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STRUCTURAL EVALUATION
FOR

SEATTLE CENTRAL COLLEGE
BROADWAY PERFORMANCE HALL
SEATTLE, WASHINGTON

PREPARED BY
PCS STRUCTURAL *SOLUTIONS*

NOVEMBER 1, 2017
17-733

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I. PREFACE

The structural evaluation of Broadway Performance Hall, located on the Seattle Central Campus, was conducted for two purposes:

- The building is currently on the City of Seattle's *List of Unreinforced Masonry (URMs) Identified by Seattle DCI – April 2016*. Regulations are being developed that may require owners of unreinforced masonry bearing wall buildings to seismically upgrade the facilities. Buildings were placed on the list after the City performed a "sidewalk" review, identifying structures that appeared to be constructed with URM walls. While the Broadway Performance Hall was originally constructed with URM walls, significant modernizations occurred in the 1970s that adjusted the vertical support system. Existing documentation was reviewed to determine if it was feasible to request the status of the facility (current listed as "No Visible Retrofit Level") be adjusted in the City's database.
- Seattle Central Community College is considering major modifications to the interior of the building, including adding an additional floor level. While seismic renovations occurred in the 1970s, the proposed level of modification will trigger another seismic and vertical support system upgrade. Included in this report are preliminary findings to what types of modifications may be required.

Documentation for the 1970's renovation was available for review. Assumptions were made where building information was limited.

II. EXECUTIVE SUMMARY

The Seattle Central College Broadway Performing Arts building is a four story facility. The top floor is an auditorium space, with catwalks, fly lofts, and other rigging systems. An attic above the auditorium supports mechanical equipment.

The building was originally constructed in 1911, and was part of Seattle first high school, Broadway High. It remained a high school until 1946, at which time it became part of the Edison Technical School. In 1966, it was acquired by Seattle Community College. Major modifications and renovations occurred in the 1970s. The modifications included reframing of floor areas, as well as other vertical and seismic upgrades.

The facility is built into the hillside. On the east face, the primary entrance is at the third floor level, while on the west face the entrance is at the second floor level. The first level is a partial basement.

Building codes and construction methods have changed over the years, incorporating lessons learned from past experience in relation to vertical and lateral (wind and seismic) design. The 1970s renovations addressed the most significant issues with the original construction:

- Unreinforced masonry walls were backed up with concrete shear and bearing walls. The new concrete walls provide vertical and lateral support for the floor and roof system.
- The roof and floors were anchored to the new concrete walls to resist out-of-plane seismic forces.
- The unreinforced masonry walls were anchored to the concrete walls, and now it effectively acts as an anchored veneer.

Summary

While it appears the previous upgrades significantly improved the anticipated performance of the facility, seismic design has continued to evolve since the 1970s. Detailing requirements are more stringent, and code-prescribed lateral loads in the Seattle area are significantly higher. Accordingly, while the intent of the previously performed upgrades is still pertinent, the capacity of those upgrades may not fully meet current code requirements. It is recommended that a report be developed that outlines the previous upgrades, with the intent that the report would be shared when meeting with the City to determine if the building will be affected by the proposed URM upgrade ordinance.

It is apparent that if additional modifications to the facility are made, such as adding another floor level, an updated analysis and upgrade will be required. This upgrade will include work to the floors and foundations, as well as the installation of new shear walls to supplement the walls previously installed.

III. INTRODUCTION

A) SCOPE OF WORK

a) Field Investigation

- Walked through the complex, looking for signs of structural distress, differential settlement or deterioration.
- Viewed structure wherever visible.
- Testing or selective demolition was not completed at this time.

b) Initial Review of Construction Drawings

- Reviewed available construction drawings.
- Where no drawings were available, or the drawings did not adequately describe as-built conditions, recommendations were based on field investigation and observations.

c) Report Preparation and Further Construction Drawing Review

- Further evaluated drawings with respect to structural concerns identified in the initial review or field investigation.
- Brainstormed conceptual ideas to mitigate structural concerns identified.
- Structural Report
  - Described vertical and lateral load resisting system for each building.
  - Summarized visual observations of building condition, signs of structural distress, and differential settlement.
  - Identified structural concerns and provided a summary of the structural recommendations.
  - Identified areas where additional analysis is warranted to verify assumptions made beyond the scope of this evaluation.

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IV. STRUCTURAL EVALUATION

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The Broadway Performance Hall was evaluated by conducting a site-visit/walk-through of the facility and reviewing existing drawings from the 1970s renovations. The methodology of the ASCE 41-13 "Seismic Evaluation and Retrofit of Existing Buildings" was used as a guideline; however, checklists were not completed. Detailed lateral/vertical analyses were not completed. The review of non-structural such as ceilings, partitions, lights, mechanical piping and equipment were also beyond the scope of this evaluation.

A. TYPE OF CONSTRUCTION/STRUCTURAL SYSTEM

The Broadway Performance Hall was constructed around 1911, and initially served as a performance hall for Broadway High School. It was purchased by Seattle Central College in 1966, and underwent significant modernizations and seismic upgrades in the 1970s. It is a four story building, built into a hillside. The lowest level is a basement, the second level is entered from the west street level, and the third level is entered from east plaza level. The fourth level is elevated and currently houses the auditorium. There is also an accessible attic that contains mechanical equipment.

SYSTEM DESCRIPTIONS

Vertical Load Resisting System:

The floor systems are framed with steel beams supporting composite metal deck (typical for the 1970s construction), or steel trusses supporting wood framing with a reinforced concrete topping (typical for the 1911 construction). The attic floor framing is wood, while the roof system is framed with heavy timber trusses supporting wood beams/joists and a roof deck. The vertical gravity framing consists of concrete walls, concrete piers, and steel columns. The unreinforced masonry walls that once supported the floor and roof framing are anchored to the concrete walls and no longer provide primary vertical or lateral support.

The foundations appear to be concrete, bearing directly on grade.

Lateral Force Resisting System:

The wood roof system acts as a flexible diaphragm that transfers seismic/wind forces to the perimeter concrete walls. The concrete floor system acts as a rigid diaphragm that transfers lateral forces to interior and exterior concrete shear walls. The concrete walls surround the perimeter of the buildings, as well as near the elevator shaft. The interior concrete walls do not extend to the attic/roof.

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B. OBSERVATIONS AND COMMENTS

- The building appears to have been well maintained. We observed no signs of significant structural distress, structural deterioration or differential settlement.
- The majority of the interior concrete walls and piers are covered by finishes. However were exposed to view, the concrete appears to be in good condition.

C. RECOMMENDATIONS

The structural concerns and recommendation differ significantly between the options of 1) continuing to use the facility in its current configuration, or 2) modifying and/or adding interior floors for different programmatic use.

I. Current Configuration

The seismic and vertical upgrades performed in the 1970s significantly improved the overall performance of the building. The unreinforced masonry walls, originally used to support the floors and roof, were also the lateral force resisting system. Concrete walls and piers were installed to support vertical and lateral loads (See Appendix A, Sheet 1). The masonry walls were also anchored to the concrete walls (See Appendix A, Sheet 3).

While the intent of the code is met with the upgrades performed in the 1970s, code prescribed forces have increased significantly since then, and anchorage/detailing requirements are more stringent. Preliminary calculations indicates that some of the concrete walls/piers, as well as floor/wall interface, are slightly overstressed under full seismic forces. Current reinforcing details requirements, specifically in the piers, is also not met.

If this facility had been originally built as a concrete building with brick veneer, and the occupant load/use was not changing, a seismic upgrade would not be required. However, if the proposed City of Seattle Unreinforced Masonry Policy proceeds, it will be mandated that all URM bearing wall buildings are seismically upgraded. The parameters on how to address the rather unique situation where a very significant modernization has already been performed that essentially removed the URM bearing wall, yet doesn't meet current code requirements, has not been developed yet. It is recommended a report be developed that describes the current condition of the facility and includes the key plans and details from the 1970s upgrade. A meeting should then be arranged with the City to develop an approved approach.

II. Interior Floor Additions/Modifications

Interior modifications, in particular adding a steel framed/concrete deck floor level above the current auditorium area, will trigger a vertical and seismic upgrade by the City of Seattle. This will require many new framing elements and/or modifications to existing elements. The following issues are the primary deficiencies noted in this study:

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Items	Structural Concern	Structural Recommendation
1	The stress in the existing concrete walls will exceed allowable limits.	Provide new concrete walls and foundations at the interior of the building to keep the stresses transferred to the existing walls/piers at allowable levels. See Appendix A, Sheet 2.
2	Out of plane anchorage (connection of the wall to the floors) may not be sufficient in some areas.	Improve the connections by installing anchor bolts and steel braces at the perimeter of the floors.
3	Existing foundations may not have the capacity to support additional vertical loads.	Remove/replace existing foundations, or increase the size of existing footings. This will require shoring in some areas.
4	Existing columns may not have the capacity to support the floor addition.	Strengthen existing columns by welding on additional steel.

D. CONCLUSION

Overall, the 1970s upgrades appears to be well designed and detailed for the era in which it was constructed. While the building does not meet the strength and detailing requirements of a facility designed to current code standards, it would likely perform relatively well in a seismic event. Since the building was once an Unreinforced Masonry Bearing Wall system, it is on the City of Seattle's *List of Unreinforced Masonry (URMs) Identified by Seattle DCI – April 2016*. As such, if the ordinance is passed, it will be necessary to develop an upgrade strategy and meet with the City. Due to the extent of the 1970s upgrade, it is feasible that the City will not require additional work; however, this cannot be considered a definitive course of action until after a meeting with the City occurs.

If a major adjustment to the layout occurs, such as the addition of another floor in the auditorium space, a full seismic upgrade will be necessary. Components installed in the 1970s can still be utilized; however, new shear walls and foundations will also be necessary. Additionally, columns and footings supporting the new gravity loads may need to be upgraded.

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APPENDIX A

REVISION

DATE 11-1-17
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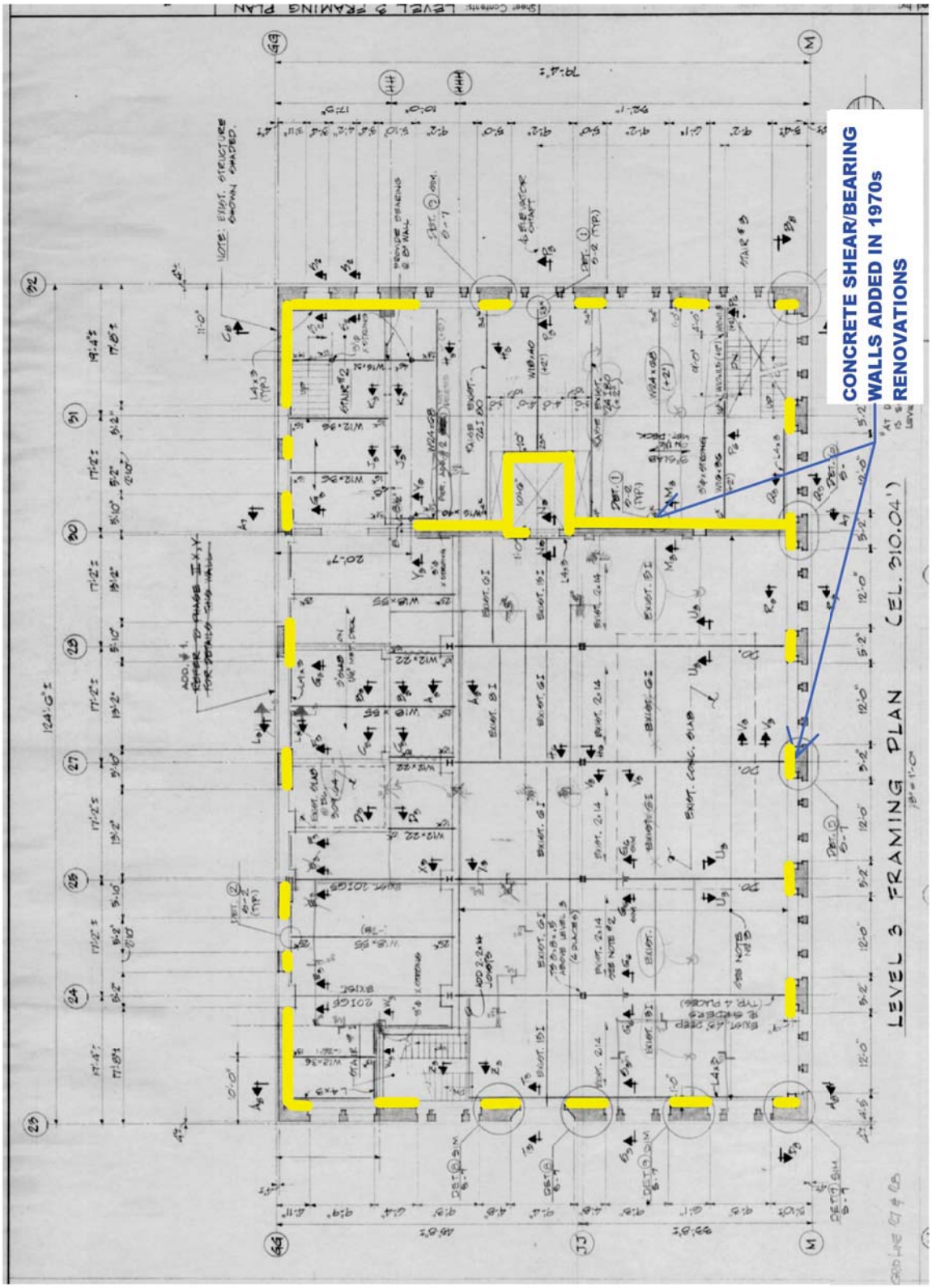
TITLE

SHEET S1



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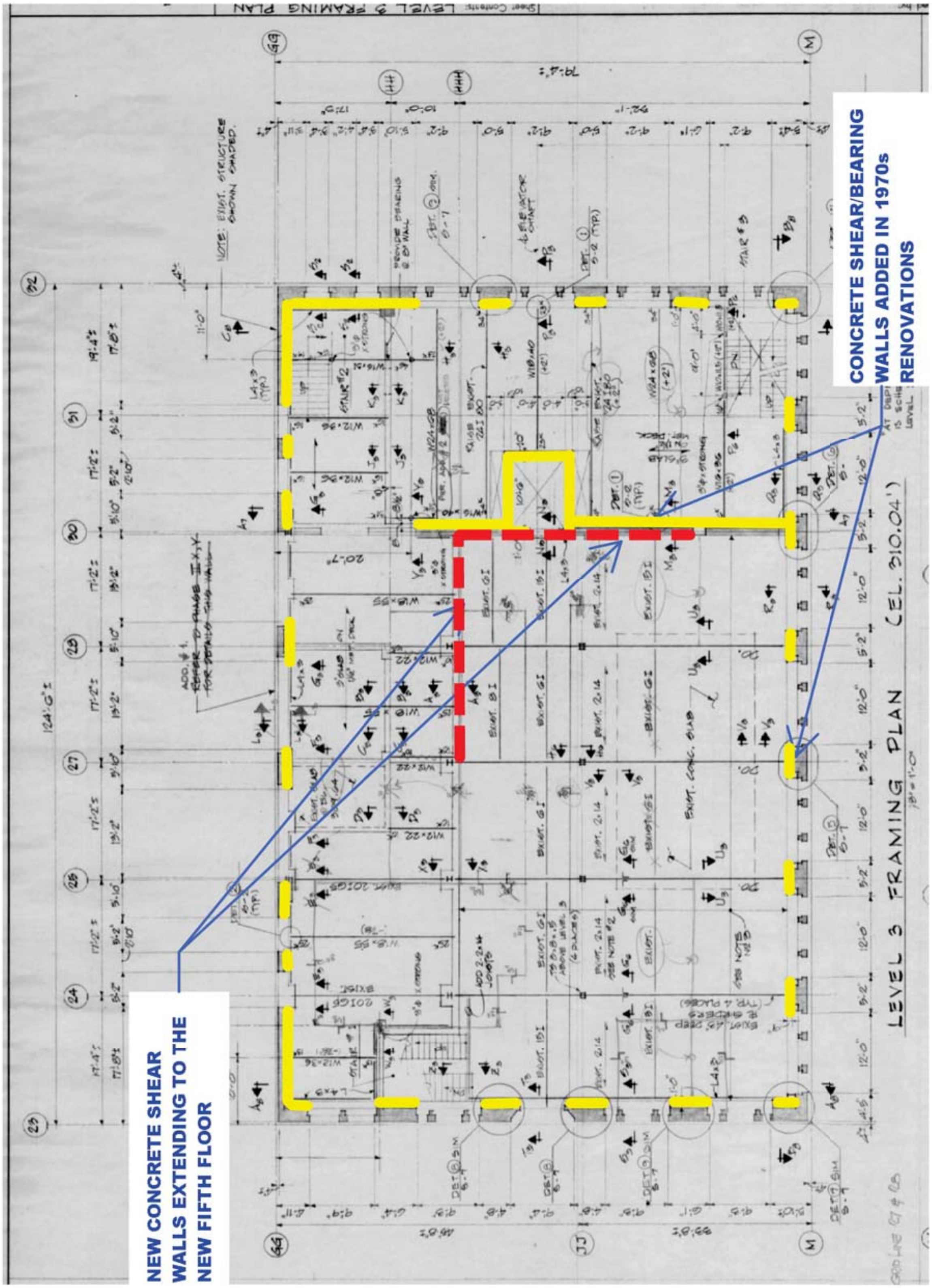
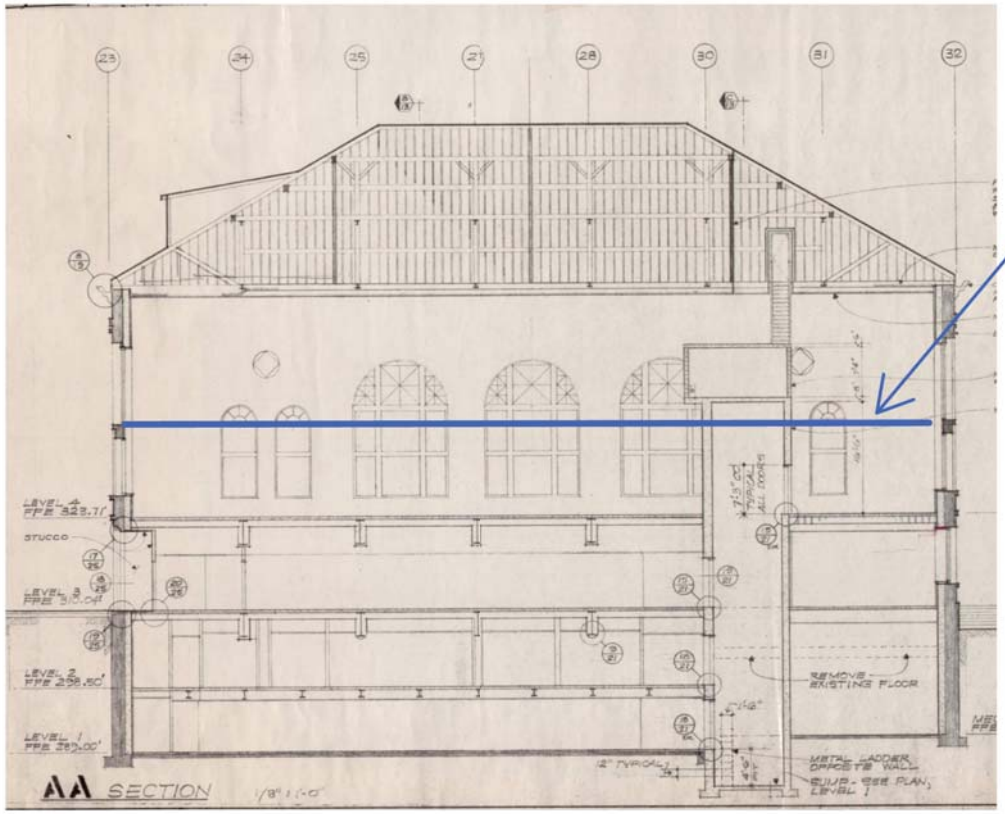
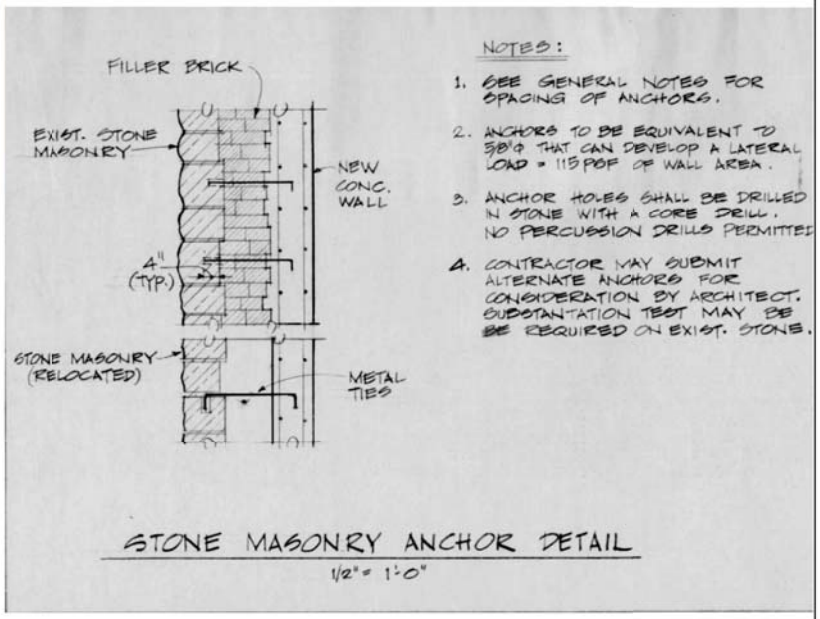
APPENDIX A







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