure
	γ_{M1} = 1.00	instability
	γ_{M2} = 1.15	fracture cross-sections in tension
6.3.2.2(2)	factor f for modifying	buckling curve torsional-flexural buckling
	of χ_{LT}: setting	general case

2.1. Classification of cross-sections acc. to DIN EN 1993-1-1, 5.5.2

2.1.1. Load combination 1 ⇒ class of cross-section 2

Nr	c mm	t mm	c/t -	ε -	σ_1 N/mm²	σ_2 N/mm²	Tab 5.2	α -	ψ -	k_σ -	class -
1	116.8	22.5	5.19	1.000	-138.12	-138.12	ones. 1/1	---	---	---	1
2	116.8	22.5	5.19	1.000	-138.12	-138.12	ones. 1/1	---	---	---	1
3	261.0	12.5	20.88	1.000	-138.12	-138.12	double 2/1	---	---	---	1
4	116.8	22.5	5.19	1.000	-138.12	-138.12	ones. 1/1	---	---	---	1
5	116.8	22.5	5.19	1.000	-138.12	-138.12	ones. 1/1	---	---	---	1

verification is done in the predefined class of cross-section 2, U = 0.549

2.2. flexural and torsional buckling acc. to DIN EN 1993-1-1, 6.3.1

verification about the y-y and z-z - axis
λ_y = 0.310 < λ_T = 0.562 ⇒ torsional-flexural buckling (λ_T) decisive
λ_z = 0.640 > λ_T = 0.562 ⇒ flexural buckling (λ_z) decisive
I_p = 53330 cm⁴, I_T = 293 cm⁴, i_p^2 = 29464 mm, c^2_y = 51300 mm², c^2_z = 12044 mm², i_m^2 = 29464 mm²
i_y = 154.5 mm, β_y = 1.00 (about the z-axis), $L_{cr,y}$ = 4.500 m, λ_1 = 93.913
i_z = 74.8 mm, β_z = 1.00 (about the y-axis), $L_{cr,z}$ = 4.500 m
λ_y = 0.562, y-buckling curve b ⇒ α_y = 0.34, **λ_z = 0.640**, z-buckling curve c ⇒ α_z = 0.49
Φ_y = 0.720, **χ_y = 0.855, $N_{by,Rd}$ = 3307.99 kN**, Φ_z = 0.813, **χ_z = 0.761, $N_{bz,Rd}$ = 2943.87 kN**

2.2.1. Utilizations

Nr	N_d kN	U_y -	U_z -
1	2500.00	**0.756**	**0.849**

max U = 0.849 ≤ 1 ⇒ verification successful!
the total utilization is: U = 0.849