

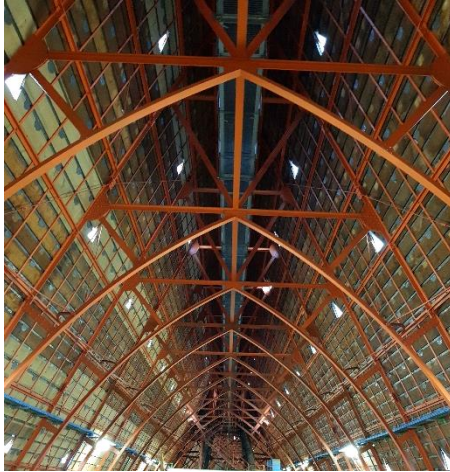


Water Mist Fire Protection for Sensitive Roof Structures

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FOGTEC Fire Protection

Fire Protection of Roof Structures



- Roof structures are sensitive areas in relation to fire protection since they often connect several parts of buildings without fire partitions
- Fires can propagate and cause substantial damages
- Roof can have wooden or metallic support structures and represent a fire protection challenge for heritage, commercial and industrial buildings
- Particularly in heritage buildings, roof structures and attics are rarely protected by active fire fighting systems

Fires in Roof Structures



- The tragic roof fire in April 2019 of the Notre Dame cathedral in Paris has shown the tremendous impact of fires in roof structures
- Fortunately, the Paris fire brigade could limit the fire propagation to the roof structure
- Irretrievable loss of cultural property has occurred
- Most likely the fire has arisen from works at the roof structure or by a fault in the electrical system

Fire Risks in Roof Structures



- Fire loads in roof structures can vary substantially depending on the structure material used, the age of the structure and if material is stored within the attic space
- Fires in such areas mainly are a result of refurbishing works, particularly hot works or faulty electrical equipment
- Environmentally induced fires e.g. by lightning in the absence of lightning conductors or arson attacks can also be causes of fires
- In case of fires the intervention by fire services is often delayed due to difficult access to roof structures

Fire Risks in Roof Structures

$$\text{Risk} = \text{Probability} \times \text{Loss}$$

Probability

- Uncontrolled presence of people during refurbishment works carrying out hot works
- Faulty electrical equipment
- Change in use of the occupancy



Reduction by use of fire retardant materials (not possible for listed buildings) or organisational fire protection measures

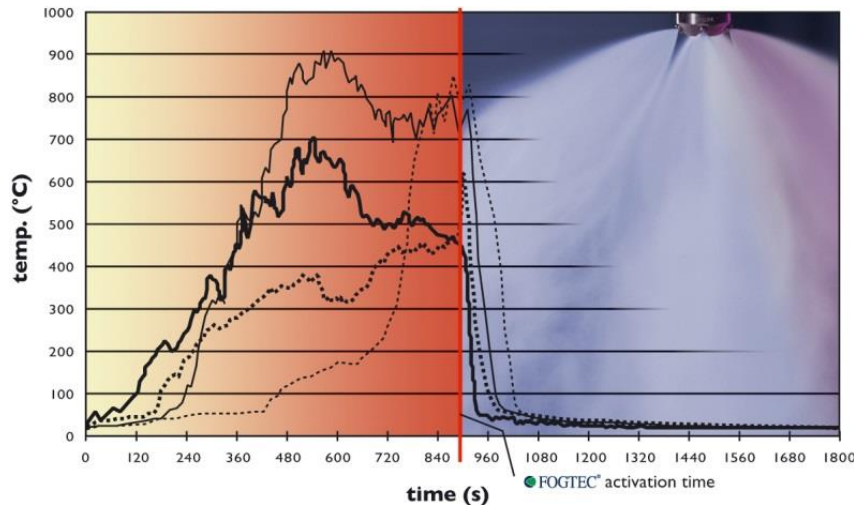
Losses

- Financial losses in commercial buildings (luxury hotels, hospitals, industrial buildings)
- Irretrievable cultural treasures (historical buildings, churches, museums, libraries)
- Out of function of technical fire protection means or no access for fire services



Mitigation by active fire fighting measures

Risk Assessment is Crucial



- No universal approach to fire protection of roof structures
- Thorough fire risk assessment is key to develop the fire protection strategy for each attic space
- Water mist technology offers high cooling ability and partly reduces smoke spread, thus protects roof support structures and creates tenable conditions for access to fire services
- Damages of the roof structure can be reduced, limiting water run-off to a minimum
- Down-times of buildings can substantially be reduced, being particularly important for commercial buildings like hotels, airports or stations

Risk Assessment Criteria



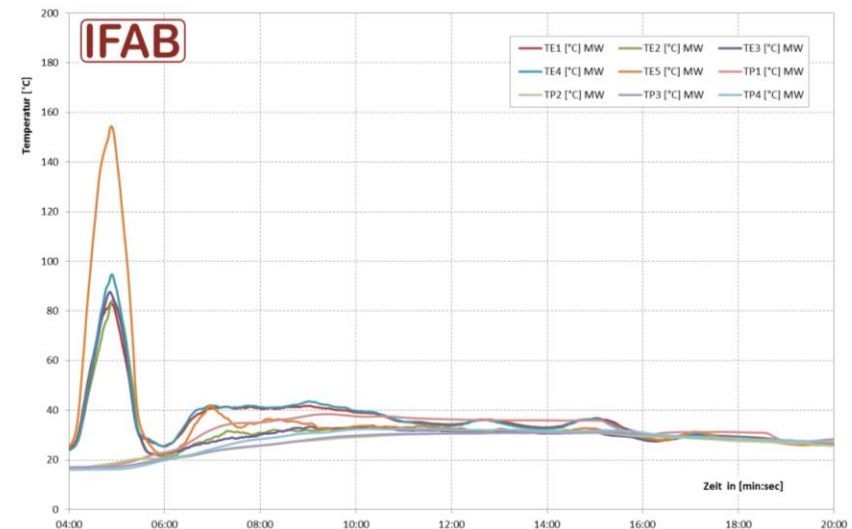
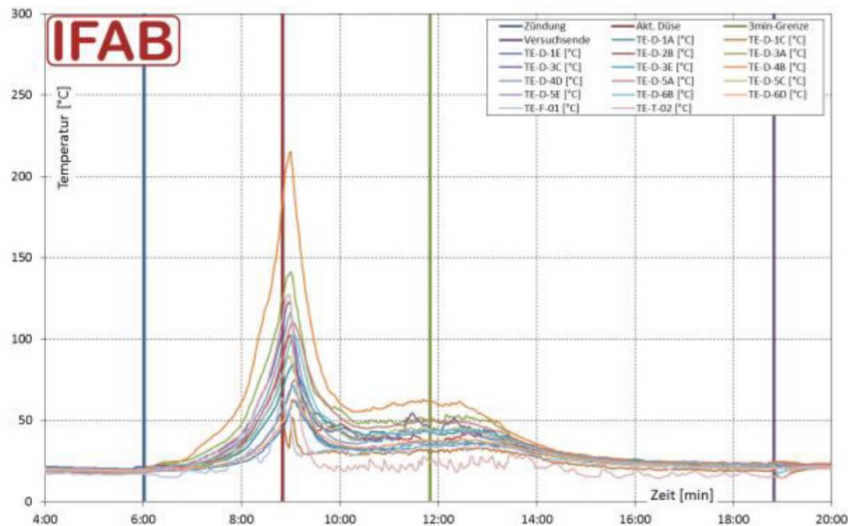
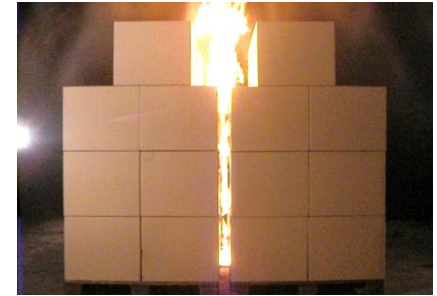
- Material of the roof support structure (metal or wood)
- Fire retardant material versus *aged dry wood*
- Clear attic space versus *storage area*
- Fire risk and fire load classification
- Open space versus *fire compartments*
- Unmanned area versus *workshop*
- Available fire protection measures (detection, fire compartments, fire service response time)
- Ambient temperature (frost)

Water Mist System Fire Fighting Approach

- Moderate fire risks in the attic



- Storage fire risks in the attic

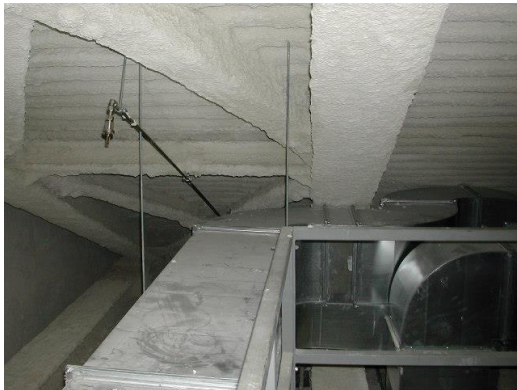


Protection of Wooden Roof Support Structures



- Famous “La Fenice” theatre in Venice was opened the first time in 1792
- A first fire in 1836 destroyed the theatre hall which could be reconstructed
- In 1996 the theatre was affected a second time by fire and was severely damaged
- Fire protection has been a major focus during the second reconstruction of the building, particularly for the wooden roof structure above the theatre hall
- Entire building is heritage listed
- Roof space above the suspended gypsum ceiling constitutes one fire zone containing air conditioning equipment

Protection of Wooden Roof Support Structures



- Risk of severe damages to of the gypsum theatre ceiling with precious paintings and frescos or even its collapse if conventional sprinklers would have been used to protect the attic space (soaking of water into the gypsum ceiling)



- Water mist was selected as fire fighting system due to the high cooling efficiency and reduced water consumption in case of activation
- A water mist system with automatic glass bulb nozzles is protecting the entire roof structure including the air conditioning machinery

Protection of Wooden Roof Support Structure



- Spanish Parliament congress building in Madrid was constructed in 1850
- Heritage building had to be equipped with an active fire fighting system due to increase of fire safety regulations
- Besides an active fire fighting system for the entire building, the roof structure above the plenary hall required fire protection
- Entire building is heritage listed

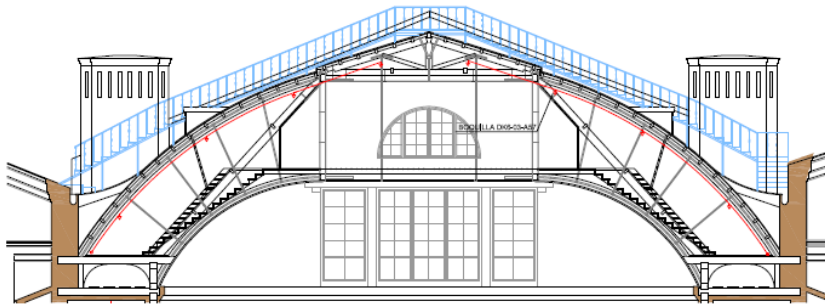
Protection of Wooden Roof Support Structure



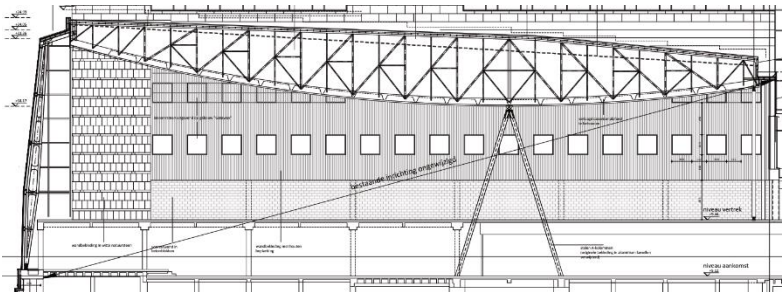
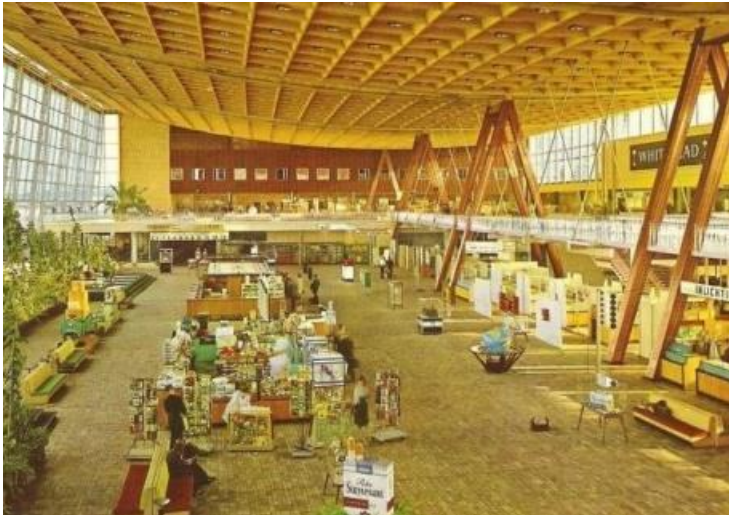
- A fire risk assessment determined the need for an active fire fighting system in the attic space due to building material conditions and no fire compartmentation



- Water mist was selected as fire fighting system due to its high cooling efficiency and reduced water consumption in case of activation
- A water mist system with automatic glass bulb nozzles is protecting the entire roof structure

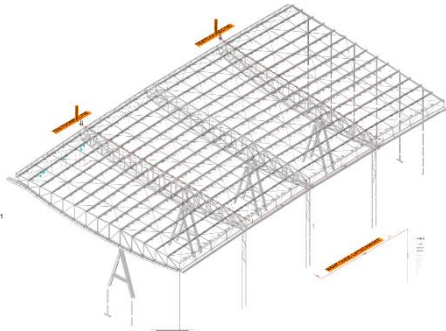


Protection of Metal Roof Support Structure



- Transit “Sky Hall” at the Zaventem Airport in Brussels with an aluminium roof structure was built in 1958
- It consists of one fire zone with 100 m length and 55 m width
- Roof consists of 4 roof segments, each supported by only 2 arc-shaped beams
- Roof had to be renewed due to new directives for fire safety, thermal and acoustic insulation
- Roof structure is heritage listed
- Existing light aluminium structure can not carry more weight

Protection of Metal Roof Support Structure



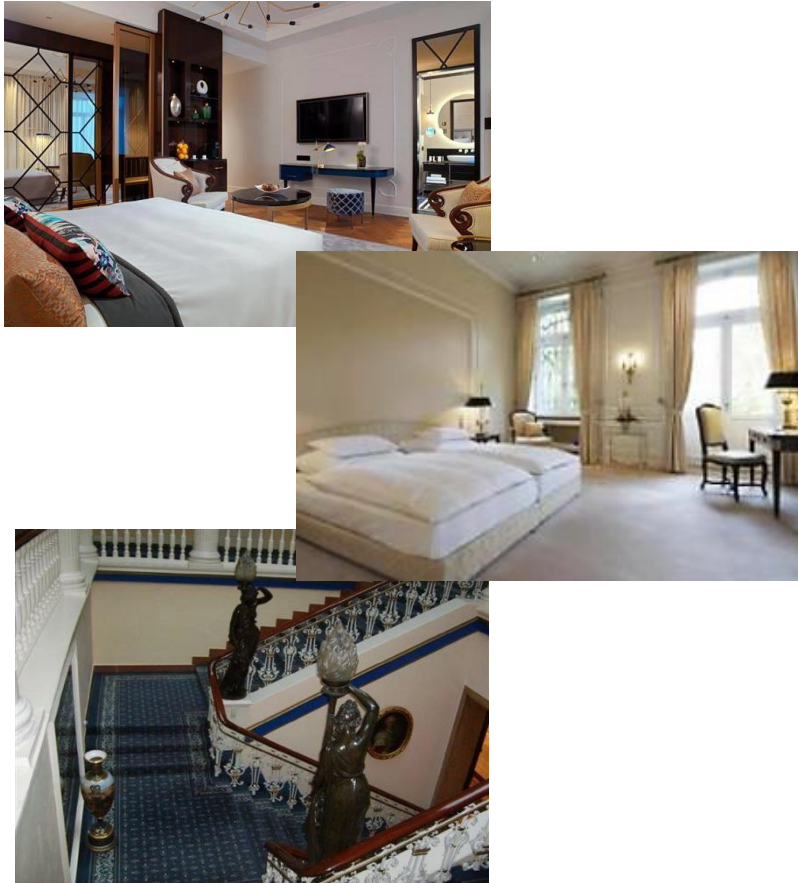
- New steel beams in between the 4 roof segments to support new roof
 - Reinforcement of the A columns
 - Old beams remained in place to support the heritage listed suspended ceiling
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- Water mist was selected as fire fighting system due to its high cooling efficiency and light weight installation with small pipe diameters
 - A water mist system with automatic glass bulb nozzles is protecting the entire roof structure

Protection of Heritage Luxury Hotel



- 5 star luxury Steigenberger Hotel “Europäischer Hof” in Baden-Baden, Germany, was constructed in 1842
- 120 luxurious rooms, conference and spa facilities
- Restauration and modernisation of the entire hotel among others to bring it in line with actual fire protection requirements
- Re-opening in 2020
- Roof and attic space, containing air conditioning equipment, had to be renewed due to new standards for fire safety and thermal insulation

Protection of Heritage Luxury Hotel



- Combination of historical and modern buildings posed special challenges concerning system engineering requirements
- Business discontinuance due to a fire would lead to extensive economic losses for the hotel operator
- The hotel operator was aiming for best possible fire protection with minimal architectural impact

Protection of Heritage Luxury Hotel



- A fire risk assessment determined the need for an active fire fighting system in the attic space due to the exposed wooden roof support structure, no fire compartmentation and air conditioning equipment being located in the attic space



- Water mist was selected as fire fighting system due to its high cooling efficiency and reduced water consumption in case of activation, thus minimal risk of collateral water damages
- A water mist system with automatic glass bulb nozzles is protecting the entire roof structure including the air conditioning machinery

Conclusion

- There is no universal solution to fire protection for roof spaces
- The fire risk assessment has to determine the best way forward to each individual project
- A holistic approach including passive fire protection means, fire detection, fire fighting by automatic systems or by fire services leads to an acceptable fire risk mitigation



- Water mist technology has been identified as one of the best suited agents to roof structure fire protection due to its high cooling abilities and minimized consequential damages



Thank You for Your Attention

Ruediger Kopp

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