

Fire Safety in buildings: Fire resistance testing

Test standards and route to compliance

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Establish fire resistance of structural elements

Codes and Standards, such as EN 1995-1-2

Testing

- Loadbearing capacity
- Fire resistance
- Acoustic performance
-

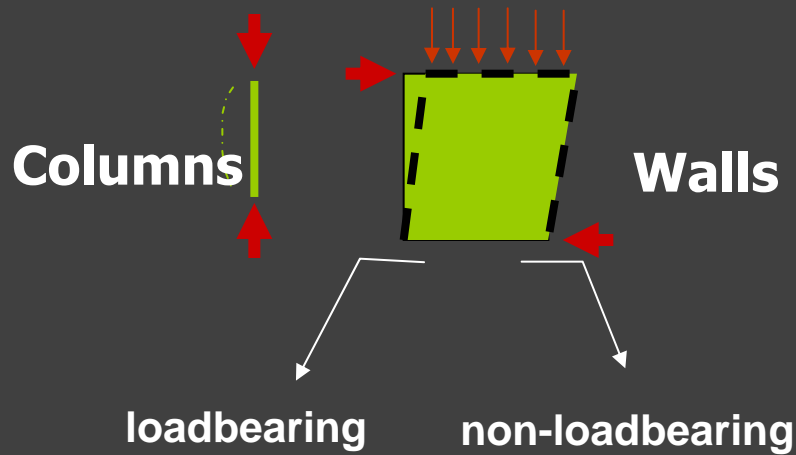
Third party approval- 'Certification'

Main structural members

Horizontal members



Vertical members

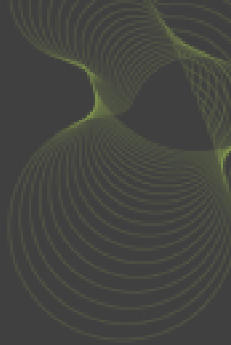


Roofs



Beams

Structural Performance



Methods and design standards available

- **Test Methods**

- BS 476: 20 and 21
- DIN 4102
- ISO 834

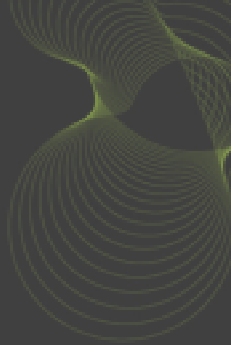
- **Design standards**

- BS 5268: Part 4
- EN1995 (Eurocode 5)
- ...

All construction types and systems can be assessed!



Fire performance

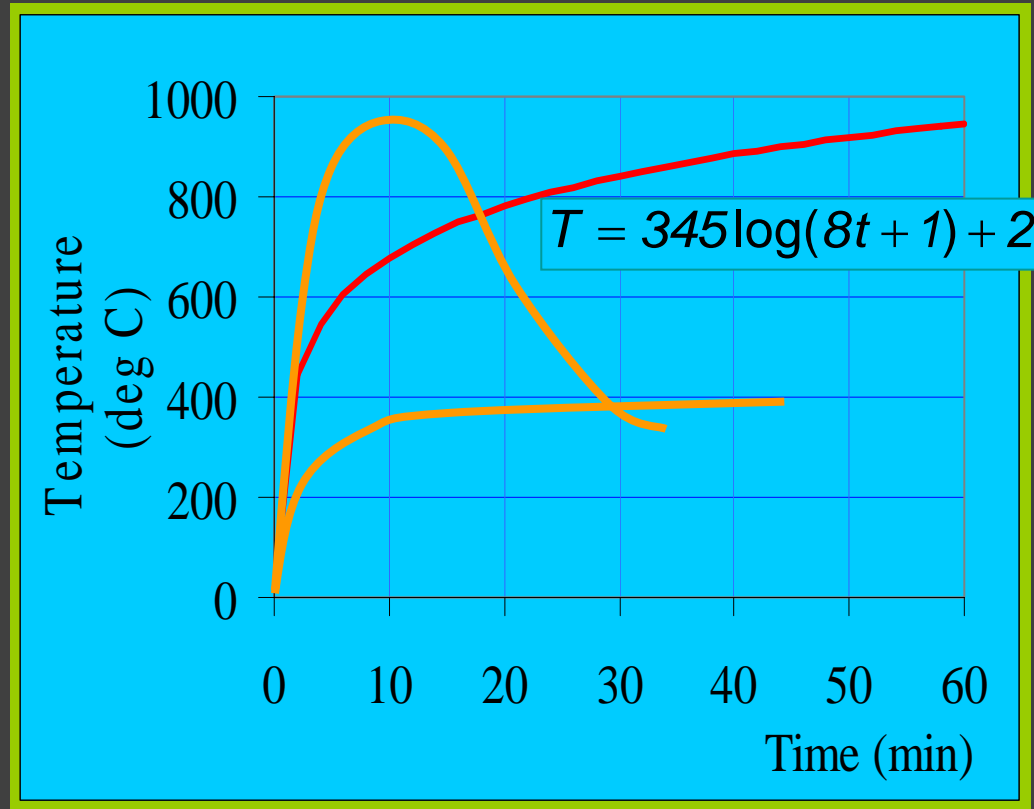
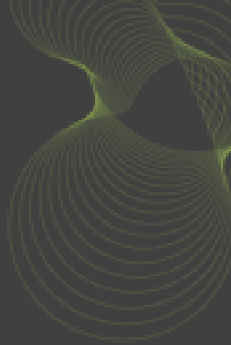


European fire resistance testing

- Four main sections
 - Walls
 - Floors and roofs
 - Beams
 - Columns
- And also
 - Balconies
 - Stairs, walkways in preparation



Fire resistance - Compartmentation



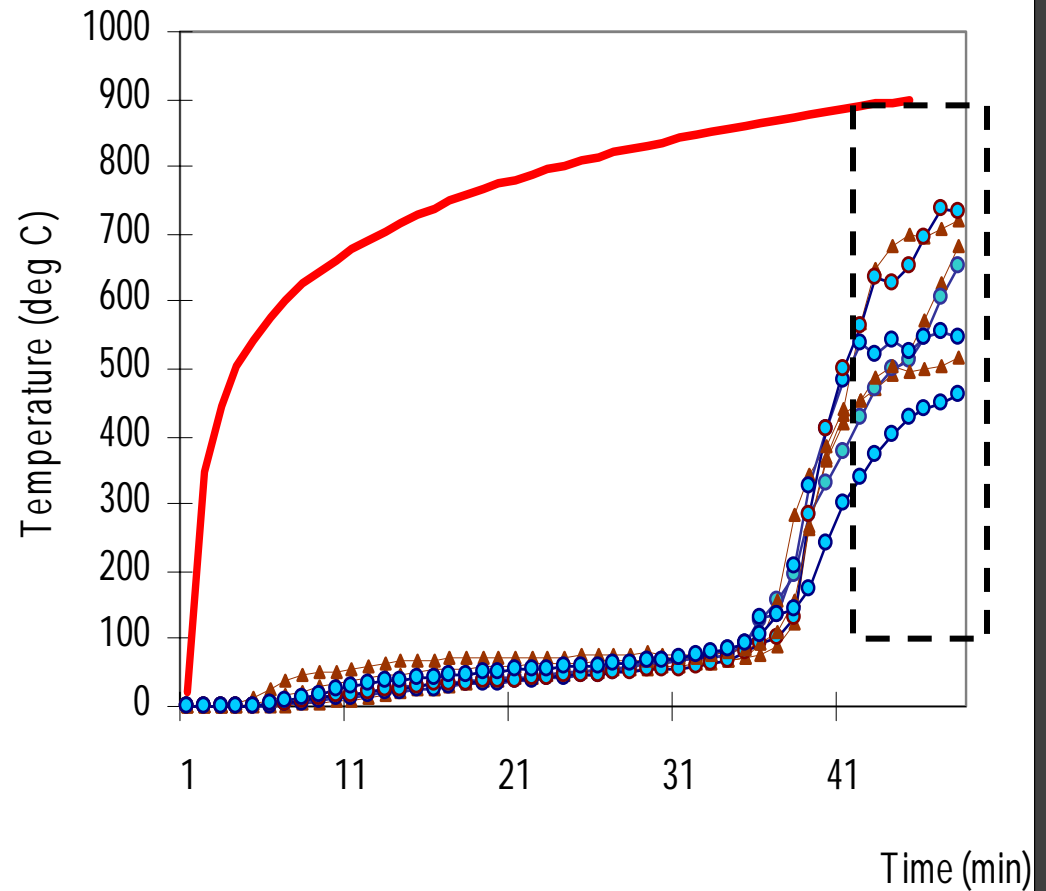
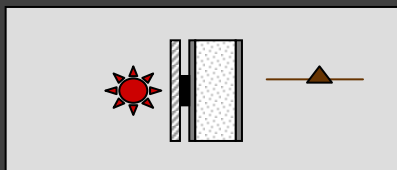
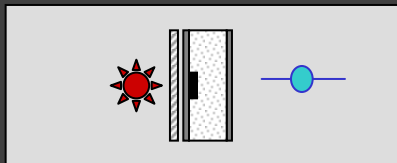
Performance requirements

- Loadbearing capacity (R)
 - Limiting deflection/ contraction
 - Limiting rate of deflection/ contraction
- Insulation (I)
 - Temperature on unexposed surface increases on average (five thermocouples) by more than **140°C**
 - Temperature on unexposed surface in one location by more than **180°C**
- Integrity (E)
 - Ignition of cotton pad
 - Passage of gap gauge
 - Sustained flaming

Fire resistance - Compartmentation

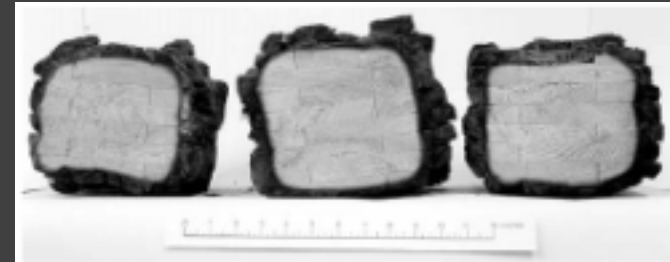
Depending on layers of plasterboard:

- 30 min or
- 60 min



Designing timber structures for fire resistance

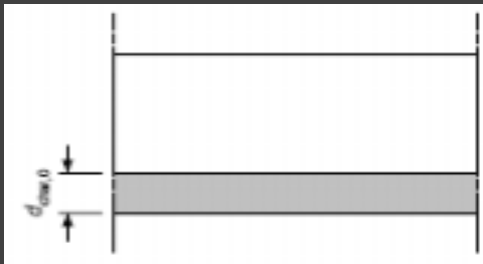
- EN 1995-1-2: Most comprehensive code for designing timber structures in fire
 - Two calculation methods mainly used
 - *Effective cross section*
 - *Reduced strength and stiffness method*
 - Advanced analytical method
- BS 5268: Part 4
 - Tested and trialled element build-up



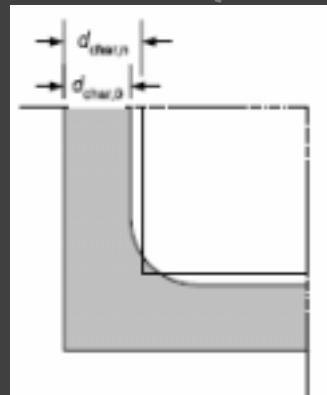
Calculating fire resistance- two methods

Table 2 Comparison of charring rates for British and European standards

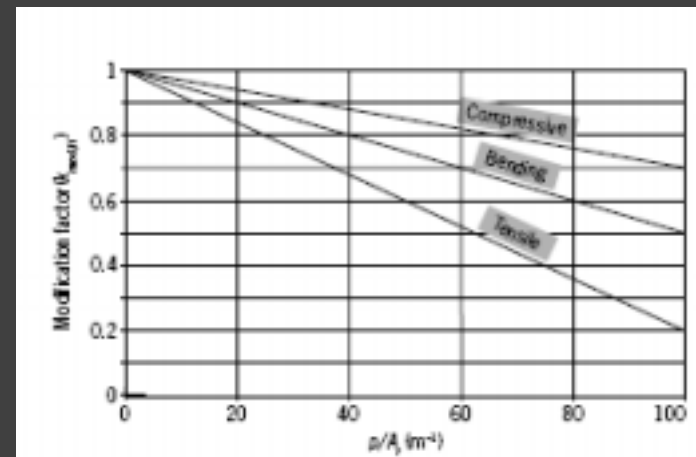
Standard	Material class	Charring rate (mm/min) (β)		Depth of charring after fire exposure (mm)			
				t = 30 mins		t = 60 mins	
BS 5268-4.1	Softwood	-		20		40	
	Hardwood, density $\rho \geq 650 \text{ kg/m}^3$ (18% moisture content)	-		15		30	
prEN 1995-1-2 (Eurocode 5)	Solid softwood and beech	One-dimensional (β_0)	Notional (β_n)	One-dimensional	Notional	One-dimensional	Notional
	Glue laminated softwood and beech	0.65	0.7	19.5	21	39	42
	Solid or glue laminated hardwood, density $\rho \geq 290 \text{ kg/m}^3$	0.65	0.8	19.5	24	39	48
	Solid or glue laminated hardwood, $\rho \geq 450 \text{ kg/m}^3$	0.65	0.7	19.5	21	39	42
		0.5	0.55	15	16.5	30	33



Effective cross section method

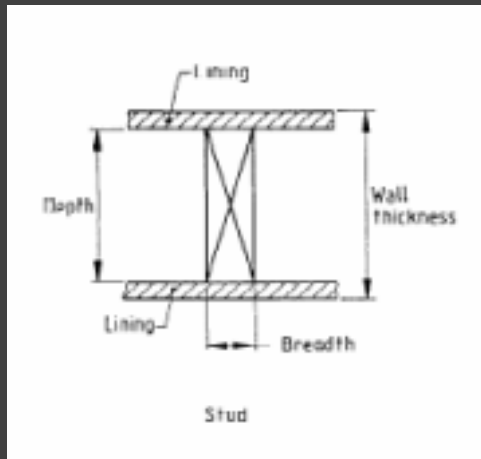


Reduced strength and stiffness method

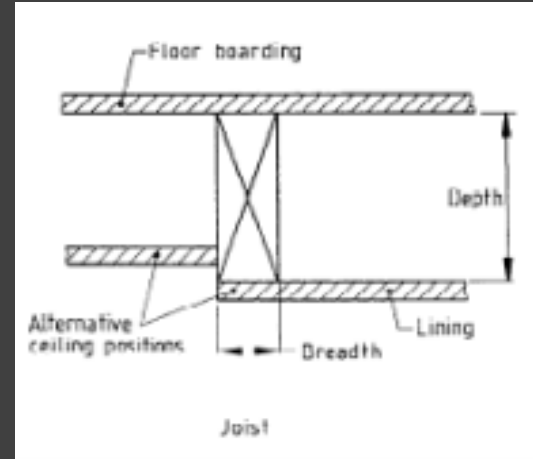


UK approach- in co-existence with Eurocode 5

Wall



Floor



- Tested and trialled elements of construction
- Both for walls and floors

Internal wall 60:60:60

Contribution
exposed lining

Contribution
unexposed lining

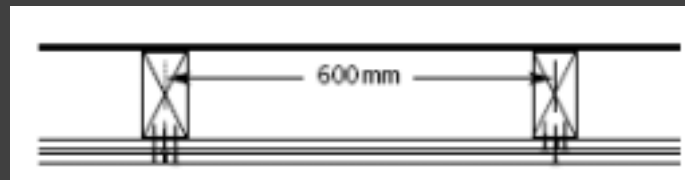
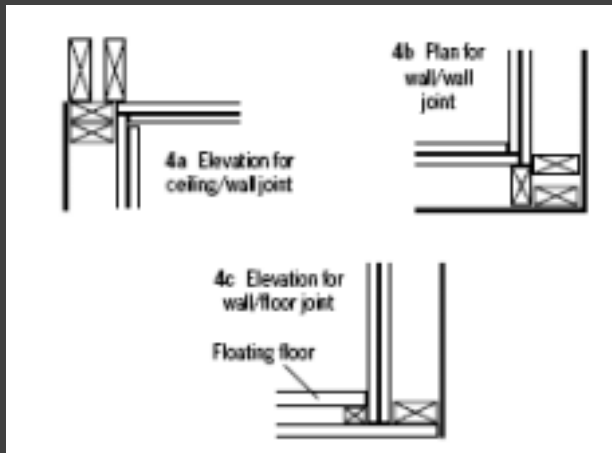
R E I

R E I

				2	Plasterboard			
83	67	67	2.1	25.0 mm	Plasterboard (2 layers 12.5 mm)	0	33	33
92	92	92	2.2		As above with infill systems b, d, f, g	0	33	33
100	92	92	2.3	31.5 mm	Plasterboard (1 layer 19.0 mm and 1 layer 12.5 mm)	0	33	33
92	75	75	2.4	* 9.5 mm	Plasterboard and 16.0 mm lightweight gypsum plaster	0	33	33
88	67	67	2.5	12.5 mm	Plasterboard and 13.0 mm lightweight gypsum plaster	0	33	33
87	87	87	2.6		As above with infill systems b, d, f, g	0	33	33
88	67	67	2.7	* 9.5 mm	Plasterboard and 13.0 mm lightweight gypsum plaster	0	33	33
92	92	92	2.8		As above with infill systems b, d, f, g	0	33	33
80	58	58	2.9	12.5 mm	Plasterboard and 10.0 mm lightweight gypsum plaster	0	25	25
88	88	88	2.10		As above with infill systems b, d, f, g	0	25	25
92	92	92	2.11		As above with infill systems f, g	0	25	25
67	50	50	2.12	19.0 mm	Plasterboard	0	25	25
84	84	84	2.13		As above with infill systems f, g	0	25	25
				3	Plywood			
75	58	58	3.1	22.0 mm	Plywood backed with 12.5 mm plasterboard	0	25	25
84	84	84	3.2		As above with infill systems b, d, f, g	0	25	25
92	92	92	3.3		As above with infill systems f, g	0	25	25
92	75	75	3.4	18.0 mm	Plywood backed with 12.5 mm plasterboard	0	33	33
57	42	42	3.5	18.0 mm	Plywood	0	25	25
84	84	84	3.6		As above with infill systems f, g	0	25	25

Construction and execution of greatest importance!

- Particular attention to detailing of protective linings at corners and junctions,
- Fixings of linings very important



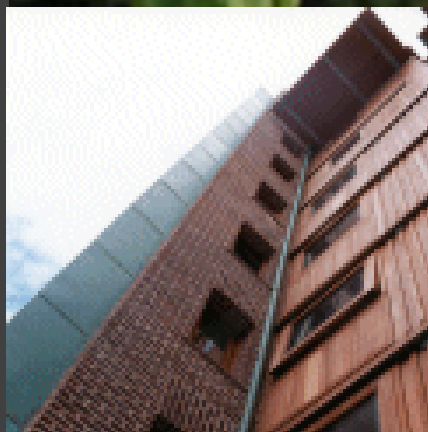
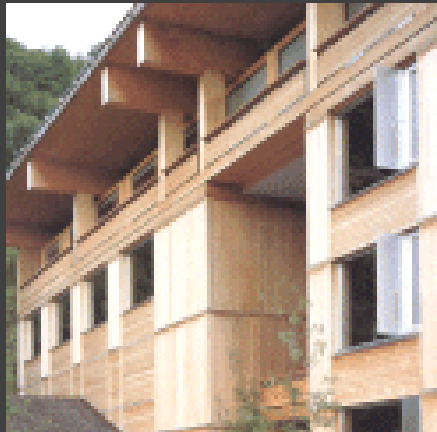
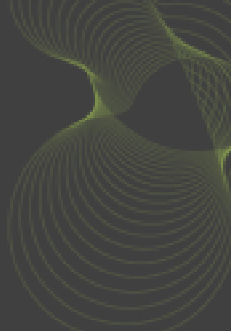
Fire protection

- Fire properties of timber well understood
- Can be modified to meet demands
- Predictable charring rate and structural response
- Timber can be used in UK buildings of up to 18m high



Extensive research in TF2000

Opportunities for timber!



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Thank you!

Questions?

