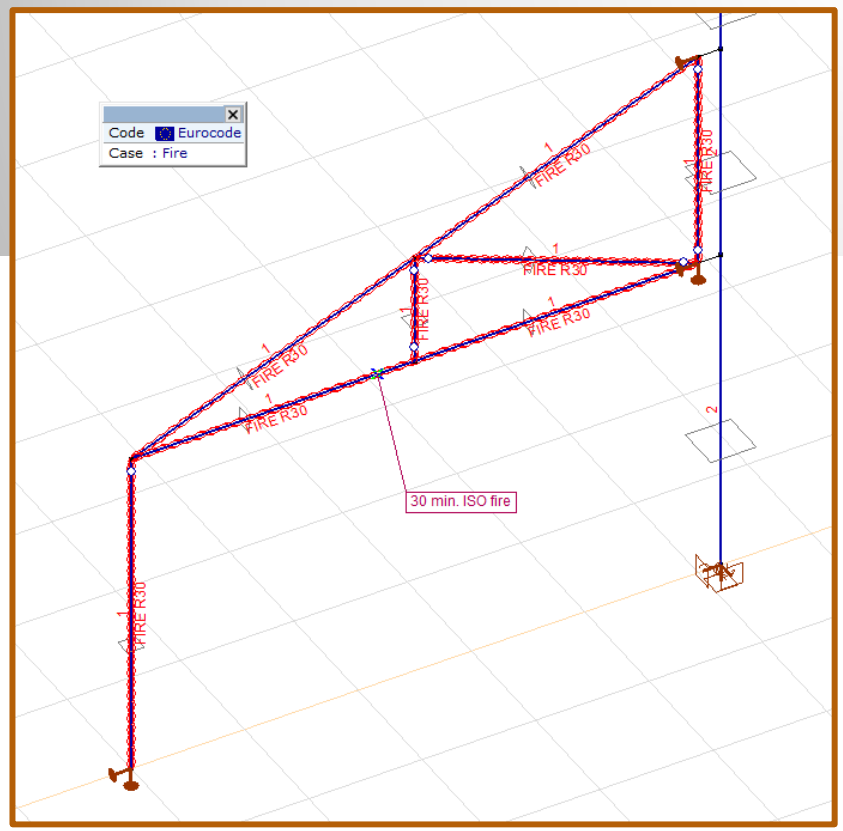
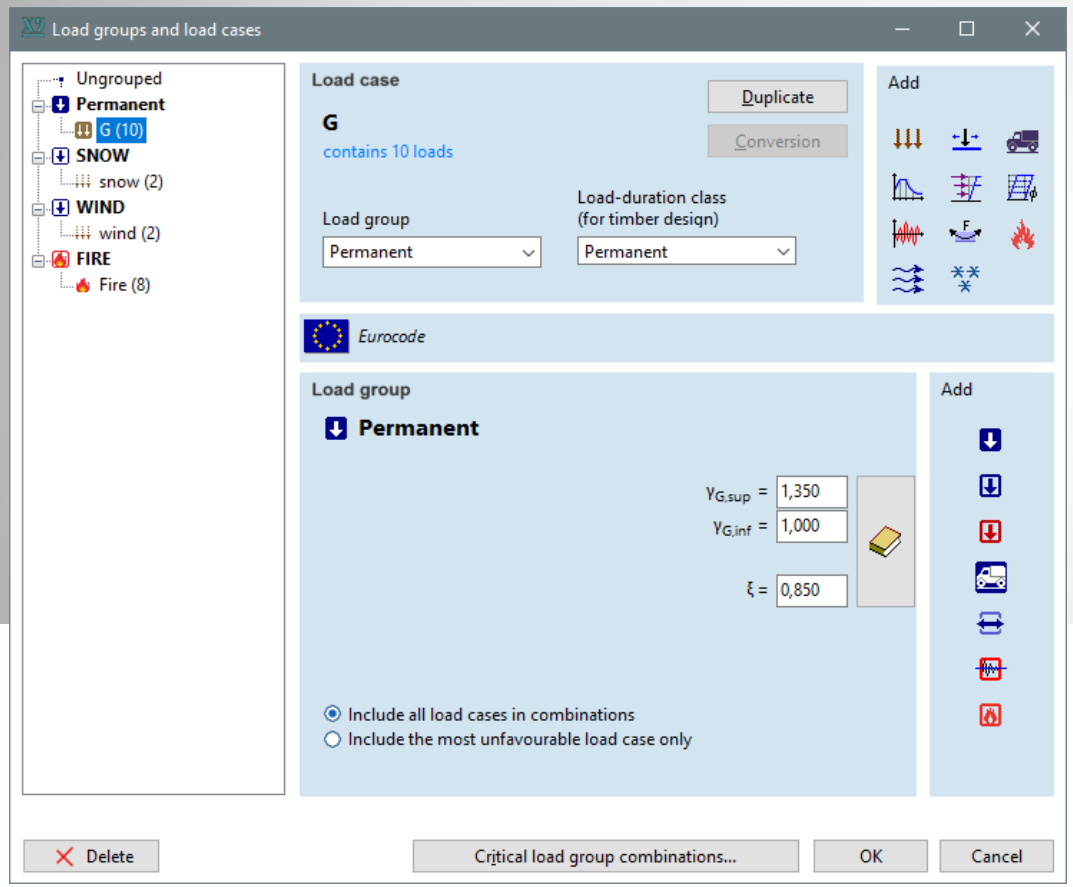
Structural fire design of timber elements in AxisVM



TD8 module

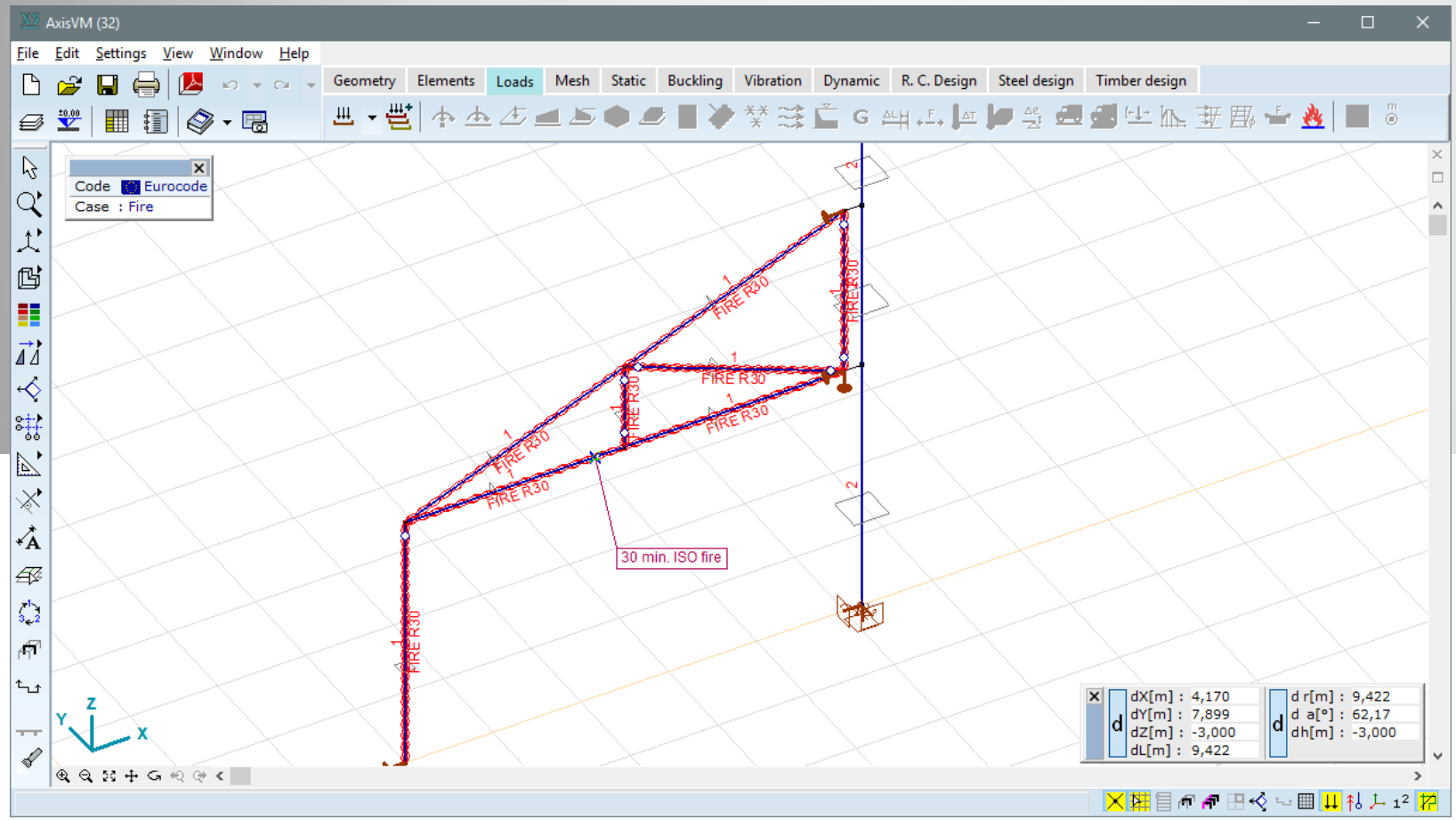


Fire load case

Fire load groups

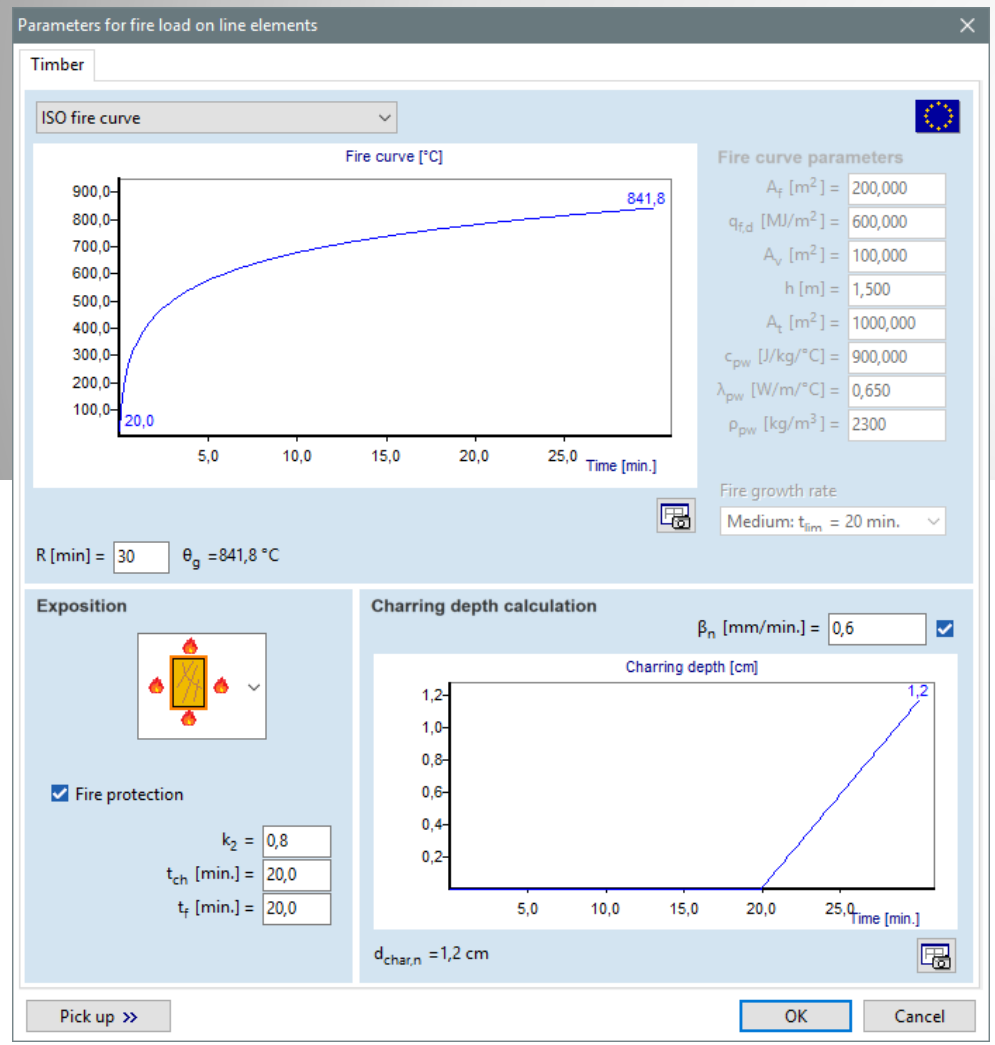
Different fire scenarios can be modeled using fire load groups!

- **FIRE SCENARIO 1 – fire in room 1 or in room 2 (mutually exclusive load cases)**
- **FIRE SCENARIO 2 – fire in room 1 and in room 2 (simultaneous load cases)**



Only fire effects can be defined in a fire load case!

Definition of fire effects on timber elements



Available fire curves:

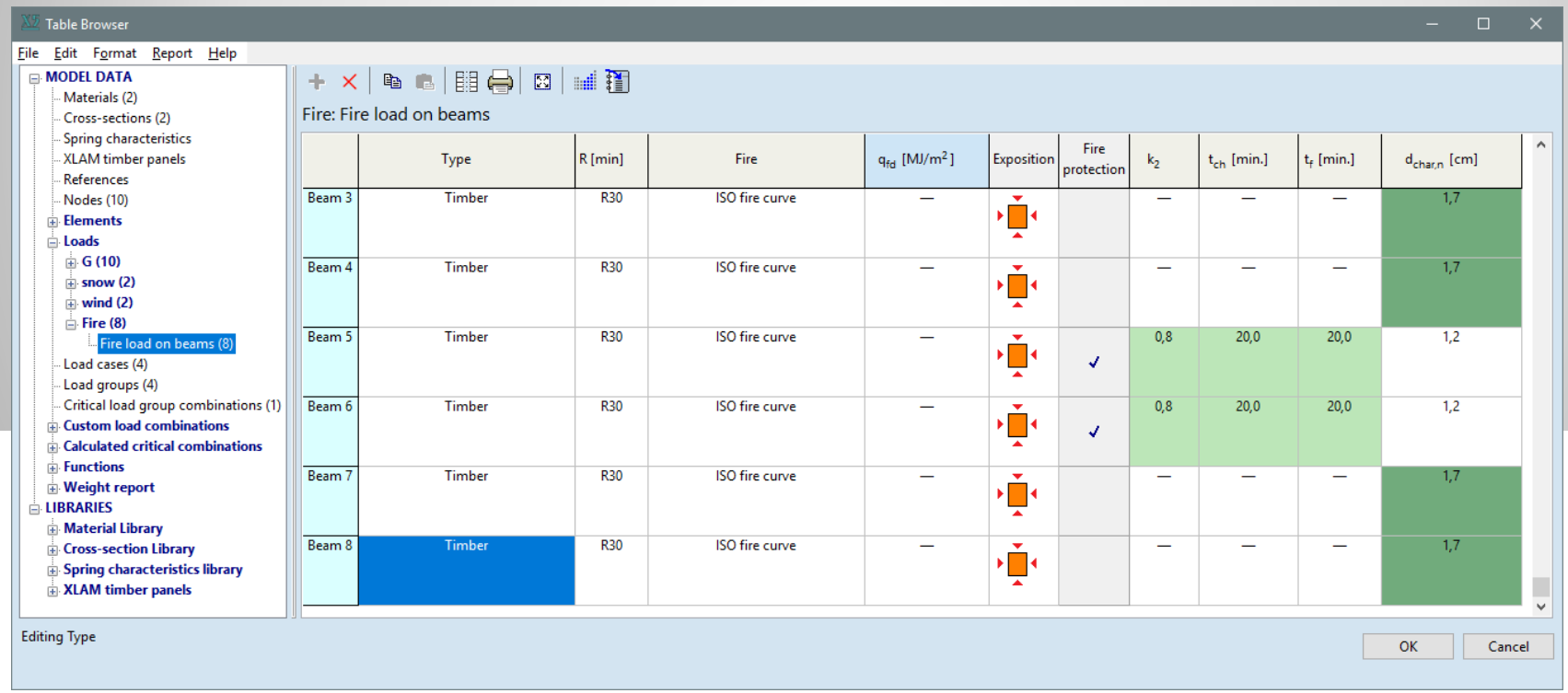
- Standard temperature-time curve (so called ISO fire curve)
- Parametric fire curve

The software calculates automatically the charring depth according to the selected design code.

The charring depth can be calculated in case of unprotected and protected elements as well.

The notional charring rate can be specified by the user.

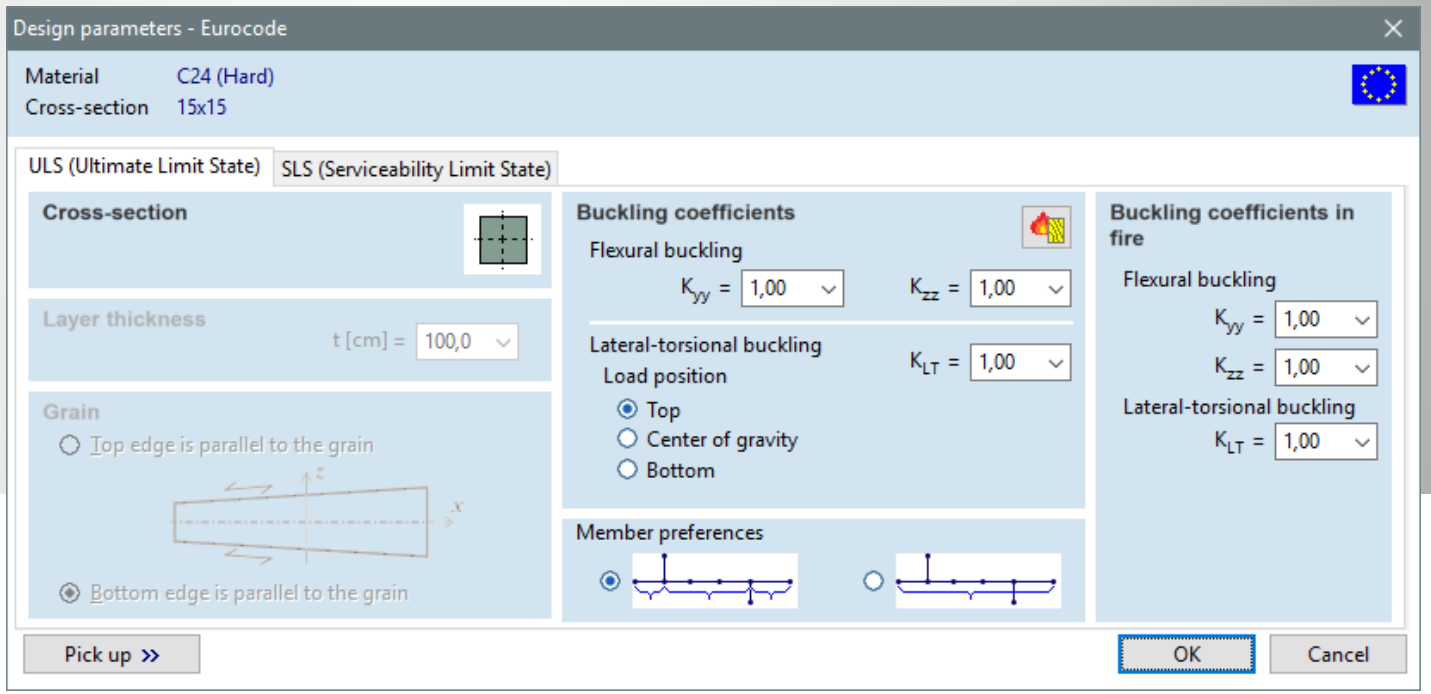
Fire effects in informative tables



	Type	R [min]	Fire	q_{fd} [MJ/m²]	Exposition	Fire protection	k_2	t_{ch} [min.]	t_f [min.]	$d_{char,n}$ [cm]
Beam 3	Timber	R30	ISO fire curve	—			—	—	—	1,7
Beam 4	Timber	R30	ISO fire curve	—			—	—	—	1,7
Beam 5	Timber	R30	ISO fire curve	—		✓	0,8	20,0	20,0	1,2
Beam 6	Timber	R30	ISO fire curve	—		✓	0,8	20,0	20,0	1,2
Beam 7	Timber	R30	ISO fire curve	—			—	—	—	1,7
Beam 8	Timber	R30	ISO fire curve	—			—	—	—	1,7

The following parameters are listed: required time of fire resistance, type of fire curve, fire load density, exposition type, properties of fire protection and notional charring depth. The tables can be saved in the documentation.

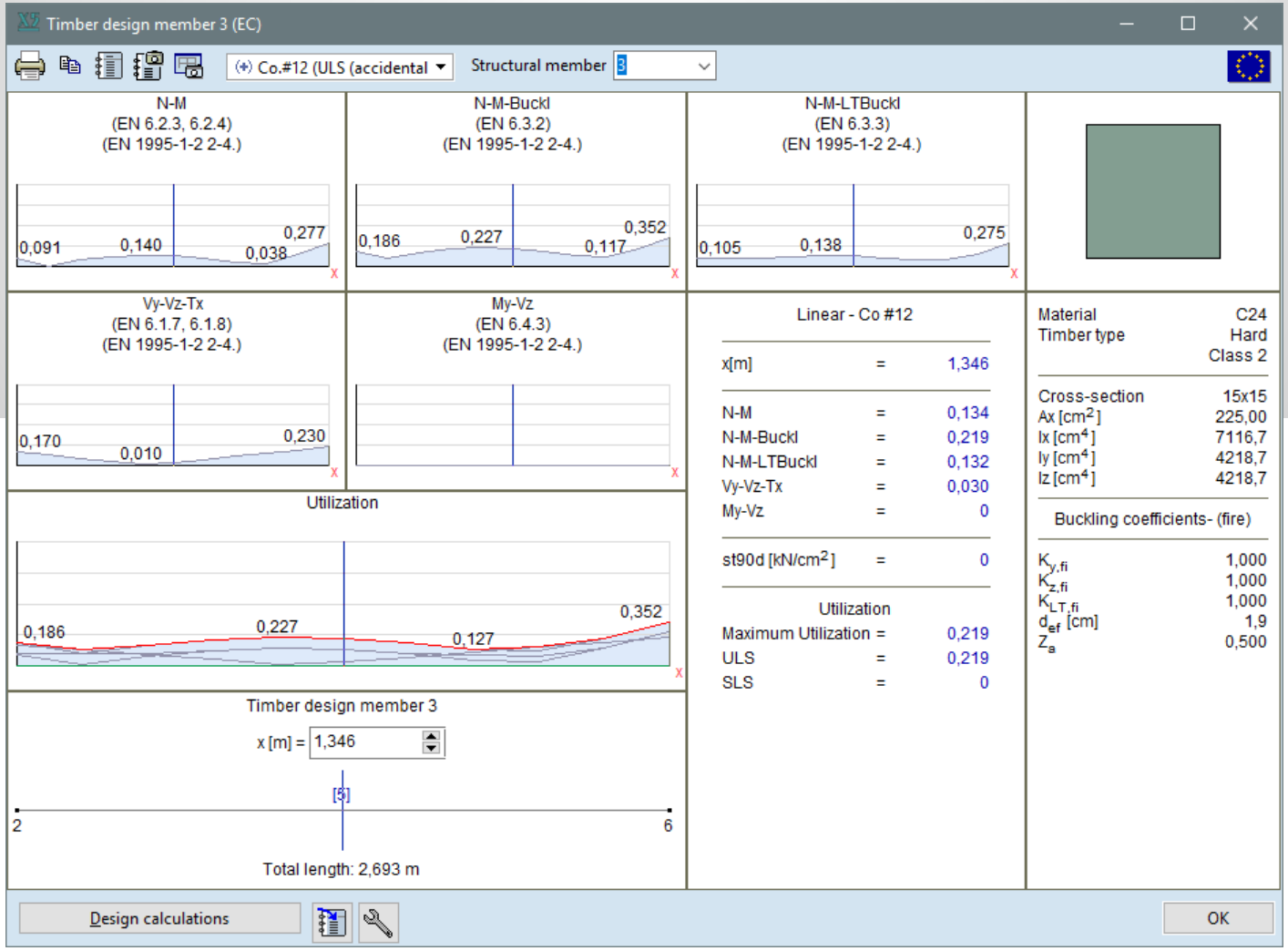
Timber design parameters in fire



Parameters related to structural fire design of timber elements can be defined after clicking on Design paramters button on the Timber design toolbar.

Fire design can be performed in AxisVM if there is fire load case in the selected load combination and there is fire effect assigned to the selected element (in the fire load case).

Design results



Design calculations

9. Axial force-Bending-Lateral torsional buckling

EN 1995-1-1: 6.3.3
EN 1995-1-2: 2-4.

Fire curve: **ISO fire curve**

Required time of fire resistance: **R30**

Effective charring depth: $d_{ef} = d_{char,n} + k_0 \cdot d_0 = 1{,}17 + 1 \cdot 0{,}70 = 1{,}87$ cm

Critical section: $x = 1{,}00 \cdot L = 1{,}00 \cdot 269{,}26 = 269{,}26$ cm

$dL = 2 \cdot h_{fi} = 2 \cdot 11{,}27 = 22{,}54$ cm

$$\sigma_{m,crit,fi} = \frac{\pi \cdot \sqrt{E_{0.05} \cdot I_{z,fi} \cdot G_{0.05} \cdot I_{x,fi}}}{(k_{LT,fi} \cdot L_{tot} + dL) \cdot W_{y,fi}} = \frac{\pi \cdot \sqrt{740{,}00 \cdot 1343{,}51 \cdot 57{,}96 \cdot 2270{,}53}}{(1 \cdot 269{,}26 + 22{,}54) \cdot 238{,}46} = 15{,}92 \text{ kN/cm}^2 \quad (6.31)$$

$$\lambda_{rel,m,fi} = \sqrt{\frac{f_{m,k}}{\sigma_{m,crit,fi}}} = \sqrt{\frac{2{,}40}{15{,}92}} = 0{,}39 \quad (6.30)$$

$$k_{crit,fi} = 1 \quad (6.34)$$

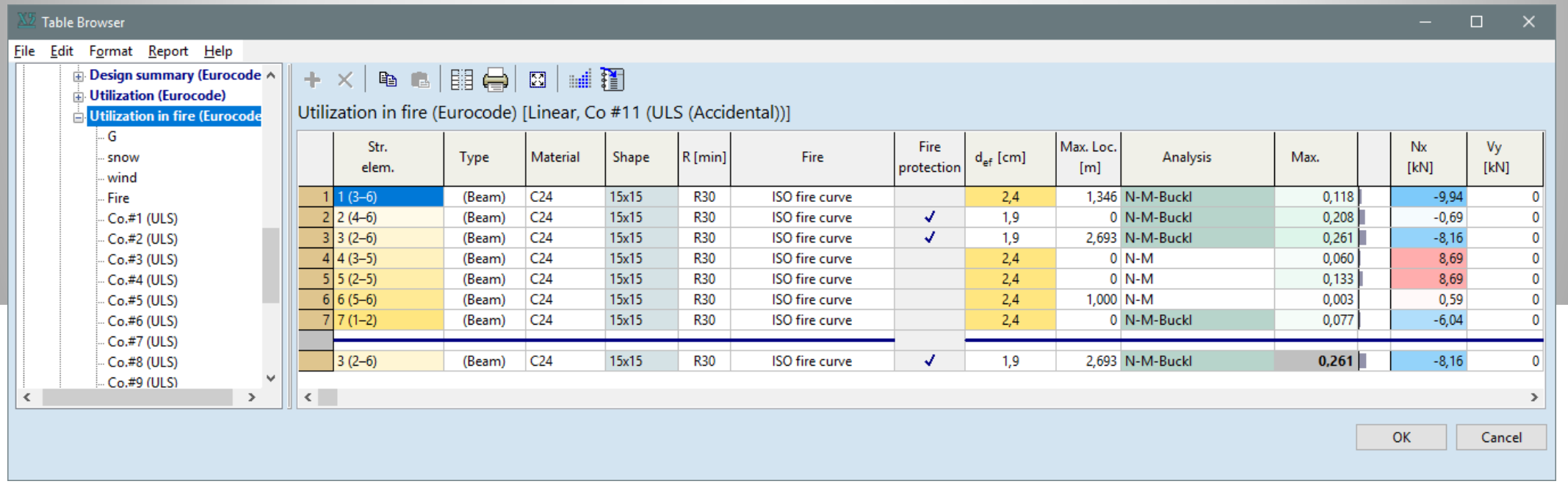
$$\eta_{1,fi} = \frac{\sigma_{c,0,d,fi}}{k_{c,z,fi} \cdot f_{c,0,d,fi}} + \left(\frac{|\sigma_{m,y,d,fi}|}{k_{crit,fi} \cdot f_{m,y,d,fi}} \right)^2 = \frac{0{,}09}{0{,}42 \cdot 2{,}63} + \left(\frac{|0{,}88|}{1 \cdot 3{,}18} \right)^2 = 15{,}2\ \% \quad (6.35)$$

$$\eta_{2,fi} = \frac{|\sigma_{m,y,d,fi}|}{k_{crit,fi} \cdot f_{m,y,d,fi}} = \frac{|0{,}88|}{1 \cdot 3{,}18} = 27{,}5\ \% \quad (6.33)$$

$\eta_{N,M,LTB,fi} = \max(\eta_{1,fi}; \eta_{2,fi}) = 27{,}5\ \%$ **passed**

After clicking on Design calculations button, the detailed calculation is available. This calculation can be saved into the documentation. In case of fire design, the type of fire curve and the effective charring depth are also shown.

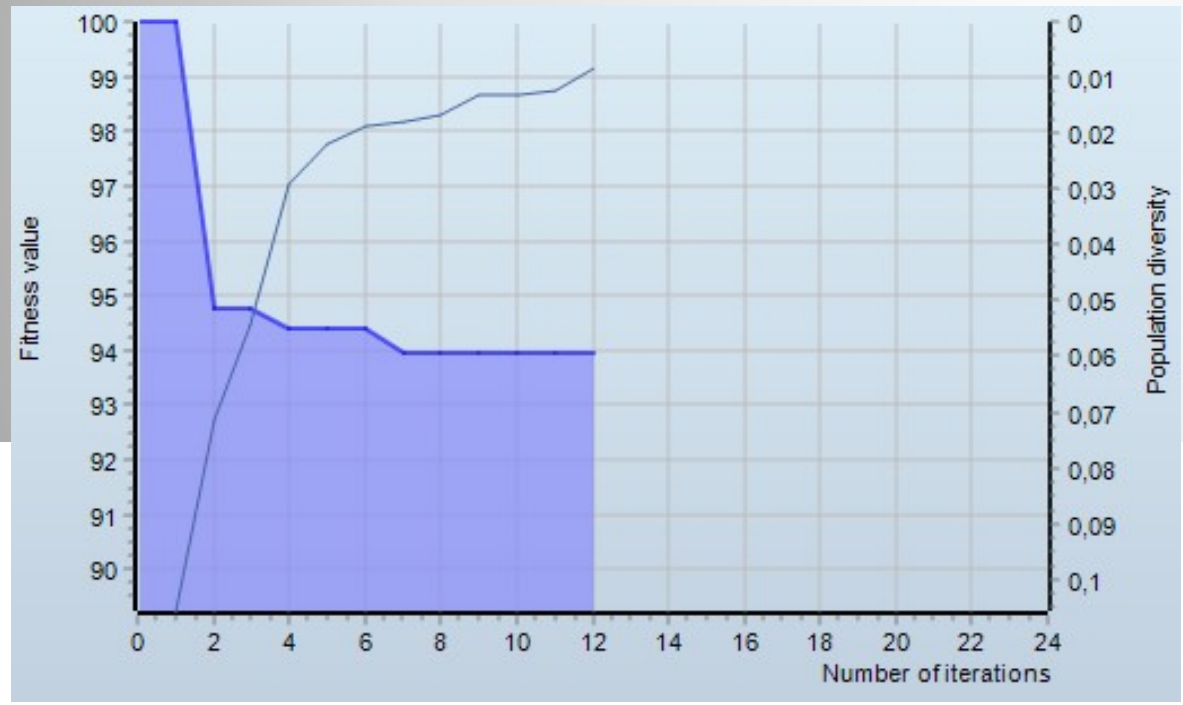
Result table



	Str. elem.	Type	Material	Shape	R [min]	Fire	Fire protection	d_{ef} [cm]	Max. Loc. [m]	Analysis	Max.	Nx [kN]	Vy [kN]
1	1 (3–6)	(Beam)	C24	15x15	R30	ISO fire curve		2,4	1,346	N-M-Buckl	0,118	-9,94	0
2	2 (4–6)	(Beam)	C24	15x15	R30	ISO fire curve	✓	1,9	0	N-M-Buckl	0,208	-0,69	0
3	3 (2–6)	(Beam)	C24	15x15	R30	ISO fire curve	✓	1,9	2,693	N-M-Buckl	0,261	-8,16	0
4	4 (3–5)	(Beam)	C24	15x15	R30	ISO fire curve		2,4	0	N-M	0,060	8,69	0
5	5 (2–5)	(Beam)	C24	15x15	R30	ISO fire curve		2,4	0	N-M	0,133	8,69	0
6	6 (5–6)	(Beam)	C24	15x15	R30	ISO fire curve		2,4	1,000	N-M	0,003	0,59	0
7	7 (1–2)	(Beam)	C24	15x15	R30	ISO fire curve		2,4	0	N-M-Buckl	0,077	-6,04	0
	3 (2–6)	(Beam)	C24	15x15	R30	ISO fire curve	✓	1,9	2,693	N-M-Buckl	**0,261**	-8,16	0

Among timber design result tables, Utilization in fire table summarizes the fire design results. The table is empty if there are no fire design results related to the selected combination.

Cross-section optimization in fire



If TD9 module is installed, timber cross-section optimization can be performed for load combinations that contain fire load case with respect structural fire design rules.

Inter-CAD Ltd. 2019

Further informations...

Detailed description of TD8 module in the User's manual (User's manual of AxisVM X5**)**

4.10.1. Load cases, load groups

4.10.30. Fire effects on timber elements – TD8 module

6.7.2. Timber beam fire design – TD8 module

Do not hesitate to download the trial version of AxisVM X5 with 30 days license (AxisVM X5 trial version**) and try our new modules!**

axisvm.eu