EVACUATION MODELING OF AN HISTORICAL CASINO IN CASE OF FIRE

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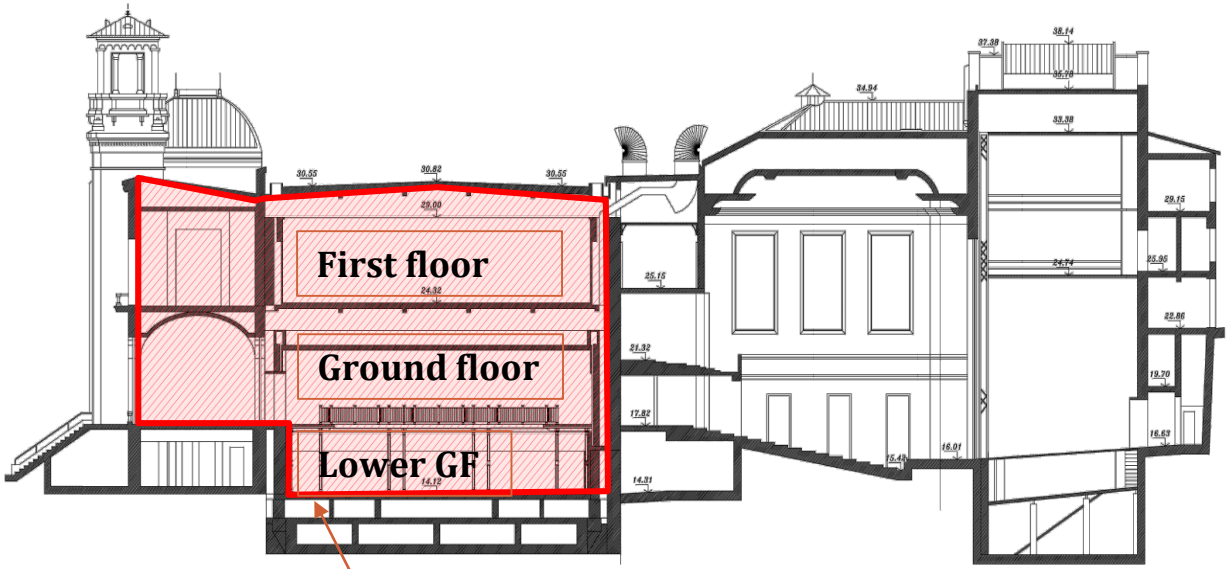
The casino is housed in a historic multi-story building, that is characterized by a liberty style.

The part of the building that is open to the public has a lower ground floor and two floors above ground. The ground floor and the first floor are connected with a monumental stair.



The public area

MATERIALS

Many materials typically inside the historical building (wood, upholstery fabrics, padding material) have not fire reaction.

NO FIRE REACTION -> FLAMES WILL QUICKLY SPREAD AND DEEP SMOKE WILL BE PRODUCE.

"FOCAL POINT"

Slot machines and game tables represent a **«focal point»: attention of occupants is mostly focused on gambling («central figure»).**

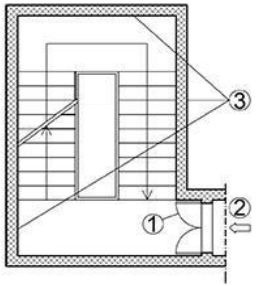
CROWD AND UNFAMILIARITY

The occupants are unfamiliar with the layout of the building.

The casino is characterized by a great crowd.

COMMON REQUIREMENT OF FIRE PREVENTION REGULATIONS

Protect egress routes



1 – FIRE DOOR
2 – ACCESS TO THE STAIR
3 – FIRE PARTITION

Smoke control system

LISTED BUILDING = ARCHITECTURAL RESTRICTIONS

Monumental stair cannot be enclosed

Facade cannot be modified

PROJECT GOAL

PROTECT EGRESS ROUTES

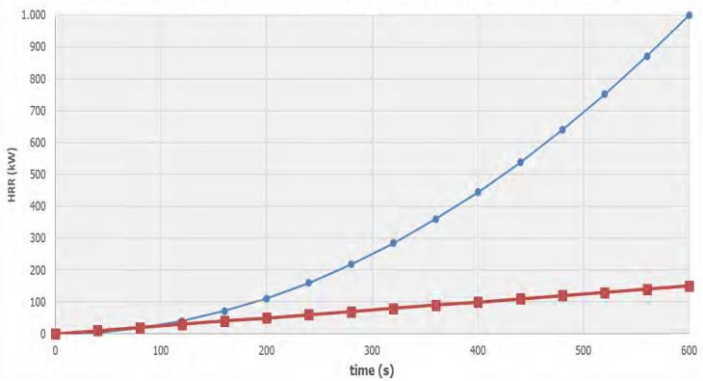
SMOKE CONTROL SYSTEM

SAFE EGRESS OF OCCUPANTS
ASET > RSET

- Identifying the safety measures that have an effect on the incipient and growth phase of the fire.
- Minimizing adjustment works and maximizing the level of safety with considerable benefits in terms of cost/effectiveness risk analysis.

FIRE REACTION AND LABORATORY TEST

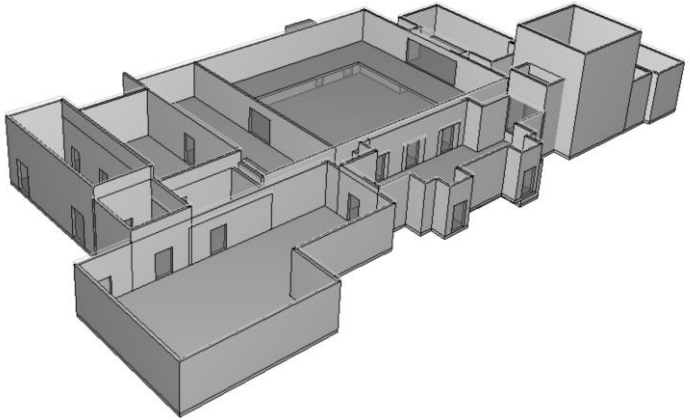
- Substitution of materials that present a fast or medium fire growth rate.
- Requalification by applications of varnishes or plasters;
- If the class was unknown or the substitution is not possible, these materials have been performed in approved laboratory.



SAFETY MANAGEMENT

- Fundamental measure in order to reduce pre-movement time.
- A new safety management plan has been developed.
- Main features are:
  - The appointment of emergency team coordinator.
  - Presence of a Building Evacuation Team.
  - A plan to reduce the property damages.

INPUT DATA



Parameter	Value
Fire Growth Rate	< 600 s (slow)
HRR_{MAX}	34 kW
Soot Factor	0,07 kg/kg [*]
CO Yield	0,10 kg/kg [*]
DHc	20 MJ/kg [*]
[*] according to Italian prevention rules for civil occupancies	

- Maximum occupancy and immediate difficulty in evacuating occupants.
- Scenarios positioned within the slot machine rooms on the ground floor (S4B, S4C).
- Using HRR curve determined in laboratory.
- Four burner were inserted into the model to simulate the fire spread.

VISIBILITY
10 m @ h= 2,0 m

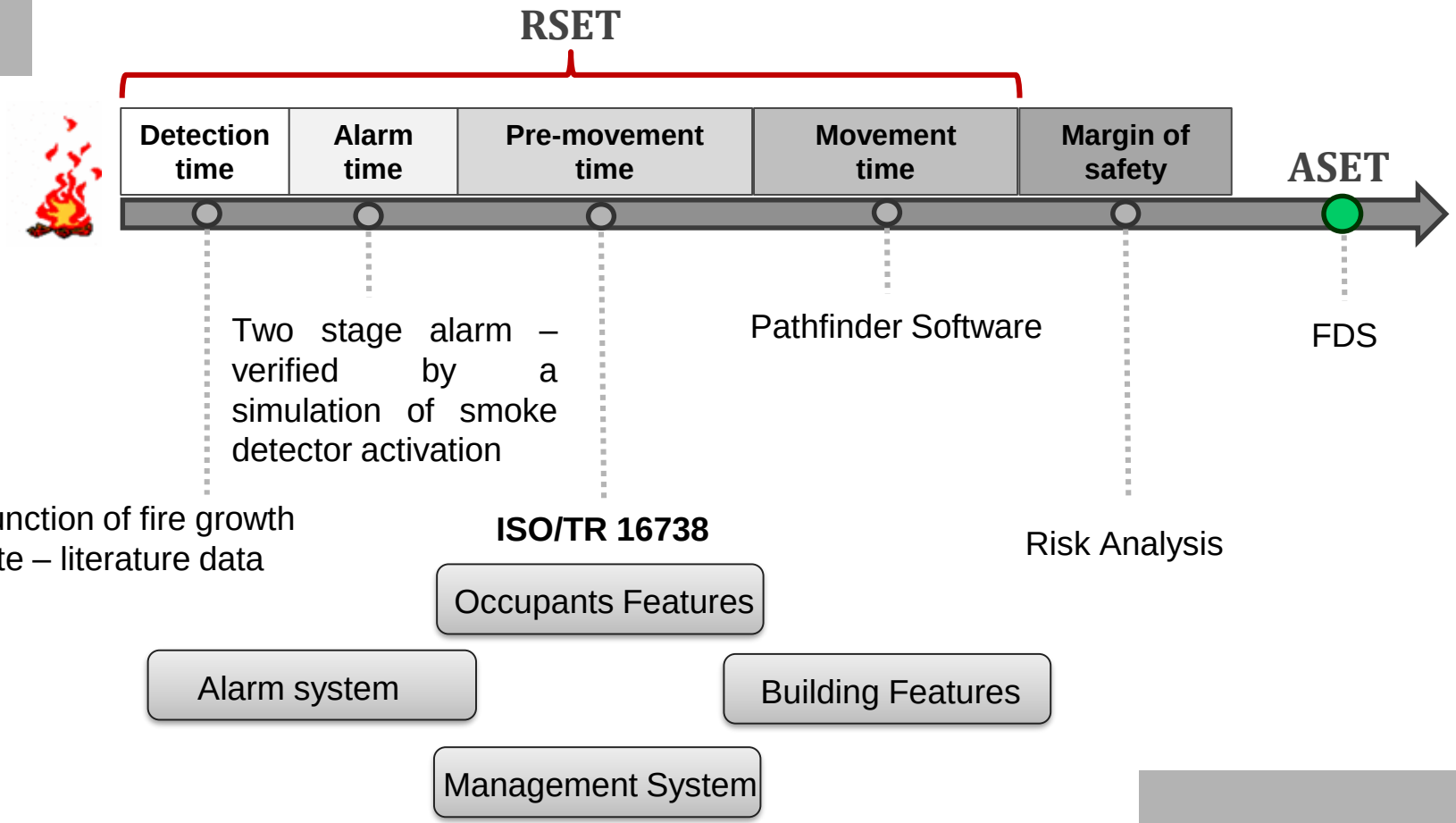
TEMPERATURE
60 C° @ h= 2,0 m

ASET

FED_{MAX} = 0,1
FED

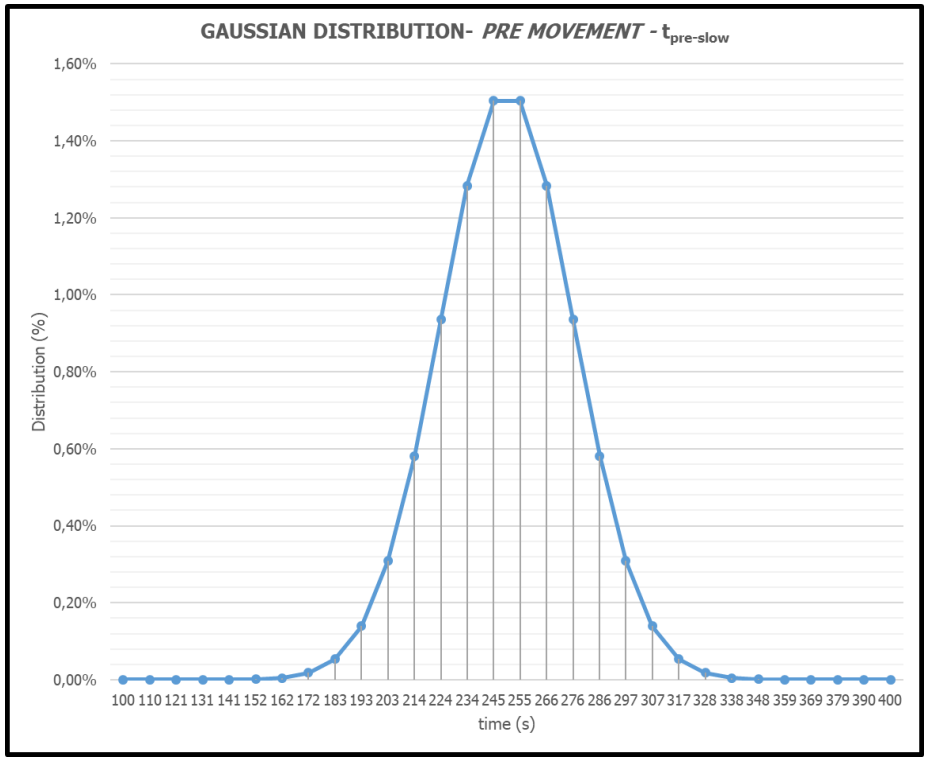
$RHFG_{MAX}$ = 2,5 kW/m²
RADIATION

FDS SIMULATION


RSET
Detection time
Alarm time
Pre-movement time
Movement time
Margin of safety
ASET
Two stage alarm – verified by a simulation of smoke detector activation
Pathfinder Software
FDS
Function of fire growth rate – literature data
ISO/TR 16738
Risk Analysis
Occupants Features
Alarm system
Building Features
Management System

PRE-MOVEMENT TIME

Parameter	Value
Occupancy types	**B** – Awake and Unfamiliar
Alarm System	**A2** – Two Stage alarm System
Building Complexity	**B2** – a simple multi-enclosure (usually multi-storey) building, with most features prescriptively designed and simple internal layouts.
Management level	**M1:** The normal occupants (staff or residents) was trained to a high level of fire safety management with good fire prevention and maintenance practice, floor wardens, a well-developed emergency plan and regular drills.



COMPUTATION OF RSET

PARAMETER OF PATHFINDER SIMULATION

Boundary layer width

A parameter that influences the walking speed.
BLw = 20 cm.
This value is conservative, because it is typical of the corridors.

Knowledge of places

This parameter specifies the possibility for the occupants to change the egress route due to the crowd. The likelihood to change the chosen egress has been supposed equal to 30 %.

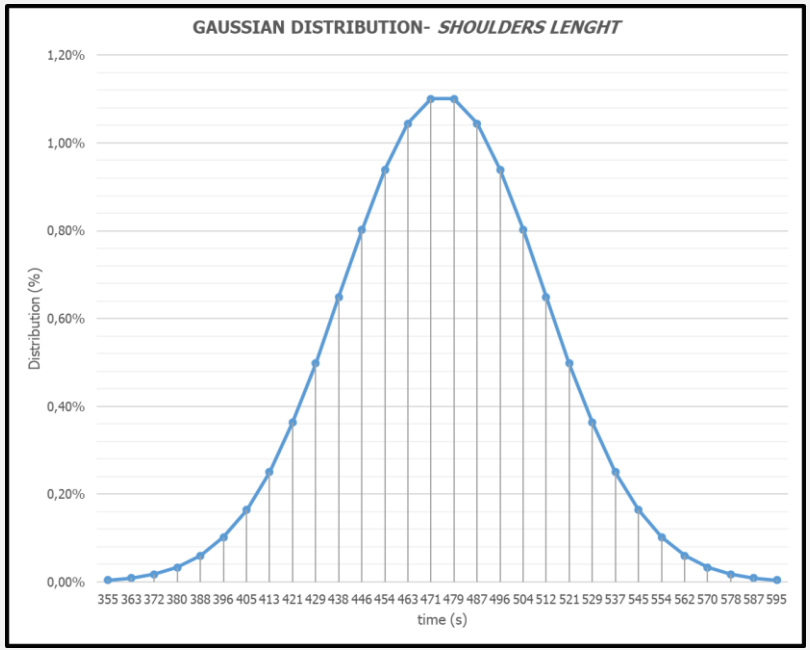
Pre-movement time

The trend of pre-movement time follows the Gaussian distribution. This distribution has been inserted into the software, considering also the detection time and the alarm time.

PARAMETER OF PATHFINDER SIMULATION

Shoulders Length

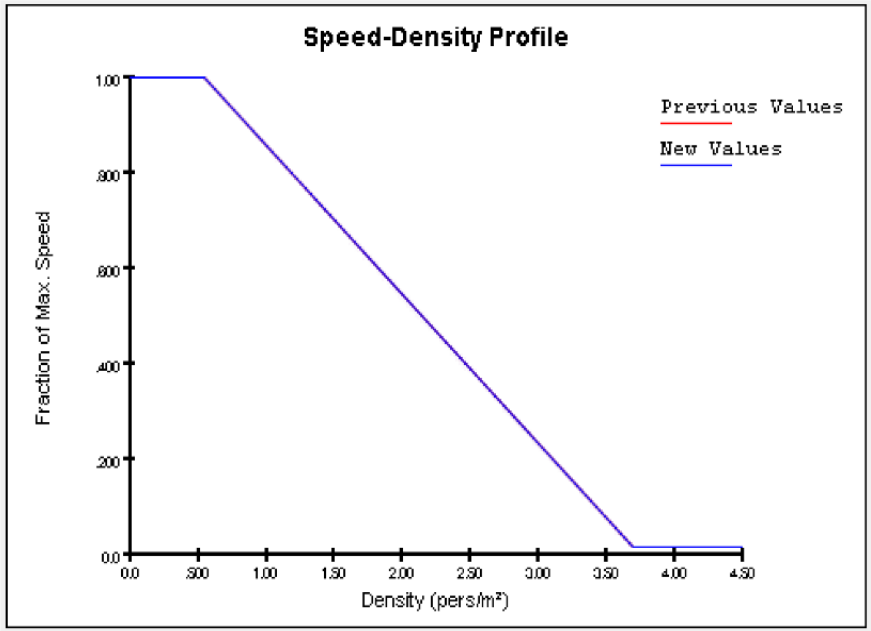
The trend of the shoulders Length follows the Gaussian distribution. This parameter has been inserted into the software



PARAMETER OF PATHFINDER SIMULATION

Travel Time

Unimpeded walking speed (Horizontal) = 1,19 m/s (ISO/TR 16738)



The crowd reduces the walking speed in accordance with the following relation:

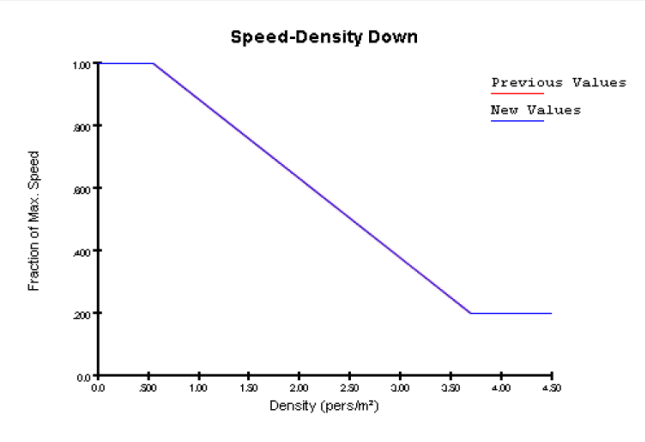
$$S = k - akD$$

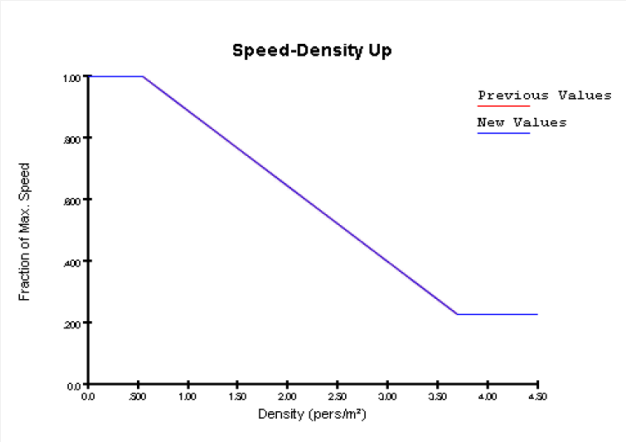
PARAMETER OF PATHFINDER SIMULATION

Travel Time

Unimpeded walking speed (Vertical) = 0,8 m/s for travel downwards

Unimpeded walking speed (Vertical) = 0,7 m/s for travel upwards





The crowd reduces the walking speed I accordance with the following relation:

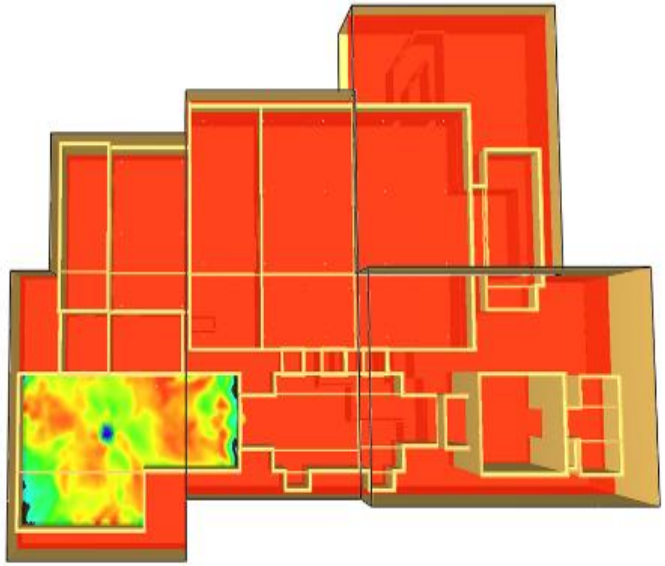
$$S = k - akD$$

With k =1

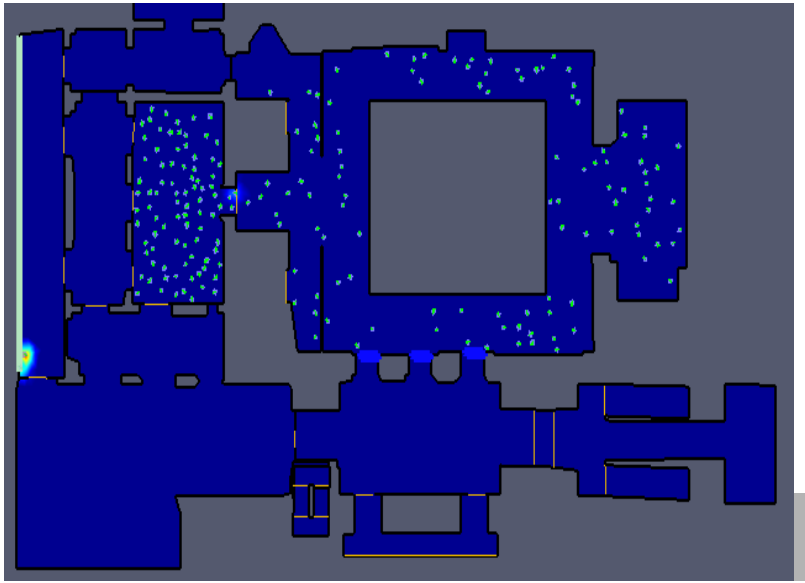
SCENARIO S4B

The first parameter that decreases below the threshold value (10 m) is the visibility.

t = 300 s



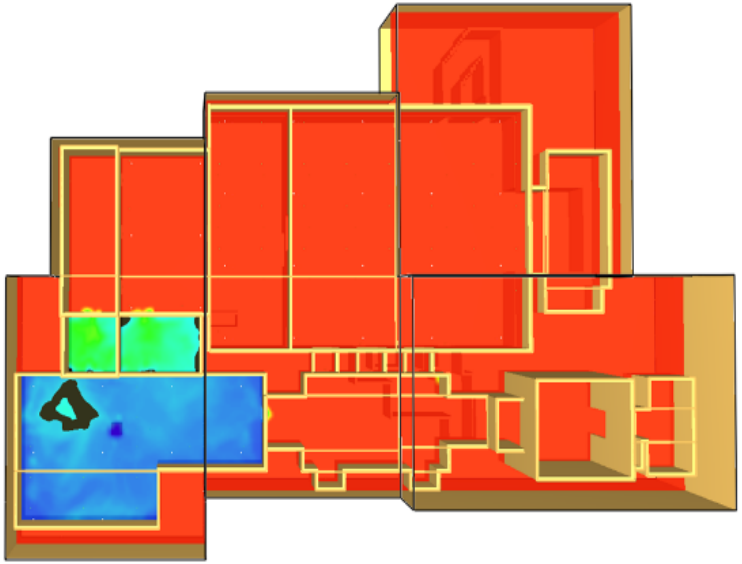
t = 152 s



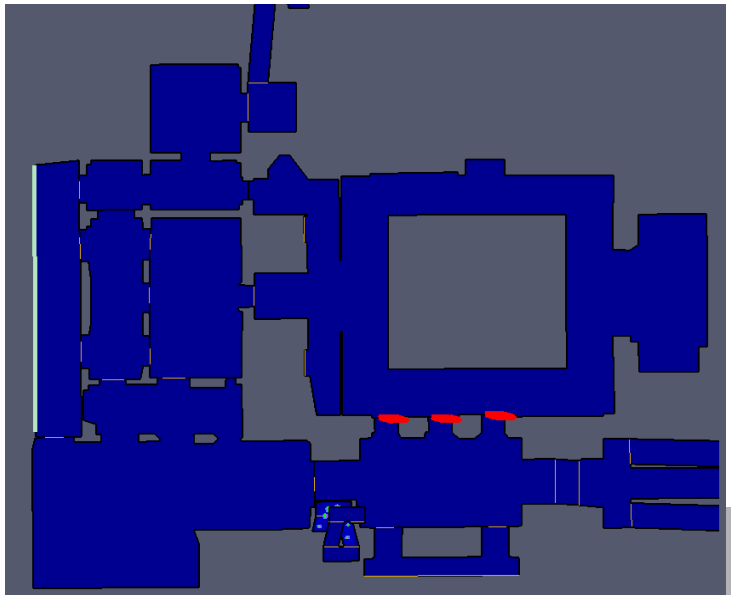
SCENARIO S4B

The first parameter that decreases below the threshold value (10 m) is the visibility.

t = 700 s



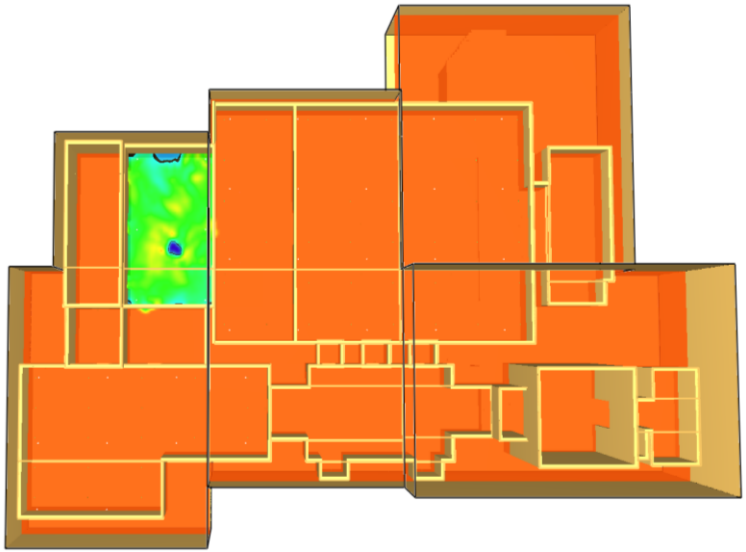
t = 320 s



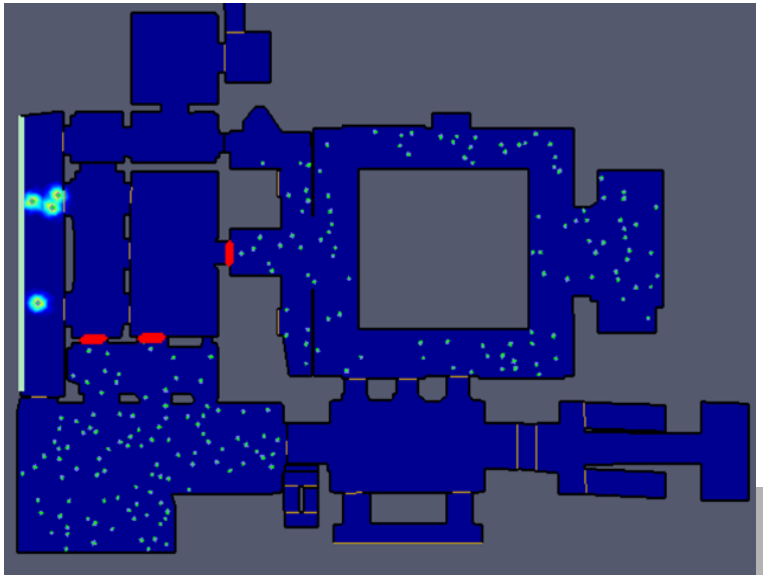
SCENARIO S4C

The first parameter that decreases below the threshold value (10 m) is the visibility.

t = 250 s



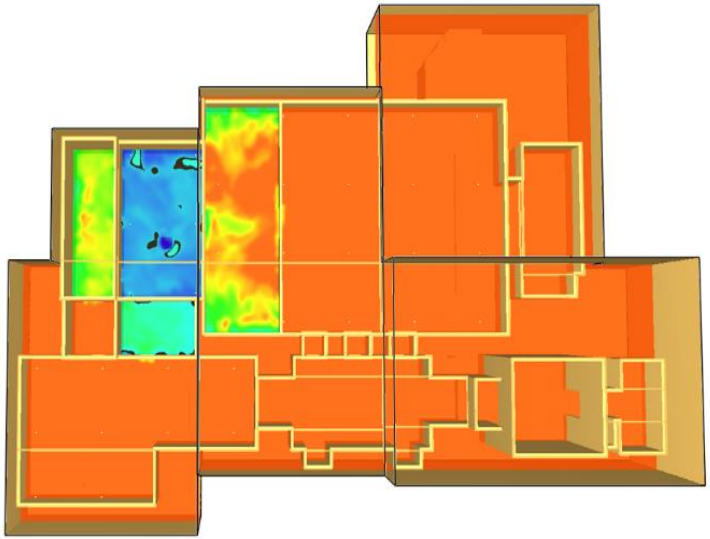
t = 140 s



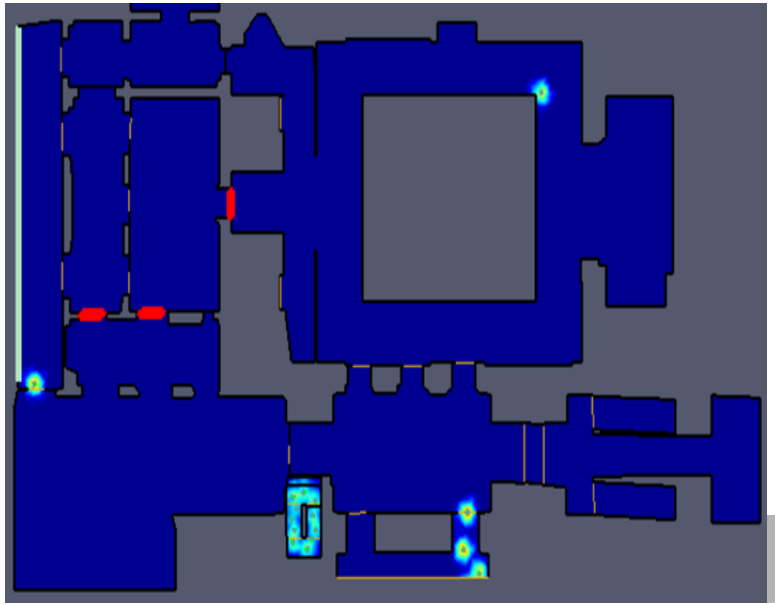
SCENARIO S4C

The first parameter that decreases below the threshold value (10 m) is the visibility.

t = 540 s



t = 290 s



CONCLUSION

- ✓ The safe egress of occupants is guaranteed and the tenability criteria are met;
- ✓ the fire growth rate and ASET has been reduced using the materials classified for fire reaction;
- ✓ the laboratory tests are fundamental to know the real characteristics of the material in case of fire.
- ✓ the computer modelling is an important tool to lead more in-depth analysis;
- ✓ an high level of safety management can reduce the time request to evacuate the building, reducing the accidents. The management measures leaded to minimize adjustment works and maximize the level of safety with considerable benefits in terms of cost/effectiveness risk analysis.

THANKS

Does anyone have any questions?

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