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The new Eurocode 5 – impact on engineered wood products and glulam

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Second generation Eurocode timeline

Timber Eurocodes on enquiry till 4 January 2024

Timber Eurocodes formal vote May 2025

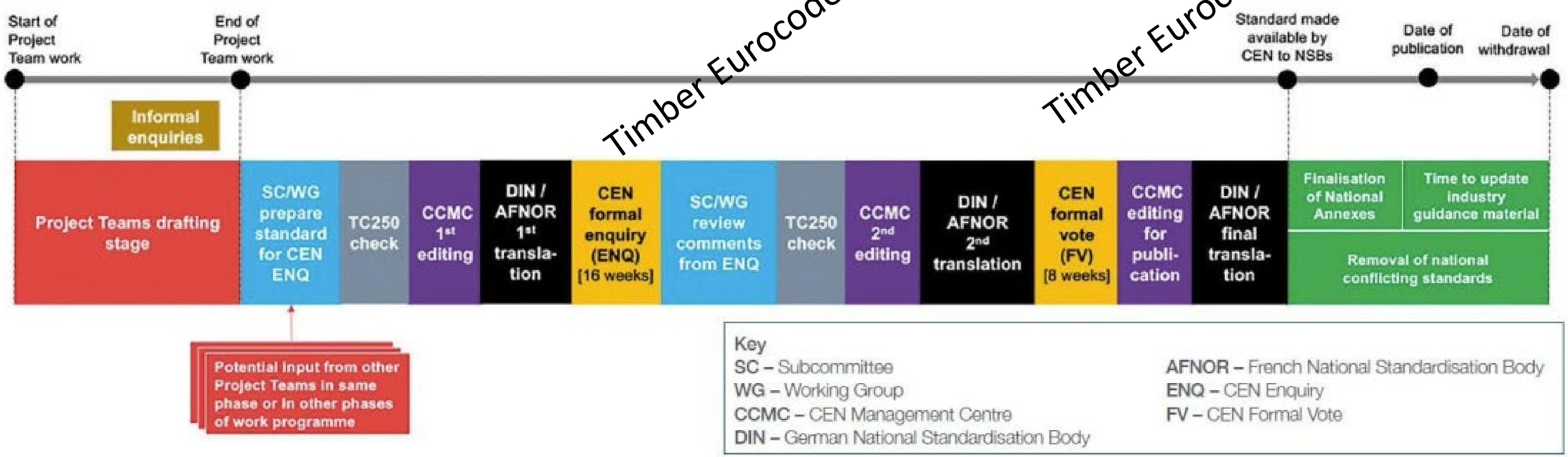

FIGURE 1 — Eurocode development process

Dates or all Eurocodes: DAV by March 2026
DoP September 2027
DoW March 2028

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Table 4.3 (NDP) — Partial factor γ_M for materials in fundamental design situations

Groups and Subgroups		Product	Abbreviation	Partial factor
Solid wood based (SWB)	Structural lumber (SL)	Strength graded structural timber with rectangular cross-section	ST	$\gamma_M = 1,3$
		Structural finger jointed timber	FST	
	Parallel laminated timber (PL)	Glued structural timber	GST	$\gamma_M = 1,25$
		Glued laminated timber	GL	
		Block glued glulam	BGL	
		Single layered solid wood panel	SWP-P	
	Cross layered timber (CL)	Cross laminated timber	CLT	$\gamma_M = 1,25$
		Multi-layered solid wood panel	SWP-C	
Veneer-based (VB)	Laminated veneer lumber (LVL)	LVL with parallel veneers	LVL-P	$\gamma_M = 1,2$
		LVL with crossband veneers	LVL-C	
	Glued laminated veneer lumber (GLVL)	GLVL with parallel veneers	GLVL-P	
		GLVL with crossband veneers	GLVL-C	
	PLY	Plywood	PW	
		Densified laminated wood	DLW	
Strand based (STB)		Oriented strand board	OSB	$\gamma_M = 1,2$
Wood-fibre-based (WFB)		Fibreboard, hard	HB	$\gamma_M = 1,3$
		Fibreboard, medium	MB	
		Softboard	SB	
		Dry process fibreboard	MDF	
Wood-particle-based (WPB)		Resinoid-bonded particle board	RPB	$\gamma_M = 1,3$
		Cement bonded particle board	CPB	
Gypsum -based (GYB)		Gypsum plasterboards	GPB	$\gamma_M = 1,3$
		Gypsum fibreboards	GFB	

NOTE The partial factor $\gamma_{M,fat}$ is equal to γ_M for persistent and transient design situation unless the National Annex gives different values.

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Size effect on the bending strength of glulam

- Europeans tackle the subject with simulations
- US/Canadians do not believe in simulations,
  they tackle the subject by testing
- This discussion is still ongoing
  in the Eurocode committee
- The European glulam industry does not wish to introduce new size effects

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Size effect on bending strength

Current Eurocode 5
EN1995-1-1 (2014)

For GL members subjected to bending the characteristic bending strength $f_{m,k}$ **for depths less than 600 mm** should be multiplied by the depth modification factor k_h as follows:

$$k_h = \left(\frac{600}{h}\right)^{0,1} \leq 1,1$$

Draft Eurocode 5 under enquiry
prEN1995-1-1

For GL members subjected to bending the characteristic bending strength $f_{m,k}$ should be multiplied by the depth modification factor k_h as follows:

$$k_h = \min\left\{\left(\frac{600}{h}\right)^{0,08};1,1\right\}$$

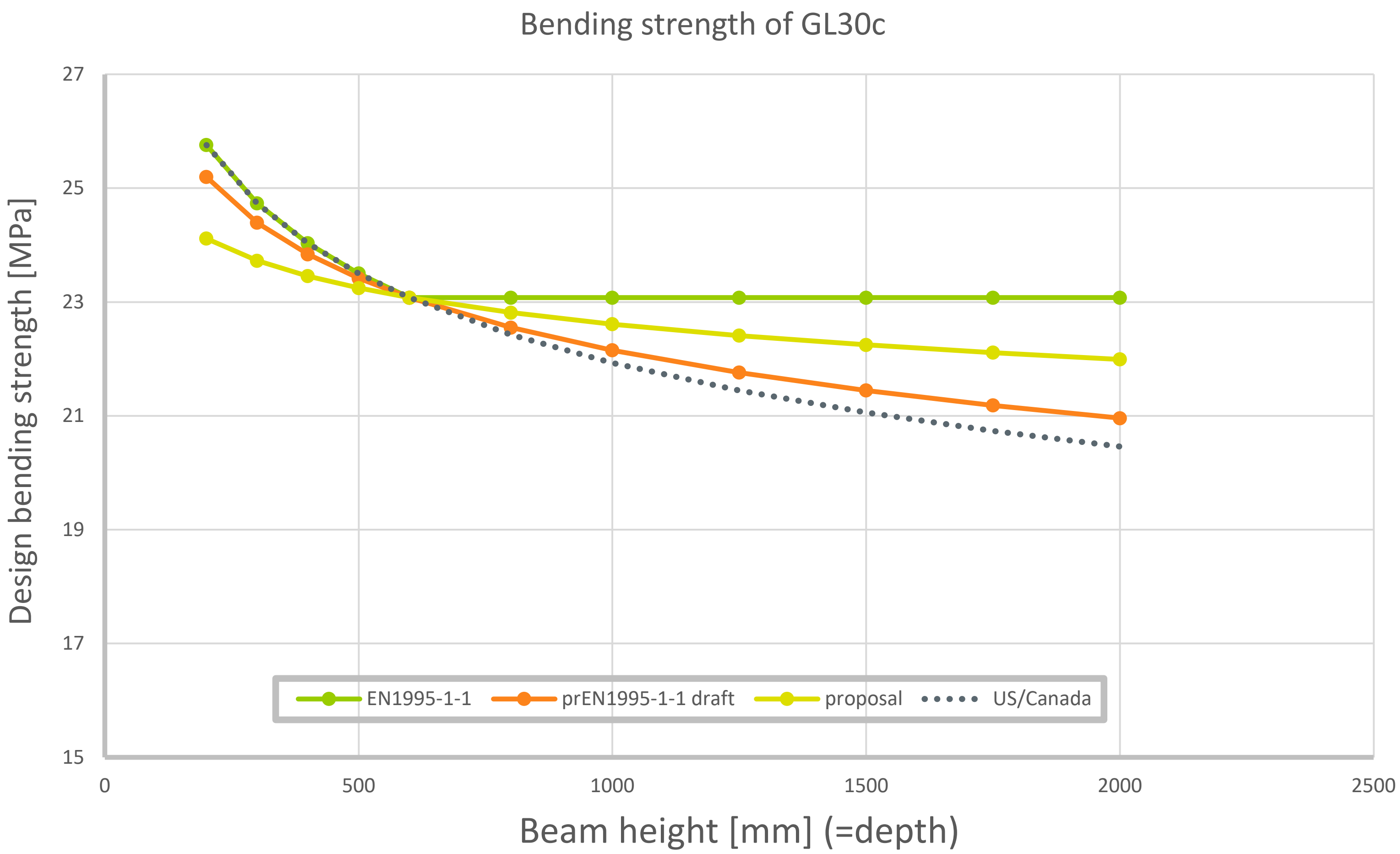
US/Canada provision:

$$K_{Zbg} = \left(\frac{130}{b}\,\frac{610}{d}\,\frac{9100}{L}\right)^{\frac{1}{10}} \leq 1.3$$

$$where\ l = length\ (m);\ b = width\ (m)$$

Some views on this debate

- In Europe researchers have done extensive simulations and the result is:
  size effect exists but this is not so significant at the level of characteristic strength
- In Canada and the USA, they don't believe in simulations but only in experiments, have made extensive glulam test series and ended up with a significant size effect
- LVL has a size effect on flexural strength throughout the size range
- No other basis for the current practice has been found
- **No failures related to bending strength of glulam have occurred**
- The code committee is divided on this



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Shear strength

6.1.7 Shear

|**A1**> (1)P For shear with a stress component parallel to the grain, see Figure 6.5(a), as well as for shear with both stress components perpendicular to the grain, see Figure 6.5(b), the following expression shall be satisfied:

$$\tau_{\mathrm{d}} \leq f_{\mathrm{v,d}} \tag{6.13}$$

where:

τ_{d} is the design shear stress;

$f_{\mathrm{v,d}}$ is the design shear strength for the actual condition.

NOTE: The shear strength for rolling shear is approximately equal to twice the tension strength perpendicular to grain.

(2) For the verification of shear resistance of members in bending, the influence of cracks shoud be taken into account using an effective width of the member given as:

$$b_{\mathrm{ef}} = k_{\mathrm{cr}}\, b \tag{6.13a}$$

where b is the width of the relevant section of the member.

NOTE: The recommended valuefor k_{cr} is given as

$k_{\mathrm{cr}} = 0{,}67$ for solid timber

$k_{\mathrm{cr}} = 0{,}67$ for gued laminated timber

$k_{\mathrm{cr}} = 1{,}0$ for other wood-based products in accordance with EN 13986 and EN 14374.

Information on the National choice may be found in the National annex.

NDP for Glulam k_{cr} = 1,0 in Finland

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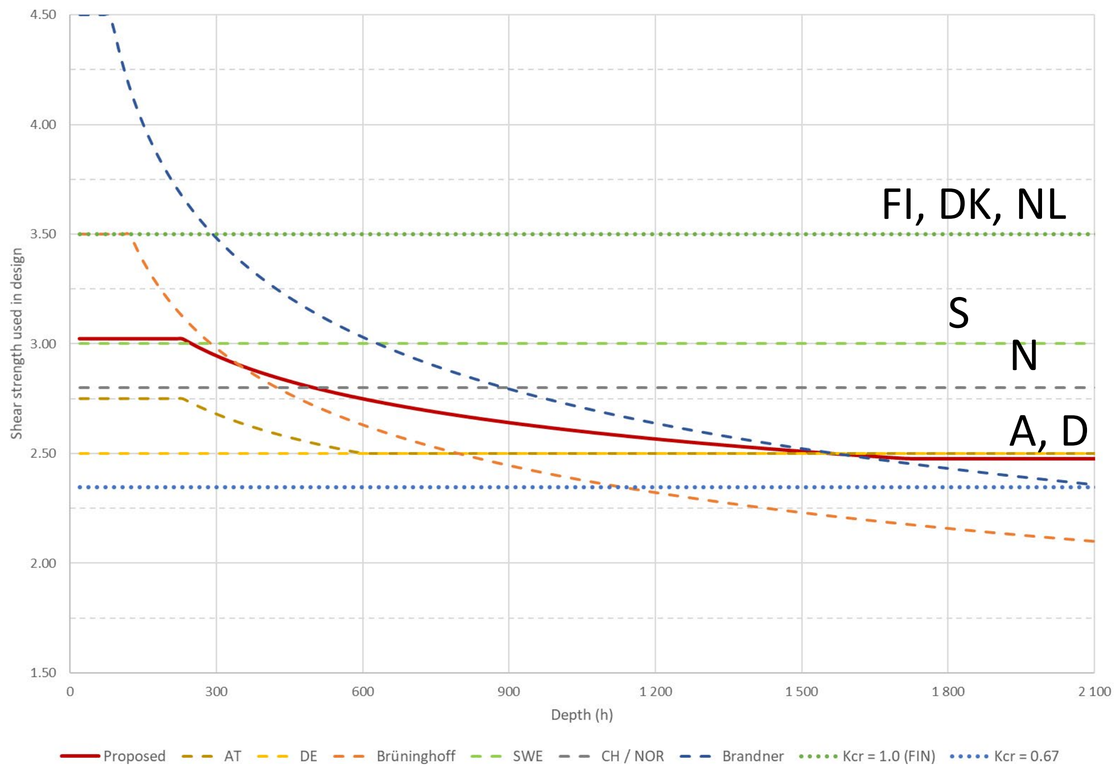

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(8.32 a)

$$k_{h,v} = \begin{cases} \min\left\{\left(\frac{150}{h}\right)^{0,2};1,3\right\} & \geq 1,0 \text{ for ST, FST and GST} \\ \min\left\{\left(\frac{600}{h}\right)^{0,1};1,1\right\} & \geq 0,9 \text{ for GLT and BGLT} \end{cases}$$

(8.32 b)

$$f_{v,k,ref} = \begin{cases} 2,30 & \text{for ST, FST and GST} \\ 2,75 & \text{for GLT and BGLT} \end{cases}$$

$\tau_d \leq k_v f_{v,d}$ (8.29) ⇒ $k_v = \min\left\{k_{h,v} k_{var} \frac{f_{v,k,ref}}{f_{v,k}}; 1,0\right\}$ $\leq 1,0$ in any case (8.31)

k_{var} : multiplicator $\geq 1,0$; recommended value = 1,0

Value of $k_{var} > 1,0$ for more positive service conditions may be agreed for the project by appropriate parties.
$k_{var} \geq 1,0$ does not apply to members subject to intense MC changes outside the scope of 4.3.1.4, for which other values of k_{var} are advisable

Simple and safe : $k_{h,v} = 0,9$; $k_{var} = 1,0$; $f_{v,k,ref} = 2,75$ N/mm^2 ➔ $k_v \cdot f_{v,k} = 0,9 \cdot 2,75 = 2,475$ N/mm^2

Summary

- The Eurocode draft is currently under a formal enquiry

Glulam
- There are some adjustments on the glulam strength
- More detailed analysis for different shapes: curved, double tapered etc.
- Design methods for holes in beams
- Design methods for reinforcements

General
- The Eurocode 5-1-1 draft is 440 pages
- National annexes to be developed; not as many NDP choices as before
- Would be good to stick with the recommended NDP values
- A huge workload is in front of us with the need to update:
  - Guide books
  - Teaching materials
  - Design software