Only large-scale tests can properly evaluate the fire behaviour of sandwich panels

Sandwich panels consist of a layer of insulation material between two metal sheets, possibly adhesively bonded. The behaviour of such panels with combustible insulation in the event of a fire has been under discussion in recent years. It is important, with composite products of this type, to investigate the whole system in its entirety, i.e. how the panels, joints and securing and fitting features work together. This can only be done by testing in full scale, as reduced-scale methods cannot properly represent) the mechanical phenomena that may be decisive for the ability of the panels to resist a fire.

The number of fires involving sandwich panels having a combustible core has increased in Europe in recent years. Initially, the problem was confined to the UK, where sandwich panels were used mainly in the food industry. During the 1990s, the number of such fires increased substantially, causing damage to an estimated value of about EUR 30 million per year. Several insurance companies have therefore started to demand full-scale testing in their certification rules: examples include FM Global in the USA and LPC (Loss Prevention Council) in the UK. Recently even fires in Belgium and Sweden have opened the discussion.

Some specific fire resistance aspects

Technically, there are a number of aspects that need to be considered in connection with fires in a building having sandwich panels with combustible insulation:

- The insulation does not catch fire until the metal sheet falls away or opens up and exposes the insulation, or until pyrolysis gases emerge from the joints. It is therefore difficult to forecast where and when ignition will occur.
- When the metal sheets fall away from the insulation, large areas are immediately exposed to ignition, resulting in a rapid spread of flame and growth of the fire.
- Falling metal sheets can present a danger to anyone still in the building, and to firefighters.

Once fire takes hold of the interior of a panel, flames can spread several metres into the panels. However, the fire becomes visible only when flames emerge from the joints between panels. This means that dangerous situations can occur, with the fire spreading without being visible. Several cases have occurred, with firefighters suddenly finding that the fire is behind them when they are tackling the fire in front of them.

Fires in sandwich panels can be difficult to extinguish. The metal cladding prevents water from reaching the burning insulation. In addition, some panels produce large quantities of smoke, having the dual effects of producing zero visibility and being toxic.

Difficult correlation

Through the report from a project financed by Nordtest and from a number of articles in the technical press, SP has shown that it is important to carry out full-scale tests. The correlation between the results of intermediate-scale tests using the SBI method and full-scale tests using both the room/corner test (ISO 9705) and corresponding tests in an individual room (ISO 13784, Part 1) is weak. Intermediate-scale tests are simply not representative of the results of tests on full-scale structures. This is because it is difficult to investigate the behaviour of the system as a whole in intermediate-scale SBI tests. This means that some cases produce relatively good results, while others produce relatively poor results, all depending on the accuracy of representation of the behaviour of joints or fastenings when exposed to fire in the intermediate-scale tests.

The product standard for sandwich panels describes how to test and install them for small-scale SBI tests. In our opinion, this means that the standard suffers from severe weaknesses, and cannot be used to demonstrate reasonable safety in the event of a fire. As a result, insurance companies will probably specify full-scale testing, as they cannot rely on the results of testing in accordance with the present product standard. This will make things difficult for the industry, as the insurance companies will refer to different test methods.

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Flashover in a room constructed from sandwich panels in accordance with ISO 13784. Note the substantial smoke production.