Compensation of Missing Fire Partitions in Buildings by use of High Pressure Water Mist

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High-Rise Buildings

Modern Building Structures

- High-rise buildings are often designed openly and transparent with preference of exposed glass and steel structures
- Fire protection becomes a challenge due to wide spread open connections between parts of the building
- Though conventional sprinkler systems are used to compensate missing fire partitions, water mist technology is valued to offer extended cooling, thus preventing fire propagation and securing escape conditions

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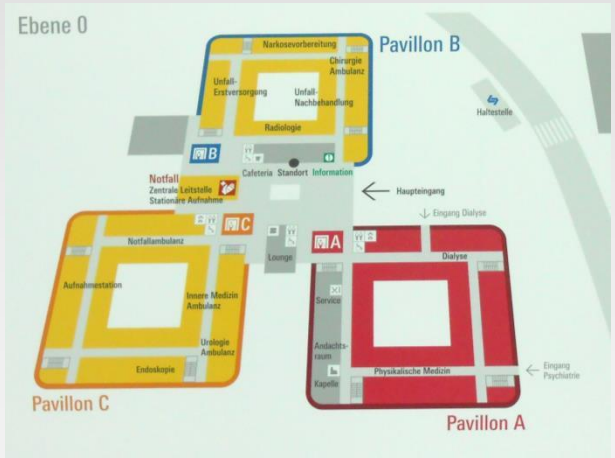

Some Facts

- One of the most modern and advanced hospitals in Europe located next to Vienna
- 6 operation rooms, 450 beds
- Overall hospital floor area is 60.000 m²
- 3 connected buildings (pavilions) each having 3 levels
- 6 years construction time with completion in 2016

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Fire Protection Requirements

- Missing compartmentation between entrance hall and pavilions to be compensated by an automatic fire fighting system to prevent fire propagation
- Control and suppression of fires in the entrance hall (e.g. cafeteria, meeting areas)
- Protection of exposed glass facades and steel structures to avoid structural fire protection measures

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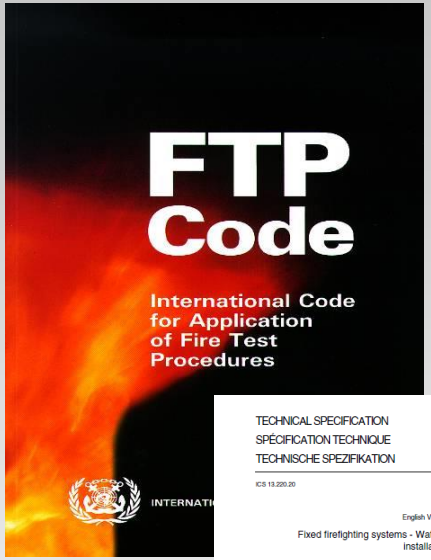
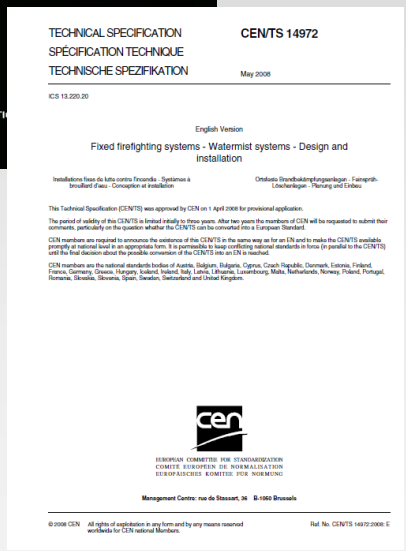
Fire Protection Concept

- Protection concept based on a wet high pressure water mist system for all areas adjacent to the entrance hall
- System design based on OH1 risk classification with 72 m^2 operational area (room + ceiling void) for 60 minutes operation time
- Challenge due to ceiling height up to 12 m in the entrance hall

→ Requirement for fire tests for up to 12 m ceiling height

System Testing and Acceptance Process





TECHNICAL SPECIFICATION
SPÉCIFICATION TECHNIQUE
TECHNISCHE SPEZIFIKATION

CEN/TS 14972

May 2006

ICS 13.220.20

English Version

Fixed firefighting systems - Watermist systems - Design and installation

Installations fixes de lutte contre l'incendie - Systèmes à brouillard d'eau - Conception et installation

Ortsfeste Brandbekämpfungsanlagen - Feinsprüh-Löschanlagen - Planung und Einbau

This Technical Specification (CEN/TS) was approved by CEN on 1 April 2006 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. CEN/TS 14972:2006: E

Definition of Fire Scenario

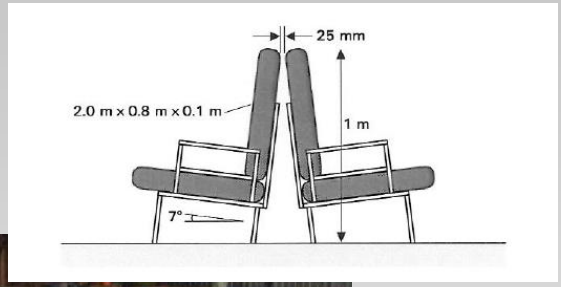
- Full scale fire test scenario developed based on requirements of CEN TS 14972 standard Annex B (in line with BS 8489)
- Fire test defined based on public spaces test of IMO A800 concerning
  - Fire load
  - Arrangement of fire load
  - Ventilation conditions

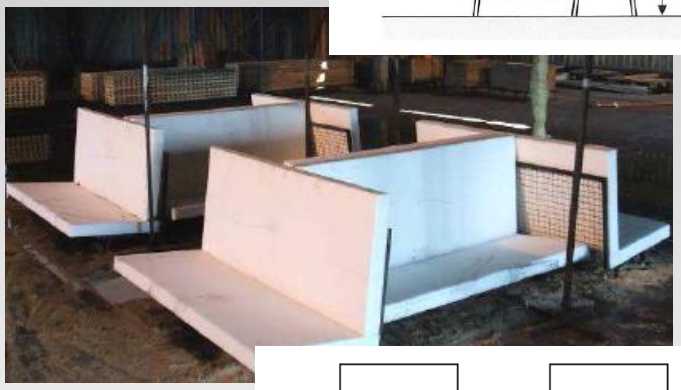
Fire Tests for Greater Ceiling Heights

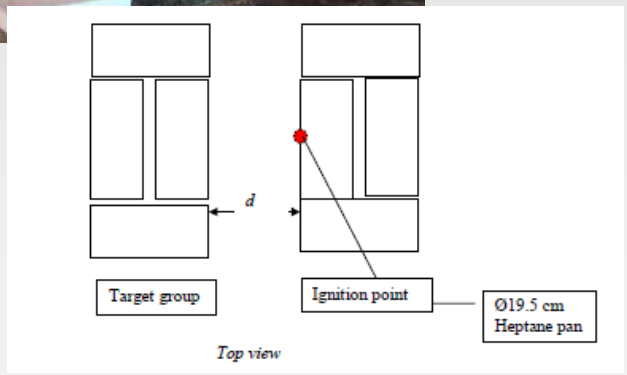
Fire Test Arrangement and Scenarios

- Test hall of 30 m x 20 m floor area with 24 m height
- Ceiling at 12 m height with open perimeters
- Natural ventilation conditions / No enclosure effect
- Fire tests under one and between four nozzles
- Automatic glass bulb water mist nozzles
- Fire test duration 30 minutes

Fire Tests for Greater Ceiling Heights







Fire Load

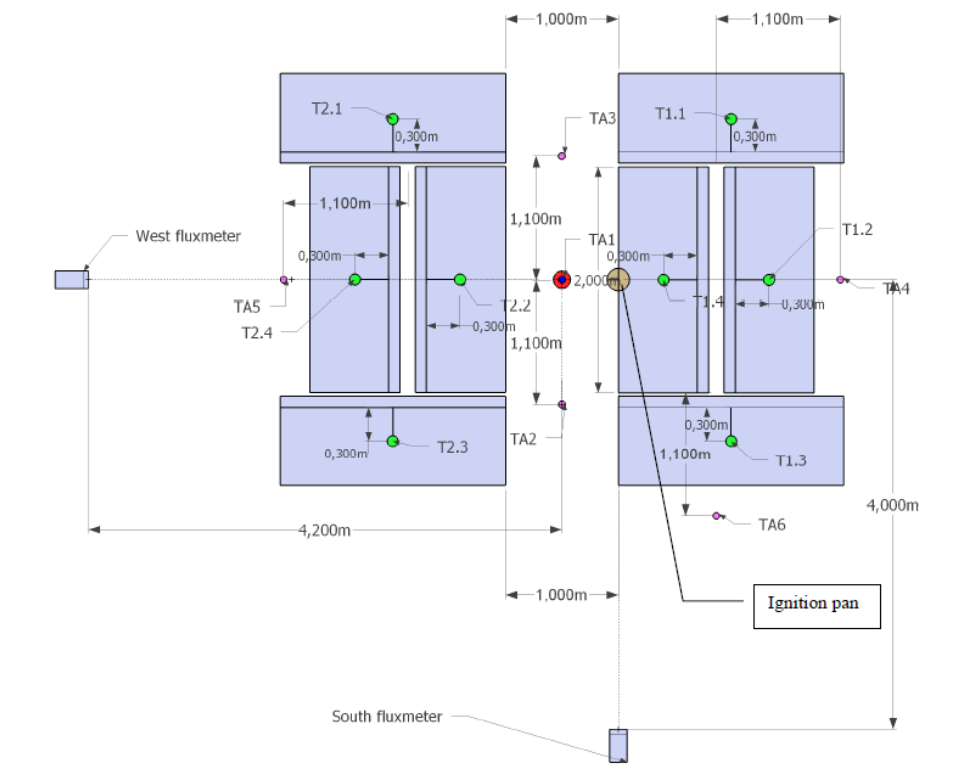
- Fuel package adapted from IMO A800 with 2 groups of 4 sofas each made of polyether foam
- One sofa group used as ignition source, one as target
- 50 cl Heptane as igniter, being placed under the centre sofa

Fire Tests for Greater Ceiling Heights

Evaluation Criteria

- Temperature reduction at ceiling and in the vicinity of the fire
- Reduction of heat radiation
- Fire control and suppression to avoid fire propagation to the target sofa group

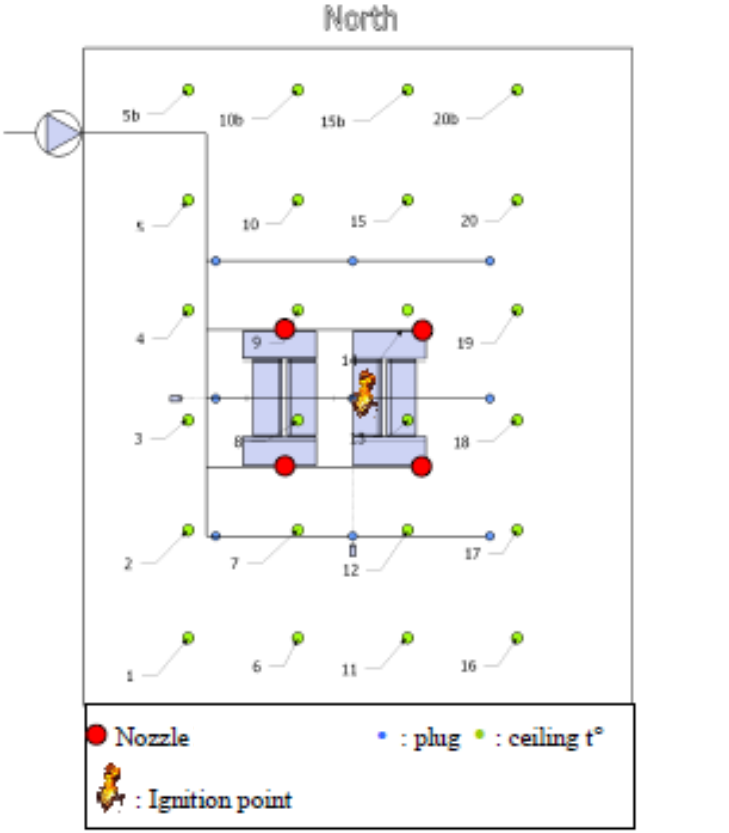
Fire Tests for Greater Ceiling Heights



Measurements

- Temperature at sofas (T1.1 to T1.4 and T2.1 to T2.4)
- Ambient temperature at 1,5 m Height above floor (TA1 to TA6)
- Heat flux

Fire Tests for Greater Ceiling Heights



Fire Test Results under 4 Nozzles

- Activation of 4 nozzles within 2 min 50 sec
- Rapid temperature and heat radiation reduction
- Fire is controlled / No propagation to target sofas

Fire Tests for Greater Ceiling Heights

T0 : ignition of the heptane pan

T0+1 min: propagation on mattress surface

T0+2 min: fire is spreading on the top of ignition mattress.

T0+2 min 15 s: HRR is increasing rapidly

T0+2 min 44 s: operation of first nozzle. Right hand mattress stats to pyrolyse.
T0+ 2 min 45 s: 2nd nozzle operates
T0+2 min 48 s: 3rd nozzle operates

T0+2 min 51 s: 4th nozzle operates. Water mist reaches floor level
T0+3 min 07 s: fire control with slight suppression.

T0+3 min 53 s

T0+4 min: mattresses continue to burn slowly

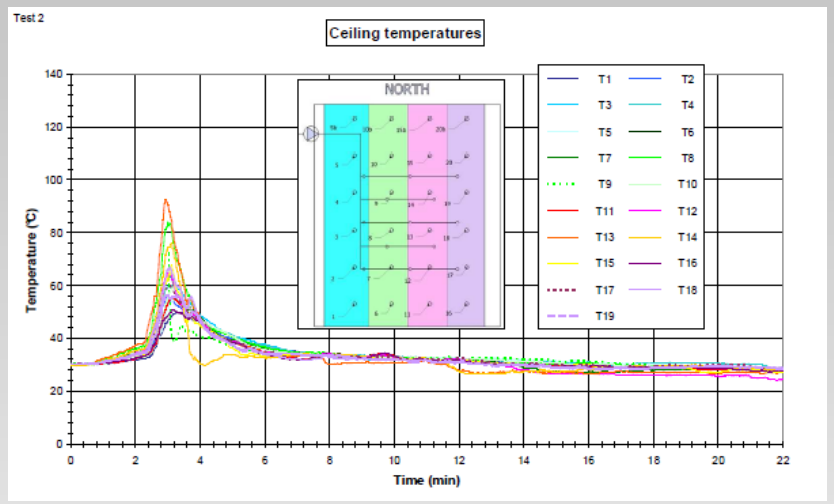
T0+6 min

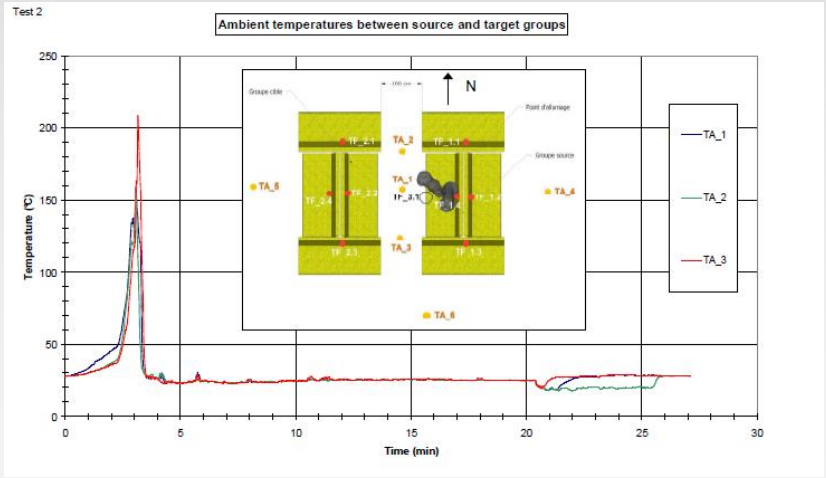
T0+10 min

T0+16 min

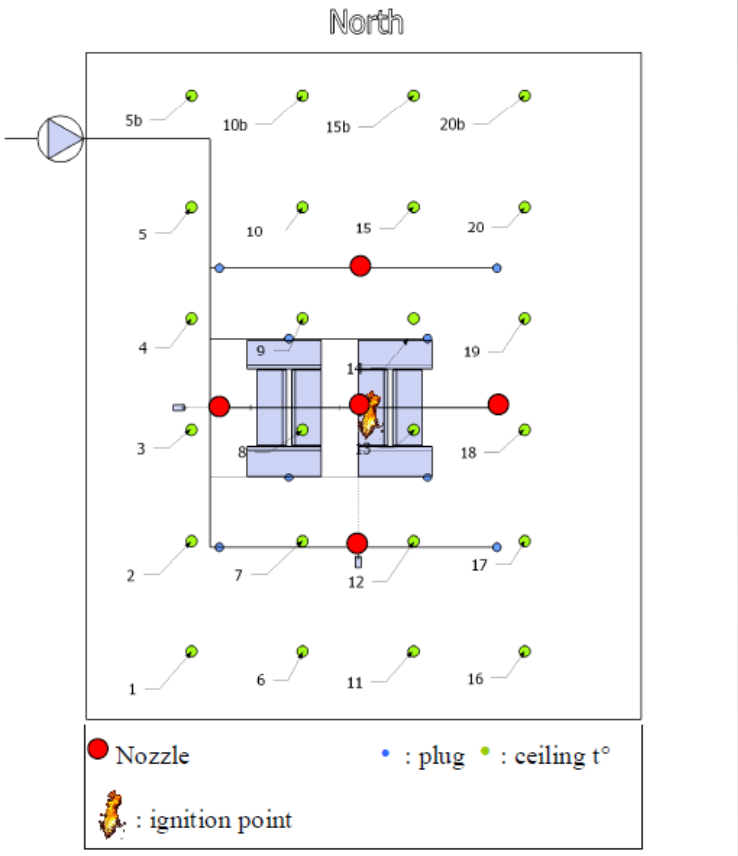
T0+18 min 20 s: no more flames.
End of test

Fire Tests for Greater Ceiling Heights





Fire Tests for Greater Ceiling Heights



Fire Test Results under 1 Nozzle

- Activation of 3 nozzles within 2 min 50 sec
- Rapid temperature and heat radiation reduction
- Fire is controlled / No propagation to target sofas

Fire Tests for Greater Ceiling Heights

T0 : ignition of the heptane pan

T0+1 min: start of propagation on mattress surface

T0+2 min 08 s: fire is spreading on the top of ignition mattress. Flames are about 2m height.

T0+2 min 30 s: HRR is increasing rapidly. Right hand mattress starts to pyrolyse (red arrow)

T0+2 min 35 s: operation of the first nozzle.
T0+2 min 39 s: 2nd nozzle operates
T0+2 min 51 s: 3rd nozzle operates

T0+3 min

T0+4 min 17 s: start of fire control. Water-mist reaches floor level.

T0+ 5 min

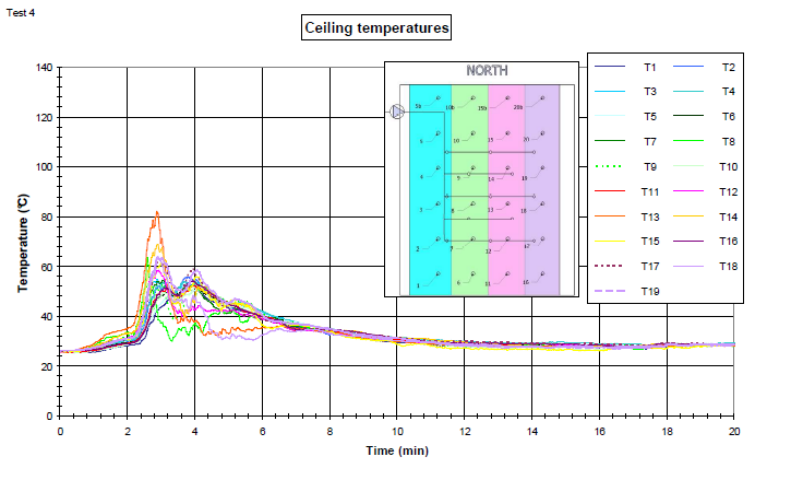
T0+6 min 31 s: remaining flames at floor level

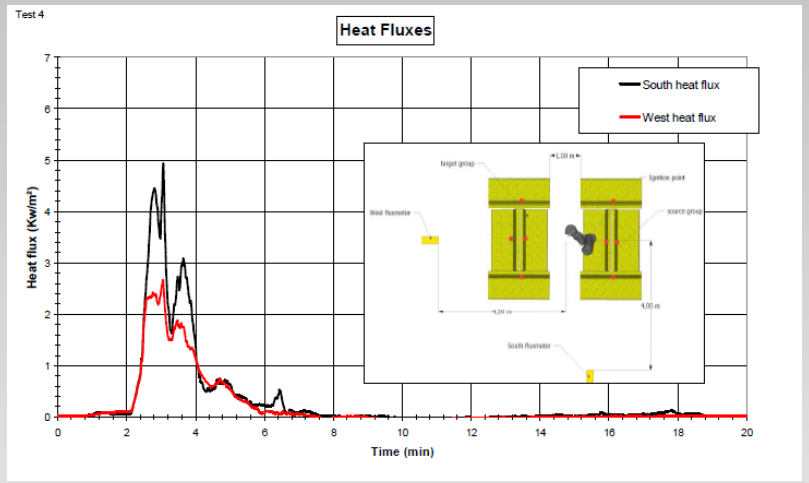
T0+7 min

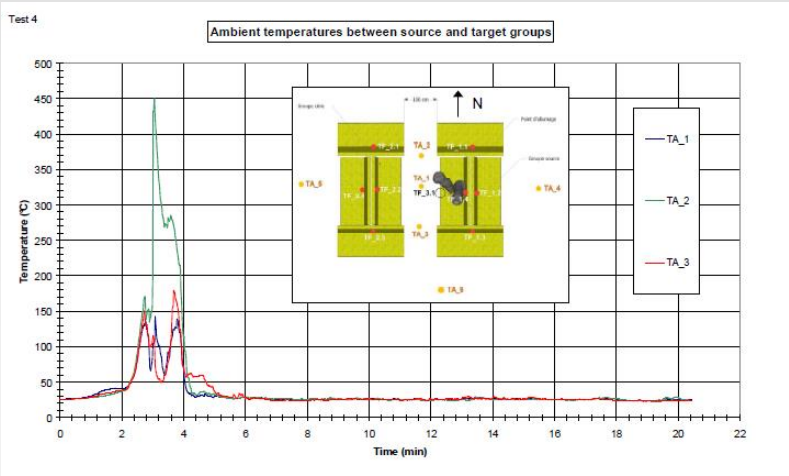
T0+10 min

T0+17 min 39 s: end of test

Fire Tests for Greater Ceiling Heights







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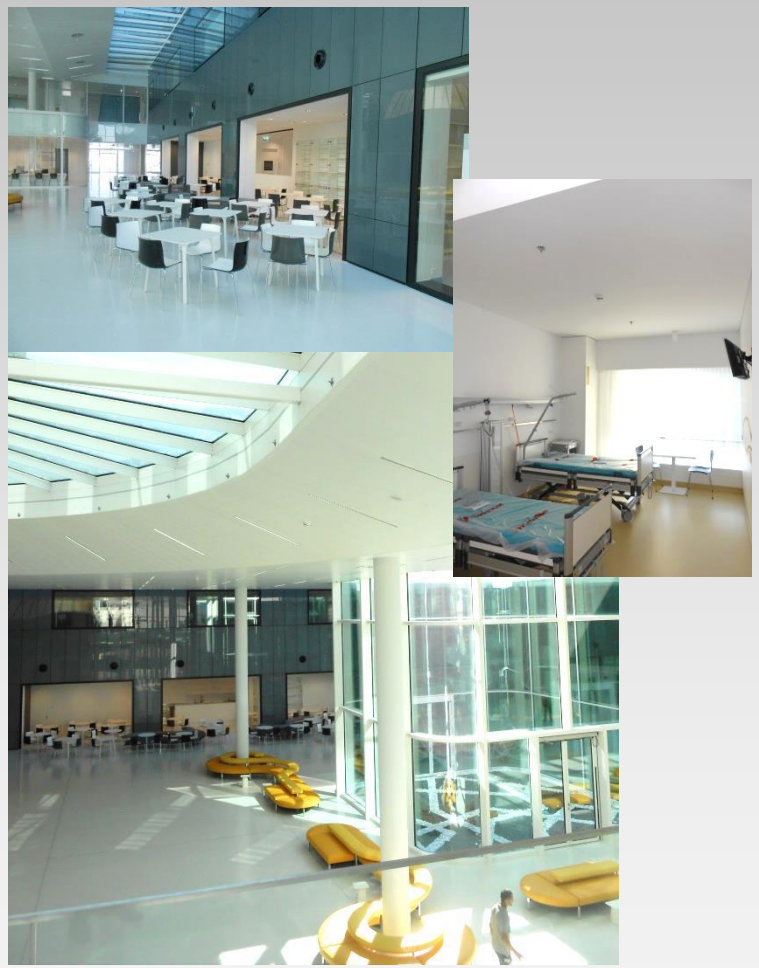

Protection Concept

- Nozzle layout based on sprinkler alternative fire test results up to 5 m ceiling height
- For ceiling heights up to 12 m, specific fire tests have determined the nozzle layout
- Wet system in the entrance hall ceiling with reduced nozzle spacing along all glass facades
- Wet system in all rooms and false ceilings (3 levels) adjacent to the entrance hall in the 3 pavilion buildings
- Small pipework due to hydraulic flexibility with pressure loss allowance up to 60 bar

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Protection Concept

- System design to operate up to 14 nozzles along glass facades (26 m) in the entrance hall respectively 72 m^2 operational areas in the adjacent buildings
- High pressure pump with 4+1 x 120 l/min at 120 bar (one redundant pump unit)
- 2 x 2000 l break tank with infill from town‘s main water supply for 60 minutes system operation
- 1 alarm valve and 10 zone valves

Conclusion

High pressure water mist allows for hydraulically flexible solutions for high-rise buildings with extended cooling potential to prevent fire propagation and additional protection of exposed glass and steel structures to secure safe escape routes for people

System design must be part of the overall fire safety concept of the building and be evaluated by authorities having jurisdiction

Thank You for Your Attention