GSE SOFTWARE
General Structural Engineering

APPLICATION
GSE Timber

FUNCTIONALITY
Fire resistance of wood elements

Fire resistance of wood elements

The resistance limit states, under fire conditions, are calculated for large cross-section wood elements. To enhance productivity of GSE users, the cross-section elements are automatically reduced during the limit state checks.

Using the defined fire duration of the element and the charring rate, the reduced cross-section is calculated for each member. The fire resistances of the elements are verified according to the National Design Specification (NDS) and CSA O86 standards.

With this function, GSE users can efficiently design and verify wood elements under fire conditions.

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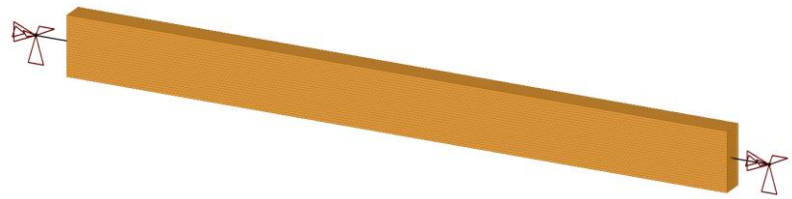
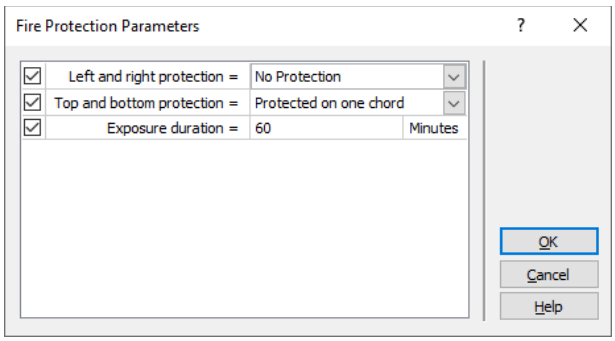
In the GSE Timber software, large cross-section sawn wood, glulam and SCL members may be verified under fire conditions. The required parameters to calculate the equivalent cross-section properties are in the *Fire Protection Parameters* menu. This menu includes options to determine the fire protected sides of the member and the fire exposure duration.





Using the properties above, the char depth is calculated for each exposed cross-section surface.

The equations used for the CSA O86 code are:

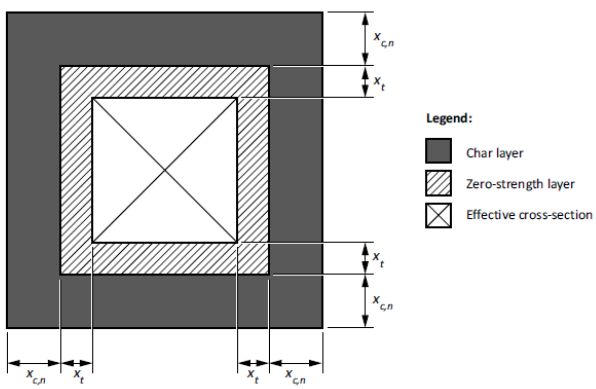


Figure 1 – Charring schema in CSA O86

$$x_{c,n} = \beta_n * t$$

$$x_t = \left(\frac{t}{20}\right) * 7 \ \ (t < 20min)$$

$$x_t = 7 \ (t \geq 20min)$$

$$a_{char} = x_{c,n} + x_t$$

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The equations used for the NDS code are:

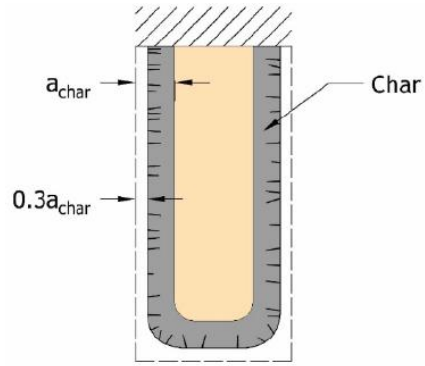
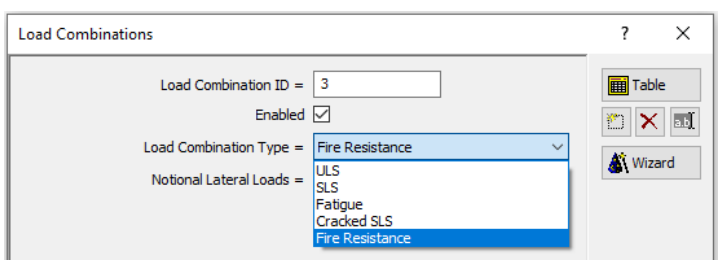


Figure 2 - Charring schema in NDS

$$a_{char} = \beta_t * t^{0.813}$$
$$a_{eff} = 1.2 * a_{char}$$

The fire load combinations may be automatically generated according to the American or Canadian building codes. The forces within those members, calculated during the analysis, are used to check the limit states of the reduced cross-section members.



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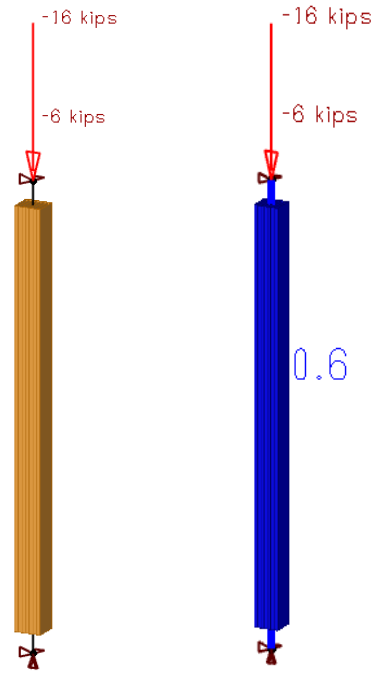
The verified limit states in the Canadian code are:

- Compression
- Tension
- Bending
- Compression and bending
- Tension and bending
- Shear
- Bearing

The verified limit states in the American code are:

- Compression
- Tension
- Bending
- Compression and bending
- Tension and bending



The limit state results for the fire load combinations are found within the designated tables of the limit state results.

Compression

Table Commands View Selection

0 2	Phys Memb	Memb ID	Section Name	Material Name	Ag in.2	Volume in.3	Fire (min)	$C_{C,x}$	$C_{C,y}$	$C_{p,x}$	$C_{p,y}$	F_{cx}' psi	Prx kips	F_{cy}' psi	Pry kips	F_c' psi	Pr kips	f_c (ana) psi	f_c psi	Pf kips	ULS Pf/Pr
	1	1	GL8.5x9.625	S.Pine N2D12 (SPGL) 4+Lam	81.8125	13744.4990		17.4545	19.7647	0.7438	0.6369	1881.8680	153.9603	1611.2372	131.8193	1611.2372	131.8193	268.9076	268.9076	22.0000	0.1669
	1	1	GL8.5x9.625	S.Pine N2D12 (SPGL) 4+Lam	29.5225	4959.7793	60.0000	27.8838	34.2857	0.3247	0.2189	1842.9430	54.4083	1242.7330	36.6886	1242.7330	36.6886	745.1945	745.1945	22.0000	0.5996

[Click here to learn more about the GSE Timber – Structural Engineering Software]

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