DEPARTMENT OF FIRE PROTECTION ENGINEERING

CURRY ARCHITECTS

MARYLAND HILLEL

COFFMAN ENGINEERS

FPE 6 Structural Fire Protection
Fighters of Fire

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FIGHTERS OF FIRE

A. JAMES CLARK SCHOOL OF ENGINEERING

Problem Definition

Project Scope

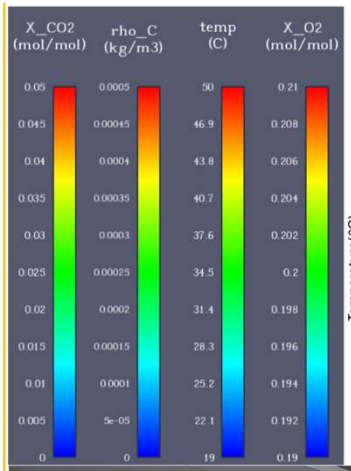
The purpose of this project it to use performance-based design methods to evaluate Hillel New Center for Jewish Life. This analysis focuses on the two-story opening and the fire resistance ratings of the structural elements in the building. The fire modeling program Pyrosim and the egress modeling program Pathfinder will be used to verify that an equivalent level of safety will be maintained for the occupants and building despite these deviations from code.

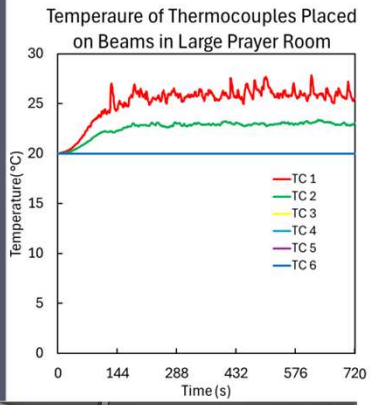
Project Goal #1: Uphold Life Safey

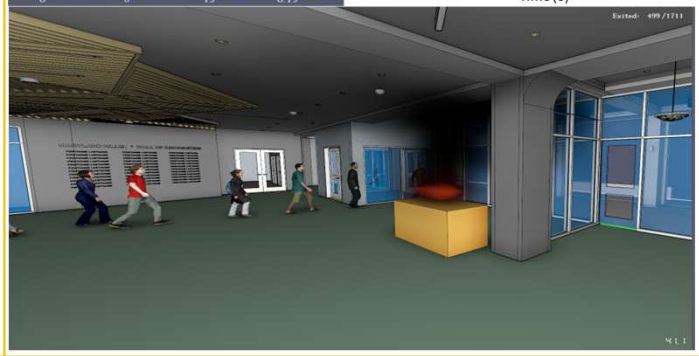
- Limit CO_2 concentration to less than 5%
- Limit the temperature to less than 50 ^oC at 6ft above all walking surfaces
- Keep oxygen concentration above 19.5%

Project Goal #2: Property Protection

- Limit temperature of structural members to less than 500 ^oC
- Limit smoke and soot particulate to less than 0.5 g/m^3







Fire and Egress Modeling Results

Smoke Detectors in Two-Story Opening

- All occupants were notified of a fire in within 30 seconds
- Occupants began to egress quicker
- Conclusion: Occupants were able to vacate the building before untenable conditions arise, thus meeting all life safety criteria

Removing Fire Resistance Ratings

- Thermocouples placed along nearby structural elements proved that the members will not reach the critical temperatures of 500 ^oC
- Soot and smoke particulate was kept under critical levels
- Conclusion: Structural integrity maintained without additional fire resistance materials, and property protection criteria met.

Cost Analysis

	Sprinkler System	Smoke Detectors	Fireproofing
Estimated Cost	$40,000	$6,200	$80,000

- Conclusion: The performance-based design is more cost effective than the prescriptive code requirements

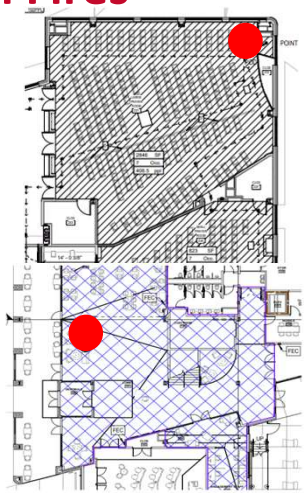
Pyrosim Design Fires

Polypropylene Trash Can Fire

- A trash can ignites from a lit match in the large prayer room while a service is being conducted
- Peak heat release rate (HRR) = 1000 kW
- "Fast Growth" fire under t^2 model
- Fully developed fire within 150 seconds

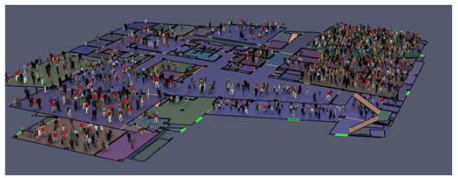
Polyurethane Sofa Fire

- A sofa ignites in the common area of the first floor near the front doors
- Peak HRR 2500 kW
- "Fast Growth" fire under t^2 model
- Fully developed fire within 230 seconds



Pathfinder Inputs for Egress Analysis

- Modeled building with 1711 occupants
- Included 4 wheelchair users and 5 elderly occupants within the model
- Walking Speeds:
  - Wheelchair Users = 0.415 m/s
  - Elderly = 0.45 m/s
  - Other Occupants = 0.81 m/s



- **Required Safe Time for Egress**

  $T_{dectection}$ = 23 sec
  T_{alarm} = 30 sec
  $T_{pre\text{-}movement}$ = 60 sec
  $T_{movement}$ = 369 sec
  20% Safety Factor

  RSET = $T_d + T_a + T_p + T_m + (.2)(T_m)$
  RSET = 9.4 minutes

- **Available Safe Time for Egress**

  ASET = 12 minutes

ASET > RSET ✓