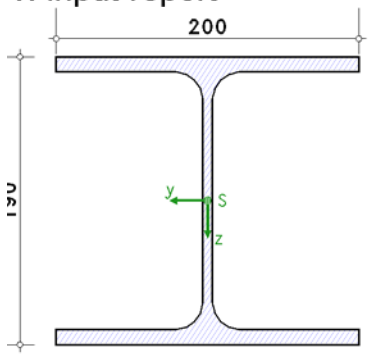
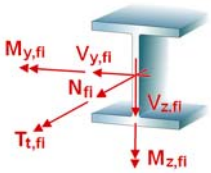
POS. 10: FIRE DESIGN EX. 5.1

fire design EC 3-1-2 (12.10), NA: Deutschland

1. input report



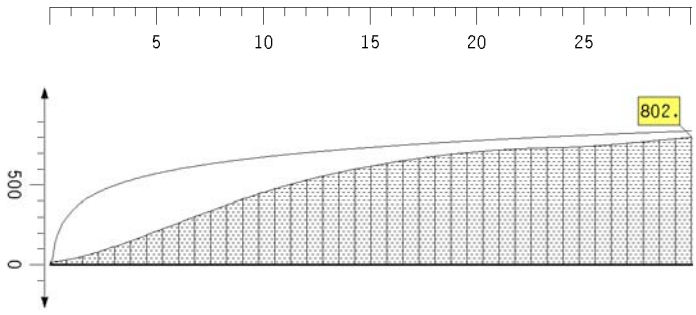
steel
steel grade S275
material safety factor
resistance of cross-sections γ_{M0} = 1.00
resistance of components in the event of fire $\gamma_{M,fi}$ = 1.00
geometry
section HE200A
cross-section temperature
thermal action due to the standard curve, fire resistance time t = 30 min
section all sides flamed
resistance
plastic verification
fire design at temperature level
adjustment factors for uneven temperature distribution
across the cross section κ_1 = 1.00, along the beam κ_2 = 1.00
internal forces and moments (event of fire)
σ-generating forces (N, M) work at centroid, τ-generating forces (V, T_t) work at shear center
Lk 1: N_{fi} = 780.00 kN



notes
stability is not investigated.

2. cross-section temperature

surface of the section exposed to fire A_m = 1136.1 mm²/mm
section factor of the unprotected component A_m/V = 1136.1 / 5383.1 ·10³ = 211.0 1/m
fire-stressed inner surface of the enclosing box A_b = 780.0 mm²/mm
section factor for the enclosing box A_b/V = 780.0 / 5383.1 ·10³ = 144.9 1/m
correction factor k_{sh} = (A_b/V) / (A_m/V) = 144.9 / 211.0 = 0.687, I-section: 0.9·k_{sh} = 0.618
temperature development:



temperature in °C
fire time in min
max T_a = 801.9°C
max t = 30 min

cross-section temperature acc. to t = 30 min: T_a = 801.9 °C

3. Lk 1

3.1. fire design

internal forces and moments (event of fire): N_{fi} = 780.00 kN

3.1.1. plastic verification

3.1.1.1. verification at temperature level

Utilisation rate at time t = 0 (normal temperature)
  plastic verification for N = 780.00 kN
  max. load factor of normal stresses (plastic): $f_{\sigma,pl}$ = 1.896 $\Rightarrow$ $U_{\sigma,pl}$ = 0.528
  verification: U_{pl} = 0.528 < 1 ok
critical temperature $T_{a,cr} = 39.19 \cdot \ln[1/(0.9674 \cdot \mu_0^{3.833}) - 1] + 482 = 576.0$ °C with μ_0 = 0.528
existing temperature T_a = 801.9 °C
verification: $U_T = T_a/T_{a,cr}$ = 1.392 > 1 fault !!

4. final result

maximum utilization:	temperature	max U_T = 1.392 > 1 fault !!
	stress	max $U_{\sigma,t=0}$ = 0.528 < 1 ok
	resistance	max U = 1.392 > 1 fault !!

resistance not ensured !!

5. Regulations

DIN EN 1990, Eurocode 0: Grundlagen der Tragwerksplanung;
  Deutsche Fassung EN 1990:2002 + A1:2005 + A1:2005/AC:2010, Ausgabe Dezember 2010
DIN EN 1990/NA, Nationaler Anhang zur DIN EN 1990, Ausgabe Dezember 2010

DIN EN 1991-1-2, Eurocode 1: Einwirkungen auf Tragwerke - Teil 1-2: Allgemeine Einwirkungen -
  Brandeinwirkungen auf Tragwerke; Deutsche Fassung EN 1991-1-2, Ausgabe Dezember 2010
DIN EN 1991-1-2/NA, Nationaler Anhang zur DIN EN 1991-1-2, Ausgabe September 2015

DIN EN 1993-1-2, Eurocode 3: Bemessung und Konstruktion von Stahlbauten - Teil 1-2: Allgemeine Regeln -
  Tragwerksbemessung für den Brandfall; Deutsche Fassung EN 1993-1-2, Ausgabe Dezember 2010
DIN EN 1993-1-2/NA, Nationaler Anhang zur DIN EN 1993-1-2, Ausgabe Dezember 2010