FINALIST—2019 PROJECT OF THE YEAR
HISTORIC CATEGORY

Napa Valley Courthouse

NAPA, CALIFORNIA
SUBMITTED BY PULLMAN

Fig. 1: Napa Valley Courthouse after repairs

OVERVIEW

Constructed in 1878 in the high Victorian Italianate architectural style, the Napa Valley Courthouse is listed on the National Register of Historic Places (Fig. 1). The 18,000 sf (1,670 m^2), three-story building consists of a concrete foundation with a full basement, a brick and stucco wall assembly, and a metal roof. The outer walls consist of masonry assemblies covered in Rosendale cement, held in place by iron bands embedded in the foundation. A hipped roof frame is supported by brick walls and timber trusses. The cornice is galvanized iron supported by block modillions. Frieze and dentils wrap the building, along with a simple molding delineating the first and second story. The structure also boasts segmental arched hoods above the wooden windows and double door entrance.

EARTHQUAKE DAMAGE

The Courthouse suffered extensive damage after a 6.0 magnitude earthquake struck the region on August 24, 2014. The load bearing masonry walls, plaster, and wood trim exhibited severe damage from the excessive movement (Fig. 2). Shear cracks ran through many of the exterior and interior walls, coupled with diagonal cracking through many of the window spandrels. A gaping hole was visible at the southeast corner roofline, and portions of the interior walls were in danger of collapsing. HVAC, fire sprinklers, and electrical systems were also impacted.

The Courthouse was deemed unsafe and closed for repairs. County officials set up temporary spaces for court services to be held elsewhere, while a team was assembled to assess the extent

of the damage and develop recovery plans. After years of planning and coordinating with various parties to secure funding, Napa County started the project with rehabilitation work beginning in the summer of 2017, three years after the earthquake hit.

The project team assisted with stabilizing and preserving the historic structure. A key solution for the project involved a unique application of seismic retrofit technology that would minimize the destruction of the historic structure.

The design team's repair strategy enhanced the structure's resiliency by evaluating each structural element for deficiencies (Fig. 3). The seismic retrofit consisted of a multi-pronged approach to address these deficiencies. Because the original masonry was unreinforced, the walls that were completely destabilized needed to be demolished, shored, and rebuilt with grout filled and reinforced concrete blocks (Fig. 4). Load bearing brick walls that did not collapse received externally applied reinforcement. To stabilize walls that were only partially damaged, helical anchors were used to tie various wythes of bricks together.

IMPLEMENTING A SEISMIC UPGRADE SOLUTION AND OTHER REPAIR STRATEGIES

To upgrade the structure for seismic conditions in the event of another earthquake, all unreinforced masonry was repaired using a fabric-reinforced cementitious matrix (FRCM). A new technology in the United States, FRCM is an externally applied composite system which combines a carbon-fiber reinforcing grid into a layer of sprayable high strength mortar (Fig. 5). The application is conceptually similar to traditional enlargements with additional concrete and steel reinforcement, but without adding significant weight or volume. The installation process is faster and requires less preparation than traditional shotcrete repairs. The system also withstands harsh environments and service conditions, including elevated temperatures, humidity, and ultraviolet (UV) light.

To implement the FRCM application, the bricks were brought to the correct moisture content and nominal 1 in (25 mm) thickness for FRCM to properly adhere. Teams sprayed the walls with water and covered them with burlap to retain the moisture two days before applying the FRCM. The FRCM was completely concealed behind new plaster and salvaged wooden wainscot. These steps were taken to accurately reinstall the historical trims. Over 15,000 sf (1395 sm) of FRCM was installed on 43 different wall locations.

Localized damaged portions of the existing load-bearing masonry walls were rebuilt with existing brick. Walls that were beyond repair were demolished and newly constructed

Fig. 3: Traditional masonry repair strategies, including grout injection and masonry ties, stabilized the structure to receive seismic upgrades

Fig. 2: The unreinforced masonry walls crumbled while the glass from the vaulted glass dome on the second floor was undamaged

Fig. 4: The versatile building block enabled reconstruction in areas that were completely destabilized

with grouted concrete masonry unit (CMU) blocks. All new walls were constructed with a specially designed expansion joint system to mimic the thermal expansion properties of the existing wall assemblies. Over 3,800 ft (1160 m) of crack injection with high strength grout was performed. Twenty-five wall assemblies were rebuilt with CMU blocks and over 300 cy (230 cm) of grout was placed within the blocks.

Fig. 5: Reinforcing a wall with the FRCM system

Fig. 6: The Courthouse after removing the sheathing, and prior to exterior plaster and coating work

Fig. 7: The Courthouse construction near completion

To ensure that all connections lined up, mock-ups were performed for each type of brick in both the horizontal and vertical planes. The team provided field verification to communicate the numerous conditions that required special detailing. The entire project required sensible material handling and efficient work flow. Moving over 10,000 different-sized CMU blocks and placing thousands of feet of reinforcement required careful staging. Building the segmented window and door arches required traditional masonry craftsmanship to repair the existing arches. In total, 28 precast concrete arches weighing over 1,000 lb (454 kg) were installed for lintels.

Refer to Figures 6 and 7 during Courthouse repairs after removing the sheathing and construction near completion.

RECOVERY AND RESILIENCY

By understanding the nuances and sensitive nature of historic restoration, the Napa Valley Courthouse project team was able to create a suitable repair program that maintained the structure's historical integrity while meeting the modern day needs of the community. With the help of ground-breaking technology and ongoing research, knowledge of seismic design and retrofit continues to grow. New technologies like FRCM offer opportunities to repair and strengthen existing structures, which limit changing the original fabric of a building. The project was completed in early 2019 with zero workplace incidents. The town held a grand re-opening in January 2019 to celebrate the community's progress toward earthquake safety and getting back to business as usual.

Napa Valley Courthouse

SUBMITTED BY
PULLMAN
Napa, California

OWNER
Napa County Public Works
Napa, California

PROJECT ENGINEER/DESIGNER
ZFA Structural Engineers
Napa, California

REPAIR CONTRACTOR
PULLMAN, A Structural Technologies Company
Benicia, California

MATERIALS SUPPLIER/MANUFACTURER
Simpson-Strong Tie
Pleasanton, California