

Grand Rapids Community College (GRCC) North Building Parking Structure Restoration

Grand Rapids, Michigan

Submitted by Carl Walker, Inc.

The Grand Rapids Community College (GRCC) North Building is a seven-story building constructed in 1970. The slab-on-grade level (Level G1) and the first supported level (Level G2) comprise a parking structure beneath office and classroom space. The parking levels accommodate 109 parking spaces over an area of approximately 20,500 ft² per level.

The original design of Level G2 consisted of a 10-in. thick conventionally reinforced concrete slab. A traffic bearing waterproofing membrane (deck coating) was installed on the supported parking slab after its original construction.

The North Building Parking Structure has been exposed to chloride contamination from road salts and moisture that progressively deteriorated the structural integrity and durability of both the slab-on-grade and supported slab. Structural assessments revealed random areas of concrete delamination on the top surface of the concrete slab and concrete spalling at the underside of the supported slab, causing unsafe conditions for pedestrians and vehicles.

A comprehensive condition appraisal and an analysis of repair options were performed in 2002 and identified the several options for repairing and protecting the structure. After consideration of both the short- and long-term economics associated with these repair options, GRCC selected full slab replacement at Level G2 with new deck coating.

Although this option had higher initial construction costs and presented significant construction challenges, it offered numerous benefits, including:

- Removal of all chloride-contaminated concrete;
- A new slab with more durable concrete;
- Improved drainage with enhanced waterproofing characteristics;
- New lighting throughout the parking areas;
- New fire protection and plumbing;
- Longer anticipated service life; and
- Lower long-term maintenance costs.

Other components of the selected repair option involved patching of concrete delaminations at the



Fig. 1: Sawcutting for slab removal

slab-on-grade, new paint throughout, new parking control equipment, and new signage. Although not part of the original repair option, deck coating was also applied over the slab-on-grade during the restoration.

Design and Construction Challenges

This option presented significant engineering and construction challenges, characterized by the need to:

- Minimize disruptions to the building occupancy;
- Coordinate deliveries to the North Building and to adjacent buildings;
- Design a unique and cost effective temporary lateral bracing system for the columns and retaining walls that support the upper occupied levels of the building;
- Minimize the construction schedule; and
- Control dust, noise, and fumes during construction.

Planning, Design Issues, and Project Administration

Scheduling

Construction for the 2005 restoration of the North Building Parking Structure lasted 6 months, starting

in May 2005 and ending in November 2005. Considering the extent of the required restoration, the construction schedule was very aggressive.

Environmental Controls

Demolition activities that created excessive noise were confined to the hours between 5:00 p.m. and 10:00 p.m. Monday through Friday, and between 9:00 a.m. and 10:00 p.m. on the weekends. Concrete demolition by saw-cutting (Fig. 1) reduced the level of noise during day operations. Concrete slurry from saw-cutting operations was controlled to prevent contamination of the storm drainage system. To minimize the effects of fumes from deck coating products, a 96% solvent-free (low-odor) deck coating system was specified and was installed during nights and weekends when the building was not occupied.

Phasing

The entire parking structure was closed at the start of construction in May 2005. The restoration work on Level G2 was completed prior to the work on Level G1 so that parking at Level G2 could be reopened while work on Level G1 was being completed.

Operational and Architectural Improvements

Operational Improvement

One of the factors that contributed to the accumulation of chloride ions and moisture in the original slab was poor drainage (Fig. 2). The original slab at Level G2 provided drainage in one direction only. The new slab was designed with an improved



Fig. 2: Ponding and ice near exit

Fig. 3: Demolition robot used for slab demolition and removal



Fig. 4: Unique shoring systems were used on the project

bidirectional drainage profile, drains were relocated, and new drains were added to maximize drainage.

Entry/Exit Configuration

New graphics and signs were installed at both entry/exits to improve access. Concrete repair and waterproofing improvements were also made at these locations.

Signage and Graphics

All traffic signage and graphics were replaced to enhance ease of use for parkers.

Architectural Improvements

All vertical and overhead surfaces were painted white to improve light reflectance and visibility, with the added benefit of improving security within the parking areas.

Internal Lighting

The existing fluorescent lights on Level G1 were replaced with metal halide lights, which dramatically improved lighting levels. All previously dark areas were eliminated, enhancing the safety and aesthetics of the structure.

ADA Compliance

The parking space layout was upgraded to comply with current Americans with Disabilities Act (ADA) requirements. Pavement markings for ADA accessible routes were improved and new ADA signs were installed.

Technical Innovation

Concrete removal was performed using a combination of hand-held jackhammers, remote-controlled demolition robots, and saw-cutting. Hand-held jackhammers were used where the existing slab reinforcement was to be salvaged near critical structural members.

The remote-controlled demolition robot (Fig. 3) was operated from a portable cable or wireless control box and used a motor that generated no exhaust fumes.

Saw-cutting was allowed in areas where existing concrete reinforcement was not salvaged. Saw-cutting of the concrete slab expedited the concrete removal process and generated relatively low levels of noise.

Logistics of Shoring and Concrete Delivery

Shoring of the original slab started immediately after the demolition of mechanical and electrical items and concurrently with the installation of lateral bracing. One of the challenges associated with shoring was to maintain an access aisle for deliveries to the building (Fig. 4).

Lateral Bracing of Structural Members

The basement wall had to be laterally braced prior to the removal of the slab at Level G2. The lateral bracing system consisted of a steel horizontal beam and diagonal struts. The beam was positioned



Fig. 5: Finished slab with deck coating

just below the slab to be removed and was attached to the wall using epoxy anchors.

Detailed structural analysis was performed during the design phase to determine the structural effect of complete slab removal on other building components. The analysis indicated that lateral bracing of the columns would be required during the construction.

Complex Structural Repairs

The new concrete slab was designed under the provisions of ACI 318-02. New reinforcement dowel bars were epoxy-anchored into the columns. Epoxy-anchoring of the dowel bars demanded great care and accuracy from the contractor because the existing column reinforcement could not be damaged during drilling operations.

Corrosion Control Measures

The new slab was designed with a high-quality concrete mixture in combination with a traffic-bearing waterproofing membrane to control corrosion of reinforcement. The concrete mixture design also contained a calcium nitrite corrosion inhibitor admixture to further extend the building's service life.

Waterproofing Systems and Fume and Odor Control

A heavy-duty low-odor deck coating system was applied at night or on the weekends to avoid any fumes or odor that could affect the occupants of the building during normal business hours.

A special deck coating was also applied over the slab-on-grade (Fig. 5). This application required special preparation of the concrete surface to account for moisture that could inhibit bonding of the coating to the slab-on-grade.

Cost Effectiveness

The original contract for construction was approximately \$1.1 million. Construction estimates for restoration projects are often difficult to establish and cost increases can result after a more accurate assessment of existing conditions is performed during construction operations. Additional costs to this project associated with unanticipated conditions,



Fig. 6: Parking levels below office and classroom space

however, were only \$15,000, or less than 1.5% of the original contract sum.

Substantial cost savings were realized from creative and technically reliable analysis and design of the lateral bracing system. The design of the lateral bracing base supports eliminated the need for more expensive alternatives such as special footings to support the lateral bracing system. Collaboration and coordination by the owner to make the entire work area available to the contractor permitted a faster, more cost-effective construction. Modern and highly efficient demolition equipment permitted high productivity in a relatively short time compared to other demolition methods.

GRCC North Building Parking Structure

Owner

Grand Rapids Community College
Grand Rapids, Michigan

Project Engineer/Designer

Carl Walker, Inc.
Kalamazoo, Michigan

Repair Contractor

Davis Construction, Inc.
Grand Rapids, Michigan

Material Suppliers/Manufacturers

Consumers Concrete
Kentwood, Michigan

LymTal International
Lake Orion, Michigan