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Fire safety in modern wooden houses – mapping of fire incidents in Sweden

Multi-storey timber frame houses have been built in Sweden since 1994, when performance-based building regulations were introduced. The construction technology is now well established and steadily growing. Life safety protection is clearly defined in the building regulations. Now, property protection is being discussed from new perspectives.

As a first step in better understanding, fire incidents have been mapped. The survey shows that modern apartment buildings with wooden frames have a lower rate of fire incidents than the entire stock of apartment buildings.

New knowledge about fire safety performance of wooden structures and wood materials has been developed in international collaboration during the past three decades in which Sweden played a leading role. This knowledge has been used to meet new European and national requirements for fire safety and has been applied for 20 years. It is therefore natural to evaluate how the fire safety functioned in reality, and a first survey has recently been carried out.

The modern wood construction is defined as apartment buildings higher than two floors, where the supporting structure is made of wood that has been built according to the Swedish Building Regulations 1994 and subsequent updates. The concept of multi-family dwellings also includes student homes and residential care.

The Strandparken building in Sundbyberg, Stockholm with wood both as load-bearing frame and as facade.
Table 1 – Fire incidents resulting in rescue service callouts

<table>
<thead>
<tr>
<th></th>
<th>Total number</th>
<th>In the starting object</th>
<th>In the starting space</th>
<th>In the starting fire cell</th>
<th>In the starting building</th>
<th>Fire spread to other buildings</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire incidents</td>
<td>48,949</td>
<td>32,386</td>
<td>11,160</td>
<td>3,885</td>
<td>1,347</td>
<td>84</td>
<td>107</td>
</tr>
<tr>
<td>Expected number in wooden buildings</td>
<td>73</td>
<td>48</td>
<td>17</td>
<td>6</td>
<td>2</td>
<td>0,1</td>
<td>0,2</td>
</tr>
<tr>
<td>Incidents in wooden buildings</td>
<td>22</td>
<td>12</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Inventory of apartment buildings with wooden frames

Apartment buildings with wooden frames in Sweden have been completely inventoried and analyzed. Data have been obtained from the component companies, developers and contractors who manufactured or built apartment buildings with more than two floors from 1994 onwards. A total of thirty companies were contacted. These contacts have resulted in a database with a total of 10,264 apartments from 188 construction projects during the period 1994-2015, which is expected to cover more than 95% of completed projects.

Swedish Civil Contingencies Agency (MSB) then delivered excerpts from their incident database with the intervention by the fire services. Modern wooden houses have been compared with the total population of apartment buildings, regardless of the structural frame type, year of construction, number of floors, etc., since that is the only basis available for comparison.

Fire incidents 1998-2014

Three fire incidents have been identified by the manufacturers for the years 1998-2014, two of which resulted in damages beyond the starting compartment. In addition to these, three fire incidents were identified during 2015 and no incidents before 1998. The compilation concentrated in the years 1998 to 2014, where statistics are available at the MSB of all fire incidents with the intervention by the fire services. Building addresses and property names are then used for checking the MSB database of all incidents in the country where the fire services were involved. Another 19 fire incidents have been identified, but with no further spread of fire outside the starting fire cell/compartment. In total, therefore, 22 fire incidents were reported during the period 1998-2014:

- 3 fires in separate garbage rooms
- 8 dry boiling on the stove etc
- but no fire
- 7 fires in the starting objects
- extinguished or self-extinguished
- 2 fires in the starting space or compartment
- Fire in the basement storage
- Fire in the apartment hall
- 2 fires with spread outside the starting compartment
- Apartment fire where the door to the corridor was left open. Fire and water damage in the apartment and corridor
- Dry boiling spreading fire to the attic that was burnt out. Then creeping fires in voids resulted in demolishing the whole house.

Accumulated number of apartments in buildings with wooden frame with more than two floors 1994-2015.

Table 1. Fire incidents resulting in rescue service callouts for apartment buildings between 1998 and 2014 according to MSB's statistics (5), and the expected number of fire incidents in apartment buildings with a wooden frame as compared to the actual number of identified incidents.

In only one of the reported fire incidents, the construction material had any impact on the fire. This fire incident refers to a student house in Luleå, Sweden, which was demolished after the fire. The fire is well documented and lacking in structural details and control procedures have been identified.

None of fire incidents in wooden buildings 1998-2014 has had fire victims, but injuries from smoke have been reported in two of the incidents.

Comparison with the entire housing

The fire incidents have been divided into six levels depending on the spread of the fire according to MSB and Rescue Service definitions, see table 1.
The total number of residential units in apartment buildings, according to Swedish statistics, increased from 2.33 million in 1998 to 2.58 million in 2014. The average number is 2.44 million. The average number of apartment buildings with wooden frames, 3,560 apartments, constitutes 0.15% of the total housing stock in apartment buildings during this period.

Based on the total number of incidents, about 73 incidents should have occurred in the stock of wooden houses if the stocks were equivalent. This is more than what has actually been found in this study (a total of 22 fires), see Table 1.

Existing statistics thus show a lower rate of fire incidents leading to the intervention of the fire services in the wooden houses, compared with the national average for all apartment buildings. This is not surprising, especially since the wooden buildings are relatively new and designed according to modern building regulations. However, there are no statistics on fire incidents with breakdown by age of the building to compare with. Fire incidents with intervention by the fire services in the modern wooden buildings are 0.4 fires per 1000 apartments and year. The corresponding data for the total apartment building stock during the same period is 1.2 fires per 1000 apartments and year.

The outcome, however, is so small that further analysis should be rather qualitative than quantitative.

**Conclusions and further work**

Reported fire incidents in Sweden during the period 1994-2015 show that modern apartment buildings with wooden frames exhibit a lower rate of fire incidents that led to the intervention by the fire services than the entire stock of apartment buildings. This can be explained by the wooden buildings being relatively new. Only one of the incidents in a total of more than 10,000 apartments has connection to the structural wood material. The most common incident is a fire in the starting object without any continued spread, which is consistent with the incidents of the total housing stock.

Further activities include analysis of statistics from other countries and preparation of recommendations for increased fire property protection in an ongoing research project.

For more information, go to [www.sp.se/en/index/services/fireproofbuilding/Sidor/default.aspx](http://www.sp.se/en/index/services/fireproofbuilding/Sidor/default.aspx).

**References**

7. SFO (Statistics Sweden) Number of dwellings by type of building 1990-2014, [link](http://www.scb.se/). Information December 2015.