ASCE 41-17 Tier 1 Seismic Evaluation

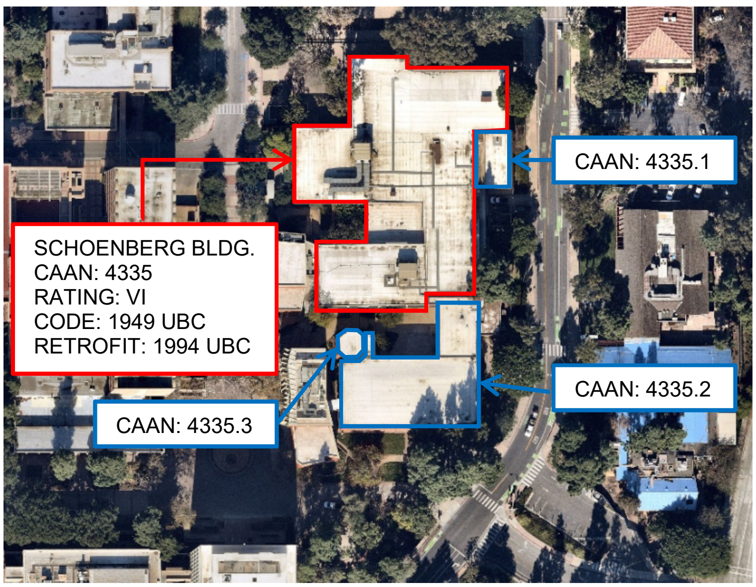
DATE: 5/18/2021
UC Campus: UCLA
Building Name: Schoenberg Building
CAAN ID: 4335
Auxiliary Building ID: 4335.1, 4335.2, 4335.3

SUMMARY OF INFORMATION PROVIDED BY EVALUATOR: THORNTON TOMASETTI

FURTHER EVALUATION RECOMMENDED: YES

UCOP SEISMIC PERFORMANCE LEVEL (OR "RATING") BASED ON TIER 1 EVALUATION FINDINGS: VI

Plan Image or Aerial Photo



Exterior Elevation Photo – Music Library

The seismic evaluation of this building is being undertaken at the request of UCLA. The ASCE 41-17 evaluation methodology and criteria, as well as the UC's evaluation criteria, are the procedures used to evaluate the seismic performance of the Schoenberg Building. This report represents the findings of the Tier 1 evaluation, which identifies potential deficiencies in the building based on the performance of similar buildings in past earthquakes. Any deficiencies found in the Tier 1 evaluation should be further investigated.

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1. BUILDING INFORMATION:

Site location coordinates:
- -Latitude: 34.07088
- -Longitude: -118.44012

ASCE 41-17 Model Building Type:

Above Grade:
- -Longitudinal Direction: C2, Reinforced Concrete Bearing Walls with Stiff Diaphragms at 2nd floor and roof
- -Transverse Direction: C2, Reinforced Concrete Bearing Walls with Stiff Diaphragms at 2nd floor and roof

- -Longitudinal Direction: RM2, Reinforced Masonry Bearing Walls with Stiff Diaphragms at 2nd floor
- -Transverse Direction: RM2, Reinforced Masonry Bearing Walls with Stiff Diaphragms at 2nd floor

- -Longitudinal Direction: RM1, Reinforced Masonry Bearing Walls with Flexible Diaphragms at roof
- -Transverse Direction: RM1, Reinforced Masonry Bearing Walls with Flexible Diaphragms at roof

Below Grade:
- -Longitudinal Direction: C2, Reinforced Concrete Bearing Walls with Stiff Diaphragms
- -Transverse Direction: C2, Reinforced Concrete Bearing Walls with Stiff Diaphragms

Note: Original building Architectural, Structural drawings as well as 1999 seismic correction drawings were provided for review.

Total Floor Area (sq. ft.): 72,700 (estimated from drawings)
Number of Stories:
- -Above grade: 1 (tall height, high volume spaces – auditoriums, library, foyer)
- -Above grade: 2 (standard heights – class room, mezzanines)
- -Below grade: 1 (standard height condition and tall height condition under main auditorium stage)

Year Original Building was Constructed: 1955 (Therefore not an ASCE 41-17 Benchmark Building)
Original Building Design Code and Year: 1949 UBC
Retrofit Building Design Code and Year: 1994 UBC (1995 CBC)

COST RANGE TO RETROFIT (if applicable): **Medium (~$50/sf-$200/sf)**

2. GEOTECHNICAL INFORMATION:

Site Information: Site Class (A-F): D (Basis: Inferred from Geotechnologies, Inc. (2011)

Geologic Hazards:
- - Fault Rupture: No (Basis: Inferred from Geotechnologies, Inc. (2011) and CGS maps)
- - Liquefaction: No (Basis: Inferred from Geotechnologies, Inc. (2011) and CGS maps)
- - Landslide: No (Basis: Inferred from Geotechnologies, Inc. (2011) and CGS maps)

CGS = California Geological Survey
Geotechnologies, Inc. = Los Angeles based soils engineering firm who prepared soils report for an adjacent building in 2011

Site-specific Ground Motion Study: No

ASCE 41 Evaluation Criteria (using ATC Hazard by Location Maps):

Hazard Level BSE-2E, Collapse Prevention
Site-modified Spectral Response (0.2 s): Sds, BSE-2E = 1.554
Site-modified Spectral Response (1.0 s): Sd1, BSE-2E = 0.949
Estimated Fundamental Period (seconds):
- Longitudinal Direction: 0.237 (per ASCE 41-17, Eqn. 4-4, assume h = 27 ft.)
- Transverse Direction: 0.237 (per ASCE 41-17, Eqn. 4-4, assume h = 27 ft.)
(h = building height above first floor)

3. FALLING HAZARDS ASSESSMENT SUMMARY (applicable when box is checked):

☒ Heavy ceilings, features or ornamentation above large lecture halls, auditoriums, lobbies or other areas where large numbers of people congregate
☐ Heavy masonry or stone veneer above exit ways
☐ Unbraced masonry parapets, cornices or other ornamentation above exit ways
☐ Masonry chimneys
☐ Heavy Partitions Braced by Ceilings
☐ Appendages

UCLA staff to verify the following potential falling hazards due to limited interior access:

- Unrestrained hazardous materials storage.
- Unrestrained natural gas-fueled equipment such as water heaters, boilers, emergency generators, etc.

4. TIER 1 SEISMIC EVALUATION SUMMARYH OF STRUCTURAL NON-COMPLIANCE/FINDINGS SIGNIFICANTLY AFFECTING RATING DETERMINATION (applicable when box is checked):

Non-Compliance items indicate potential significant structural deficiencies potentially affecting the seismic performance level designation (CP) of the building:

Building Basic Configuration Checklist – Collapse Prevention (CP)

Low Seismicity:

☐ Load Path
☒ Adjacent Buildings
☐ Mezzanines
☐ Weak Story
☐ Soft Story
☐ Vertical Irregularities (all elements continuous to foundation check)
☐ Geometry
☐ Mass – Vertical Irregularity
☒ Torsion

Moderate Seismicity:

☐ Liquefaction
☐ Slope Failure
☐ Surface Fault Rupture

High Seismicity:

☐ Overturning

☐ Ties between Foundation Elements

<u>Structural Checklist for Building Type RM2</u>

Low and Moderate Seismicity:

☐ Redundancy

☐ Shear Stress Check

☐ Reinforcing Steel

Stiff Diaphragms:

☐ Topping Slab – Precast

Connections:

☐ Wall Anchorage

☐ Wood Ledgers

☐ Transfer to Shear Walls

☐ Topping Slab to Walls or Frames

☐ Foundation Dowels

☒ Girder-Column Connection

High Seismicity:

Stiff Diaphragms:

☐ Openings at Shear Walls (concrete or masonry)

☐ Openings at Exterior Masonry Shear Walls

Flexible Diaphragms:

☒ Cross Ties *(Unknown – more information required)*

☐ Openings at Shear Walls (concrete or masonry)

☐ Openings at Exterior Masonry Shear Walls

☐ Straight Sheathing

☐ Spans

☐ Diagonally Sheathed and Unblocked Diaphragms

☐ Other Diaphragms

☒ Stiffness of Wall Anchors *(Unknown – more information required)*

<u>Structural Checklist for Building Type C2</u>

Low and Moderate Seismicity:

☒ Complete Frames

☐ Redundancy

☐ Shear Stress Check

☐ Reinforcing Steel

Connections

☒ Wall Anchorage at Flexible Diaphragms

☐ Transfer to Shear Walls

☐ Foundation Dowels

High Seismicity:

☐ Deflection Compatibility

☐ Flat Slabs

☐ Coupling Beams

Stiff or Flexible Diaphragms

☐ Diaphragm Continuity

☐ Openings at Shear Walls

Flexible Diaphragms

☒ Cross Ties

☐ Straight Sheathing

☐ Spans

☐ Diagonally Sheathed and Unblocked Diaphragms

☒ Other Diaphragms

Connections

☐ Uplift at Pile Caps

NON-STRUCTURAL FALLING HAZARD NOTES: Given the size of the auditoriums, the ceilings above them should be reviewed to verify the adequacy of the existing ceiling bracing system. The ceiling hangers are from the steel beams and “Bulb-Tee” rails spaced at 32-5/8” on center. As per the architectural drawings, the ceiling is 3/4" vermiculite plaster over 3/4" furring at 16” O.C. supported by 1-1/2” runners at 48” O.C. It is likely supporting other miscellaneous items like conduit and other wiring and items abandoned over the years.

The small theater has had a recent renovation, and the suspended ceiling system is assumed compliant with current building codes.

DEFECTS AND DETERIORATION: The first floor level southern windows of the courtyard on the west side of the building are showing signs of deterioration around the edges of the windows.

5. BRIEF DESCRIPTION OF ANTICIPATED FAILURE MECHANISM:

The Schoenberg Building is a reinforced brick masonry and reinforced concrete wall building that was built in 1955 under the provisions of the 1949 Uniform Building Code (UBC). The building is separated by 3 inch seismic joints between the Scene Shop building to the east, the Herb Albert building to the south and the Ostin Music Center B to the west. The Schoenberg building houses several performance and teaching auditoriums, a music library, classrooms and offices. The building is a free flowing rectilinear shape with the long axis oriented in the north-south direction.

The building framing system utilizes reinforced concrete columns, beams, bearing walls, and reinforced masonry bearing walls to support cast-in-place reinforced concrete slabs, pan joist and beams at the floor levels. Steel beams and girders are used to support the gypsum concrete / steel bulb-tee roof system for the majority of the building roof. The southwest corner of the building has a cast-in-place concrete roof. There is a canopy structure at loading dock on east side of building.

This gypsum roofing system is no longer used today and while adequate for gravity loads is likely deficient for transferring anticipated seismic forces to the perimeter walls. There are five auditoriums and the music library, where the occupancy can be high. In the auditorium and library spaces there is a concern the roof diaphragms could separate from the wall causing damage to the roof system. Connection details of exterior and interior bearing walls lack information for transferring forces at the gypsum roof diaphragm, specifically at diaphragm cross ties. A more detailed analysis will be needed to determine the adequacy of these steel connection details and the roof diaphragm strength.

The shear wall and drag collector system should be further reviewed in the east-west direction for the 2 story rigid floor and roof diaphragm portion in the southwest corner of the building. The shear walls are short and the columns are trapped between deep concrete lintel beams.

6. COMMENTS AND ADDITIONAL DEFICIENCIES:

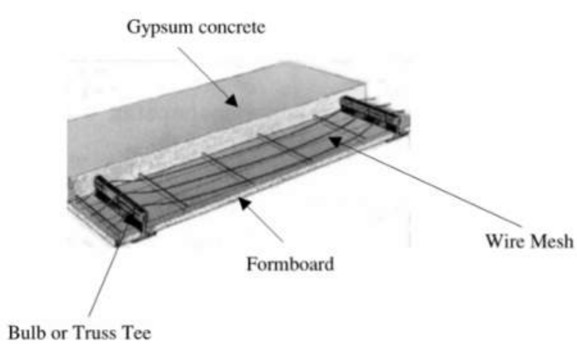
During intense seismic ground shaking there are other areas of the building that may experience damage beyond what has been identified in the Tier 1 review and are discussed below. As there are multiple auditorium spaces within the building additional investigation, such as a Tier 2 or Tier 3 investigation, would further clarify the potential damage risk of the following items.

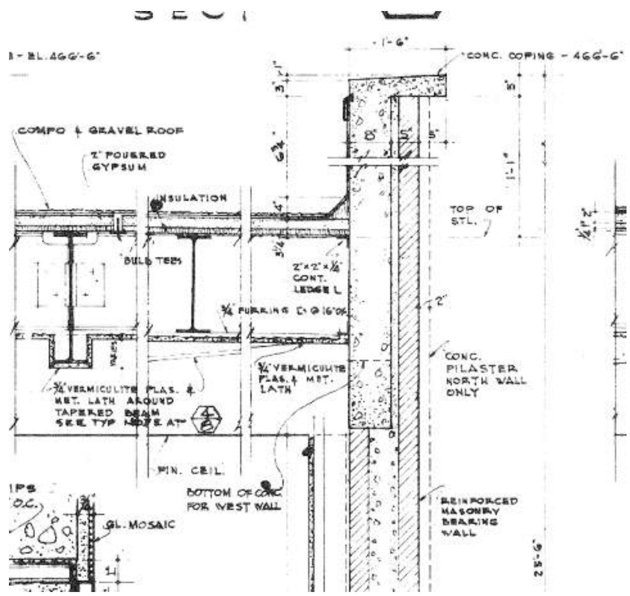
6.1. Possible inadequate joint separation between buildings: The two structures could collide causing localized damage at the existing seismic joint at the Herb Albert Building. The seismic gap between the buildings is three inches. The damage would likely be limited to brick damage along the seismic joint and buckling of wall flashing/joint cover at the top of the adjacent parapets that serves as the roof seismic joint cover. There is also a pair of water lines and a conduit that cross the seismic joint that have no flex connections, which could lead to pipe and conduit failure when the buildings move during an earthquake.

Parapet wall flashing cover that serves as seismic joint cover where two adjacent buildings occur

Water pipes and conduit crossing seismic joint with no visible flexible connections provided.

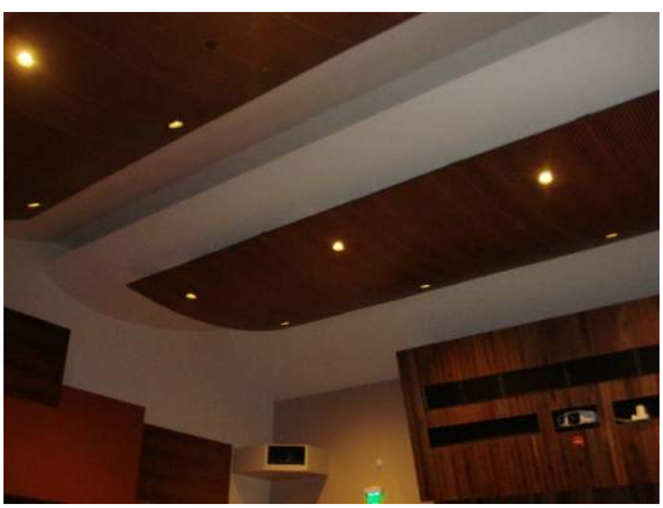
6.2. Roof Diaphragm of weak strength: The majority of the roof diaphragm consists of two-inch thick gypsum concrete, reinforced with 4”-8”/12-18 welded wire mesh placed over a one inch thick insulation board that spans between steel rails (Bulb-Tees) located at 2’-8 5/8” on center that are supported by steel beams and steel angle wall ledgers. As building codes have evolved over the years, and the seismic design forces have increased as well, there is the concern the existing gypsum roof diaphragm may be inadequate to resist current building code seismic design forces and remain connected to the wall. Similar roof systems today now utilizes a continuous metal deck for diaphragm strength in lieu of the gypsum concrete over form board.





Component Illustration of Gypsum Concrete Roof System   Building Section from Architectural Drawings

6.3. Bracing of Existing Heavy Ceilings (acoustical attachments): The existing auditorium ceilings that have not been redone in the last 15 years or so should be reviewed for bracing relative to current building code requirements. Additional ceiling bracing wires and closer spaced compression posts may be required. For the more recent ceiling remodels within the building, it is assumed they comply with the more modern codes.



Small auditorium - ceiling remodel recently   Main auditorium ceiling – three ceiling sections

6.4. Roof MEP Anchorage: The large mechanical unit on the roof may require additional seismic bracing than is currently provided. The concern is the unit could pull free during a significant earthquake as it sits on four cantilever posts.

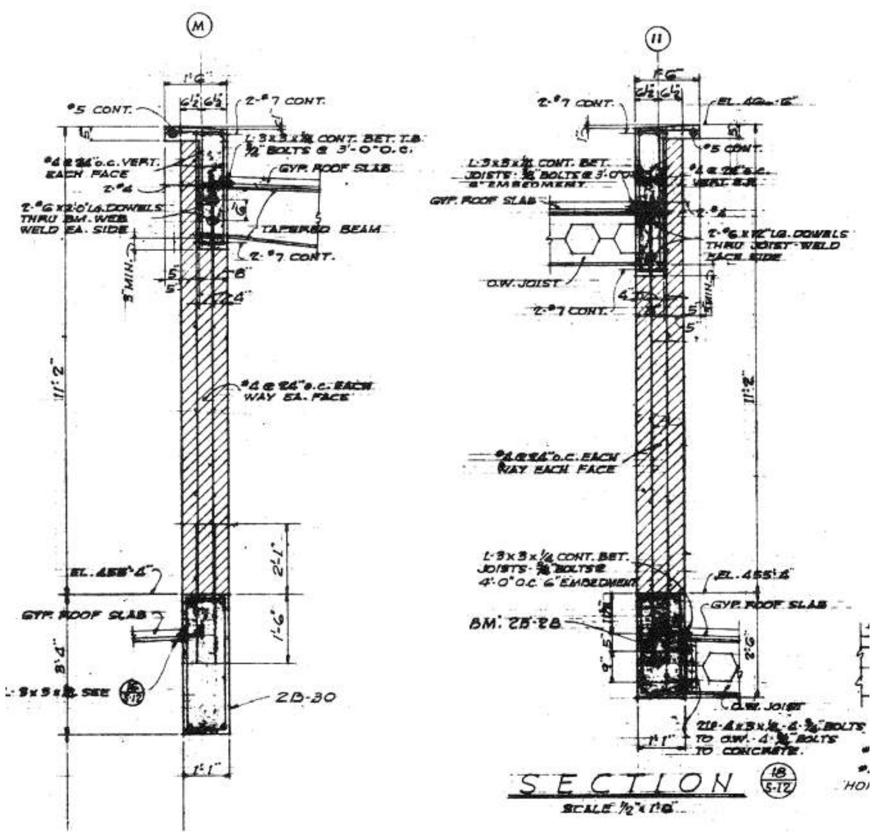
Mechanical Unit #1 (south end of building)

Mechanical Unit #2 (north end of building)

Mechanical Unit #2 supports

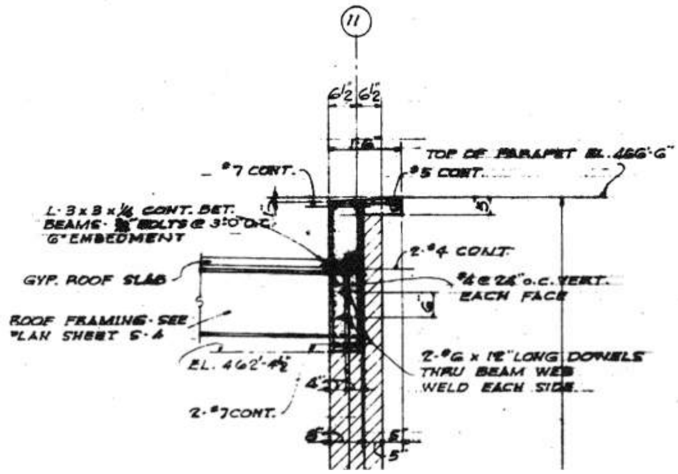
Mechanical Unit #2

6.5. Wall out-of-plane anchorages at the gypsum roof: There has been a significant increase in seismic design forces for masonry and concrete wall anchorages to roofs since the gypsum concrete roof framing system wall attachments were designed for this building. The adequacy of the existing wall anchor system to the gypsum roof diaphragms should be verified.

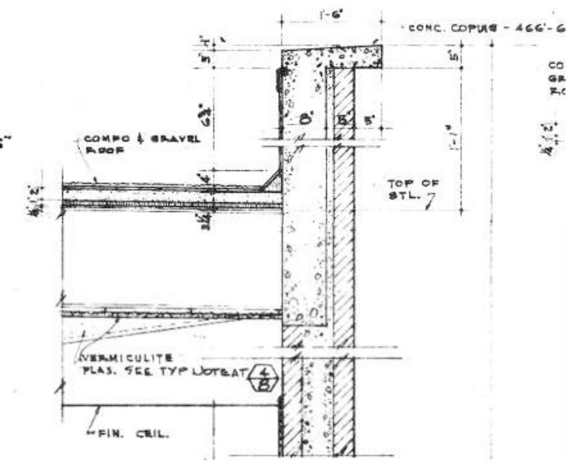


Beam to wall connections with welded rebar dowels

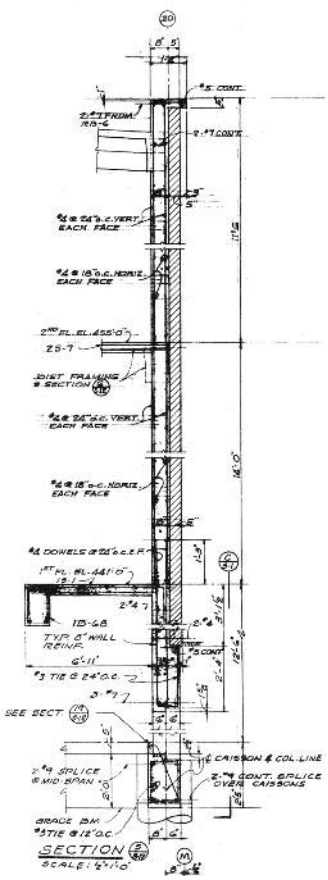
6.6. Brick Veneers: The perimeter walls of the building are a combination of reinforced concrete and reinforced brick masonry. Typically, along the roof level, there is a single wythe brick veneer in front of a concrete beam. There appears to be no positive anchorage between this brick veneer and the concrete beam surface shown on the original construction drawings, as would be required by the current building code.



Steel beam connection at concrete beam with brick veneer



Steel beam connection at concrete beam with brick veneer



Two story concrete wall section with masonry brick veneer (south side of building)

6.7. Library book storage racks – lateral system: The library stacks in the music library is a two-story manufactured light gauge metal framing system. Given the age of this framing system it should be reviewed and evaluated based on current building code seismic design requirements to verify the adequacy of the existing system. This would include anchorages to the building walls and floor.

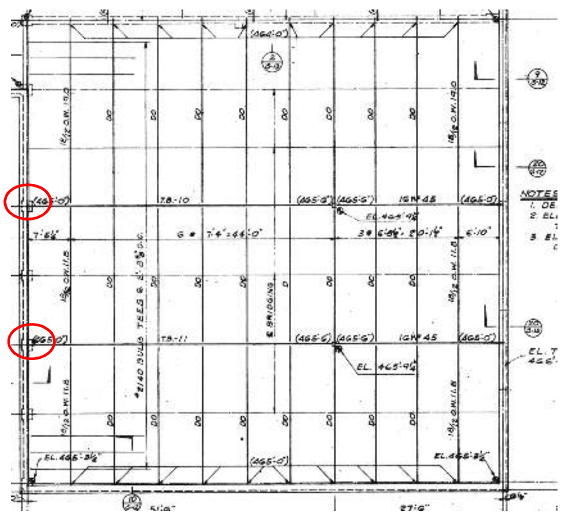
2-story, pre-manufactured book stacks in Music Library

Continuous book case strut to wall at 2nd floor level.

6.8. Long Span Roof Member Connections: The long span steel roof members' connection to concrete columns, concrete walls and brick masonry walls represent a concern. These connections typically occur in the auditorium spaces and music library.

Library Column: Beam Span = 51'-5 ¼"

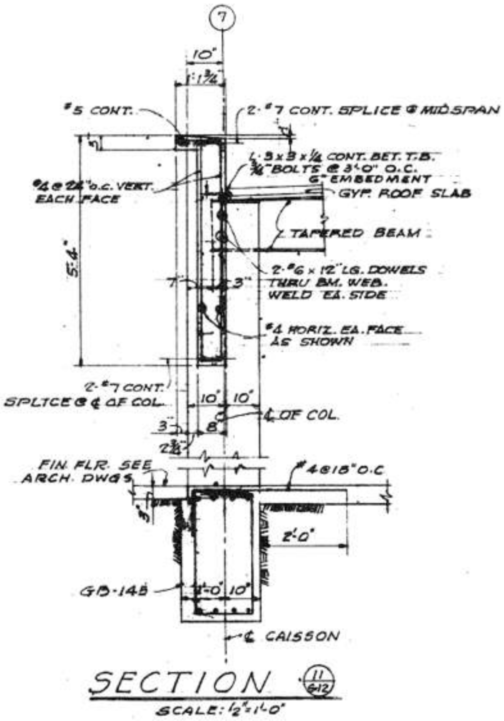
At the north side of the music library, the tapered steel beams frame to the concrete columns as shown below:



Partial Roof Plan at Music Library

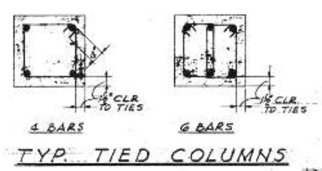
Exterior North Elevation of Library

The concern is that there should be a more adequate connection between the column and the beam, particularly given the weak capacity of the existing roof diaphragm. Section 11/S12 and the column cross section, shown below, shows how little anchorage there is between the beam and column and how lightly reinforced the column is. There is likely little column rebar at the roof level above the bottom of the steel beam along the sides of the steel beam. There is a similar condition at the main auditorium (shown below), the small auditorium, as well as the three teaching auditoriums. They all have similar girder spans. In some seismic retrofits, a new secondary column is placed under the beam, in front of the wall, to support the beam should the beam pull away from the existing wall anchorage.



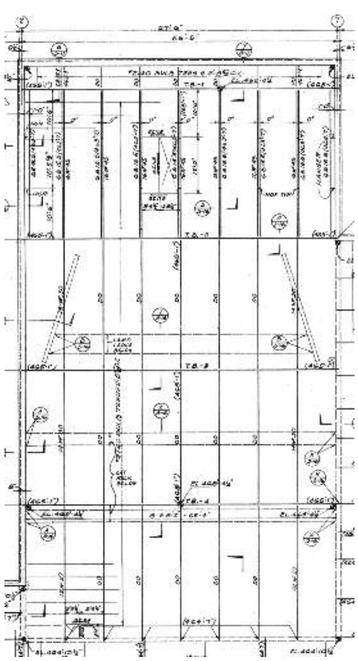
Steel beam with minimal anchorage to the concrete beam, rebar dowels are at face of concrete beam

Column Location: C-7, E-7
Column size: 20"x 20"
Column Reinforcing: 4-#7, #3 ties at 14" o.c.

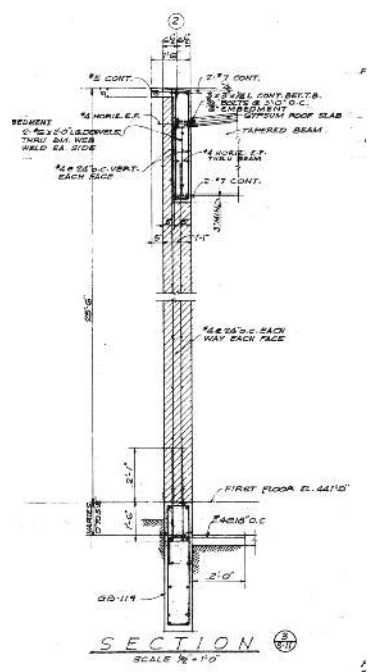


Columns with minimal confinement ties

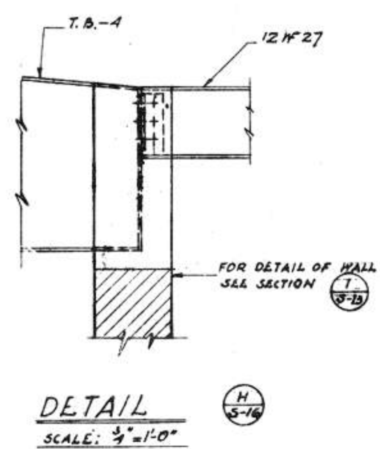
Main Auditorium Wall Connection: Beam span = 67'-6"



Partial Roof framing Plan



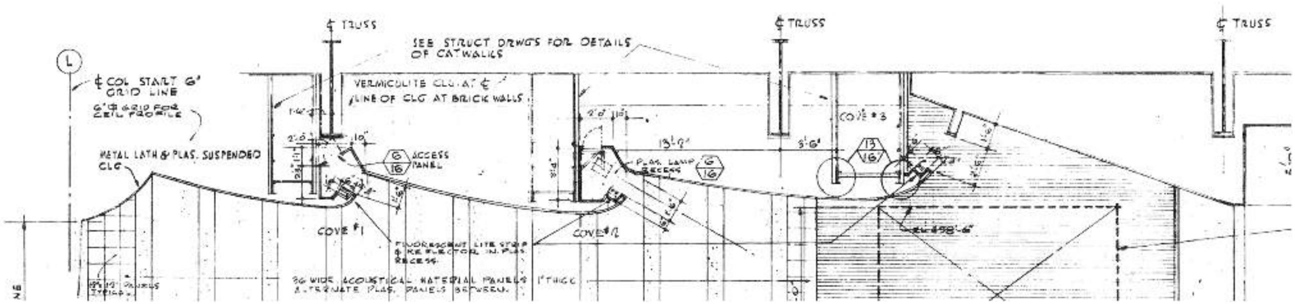
Beam connection at Grid 2 at Wall



Beam Connection at Grid 7 at Wall

7. OTHER CONSIDERATIONS:

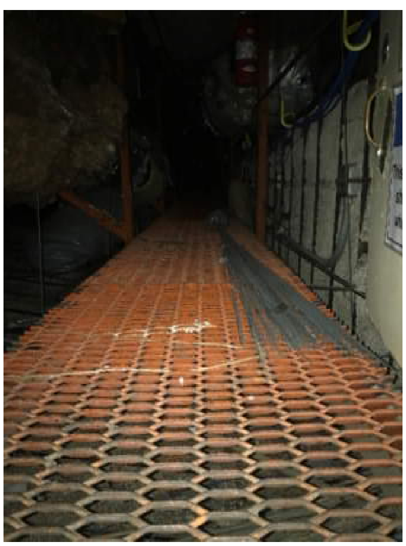
7.1. Catwalks – Ceiling / Lighting attachments in the Main Theater:



Architectural section through main auditorium showing ceiling and catwalk profile.

It is unclear as to the anchorage of the existing ceiling to the steel beam member above. Given the age of the building, its highly likely additional bracing supports are required for the ceiling (compression posts and diagonal splay wires). The structure of the lighting supports off of the catwalks was not reviewed. We were not able to view this area, so additional investigation is required.

The lighting support framing suspended from the roof over the stage in the main auditorium area should be reviewed for adequate seismic bracing. We understand that new stage lighting was provided in the last several years, so the current support framing bracing may be adequate.



Catwalk framing above man auditorium
(catwalk shown in ceiling section above)

7.2. Ceiling framing: Partition Stud walls only braced by ceiling as can be seen on the left side in the photograph below. The ceiling visible in the picture is a hard-lid gypsum board ceiling. The studs extending above the ceiling should have bracing extending up to the roof framing.

7.3. Seismic Corrections 1999: In 1999, a seismic correction/renovation was implemented in Schoenberg Hall. How the correction impacted the seismic force resisting system is not clear from the information reviewed. The adequacy of this retrofit would be part of a Tier 2 analysis. This seismic retrofit incorporated the following:

a. Steel moment frame using a Reduced Beam Section (RBS) for the beam to column connection. This extends from the 2nd floor to the roof. There are steel framing members that act as drag collectors to concrete walls

b. Strengthening of the rear wall of the main auditorium with steel strong-backs

c. Strengthening of the east wall of the library with two additional steel column strong-backs

d. Some corridor ceiling bracing.

e. New concrete shear wall in main auditorium, north side of the stage.

8. SEISMIC RETROFIT CONCEPT SKETCHES/DESCRIPTIONS (only required for buildings rated SPL V or worse):

Description:

The VI rating for the building is not necessarily due to the utilizations in the lateral system members (e.g., masonry shear walls), as the seismic demands on these members are not that high and the capacity of the shear walls are sufficient based on the Tier 1 evaluation loading criteria. The concerns leading to a VI rating is the adequacy of the connections between the various members of the lateral force resisting system to transfer these lateral forces between individual members, such as the shear transfer from roof diaphragm to the wall. Also the adequacy of the connections to keep the individual lateral framing members and gravity framing members from separating during an earthquake.

The Tier 1 deflection quick checks show that the existing 3 inch seismic separations between buildings is <u>not</u> adequate, but a more detailed analysis could rule out this potential deficiency. Additionally, a more detailed analysis could show that the beam to wall anchorages may be adequate at the gypsum roof to be a Seismic Performance Level V or better. However, if a more detailed analysis shows the beams anchorages to be inadequate a retrofit of the wall anchorages may require adding columns or other support members under some of the longer span beams in the auditoriums and other areas of the building.

9. LIMITATIONS

Thornton Tomasetti's professional services have been performed in accordance with the standards of skill and care generally exercised by other professional consultants acting under similar circumstances and conditions at the time the services were performed. Thornton Tomasetti's findings, conclusions and opinions are based on Thornton Tomasetti's visual observations, professional experience and evaluation of documentation provided. This report shall not be construed to warrant or guarantee the building and/or any of its components under any circumstances. No other warranty, expressed or implied, is made as to the professional advice presented in this report.

10. APPENDICES

A. ATC Hazards by Location Data
   a. Geotechnical Information
   b. CGS maps
B. ASCE 41-17 Tier 1 Checklists (Structural Only)
   a. Building Basic Configuration
   b. Structural Checklist for Building Type RM1-RM2
   c. Structural Checklist for Building Type C2
C. Quick Check Calculations