

BASIC CONCEPTS ON FIRE DEVELOPMENT, FAÇADE CONSTRUCTION



Conforming the European directives the relevant fire safety requirements in the regulations have the following objectives:

- the capacity of structures during a given burn time guarantee
- the production and spread of flames and smoke limit
- the risk of spread of the fire to neighboring construction limit
- the attendees the chance to evacuate the building or to be helped
- take into account the safety of the intervention teams.

To meet these objectives, concerning wall cladding the following requirements are applicable:

- **the fire stability**

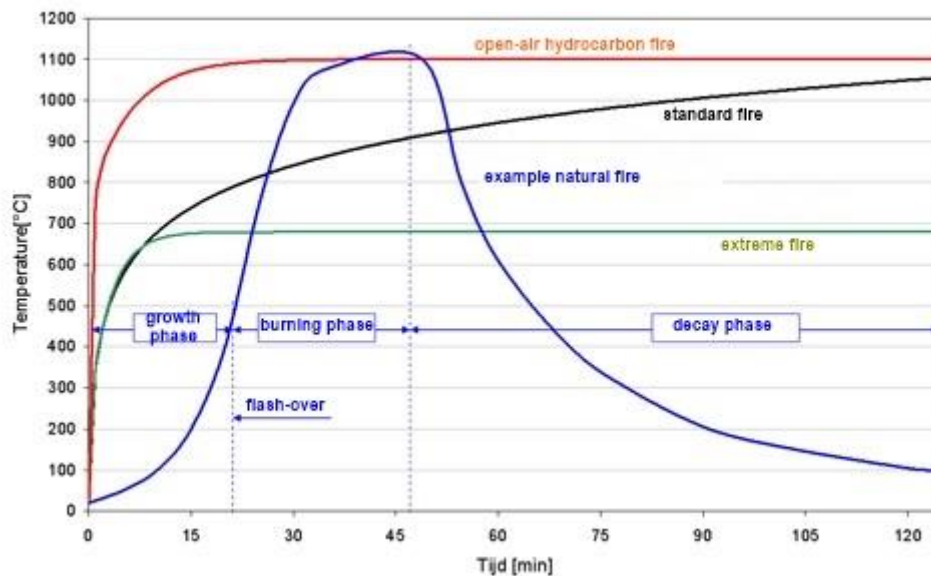
The standard fire shows a common known conventional fire-curve. These nominal curve does not depend on parameters that the actual fire in the fire compartment influence as the fire load, the ventilation conditions and the active fire prevention measures as sprinkler systems.

The standard fire curve (black) is shown, with different other nominal fire curves, in figure below. For comparison, also an arbitrary example of a natural fire curve (blue) is given. A natural fire curve is a curve that is calculated on the basis of the main parameters that determine fire development in the compartment. A natural fire curve is characterized by its growth phase, heating phase and cooling phase. In the growth stage, the fire is still local.

There exist many differences in temperature in the compartment.

In the transition from the growth phase to the phase of a real fire, the fire expands rapidly to the entire compartment. This is called the flash-over or flashover called. In this phase of fire or heating phase can be assumed that the temperature in the compartment is uniformly distributed.

If the burning parts are largely burned out the fire extinguishers. This is the decay phase which is characteristic for the natural fire.



- **the performance of the outer walls concerning the fire resistance from the inside to the outside**

Please note that is required that windows in general shall have the same fire resistance as the rest of the façade: 60 minutes or more. This means that façade claddings cannot be exposed to fire with flames emerging out through a window opening within these 60 minutes so, in relation to the structural strength of the cladding in case of fire, within this evacuation-time no problems will be expected.

This time period is to avoid flash-over between compartments in the building to give residents sufficient time to evacuate.

- **the response of the building materials in case of fire**

The reaction in case of fire is defined as the whole of the properties of a construction material with regard to its influence on the emergence and on the development of a fire. The reaction to fire so characterizes the ability of materials to ignite a fire to spread. The response of materials used in the wall cladding construction, such as the cladding material, insulation material etc.

Determination and assessment of the mechanical and thermal behavior of the adhesives from Tweha used in wall or façade panel compositions with steel, aluminum and/or wooden mounting support under thermal attack SBI test according EN 13823:2002 shows that the contribution to the fire growth rate (FIGRA), the total heat release over 600 seconds (THR 600s), the smoke growth rate (SMOGRA) and the local smoke production over 600 seconds (TSP 600s) by the adhesives from Tweha is minimal and could result in the highest possible

classification using the SBI test and therefore is classified as B-s1,d0 =

A very minor contribution to fire, no smoke production and no flaming droplets and particles occur. (Source: Report Effectis (previously TNO Centre for Fire Research) project 2008873, October 2009)

- **the partitioning of the cladding construction to avoid spreading of fire**

Prevent spreading of fire without onto different fire compartments through the wall construction by continuing the horizontal fire partitioning into the wall construction to realize a vertical fire partition in the wall construction also.

- **the mandatory distance to neighboring buildings concerning fire spread through flash-over or radiation**

The fire spread through radiation, the radiation flux can be calculated from a wall opening onto another building. The building code indicates that a building on an adjacent opposite façade/building should be based on an identical but mirror symmetric to the boundary located building. If the flux in an opening in the receiving wall is greater than 15 kW/m² (this corresponds to a temperature of 500-650 °C.), flashover is supposed to act. Given the fixed source radiation, the radiation that the flashover provision applies to the burning compartment of an industrial building of 45 kW/m² can directly be determined that for all considered here facades (up to 15 meters high and up to indefinitely) a radiation receiving wall 15 kW/m² never be achieved at a distance of more than 10.6 facade meter³.

- **conclusion.**

This means that the fire must be controlled by designing fire-compartments to avoid flashover within 60 minutes to give residents sufficient time to evacuate.

After this time fire will expand by flashover from the inside to the outside, glass from the window will fall down, and the cladding construction will react on exposure to fire.

In relation to the resistance time of 60 minutes, the fire partition with the designed fire compartments will fail, the fire will expand and temperatures in the building will increase.

The increase of temperatures in the building will cause a loss of strength and stiffness of the construction. At 400° C, there is the strength of the building structure strongly decreases and at 800 °C there is only about 10% of the strength left. This means the building must be considered as lost and fire spread though radiation and flash over to an opposite building must be avoid only.