Confederation of Finnish Construction Industries

Finnish Execution Standard for Timber Buildings

Tomi Toratti

Quality = $\frac{\text{performance}}{\text{expected performance}}$

1) The *process quality* is made up of the design and building processes as well as the communication and co-operation between these parties

2) The *quality of the end-product* on the other hand may be divided to visual, functionality, ecological and technical quality. The service-life perspective is an essential part of the end-product quality

1) Indicators of a good quality process are

- The objectives of the building project are well defined and clear
- The schedule is realistic
- The staging and decision making processes function
- The responsibilities and tasks of the building partners as well as the related scheduling is agreed
- The competences of the persons involved is adequate
- The building partners form a positive atmosphere and a desire to cooperate
- Sufficient resources are allocated to the design and building processes
- The security measures are taken care of
- The critical stages are identified and these are emphasized

2) End-product quality

- *Visual quality* is composed of the appearance of the visible structures, the rooms and building volumes, the environment and the combinations of the above.
- The *functionality quality* is determined on how the building performs its intended functions, eg. logistics and ergonomics or in other ways efficiently and comfortably.
- The *technical quality* is made up of durability, strength, safety and healthiness.
- The *ecological quality* is first effected when the building materials are chosen in the initial stages of the project, however the major part is determined on the building use. The main issues are the energy efficiency of the building, long service life, good maintenance procedures and modifiability of the building.

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**Design of safe timber structures –
How can we learn from structural failures in concrete, steel and timber?**

Eva Frühwald
Erik Serrano
Tomi Toratti
Arne Emilsson
Sven Thelandersson

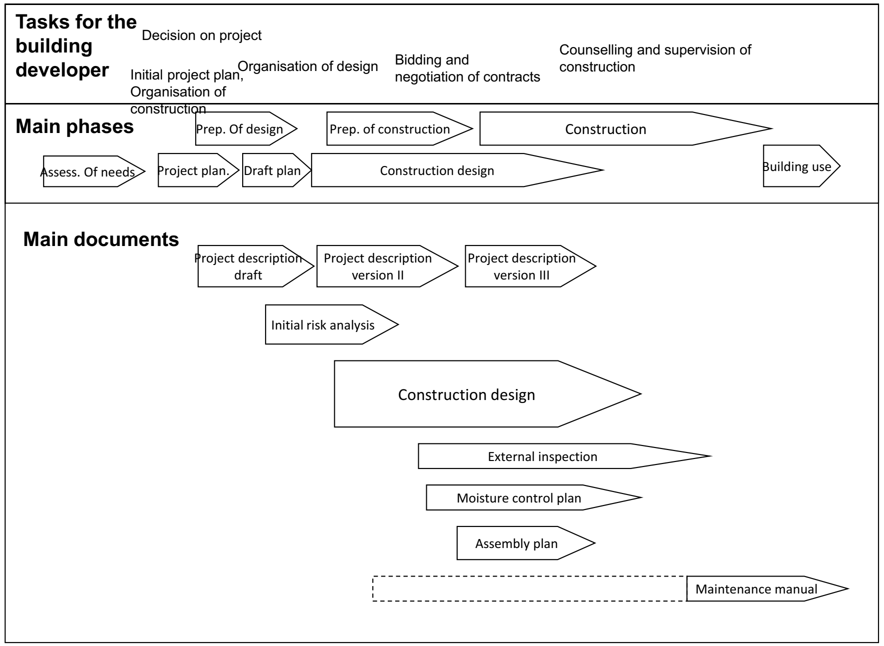
Result:
50 % of cases relate to bad design
25 % of cases relate to human factors on the site

Conclusion:
Human factors in the building process are dominant

Considering timber the following should receive special attention

- Handling of information and communication between the building project partners
- Bracing of load bearing structures
- Considerations on performance of connections and how these are effected by variable humidity conditions
- Swelling and shrinking of timber elements
- Cracks caused by shrinkage of moist wood
- Orthotropic strength of wood
- Fire safety

SFS 5978 Execution of timber structures
Rules for load-bearing structures of buildings



Moisture control plan •This covers the whole chain from production and building process of the timber structure •This plan is communicated to the personnel on site.	
•**Responsible**	Building developer
•**Who delivers:**	A cooperation between the structural designer (leader), the building contractor, the element designer and the element producer
•**Who verifies:**	The building officials, the building developer, the structural designers and the contractors
•**Who follows:**	The producers of building components and the contractors operating on site.

Moisture control plan

- The moisture control plan is drafted for building projects that are carried out at least partly in external conditions.
- Basic information of the building project (address and other coordinates of the building site, the person responsible for the construction on site, the main author of the moisture control plan)
- List of wood products to be used in the construction site
- The target moisture content of wood and wooden elements at different stages of the industrial production.
- The target moisture content of wood and wooden elements when delivered to the building site, during assembly and when the building is finalized.
- Inspections on site and the person responsible for these.
- Possible sources of moisture in the building site (for instance, rain, snow, ground water etc.)
- The protection level (ST0-ST3) chosen for the building phase and an estimate on the necessary protection duration.
- The protection of wood and wooden elements on the building site:
  - storage method and protection of storage
  - protection during assemble (as determined by the protection level),
  - drying methods applied for wood that has gained moisture
- Risk assessment of moisture in the building project
  - Sensitivity of the project to unfavorable weather
  - Needs on drying duration and how drying conditions are realized
  - Effects on the overall schedule of work on site
- Moisture measurement plan (measurement method, timetable, documentation and person responsible)

Tolerance classes

(1) The tolerances of timber structures can be given in three tolerance classes:

Tolerance class 3:
Structure components which demand very high accuracy on dimensions and assembly and where there is a high demand on visual aspects
Tolerance class 2:
Structure components of residence, commercial and office buildings or similar. Class 2 is the most frequently used tolerance class
Tolerance class 1:
Structure components of hall structures and similar, where the demand on the accuracies and on visual aspects can be allowed to be lower than on class 2.

(2) Tolerances stricter than in tolerance class 3 or looser than in tolerance class 1 can be defined in the documentation. Essential tolerances that are looser than presented in this standard should not be used if the effects of them are not separately considered in the design of structures.

Table 5.1 Assembly tolerances for timber structures

Dimension and location	Maximum deviation allowed		
	Tolerance class 3	Tolerance class 2	Tolerance class 1
Wall structures			
Side location from base line	± 3 mm	± 5 mm	± 10 mm
Spacing of wall studs	± 3 mm	± 5 mm	± 10 mm
Size of windows and doors	± 3 mm	± 5 mm	± 10 mm
Location of windows and doors	± 3 mm	± 5 mm	± 10 mm
Distance between two adjacent walls	± 3 mm	± 5 mm	± 10 mm
Straightness of walls[1)]	± 1,5 ‰	± 1,5 ‰	± 1,5 ‰
Deviation of the wall frame from vertical line			
- height maximum 3 m	± 5 mm	± 5 mm	± 5 mm
- height over 3 m	± 8 mm	± 8 mm	± 8 mm

Table 5.2 Tolerances for connections in timber structures. The allowed deviation is given from the nominal location if not mentioned otherwise in the structural design. *d* is the diameter of the connector.

Connection type	tolerance	description / base value	Allowed deviation or gap
Nailed connections wood-wood Screwed connection wood-wood	location of connector	spacing a_1,a_2 [1]	± max(10%; *d*)
		end distance a_3	-0 / +10 mm
		side distance a_4	-*d* / +10 mm
	penetration	head flat with surface	-0 / +3 mm
Nailing plate connection	location of hole	holes in the nailing plate	± 3 mm
(also screwed)	location of nailing plate	in both directions	± 5 mm
Metal framing plates and hangers	location of connector	general	± 5 mm
		from contact surface	± 2 mm [9]
	edge or end distance of connector		- *d*
	gap to wood surface	full contact	skewed gap max. 3 mm
Bolt connections	location of bolt	simultaneous drilling [2]	± 5 mm [5]
	location of hole	separate drilling	± 1,5 mm [3]
	tightening	full contact between members	skewed gap max. 3 mm
Dowel connections	location of connector [4]	simultaneous drilling	± 3 mm
	location of hole [4]	separate drilling	± 1 mm [6]
	length of dowel in wood member *t*		- max(2 mm; 0,05*t*) [7]
	gap of contact	grooved or battened members	≤ min(3 mm; 0,25t_t) [8]
Incline screw connections	angle of screw		± 5°
Glued-in rods	location of rod	position at wood surface	± 5 mm
Glued-screw connections	skewness of holes	drilling length L_a	± L_a/50
Contact connections	gap	contact required	skewed gap max. 3 mm
	contact length	contact length	- 10%
	length of notch depth of notch	in grain direction perp to grain direction	+ 10% ± 5 mm

1) In the direction of grain, the nails have to be at least *d* out of line from each other if $a_1 < 14d$.

2) Drilling once through all members or using one drilled member as a template.

3) When wood members have 1 mm oversize holes and metal parts have 1,5..2 mm oversized holes

Conclusions

- SFS 5978 Execution of timber structures has been published
- The publication has received a varying feedback
- Building developers regard the procedures as complicated
- Structural designers, material producers and clients of the buildings are more satisfied
- Concerns on additional work load for a building project
- A pdf file of the full report in English is available