EMERGENCY MASONRY REPAIRS TO SAM H. WHITLEY HALL

TEXAS A&M UNIVERSITY AT COMMERCE

BY MARK LeMAY

Sam H. Whitley Hall, located on the south end of the Texas A&M University campus in Commerce, TX, is one of the tallest buildings in rural Hunt County. Constructed in 1969, the Whitley Hall dormitory building is a 12-story, concrete-framed structure with brick veneer exterior cladding. On each floor, the dormitory rooms are arranged along an east-west double-loaded corridor. The concrete columns and beams articulate the north and south façades, infilled with windows atop brick veneer that is backed by concrete masonry unit knee walls. Emergency egress stairways are situated on the east and west ends of the building. Cast-in-place reinforced concrete shear walls serve as the back-up for the brick veneer on the east and west elevations. Portions of the brick veneer are laid in a stacked bond configuration, while other parts are arranged in a standard running bond pattern.

SEVERE WEATHER EVENT PROMPTS NEED FOR EMERGENCY REPAIRS

In January 2012, 2 days prior to the start of the spring semester, an unusually severe wind storm resulted in a potentially life-threatening situation at Whitley Hall. Winds in excess of 60 mph (97 kph) caused a 10 x 12 ft (3 x 3.7 m) section of brick veneer to become dislodged from the southeast face of the Penthouse level (Fig.1), falling 140 ft (43 m) onto the adjacent parking lot and first-floor roof of the resident assistant's apartment below (Fig. 2). Fortunately, no injuries resulted from this unexpected failure.

Beginning with a call to the engineer the morning following the catastrophic event, plans were immediately discussed and implemented to cordon off the area of the parking lot where debris had landed, provide protective coverings over entrances for the arriving students, and to assess the structural condition of the building. University personnel provided copies of the original construction drawings, confirming that the detached masonry was an exterior veneer system, non-load-bearing, and not integral to the structural frame of the building. The engineer immediately replied to the university with a letter confirming this information, with assurances that the building remained suitable for occupancy provided that adequate barricades were in place and overhead protection was in place for building occupants at each set of entry/exit doors.

INITIAL INSPECTION AND EVALUATION

Within hours of notification by the university, the engineer's initial observations of the failed section from the adjacent roof provided several significant clues regarding the failure:

1. Dovetail anchor slots were cast into the reinforced concrete backup wall.
2. Asphaltic damp-proofing was applied over the concrete backup wall.
3. Moderately to severely corroded corrugated metal wall ties occurred in some random portions of the failed sections of brick (Fig. 3).
4. Locations where the metal wall ties had been pulled out of the dovetail anchor slots were

Fig. 1

Fig. 2

Fig. 3

observed only in the lower portions of the failed section—no such locations were observed in the upper two-thirds of the detached section of brick (Fig. 4).

Preliminary findings pointed to the absence of corrugated metal wall ties in the upper portion of the failed section of brick. Despite having remained in place for 43 years, the unique wind conditions that January evening most likely produced a vacuum effect that essentially sucked the untied brick veneer off the face of the building. The degree of corrosion observed on the metal wall ties also created a significant degree of uncertainty regarding the integrity of the remaining ties. Immediate plans were made to review original drawings and further investigate the condition of the metal ties in other sections of the exterior walls.

An examination of the original drawings revealed the following:

1. Corrugated metal wall ties were to be spaced at 16 in. (406 mm) on center horizontally and vertically.
2. Damp-proofing was specified for exterior surfaces of the backup walls.
3. Steel relief angles at 4 x 3.5 x 0.187 in. (102 x 89 x 5 mm) were to be located at each floor level to support the brick veneer and were to be coated with "mastic."
4. Weep holes were to be spaced at 24 in. (610 mm) on center, but only at the base of the masonry walls, not at each relief angle location.

Based on initial observations and a review of original drawings, the as-built construction of the brick veneer was not in compliance with the construction documents, and was a contributing factor in the failure of the dislodged section of brick. Furthermore, the lack of conformance with the construction documents had caused premature

Fig. 4

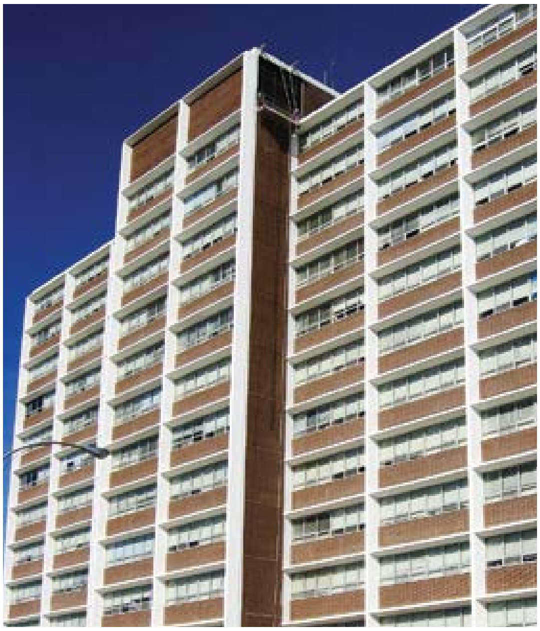

Fig. 5

deterioration of the brick support and anchorage systems that resulted in a reduced life expectancy of the brick veneer system.

FURTHER INVESTIGATION AND CLOSE-UP INSPECTION

Immediately following the initial evaluation performed the day following the event, the university recognized the severity of the situation and took swift and decisive measures to authorize emergency action. A contractor was hired and a swing stage scaffold was put into place at the location of the dislodged section (Fig. 5).

The remaining brick veneer was removed from the failed section and close-up inspections commenced. The existing corrugated metal wall ties were located using nondestructive methods. At all locations, the spacing of the wall ties was found to be extremely variable, and not in conformance with the project requirements. Random sections of the brick veneer were removed to examine the condition of the ties. Corrosion on the corrugated, galvanized ties ranged from mild to severe. A few of the ties were observed to be completely severed, thereby providing no anchorage to the backup wall (Fig. 6).

Because no weep holes were observed at any of the relief angle locations, random removal of the brick veneer was performed at several floor levels. Mastic was not observed at any of the relief angles and many of the steel angles were observed to be mildly corroded on the lower levels to severely corroded on the upper levels (Fig. 7). The lack of proper flashing over the relief angles and the absence of weep holes to direct moisture to the exterior of the wall significantly compromised the life span of the brick veneer system on the east and west elevations.

At the stacked bond sections of brick veneer, located at the center sections of the east and west elevations and at the Penthouse level on the north and south elevations, extensive areas of spalled mortar were exhibited. Ladder-type reinforcement installed too close to the exterior surface of the joint resulted in significant corrosion of the steel and spalling of the mortar (Fig. 8). Investigation of the metal wall ties in the stacked bond veneer revealed the same random spacing and mild-to-severe corrosion found in other locations.

Investigations were also conducted on the lower portions of the north and south elevations. According to the original drawings, the 4 ft (1.2 m) high sections of brick veneer under the windows were shown to be tied to the concrete unit masonry backup walls using ladder-type reinforcement. Initially, the metal reinforcement was located using nondestructive methods. However, to confirm the condition of the reinforcement, the brick veneer was removed at several locations. In all instances, the reinforcement was observed to be in good condition (Fig. 9). Nondestructive investigations were performed at all brick veneer locations to confirm that the ladder reinforcement had been installed. No deficiencies were found at these locations.

DEVELOPMENT OF REPAIR METHODOLOGY

Because university officials were faced with the daunting and costly potential of having to remove and replace 22,000 ft^2 (2045 m^2) of brick veneer on

Fig. 6

Fig. 8

Fig. 7

Fig. 9

14 "drops" around the building, the engineer began to investigate alternative repair options. Through a collaborative effort involving the contractor and various material suppliers, tests were conducted on several of the repair alternatives. The tests showed that stainless steel helical wall ties installed through the mortar joints of the brick veneer into the concrete backup wall could properly restore the anchorage of the veneer to the concrete wall. Pullout values of the helical wall ties were tested on all drops where repairs were performed with no results less than 400 psi (2.8 MPa).

Because the adequacy of the original corrugated metal wall ties was compromised at several locations, the decision was made to install the remedial wall ties at all brick veneer locations on the east and west elevations, and at the sections of stacked bond brick located at the Penthouse level on the north and south elevations. Spacing of the ties was specified to be 24 in. (610 mm) on center horizontally and 16 in. (406 mm) on center vertically.

Although the lack of protection for the steel relief angles had yet to result in the failure of an angle, all parties agreed that this condition needed to be rectified. Working closely with the contractor and the material supplier, the engineer devised an innovative approach to holding the upper portions of brick veneer in place while several rows of brick were removed to facilitate the removal and replacement of corroded steel relief angles. It was determined that staggered rows of stainless steel helical wall ties installed just above the removal area could hold the brick veneer in place during the short period of time it took to remove and replace the relief angles, install proper flashing, and reinstall the brick.

RESTORATION PROGRAM

Within weeks of the failure, galvanized steel angles were fabricated and shipped to the site. In an effort to provide a less-noticeable appearance to the repairs, approximately 60% of the removed brick units were salvaged for reuse. A new brick blend and mortar samples were matched to the original materials, and full-scale repairs commenced using four swing stages. The new angles were anchored to concrete beams using adhesive anchors spaced at a maximum of 18 in. (457 mm) on center (Fig. 10). Pairs of holes were provided in the angles to provide for adjustability should the existing embedded reinforcing steel interfere with the specified hole spacing (Fig. 11). A cover meter was used to locate the embedded reinforcing steel prior to drilling the anchor holes. Coated copper flashing was provided over the new relief angles, along with a mortar net (Fig. 12), and vented weep units placed in the head joints at 24 in. (610 mm) on center.

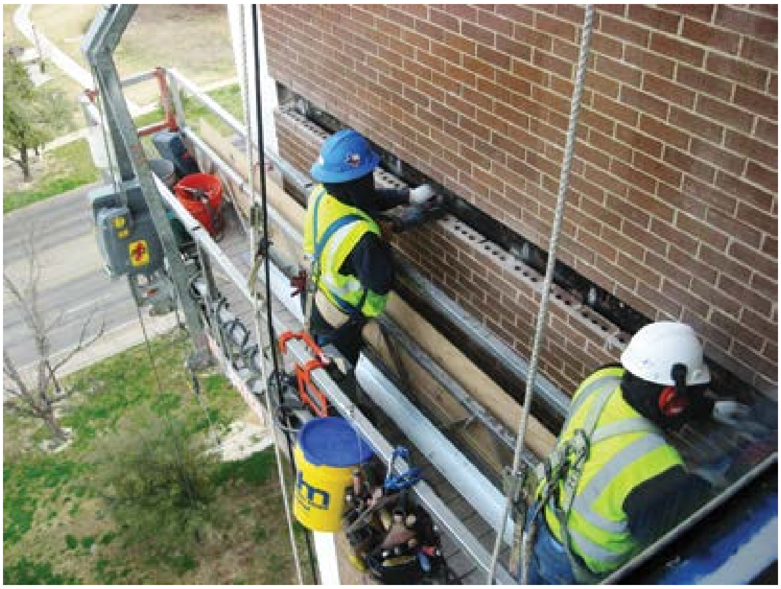

Fig. 10

Fig. 11

Fig. 12

Fig. 13

Fig. 14

Extensive deterioration of the mortar joints in the areas of brick placed in a stacked bond configuration led to a decision to cut out and re-point 100% of the joints in these areas (Fig. 13). The "Norman-size" brick units used at these locations (12 x 2.25 x 3.75 in. [305 x 57 x 95 mm]) could not be made without negatively impacting the project schedule. Therefore, the owner directed the contractor to reuse the salvaged bricks at the relief angle locations to help minimize the visual impact of the repairs (Fig. 14). Repairs were completed in June 2012.

Sam H. Whitley Hall

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Commerce, TX

PROJECT ENGINEER
JQ
Dallas, TX

REPAIR CONTRACTOR
Phoenix I Restoration & Construction Ltd.
Dallas, TX

MATERIAL SUPPLIER
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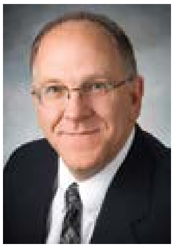

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