2009 Outstanding Repair & Rehabilitation Project

Seismic Retrofit to the University of Memphis' Cecil C. Humphreys School of Law

In January of 2006, the University of Memphis officially announced that it was moving the Cecil C. Humphreys School of Law to the historic building that housed the Memphis Customs House, the Federal Court House, and the Post Office. The United States Post Office was the last of the original occupants to leave the building when it relocated in 2005. The building was donated to the state of Tennessee for the Tennessee Board of Regents through a series of easement transfers from the United States Postal Service to the city of Memphis and then to the state of Tennessee. The classical revival-style building was placed on the National Register of Historic Places in 1980, and has a beautiful view overlooking the Mississippi River and Mud Island River Park. The architects, Askew, Nixon, Ferguson Architects, Inc. & Fleming Associates Architects, worked with the University of Memphis and the Tennessee Board of Regents to redesign the building to include auditorium classrooms, a law library, and faculty and administrative offices; and remodeled high-ceilinged courtrooms and student activity areas. Burr & Cole, CE Inc. and Rutherford & Chekene, Inc., provided the structural and seismic engineering designs that met the new requirements.

Building History

The 140,000 ft^2 (13,006 m^2) building has a core that dates back to the early 1880s, but includes additions that were built in 1903 and 1929. During the major expansion and remodeling in 1929, limestone replaced the building's previously marble exterior. The beautiful structure of limestone, granite, and marble was built to last, but it wasn't built up to earthquake building codes. Memphis sits along the New Madrid Fault Line and authorities are doing their best to prepare for possibly large earthquakes that could hit the area at any time. In this case, the new construction within the 1903 addition was designed to meet earthquake requirements of the code, but other areas of the building needed modification. In addition, the Tennessee Board of Regents allowed approximately $2.1 million to retrofit the balance of the building with seismic shear walls and other seismic restraints.

East façade of the University of Memphis' Cecil C. Humphreys School of Law during the renovation project

Seismic Retrofit

In June of 2006, Bruce Burr of Burr & Cole, CE Inc. contacted Pat Mooney of Proshot Concrete, Inc., to discuss the possibility of using shotcrete as part of the seismic retrofit. Proshot Concrete, Inc. was contacted for their shotcrete expertise to complete a seismic retrofit that would bring the building up to code. Because the building was constructed in separate phases using different building techniques, the design for the seismic retrofit wasn't the same for all parts of the structure. The original rectangular core of the building was scheduled to receive the most drastic architectural and structural design changes. It received a

Lower portion of 18 ft (5.49 m) reinforced concrete wall

complete internal shell of steel reinforcement and shotcrete from the basement to the fourth floor attic.

Building's Core

Two reinforcement walls of No. 5, No. 6, and No. 8 steel reinforcing bar were constructed on a new footer in the basement floor and then covered with 12 in. (304.8 mm) of shotcrete to create the reinforced concrete shear walls. The 4 ft (1.22 m) wide footer was built with a depth of 4 or 6 ft (1.22 or 1.83 m) to meet the design specifications. During the construction of the steel-reinforced shear walls, mounting plates and dowels were carefully placed for the location of the new floors. Within the building's rectangular core, a 3 ft (1 m) area was demolished around the perimeter of the existing floors to provide access to the walls of the steel reinforcing bar that connected the separate levels of the building. The completed internal shell of reinforcement steel and shotcrete provided the structure with enough strength to allow for the removal of the preexisting flooring and support beams. The roof above the building's rectangular core was demolished to provide access to the interior levels. Large cranes used wrecking balls to demolish the old horizontal floor of arched brick and concrete around the steel support beams. The old beams were connected to the crane and then cut to be lifted away just before the new steel I-beams were installed at each level. The new floor plans included auditorium seating in the large class rooms, so they required slanted support beams at varying heights. The accurate placement of the end plates during the shotcrete process was critical to the I-beam installation. The application of shotcrete allowed for minimal forming for the 12 to 20 ft (3.66 to 6.1 m) tall shear walls and ease of access for multiple contractors working on the project.

Building's L-Shaped Wings

The north and south wings of the building received steel reinforced shotcrete corners instead of a complete perimeter lining like the building's original core. The 12 in. (304.8 mm) of reinforced shotcrete stretch 12 to 20 ft (3.66 to 6.1 m) in each direction from the building's internal corners, depending on the specifications. Similar to the shear wall shell of the building's core, the reinforcement corner walls began in the basement and created a continuous wall of steel to the building's attic. Instead of demolishing a gap for the wall of steel and shotcrete, holes were bored into the existing concrete floors for the steel reinforcement and the shotcrete was finished flush to the existing surface.

Wooden forms were built to protect the tall, arched windows during the retrofit process. Three ft (1 m) epoxy-coated angled dowels were also installed around the perimeter of each floor

Internal corner with reinforced shotcrete around arched windows

Wooden window form and reinforcement prior to receiving 12 in. (304.8 mm) of concrete

to join the exterior façade to the reinforced interior. In all, 300 tons (272.2 metric tonnes) of steel and 2000 yd^3 (1529.1 m^3) of concrete were used throughout the building to accomplish the seismic retrofit. The specifications for the job required an average compressive strength of 5000 psi (34.5 MPa), but Proshot Concrete, Inc., was able to maintain an average compressive strength between 7000 and 8000 psi (48.3 and 55.2 MPa).

Fourth Level Renovations

The beautiful limestone exterior of the building received a cleaning and repointing of joints, but wasn't disturbed or altered for the seismic retrofit. The roof was removed from the original rectangular building to convert the attic into a useful human-occupied space. The dark attic that was once just used for storage is now a light-filled area that contains the law review suite, learning commons, and a reading room with large windows overlooking the Mississippi River.

Project Summary

Bell & Associates Construction, LP, was the general contractor on the project and they worked

with Proshot Concrete, Inc., the University of Memphis; the Tennessee Board of Regents; and A&E to preserve the historic features of the building while completing the seismic retrofit. Bell & Associates Construction, LP, did a great job coordinating the multiple contractors working on the job. Working with electrical; heating, ventilating, and air conditioning (HVAC); plumbing; fire sprinklers; telecommunications; and other contractors who needed to penetrate the steel-reinforced walls during the project was a major task for Proshot Concrete, Inc. Shotcrete's characteristics made it a key factor to the overall quality of the seismic retrofit and remodeling project. Shotcrete's minimal forming allowed large areas to be prepared with reinforcing bars in advance of the shotcrete placement. The large historical building with multiple levels and an existing floor plan created many challenges during this project, but the use of shotcrete allowed the seismic retrofit to have minimal impact to the building's appearance. The Cecil C. Humphreys School of Law will be a modern learning environment in a historical building and the use of shotcrete is helping to ensure a safe environment for many years to come.

Concrete pump at the southwest corner of the Cecil C. Humphreys School of Law

The Outstanding Repair & Rehabilitation Project

Project Name
Seismic Retrofit to the University of Memphis Cecil C. Humphreys School of Law

Project Location
Memphis, TN

Shotcrete Contractor
Proshot Concrete, Inc.*
Daniel Wallace, Superintendent
Patrick A. Mooney, Project Manager

General Contractor/ Project Management
Bell & Associates Construction LP
John Thayer, Project Manager

Architects
Askew, Nixon, Ferguson Architects/ Fleming Associates

Engineers
Burr & Cole, CE Inc./Rutherford & Chekene, Inc.

Project Owner
Tennessee Board of Regents/ University of Memphis Law School

*Corporate Member of the American Shotcrete Association