Fire design of a HEB section column

Steel Document SX044a-EN-EU

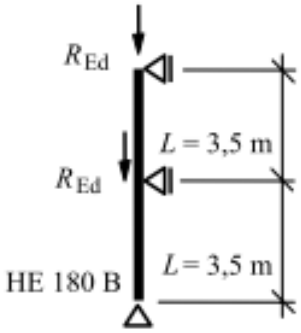
Scia Engineer Version 10.0.86

Introduction

This benchmark concerns the example *SX044a-EN-EU Fire design of a protected HEB section column exposed to the standard temperature time curve* of *Access Steel, http://www.access-steel.com/, 2006.*

This worked example illustrates the fire design of a column that is continuous over two storeys. Heat transfer into the section is evaluated using the EN1993-1-2 calculation procedure. The resistance of the column is evaluated using the simple calculation model for compression members given in EN1993-1-2.

The column, fabricated from a hot-rolled HEB section, supports two floors and is fire protected with sprayed vermiculite cement. The required period of fire resistance is **R90**.



Reference Results

The reference gives following results:

Fire Situation	
Ap/V	159 m^{-1}
θg at 90 min	1006,0 °C
θa,t at 90 min	553,8 °C
ky,θ	0,613
kE,θ	0,444

Classification		
Flanges	c/tf	5,05
	Class 1 limit	6,22
		⇒ Flanges Class 1
Web	c/tw	14,35
	Class 1 limit	22,80
		⇒ Web Class 1

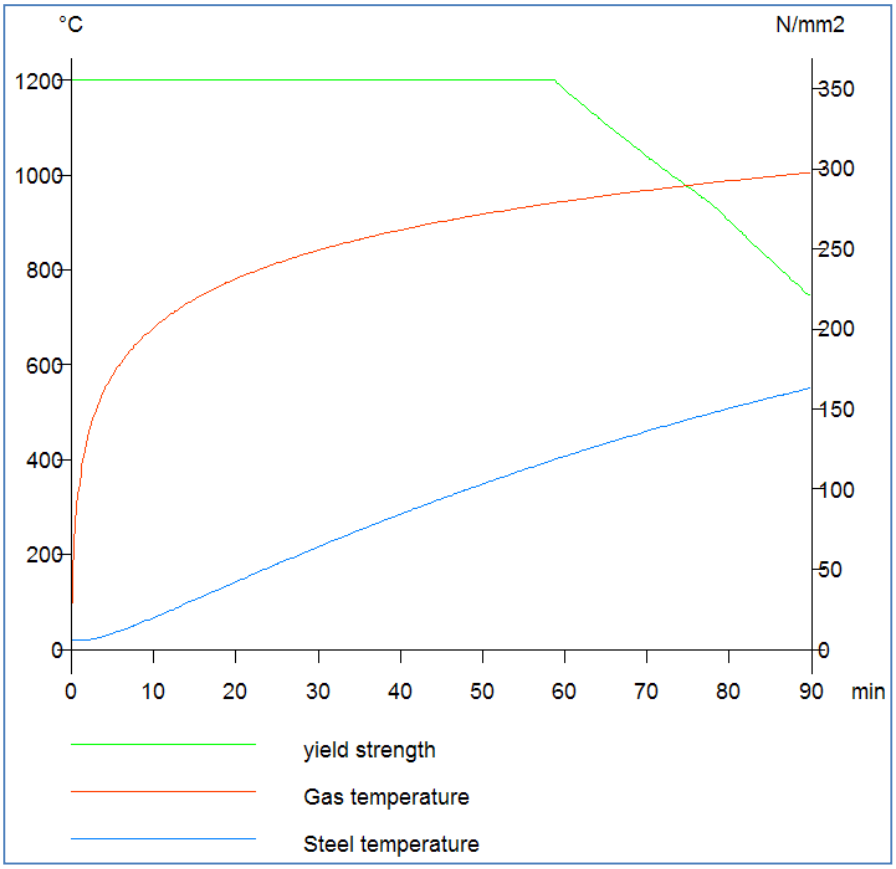
Buckling resistance	
Lcr,z,fi	2,45 m
Ncr,z	4706 kN
red λ,z	0,702
red λ,z,θ	0,825
$\chi_{z,fi}$	0,581
Nb,fi,θ,Rd	825,0 kN

Scia Engineer Results

Fire resistance according to EN 1993-1-2 in resistance domain.
Results are given for checks at time t = 90.0 min

Fire resistance data		
Temperature-time curve	Standard temperature-time curve (ISO 834)	
Coefficient of heat transfer by convection Alfa,c	25.00	W/m2K
Emissitivity related to fire compartment Epsilon,f	1.00	
Emissitivity related to surface material Epsilon,m	0.70	
Configuration factor for radiation heat flux Fi	1.00	
Required fire resistance	90.00	min
Material temperature Teta a,t	552.00	°C
Gas temperature Teta,g	1005.99	°C
Correction factor Kappa 1	1.00	
Correction factor Kappa 2	0.85	
Beam exposure	All sides	
ky,Teta	0.62	
kE,Teta	0.45	

Insulation properties		
Name:	Vermiculite cement (high density)	
Thickness	20.00	mm
Incasement type	Contour encasement	
Insulation type	Spray	
Unit mass	550.00	kg/m^3
Thermal conductivity	0.12	W/mK
Specific heat	1100.00	J/kgK
Ap/V	0.159	1/mm



Width-to-thickness ratio for internal compression parts (EN 1993-1-1 : Tab.5.2. sheet 1).
ratio 14.35 on position 0.00 m

ratio		
maximum ratio	1	22.82
maximum ratio	2	26.28
maximum ratio	3	29.05

==> Class cross-section 1
Width-to-thickness ratio for outstand flanges (EN 1993-1-1 : Tab.5.2. sheet 2).
ratio 5.05 on position 0.00 m

ratio		
maximum ratio	1	6.22
maximum ratio	2	6.92
maximum ratio	3	9.68

==> Class cross-section 1

Compression check
according to article EN 1993-1-2 : 4.2.3.2 and formula EN 1993-1-2 : (4.5)
Section classification is 1.

Table of values		
Nfi,t,Rd	1433.34	kN
unity check	0.33	

Buckling parameters	yy	zz	
type	sway	non-sway	
Slenderness	31.97	53.61	
Reduced slenderness	0.49	0.82	
Reduction factor	0.76	0.58	
Length	3.50	3.50	m
Buckling factor	0.70	0.70	
Buckling length	2.45	2.45	m
Critical Euler load	13228.15	4706.33	kN

Buckling check
according to article EN 1993-1-2 : 4.2.3.2 and formula EN 1993-1-2 : (4.5)

Table of values		
Nb,fi,t,Rd	833.79	kN
unity check	0.57	

Comments

- The results correspond to the benchmark results.