DESIGN, CONSTRUCTION AND PERFORMANCE OF A MODERN ADOBE HOME IN IN SOUTHERN CALIFORNIA

Introduction

In 1964, Mr. Walter Jakway began construction of an adobe home near Fallbrook, California. Due to his love of Mexican-Indian culture, he decided to construct the home utilizing adobe materials and workmanship common to the Indians near Mexico City during the early part of the 20th Century. The home was completed after approximately 1-1/2 years of construction work. In the attempt to duplicate both the materials of construction and workmanship of the Mexican Indians, Mr. Jakway acted as the construction foreman. He employed five members of the Mexican-Indian tribe with which he was familiar since Mr. Jakway lived and toured Mexico on many occasions. This paper briefly describes the construction details of this adobe home and its performance under Southern California-type climatic conditions and earthquakes.

Design of the Adobe Home

The home is located in an unincorporated area of Southern California, hence the design and construction procedures were approved by the Building Department of San Diego County. According to the 1979 UBC Seismic Risk map of the United States, this region is located in Seismic Zone 4. Since the home was constructed prior to the 1971 San Fernando Earthquake, the design of the home apparently involved only a simple set of calculations for the roof beams and girders. The adobe walls were approved on the basis of their overwhelming thicknesses ranging from 18 in. to 24 in. The home is located 70 miles directly south of the epicenter of the 1971 San Fernando Earthquake and approximately 60 miles west of the southern portion of the San Andreas Fault as shown on Fig. 8 and 30 miles west of the San Jacinto Fault. The extensive damage to buildings and bridges produced by the 1971 San Fernando Earthquake resulted in major changes in various building codes in regards to seismic design. Hence, if this adobe home were to be constructed under the current code requirements, additional calculations and different construction practices would be required since unburned clay brick walls must be stabilized with emulsified asphalt and compressive and shear stresses must exceed 30 psi and 8 psi, respectively (1979 UBC).

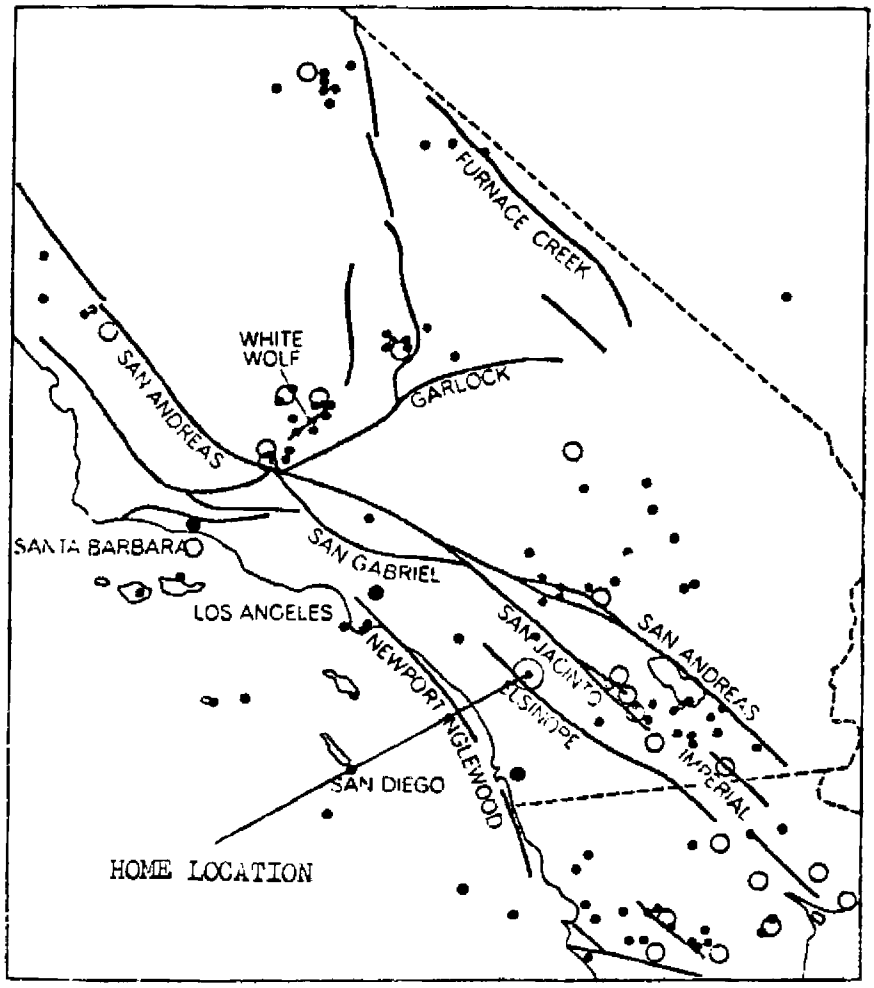

FIG. 8

Thirty-six year earthquake record shows the epicenters of all events of magnitude 5 or greater recorded in Southern California and in the northern part of Baja California from 1931 through 1969. The epicen is the point on the earth's surface above the initial break. Dots s earthquakes between 5 and 5.9 in magnitude. Open circles indicate e quakes of magnitude 6 or greater. The hypocenter, the point of the break in the earth's crust, is often many miles below the surface in thrust-type earthquakes, a type frequently observed in this region. the 36-year period Southern California and adjacent regions experien more than 7,300 earthquakes with a magnitude of 4 or more. Earthqua are about 10 times more frequent in this area than they are in the world as a whole.

The home consists of two bedrooms, 1-1/2 baths, large family room and a spacious kitchen and dining room. The L-shaped home has floor dimensions of 70 ft. by 25 ft. The total floor area is about 1,800 sq. ft., including a two-car garage. Due to the thick adobe walls, insulated roof, and relatively low window glass area, the energy consumption for heating and cooling are minimum. The temperatures outside the home vary from a low of about 30°F during winter nights to over 100°F in the summer. However, without the benefits of air conditioning or heating, the home inside temperature varies between 60°F to 75°F throughout the year.

Preparation of Adobe Brick

The soil surrounding the adobe home has a distinctive reddish clay appearance. For aesthetic purposes and in keeping with the Mexican-Indian customs most adobe bricks were manufactured with on-site soil and on-the-job site. The bricks were manufactured in wooden molds to a finish size of approximately 4" x 12" x 18". The mixture used for the adobe bricks was as follows: 15 shovels of soil, one quart of asphalt stabilizer, a minimal amount of straw and sufficient amount of water to produce a mix which would yield about a comparable 3-inch concrete slump. The soil used to make the adobe bricks was graded with large sieves. The final soil mix consisted of about 30% passing the number 200 sieve and nearly 100% passing the number 4 sieve. The soil, water, stabilizer and some organic straw were mixed with a typical 1/2 cement sack mixer. Some small lumps of soil can be seen in the finished brick due to lack of mixing. The final adobe bricks were dried in the sun for a period of about two months. Sample bricks were sent to testing laboratories for compression strength, shear strength, water content and stabilizer content. The test results were approved by the San Diego County Building Department.

Foundation and Wall Construction

The foundation for this adobe home consists of concrete with minimal amount of reinforcement. All existing floors consist of unreinforced concrete pads about 4 inches thick poured after the foundation had been placed but before the walls were constructed. The exact cross-sectional dimensions for the foundation are unknown with the exception of the depth of 15 inches to 18 inches.

All walls were constructed with adobe brick discussed earlier resulting in 18-inch wall thicknesses. Oval pilasters at the house corners were about 24-inches thick. The mortar consisted of the same adobe mix used for the fabrication of the brick. Each adobe brick layer was completed before the next layer was begun in order to permit each mortar joint to gain sufficient strength to avoid settlement. The mortar joint thickness varies

from a minimum 3/8-inches to about 5/8-inches in order to compensate for irregular dimensions of the adobe brick.

The interior of the walls was plastered with about a 1/2-inch to 3/4-inch thick gypsum plaster base coat followed by a 1/8-inch thick interior finish gypsum coat. The resulting interior wall surfaces were smooth and were painted periodically with common water based paints. Peeling of paint has not been observed. However, as a result of moisture accumulation near windows and doors, blistering and effervescence appear to be a continuous problem.

The exterior of most walls was neither plastered nor treated with admixtures or surface coatings. However, as a result of weathering, the exterior walls have been painted about every 10 years with the adobe type coating mix.

Due to lack of tooling or precise workmanship, the Mexican-Indian adobe homes built near Mexico City were constructed with slightly crooked walls. Such wall crookedness was duplicated by Mr. Jakway in his adobe home shown in Fig. 9. The slight curvature in the walls provides an aesthetically appealing view without providing a sense of insecurity. All door and window frames were cut from hewed logs and set flush into the walls. The windows were constructed from iron bars and glass set into a soft lead sodder. Thus, the windows cannot be opened.

Roof Construction

The roof has a pitch of approximately 1/2-in. per foot and sloping in one direction only. The beams, girders and slats were hewed from local spruce pine trees using a small hand ax as was common practice of the Indians. The roof tile consists of a local fired clay product. The roof tile is attached to the 2-in. by 2-in. wooden slats by a tongue and groove type of construction. The slats rest on beams and were placed diagonally as shown in Fig. 4b. Small clearances and embedment into the adobe walls prevent movement of the slats.

The beams and the girders are embedded into walls. Nails were sparsely used in the roof construction primarily for the purpose of beam and girder alignment during the construction. All beams and girders were erected with pully systems and manpower. The slats, beams, and girders were cut to length utilizing a cutting tool similar to a saw that was common to Mexican-Indians during the early years of the 20th Century. The beam spans range from 5 ft. to over 8 ft. with cross-sectional dimensions of 4 in. by 8 in. The girders span lengths of up to 22 ft. with varying cross-sections.

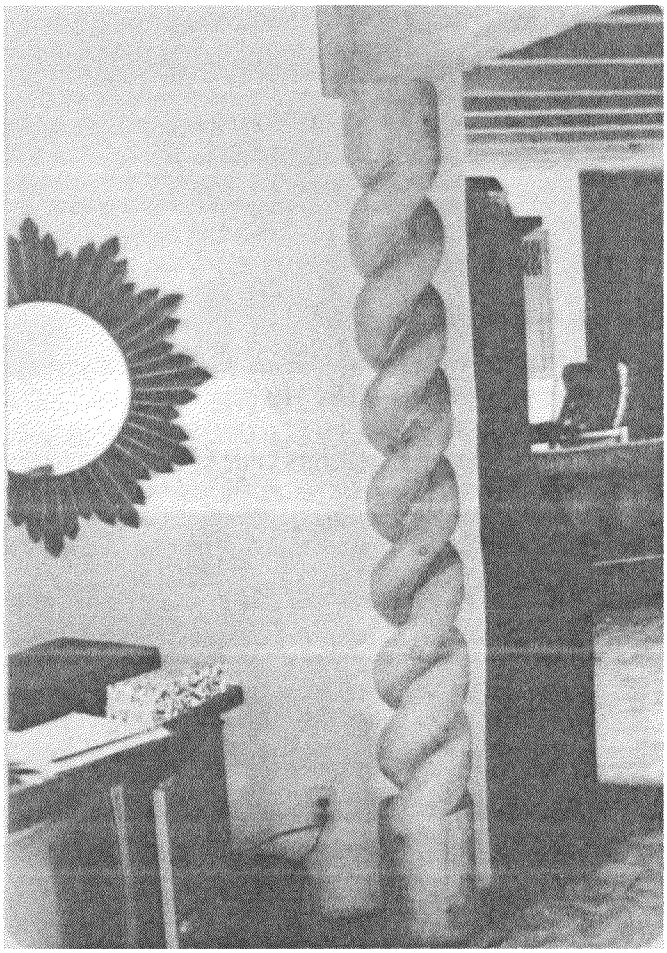

FIG. 9

Crooked Wall and Spiral Wood Column