

Problem Definition

Project Scope:

The purpose of this report is to conduct a performance-based design for the University of Maryland Hillel New Center for Jewish Life building, focusing on the two story opening and the open stair configuration.

Project Goal:

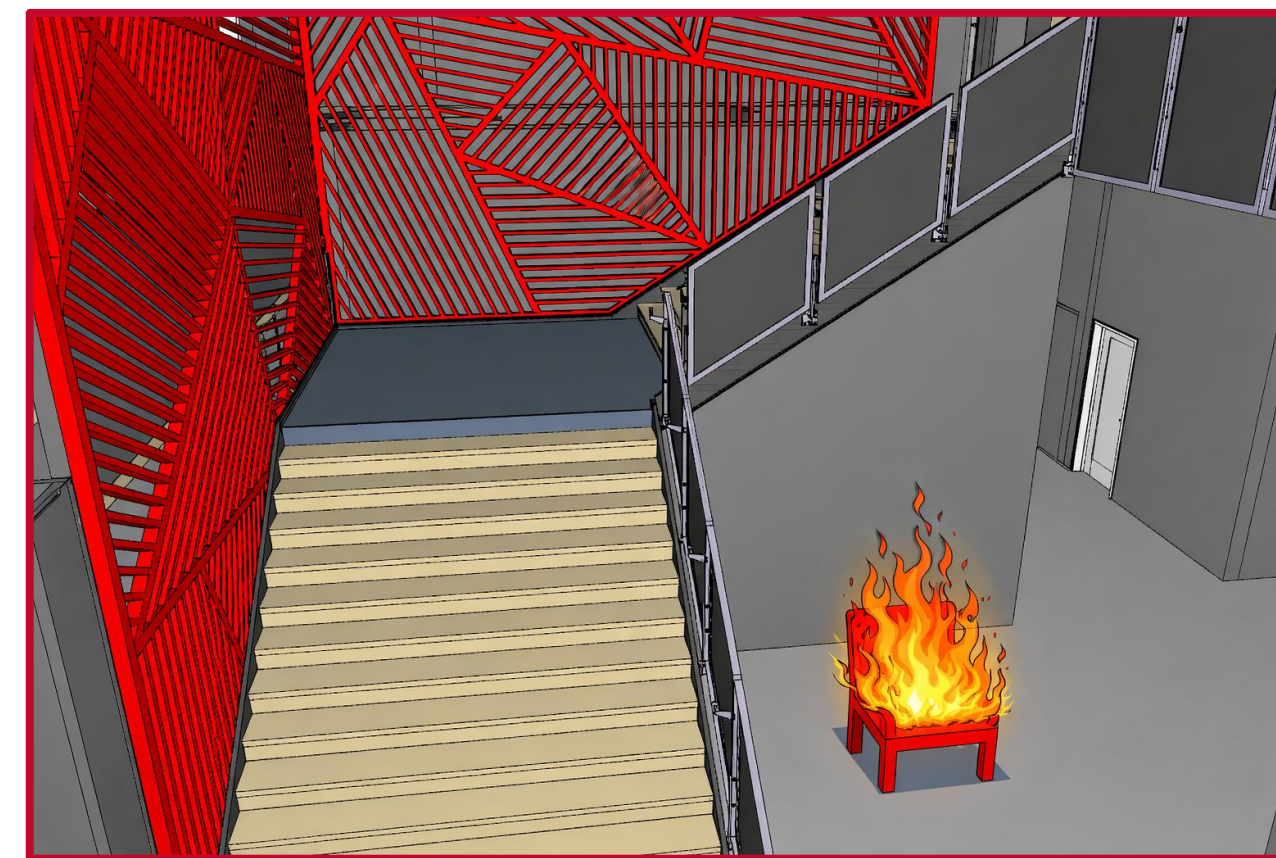
The goal of this project is to ensure that all occupants are able to safely evacuate. This means that the available safe egress time (ASET) needs to be greater than the required safe egress time (RSET).

Project Objective:

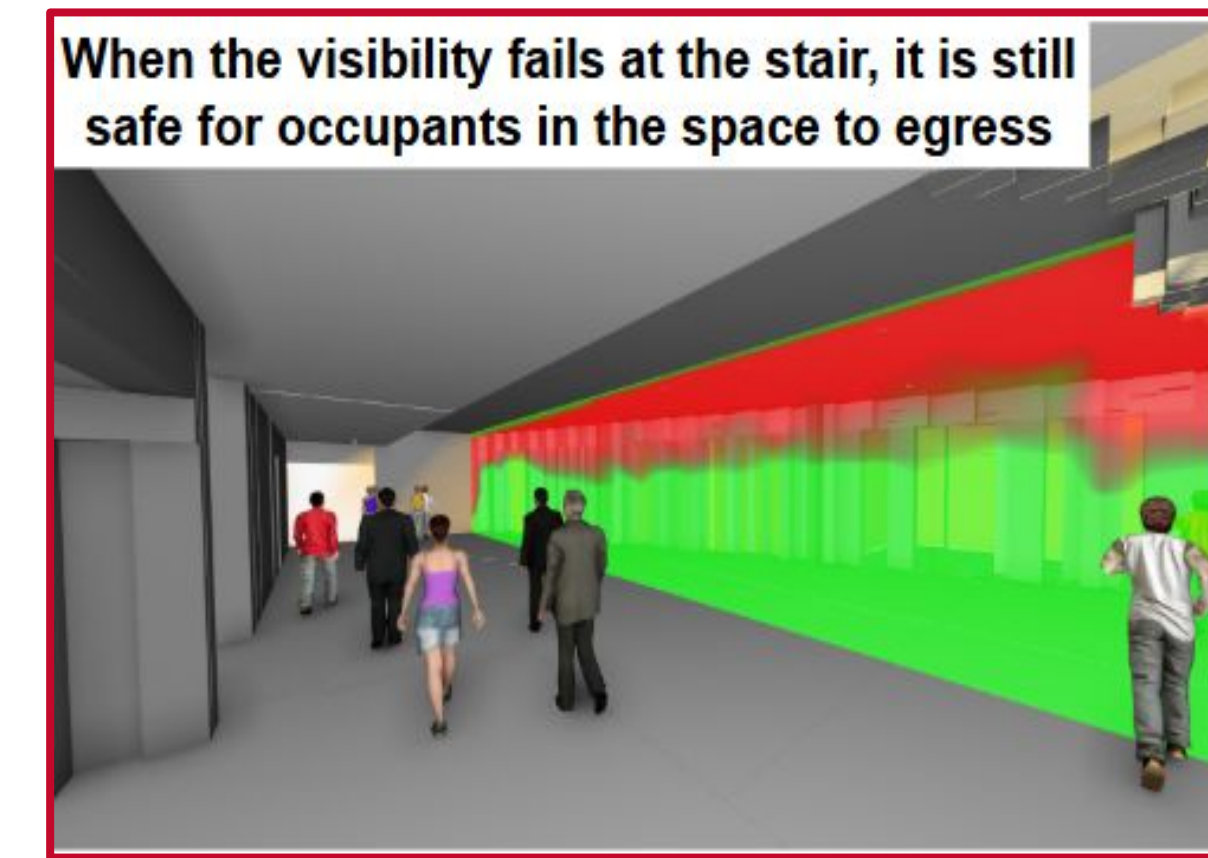
The objective for this goal is to maintain tenability limits during egress to guarantee that all occupants safely evacuate the building in time. If any performance criteria fails while occupants are still in the surrounding area, the performance-based design is not sufficient.



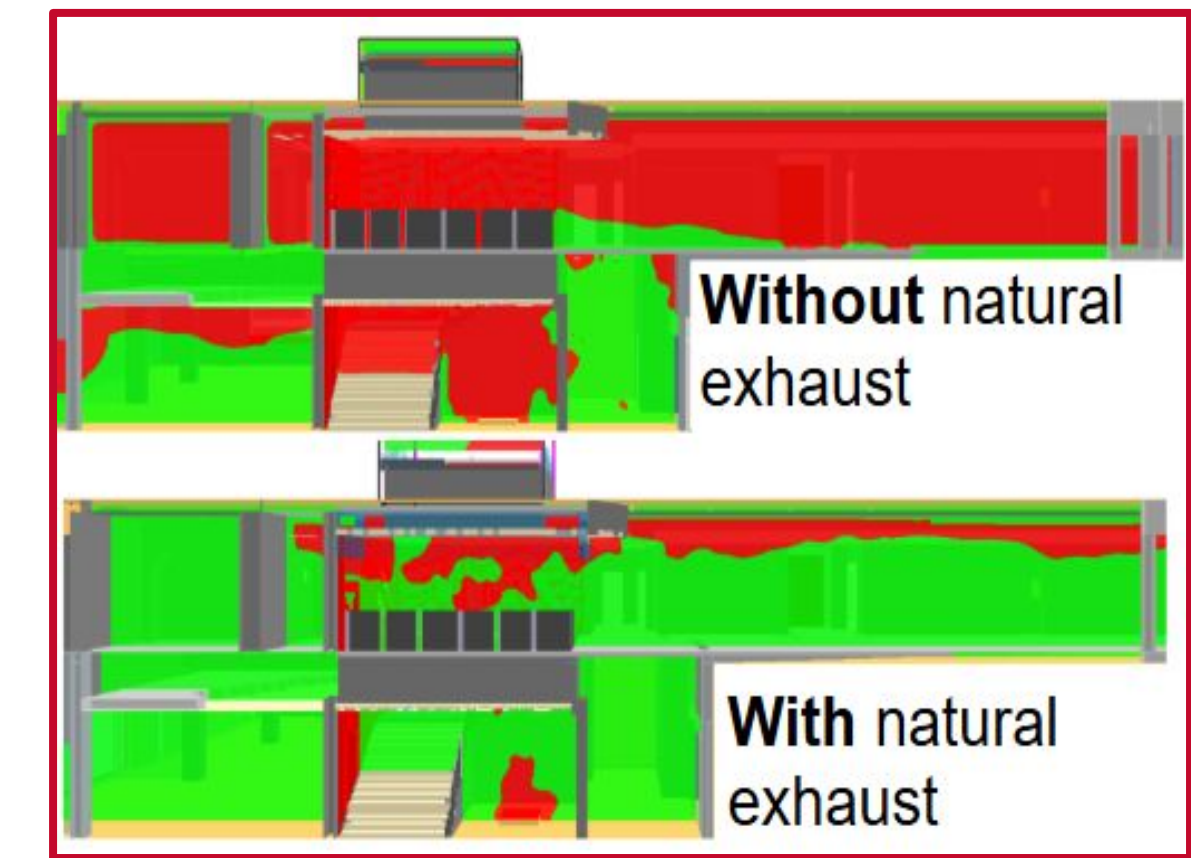
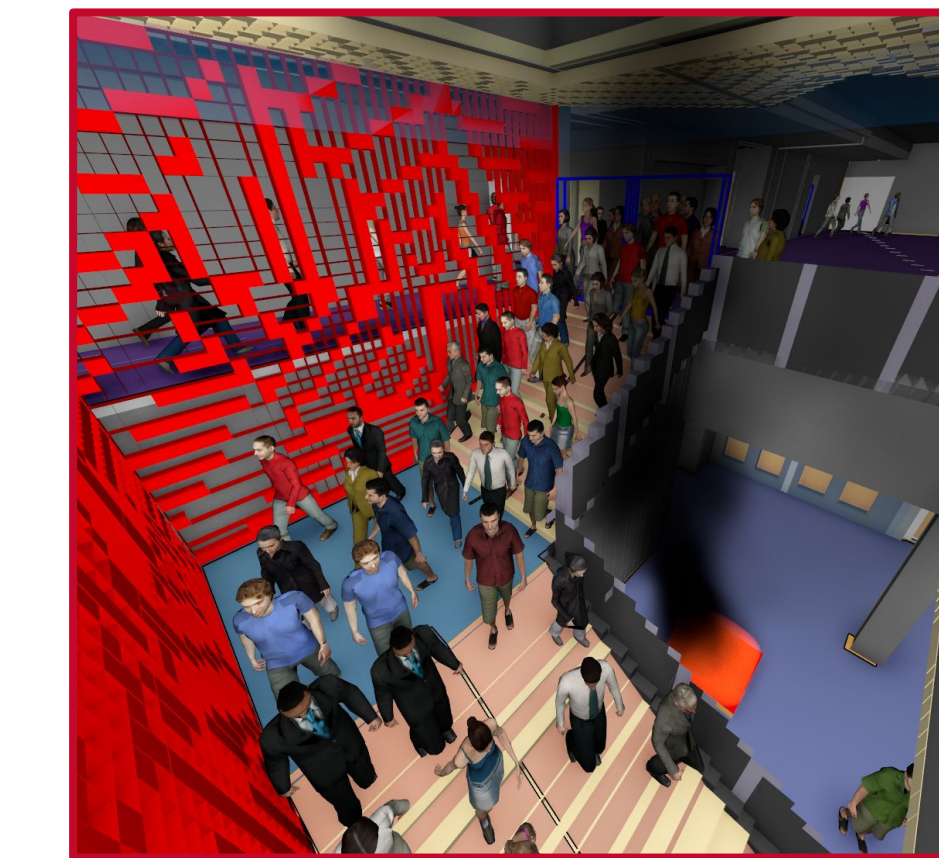
Fire Scenarios and Simulation Results



Design Fire 1: A polyurethane chair in the center of the two-story opening with a peak HRR of 2000 kW and a growth rate of 0.035 kW/s².



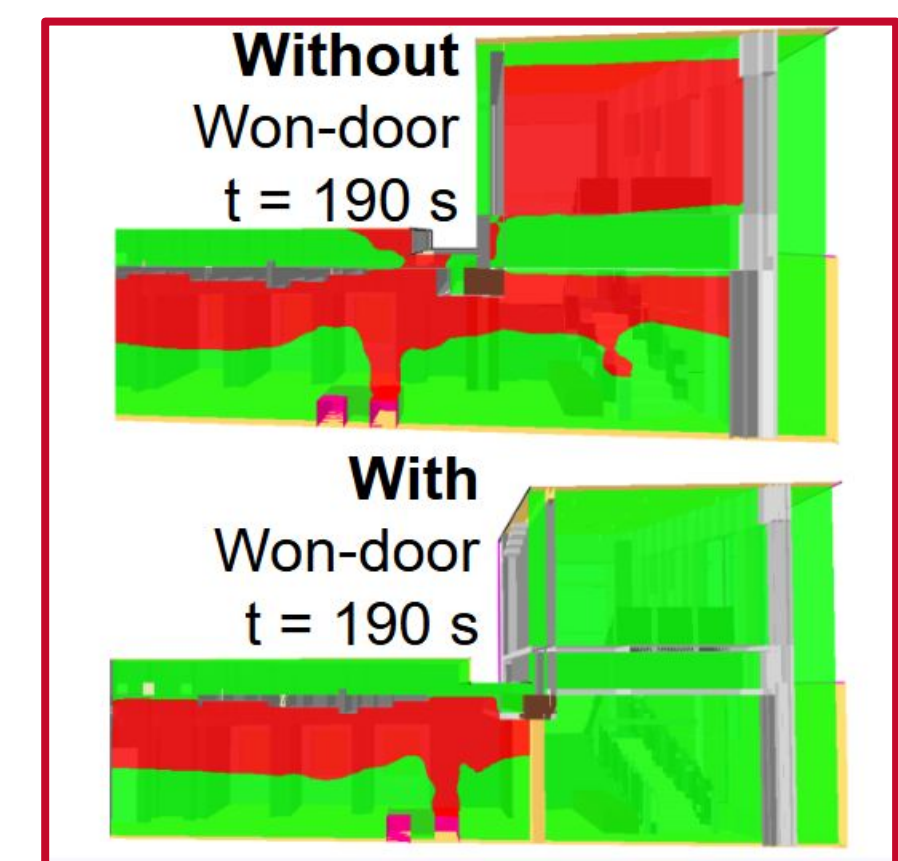
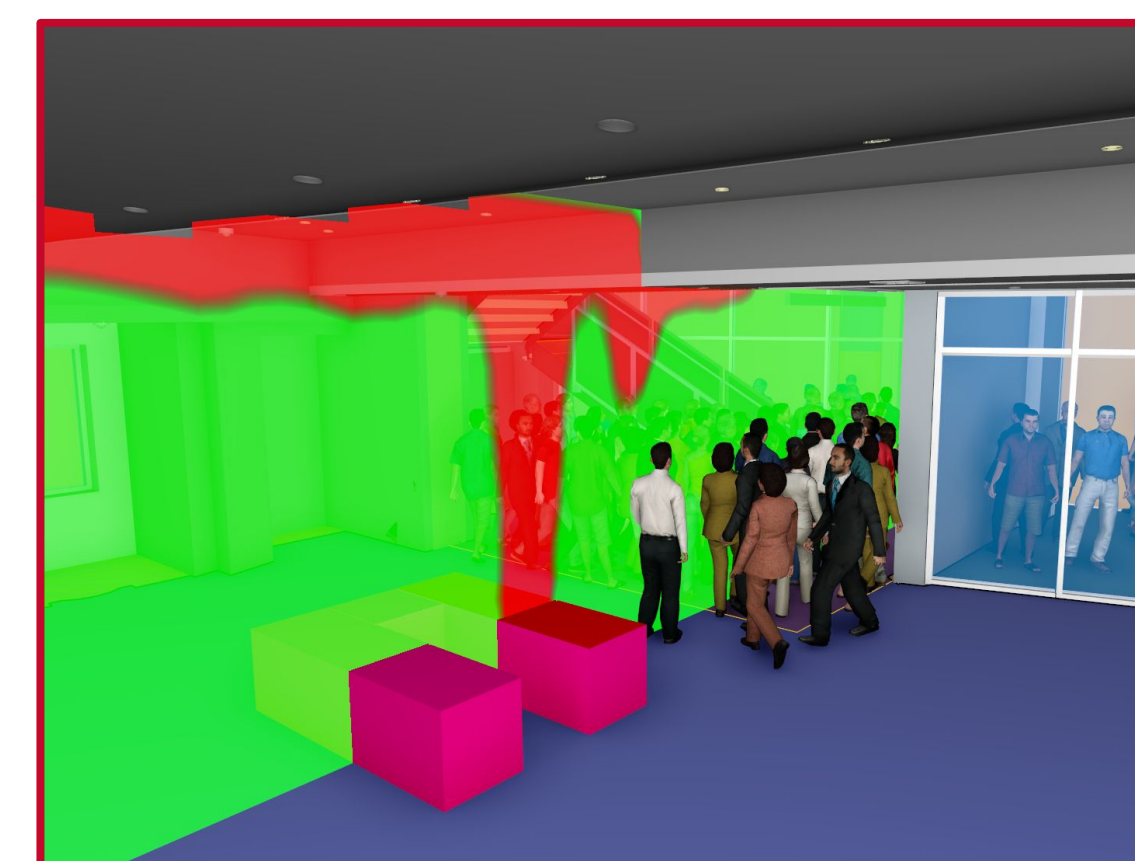
When the visibility fails at the stair, it is still safe for occupants in the space to egress



The results of two-story opening are displayed above. The visibility (measured by the soot yield) slice file in the Y plane is shown, which is the first criteria to fail. Any red portion is deemed a failure, but only when the smoke layer reaches a height of 6 feet off the floor. Occupants are able to safely evacuate the area in 595 seconds without performance criteria being reached. Natural exhaust and smoke baffles greatly increases the tenability in and near the two-story opening.



Design Fire 2: A polyurethane booth near the won-door in the cafeteria with a peak HRR of 2000 kW and a growth rate of 0.01172 kW/s².



The results of an extended Won-Door are displayed above. The visibility slice file in the Y plane is shown. Any red portion is deemed a failure, but only when the smoke layer reaches a height of 6 feet off the floor. Occupants are able to safely evacuate the area in 463 seconds without the performance criteria being reached. A Won-Door greatly increases tenability in the open stair.

Design Analysis

Design Assumptions:

- Ignition is the starting point of the fire scenario
- Smoke is confined to the room of origin and spaces that are directly open to the room of origin
- The ambient environmental conditions are established using climate data for College Park, Maryland
- System reliability is assumed based on the current installed fire protection features

Methods of Evaluation:

- PyroSim was used in conjunction with FDS. Slice files were taken six feet above the floor for both levels and the landing in the communicating space
- Heat detectors (sprinklers) are used. Smoke detectors are used to activate the Won-Door
- Pathfinder was used to determine occupant evacuation behavior and the total time for egress

Table 1. Performance Criteria.

| Performance Criteria | Measurable Values |
|-------------------------|-------------------|
| Visibility | 10 m |
| CO Concentration | 1200 ppm |
| Smoke Layer Temperature | 60 °C |

Final Design

- Smoke baffles were added at the ceiling surrounding the perimeter of the opening.
- The skylight has panes that open upon the activation of a smoke detector to naturally exhaust smoke
- An additional door was added in the southeast stair
- The Won-Door will be a curved configuration, allowing for more open space in the southeast stair
- The solutions to both areas of interest meet the project goal without adding a large cost. The owner's interests of safety, compliance, and openness are kept in mind



Smoke baffles solution.



Natural smoke exhaust solution.



Curved Won-Door.