ADOBE CONSTRUCTION AND ITS PERFORMANCE IN SOUTHERN CALIFORNIA

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ABSTRACT

This paper presents a discussion on the construction and performance of two adobe structures in Southern California. First, a discussion on the San Fernando Mission, the largest adobe structure in California, is presented relative to its adobe construction details and its performance and rehabilitation during and after the 1971 San Fernando Earthquake. Second, an adobe home located near Oceanside, California is discussed regarding its method of construction and performance under weathering and earthquakes since its construction in 1964.

General History and Description

On September 8, 1797, the Mission of San Fernando Rey de Espana (the Mission San Fernando) was founded by Padre Fermin Lasuen, founder of eight other California missions. This was the 17th of the 21 missions to be founded by the Spanish priests along the coast of California. The mission was located in the oaken valley so named by the Spaniards in 1769, but known to local Indians as Achois Comihabit. The mission grounds are approximately 25 miles north of downtown Los Angeles which is presently known as the San Fernando Valley.

The first chapel was completed in 1799. The third chapel was completed in 1806 and was damaged extensively by the 1812 earthquake. The 1971 San Fernando Earthquake damaged the adobe walls to the extent that a decision was made to demolish the damaged chapel and reconstruct an exact replica.

The Mission San Fernando from its beginning flourished and grew. The various buildings were made from adobe and tile decorated by artwork of both Spanish and Indian cultures. As the mission grew, it became known for its leather, cloth and iron goods. In the early 19th Century, it became a trading center for what is now the San Fernando Valley. The mission continued to prosper until the 1830's when the missions were secularized. By the time of the Civil War, this and many other California missions were no longer used and its buildings deteriorated.

The mission grounds consisted of numerous buildings as shown in Fig. 1. The present chapel is the mission's fourth chapel which is an exact replica of the third chapel. The chapel is 166 ft. long and 35 ft. wide with tapered walls over five ft. thick (at some locations over 8 ft. thick) at the base and tapering to over three ft. at the top. The wall taper gives the impression that the walls are leaning inward. Due to the severe winds from the Mojave Desert, no windows were placed on the north-facing wall of the building.

Much of the chapel's current interior artwork is original. Of all the wall murals, most are original although in some damaged areas the murals were repainted. The statue over the alter of St. Ferdinand III, the Spanish king for whom the mission was named, and the painting of St. Francis of Assisi are both original artworks from the 19th Century chapel. Also located throughout the chapel are French lithographs and some modern statues.

Southwest of the chapel is located the Convento Building which took 13 years to construct. The one-story adobe building is 243 ft. long and 60 ft. wide, making it suitable for long strings of living quarters. The building has 21 Roman arches along the exterior walkway and Moorish arches on the windows and doors. The walls were constructed of 4 ft. thick adobe bricks decorated with Indian wall decorations.

The Convento Building houses many different rooms. The largest of the rooms is the Sala or Reception Room. It's ceiling, unlike the chapel ceiling where beams rest on corbels, rests on square beams and fasten to the walls directly. Rawhide thongs were used to fasten members together since iron

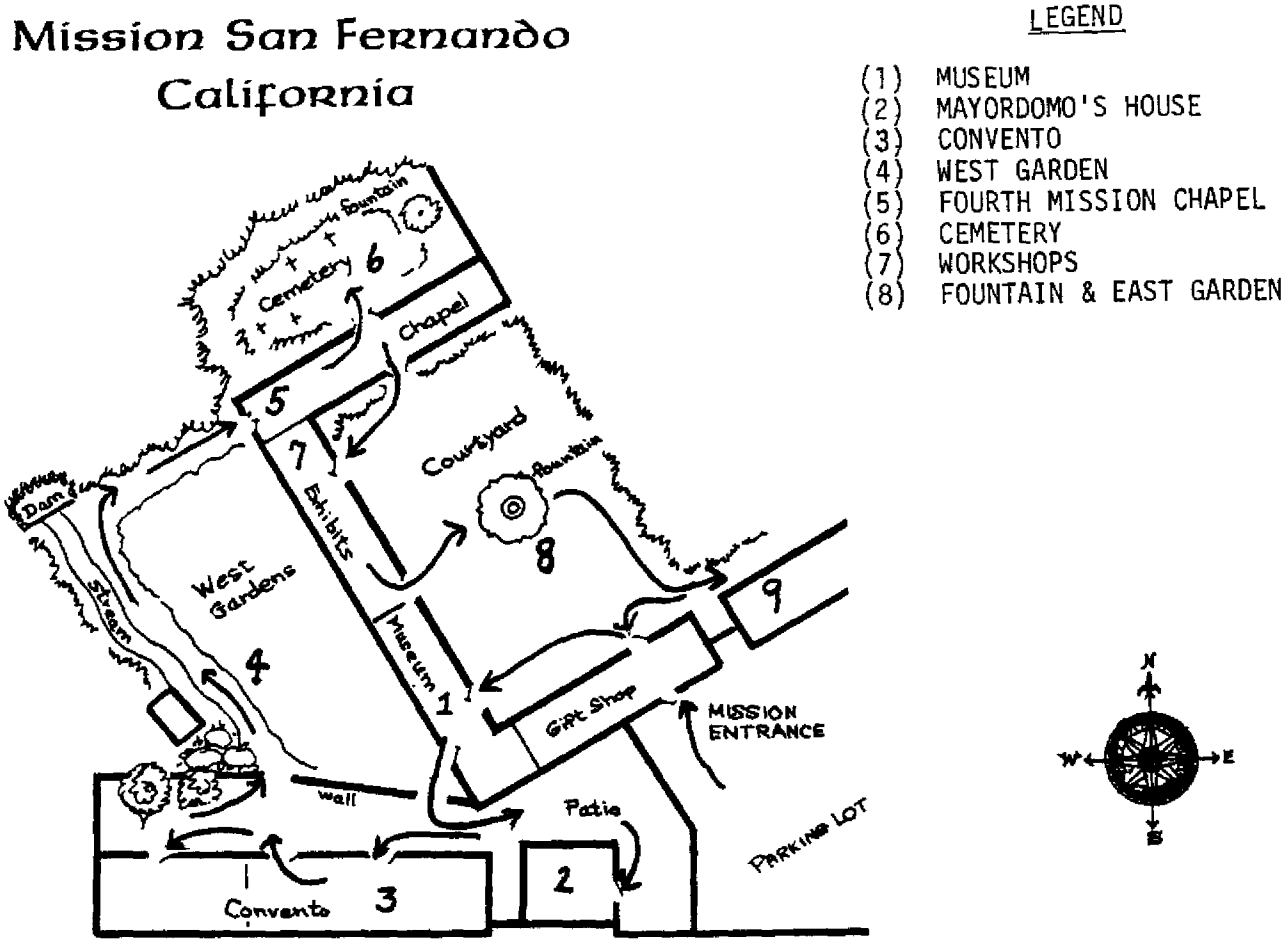

FIG. 1

San Fernando Mission Grounds

shortages existed around the mission. Indian murals depicting the Indian point of view decorate the Reception Room.

The Convento also contains dining rooms, mission offices, a wine cellar where wine was made, a library, a governors' room for prominent visitors, the bishop's room, a kitchen, a smokehouse, and the Valley's first hotel known as the "hospice". In addition, many of the rooms are presently being used to house a museum which has many of the mission carvings, paintings and old vestments.

Located adjacent to the Convento is the Mayordomo's house. It housed the foreman of the mission ranch which was 121,542 acres and had over 21,000 head of livestock at one point. The house, built in 1801, is a three-room building. By 1900 it was in ruins and was finally restored in 1949. The house is presently decorated to depict the look of an overseer's home.

The remaining buildings all of adobe construction on the mission grounds were used for various functions required to operate the mission in the early part of the 19th Century. As a self-sustaining mission, workshops for such trades as carpentry, saddlery, pottery, weaving and blacksmithing were vital to the survival of the mission. All shops were of one-story construction with numerous rooms and doors. A colonnade, or patio, in front of the workshops was supported by large plastered rectangular columns made from adobe brick. This part of the mission deteriorated rapidly after the 1850's and by the early 1900's, it became a pile of rubble. The adobe bricks varied in size since restoration occurred over a period of 150 years. The adobe bricks were manufactured primarily with soil, water and minimal amounts of straw. Asphalt stabilizers were not used until after 1930 in the construction of the adobe bricks.

The mission grounds also consist of a large cemetery, central courtyard of exotic gardens and a large fountain. The cemetery contains the remains of more than 2,500 Indians and early settlers. The gardens were and still are planted with rare trees, beautiful flowers, cacti and fruit bearing trees. The main fountain is located at the center of the courtyard as illustrated in Fig. 1. The courtyard, once the center of the mission's everyday work-life, is now planted with grass, trees and shrubs.

The mission is located at the northern end of the San Fernando Valley about 10 miles from the Pacific Ocean. The climatic conditions are typical of the temperate and pleasant weather conditions for which Los Angeles is recognized. The temperatures since the founding of the mission have probably varied from a low of about 40°F during the winter month evenings to over 110°F during the hot summer days. Since 1900 the annual rainfall for the Los Angeles Basin varied from a low of about 2 inches to a high of more than 30 inches with an average of about 10 inches. Prevailing winds are from the West (the Pacific Ocean) and the East (Mojave Desert). The combination of neglect, wind, and rain over the period of nearly 180 years resulted in virtual disintegration of the adobe construction.

In relationship to seismic activity, the San Fernando Mission is located in UBC Seismic Risk Zone 4. Fig. 2 provides the location of the mission in relation to the epicenter of the 1971 San Fernando Earthquake. Within a 0.5 mile radius of the mission two concrete structures were severely damaged.

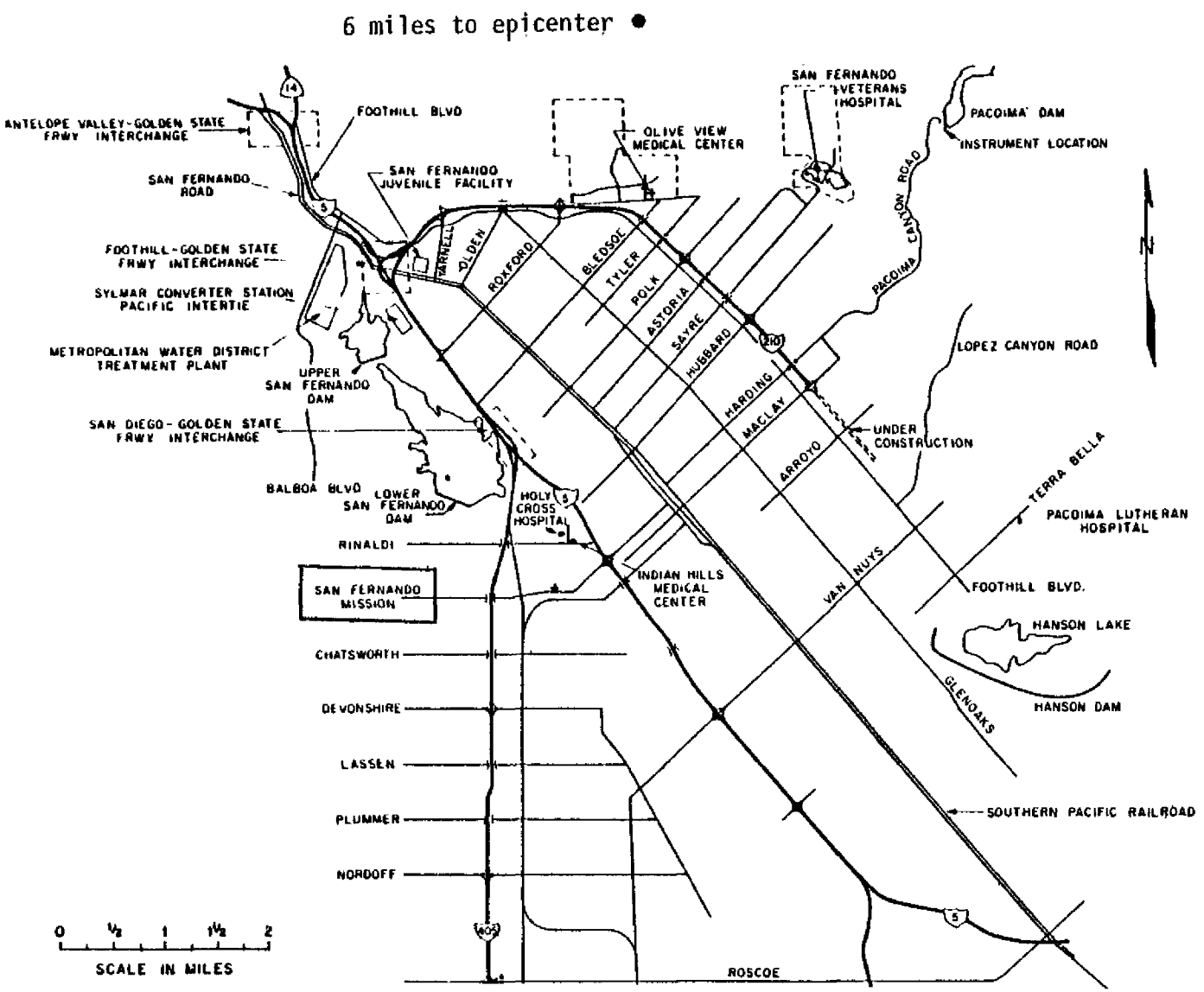

FIG. 2

Mission Location Relative to Epicenter of 1971 San Fernando Earthquake

The four-story St. Mary's Hospital was damaged to the extent that repair was not feasible and, as a result, it was demolished in 1973. The eight-story Indian Hills Medical Center suffered extensive damage, but repair in the form of epoxy injection was feasible.

Restoration Prior to 1971 San Fernando Earthquake

San Fernando Mission was secularized in 1834 and for the next 28 years it would be used as a stage station. In 1862, President Lincoln restored by order the mission and the grounds to the Catholic Church. Thereafter, the mission was used for various religious and educational purposes. Through neglect and deterioration, most mission buildings became a pile of rubble by the end of the 19th Century. Restoration was attempted at least on four different occasions; 1879, 1912, 1926 and 1930. Due to the lack of funds and possibly a lack of restoration technology, all four of these restoration attempts were unsuccessful. After World War II, William Randolph Hearst established the Mission Restoration Fund and endowed it with sufficient funds to restore the mission and its grounds to the beauty and authenticity of the early 1800's when the mission flourished and prospered. The nature of this restoration involved placement of concrete bond beams, reconstruction of the workshop area using new adobe bricks and replastering both the interior and exterior wall surfaces of the chapel and other buildings.

Damage of Mission Buildings Due to 1971 San Fernando Earthquake

The chapel suffered the most severe damage of all the mission buildings, primarily due to large open areas not common to other buildings where many interior walls provided resistance to the seismic loads. The most severe seismic damage to the chapel occurred at the choir loft and near the base of the exterior walls. Despite such damage, the adobe chapel survived the earthquake without collapse.

Figure 3 shows the damage suffered by the adobe walls due to load transfer from the wooden beams of the choir loft. These wooden beams were apparently embedded into the adobe walls to a depth of only about 18 inches. As a result, at least one course of adobe brick peeled away from the adobe wall and collapsed as shown more vividly in Fig. 4 . This portion of the church suffered the most severe damage.

The east wall represents the front of the chapel. Fig. 5 provides a general interior view of the east wall, the altar and portions of the north and south walls. Extensive damage to the interior plaster included both cracking and spalling. At least one course of adobe brick peeled from the north wall in several regions near the pulpit. Other portions of the interior surfaces of the adobe walls were damaged primarily in the form of cracking