SEISMIC EVALUATION
Of

UCLA Clark Library Gatehouse

University of California
Los Angeles, CA

Prepared for:

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0.0 EXECUTIVE SUMMARY

The objective of this report is to present the results of the seismic evaluation of the UCLA Clark Library Gatehouse Building located at 2520 Cimarron Street in Los Angeles, California.

The building consists of a central 2-story space housing a single residential unit above a garage and two single story side wings. The first floor is 2,640 sf and the second floor is 850 sf. There is also a 960 square foot basement area. The building was constructed in the early 1900's. There is no record of the existing blueprints for the building.

The gravity system consists of wood framed roof rafters and ceiling joists, supported by the exterior perimeter un-reinforced hollow clay tile (HCT) bearing walls. Wood framed floor joists are also supported by the exterior bearing walls. The walls are supported on a continuous concrete shallow foundation.

The lateral system consists of the horizontal 1x wood sheathing acting as a structural diaphragm to deliver seismic forces to the vertical resisting elements. The exterior perimeter unreinforced hollow clay tile walls provide some level of seismic resistance to the building.

The property was visited by NYA staff to observe the general condition of the visible portions of the property. The majority of the structural system was covered and was not visually observable. In general, the building appeared to be in fair condition; there were no signs of significant structural cracking. The quality of construction appears to be good.

A detailed evaluation of the building was performed, including an ASCE 31 tier 1 and tier 2 evaluations. Based on our evaluation the following deficiencies were identified:

- Inadequate strength of roof diaphragms;
- Inadequate out-of-plane strength of the exterior walls;
- Inadequate in-plane shear strength of the exterior walls;
- No visible out-of-plane and in-plane shear connections between the horizontal floor and roof diaphragms to the existing walls;
- No visible connections between the façade brick and the load bearing walls;
- Discontinuous walls due to the large garage door openings;
- No visible connection between the tower and the main building; and
- Inadequate strength of the parapet walls to resist seismic out-of-plane forces.

The building has been assigned a UCLA Seismic Performance Level VI, based on these deficiencies.

A conceptual strengthening scheme was developed, based on our limited understanding of the building's construction, to mitigate the identified deficiencies and improve the building performance to both Performance Levels IV and III. The conceptual scheme is based on visible structural elements at time of visit, prior engineering reports and the results from limited testing and investigation performed by an independent testing laboratory.

In order to improve the seismic performance rating of the building we recommend the following:

UCLA Seismic Performance Level IV

- Provide new pony walls above the existing interior wood walls to act as “cross walls” for the building
- Provide new interior light gauge framed bearing walls at all exterior walls anchor to existing HCT walls with concrete screws at 2′-0″ o.c.
- Provide new plywood or “sure-board” sheathing at all exterior walls.
- Provide out-of-plane wall anchors between the existing wood roof and new light gauge framed
- Provide in-plane shear connection between the existing wood roof and the new light gauge framed walls.
- Provide a steel beam and columns to support the lintels over the garage door openings.
- Provide drag strap connections between the tower floor and roof diaphragm and the main building.
- Provide retrofit anchors between the façade brick to the new light gauge framed walls and repoint deteriorated brick mortar directly above exit ways.
- Provide steel backing framing at unbraced parapet walls above all exit ways.

UCLA Seismic Performance Level III

- Strengthening required for Level IV performance rating
- Provide retrofit anchors between the façade brick to the new light gauge framed walls and repoint deteriorated brick mortar throughout building.
- Provide steel backing framing at all unbraced parapet walls.

Figure 0.1 depicts the extent of recommended strengthening. Section details of the proposed strengthening scheme are included in Appendix C.

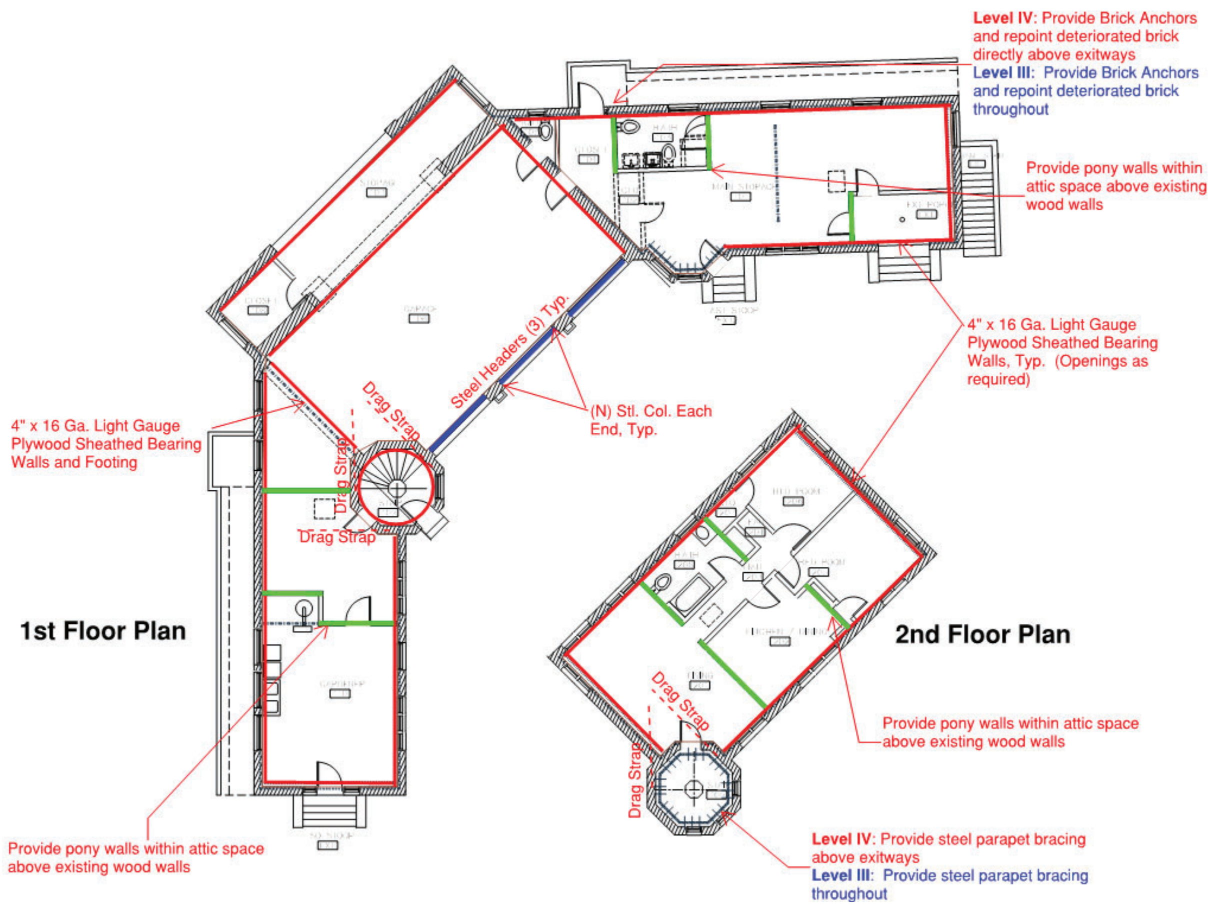


Figure 0.1: Plan - Proposed Strengthening Scheme

1.0 INTRODUCTION

1.1 General

The objective of this report is to present the results of the seismic evaluation of the Clark Library Gatehouse building located on 2520 Cimarron Street in Los Angeles, California. Figure 1.1 shows a vicinity map of the site.

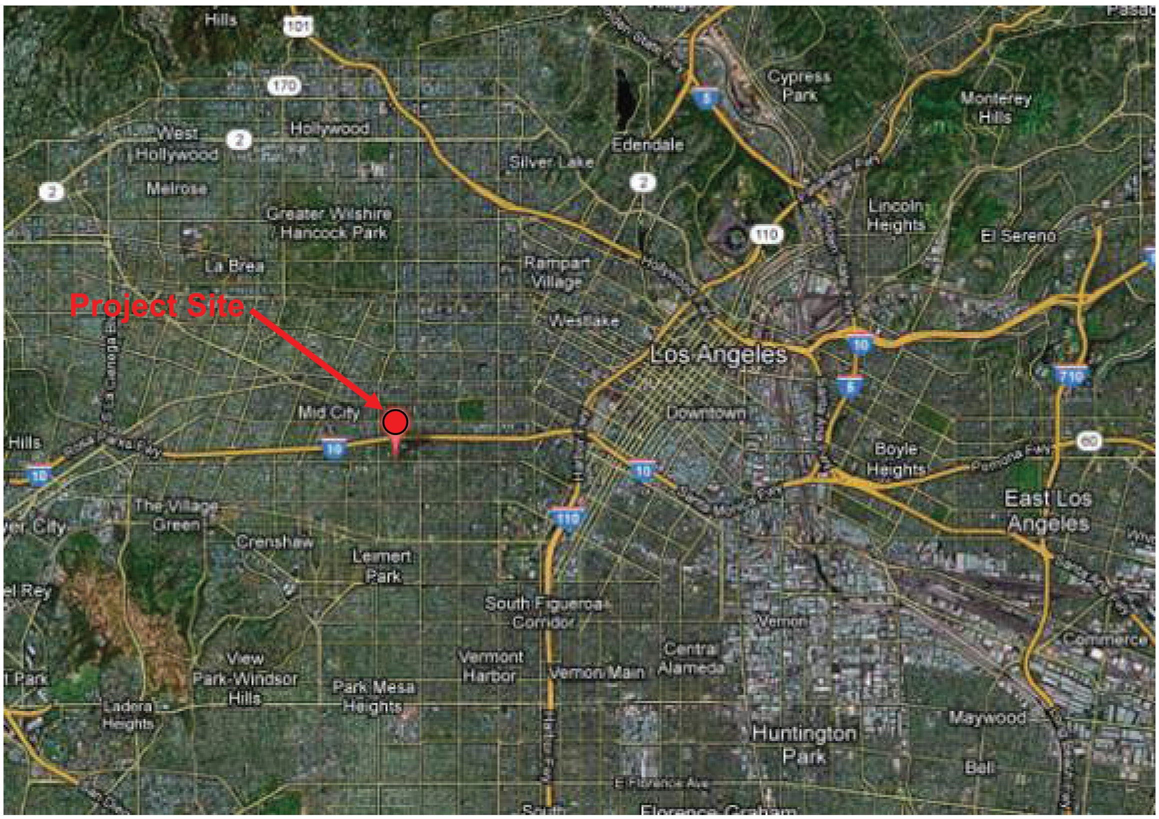


Figure 1.1 - Vicinity map

The property was visited by *Nabih Youssef and Associates* (NYA) staff to observe the general condition of the visible structural portions of the property. A general review of the structural elements was performed during the site visit to develop an understanding of the building construction.

The expected seismic performance of the building was determined by a site review of the building, review of architectural drawings, review of prior evaluations performed for this building and a Tier 1 Seismic Evaluation as recommended by ASCE 31-02 *Seismic Evaluation of Existing Buildings*.

A conceptual strengthening scheme was developed to mitigate the structural deficiencies identified by the analysis. The scope of the recommended strengthening is provided.

This evaluation of the structural system represents the opinion of *Nabih Youssef & Associates (NYA)* based on the available information. This review is not intended to preempt the responsibility of the original design consultants.

1.2 Scope of Work

The following tasks outline the scope of work for the structural evaluation of the complex:

1. Preform a site visit to observe the general condition of the 1900's Unreinforced Masonry structure.
2. Review existing structural reports and documents provided by the owner.
3. Identify seismic force resisting elements and the seismic load path for the building.
4. Develop a physical investigation and testing program for 3rd party testing company to determine structural properties of the existing building.
   i. Coordinate the physical testing program with the owner & testing agency.
   ii. Review and interpret testing report, incorporating results into the structural analysis model.
5. Perform structural analysis of the building and review expected seismic performance.
   i. Perform a Tier 1 analysis according to ASCE-31, "Seismic Evaluation of Existing Buildings."
   ii. For items not compliant according to the Tier 1 analysis, preform a Tier 2 analysis for a more detailed evaluation.
6. Develop professional opinion of the adequacy of the structure to resist seismic forces.
7. Provide preliminary strengthening recommendations based on the analysis.
   i. Strengthening recommendations will focus on methods of improving the performance with minimal intervention to be both economical and to preserve the historically important features of the structure.
   ii. Investigate options of either a single upgrade or a phased upgrade.
      1. A single upgrade from seismic rating level VI (" very poor") to III ("good").
      2. A phased upgrade first from VI ("very poor") to IV ("fair"), and later from IV to III ("good").
8. Prepare a written report summarizing the result of the site visit, structural evaluation, and upgrade study.

1.3 Evaluation References

The following documents and available information were examined in the evaluation:

- Set of architectural drawings prepared by *Kaplan Chen Kaplan Architects & Planners*, dated January 25, 2011.
- UCLA Clark Library Gatehouse Conservation & Assessment Report dated February 27, 2011 and prepared by Kaplan Chen Kaplan Architects & Planners.

- Sections 7, 8, and Appendix C of the Seismic Evaluation Report prepared by Melvyn Green & Associates, Inc., date of report unknown.
- *Soil Engineering Investigation for the Proposed Addition to Clark Memorial Library* prepared by Kovacs-Byer and Associates, Inc. and dated July 8, 1988.
- Preliminary Investigation and Test Report of the Clark Gatehouse as prepared by Accu-test Structural Laboratories, Inc. and dated August 3, 2012. Refer to Appendix A.
- Final Test Report of the Clark Gatehouse as prepared by Accu-test Structural Laboratories, Inc. and dated August 20, 2012. Refer to Appendix A.

2.0 BUILDING DESCRIPTION

2.1 General

The Clark Library Gatehouse is located at 2520 Cimarron Street in Los Angeles, California. The building consists of a central 2-story space housing a single residential unit above a garage and two single story side wings. Figure 2.1 shows an aerial view of the property. The building was most likely constructed in the early 1900's.

Figure 2.1 – Aerial view of site

The central space is rectangular in plan with overall plan dimensions of 32′ by 42′. The side wings are also rectangular shaped in-plan with approximate overall plan dimensions of 55′x18′ each. The floor-to-floor height of the first floor garage 10′8″. The floor to floor height of the two wings is 8′-6″ and the second floor residential unit is 8′-0″. An octagonal shaped stair tower is located at the southwest corner of the central portion of the building. A small basement is located on the north wing of the structure.

2.2 Gravity System

The gravity framing system typically consists of the following:

Roof:

- The roof sheathing is constructed of straight wood planks. The wood sheathings spans to conventional wood rafters.
- Wood rafters are 2x framing spaced at 12 or 16 inches on center.
- Ceiling joists consists of 2x framing spaced at 12 or 16 inches on center.
- The wood rafters and ceiling joists span to and are supported by the exterior Hollow Clay Tile (HCT) bearing walls.

2nd Floor:

- The floor sheathing is constructed of diagonal wood planks. The wood sheathing spans to conventional wood joist framing.
- The floor joists span to the exterior HCT bearing walls or steel beams at the larger openings.
- The steel beams are supported by the HCT pilasters. Two steel columns were observed on the north side of the Central Building.

Foundations/Basement:

- The foundation system was investigated along the north side of the building and determined to be a continuous shallow spread footing below the perimeter walls. Refer to Appendix A for more detailed information of the footing.
- The basement level is constructed of cast-in-place concrete. The extent of wall reinforcing is unknown. The foundation system of the basement was not investigated, but is assumed to be similar to the ground floor footing construction.

2.3 Lateral System

The seismic system of the building typically consists of the following:

- The horizontal wood roof planks and diagonal wood floor planks act as a structural diaphragm to transfer the seismic inertial forces to the vertical resisting system.
- The exterior HCT walls provide some level of vertical seismic resistance to the existing structure.

3.0 FIELD OBSERVATIONS

3.1 General

A site visit was made on March 28, 2012 and again on June 12, 2012 to assess the field conditions of the subject building by representatives of Nabih Youssef & Associates. The majority of the structural system was covered and was not visually observable. Observation was limited to the visible areas of the structure.

3.2 Structural Observations

- In general, the building appeared to be in fair condition; there were no signs of significant structural cracking. The quality of construction appears to be good.

- Deterioration of exposed wood was observed at roof rafter tails, and around window frames. See Photo B.1

- Several locations of repointed mortar were visible. See Photo B.2. At some locations the exterior brick mortar was deteriorating. See Photo B.3

- Cracks were visible between the plaster ceiling and the exterior walls. See Photo B.2

- A wall crack at the basement wall was observed. See Photo B.4

- No mechanical connections between the roof framing and the exterior HCT walls were observed. See Photo B.5

- No permanent offset of the building that would indicate structural distress was observed.

- Existing wood walls stop at underside of existing ceiling.

3.3 Nonstructural Observations

- At one location an exterior face brick was removable. The mortar had been intentionally removed. A loose brick anchor tie was observed behind the brick. See Photo B.6

4.0 BUILDING PERFORMANCE IN EARTHQUAKES

A detailed evaluation of the building was performed, including an ASCE 31 tier 1 and tier 2 evaluations. The criteria used to evaluate the performance of the building, the analysis procedures and results are discussed in the following sections.

4.1 Evaluation Criteria

The University of California has developed a seismic performance rating system to assess the vulnerability of its building stock to seismic hazards. The rating system assigns grades Levels to a building based on its expected seismic performance. The expected seismic performance is defined in qualitative terms of structural and nonstructural damage, and threat to life safety. Table 4.1 shows a table summarizing the UC seismic performance rating.

Definitions based upon California Building Code (CBC) requirements for seismic evaluation of buildings using Occupancy Categories of CBC Table 1604A.5, depending on which applies, and performance criteria in CBC Table 3417.5 [2]	Rating Level [1]	
	No Peer Review [5]	Peer Review [5]
A building evaluated as meeting or exceeding the requirements of CBC Chapter 34 for Occupancy Category IV performance criteria with BSE-1 and BSE-2 hazard levels replacing BSE-R and BSE-C as given in Chapter 34.	I	I
A building evaluated as meeting or exceeding the requirements of CBC Chapter 34 for Occupancy Category IV performance criteria.	II	II
A building evaluated as meeting or exceeding the requirements of CBC Chapter 34 for Occupancy Category I-III performance criteria with BSE-1 and BSE-2 hazard levels replacing BSE-R and BSE-C respectively as given in Chapter 34; alternatively, a building meeting CBC requirements for a new building.	III	II[5]
A building evaluated as meeting or exceeding the requirements of CBC Chapter 34 for Occupancy Category I-III performance criteria.	IV	III[5]
A building evaluated as meeting or exceeding the requirements of CBC Chapter 34 for Occupancy Category I-III performance criteria only if the BSE-R and BSE-C values are reduced to 2/3 of those specified for the site.	V	IV[5]
A building evaluated as not meeting the minimum requirements for Level V designation and not requiring a Level VII designation.	VI	VI
A building evaluated as posing an immediate life-safety hazard to its occupants under gravity loads. The building should be evacuated and posted as dangerous until remedial actions are taken to assure the building can support CBC prescribed dead and live loads.	VII	VII

Table 4.1 – UC seismic performance rating system

In order to rate the expected seismic performance of the building, the quantitative terms of the structural and nonstructural damage need to be quantified in specific engineering limit states that can be verified. Two national standards, ASCE 31, *Seismic Evaluation of Existing Buildings* and ASCE 41, *Seismic Rehabilitation of Existing Buildings*, provide guidelines for relating engineering limit states to expected damage/performance.

A III-rating level in the UC seismic rating system requires an ASCE 41 evaluation of the existing building. These procedures typically use earthquake hazard levels (seismic demand) corresponding to a 475-year earthquake (BSE-1) and a 2500-year earthquake (BSE-2) when evaluating life safety and collapse prevention performance, respectively. However the UC rating system allows the reduction of the seismic demand to that of a BSE-R (225-year earthquake) and BSE-C (975-year earthquake) earthquake hazard level provided that a Peer Review is performed. This reduction is also in accordance with the California Historical Building Code.

When assessing the structure using the guidelines of ASCE 31, a reduced (0.75) seismic demand produces the same demand as that of a BSE-R (225-year earthquake). Furthermore, Chapter 5 of ASCE 31 allows the use of reduced (0.75) seismic demand when performing a detailed (Tier 3) evaluation of an existing building. A Tier 3 evaluation must use component based evaluation procedures developed for seismic rehabilitation of existing buildings (ASCE 41).

Thus, the Clark Library Gatehouse building has been evaluated using the procedures and methodology of ASCE 31 using a reduced seismic demand consistent with the requirements of the UC Seismic Policy.

A IV-Rating Level in the UC seismic rating system comports to a seismic demand 2/3 that used for a III Rating Level evaluation.

4.2 Structural Evaluation

The lateral resisting system utilized in this building has proven to be inadequate to resist seismic inertial forces in previous earthquakes. As such the City of Los Angeles implemented Division 88 in the City of Los Angeles Building Code which requires a mandatory seismic upgrade of all such buildings within the City of Los Angeles. Division 88 is now being phased out of the City of Los Angeles Building Code and reference to the International Existing Building Code (IEBC) is being made. Appendix A1 of the IEBC provides guidelines for seismically retrofitting unreinforced masonry bearing wall buildings.

The main deficiency in the lateral resisting system is the lack of ductility or ability of the structure to deform beyond its elastic limit. Once the walls reach their maximum capacity failure of Hollow Clay Tile walls is brittle and immediate. This would lead to a partial or complete collapse of the floors and roof.

The other major deficiency is the lack of visible connection between the floor and roof diaphragms to the exterior walls. Although the walls are not ductile, they do provide some level of lateral stiffness to the structure. However, without a positive connection between the roof/floors to the walls, in a seismic event, the walls can separate from the floors and roof leading to partial or complete collapse of the building.

A linear static lateral analysis was performed for the structure following the criteria of ASCE 31. The seismic mass of the building was estimated based on the site visit and documented weights of the observed materials. The element with the most significant contribution to the seismic mass of the building is the exterior walls. The weight of these walls was estimated as a solid 4" face brick and two four inch HCT bearing blocks and 1 inch of plaster.

The seismic base of the building was assumed to be the ground level.

The wood diaphragms were assumed to be "Flexible" and the seismic mass contribution to the walls was based on the tributary area to each wall.

Based on this evaluation, the following deficiencies exist:

- Diaphragms:

  The roof diaphragms provide the horizontal lateral resistance of the structure and deliver the seismic inertial load to the vertical load carrying elements; in this building the perimeter load bearing walls. Based on the analysis, the horizontal sheathed roof diaphragms have inadequate strength to deliver the seismic forces to the perimeter walls. However, intermediate wood walls, known as "cross walls", can increase the capacity of the diaphragm.

  There does not appear to be a positive connection between the roof and floor diaphragms to the shear walls. Without a positive connection the walls cannot deliver the seismic load to the walls.

  The exterior masonry walls are dependent on the diaphragm for lateral support. Current practice requires providing out of plane anchorage between the walls and the floor and roof diaphragms. Without a positive connection the walls can pull away from the diaphragm leaving the gravity system unsupported leading to collapse of the structure.

  Cross ties between diaphragm chords are required.

- Shearwalls:

  A shear stress check of the HCT unreinforced masonry walls was performed. The in-plane shear stress in the walls exceeds the maximum allowable of 30 psi for both the IV and III Performance Levels.

  The inertial seismic forces apply an out-of-plane load to the walls. Typically walls are reinforced vertically to provide adequate out-of-plane wall strength. Unreinforced walls have very little out-of-plane flexural strength and ductility. ASCE 31 provides acceptable height to thickness (h/t) ratios which do not require walls to be strengthened for out-of-plane loads. Assuming an 8" wall thickness the h/t ratio of the walls varies between 13 and 16. The maximum acceptable limit is 13 for one story and multi-story buildings and 9 for the top floor of a two story building. Therefore some walls will require out-of-plane strengthening.

- Wall Discontinuities:

  Due to the large garage door openings, the second floor walls are not continuous to the foundations. During a seismic event a high concentration of load develops at the ends of wall piers due to overturning or rocking of the walls. Where walls do not continue to the foundation, the supporting beam elements are required to carry the seismic overturning forces of the discontinuous walls. It appears that a steel beam has been added over the large opening on the north side of the structure, but no beams are apparent on the south openings.

- Unreinforced Bearing Walls:

  A major concern of unreinforced load bearing masonry walls is their inability to deform beyond their elastic limit state. In the event of a seismic event larger than the design level earthquake the bearing walls can fail and no longer support the gravity floor and roof framing leading to a collapse of the building.

- Stair Tower:

  At the stair tower there does not appear to be a positive connection between the tower floor and roof and the main house floor and roof. Without a positive connection between the tower and the main building, the tower could separate from the main building during a seismic event. As a separate structure the tower would behave as a tall slender structure with very little, if any, out-of-plane capacity, which can lead to collapse.

- Non-structural Falling Hazards:

  A major cause of damage and injury during earthquakes in buildings is due to exterior falling hazards. The brick façade of this structure is most likely not adequately anchored to the bearing walls and can peel away in a major seismic event.

  Another non-structural element that can cause injuries during a seismic event is the unreinforced parapet walls of the building. Since the masonry walls have little flexural capacity, the parapet walls are unable to resist seismic out-of-plane loads caused by the self-weight of the walls, which can lead to failure.

5.0 CONCLUSION

The analysis identified several structural deficiencies, including:

- Inadequate strength of roof diaphragms;
- Inadequate out-of-plane strength of the exterior walls
- Inadequate in-plane shear strength of the exterior walls;
- No visible out-of-plane and in-plane shear connections between the horizontal floor and roof diaphragms to the existing walls;
- Discontinuous walls due to the large garage door openings;
- No visible connection between the tower and the main building;
- No visible connections between the façade brick and the load bearing walls; and
- Inadequate strength of the parapet walls to resist seismic out-of-plane forces.

Conceptual strengthening schemes were investigated to mitigate the identified deficiencies and improve the building performance incrementally to both a IV and III seismic performance level. A description of the strengthening schemes is provided in the following sections.

Several schemes were evaluated to strengthen the vertical lateral resisting system of the building. Some options include, 1) providing reinforced shot-crete walls at the perimeter of the buildings, 2) an external Fiber Reinforced Polymer (FRP) overlay, and 3) providing a new light gauge framed wall system at the perimeter of the building.

Based on our experience and evaluation strengthening schemes utilizing reinforced shot-crete or an FRP overlay application may prove to be costly.

5.1 Proposed Strengthening Schemes

To strengthen the vertical lateral resisting system, we recommend providing a back-up light gauge steel framed wall system at the interior side of the perimeter walls. The new wall would not only provide the lateral resisting system of the existing building but would also become a back-up gravity support system. The light gauge framing would also behave as a strong back to the exterior HCT walls to resist seismic out-of-plane loads. A new plywood or "Sure-Board" overlay can be applied to the interior face of the stud framing to provide additional shear strength to the structure. The light gauge framing would be attached to the HCT walls through small concrete screw anchors.

In order to mitigate the diaphragm strength deficiency two options were evaluated. One option could be to provide a new plywood overlay to the roof and floor system to increase the shear strength of the diaphragm. The new diaphragm would then be able to span the width of the roof to transfer seismic forces to the exterior walls, without the need for interior cross walls or footings.

Another option to mitigate the diaphragm deficiency would be to extend the existing wood framed walls up to the underside of the existing roof diaphragm. These walls would act as "cross walls" to reduce the demand to the existing wood diaphragm. The latter option would prove to be more cost efficient, however it limits the amount of open space in the floors.

To provide adequate shear transfer between the floor and roof diaphragms and the walls, anchors should be provided between the existing wood framing to the new light gauge framed walls to provide a positive connection.

The roof diaphragm would be attached to the new walls with screws from the roof or floors to the light gauge framing to transfer in-plane shear forces. Tension anchors would be provided between the roof and floor diaphragms to the new light gauge walls.

In order to mitigate the falling hazards deficiencies, the recommended seismic upgrades include providing adequate out-of-plane anchors of the exterior façade brick and the structural walls. This can be achieved by providing brick retrofit anchors from the brick to the structural wall. Repointing of brick mortar at deteriorated locations will also be required.

The stair tower has an unbraced parapet that extends above the roof level. It is recommended that the parapet be strengthened by providing adequate bracing to the top of the wall. A steel ring beam with braces connecting the steel beam to the roof diaphragm would provide adequate bracing for the parapet wall.

The stair tower should be tied back to the main structure by providing tie straps between the tower diaphragms and the main building diaphragm at the roof and second floor. This would reduce the aspect ratio of the tower and prevent it from separating from the main building.

5.2 Evaluation and Testing

In order to validate our assumptions and proposed retrofit scheme, limited investigation and testing was provided by an independent testing laboratory. The inspection report is provided in Appendix A. The investigation provided:

- Discovery of the profile of the existing HCT walls
- Discovery of the existing ground floor footing
- In-situ tension tests of ¼″ diameter x 1-½″ long anchor screws into the HCT walls.

Prior to beginning design of the retrofit project, additional investigation should be provided to accurately address field conditions which are currently concealed. An allowance should be provided in the budget for additional preliminary investigation.

Recommended Additional Investigation

- Document the floor framing as follows:
    - Floor joist size, spacing, and orientation
    - Ceiling joist, size, spacing, if any
    - Beam elements, if any

- Uncover a portion of the ceiling to expose the connection, if any, between the roof framing and the exterior walls.

- Uncover a portion of the ceiling to expose the connection, if any, between the second floor framing and the exterior walls.

- Uncover a portion of the ceiling around the tower at the second floor and roof to verify if there is a connection to the main building.

- At exposed locations, visually inspect for deterioration of structural members.

- Investigate and document the basement wall footing size and depth.

- Determine if any anchors exist between the exterior veneer brick and the HCT walls, if so, document size and spacing.

- Validate the soil bearing capacity below the building based on the as-built configuration of the existing footings

5.3 Recommendation

In order to improve the seismic performance rating of the building we recommend the following:

UCLA Seismic Performance Level IV

- Provide new pony walls above the existing interior wood walls to act as "cross walls" for the building
- Provide new interior light gauge framed bearing walls at all exterior walls anchor to existing HCT walls with concrete screws at 2′-0″ o.c.
- Provide new plywood or "sure-board" sheathing at all exterior walls.
- Provide out-of-plane wall anchors between the existing wood roof and new light gauge framed walls.
- Provide in-plane shear connection between the existing wood roof and the new light gauge framed walls.
- Provide a steel beam and columns to support the lintels over the garage door openings.
- Provide drag straps between the stair tower and the main building.
- Provide retrofit anchors between the façade brick to the new light gauge framed walls and repoint deteriorated brick mortar directly above exit ways.
- Provide steel backing framing at unbraced parapet walls above exit ways.

UCLA Seismic Performance Level III

- Strengthening required for Level IV performance rating.
- Provide retrofit anchors between the façade brick to the new light gauge framed walls and repoint deteriorated brick mortar throughout building.
- Provide steel backing framing at all unbraced parapet walls.

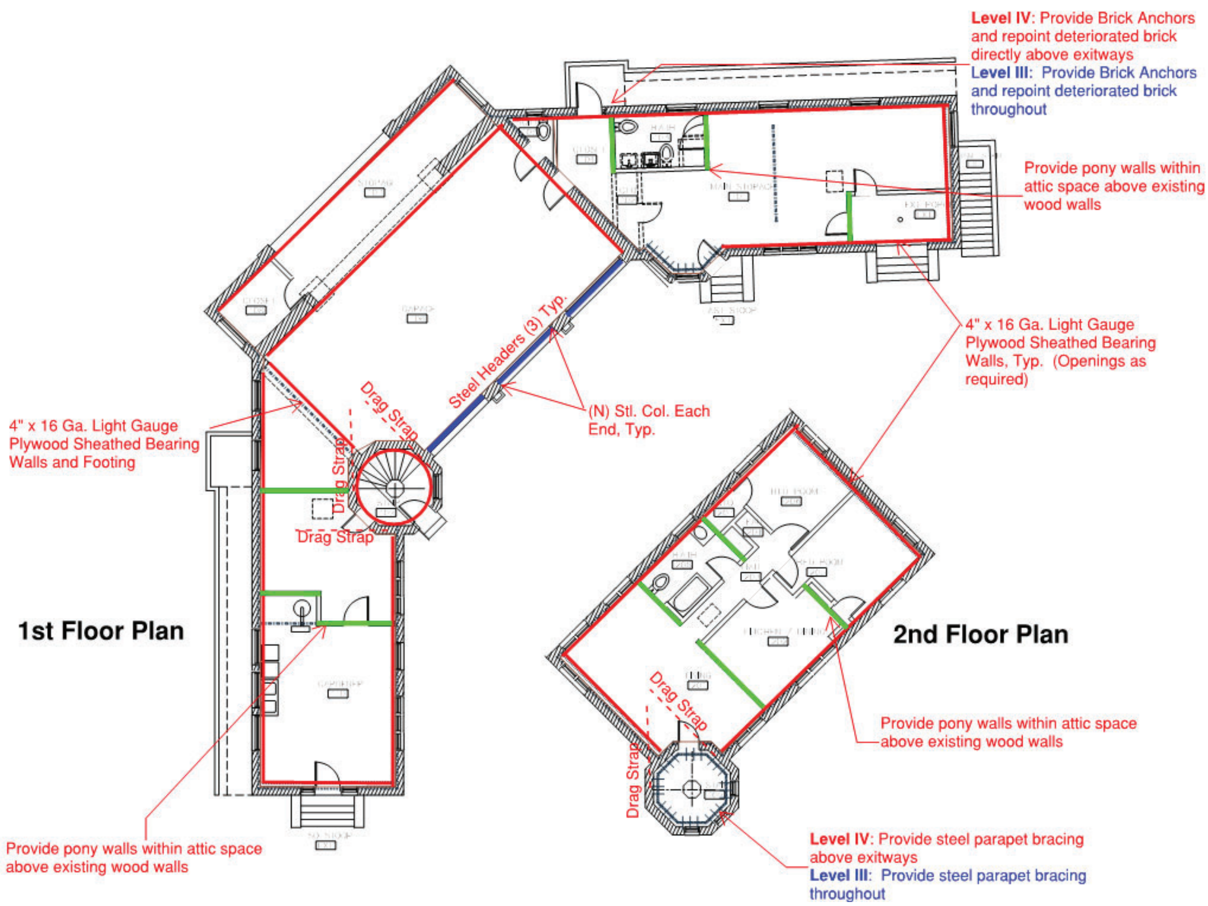


Figure 5.2: Proposed Strengthening Scheme

APPENDIX A – TESTING & INVESTIGATION REPORT (FOR REFERENCE ONLY)

Subject:	Results of Structural Footing Investigations UCLA Clark Library Gatehouse, 2520 Cimarron St., Los Angeles	**Test ID**: Wall Footing **Test Dates**: 7/24 – 8/6/2012	
Report By: Robert M./AA/DP/gu/s		**Checked By:** S. Sethee, Ph.D.	

Test 1.1 Structural Footing Investigations (West Side: Wall)

Member Investigated: Poured-in-place concrete footing supporting the perimeter West wall on the ground level of the existing single-story library wing on the west side.

Location: Investigated the specified footing/foundation of the wall in the specified middle part of the wing. The footing location is marked as "WF-1.1" in the plans included in Appendix "A".

Test Procedure: At the specified test location, the ground cover, adjacent to the wall, was removed from an area measuring approximately 3 feet by 3 feet. The soil underneath was excavated to expose a representative part of the footing and reveal the top surface, as well as the longitudinal edge of the footing. A trench was then excavated along the vertical edge of the footing to fully expose the vertical face.

To establish the width of the footing, an exploratory hole was drilled horizontally into the vertical face operating from the excavated trench.

Since the concrete footings are commonly poured in an excavated soil trench, the outer faces of the footing are generally irregular. Therefore the dimensions given below should be considered as approximate.

Test Results: The results of on-site foundation investigations, including the required footing details, are shown in the following table and figures.

Table 1.1a Results of Wall Footing Dimensional Investigations
(Also See Figures 1.1a and 1.1b)

Test ID	**Side Exposed**	**Footing X-Section**	**Wall Thickness & Composition at Test Location** (inches)	**Top of Footing Below Grade, or Finished Floor** (inches)	**Depth of Footing** (inches)	**Footing Offset** (inches)	**Estimated Footing Width** (inches)
WF1.1	Exterior (West Side)	Rectangular	13"± Masonry Wall	2"±	12"±	4"±	21"±

PRELIMINARY

Subject:	Results of Structural Footing Investigations UCLA Clark Library Gatehouse, 2520 Cimarron St., Los Angeles	**Test ID**: **Test Dates**:	HCT Walls 7/24 – 8/6/2012
Report By:	Robert M./AA/DP/gu/s	**Checked By:**	S. Sethee, Ph.D.

Test 2.1 Structural Masonry Walls Investigations (WC1.1)

Member Investigated: Interior wall just southeast of the rear northwest wall of the central two-story portion of the building.

Location: Investigated the specified part of the masonry wall from the interior on the left side of the opening. The test location is marked as "WC-1.1" in the plans included in Appendix "A".

Test Procedure: At the specified test location, removed the wall coverings over a considerable area, drilled exploratory holes and examined the composition of the wall. A flexible Boroscope was also inserted through the drilled holes to examine the orientation of the cells and inspect the interior composition of the blocks.

Test Results: The wall appears to be built with URM solid clay bricks in the interior up to a height of approximately 4 feet.

The upper part of the interior face of the wall was found to be built with Hollow Clay Tiles (HCT) covered with plaster. The tiles were found to be placed such that the cells of the blocks run horizontally. A typical unit appears to have three rows of cells running horizontally and two columns of cells going vertically. The construction of the block, in the vertical cross-section, appears to be not a uniform rectangle but, "Z" shaped turned 90 degrees clockwise, which allows interlocking of the tiles in the vertical plane. Thus the overall dimensions of each typical HCT in the examined area appear to be 15-inches (vertical), 11-inches (horizontal), and 8-inches thick. The blocks are held together with mortared joints.

Effort was also made to check the presence of grout in the cells of the HCT blocks. No grout was found; all the cells appeared empty in the examined area.

PRELIMINARY

Test 2.2 Structural Masonry Walls Investigations (WC1.2)

Member Investigated:	Exterior rear northwest wall of the central two-story portion of the building.
Location:	Investigated the specified part of the masonry wall from the interior on the Right side of the opening with wide sliding doors. The test location is marked as "WC-1.2" in the plans included in Appendix "A".
Test Procedure:	At the specified test location, removed the wall coverings where necessary, drilled exploratory holes and examined the composition of the wall. Inspected the wall up to a height of about 6 feet.
Test Results:	The wall appears to be built with URM solid clay bricks in the interior in the examined area. The exterior face of the wall has the appearance of veneer bricks.

PRELIMINARY

Test 2.3 Structural Masonry Walls Investigations (WC1.3)

Member Investigated: Exterior north wall of the existing single-story wing on the northeast side of the central building.

Location: Investigated the specified part of the north masonry wall from the interior on the west side of the wing. The test location is marked as "WC-1.3" in the plans included in Appendix “A”.

Test Procedure: At the specified test location, removed the wall coverings over a considerable area, drilled exploratory holes and examined the composition of the wall. A flexible Boroscope was also inserted through the drilled holes to examine the orientation of the cells and inspect the interior composition of the blocks. One infill brick was also removed to inspect the interior construction.

Test Results: The interior face of the wall was found to be built with Hollow Clay Tiles (HCT) covered with plaster. In the examined area, the tiles were found to be placed rather randomly with no obvious pattern, such that the cells of the blocks sometimes run horizontally, and some times vertically. Thickness of the interior primarily HCT part/wythes appears to be approximately 8-inches. The blocks are held together with mortared joints.

Besides HCT blocks, it was found that solid bricks were also used to fill in the spaces in the construction of the interior face.

The photograph on the following page depicts the mixed placement of HCT units and bricks at the investigated test location.

Effort was also made to check the presence of grout in the cells of the HCT blocks. No grout was found; all the cells appeared empty in the examined area.

The exterior face of the wall, like in the other parts of the structure, appears to be built with veneer bricks.

PRELIMINARY

Subject:	Results of Structural Footing Investigations UCLA Clark Library Gatehouse, 2520 Cimarron St., Los Angeles	**Test ID**: HCT Walls	**Test Dates**: 7/24 – 8/6/2012
Report By:	Robert M./AA/DP/gu/s	**Checked By:**	S. Sethee, Ph.D.

Figure 2.1 Interior face of the north wall of the single-story wing on the northeast side of the central building. This photo depicts the random arrangement of HCT units and some solid bricks in the test area identified as WC1.3

Subject:	Results of Tensile Tests on Screw Anchors in HCT Walls	**Test ID**:	Screw Anchors
	UCLA Clark Library Gatehouse, 2520 Cimarron St., Los Angeles	**Test Dates**:	7/24 – 8/6/2012
Report By:	Robert M./AA/DP/gu/s	**Checked By:**	S. Sethee, Ph.D.

TYPE OF TEST: In-situ tension pull-off tests on screw anchors installed in Hollow Clay Tile walls

SPECIFICATIONS: Project EOR Specified tension tests on Hilti Kwik-Con II screw anchors, 1/4-inch in diameter and 1-1/2-inch long, with embedment of approximately 1 inch.

TEST EQUIPMENT: Portable pull-off / tension testing apparatus, "Positest Digital Pull-Off Adhesion Tester" by Defelsko Corporation, USA. Model: PosiTest AT, Serial No: AT03940 Accuracy: Within ± 1%

The testing machine essentially comprises of a hydraulic pump, a special self-aligning hydraulic cylinder, and a calibrated digital pressure gauge. A uniform tensile force is exerted through a coupling device, such that a pawn-shaped stud (metal dolly) linked with a swivel joint applies a concentric pull-off load on the test specimen.

ENVIRONMENT: Indoors: Daytime Temperature at Site 80°±
Dates: 7/26 – 8/6/2012

TEST TECHNICIANS: Andi Anthony, Danny Pungdurmi

TEST LOCATIONS: A total of fourteen test locations were specified over various HCT masonry walls at the site. Eight tests were to be performed in the central two-story portion; and three tests were conducted in each of the one-story wings on the two sides of the main building.

All the specified HCT wall test locations were overlaid with plaster approximately 3/4 inch thick. Typical walls of the hollow clay tiles drilled to fasten the test anchors were measured to be approximately 7/8-inch thick.

TEST PROCEDURE: 1. Per EOR instructions, the plaster was carefully removed and the clay tiles exposed at 50% of the test locations before installing the screw anchors and conducting the tests.

2. The specified screw anchor (1/4" dia. x 1-1/2" long) was carefully installed in the HCT wall through a “U” shaped steel channel, which was specially machined to a suitable size and appropriately drilled to accommodate the given screw anchors.

PRELIMINARY

3. Custom fabricated pulling assembly grabbed to the "U" channel on one end, and carried a firm stud (with a base 2-inch in diameter) on the other end to linkup with the pull-off testing apparatus.

4. At each test location, the testing apparatus was carefully set-up over a bridge, and the hydraulic actuator assembly was placed over the stud. The built-in coupling device was gently engaged to the self-aligning spherical stud head, which was already linked to the test anchor. Adjustments were made to ensure that the tensile loading axis is coincident with the anchor and perpendicular to the wall surface.

5. After zeroing the instrument force indicator, prime the pump gently.

6. Operating the pump smoothly at a uniform rate, increase the tensile force on the test anchor, via the stud and pulling assembly, till the test specimen failed, or was unable to sustain further loading.

7. The test data and observations were recorded including the greatest perpendicular tensile force applied, and the mode of failure.

TEST RESULTS: For the two types of HCT wall test locations, the anchor tensile failure load was observed to be:

HCT without plaster: 300 to 560 pounds

HCT with plaster: 600 to 1400 pounds

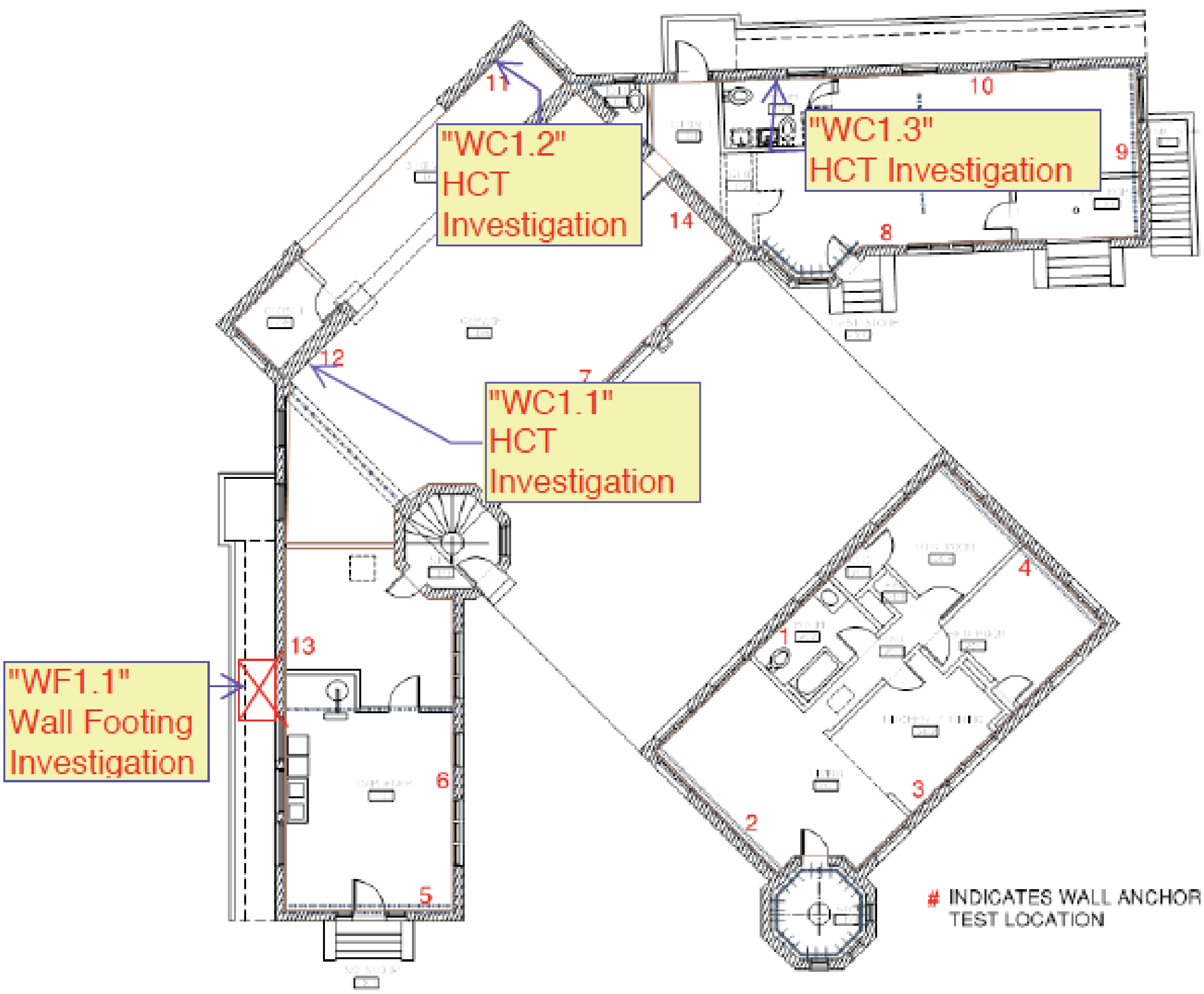
It is to be noted that the length of embedment of the test anchor is significantly different for the two cases of with and without plaster.

MODE OF FAILURE: The screw anchors pulled out of the wall in one piece practically intact. Generally there was no visible damage to the clay tiles; occasionally the tiles, with the plaster removed, developed a crack.

PRELIMINARY

Subject:	Results of Structural Footing Investigations	**Test ID**:	Test locations
	UCLA Clark Library Gatehouse, 2520 Cimarron St., Los Angeles	**Test Dates**:	7/24 – 8/6/2012
Report By: Robert M./AA/DP/gu,s		**Checked By:**	S. Sethee, Ph.D.

Figure A.1 Structural Investigations Test Locations



PRELIMINARY

Subject:	Results of Tensile Tests on Screw Anchors in HCT Walls	**Test ID**:	Screw Anchors
	UCLA Clark Library Gatehouse, 2520 Cimarron St., Los Angeles	**Test Dates**:	7/24 – 8/8/2012
Report By:	Robert M./AA/DP/gu/ss	**Checked By:**	S. Sethee, Ph.D.

TYPE OF TEST: In-situ tension (pull-out) tests on screw anchors installed in Hollow Clay Tile or URM Solid Clay Brick walls

SPECIFICATIONS: Project EOR Specified tension tests on Hilti Kwik-Con II screw anchors, 1/4-inch in diameter and 1-1/2-inch long, with embedment of approximately 1 inch.

TEST EQUIPMENT: Portable pull-off / tension testing apparatus, "Positest Digital Pull-Off Adhesion Tester" by Defelsko Corporation, USA. Model: PosiTest AT, Serial No: AT03940
Accuracy: Within ± 1%

The testing machine essentially comprises of a hydraulic pump, a special self-aligning hydraulic cylinder, and a calibrated digital pressure gauge. A uniform tensile force is exerted through a coupling device, such that a pawn-shaped stud (metal dolly) linked with a swivel joint applies a concentric pull-off load on the test specimen.

ENVIRONMENT: Indoors: Daytime Temperature at Site 80°±
Dates: 7/26 – 8/8/2012

TEST TECHNICIANS: Andi Anthony, Danny Pungdurmi, Kyle alo

TEST LOCATIONS: A total of fourteen (14) test locations were specified over various masonry walls at the site. Eight tests were to be performed in the central two-story portion; and three tests were specified for each of the one-story wings on the two sides of the main building. Because of unexpected site conditions, a total of 15 tests were performed to make sure that EOR requirements are fully satisfied.

All the specified masonry wall test locations were overlaid with plaster approximately 3/4 inch thick. Typical walls of the hollow clay tiles drilled to fasten the test anchors were measured to be approximately 7/8-inch thick.

TEST PROCEDURE:

1. In accordance with the EOR directions, the plaster was carefully removed and the clay tiles, or masonry, exposed at most of the test locations before installing the screw anchors and conducting the tests. At a few locations, the plaster was not removed per EOR instructions.

2. The specified screw anchor (1/4" dia. x 1-1/2" long) was carefully installed in the masonry wall through a “U” shaped steel channel, which was specially machined to a suitable size and appropriately drilled to accommodate the given screw anchors.

3. Custom fabricated pulling assembly grabbed to the "U" channel on one end, and carried a firm stud/dolly (with a base 2-inch in diameter) on the other end to linkup with the pull-off testing apparatus.

4. At each test location, the testing apparatus was carefully set-up over a bridge, and the hydraulic actuator assembly was placed over the stud. The built-in coupling device was gently engaged to the self-aligning spherical stud head, which was already linked to the test anchor. Adjustments were made to ensure that the tensile loading axis is coincident with the anchor and perpendicular to the wall surface.

5. After zeroing the instrument force indicator, prime the pump gently.

6. Operating the pump smoothly at a uniform rate, increase the tensile force on the test anchor, via the stud and pulling assembly, till the test specimen failed, or was unable to sustain further loading.

7. The test data and observations were recorded including the greatest perpendicular tensile force applied, and the mode of failure.

TEST RESULTS: Results for a total of 15 tests are reported on the following three pages, and cover three conditions at site:

1. HCT without plaster
2. HCT with plaster
3. URM Solid Clay Bricks with plaster

It is to be noted that the length of embedment of the test anchor is significantly different for the two cases of with and without plaster.

MODE OF FAILURE: In all cases, the screw anchors pulled out of the wall in one piece practically intact with no apparent damage to the anchor. Generally there was no visible damage to the clay tiles; at a few locations with the plaster removed, however, the tiles were found to have developed a crack, or chipped slightly.

Subject:	In-Situ Tension Tests on Hilti Kwik-Con II Screw Anchors UCLA Clark Library Gatehouse, 2520 Cimarron St., Los Angeles	**Test ID:**	Screw Anchors
		Test Dates:	7/24 – 8/8/2012
Report By:	Robert M./AA/DP/ss	**Checked By:**	S. Sethee, Ph.D.

Table 1. Results of Tension (Pull-Out) Tests on Anchors Installed in Masonry Walls

Test No.	Building	Floor Level	Test Location	Wall Composition at Test Location	Plaster	Anchor Pull-Out Strength (pounds)
1	Central Two-Story Building	2nd Floor	Northwest Wall, 4'-6" ± above floor	Hollow Clay Tile	Plaster Removed	300
2	Central Two-Story Building	2nd Floor	Southwest Wall, 4' ± above floor	Hollow Clay Tile	Plaster Removed	561
3.1	Central Two-Story Building	2nd Floor	Southeast Wall, 3'-10" ± above floor	Hollow Clay Tile	Plaster Not Removed	624
3.2	Central Two-Story Building	2nd Floor	Southeast Wall, 3'-3" ± above floor	Hollow Clay Tile	Plaster Removed	1332
4.1	Central Two-Story Building	2nd Floor	Northeast Wall, 2'-10" ± above floor	Hollow Clay Tile	Plaster Not Removed	1410
4.2	Central Two-Story Building	2nd Floor	Northeast Wall, 2'-8" ± above floor	Hollow Clay Tile	Plaster Removed	300
11.1	Central Two-Story Building	1st Floor	Northwest Wall, 4' ± above floor	URM Solid Clay Brick	Plaster Not Removed	444
11.2	Central Two-Story Building	1st Floor	Northwest Wall, 4' ± above floor	URM Solid Clay Brick	Plaster Not Removed	435
12	Central Two-Story Building	1st Floor	Northwest Wall, 6'-3" ± above floor	Hollow Clay Tile	Plaster Removed	315

Subject:	In-Situ Tension Tests on Hilti Kwik-Con II Screw Anchors UCLA Clark Library Gatehouse, 2520 Cimarron St., Los Angeles	**Test ID**:	Screw Anchors
		Test Dates:	7/24 – 8/8/2012
Report By:	Robert M./AA/DP/ss	**Checked By:**	S. Sethee, Ph.D.

Table 2. Results of Tension (Pull-Out) Tests on Anchors Installed in Masonry Walls

Test No.	**Building**	**Floor Level**	**Test Location**	**Wall Composition at Test Location**	**Plaster**	**Anchor Pull-Out Strength** (pounds)
5	West Wing One-Story Building	1st Floor	South Wall, 4'-4" ± above floor	Hollow Clay Tile	Plaster Removed	462
6	West Wing One-Story Building	1st Floor	East Wall, 5'-4" ± above floor	Hollow Clay Tile	Plaster Removed	699
13	West Wing One-Story Building	1st Floor	West Wall, 4'-3" above floor	Hollow Clay Tile	Plaster Removed	384

Subject:	In-Situ Tension Tests on Hilti Kwik-Con II Screw Anchors UCLA Clark Library Gatehouse, 2520 Cimarron St., Los Angeles	**Test ID:** Screw Anchors **Test Dates:** 7/24 – 8/8/2012
Report By: Robert M./AA/DP/ss		**Checked By:** S. Sethee, Ph.D.

Table 3. Results of Tension (Pull-Out) Tests on Anchors Installed in Masonry Walls

Test No.	Building	Floor Level	Test Location	Wall Composition at Test Location	Plaster	Anchor Pull-Out Strength (pounds)
8	North Wing, One-Story Building	1st Floor	South Wall, 4'-9" ± above floor	Hollow Clay Tile	Plaster Removed	375
9	North Wing, One-Story Building	1st Floor	East Wall, 3'-3" ± above floor	Hollow Clay Tile	Plaster Removed	300
10	North Wing, One-Story Building	1st Floor	North Wall, 4'-11" above floor	Hollow Clay Tile	Plaster Removed	549

APPENDIX B – PHOTOS

Photo B.1: Exterior Rafter Tail and Window Frame Deterioration

Photo B.2: Repointed Mortar and Plaster Cracks

Photo B.3: Mortar Deterioration at Façade Brick

Photo B.4: Basement Wall Crack

Photo B.5: Roof Framing to Exterior HCT Walls

Photo B.6: Exposed HCT at Exterior

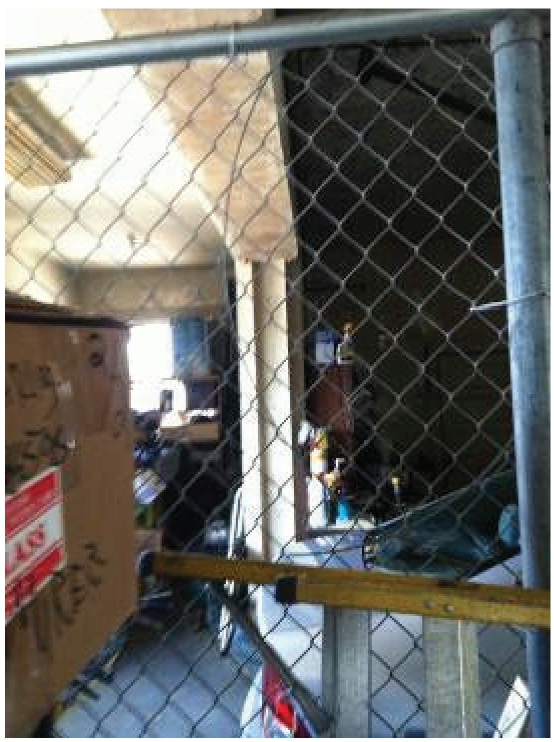
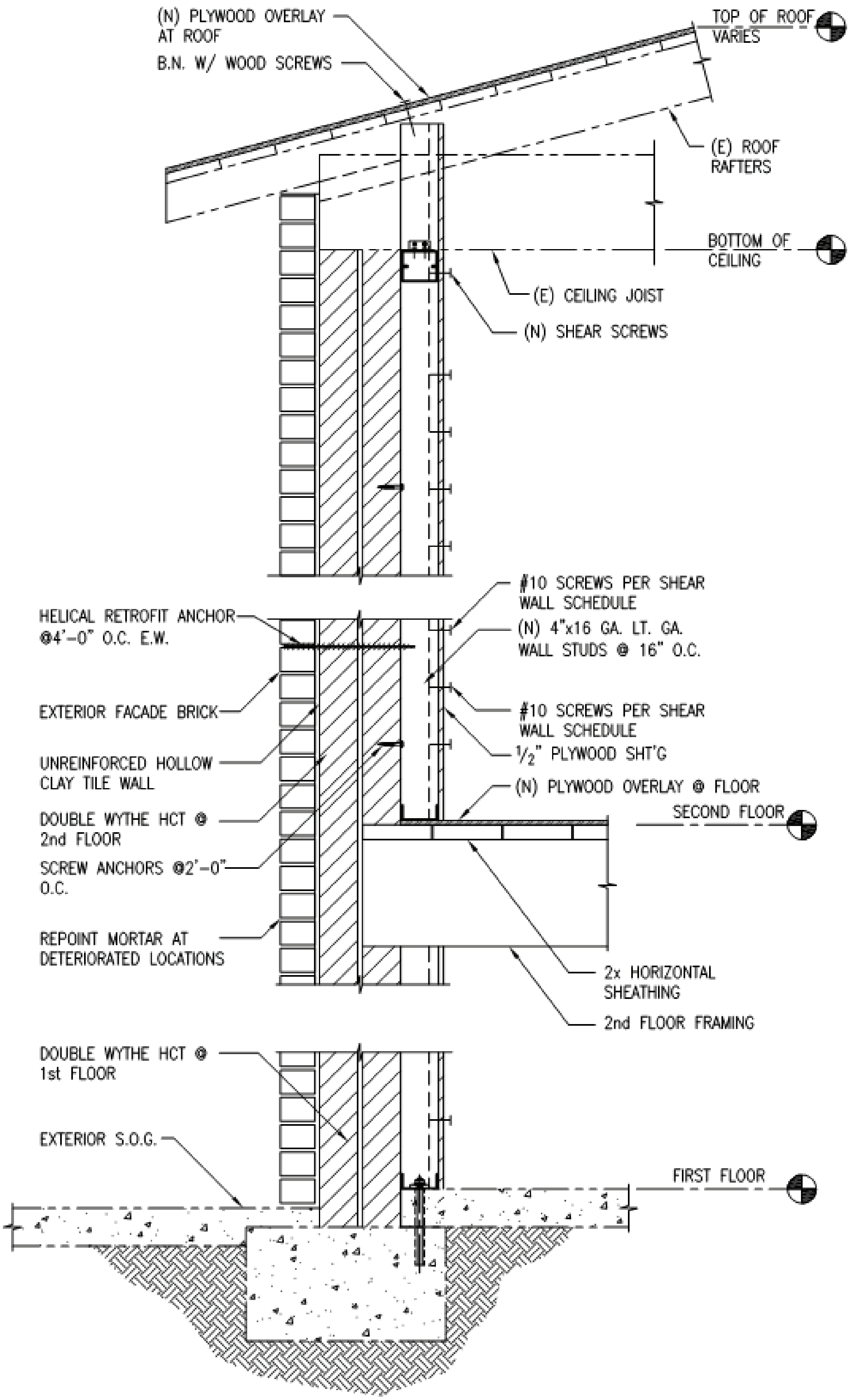


Photo B.7: Steel Column and Beam at Opening

APPENDIX C – DETAILS



Detail C.1: SECTION THROUGH EXTERIOR WALL