National fire regulations limit the use of wood in buildings

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Summary
Fire regulations form the main obstacle to the use of wood in buildings in many countries. European standards for the fire safety in buildings have been agreed, but fire safety will continue to be a national responsibility. The national limitations for the use of wood products in the two main stages of building fires, the initial and the fully developed fire, have been reviewed [1]. The results from more than 20 European countries and some non-European countries (Australia, Japan, New Zealand, Canada, USA) are included. They are presented as number of storeys permitted for the use of wood in load-bearing structure, wooden facade claddings and visible wood surfaces on walls, ceilings and floors in flats and escape routes. Further possibilities to increased use of wood by installation of sprinkler systems are included.

Major differences between the countries have been identified both for the number of storeys with timber structure and for visible wood surfaces in interior and exterior applications.

Keywords: Building materials, façade claddings, fire resistance, load-bearing structure, multi-storey buildings, reaction to fire, residential sprinklers, timber structures, visible wood, wall linings.

1. European harmonisation of methods
The European development towards performance criteria was speeded up by the Construction Products Directive (CPD) and adopted by the European Union and EFTA in 1988. Safety in the case of fire is one of the six essential requirements in the CPD. The move to performance based requirements are especially pronounced for the fire regulations that traditionally have been prescriptive. The CPD gives the following definition of the essential requirement in the case of fire: The construction works must be designed and built in such a way that in the event of an outbreak of fire:
• the load-bearing capacity of the construction can be assumed for a specific period of time,
• the generation and spread of fire and smoke within the construction works are limited,
• the spread of fire to neighbouring construction works is limited,
• occupants can leave the construction works or be rescued by other means,
• the safety of rescue teams is taken into consideration.

2. National responsibility for the fire safety
The European standards deal mainly with harmonised methods for verification. These standards exist on the technical level, but fire safety is on the political level governed by national legislation.
National or local authorities will also in the future set the level of requirements to maintain present national safety levels. Even if the European harmonisation will reduce the obstacles to trade and facilitate a wider use of wood and timber products in buildings, there are still limitations since the national building regulations are not harmonised with respect to safety levels. A main problem is also that the link between required national safety level and knowledge about the performance of wood in building fires often is unclear. Other factors that influence the possibilities of using wood are the organisation, strategies and resources of national or local rescue services. However, on a longer term, the national building regulations will probably be more unified. In the Nordic countries, a design guide for Fire safe timber buildings was published recently [2]. Its main focus is the new possibility for multi-storey buildings in timber.

2. **Two stages in building fires**

There are two different stages of a fire scenario to be considered in the fire safety design of buildings in relation to building materials and structures. These are the initial and the fully developed fire, see Figure 1. In the initial fire, the building content and furnishing, e.g. furniture, is of major importance both for the initiation of the fire and its development, but these are not subject to building regulations. Surface linings also play an important role in the initial fire, especially in escape routes. Limitations of their reaction to fire performance are included in most building regulations. In the fully developed fire, the performance of load-bearing and separating structures is important in order to limit the fire to the compartment of fire origin. This is called the fire resistance of the building structure. Generally speaking, timber structures can obtain high performance for fire resistance, while the performance of wood or wood-based linings in the initial fire may be less favourable and also more difficult to quantify.

*Figure 1.* There are two main stages that are relevant for the fire safety in buildings in relation to building materials and structures. One is the initial fire in which the properties of surface linings may be important. The other is the fully developed fire in which the load bearing and separating structures are essential to limit the fire to the room or fire compartment of origin.

4. **National limitations for the use of wood in buildings**

The present situation in Europe for multi-storey residential buildings in timber has been reviewed. A few non-European countries with traditions in timber building are also included. Several
countries do not have any specific regulations or do not limit the number of storeys in timber buildings. However, eight storeys are often used as a practical and economical limit for the use of timber structures. For facades, linings and floorings, this limit may be higher since these applications may also be used in e.g. concrete structures.

To visualise national legislations and to be able to compare the situation in different countries, maps are presented. One example is presented in Figure 2. Other examples as façade claddings, interior wall and ceiling linings and flooring are given in the full report [1]. At the headline graphic symbols describe which application the map presents.

Figure 2. Possibility to use timber for the load-bearing structure in multi-storey buildings in different countries.
5. Discussion
At least twelve European countries allow four storeys or more in timber structure and nine countries allow seven storeys or more. However, in some of these countries timber structures are very rare. On the other hand, at least nine European countries do not allow timber structures of more than one to three storeys.

Most countries have restrictions on the use of wooden facade claddings. Some countries have no restrictions, but, on the other hand also very limited experience of using wooden facades due to building traditions.

Several countries allow wooden panelling in flats, but usually not in escape routes. Wooden floorings are permitted in flats in most countries and in some countries also in escape routes.

Installation of active fire protection systems, e.g. residential sprinklers, may allow for higher buildings with timber structure or further use of visible wood in some countries. However, these systems are still quite unknown in most countries.

Outside Europe, unlimited number of storeys in timber structure is allowed only in New Zealand, where performance based requirements were introduced in 2000. Wooden facades are usually not allowed in more than three storeys. Visible wood may be used without limits in flats in three countries, but not in escape routes.

The building regulations have been changed in some countries since 1995, e.g. in Denmark, Finland, Ireland, Italy and Norway. Switzerland has announced a change to take place during 2004. Changes are soon also expected in Germany and Australia.

6. Conclusions
Main conclusions are
- There are major differences between the countries included in this survey for the use of wood products in buildings due to national fire regulations
- Technical design solutions are available only in some countries [3]
- There is a need for exchange of experience

Further development and application of new technologies for fire safety engineering [4, 5] and performance based design will facilitate extended and fire safe use of timber in buildings.

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References