Research of the risks of firespread from a fully developed fire in an industrial building to neighbouring buildings.

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Fire spread between buildings should be avoided to be able to control the fire. Fire safety goals set by regulations mainly focus on 'life safety' and on the possibility to control the fire. Insurance companies can demand a higher level of fire safety mainly to restrict the costs due to property losses. Based on performed risk assessment analysis, the owner or user of a building can have extra safety desires.
In Belgium a new Royal Decree – Annex 6 for industrial buildings - will soon become valid. A method for calculating separation distances and minimale distance requirements are included in this document.
The objective of this report is to make a review of available methods and regulations for determining separation distances between buildings. An investigation is made on the levels of radiation emitted from flames projected through a collapsed roof and their impact on the separation distances needed.

An assessment and comparison of existing calculation methods is made. A comparison between the different methods is made for an industrial building.
Based on an extensive literature study a risk analysis is made to define possible scenario's leading to fire spread between buildings. Especially fires in large warehouses lead to major losses. Detailed investigation has been made on the scenario where the roof of a burning warehouse collapses and projected flames are coming through the roof.

A number of methods are worked out to determine the impact of the radiation coming from flames above the roof on the necessary separation distances between buildings.
To define the emitted radiation from these flames, the radiating surface and the temperature of the flames need to be defined. The surface of the radiating flames above the roof is defined by calculating a flame height and defining a width. Possible flame heights of projected flames through the roof are calculated according to the Heskestad formula, which assumes a circular burning surface and according to the Hasemi & Nishihata correlation, which was setup for rectangular surfaces. The flame heights depend on the surface and the heat release rate (HRR) of the burning materials. HRR of 630kW/m², 1250 kW/m² and even higher values in accordance with values used for the design of smoke and heat control systems for stored goods up to 4m are used.
It is assumed that the base of the burning surface is parallel to the external wall.
The impact of the temperature of the flames is analysed by considering 3 temperature levels:.
550°C is known as the temperature at the visible limit of the flame
680°C is the maximum temperature of an exterior fire according to the standard time temperature curve for exterior fires.
850°C is taken for fires which could due to the nature of the materials – for instance plastics - produce higher flame temperatures.

Depending on the location on the exposed building – on the roof or the facade - the required configuration factor for the emitting radiator surface is calculated.

The required separation distance is derived from the fact that the incident radiation should be less than the critical radiation flux of the exposed materials.
The critical radiation flux is set at 15 kW/m² in the Dutch and Belgium regulations. Other regulations are more severe and use a critical radiant flux of 12,5 kW/m².

Conclusions:

- Some methods like NFPA 80A, Collier, Barnett and BRE 187 lead to very high separation distances when the external wall is assumed as 100% opening. This is due to the level of emitted radiation from the fire which is maintained as if it were a compartment fire.
- Separation distances required according to Annex 6 of the Belgium decree are calculated for one typical wall dimension. Locally, perpendicular to openings, higher separation distances may be necessary to get an incident radiation level below the critical radiation flux.
- When a wall has no fire resistance the total wall should be seen as a radiator. The required distances mentioned in the Annex 6 for industrial buildings are for the dimensions of 60mx12m. Facades with smaller dimensions may fulfil the radiation

requirement with a smaller separation distance.

- Dimensions of projected flames above the roof, depend on the HRR and the surface of the burning material.
- Impact of the radiation coming from these flames depends mainly on the defined flame temperatures and the dimensions of the flames.
- For flame temperatures of 550°C the extra required separation distance is minimal, even with flames up to 60m.
- Comparing flame temperatures of 850°C with 680°C, the required distances are more than double.
- The impact in cases where neighbouring buildings have the same height, is highest on the top side of the façade and on the roof of the adjacent building.