Agenda Item No. 2

CITY OF LONG BEACH

DEPARTMENT OF DEVELOPMENT SERVICES

333 West Ocean Boulevard, 5th Floor • Long Beach, CA 90801 • (562) 570-6194 • Fax (562) 570-6068

August 10, 2015

CHAIR AND CULTURAL HERITAGE COMMISSIONERS
City of Long Beach
California

RECOMMENDATION:

Approve a Certificate of Appropriateness to complete a seismic upgrade to the adobe walls of the ranch house, removal of the existing roof and installation of new roof sheathing and shingles, repair of deteriorated wood elements including windows, doors and dormers and new exterior paint at Rancho Los Alamitos, a designated landmark building at 6400 Bixby Hill Road. (District 3)

APPLICANT: City of Long Beach, Department of Parks, Recreation and Marine
c/o Mike Burrous
4626 N. Virginia Road
Long Beach, CA 90807
(Application No. HP15-276)

THE REQUEST

The proposed project includes the third and final stage in rehabilitation and seismic upgrading the Rancho Los Alamitos. Construction of this work will involve the removal of the roof, structural strengthening via insertion of steel and wood elements into the adobe walls, strategic upgrades of windows and other features during the work and painting to complete the restoration.

BACKGROUND

The Rancho Los Alamitos is among the most important and valued historic structures in Long Beach. The site's history dates back to the pre-history period with the Gabrielino-Tongva peoples. That history continues into the 1790 granting of the ranch from the Spanish Crown, the 1800-1840 construction of the original ranch house, barns and other structures, the 1881 purchase by John Bixby and ultimately the 1968 transfer of ownership to the City of Long Beach. This living museum and historic destination was added to the national register of historic places in 1981 (Exhibit A - Location Map).

In 1985 the City delegated the management and operations of Rancho Los Alamitos to the Rancho Los Alamitos Foundation. The Foundation commissioned a comprehensive Master Planning program for the interpretation and restoration of the historic site. The plan was prepared in 1987 and presented to the Cultural Heritage Commission on April 6, 1989. This plan includes interpretation, restoration of the ranch house and gardens and restoration of the barns area. The vast majority of the improvement projects have been completed with the most notable being the barns restoration and visitor center project completed in 2008. The master plan calls for the seismic reinforcement of the adobe structure with three major components: the chimneys, the foundation and the original walls. The exterior chimney and foundation repairs have been completed, the wall upgrades and the associated work on the roof are now before the Cultural Heritage Commission.

In 1992, Architectural Resources Group (ARG) prepared a preliminary structural recommendation report (Exhibit B – Preliminary Seismic Retrofit Options 1992). Based on a Historic Structures Report (HRS) performed in 1987-1988, ARG created structural strengthening design recommendations. These include the following items:

- Seismic strengthening of the adobe walls
- Seismic bracing and repair of the brick chimneys
- Investigation and repair of damaged brick foundation
- Seismic strengthening of wood-framed wings
- Strengthening of the roof, roof and ceiling diaphragms

This scope of work was always anticipated to occur in phases due to financial and physical constraints. The current phase has been engineered under the direction of Structural Focus and ELT & Associates as lead consultants to the project. ELT & Associates specializes in seismic analysis of earthen and wood framed buildings. (Exhibit C – ELT Letter for Firm Qualifications)

The seismic upgrade and rehabilitation of adobe structures has advanced remarkably since 1992 when the initial recommendation report was prepared. The current proposal reflects this evolution in engineering and features the use of a wood bond beam instead of the originally proposed concrete beam. The use of a plywood bond bean instead of concrete is significantly lighter in weight, better connects the joints to the horizontal rods and has more flexibility. The plans for the seismic upgrade to the adobe core include specific control measures to protect the existing historic fabric (Exhibit D – Plans and Photographs).

THE PROPOSED SCOPE OF WORK

The seismic work proposed by the foundation includes the strengthening of chimneys that were not addressed in initial phases, the removal and replacement of the roof, and the strengthening of the walls themselves through the insertion of material from the upper levels through the layers of adobe wall (Exhibit E – Phase III Ranch House Scope of Work and Structural Focus Letter). The project also includes strategic upgrades and rehabilitation of the property that takes advantage of the roof removal. Overall the project includes:

- Chimneys – stabilization of three interior chimneys. Exterior chimneys were previously completed.
- Second floor porch – repair as needed with new waterproof flooring, paint and re-plaster of the ceiling
- Skylights – repair waterproofing, remove broken elements, repaint metal frame, replace as necessary.
- Dormers – install new copper flashing, replace deteriorated window frames and sills, install new roofing materials.
- Windows – repair as needed including reglazing, replace damaged glass, repaint frames and elements.
- Restoration Carpentry – repair and restore termite damaged wood elements at various locations throughout the ranch house.
- Plumbing – system wide upgrades.
- Hardwood Flooring – repair and replacement as necessary with like materials.
- Electrical – system wide upgrades.
- HVAC – address ducting and other system wide issues.
- Roofing – complete removal of the roof, replacement with new roof, identical design with fire-treated shingles.
- Fire alarm and security – upgrading and relocation of systems, cabling and controls.
- Telephone – removal of duplicative cabling, streamlining of systems.
- Walls – new bond beams inserted through the attic to strengthen adobe walls.

ANALYSIS

The Secretary of Interior's Standards for Rehabilitation prioritize the preservation of historic fabric and limits to alterations in order to preserve the integrity of the structure. Historic structures however were built to different standards and require interventions to prevent the loss of the structure due to natural hazards as well as deterioration over time. The proposed improvements to the Ranch Los Alamitos are not minor, but they are necessary.

The reroofing of the structure will create a noticeable visual change from the current condition; however, this change will actually bring the roof closer to how it would have looked during its early period prior to 1900. The current condition has several layers of roof atop each other, creating a heavy weight that compounds the structural issues of the structure.

The seismic upgrades to the walls, while a complex engineering endeavor, will ultimately result in no visual change to the structure. The painting, window and other improvements to the site will likewise either have no visual impact or will bring the structure closer to its original condition.

RECOMMENDATION

In compliance with Section 2.63.070 of the City of Long Beach Municipal Code (Cultural Heritage Commission), the Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings, and the Landmark Designation Ordinance for the Rancho Los Alamitos (C-5479), staff has analyzed the revised project and finds the project meets the requirements for approval pursuant to the imposed conditions (Exhibit F- Findings and Conditions).

PUBLIC HEARING NOTICE

Public notices were distributed on July 23, 2015. As of this date no letters have been received.

ENVIRONMENTAL REVIEW

In accordance with the 15331 Guidelines for Implementation of the California Environmental Quality Act (CEQA), environmental review is not required for maintenance and rehabilitation of historic structures.

Respectfully submitted,

Christopher Koontz

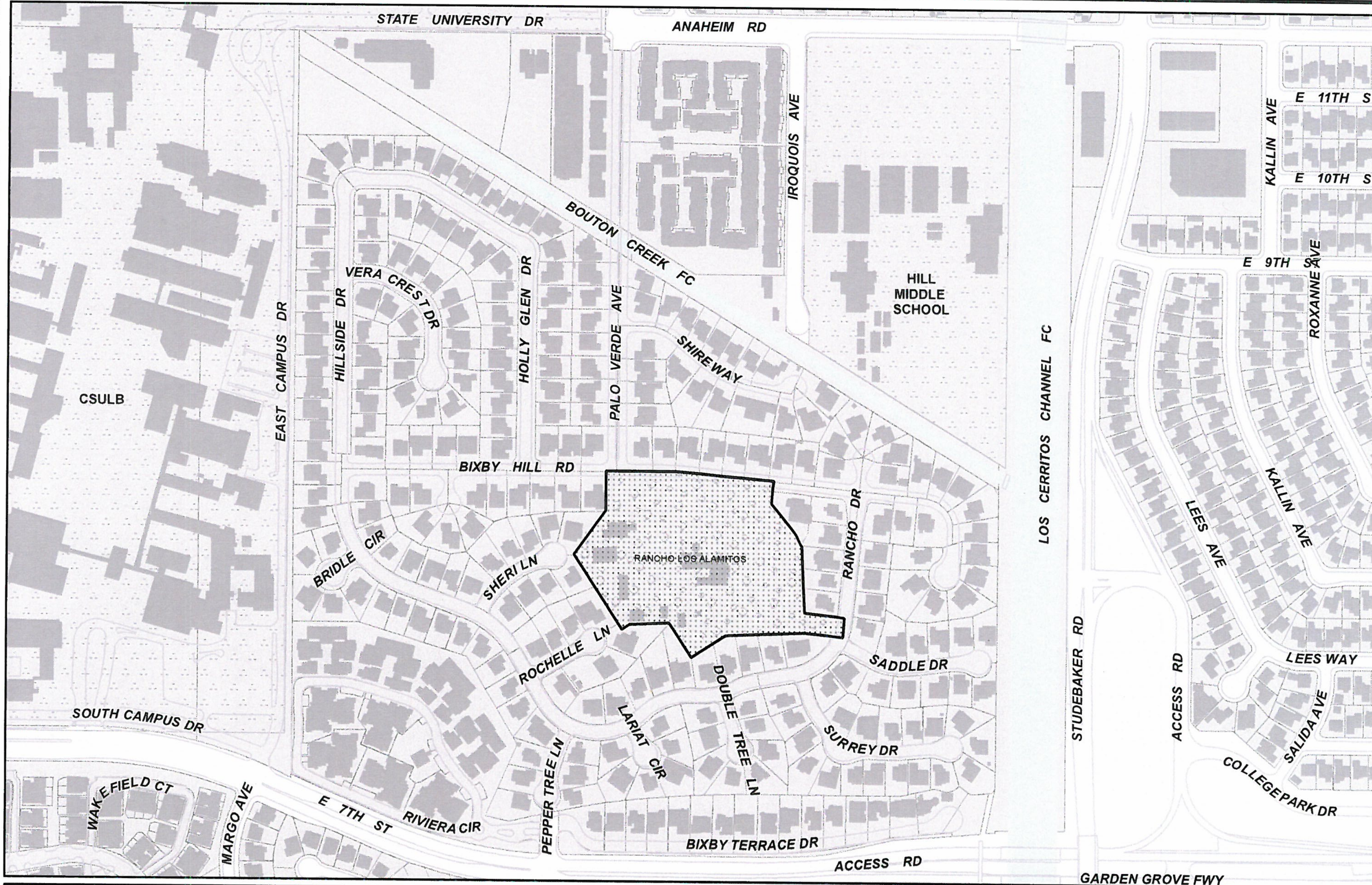
CHRISTOPHER KOONTZ, AICP
ADVANCE PLANNING OFFICER

Linda F. Tatum

LINDA F.TATUM, AICP
PLANNING BUREAU MANAGER

LFT:CK:lf

Attachments:
Exhibit A - Location Map
Exhibit B - 1992 Preliminary Seismic Retrofit Options
Exhibit C - ELT & Associates Letter
Exhibit D - Plans and Photographs
Exhibit E - Ranch House Scope of Work and Structural Focus Letter
Exhibit F - Findings and Conditions



Subject Property:

6400 Bixby Hill Rd
Application No. HP15-276
Council District 3
Zoning Code : P

Exhibit A

N

200 100 0 200 400 Feet

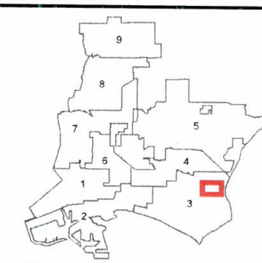


Exhibit B

ELT & Associates

Engineering and Architectural Specialists in Buildings of Earth

251 Lafayette Circle, Suite 240
Lafayette, CA 94549-4387
U.S.A.

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Office: (925) 284-3558
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FAX: (925) 299-9573

email: rtolles@44adobe.com

January 17, 2003

Rancho Los Alamitos
Long Beach, California

attn: Pamela Seager

re: Preliminary Seismic Retrofit Options for Rancho Los Alamitos

Dear Ms. Seager,

At your request and the request of Stephen Farneth, Architect at Architectural Resources Group, I am preparing this letter report with accompanying plan and details. The goal of my investigation is to provide an alternative seismic retrofit strategy for the adobe portions of the Main Ranch House at Rancho Los Alamitos.

To accomplish that goal, I have performed the following tasks:

1. Review the seismic retrofit plans prepared by GFDS Engineers and Architectural Resources Group dated 4/17/96.
2. Visit the site and inspect the building for the purpose of developing and alternative retrofit strategy based upon the design criteria and methodologies presented in the Planning and Engineering Guidelines for the Seismic Retrofit of Historic Adobe Buildings prepared by the Getty Conservation Institute, a division of the Getty Foundation.
3. Performed preliminary calculations to assess the feasibility of the new proposed retrofit system.
4. Prepare this memorandum and drawings.

Intent and Scope of the Investigation

The intent of the investigation was to develop preliminary scheme for an alternative retrofit system to the one proposed in the GFDS design drawings. The alternate retrofit system was to provide a system with safety at relatively the same level as that provided for by the concrete bond beam system in the GFDS plans. The goals of the alternate retrofit system was also to reduce costs and reduce the impact on the historic fabric of the existing building compared to the costs and impact of the GFDS plan.

The purpose of this investigation was not to evaluate the specifics of the GFDS retrofit system or to estimate the cost or impact of that system in detail. Nevertheless, given the nature of the retrofit system proposed in this report, it is clear that both the cost and the impact on the historic fabric would be substantially less than those of the GFDS retrofit system.

Background on the Getty Guidelines

The Getty Guidelines are the final product of the Getty Seismic Adobe Project (GSAP) a multi-year, multi-disciplinary effort by the Getty Conservation Institute started in 1990. The goal of the guidelines was to develop a range of methodologies for retrofitting historic adobe buildings that had minimal impact on the historic fabric of a building but still structurally effective. In the early phases of the program, "structurally effective" meant to provide for life-safety in and around adobe buildings. In the later phases of the research, "structurally effective" also included means by which damage to an historic adobe building during severe earthquakes could be minimized.

The GSAP research included field surveys of existing historic adobes in California and New Mexico and current practices in the seismic retrofit of historic adobe buildings. The characteristic properties of the existing historic adobe buildings were categorized and classified.

Wall thickness is a fundamentally important characteristic of adobe buildings were categorized into three general groups depending on the slenderness ratio (the ratio of the height to the thickness).

1. Thick walls: slenderness ratio of 5 or less.
2. Moderate walls: slenderness ratio between 5 and 8.
3. Thin walls: slenderness ratio greater than 8.

The GSAP research also included laboratory research on a variety of retrofit strategies on buildings with different wall slenderness ratios. Walls were tested with slenderness ratios of 5, 8 and 11. Buildings were tested on shaking tables which simulate earthquake motions. Ground motions were increased until either collapse of the structure occurred or the capacity of the shaking table was exceeded. The largest simulated ground motions were comparable to the largest earthquakes that might be expected in California or, for that matter, anywhere in the world.

The fundamental issue with regards to wall thickness is that a significant amount of the stability of thicker (thick and moderate) adobe walls is that a significant amount of the resistance to out-of-plane motions is provided by the racking of the walls about their bases. Walls with slenderness ratios of 11 rotate freely about their bases and their out-of-plane motions are primarily retrained by the connections to the floor or roof diaphragms of the building.

The out-of-plane motions was walls with slenderness ratios of less than 8 are largely restrained by rocking motion about the base of these walls. Typical static force methods for determining these loads will overestimate the load requirements at these connections. The demand on the connections at the tops of moderate and thick walls is less than typically calculated by static methods since much of the out-of-plane stability is provided by rotation about the base of the moderate and thick walls.

The issue of wall slenderness ratios is particularly significant for the Main Adobe at Rancho Los Alamitos because the one-story adobe walls are particularly thick. The "thinner" interior walls are 24 inches thick and have a slenderness ratio of approximately 5 and the thicker perimeter walls have slenderness ratios as low as 3.5 with wall thickness approaching 3 feet. These walls are thick and VERY thick by GSAP standards making the risk of overturning or collapse small even before more significant retrofit measures are installed.

It is also worth noting that the out-of-plane rocking motion of a thick-wall requires nominal forces at the top of the wall to greatly decrease the likelihood of overturning of that wall. As an example, visualize a solid block that is 2.5 inches wide and 10 inches high. If the block starts to rock around its base, small forces are required to substantially reduce the risk of overturning the rocking block.

Characteristics of Bond Beams

Adobe walls are low-strength and massive. During moderate ground motions, adobe walls are likely to crack. The most advantageous approach for managing the seismic performance of an adobe building is to allow the walls to crack and then manage the motion of the cracked elements of the walls after the cracks have developed.

Bond beams have two fundamental characteristics. First is the resistance to out-of-plane motions at the tops of the walls. This is the fundamental characteristic which is typically analyzed and is easy to calculate analytically with standard design methodologies. A second feature that is also very important for the effective performance of adobe buildings during extended severe earthquake is the in-plane continuity provided by the tensile strength of the bond beam along the length of the adobe wall. The tensile requirements of the bond beam are fairly nominal as the main requirement of the tensile capacity is to act passively to keep the cracked sections of the adobe walls from separating once cracks have developed.

Getty Research and Bond Beams

Bond beams were tested as part of the GSAP research program on buildings with slenderness ratios of 5, 8 and 11. The thin-walled buildings fully activated the strength and deflection characteristics of the bond beams because the walls were completely free to rotate about the base of the wall.

The buildings with moderate walls required less of the bond beams as the rotation was controlled largely by the rotation of the wall about the base. The dynamic characteristics were very non-linear and not a function of the flexural properties of the bond beam. The long out-of-plane adobe walls cracked first in the out-of-plane direction before crack damage was observed in the in-plane walls. The bond beam was considerably lighter than would be required by a simple static analysis but was more than adequate for both the strength and deflection requirements for stability.

A thick-walled building with walls having a slenderness ratio of 5 responded similarly to a building with moderately thick walls. The out-of-plane rocking motion of the walls was dominated by rotation of the walls about the base. In addition, the in-plane walls and the out-of-plane walls failed at the same test level indicating that out-of-plane flexural cracks was occurring at approximately the same level as in-plane shear cracks or the out-of-plane walls were simply failing in shear.

Significant Conditions of the Main Ranch House at Rancho Los Alamitos

The adobe portion of the building in the Main Ranch House at Rancho Los Alamitos has a rectangular plan and creates four rooms as show in the attached plan on Sheet S1. There are three parallel walls that are approximately three feet thick that run the length of the building at lines 1, 2 and 3. There are two "thinner" interior walls at lines B and C between the walls at line 2 and 3. In total, this creates four interior rooms. The floor framing for the attic is 3x8 members at 32 inches on center.

The thinnest walls are the interior walls and are 24 inches thick and approximately 10 feet high. This makes the slenderness ratio of these wall 5 which was as thick as the thickest walls tested as part of the GSAP program. The long walls are nearly three feet thick. Part of this thickness can be attributed to a concrete layer of variable thickness which apparently was applied after the 1933 Long Beach earthquake. In several locations, most notably the west side of the adobe wall at line 1, there are wood-framed walls placed directly against the adobe walls.

The finished rooms of the attic that is enclosed by wood-framed walls are indicated by the narrow sets of solid lines over the adobe walls on Sheet S1. In this area, 2x4 sleepers appear to have been laid flat over the original 3x8 ceiling joists. The subfloor and finish flooring attached to the tops of these area. The areas of the floor over the wall at line 2 are either closets or back room storage areas where the removal of the floor would not be particularly disruptive the the functioning of the building.

The area of the attic floor over the adobe wall at line 1 is in the center or usable rooms with nicely finished oak flooring. The desire in this area is to disrupt the area as little as possible and providing sufficient anchorage.

Building Code Issues and Requirements

The role of existing building codes and local building officials is significant in the options that can be considered in a retrofit design. The lateral force procedures in the UCBC and SHBC are adequate for the overall design analysis. Unfortunately, neither of these procedures provides a method for calculating the benefit for thick-walled construction. In fact, the thicker the walls, the more difficult it is to satisfy the design requirements.

Both design procedures of the SHBC and UCBC refer to the use of bond beams on adobe masonry. Fortunately, the SHBC now provides for a "bond beam of reinforced concrete or an equivalent design of other materials." Load values and shear capacity have been checked and will not be an issue.

Anchorage at the top of the adobe walls is one area that may be an issue. The SHBC and UCBC refer back to the UBC static force design procedures. Unfortunately, these procedures result in greater and greater amounts of anchorage as the walls get thicker. In the GSAP research efforts, anchorage was typically spaced at approximately 2x the wall thickness. Based upon a static design analysis of top of wall capacity, the MINIMUM spacing should be 1.5x the wall thickness. When anchors are placed closer than 1.5 times the thickness, the anchors will actually create a weak zone in the top of the wall and more anchorage will likely result in a weaker connection.

The spacing and nature of the top-of-wall anchorage will likely be an issue in negotiating an acceptable design with the local building official.

The proposed design is discussed in the following section but deserves mention here. The main aspect of the design is the use of a plywood bond beam on top of most of the adobe walls. The exception is the lack of a full-plywood bond beam down the lengths of the walls at lines 1 and 2 in the area under the floor areas on the second floor. The out-of-plane stiffness is provided by the heavy plywood bond beam over the adobe wall at line 3 which will be more than adequate for the strength and stiffness in the out-of-plane direction.

In-plane continuity over line 2 will be provided by longitudinal metal strapping in the areas under the existing finished rooms.

The in-plane continuity over line 1 will be provided by the existing floor sleepers, subfloor and flooring. Additional continuity is contributed to by the concrete cover on the east side of the adobe wall at line 2 and the wood framed wall on the west side of the adobe wall. In addition, the plywood over the first 10 feet of each end of the wall at line 1 will anchor the ends of the adobe wall at line 1 and effectively create a buttresses at each end for the wall in this area. Overall, requirements for in-plane continuity is relatively nominal for these walls given the confinement provided by all the other elements of the structure that contribute to the in-plane continuity in this area.

Overview of Alternative Retrofit Design

The layout of the alternative design for the seismic retrofit system is best summarized in the plan show on sheet S1.2. A plywood bond beam will be installed on the tops of all walls that are exposed in the unfinished attic space. The bond beam will be anchored to the walls at approximately 36 to 48 inches on center using 3/4- inch diameter rods that extend a minimum of 24 inches into the adobe walls and anchored with epoxy grout. Along line 3, these anchors may be angled up to 20 degrees if required for installation. A general detail for the bond beam over line 1 is shown in detail on sheet S4.1. The existing roof framing shall be anchored to the new plywood bond beam as indicated in the detail on Sheet 4.1.

In the area of the finished attic along line 2, anchorage and connectors shall be used to anchor the floor framing to the adobe wall and to connect the existing floor joists over the top of that wall. This connection shall be used to tie the adobe walls at lines 1 and 2 to the bond beam at line 3. The detail of the connection over the wall at line 2 is presented on sheet S4.2.

In the area of the finished attic along in the wall at line 1, a three-inch diameter hole will be drilled over the end of each floor joist. Then, a one-inch diameter hole will be drilled through in existing floor joist and into the adobe wall. A 3/4 inch anchor will be placed twenty-four inches into the adobe wall and the end shall be exposed under the existing subfloor.

These are the rough details of the proposed design that I consider adequate to comply with the basic requirements of the California State Historic Building Code. The details of the design will need to be negotiated with the local City of Long Beach Building official and all other interested parties.

If you have any questions, please don't hesitate to call.

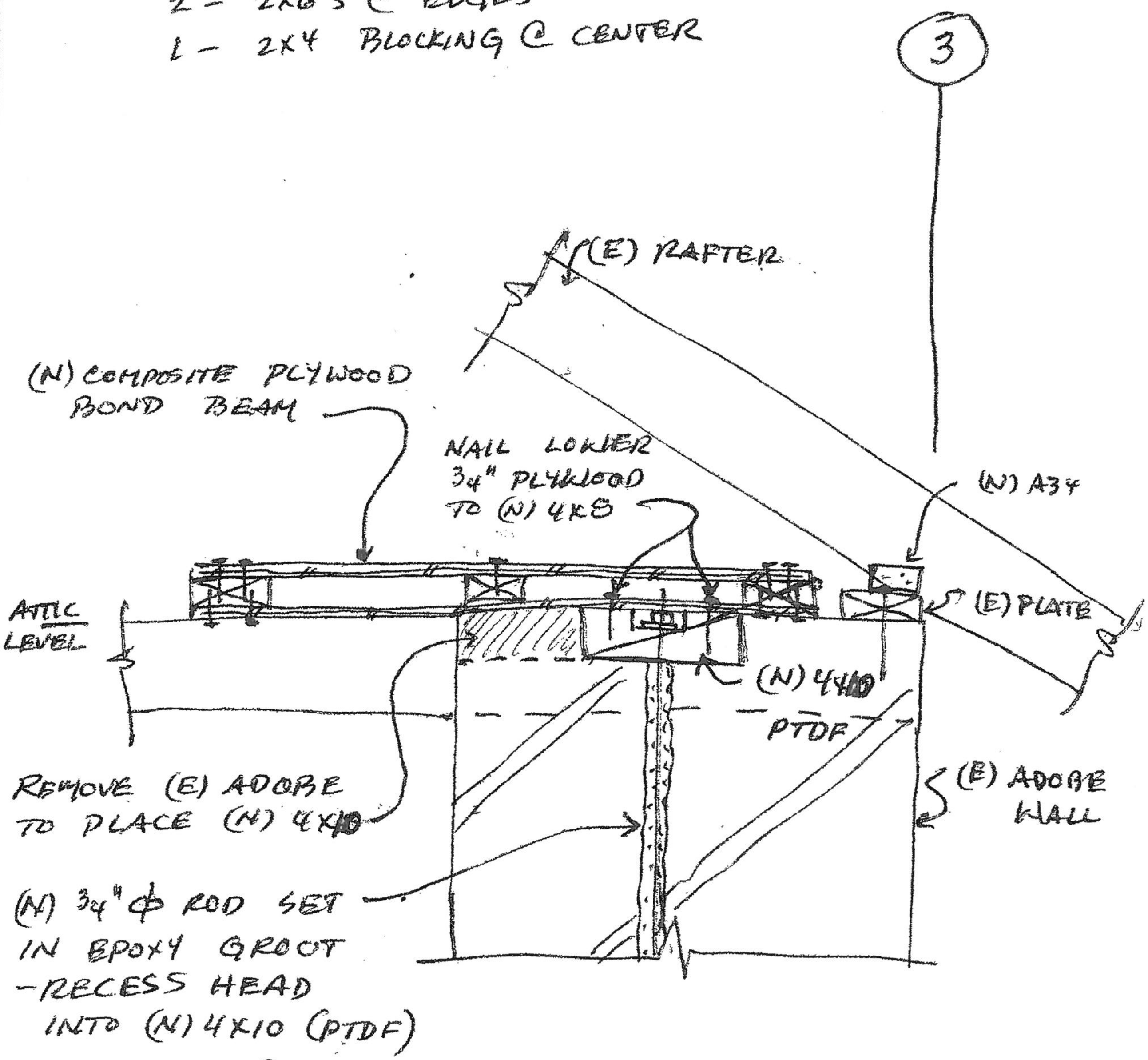
Sincerely,

REGISTERED PROFESSIONAL ENGINEER
E. LEROY TOLLES
No. 37818
exp. 6/30/04
CIVIL
STATE OF CALIFORNIA

E. Leroy Tolles, P.E., Ph.D.

ELT & Associates 251 Lafayette Circle, Suite 230 Lafayette, CA 94549 Phone: 925-284-3558 Fax:925-299-9573

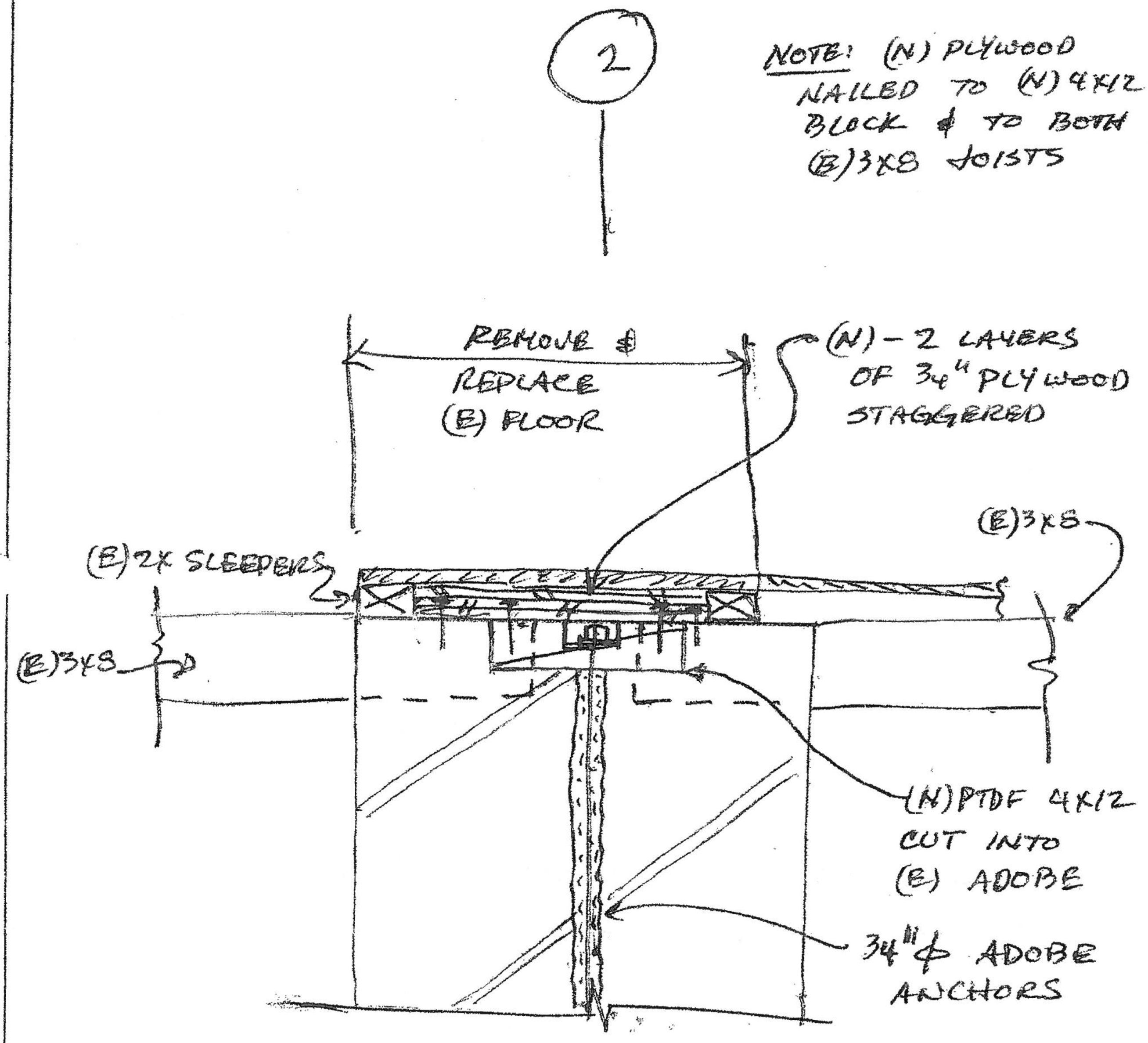
COMPOSITE PLYWOOD BOND BEAM
2 - 3/4" PLYWOOD (4' PANELS)
2 - 2x6's @ EDGES
1 - 2x4 BLOCKING @ CENTER



(D/4.1) SECTION DETAIL
N.T.S.

S4.1

Job Title: RANCHO LOS ALAMITOS	Date: 1/17/03 by: ELT
Subject: DETAILS	Page 2 of 5



1/S4.2 SECTION DETAIL

N.T.S.

S4.2

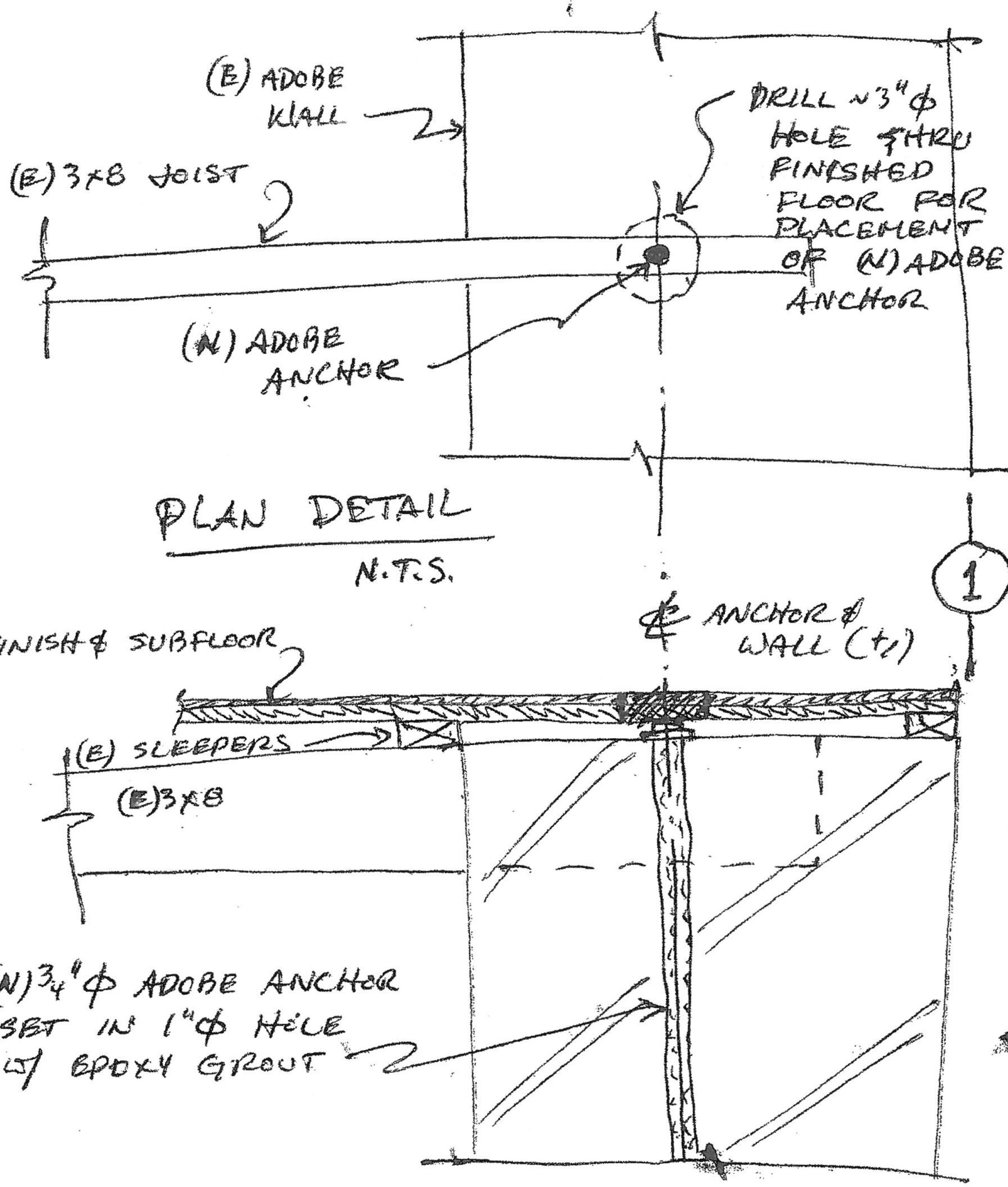
Job Title: Rancho Los Alamitos

Subject: Details

Date: 1/17/03 by: ELT

Page 3 of 5

ELT & Associates 251 Lafayette Circle, Suite 230 Lafayette, CA 94549 Phone: 925-284-3558 Fax:925-299-9573

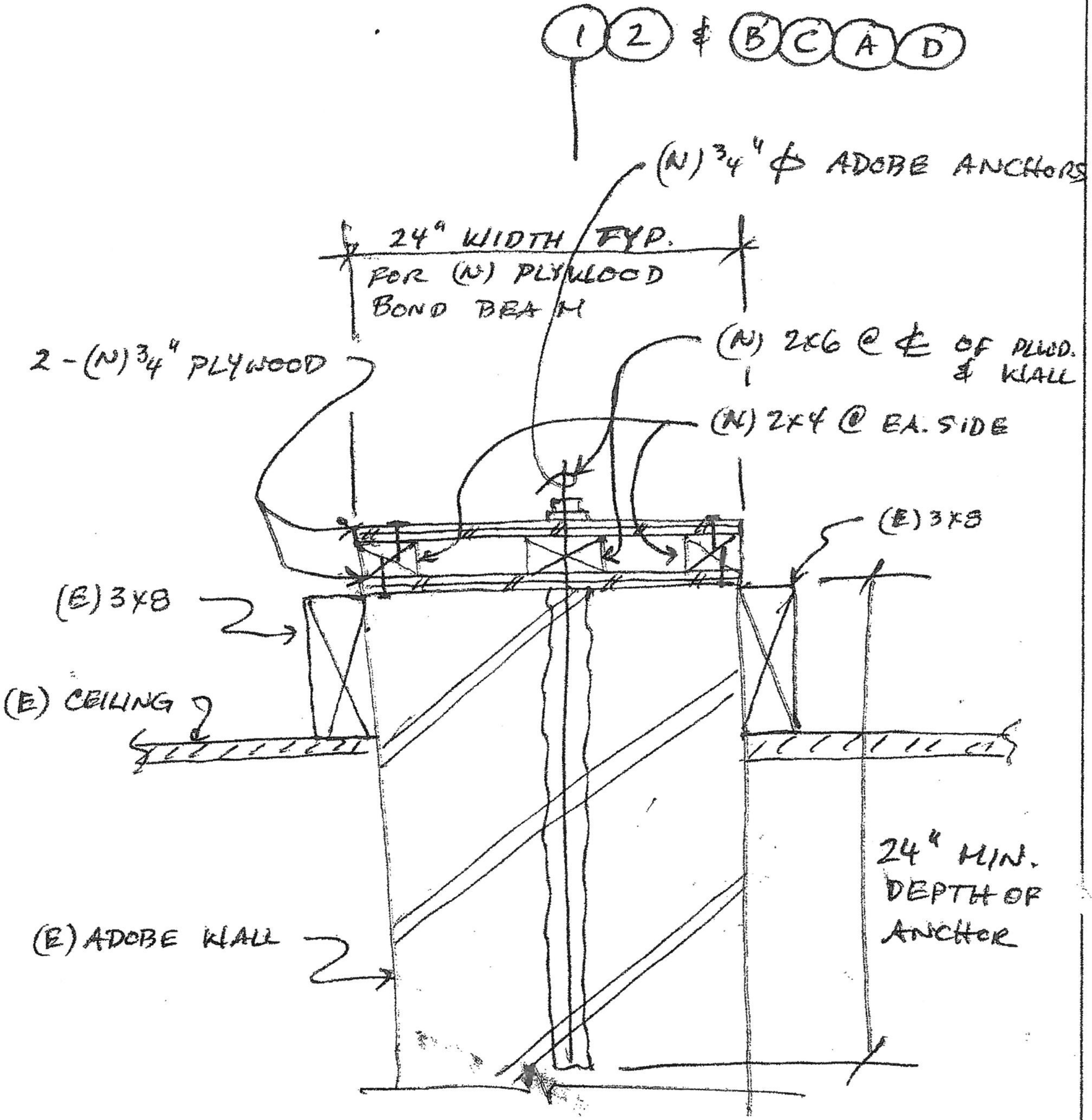


1/S4.3 SECTION DETAIL
N.T.S.

S4.3

Job Title: Rancho Los Alamitos
Subject: Details
Date: 1/17/03 by: ELT
Page 4 of 5

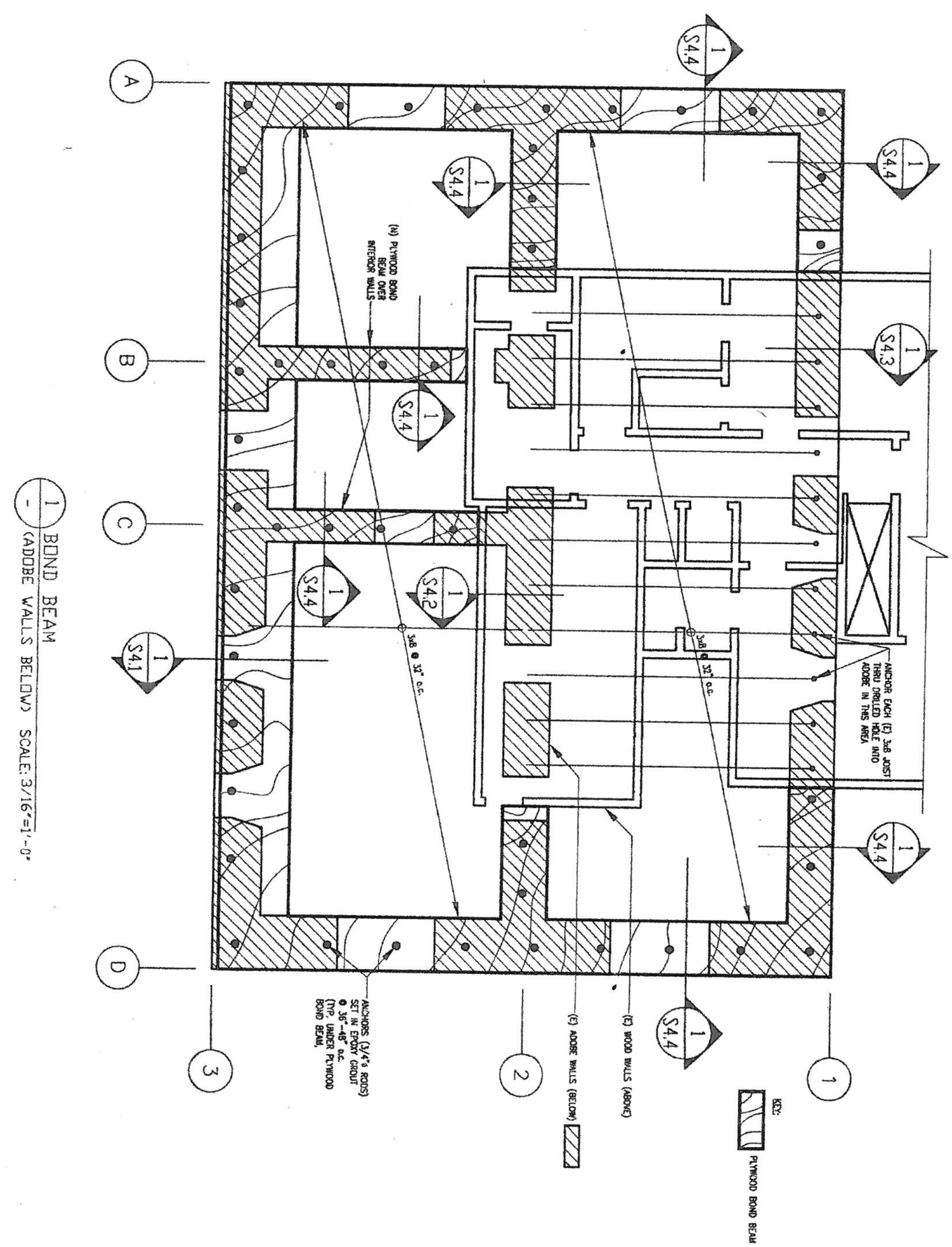
ELT & Associates 251 Lafayette Circle, Suite 230 Lafayette, CA 94549 Phone: 925-284-3558 Fax:925-299-9573



1 / S4.4 TYPICAL PLYWOOD BOND BEAM (except @ LINE 3) N.T.S.

S4.4

Job Title: Rancho Los Alamitos	Date: 1/17/03 by: ELT
Subject: Details	Page 5 of 5



SHEET	S1.2

ATTIC FLOOR PLAN

RANCHO LOS ALAMITOS

LONG BEACH, CALIFORNIA

ELT & Associates

251 Lafayette Circle, Suite 230

Lafayette, Ca. 94549

Tel:(925)284-3558 Fax:(925)299-9573

REV	DATE	DESCRIPTION
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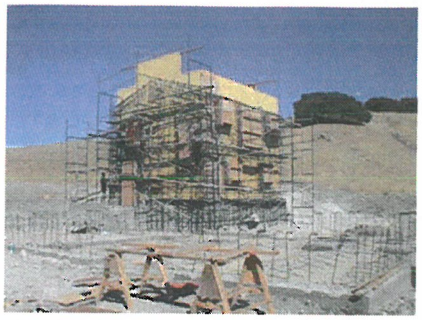
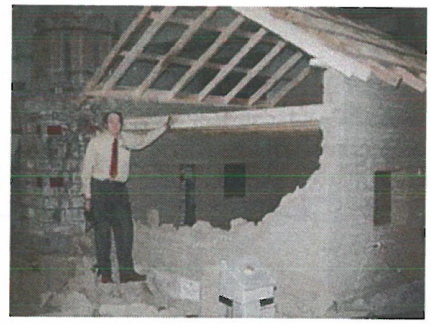
Exhibit C





FIRM QUALIFICATIONS

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Oakland, CA 94610
telephone: 510.295.4299

Main Contact:
Roy Tolles, P.E., Ph.D.,
rtolles@44adobe.com

ELT & Associates

ELT & Associates was founded by E. Leroy (Roy) Tolles in 1985. The firm specializes in the seismic analysis of earthen and wood-framed buildings. The firm principal is Roy Tolles. The firm has been designing retrofits on adobe buildings since the early 1990's. The work on adobe buildings has grown over the years and is currently the vast majority of the projects performed by ELT & Associates.

Dr. Tolles has a rare combination of knowledge regarding the seismic performance and retrofit of adobe buildings. He has conducted basic research for over 20 years by testings models of adobe buildings on shaking tables. He has designed retrofit strategies for dozens of adobe buildings in California. He has written guidelines for retrofitting adobe buildings as published by the Getty Conservation Institute (GCI) and assisted in recent revisions to the California Historical Building Code (CHBC).

ELT & Associates has performed the necessary investigation and design on new earthen buildings in California and Oregon. We have sufficient knowledge of advanced testing protocols to conduct the necessary research for earthen buildings and how to translate that information into new building design. This work must be done in collaboration with the local building officials as there are not prescriptive design requirements for earthen buildings provided in current building codes.

Dr. Tolles received his doctorate from Stanford University in 1989 where he conducted research on the seismic improvement on rural adobe houses. He was then the Principal Investigator for the Getty Seismic Adobe Project (GSAP) for most of the 1990's. The project was a multi-disciplinary, multi-year project whose goal was to develop innovative methodologies for retrofitting historic adobe buildings. Three major publications were released from the GSAP work and can be purchased online or downloaded for free from the GCI web site.

E. LEROY TOLLES

ELT & Associates
Structural Engineering firm established 1984. Specializing in structural design and analysis of adobe, rammed earth, brick and wood buildings. Detailed knowledge of design, retrofit, analysis, and seismic testing of adobe construction. Experience with earthquake simulator shake table tests on adobe structures, dynamic analysis, finite element analysis, and laboratory and field tests.

PROFESSIONAL REGISTRATION
Civil Engineer: California C-37318

EDUCATION
Ph.D., Structural Engineering, Stanford University, 1989
M.S., Structural Engineering, Stanford University, 1982
B.S., Civil Engineering, Stanford University, 1977

Major Research and Investigation Projects

Getty Seismic Adobe Project (GSAP), 1991-2006

April 2006 – Getty Seismic Adobe Program Colloquium, presenter.
Sept. 2006 – New Concepts in Seismic Strengthening of Historic Adobes, presenter.

GSAP was directed by the Getty Conservation Institute as a multi-year, multi-disciplinary investigation of seismic retrofit strategies for historic adobe buildings that are both effective in protecting life-safety and minimize the impact on a building's significant historic fabric.

It was a three-phase program. The first phase included development of a theoretical framework for understanding the seismic performance of adobe buildings; research on currently used retrofit technologies; a survey of existing historic adobe buildings in Southwestern United States; development of a testing program plan that included materials, analytical computer modeling, and shake table tests; and, the first draft of conservation principles that would act as planning guidelines for retrofitting historic adobe buildings.

The second phase was the beginning of the testing program. It included tests on 1:5 scale adobe walls and simple four-wall buildings. The walls of the buildings had different height to thickness ratios and had been retrofitted using different techniques.

In the final phase included completion of the testing program and the final draft of the Planning Guidelines. The Engineering Guidelines were finalized after the large-scale testing program at IZIIS was completed.
The 1994 Northridge earthquake also occurred during the project, which allowed for investigation of actual damage to adobe structures.

The Advisory Board included:
James Jackson, California Dept. of Parks and Recreation, Sacramento, California
Anthony Crosby, National Park Service, Denver Colorado
Edward Crocker, New Mexico Community Foundation, Santa Fe, New Mexico
Nicholas Magalousis, Mission San Juan Capistrano, Laguna Beach, California
Julio Vargas Neumann, Pontifica Universidad Catolica del Peru, Lima Peru
Wayne Donaldson, Architect, San Diego, California
Melvyn Green, Structural Engineer, Manhattan Beach, California
Helmut Krawinkler, Stanford University, Stanford, California
John Loomis, Thirtieth Street Architects, Newport Beach, California

The final report, entitled Planning and Engineering Guidelines for the Seismic Retrofitting of Historic Adobe Structures, will be published in early 2003.

Survey of Historic Adobe Buildings after the 1994 Northridge Earthquake, 1994-1996

The project was partially supported by the Getty Conservation Institute and the resulting report became one of their publications. The project team was lead by E. Leroy Tolles and included Anthony Crosby and Edna E. Kimbro. The study of earthquake-damaged adobe buildings documented in this study revealed details of their performance under stress that are essential for determining the means for retrofitting these types of structures. The publication of this research represents a comprehensive reference for documentation methods and details of damage from an earthquake to adobe buildings.

Large-Scale Testing of Adobe Buildings, 1996-1998

This research was funded by the Getty Conservation Institute as an augmentation to the basic GSAP research effort. The testing was performed at the IZIIS institute in Skopje, Macedonia. IZIIS was established by the government of Yugoslavia after the 1963 earthquake in that region of central Europe. The testing involved large-scale, 1:2, tests performed on two model buildings. It compared an unretrofitted structure with one that had two basic retrofit techniques research and tested in GSAP. The GSAP methods were proven successful in reducing the amount of damage suffered by the adobe walls. Results were published in the final report of the GSAP research project.

Workshop on the Seismic Retrofit of Historic Adobe Buildings, 1995

Principal organizer and editor was E. Leroy Tolles of Earthen Building Technologies with Edna E. Kimbro and Frederick A. Webster. Sponsored by the Historic Preservation Partners for Earthquake Response, the Leonis Adobe Associations, and the Getty Conservation Institute. The 10 most active architectural and engineering experts in historic adobe building construction presented their efforts in research, design, repair, retrofit, preservation, and reconstruction to the public following the 1994 Northridge earthquake. Attended by approximately 250 participants at the J. Paul Getty Museum.

Seismic Studies on Small-Scale Models of Adobe Buildings, 1982-1989

The research was funded by the National Science Foundation and conducted by E. Leroy Tolles under the direction of Professor Helmut Krawinkler at Stanford University. This Doctoral study represents a fundamental starting point for the stability-based analysis of the dynamic performance of adobe buildings that is critical to matters of life-safety. By comparison, other previous research had focused on strength and crack damage which do not themselves directly affect life-safety.

This research included the dynamic testing of six reduced-scale adobe buildings on a shake table at Stanford University. The shaking table simulated earthquake motions by duplicating an actual recorded earthquake or synthesized earthquake motions. The severity of the earthquake motions was increased on succeeding tests until either the building collapsed or the capacity of the shaking table was exceeded. The study examined the dynamic behavior of adobe buildings and evaluated simple seismic retrofit measures that could be implemented for use in low-cost adobe housing in developing countries.

Structural Investigator, INTERTECT, 1985
Investigation of earthquake-damage to adobe buildings in Mexico City and coastal region near the epicenter of the October 1985 earthquake.

Structural Damage Investigator at SUUM Engineering, Forensic Technologies International, and Failure Analysis Associates; consulting on building damage investigations, post-earthquake damage evaluation and providing expert testimony, experimental testing, computer analysis, and computer programming.

Selected Design Projects

HISTORIC ADOBE AND BRICK BUILDINGS

French Consulate, Monterey, California
Historical Designation: National Register
Building Description: One-story adobe building.
Retrofit Description: New partial plywood diaphragm with anchorage to adobe walls. Coring of stone-gabled end walls.
Project Team: E. Leroy Tolles, Design Engineer and Architectural Resources Group.
Current Status: Retrofit installation completed 2010.

San Joaquin Experimental Station, Sierra Foothills near Madera, California
Historical Designation: California Register
Buildings Description: One-story adobe buildings building in the 1930s.
Retrofit Description: New roof diaphragm, anchorage of existing concrete bond beam to the roof and walls and installation of center cores in thin adobe walls.
Project Team: E. Leroy Tolles, Design Engineer
Current Status: Retrofit installation completed on first building in 2011.

Rios-Caledonia Adobe, San Miguel, California
Historical Designation: California Register
Building Description: One and two-story adobe building.
Retrofit Description: New second-floor ceiling diaphgram and anchorage of existing bond beam. Additional ties and anchors throughout the building.
Project Team: E. Leroy Tolles, Design Engineerand Architectural Resources Group.
Current Status: Retrofit installation completed 2008.

Casa Abrejo, Monterey, California
Historical Designation: National Register
Building Description: Single story adobe building. Adobe construction in 1850's.
Retrofit Description: Partial plywood diaphragm/bond beam anchored to adobe walls.
Project Team: E. Leroy Tolles, Design Engineer
Current Status: Retrofit installation completed 2007.

Main Residence at Rancho Camulos, Piru, California
Owned by: Owned and managed by the private non-profit Rancho Camulos Museum
Historical Designation: National Landmark Designation for the entire site "Home of Ramona"
Building Description: Main residence on the Rancho Camulos Museum 10 acre site is a 7,600 square foot, one and two story adobe building with a few stone wall additions. Built in 1852
Retrofit Description: Retrofit of entire building including roof-wall anchors, horizontal cables, vertical straps on adobe and stone walls, partial plywood diaphragm/bond

beam, and concrete bond beams. Several walls were reconstructed due to collapse or severe damage from the 1994 Northridge earthquake.
Project Team: ELT & Associates Team: E. Leroy Tolles, Project Manager and Design Engineer; Historical Architect, Anthony Crosby; Edna E. Kimbro, Architectural Historian and Design Consultant
Current Status: Completed 1997

Las Flores Adobe, Camp Pendleton, California
Owned by: United States Marine Corps
Historical Designation: National Register; National Historic Landmark
Building Description: Adobe building with one and two-story sections, 1867
Retrofit Description: Project directed by the U.S. National Park Service for the United States Marine Corps. Camp Pendleton. Full Seismic retrofit of entire building using roof-wall anchors and a partial plywood diaphragm/bond beam.
Project Team: E. Leroy Tolles, Design Engineer and architects from the National Park Service. Performed in cooperation with Stephen Farneth of the Architectural Resources Group, Historical Architect
Current Status: Completed 2002

Carriage House, Camp Pendleton, California
Owned by: United States Marine Corps
Historical Designation: National Register; National Historic Landmark
Building Description: Single-story adobe building late 1800's.
Retrofit Description: Project directed by the U.S. National Park Service for the United States Marine Corps. Camp Pendleton. Full Seismic retrofit of entire building using roof-wall anchors and an existing concrete bond beam.
Project Team: E. Leroy Tolles, Design Engineer and architects from the National Park Service. Performed in cooperation with Stephen Farneth of the Architectural Resources Group, Historical Architect
Current Status: Completed 2004.

Casa de la Torre, Monterey, California
Historical Designation: Situated in the City of Monterey Old Town National Historic Landmark District; and, National Register
Building Description: Private residence of 1½ story and single story adobe walls. Built in 1849.
Retrofit Description: Retrofit using adobe anchors and center-core rods attaching the walls to a plywood diaphragm.
Project Team: E. Leroy Tolles, Design Engineer. Separately, Anthony Crosby and Edna Kimbro
Current Status: Completed in 2001

Jameson Adobe, Corona, California
Historical Designation: Local city designation
Building Description: Single story adobe residence. Built in the late 1800's.

Retrofit Description: Perimeter horizontal cable anchors to upper adobe wall and attached to roof diaphragm.
Project Team: E. Leroy Tolles, Design Engineer
Current Status: Completed 1994

Las Cruces Adobe, near Solvang, California
Owned by: California State Parks and Recreation
Historical Designation: Unknown
Building Description: Single story adobe building in state of ruin, Wood-framed roof structure built over the site to protect the ruins.
Retrofit Description: Independent damped steel framing system attached to the adobe walls to stabilize the adobe walls and protect individuals from falling debris.
Project Team: E. Leroy Tolles, Design Engineer in cooperation with M. Wayne Donaldson, FAIA, Inc.
Current Status: Design completed. Construction pending funding.

Winery, Rancho Camulos, Piru, California
Owned by: Owned and managed by the private non-profit Rancho Camulos Museum
Historical Designation: National Landmark Designation for the entire site. "Home of Ramona"
Building Description: 1½ story brick ranch building.6,400 square feet. Built in 1867
Retrofit Description: Primary bracing system provided by concrete shear walls hidden in an attached wood shed. Diagonal steel braces between second floor framing and the roof system. Reconstructed gable end walls that collapsed during the 1994 Northridge earthquake with wood-framed walls with brick veneer.
Project Team: E. Leroy Tolles, Design Engineer. Anthony Crosby, Historical Architect.
Current Status: Design in final stages. Currently under review by building officials.

Small Adobe Residence, Rancho Camulos, Piru, California
Owned by: Owned and managed by the private non-profit Rancho Camulos Museum
Historical Designation: National Landmark Designation for the entire site. "Home of Ramona"
Building Description: Single story adobe building with interior courtyard building in 1920.
Retrofit Description: Adobe walls reinforced with small-diameter center core rods. Flat roof system with plywood diaphragm anchored to upper adobe walls with anchors and center core rods.
Project Team: E. Leroy Tolles, Design Engineer. Anthony Crosby, Historical Architect. Kirk E. Peterson, Architect
Current Status: Construction completed in 2007.

Castro Breen Adobe, San Juan Bautista, California
Owned by: California State Parks and Recreation
Historical Designation: National Register
Building Description: Two story adobe building constructed in 1841.
Retrofit Description: Combination of center core rods and roof-wall anchors attached to a partial plywood diaphragm/bond beam.

Project Team: E. Leroy Tolles, Design Engineer in conjunction with architects from the California State Parks and Recreation
Current Status: Construction completed 2004.

Castro Adobe, Watsonville, California
Owned by: California State Parks and Recreation.
Historical Designation: National Register
Building Description: Two story adobe building built in 1830.
Retrofit Description: To be determined by the investigation.
Project Team: E. Leroy Tolles, Design Engineer
Current Status: Historic Structures report completed. Design and retrofit by others reviewed by ELT & Associates 2006.

Main Ranch Residence, Rancho Los Alamitos, Long Beach, California
Historical Designation: National Register
Building Description: Single story adobe building with a one and two-story wood-framed building surrounding the entire one-story adobe rooms. Adobe construction in 1806.
Retrofit Description: Partial plywood diaphragm/bond beam anchored to adobe walls in current proposed design.
Project Team: E. Leroy Tolles, Design Engineer
Current Status: Alternate design submitted to museum board for consideration.

NEW EARTHEN CONSTRUCTION DESIGN

Liviakis Residence, Lafayette, California. Stabilized soil cement, 3,200 sq. ft., 2002
D'Arrigo Residence, Eugene, Oregon. Rammed earth residence, 2,400 sq. ft., 1995
Private Residence, Eugene, Oregon. Rammed earth garden structure, 120 sq. ft., 1994

HOUSING IN DEVELOPING COUNTRIES

Working with 3ei, a private non-profit, to develop cost-effective solutions for adobe housing in developing countries. Joint effort with Prof. V.V. Bertero (emeritus professor at UC Berkeley), Dr. Yousef Bozorgnia (Associate Director of the Pacific Earthquake Engineering Research Center (PEER) and Dr. Dominique Doweling recent recipient of the world's third known Ph.D. on the subject of the seismic design of earthen/adobe buildings.

Publications and Conferences

GCI Scientific Program Reports – Planning and Engineering Guidelines for the Seismic Retrofitting of Historic Adobe Structures, 210 pages. E. Leroy Tolles, Edna E. Kimbro, and William S. Ginell. The Getty Conservation Institute, Los Angeles California. 2003

GCI Scientific Program Reports – Seismic Stabilization of Historic Structures, Final Report of the Getty Seismic Adobe Project, 158 pages. E. Leroy Tolles, Edna E. Kimbro, Frederick A. Webster, and William S. Ginell. The Getty Conservation Institute, Los Angeles California. 2000

GSAP: Getty Conservation Institute Guidelines for Seismic Retrofitting of Adobe Project–Report on Third Year Activities, E. Leroy Tolles, Edna E. Kimbro, Charles C. Thiel, Frederick A. Webster, and William S. Ginell. Proceedings of the Getty Conservation Institute, Marina del Rey, California. 1998

GSAP: Survey of Damage to Historic Adobe Buildings After the January 1994 Northridge Earthquake, 160 pages. E. Leroy Tolles, Frederick A. Webster, Anthony Crosby, and Edna E. Kimbro. Getty Conservation Institute Program Report, Los Angeles, California. 1996

"Overview of the Getty Seismic Adobe Project," E. Leroy Tolles, Principal conference organizer, Proceedings of the Conference on the Seismic Retrofit of Historic Adobe Buildings. Presentations by 10 of the leading architects and engineers in the field of seismic retrofits of historic adobe buildings. J. Paul Getty Museum, Malibu, California. March 10, 1995

"Advances in the Seismic Retrofitting of Adobe Buildings," E. Leroy Tolles, Charles C. Thiel, Frederick A. Webster and William S. Ginell. Proceedings of the Fifth National Conference on Earthquake Engineering, Chicago, Illinois. July 1994

GSAP: Getty Conservation Institute Guidelines for Seismic Retrofitting of Adobe Project–Report on Second Year Activities, E. Leroy Tolles, Edna E. Kimbro, Charles C. Thiel, Frederick A. Webster, and William S. Ginell. Proceedings of the Getty Conservation Institute, Marina del Rey, California. October 1993

"Seismic Retrofitting of Historic Adobes," E. Leroy Tolles, Proceedings of the Seventh International Conference on the Study and Conservation of Earthen Architecture, Terra 93, Silves, Portugal. October 1993

"A Framework for Understanding the Seismic Performance of Adobe," E. Leroy Tolles, et al., Proceedings of the Seismic Retrofit of Historic Buildings Conference, sponsored by the United States National Park Service, San Francisco, USA. November 1992

GSAP: Getty Conservation Institute Guidelines for Seismic Strengthening of Adobe Project – Report on First Year Activities, Charles C. Thiel, E. Leroy Tolles, Edna E.

Kimbro, Frederick A. Webster and William S. Ginell. Proceedings of the Getty Conservation Institute, Marina del Rey, California. October, 1991

"Seismic Studies on Small-Scale Models of Adobe Houses, Report No. 91," E. Leroy Tolles and Helmut Krawinkler. John A. Blume Earthquake Engineering Center, Stanford University, Stanford, California. October 1990

"Seismic Testing on Small Scale Models of Adobe Houses, Vol. VIII," E. Leroy Tolles and Helmut Krawinkler, Ninth World Conference on Earthquake Engineering. Tokyo-Kyoto, Japan. 1988

"Performance Evaluation of Adobe Houses Through Small Scale Model Tests on a Shake Table," E. Leroy Tolles and Helmut Krawinkler, Middle East and Mediterranean Regional Conference on Earthen and Low-Strength Masonry Buildings in Seismic Areas. Middle East Technical University, Ankara, Turkey. September 1986

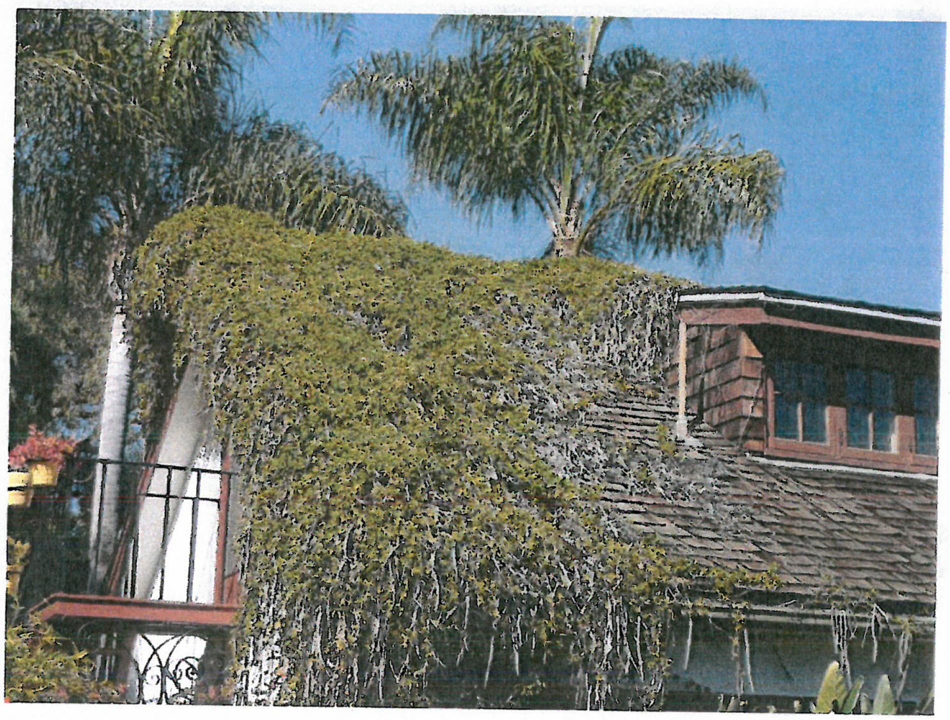
"Small-Scale Model Testing of Adobe Houses," E. Leroy Tolles and Helmut Krawinkler, Tenth CIB Congress. Washington, D.C. October 1986

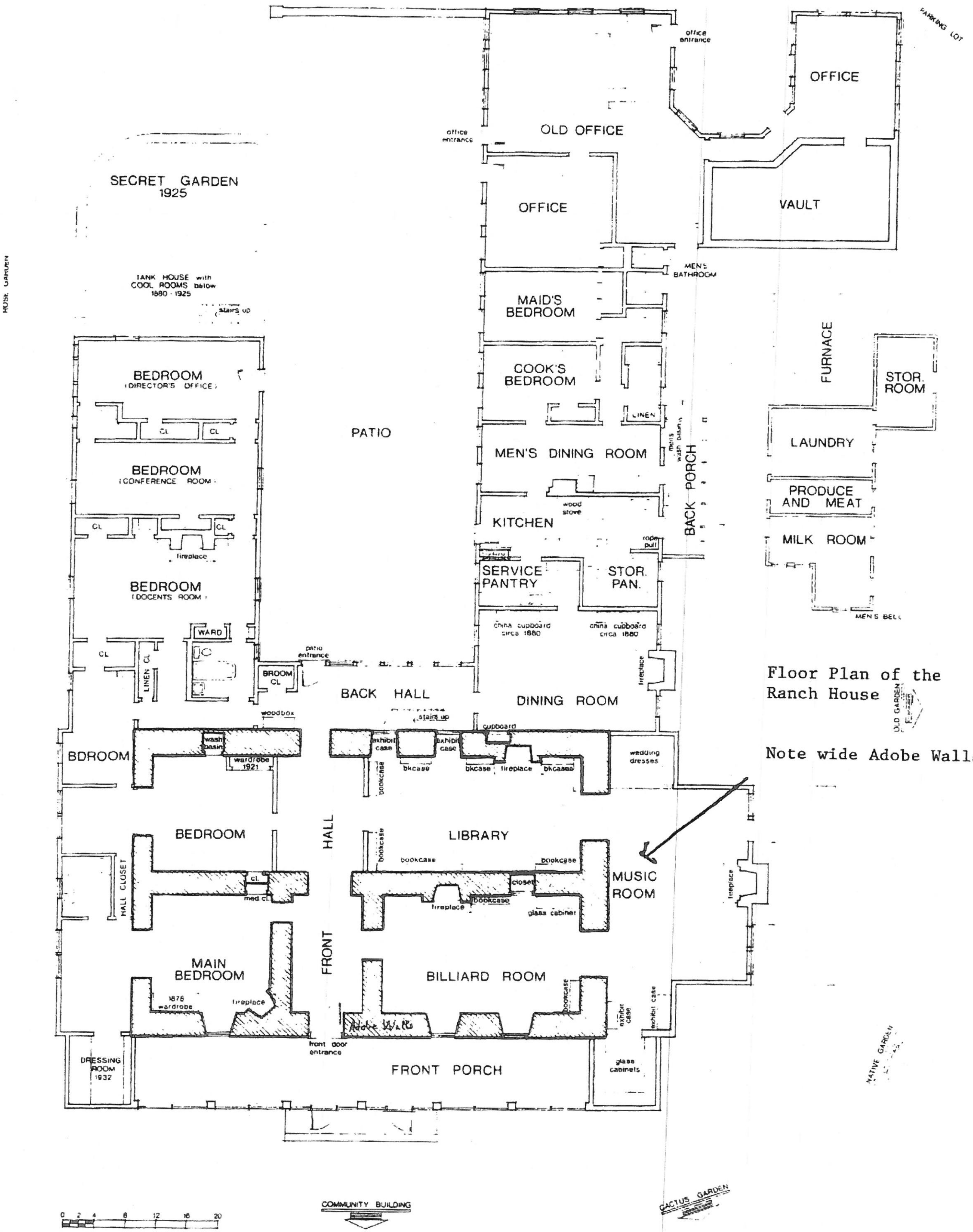
"Shake Table Studies of Masonry and Adobe Houses," Helmut Krawinkler and E. Leroy Tolles, CIB International Conference on Natural Hazards Mitigation. New Delhi, India. October 1984

Work History

Principal, ELT & Associates, Lafayette, CA. 1984–Present
Senior Civil Engineer, FTI Corporation, San Francisco, CA. 1986–1995
Civil Engineer, Failure Analysis Associates, Palo Alto, CA. 1982–1985
Structural Designer, William S. Kaplan, Inc., San Francisco, CA. 1979–1981
Structural Designer, Tuan and Associates, San Francisco, CA. 1980–1981

Exhibit D





Floor Plan of the
Ranch House

Note wide Adobe Walls