

POSITION 7: EXAMPLE 6

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)

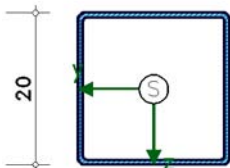
torsional-flexural buckling by the method of fictitious bars acc. to EN 1993-1-1 6.3.2 only My

1.2. Cross-section

material: S355 (St52)

section: MSH200X200X6.3

section scale 1:10



1.3. Section properties (referring to centroid S)

$I_y = 2960 \text{ cm}^4$, $I_z = 2960 \text{ cm}^4$, $I_w = 0.0 \text{ cm}^6$, $I_t = 4660.00 \text{ cm}^4$

$W_y = 296.00 \text{ cm}^3$, $W_z = 296.00 \text{ cm}^3$, $W_{p1,y} = 345.00 \text{ cm}^3$, $W_{p1,z} = 345.00 \text{ cm}^3$

$z_{m,y} = 0 \text{ mm}$, $z_{m,z} = 0 \text{ mm}$, $A = 4780 \text{ mm}^2$, cross-section ist verdrehsteif

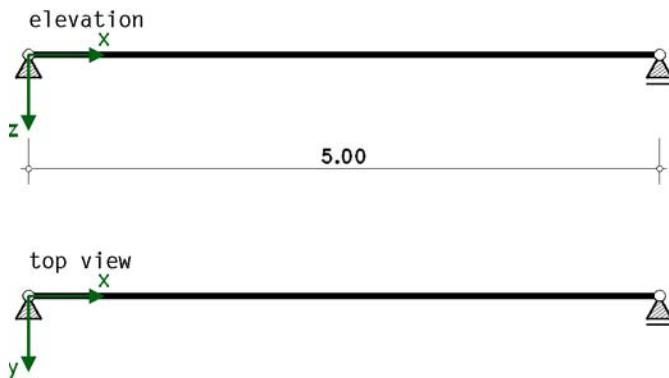
1.4. Load application point (referring to centroid S)

$z_{load} = 0 \text{ mm}$ (centroid),

1.5. Structural system

all supports with fork conditions, beam length 5.000 [m]

no support in z-direction, no 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	27.81	3	0.000	0.940	1.128	

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. $\gamma_{M0} = 1.00$ $\gamma_{M1} = 1.10$ $\gamma_{M2} = 1.25$	partial factors for structural steel Cross-section failure instability fracture cross-sections in tension
	accidental situation $\gamma_{M0} = 1.00$ $\gamma_{M1} = 1.00$ $\gamma_{M2} = 1.15$	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 \Rightarrow class of cross-section 1

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	96.8	6.3	15.37	0.814	0.91	0.91	-----	---	---	---	---
2	96.8	6.3	15.37	0.814	0.91	-0.91	double 1/1	---	---	---	1
3	96.8	6.3	15.37	0.814	-0.91	-0.91	double 1/1	---	---	---	1
4	96.8	6.3	15.37	0.814	-0.91	0.91	double 1/1	---	---	---	1

verification is done in the predefined class of cross-section 2, $U = 0.228$

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

$c^2 = 1538155 \text{ mm}^2$, buckling curve b $\Rightarrow \alpha_{LT} = 0.34$, $N_{cr} = 2453.98 \text{ kN}$

2.2.1. Utilizations

Nr	M_{cr} kNm	λ_{LT} -	f -	Φ_{LT} -	χ_{LT} -m	M_{Ed} kNm	$M_{b,Rd}$ kNm	U -
1	3433.23	0.189	1.000	0.477	1.000	27.81	111.34	0.250

max $U = 0.250 \leq 1 \Rightarrow$ verification successful!

the total utilization is: $U = 0.250$