

POSITION 46: 8.11 KLASSIFIZIERUNG

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)

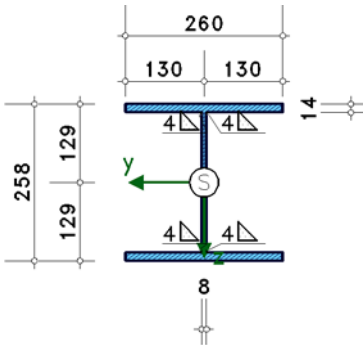
torsional-flexural buckling by the method of fictitious bars acc. to EN 1993-1-1 6.3.2 only M_y

1.2. Cross-section

material: S355 (St52)

designation: HE200A

section scale 1:125



1.3. Section properties (referring to centroid S)

$I_y = 11659 \text{ cm}^4$, $I_z = 4102 \text{ cm}^4$, $I_w = 610402.7 \text{ cm}^6$, $I_t = 50.75 \text{ cm}^4$

$W_y = 903.77 \text{ cm}^3$, $W_z = 315.54 \text{ cm}^3$, $W_{p1,y} = 1007.23 \text{ cm}^3$, $W_{p1,z} = 473.20 \text{ cm}^3$

$z_{m,y} = 0 \text{ mm}$, $z_{m,z} = 0 \text{ mm}$, $A = 9120 \text{ mm}^2$, cross-section is susceptible to torsional deformations

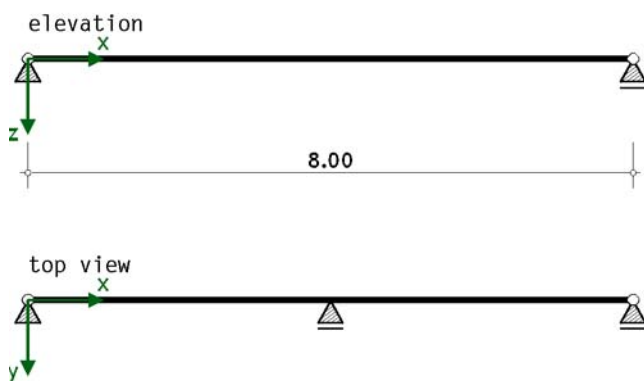
1.4. Load application point (referring to centroid S)

$z_{\text{load}} = -129 \text{ mm}$ (top edge of cross-section),

1.5. Structural system

all supports with fork conditions, beam length 8.000 [m]

no support in z-direction, 1 support in y-direction



1.6. Buckling factors

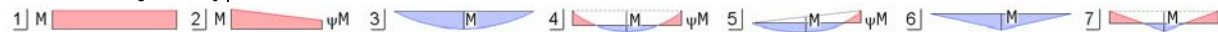
about the y-axis: $\beta_z = 1.000$, about the z-axis: $\beta_y = 1.000$

warping restraint intensity $\beta_0 = 1.000$

1.7. Combinations of design internal forces

Nr	M _{0y,d} kNm	type	ψ _y	k _{c,y}	ζ _y	A
1	32.00	3	1.000	0.940	1.311	

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. γ _{M0} = 1.00 γ _{M1} = 1.10 γ _{M2} = 1.25	partial factors for structural steel Cross-section failure instability fracture cross-sections in tension
accidental situation	γ _{M0} = 1.00 γ _{M1} = 1.00 γ _{M2} = 1.15	partial factors for structural steel Cross-section failure instability fracture cross-sections in tension
6.3.2.2(2)	factor f for modifying of χ _{LT} : setting	buckling curve torsional-flexural buckling 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 3

Nr	c mm	t mm	c/t	ε	σ ₁ N/mm ²	σ ₂ N/mm ²	Tab 5.2	α	ψ	k _σ	class
1	1203.4	140.0	8.60	0.814	-0.33	-0.33	ones. 1/3	---	---	---	3
2	1203.4	140.0	8.60	0.814	-0.33	-0.33	ones. 1/3	---	---	---	3
3	2186.9	80.0	27.34	0.814	-0.33	0.33	double 1/1	---	---	---	1
4	1203.4	140.0	8.60	0.814	0.33	0.33	-----	---	---	---	---
5	1203.4	140.0	8.60	0.814	0.33	0.33	-----	---	---	---	---

verification is done with the smallest possible class of cross-section 3, U = 0.755

2.2. Torsional-flexural buckling acc. to DIN EN 1993-1-1 6.3.2 about the y-y-axis

c² = 22616 mm², buckling curve c ⇒ α_{LT} = 0.49, N_{cr} = 5313.73 kN

2.2.1. Utilizations

Nr	class	M _{cr} kNm	λ _{LT}	f	Φ _{LT}	χ _{LT} -m	M _{Ed} kNm	M _{b,Rd} kNm	U
1	3 ⇒ W _{e1,y}	690.84	0.681	0.971	0.743	0.837	32.00	251.47	0.127

max U = 0.127 ≤ 1 ⇒ verification successful!

the total utilization is: U = 0.755