## AWARD OF EXCELLENCE

SPECIAL PROJECTS CATEGORY

# Eisenhower Barracks at West Point

WEST POINT, NEW YORK

SUBMITTED BY STRUCTURAL, A STRUCTURAL TECHNOLOGIES COMPANY

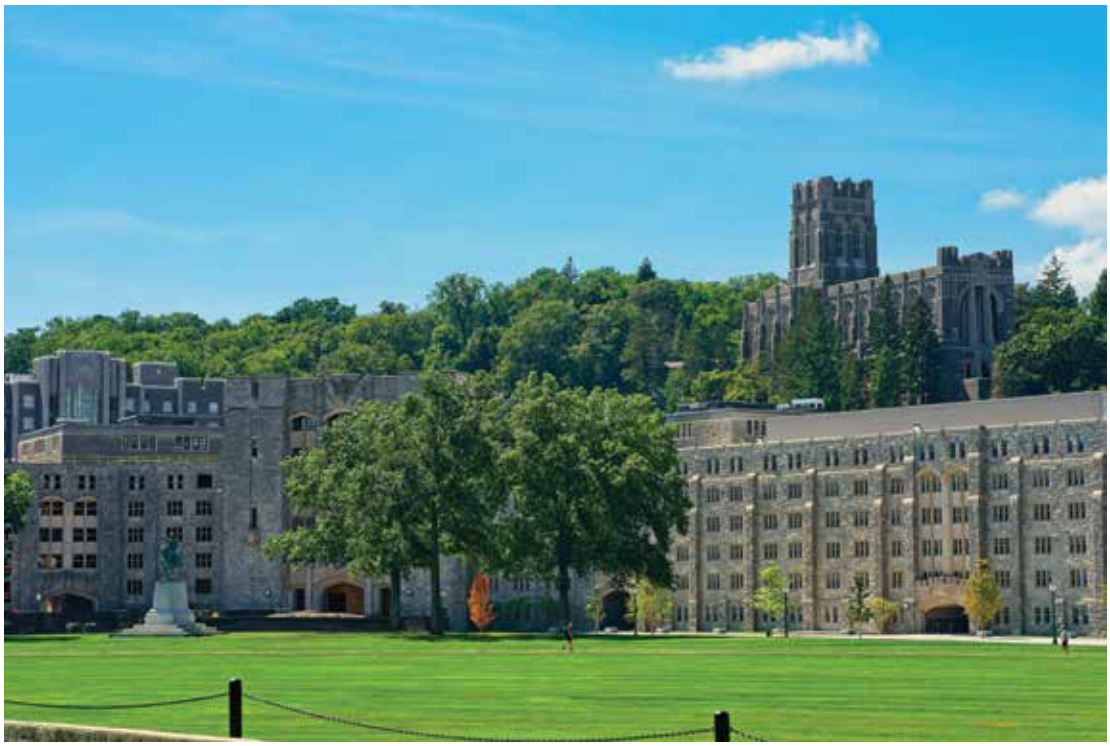

Fig. 1: Eisenhower Barracks

## BACKGROUND

The United States Military Academy at West Point developed the Cadet Barracks Upgrade Program to address the housing units on campus. The purpose of this initiative was to modernize the existing barracks to attract the right candidates to the academy, one of which is the Eisenhower Barracks (Fig. 1). Originally built in 1968, the Eisenhower Barracks were beginning to succumb to the universal factors that plague buildings in need of repair—time and use.

For five decades, the housing unit had served well under its current load and use; however, dramatic signs of deterioration began to appear. The overstress from heaving moment, punching shear, and localized beam shear caused cracking. The cracking, concrete delamination and spalling, and other aesthetic modifications adjusted the way the building reacted when supporting new loads. With the modifications and the updated mechanical, electrical, and plumbing systems, the owner needed to ensure that the building had suitable strength to support the new renovation. For the project to be successful, the building needed strengthening for the new loads.

## CONDITIONS AND EVALUATION

While general inspections were performed by others, the project team completed its own internal inspections. This gave the QA/QC team more insight into the issues of the building, which helped the team to develop better and unique solutions to the problems. Most of the concrete deterioration and cracking could be determined visually. The delaminations were identified by using a geology hammer and chains to sound the surfaces.

Based on the evaluation, the primary task for the project team was to restore and strengthen the structure's load capacity. This included

Fig. 2: Barrack slabs prepared by shotblasting before installing the crack infills and CFRP

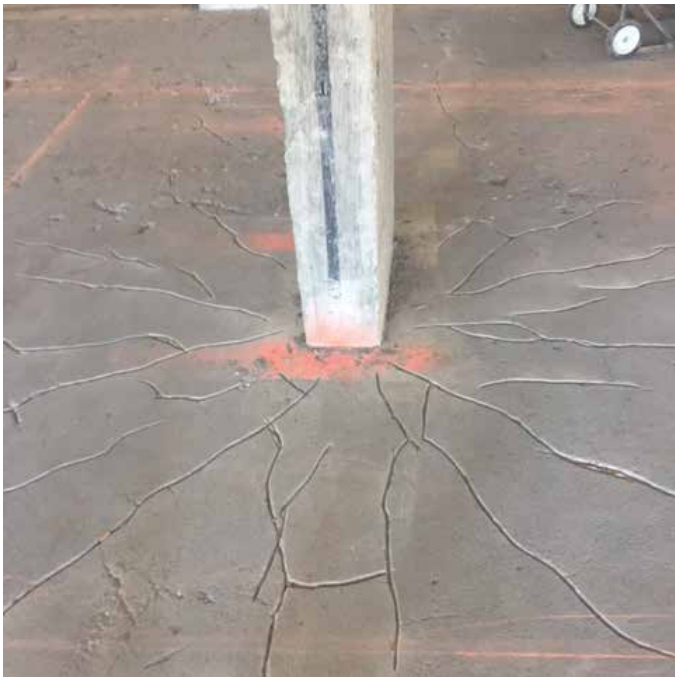

Fig. 3: Prepared slab around a column prior to installing the crack infill and CFRP

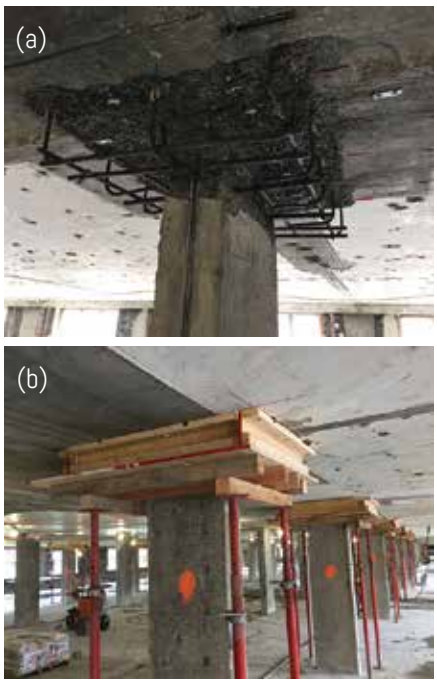


Fig. 4: Shear capital repair: (a) preparing and reinforcing the concrete surface, and (b) installed formwork prior to concrete pumping

strengthening six floors of slab with concrete repairs, penetration and crack infills, shear capitals, and CFRP installation. The renovation also included concrete repairs to the walls, ceiling, and beams, in addition to strengthening the beam's shear with CFRP.

## PREPARATION AND CONSTRUCTION

Prior to demolition, the existing interior fixtures were completely removed by the general contractor. The project team utilized a laydown area and containment unit on-site. Then, crews hydro-blasted the column tops and shotblasted the slabs (Fig. 2 and 3). Ultra high-pressure hand lances were also used to create the required surface profile and strengthen the punching shear drop panels. Once the site was prepared for construction, the repairs started on the sixth floor and worked downward to the basement and were performed from ceiling to floor.

The shear capitals were reconstructed not only by using a CFRP solution, but also incorporating formwork and utilizing versa pumps that put pressure on the shear capitals to ensure an integral bond between the new and existing concrete (Fig. 4). By utilizing the pressurized form and pump method of concrete placement for the overhead drop panels, structural integrity was restored.

Prior to installing the CFRP solution, standard QA/QC tests were conducted (Fig. 5). By setting and pulling bare concrete "pucks" on each floor, a map of all crack repairs was developed and updated daily to stay ahead of installation.

Once the strengthening work was complete, deteriorated wall and column slabs were restored and included over 2100 sf (195 sm) of spall repairs and crack, wall, and slab infills. Once everything cured, the CFRP was installed on the floor slabs, and included the installation of 8 in (200 mm) and 50 in (1270 mm) of CFRP (Fig. 7, 8 and 9).

During repairs, it was discovered that the basement also required a new plumbing system. For the system to be installed, the concrete placement work, wall infills, and CFRP installation had to be performed on required beams in the basement trenches.

## CHALLENGES

As a design-build project, the team had to come up with a design that incorporated the engineer's requirements and general contractor's limited budget. Establishing the line of communication for this project proved to be challenging, as the initial set up for the process was geared toward a bid-build project, rather than design-build.

Another unique challenge was working on the West Point campus. As a military academy, everyone on the project was required to undergo a background check, a security screening process, and coordinate site visits prior to beginning work. In addition, the campus was active

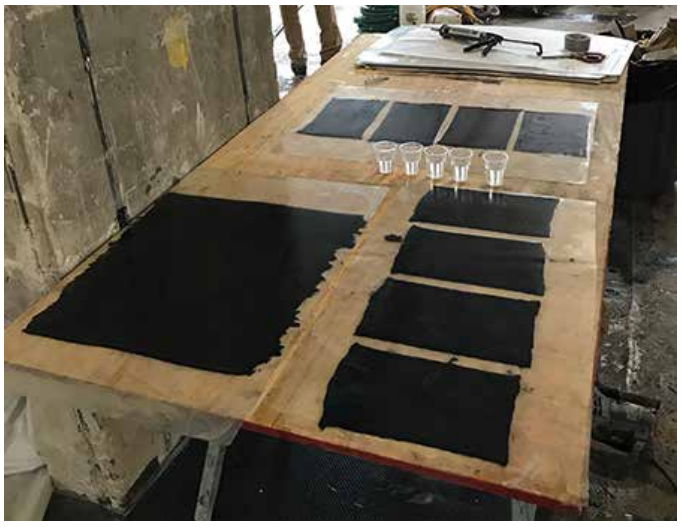

Fig. 5: Witness panels and epoxy resin cups for the QA/QC plan

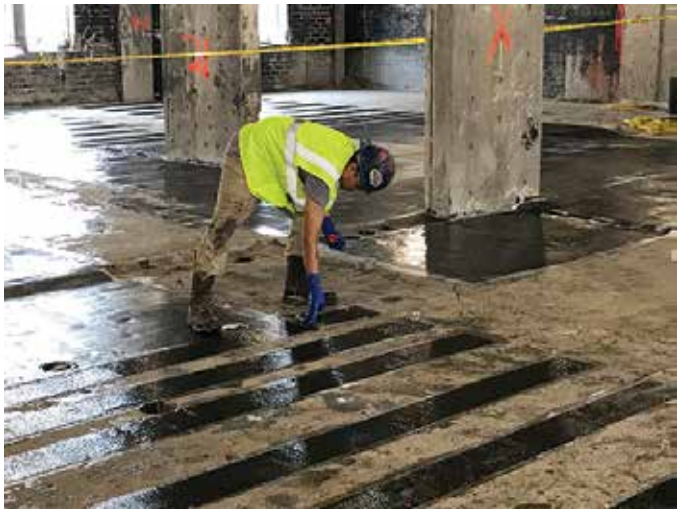

Fig. 6: Installing the final epoxy resin layer for CFRP (also performed to "knock down" any fiber edges)

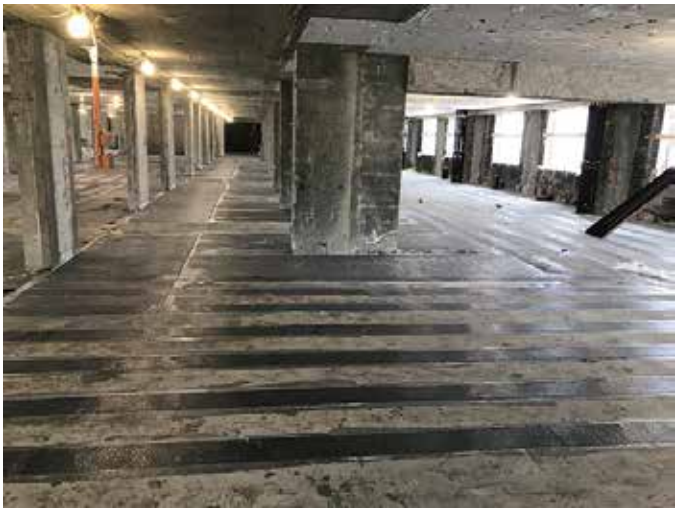

Fig. 7: The hallway and room slabs after the CFRP installation, focusing on the 8 in (200 mm) wide application

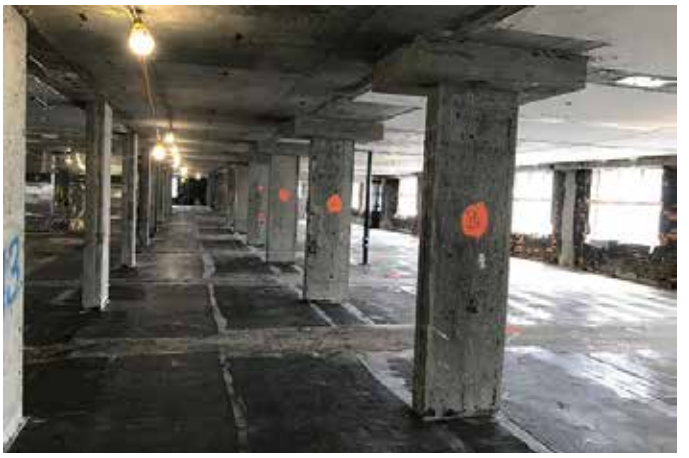

Fig. 8: The hallway and room slabs after the CFRP installation, focusing on the 50 in (1270 mm) wide application

throughout the renovation, which required advance notices for all deliveries. Special occasions also required mandatory shut-downs that would range from hour-long events to multiple day celebrations.

## CONCLUSION

The Eisenhower Barracks at West Point is a good example of how the design-build process can effectively restore a deteriorating structure. By developing unique solutions, using new technologies and equipment, and leveraging a repair and installation team, the Eisenhower Barracks were restored.

Throughout the entire project, the team collaborated on the design, material supply, and creation of a specialized strengthening solution for the historic barracks on the military campus. The team was able to strengthen 99 beams in total by adding new shear capitals and installing roughly 90,000 sf (8360 sm) of CFRP. In addition to the strengthening work, the wall, ceiling, and beam slabs were also repaired.

## Eisenhower Barracks at West Point

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