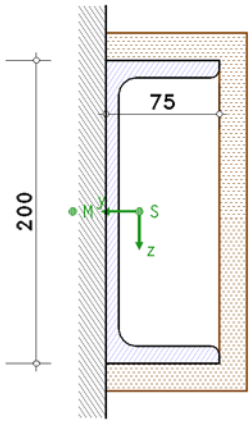
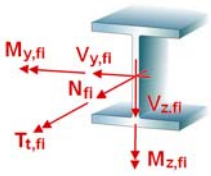
POS. 181: U-SECTION

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

1. input report



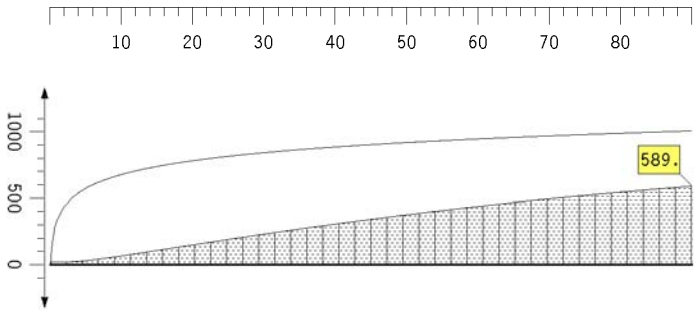
steel
steel grade S235
material safety factor
resistance of cross-sections γ_{M0} = 1.00
resistance of components in the event of fire $\gamma_{M,fi}$ = 1.00
geometry
section U200
cross-section temperature
thermal action due to the standard curve, fire resistance time t = 90 min
shadow effect of the section by wall/ceiling left
thermal insulation protection by plate cladding s. EC 3-1-2, appendix AA:
thermal conductivity λ_p = 0.20 W/(m·K), specific heat capacity c_p = 1700 J/(kg·K), maximum density ρ_p = 945 kg/m³
thickness of insulating material d_p = 18.0 mm
resistance
plastic verification incl. c/t-verification
fire design at load level
adjustment factors for uneven temperature distribution
across the cross section κ_1 = 0.85, 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: $M_{y,fi}$ = 7.00 kNm, $M_{z,fi}$ = 5.00 kNm



notes
stability is not investigated.

2. cross-section temperature

section factor of the protected component A_p/V = 350.0 / 3270.8 ·10³ = 107.0 1/m
temperature development:



temperature in °C
fire time in min
max T_a = 589.2°C
max t = 90 min

cross-section temperature acc. to t = 90 min: T_a = 589.2 °C
material parameters: $f_{y,fi}$ = 118.3 N/mm², E_{fi} = 71648.0 N/mm², $\alpha_{T,fi}$ = 1.44·10⁻⁵ 1/K

3. Lk 1

3.1. fire design

3.1.1. plastic verification

3.1.1.1. verification at load level

plastic verification for $M_y = 5.95$ kNm, $M_z = 4.25$ kNm
max. load factor of normal stresses (plastic): $f_{\sigma,pl} = 1.109 \Rightarrow U_{\sigma,pl} = 0.902$
verification: $U_{pl} = 0.902 < 1$ ok
c/t-verification: utilization $U_{c/t} = 0.550 < 1$ ok

4. final result

maximum utilization:	stress	max $U_\sigma = 0.902 < 1$ ok
	c/t-ratio	max $U_{c/t} = 0.550 < 1$ ok
	resistance	max $U = 0.902 < 1$ ok

verification succeeded

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