

Reliability of fire compartmentation

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Research and innovation

Reliability of fire resistant separation constructions under natural fire load

Abstract

Like in most building codes, the fire safety requirements in the Dutch building code are prescriptive. These requirements provide for each building function general measures to reach a sufficient level of fire safety. Tailor-made fire safety solutions are not possible with prescriptive requirements. Therefore, project-specific characteristics should be taken into account. That is possible with a performance based approach with a natural fire concept.

A performance based approach is difficult to link to the building code, although this is necessary to determine whether or not the performance based approach meets the public required safety level. To link to the building code it is necessary to do a performance based approach with project-specific characteristics in risk subsystems:

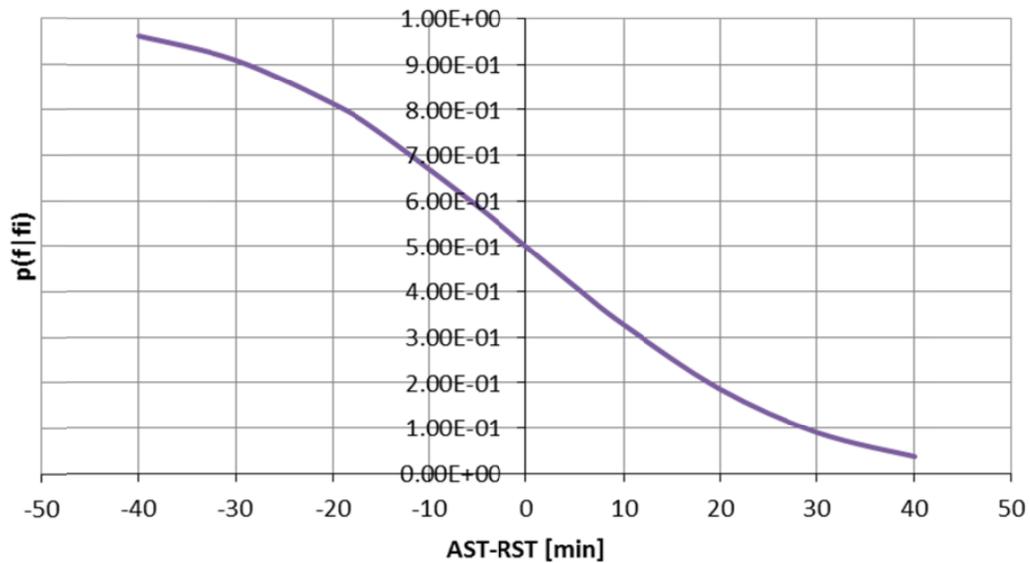
- Safety of environment;
- Safety of the building (load bearing structure);
- Safety of compartmentation (spread of fire and smoke);
- Safety of escape and attack routes.

In all risk subsystems it is possible to compare RST (required safe time) and AST (available safe time). The assessment on fire safety is positive (safe) as long as $AST > RST$. However, in a natural fire, based on project-specific building and fuel characteristics, there are a lot of uncertain boundary conditions (stochastic parameters). Taking into account those uncertainties, a safe time interval (ST) between AST and RST is needed: $AST > RST + ST$.

For the risk subsystem 'compartmentation' the thermal load by a natural fire has been translated in an equivalent duration according to the standard fire curve. This translation has been done for several fire compartments with different building functions. The equivalent fire duration is the RST and has to be compared to the AST. The AST is the fire resistance (EI) of the separation constructions according to the standard fire curve.

The results of a probabilistic approach, taking into account the uncertainties in stochastic boundary conditions, show that the failure probability of a 60 min. fire resistant 'ideal' separation construction varies between 20 and 80%, depending on fire load and definition of the fire compartment. With an 'ideal' separation construction, only one dimension is considered. This means that impairments by openings, doors, windows and adjoining constructions are not included. The failure probability will increase when these impairments will be also considered. The conclusion is that without suppressive support by the fire brigade compartment fires can easily extend to building fires.

failure probability in case of fire



Example of the failure distribution for separation constructions of a retail compartment of 1,000 m², with a fire load density of 900 MJ/m². The RST appears to be 75 min. With 60 min fire resistant separation constructions (AST) the failure probability of the separation constructions is almost 75%.

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