Center for the Arts Building

Fire Protection Evaluation

Steven Carman
Fire Protection Engineering Program
Cal Poly University, San Luis Obispo
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<td>• Building Description</td>
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Historical Overview

• 1947 - Main, two-story portion of the building was constructed as an auto dealership and repair garage. Served as such until 1984. Initial fire protection system was structural-based.

• Rear, single-story wing added in 1960s. It has no interior connections to the main building.

• Late-1980s - Building redesigned for use as a beauty school.

• Mid-1990s – Again modified into a gymnasium and dance center. Sprinklers required by FD.

• 2002 - Remodeled into the Center for the Arts
Building Information

- Type III-A (Ordinary) Construction
  - Fully Sprinklered (as of 1990s)
  - Partial Fire Detection/Notification Coverage
  - No Smoke Control Systems
- Two Stories in front. Single story middle and rear.
  - Overall floor area approximately 19,000 square feet
    - 13,900 sq. ft. on ground floor. 4,750 sq. ft. on second floor
    - Maximum overall height approximately 28 feet
- Maximum permitted height – 65 feet
- Maximum floor space per floor – 14,000 sq. feet for A-1 occupancies including theaters as per Calif. Bldg. Code
Building Occupancy

- Mixed Occupancy (as per Calif. Bldg. Code)
  - Primary: A-1 (Main and Rear Theaters)
  - Secondary: B and S-1

<table>
<thead>
<tr>
<th>Occupancy Load Factors</th>
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<tbody>
<tr>
<td>Assembly</td>
</tr>
<tr>
<td>Less than concentrated use</td>
</tr>
<tr>
<td>Concentrated use</td>
</tr>
<tr>
<td>Business</td>
</tr>
<tr>
<td>Storage</td>
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</table>
# Building Occupancy

<table>
<thead>
<tr>
<th>Maximum Occupancy Load</th>
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<tbody>
<tr>
<td>Main Theater &amp; Adjacent Storage Rooms</td>
<td>358 persons</td>
</tr>
<tr>
<td>Front Lobby/Offices</td>
<td>199 persons</td>
</tr>
<tr>
<td>Art Gallery</td>
<td>132 persons</td>
</tr>
<tr>
<td>Rear Theater</td>
<td>110 persons</td>
</tr>
<tr>
<td>Rear Lobby</td>
<td>48 persons</td>
</tr>
<tr>
<td>Rear Storage</td>
<td>3 persons</td>
</tr>
<tr>
<td>Second Floor</td>
<td>211 persons</td>
</tr>
</tbody>
</table>

**TOTAL MAXIMUM BUILDING OCCUPANCY** 1,061 persons
<table>
<thead>
<tr>
<th>Egress Analysis</th>
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</thead>
<tbody>
<tr>
<td><strong>Required Exits</strong> - 3 (&lt;1,000 per floor) / <strong>Existing Exits</strong> - 7</td>
</tr>
<tr>
<td><strong>Some exit paths require passage through intervening rooms.</strong></td>
</tr>
<tr>
<td>• Approved by AHJ as it is an existing building meeting other LSC provisions.</td>
</tr>
<tr>
<td><strong>Dead Ends</strong></td>
</tr>
<tr>
<td>• First Floor Lobby - Into bathrooms/office</td>
</tr>
<tr>
<td>• Main Theater - Along south side of fixed seating</td>
</tr>
<tr>
<td>• Second Floor - None</td>
</tr>
<tr>
<td><strong>Travel Distance of 250 feet in sprinklered building is met throughout</strong></td>
</tr>
</tbody>
</table>
Egress Analysis

- **Occupant Types**
  - Most are transient; not intimately familiar with the building
  - Some may be influenced by alcohol

- **Pre-movement times**
  - Will vary between first and second floors
  - Visitors in the theatres may not recognize a fire as being other than part of a show similar to conditions in the Station Nightclub fire.
  - Initially darkened conditions could add to initial confusion and lengthen pre-movement times – Possibly around 2-3 minutes
  - Pre-movement times will likely be shorter for people in the smaller, rear theatre.
Floor Plan – First Floor - Overall

- Day Theatre
- Main Theatre
- Waiting Area
- Storage
- Main Stage
- Alternate 2nd Floor Exit
- Assembly
- Main Entry
- 2nd Floor Entrance

North
Occupancies– First Floor – Front Section

358 persons

199 persons

132 persons
Main Theatre

- **Arched truss roof**
  - 27’ at peak, 16’ at sides
  - Laminated wood trusses 20” deep, 8” wide
  - Spaced 16’ on center

- **Platform (Stage)**
  - No overhead proscenium curtain
  - CBC classifies the “stage” as a platform since no overhanging curtains, sets, etc. Fewer fire resistance ratings required.

- **Seating**
  - 170 fixed seats
  - Up to 50 portable seats placed on main floor between fixed seating and platform/stage
  - Lounge area alongside fixed seating for pre-show refreshments
First Floor - Front – Exit Layout

Main Theatre

Lounge

Stage

Storage

Dressing Room

Rest Room

Front Waiting

Office

Coffee

Hall

Rest Room

Art Gallery

199 people

132 people

358 people

72-inch exit

36-inch exit

32-inch door

36-inch exit

2nd floor

Exit to exterior
First Floor - Front – Exit Paths

- Path from platform/stage
- Path from seats
- Common Travel Path
Main Theatre – Fixed Seating
Main Theatre / Lounge
Main Theatre – Platform / Stage
Front Lobby / Reception

8 foot drop ceiling.

3 foot space above ceiling

Main exit at far south end.
First Floor – Rear Wing
Occupancies – First Floor - Rear

110 persons

48 persons

3 persons
Rear Theatre
First Floor - Rear Wing

• **Bow-truss roof**
  - 16’ at peak, 11’ at sides
  - Trusses spaced 12’ on center
  - Exterior walls filled concrete block

• **Rear Lobby**
  - Entered through separate door from rear theater main exit
  - Connected to rear theater via interior hallway

• **Seating**
  - 60 portable seats positioned loosely on elevated platform
  - Seats not required to be connected or fixed to floor since < 200 seats overall
First Floor - Rear – Exit Layout

- 110 people
- 48 people
- 3 people

- 72-inch exit
- 36-inch exit
- 32-inch door

36-inch doorway

Exit to exterior
First Floor - Rear – Exit Paths

Paths for actors/stagehands
Occupancies– Second Floor

211 persons
Second Floor
Dance Studio
Second Floor– Exit Layout

Exit to first floor theater

Exit from floor

32-inch door
36-inch exit

211 people
Second Floor – Exit Paths
Interior Finish

• Ceiling finish of theaters and dance studios consists in large part of exposed insulation facing. Likely not rated as Class B finish as required. No documentation of testing.

• Actual material tested with small, open flame; found to easily ignite.

• Curtains on stage reportedly treated with flame retardant materials. No documentation.
Ceiling Finish

Main Theater Ceiling

Main Theater Ceiling - Closeup
Ceiling Finish

Rear Theater Ceiling

2nd Floor Dance Studio Ceiling
Fire Detection & Notification

• Existing buildings have limited requirements.

• The California Fire Code specifically relieves existing building owners of the need to install fire detection and notification systems with minor exceptions.

• Exception: Required detectors CFC Section 903.4
  • Water flow alarm for sprinkler system
  • Manual alarm initiation at sprinkler riser
  • Automatic detection at sprinkler riser
Fire Detection & Notification

- Two separate alarm detection and notification systems installed.
  - One at the rear of the building at sprinkler riser
  - One in front, first floor lobby / art gallery
- Each has separate fire alarm control panels and detection/notification circuits and is monitored by a central supervising station.
- No alarm detection or notification appliances in the main theatre or in the second floor dance studio occupancies.
Fire Detection/Notification Appliances
First Floor – Front Section
Fire Detection/Notification Appliances
First Floor – Rear Section
<table>
<thead>
<tr>
<th>Water-Based Suppression Sprinkler System Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Coverage based on Ordinary Group 1 occupancy hazard</td>
</tr>
<tr>
<td>• Sprinkler head coverage 126 ft² / head</td>
</tr>
<tr>
<td>• K-factor 5.6, 165°C activation, density - 0.16 gpm/ft² over 1500 ft²</td>
</tr>
<tr>
<td>• End sprinkler demand 20.2 gpm, 13 psi</td>
</tr>
<tr>
<td>• Total Demand: 496 gpm, 53.7 psi</td>
</tr>
<tr>
<td>• Available City Supply: Static 64 psi, Residual 54 psi, Flow 2400 gpm</td>
</tr>
</tbody>
</table>
Elevation View of Sprinkler Layout
Elevation View of Sprinkler Layout

- **Main Feed**
- **Branch Line (BL)**
- **Cross Main**
- **Riser Nipple to BL**
- **Sprinkler Extension to Under Roof**
- **Sprinkler Extension through Roof**
As per Table 720.1(2), CBC, the exterior walls have a fire resistance rating of > 4 hrs.
First Floor - Rear – Wall Structure

- Fire Dept. Connection
- Sprinkler Control
- Platform/Stage
- Actors / Stage Crews
- Dressing Rooms
- Restrooms
- Hallway
- Rear Entry / Waiting
- Storage D
- Storage B & C
- Storage E

North

8” filled concrete block wall
Wood framed wall
Second Floor - Wall Structure
Performance Based Analyses

Four design fires scenarios were evaluated to determine their effects on Available Safe Egress Time (ASET).

Three in main theater - One in rear theater.
Each occurs during performances – Max occupancy

Each scenario was evaluated for ASET based upon visibility, temperature, heat flux and CO exposure.

**Tenability Limits**

- Visibility < 10 meters
- Temperature < 60 °C
- Heat Flux < 2.5 kW/m²
- CO conc. < 1,000 ppm
Scenario 1
Fire in Stacked Chairs in Main Theater

• Similar to LSC Design Fire Scenario 1
• Theater fully occupied
• 1,500 kW peak HRR under chairs, 60 s growth
• 1st sprinkler activates at 68 s
• Visibility untenable:
  – 220 s south half theater
  – 280 s entire theater
• Temp/Flux/CO conditions do not become untenable
• RSET – 280 s (4.7 m)
Scenario 1 – Heat Release Rate

HRR curves from SFPE Handbook for up to 8, metal framed, upholstered chairs in a stack

HRR curves from SFPE for up to 12 polypropylene chairs in a stack

Estimated HRR curve calculated by FDS for 2 stacks of 10 metal framed, upholstered, chairs each as well as the same arrangement of thermoplastic stacked chairs
70 secs after ignition
Initial sprinkler activation
2nd floor rear exit already untenable due to low visibility

2 mins after ignition
Southern door of theater untenable
Visibility < 10 meters
2 sprinkler heads flowing. Smoke driven nearly to floor
2 mins after ignition
Slice file viewed from south. Visibility < 10 meters, 6 feet above floor at southern door

3.4 mins after ignition
Slice file viewed from north. Visibility < 10 meters, 6 feet above floor over all fixed seating area
### Scenario 1 - Required Safe Egress Time

<table>
<thead>
<tr>
<th>Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection/Notification Time*</td>
<td>30 secs</td>
</tr>
<tr>
<td>Pre-movement Time*</td>
<td>30 secs</td>
</tr>
<tr>
<td>Movement Time</td>
<td>2.6 to 3.3 mins</td>
</tr>
<tr>
<td><strong>Total RSET</strong></td>
<td><strong>3.6 to 4.3 mins</strong></td>
</tr>
</tbody>
</table>

* Estimated values. No automatic detection in theater. Delays exacerbated by dark theater and possible elevated sound levels.*
SCENARIO 1 – Fire in Stacked Chairs

**REQUIRED SAFE EGRESS TIME (RSET)**

- Detection/Alarm Time
- Pre-movement Time
- Movement Time 2 Exits
- Movement Time 1 Exit

**AVAILABLE SAFE EGRESS TIME (ASET):**

- Visibility - South Door
- Visibility - Southern Half of Theater
- Visibility - Northern Half of Theater
- Temperature
- Heat Flux
- Carbon Monoxide

PASS? No safety Margin
Scenario 3
Fire on Gym Mat on Main Stage

- Similar to LSC Design Fire Scenario 6
- Theater fully occupied
- 2,000 kW fire on gym mat on stage, 60 s growth rate
- 1st sprinkler activates at 73 s
- 8 heads activate in total
- Visibility untenable 200 s
- Temp/Flux/CO conditions do not become untenable
- RSET – 270 s (4.5 min)
Scenario 3 – Heat Release Rate

HRR curves from SFPE Handbook for various upholstered furniture items. Note growth rate.

HRR curves estimated for 1.5m x 2m x 1.5 m high stack of foam gym mats.
95 secs after ignition

Slice file viewed from south.
4 sprinkler heads activated.
Visibility < 10 meters, 6 feet above the upper portion of fixed seating

4 minutes after ignition

Slice file viewed from north.
8 sprinkler heads activated.
Visibility < 10 meters, 3 feet above the floor at north door
Sprinkler Activations for Gym Mat Fire
Scenario 3 - Required Safe Egress Time

Detection/Notification Time* (estimated) 60 secs

Premovement Time* 45 secs

Movement Time 2.6 – 3.3 mins

Total RSET 4.35 – 5.05 mins

* Estimated values. No automatic detection in theater. Delays exacerbated by dark theater plus early flames likely not visible from audience seating.
SCENARIO 3 – Fire on Gym Mat on Stage

REQUIRED SAFE EGRESS TIME (RSET)

AVAILABLE SAFE EGRESS TIME (ASET)

Visibility Throughout Theater

Temperature

Heat Flux

Carbon Monoxide

FAIL

Detection/Alarm Time

Pre-movement Time

Movement Time 2 Exits

seconds

30 60 90 120 150 180 210 240 270 300 330
Scenario 4
Fire Behind Seating Platform Rear Theater

- Similar to LSC Design Fire Scenario 5
- Theater fully occupied
- 400 kW fire under rear chairs, 60 s growth rate
- 1st sprinkler activates 73 s
- Visibility untenable 100 s
- Temp/Flux/CO conditions do not become untenable
- RSET – 150 s
Scenario 4 – Heat Release Rate

HRR curve from SFPE for wooden pallets. Estimated that pallet growth rate would be similar to that for wooden seating platform and control booth during early stages of fire.

HRR curve estimated for early stages of rear theater seating platform, chairs and control booth fire.
30 secs after ignition

By 30 secs after ignition, plume should alert many occupants of rear theater

87 secs after ignition

By 87 secs after ignition, visibility untenable throughout audience seating
100 secs after ignition

Visibility at main exit and throughout theater < 10 m at 6 feet above the floor

120 secs after ignition

At 120 seconds, maximum temperature throughout theater at 6 feet above the floor is ~ 30 °C (outside fire plume)
## Scenario 4 - Required Safe Egress Time

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection/Notification Time</td>
<td>30 secs</td>
</tr>
<tr>
<td>Pre-movement Time*</td>
<td>30 secs</td>
</tr>
<tr>
<td>Movement Time</td>
<td>90 secs</td>
</tr>
<tr>
<td><strong>Total RSET</strong></td>
<td>150 secs</td>
</tr>
</tbody>
</table>

- Estimated values. No automatic detection in theater. Delays exacerbated by dark theater and possible elevated sound levels.
SCENARIO 4 – Fire on Seating Platform in Rear Theater

REQUIRED SAFE EGRESS TIME (RSET):

AVAILABLE SAFE EGRESS TIME (ASET):

Visibility at Main Exit

Temperature

Heat Flux

Detection/Alarm Time

Pre-movement Time

Movement Time 2 Exits

Movement Time 1 Exit

FAIL
Recommendations

• Alarm Detection/Notification System
  • Consider installing detection and notification devices in the main theater and on second floor.
  • All detection tied into lighting/sound circuits in each theater and HVAC control circuits.
  • Art Gallery detector raised; two more detectors added.

• Wall between main theater and front lobby - horizontal exit
  • Seal through-wall penetrations.
  • Adding a fire rated door.

• Ceiling finish / Curtains should be immediately tested.
  • If they do not meet ASTM E84 Class B / NFPA 701 standards, they should be enclosed, upgraded or treated.
Recommendations

• 2\textsuperscript{nd} floor rear exit stairs
  • Enclosed in fire resistant barrier/separated from theater, or
  • Relocated for exit discharges directly to exterior.

• Rear theater
  • Adjust arrangement to make an additional exit available.
  • Exit must be clearly marked/readily accessible.
  • Remoteness requirements must be followed.
  • Exit behind the platform/stage might be acceptable to the AHJ with modifications to the existing layout.