CALPOLY Recreation Center
Fire Protection Review

Presented by Alain Mamada
PRESENTATION OUTLINE

- Overview of the building
- Prescriptive Design Approach
  - Structural Analysis
  - Fire Protection Systems:
    - Fire Alarm and Detection System
    - Water-based Fire Suppression System
  - Egress Analysis
- Performance-Based Design Approach
  - Design Fire Scenarios
  - FDS
- Conclusion and Recommendations
REC Center-Building - 43
OVERVIEW

- Opened first time: 1993
- Expansion construction: 2009 to 2011
- Renovated building opened: January 2012
  - 165,715 square feet
  - State of the art weight and cardio equipment
  - Fitness studios
  - Indoor track
Applicable Codes and Standards

- California Fire Code (2007)
STRUCTURAL ANALYSIS

- Classification: IBC: Based on intended use and occupancy:
  - Group A [IBC, Section 303]
- IBC: Mixed and non-separated occupancy: [IBC, Section 508.3.1]

<table>
<thead>
<tr>
<th>Use of room / Space</th>
<th>Occupancy Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gymnasium</td>
<td>A-3</td>
</tr>
<tr>
<td>Fitness</td>
<td>A-3</td>
</tr>
<tr>
<td>Offices / Administration</td>
<td>B</td>
</tr>
<tr>
<td>Yoga / Meditation</td>
<td>A-3</td>
</tr>
<tr>
<td>Storage rooms</td>
<td>S</td>
</tr>
<tr>
<td>Mechanical/Electrical Equipment rooms/spaces</td>
<td>Accessory (Incidental use)</td>
</tr>
</tbody>
</table>

- LSC: Mixed and non-separated occupancy [LSC 6.1.14.3]
As a multiple occupancy building, the Recreation Center shall comply with all requirements that are applicable to each of the purposes for which the room or space will be occupied.

- The means of egress facilities, construction type, protection, and other safeguards in the building shall comply with the most restrictive fire and life safety requirements of the occupancies involved.
Building Construction Type: I-B

- **Physical Dimensions:**
  - Stories: 2
  - Height: 65 ft (average height)
  - Total area: 165,715 square ft (15,396 m²)
### STRUCTURAL ANALYSIS

**GENERAL BUILDING HEIGHTS AND AREAS**

**TABLE 503**

Allowable building heights and areas*<sup>8</sup>

Building height limitations shown in feet above grade plane. Story limitations shown as stories above grade plane. Building area limitations shown in square feet, as determined by the definition of “Area, building,” per story.

<table>
<thead>
<tr>
<th>TYPE OF CONSTRUCTION</th>
<th>TYPE I</th>
<th>TYPE II</th>
<th>TYPE III</th>
<th>TYPE IV</th>
<th>TYPE V</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEIGHT (feet)</td>
<td>UL 100</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>60</td>
</tr>
<tr>
<td>GROUP</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>HT</td>
<td>A</td>
</tr>
<tr>
<td>STORIES(S) AREA (A)</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>A-1</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>1</td>
</tr>
<tr>
<td>A-2</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>1</td>
</tr>
<tr>
<td>A-3</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>1</td>
</tr>
<tr>
<td>A-4</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>1</td>
</tr>
<tr>
<td>A-5</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>NP</td>
</tr>
<tr>
<td>E</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>1</td>
</tr>
<tr>
<td>F-1</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>1</td>
</tr>
<tr>
<td>F-2</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>1</td>
</tr>
<tr>
<td>...</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Building construction TYPE: IB
STRUCTURAL ANALYSIS

- IBC, Section 506.1 allows Table 503 building areas to be increased due to frontage and automatic Sprinkler System protection.
- Summary of increased tabular values

<table>
<thead>
<tr>
<th>Occupancy Groups</th>
<th>Type II</th>
<th>Type III</th>
<th>Type</th>
<th>Type V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td><strong>Group A-3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tabular A</td>
<td>15500</td>
<td>9500</td>
<td>14000</td>
<td>9500</td>
</tr>
<tr>
<td>Increased A</td>
<td>49083</td>
<td>30083</td>
<td>44333</td>
<td>30083</td>
</tr>
<tr>
<td><strong>Group B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tabular A</td>
<td>37500</td>
<td>23000</td>
<td>28500</td>
<td>19000</td>
</tr>
<tr>
<td>Increased A</td>
<td>118750</td>
<td>72833</td>
<td>90250</td>
<td>60166</td>
</tr>
</tbody>
</table>
Analysis of increased values for areas, story heights due to frontage and automatic sprinkler system installation revealed that no other building construction types would have been allowed in accordance with IBC provisions.

Limiting factor is the building floor area
STRUCTURAL ANALYSIS

- Fire resistance ratings of construction elements [IBC section 602]
  - Interior and exterior building elements

<table>
<thead>
<tr>
<th>Building Element</th>
<th>Fire Resistance Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary structural frame</td>
<td>2</td>
</tr>
<tr>
<td>Exterior bearing walls</td>
<td>2</td>
</tr>
<tr>
<td>Interior bearing walls</td>
<td>2</td>
</tr>
<tr>
<td>Exterior nonbearing walls &amp; partitions</td>
<td>See Table 602</td>
</tr>
<tr>
<td>Interior nonbearing walls &amp; partitions</td>
<td>0</td>
</tr>
<tr>
<td>Floor construction &amp; secondary members</td>
<td>2</td>
</tr>
<tr>
<td>Roof construction &amp; secondary members</td>
<td>1</td>
</tr>
</tbody>
</table>
**STRUCTURAL ANALYSIS**

- Exterior Walls

<table>
<thead>
<tr>
<th>FIRE SEPARATION DISTANCE = x (feet)</th>
<th>TYPE OF CONSTRUCTION</th>
<th>OCCUPANCY GROUP 1</th>
<th>OCCUPANCY GROUP F-1, M, S-1</th>
<th>OCCUPANCY GROUP A, B, E, F-2, I, R, S-2</th>
<th>OCCUPANCY GROUP U</th>
</tr>
</thead>
<tbody>
<tr>
<td>X &lt; 5'</td>
<td>All</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5' &lt; X &lt; 10</td>
<td>IA, Others</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10' &lt; X &lt; 30</td>
<td>IA, IB, Others</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>X ≥ 30</td>
<td>All</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*TABLE 602: FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE.*
Examples of building elements

Typical GFRC Exterior Column-FR 2h

Typical Interior Gypsum Wallboard Column-FR 2h

Floor and roof assemblies covered with 5/8” gypsum wallboard or with 7/8” plaster over metal – required fire ratings
FIRE PROTECTION SYSTEM
FIRE ALARM & DETECTION SYSTEM

- Fire Alarm System in the REC Center:
  - Building Fire Alarm System connected to a proprietary supervising Station [Cal Poly University Police building]
  - Addressable initiating devices
  - Addressable notification appliances
  - Interfaces with auxiliary systems
    - Elevator recall
    - Fire dampers

- Fire control panel displays/transmits three signal types:
  - Alarm signals
  - Supervisory signals
  - Trouble signals
FIRE PROTECTION SYSTEM
FIRE ALARM & DETECTION SYSTEM

- Initiating devices
  - Smoke detectors
  - Heat detectors
  - Manual pull station
  - Wet-pipe sprinkler system flow switch
  - Duct-smoke detector

- Notification Appliances
  - Speaker / Strobes
  - Horn / Strobes
Supervisory signal initiating devices

- Flow switch:

- Tamper switch: Gate valve OSY monitoring switch

Devices are UL listed & FM approved for applications
FIRE PROTECTION SYSTEM
FIRE ALARM & DETECTION SYSTEM

- Activate local audible and visible alarm notification appliances to notify the occupants to evacuate the building
- Send a fire alarm signal to the supervising station; where operators, in constant attendance, monitoring all signals will respond accordingly
- “Female vs male” voice recorded message for EVAC system
FIRE PROTECTION SYSTEM
WATER-BASED SUPPRESSION SYSTEM

- Occupancy hazard classification:
  - Light Hazard [NFPA13,§5.2]
  - Ordinary Hazard (Group 1) [NFPA13,§5.3.1]

- Automatic sprinkler system required [NFPA13,§12.3.5.2]

- Wet-pipe automatic sprinkler system installed throughout the building
  - QRSC: Quick Response Standard Coverage
  - QREC: Quick Response Extended Coverage
FIRE PROTECTION SYSTEM
WATER-BASED SUPPRESSION SYSTEM

- Using CMDA [Control Mode Density/Area]:
  - Hose stream allowance: 100 gpm for 30 minutes

<table>
<thead>
<tr>
<th>Rooms</th>
<th>Hazard Classifications</th>
<th>Density and Design Area of Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gymnasiums/MAC</td>
<td>Light Hazard</td>
<td>0.10 gpm/ft²</td>
</tr>
<tr>
<td>Fitness/Weight rooms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Racquet ball courts</td>
<td></td>
<td>900 ft²</td>
</tr>
<tr>
<td>Prefunction areas</td>
<td></td>
<td>Reduced area as per NFPA13, Figure</td>
</tr>
<tr>
<td>Offices/Corridors/Lobbies</td>
<td></td>
<td>11.2.3.2.3.1 for quick response</td>
</tr>
<tr>
<td>Restrooms/Locker rooms</td>
<td></td>
<td>sprinklers</td>
</tr>
<tr>
<td>Storage rooms</td>
<td>Ordinary Hazard (Group 1)</td>
<td>0.15 gpm/ft²</td>
</tr>
<tr>
<td>Mechanical/Electrical rooms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Custodian rooms</td>
<td></td>
<td>Reduced area as per NFPA13, Figure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.2.3.2.3.1 for quick response</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sprinklers</td>
</tr>
</tbody>
</table>
FIRE PROTECTION SYSTEM
WATER-BASED SUPPRESSION SYSTEM

- Sprinkler riser locations
Water Supply vs System demand [Gymnasium]

System demand:
- Calculated $Q = 196$ gpm
- $P = 78$ psi
- Hose Allowance = 100 gpm
- Safety Margin = 62 psi

City Water Supply:
- Static $P = 140$ psi
- Residual $P = 132$ psi
- Residual Flow = 1186 gpm

$P_{\text{static}} = 140$ PSI
$P_{\text{system}} = 78$ PSI
EGRESS ANALYSIS & DESIGN

- Life Safety Code: NFPA101
  - Occupation load calculations based on the use of each space. [Reference §7.3.1.2, Table 7.3.1.2]
  - Summarized Occupant Load factors used:

<table>
<thead>
<tr>
<th>USE</th>
<th>OLF (Square ft/person)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly Use</td>
<td></td>
</tr>
<tr>
<td>Concentrated use without fixed seating</td>
<td>7 net</td>
</tr>
<tr>
<td>Less concentrated use without fixed seating</td>
<td>15 net</td>
</tr>
<tr>
<td>Exercise room with equipment</td>
<td>50 net</td>
</tr>
<tr>
<td>Exercise room without equipment</td>
<td>15 net</td>
</tr>
<tr>
<td>Business Use</td>
<td></td>
</tr>
<tr>
<td>Offices</td>
<td>100</td>
</tr>
<tr>
<td>Storage Use</td>
<td></td>
</tr>
<tr>
<td>Store rooms</td>
<td>500</td>
</tr>
</tbody>
</table>
EGRESS ANALYSIS & DESIGN

- Life Safety code: NFPA101
  - Egress capacity based on capacity factors in accordance with §7.3.3.1
  - The minimum required width:
    - Stairways: 0.3 inches (width/person)
    - Other components (e.g. doors): 0.2 inches (width/person)
EGRESS ANALYSIS & DESIGN

- Summary of occupant load calculations (2nd floor):

<table>
<thead>
<tr>
<th>Floor/Space</th>
<th>Occupancy</th>
<th>Area (ft²)</th>
<th>OLF (ft² / OCC)</th>
<th>Calculated Occupant Load</th>
<th>Number of Exits Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitness Studio 1</td>
<td>B</td>
<td>1688</td>
<td>50</td>
<td>34</td>
<td>1</td>
</tr>
<tr>
<td>Fitness Studio 2</td>
<td>B</td>
<td>1962</td>
<td>50</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>Main Gym North</td>
<td>A-3</td>
<td>6396</td>
<td>-</td>
<td>1180</td>
<td>2</td>
</tr>
<tr>
<td>Main Gym South</td>
<td>A-3</td>
<td>6414</td>
<td>-</td>
<td>1180</td>
<td>2</td>
</tr>
<tr>
<td>Fitness Studio 3</td>
<td>B</td>
<td>2356</td>
<td>50</td>
<td>48</td>
<td>2</td>
</tr>
<tr>
<td>Cardio Fitness</td>
<td>A-3</td>
<td>3330</td>
<td>50</td>
<td>67</td>
<td>2</td>
</tr>
<tr>
<td>Jogging Track</td>
<td>A-3</td>
<td>2014</td>
<td>-</td>
<td>69</td>
<td>2</td>
</tr>
</tbody>
</table>
EGRESS ANALYSIS & DESIGN
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EGRESS ANALYSIS & DESIGN

Space designations
- Assembly
- Business
- Storage
- Mechanical rooms
- Electrical rooms
- Changing/Restrooms

Color codes

[Diagram of a building layout with various spaces marked and a legend indicating color codes for different types of spaces.]
EGRESS ANALYSIS & DESIGN

- Exit Stairway sizes larger than required
- Arrangement of exits:
  - Arranged to provide access for each occupant to not less than two exits by separate ways of travel
- Remoteness of means of egress
  - Remotely located from each other and
  - In accordance with NFPA101, §7.5.1.3.2, the minimum separation distance between two exits is not less than one-third the length of the maximum overall diagonal of the area served
- Travel distance, common path of travel
  - Code compliant in accordance with NFPA101, §7.6.1
EGRESS ANALYSIS & DESIGN

- Building egress time

SFPE mode: 2 min 47 s
STEERING mode: 2 min 41 s
The following areas raised concerns about enforcement:

- Maximum occupancy load of the “event” areas rely on administrative control:
  - Gymnasium: 2nd Floor
    - Seats: 1180 people (bleachers)
    - Egress capacity: 720 people
    - Maximum occupancy: 424 people
  - Who controls? But what if?
PERFORMANCE BASED ANALYSIS

- **Goal:**
  - To demonstrate that occupants in the REC Center are protected against fire hazards

- **Objectives:**
  - To confirm that REC Center occupants are able to evacuate safely and timely (before conditions become untenable) during a fire emergency

- **Performance Criteria:** [Reference SFPE Handbook, 4th ed., Section 2-6]
  - Visibility level: $> 5 \text{ m} [2 \text{ m above walking floor}]$
  - Exposure to temperature: $< 60 \degree \text{C}$
  - Exposure to toxic gases [CO concentration]: $< 1200 \text{ ppm} [30 \text{ min}]$
PERFORMANCE BASED ANALYSIS

- Postulated Design Scenarios: 1st Floor

- A concert fire in the main Gym
- Floor mat fire in the martial arts studio
- Storage area fire
- Laundry room fire
- Administrative office fire
PERFORMANCE BASED ANALYSIS

- Postulated Design Fire Scenario: 2nd Floor

- Fire under bleachers
**PERFORMANCE BASED ANALYSIS**

- **ASET**: Available Safe Egress Time: Time from ignition until building becomes untenable. Determined using FDS modeling.
- **RSET**: Required Safe Egress Time: Time needed by occupants to evacuate from the building. Determined using Pathfinder egress simulator:
  - \[ t_{RSET} = \Delta t_{detection} + \Delta t_{alarm} + \Delta t_{pre-movement} + \Delta t_{travel} \]

\[ t_{ASET} > t_{RSET} \]
PERFORMANCE BASED ANALYSIS

- Egress time assumptions:
  - All building occupants start evacuation at same time
  - Occupants use the exits in an optimum balance
  - Occupant flow does not involve interruptions caused by evacuee decisions
  - Occupants considered are free of physical and mobility impairments
Design fire scenario 1: GYM Concert Fire
The following assumptions were made:

- 3900 people attending a recreation event
- An electric fault ignites:
  - Sound system equipment
  - Computer boards
- Fire blocks South-West doors
- No automatic fire suppression available
- Ultrafast fire – t² fire
- Fuel properties
  - HRR = 3000 kW
  - [Estimated from SFPE HB, Chap 3-1]
  - Ys = 0.2 (Polyurethane)
  - [SFPE HB, Tb 3-4.16]
RSET Time Analysis

Detection: Sprinkler activation time

DETACT prediction:
- Inputs: QRS; RTI = 50 (m.s)\(^{0.5}\); Actuation Temperature = 155°F
- Time of activation: 232 s (~4 min)
- Sprinkler activation time excessive due to high roof
- Manual pull device activation: 30 s

Alarm: Time of activation of Notification Appliances = 10 s [NFPA72,§10.12.1]

Pre-movement: <3 min [SFPE-3rd edition, Table 3-13.1]

Travel: Determined using Pathfinder simulator
PERFORMANCE BASED ANALYSIS

- Using Pathfinder:
PERFORMANCE BASED ANALYSIS

- $t_{RSET} = \Delta t_{\text{detection}} + \Delta t_{\text{alarm}} + \Delta t_{\text{pre-movement}} + \Delta t_{\text{travel}}$
  - $RSET = \frac{30}{60} + \frac{10}{60} + \frac{30}{60} + 5 \approx 7 \text{ min}$
  - $T < 3$ [SFPE, 3rd edition, Table 3-13.1]

- $t_{ASET}$ to be established as $t_{\text{minimum}}$ to reach either:
  - Minimum visibility limit
  - Maximum CO concentration (dose)
  - Maximum temperature limit
PERFORMANCE BASED ANALYSIS

- FDS Output: Visibility @ 2 m above top seats (2nd floor)

Visibility = 5 m

@time = 5 min

Time and location where visibility limit is reached.
PERFORMANCE BASED ANALYSIS

- FDS Output: Visibility in 2nd floor

Visibility = 5 m

Time and location where visibility limit is reached
PERFORMANCE BASED ANALYSIS

- FDS Output: Visibility above top seats (1st floor)

Visibility = 5 m

@time = 10 min
PERFORMANCE BASED ANALYSIS

FDS summary: @ 5 min on second floor

$\Delta t_{\text{FDS-visibility}} = 5 \text{ min} < t_{\text{RSET}} [7 \text{ min}]$

$\Delta t_{\text{FDS-visibility}} = 5 \text{ min} < t_{\text{RSET}} [7 \text{ min}]$

$t_{\text{RSET}} > t_{\text{ASET}}$

- Concert attendees on second floor are unable to evacuate safely before conditions become untenable
- Recommend:
  - Egress time on second floor needs to be improved

<table>
<thead>
<tr>
<th>Visibility</th>
<th>Carbon Monoxide</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit</td>
<td>Minimum Value</td>
<td>Limit</td>
</tr>
<tr>
<td>5 m</td>
<td>5 m</td>
<td>1200 ppm</td>
</tr>
</tbody>
</table>
Design fire scenario 2: Fire under bleachers

The following assumptions were made:

- Bleachers on ground floor retracted
- Bleachers on second floor 80% full [926 people seated]
- Fire intentionally set: Gasoline spill under bleachers ignites:
  - HRR = 800 kW [NIST Spill Test]
  - Spill of 1000 mL
  - Ys = 0.1
- Fire blocks one exit double-door
- No automatic fire suppression
PERFORMANCE BASED ANALYSIS

RSET Time Analysis

- Detection: Sprinkler activation time
  - DETACT prediction:
    - Inputs: QRS; RTI= 50 (m.s)\(^{0.5}\); Actuation Temperature=155°F
    - Time of activation: 182 s (~3 min)
    - Sprinkler activation time excessive due to high roof
    - Manual pull device activation: 30 seconds
  
- Alarm: Time of activation of Notification Appliances =10 s [NFPA72, §10.12.1]
- Pre-movement: <3 min [SFPE-3rd edition, Table 3-13.1]
- Travel: Determined using Pathfinder simulator
PERFORMANCE BASED ANALYSIS

- Pathfinder simulation: Scenario 2

SFPE mode: 8 min
PERFORMANCE BASED ANALYSIS

- Using Pathfinder:
  - Travel time: 8 min (SFPE mode)
  - \[ t_{RSET} = \Delta t_{detection} + \Delta t_{alarm} + \Delta t_{pre-movement} + \Delta t_{travel} \]
    - \[ RSET = \frac{30}{60} + \frac{10}{60} + \frac{30}{60} + 8 \approx 10 \text{ min} \]
  - \( t_{ASET} \) to be established as \( t_{minimum} \) to reach either:
    - Minimum visibility limit
    - Maximum CO concentration (dose)
    - Maximum temperature limit
PERFORMANCE BASED ANALYSIS

- FDS Output: Temperature

Temperature = 60°C

At time = 10 min

Time and location where temperature limit is reached
PERFORMANCE BASED ANALYSIS

- FDS Output: Visibility @ 6ft above to seats

Visibility = 5 m

@time = 5 min

Time and location where visibility limit is reached
PERFORMANCE BASED ANALYSIS

- FDS summary: @ 5 min on second floor

<table>
<thead>
<tr>
<th>Visibility</th>
<th>Carbon Monoxide</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit</td>
<td>Minimum Value</td>
<td>Limit</td>
</tr>
<tr>
<td>5 m</td>
<td>5 m</td>
<td>1200 ppm</td>
</tr>
</tbody>
</table>

- \( t_{ASET} = \Delta t_{FDS-visibility} = 5 \text{ min} < t_{RSET} \) [10min]

- \( t_{RSET} > t_{ASET} \)

- **Event attendees are unable to evacuate safely before conditions become untenable**
  - **Recommend**: Administrative controls to be strictly enforced for second floor gymnasium occupancy
RECOMMENDATIONS

- Safety factor improvement: ASET vs RSET:
  - Reduction of egress time from second floor gymnasiums
    - Training of personnel in emergency crowd management [Life safety management]
    - Regular fire safety awareness campaigns

- Performance re-assessment of installed sprinkler system in the gymnasium

- Review enforcement of all administrative controls

- Update documentation to reflect as-built conditions

- Encourage further performance based analysis of the building
ACKNOWLEDGMENT

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- Thank you

- Questions and Comments