

# Missouri State University's Historic Quad Restoration

Springfield, Missouri

Submitted by Structural Engineering Associates, Inc.

Located in Springfield, MO, Missouri State University (MSU) has operated under various names and programs since 1905. Between 1908 and 1927, three majestic limestone structures were constructed that today comprise the Historic Campus Quad: Carrington, Hill, and Sicheluff Halls.

Carrington Hall is the oldest building at MSU. Construction on this mammoth structure began in 1908. Carrington Hall is a load-bearing masonry three-story structure with interior reinforced concrete columns and floor slab systems. The roof structure consists of timber trusses that bear on brick pilasters around the exterior perimeter of the building. The exterior veneer is primarily constructed of cut limestone rich in graining and fossils.

Built in 1924, Hill Hall is likewise a load-bearing masonry three-story structure with a limestone veneer, interior concrete framing, and wood timber roof trusses. Around the structure's upper perimeter is a band of limestone bearing the names of individuals through history that have influenced science and education.

The third building on the quad, Sicheluff Hall, was built in 1927 and served as the University's first science building. Sicheluff Hall flanks Carrington Hall on the north and frames the original Quad. It too is a load-bearing masonry three-story structure with a limestone veneer, interior concrete framing, and wood timber roof trusses. A limestone stairway is prominent at its main entrance and adds to the stateliness of the building.

## Investigation and Repairs

### Sicheluff Hall

The first segment of the Historic Quad Restoration involved Sicheluff Hall. To begin, an investigation was performed on the exterior veneer of the building. The investigation revealed four main problems: water infiltration, corrosion, rotted timber trusses, and environmental attack on the stone and mortar.

Years of exposure to the elements had led to deterioration of some of the mortar joints. During

the investigative stage, the amount of required tuckpointing was quantified. Areas where stone had been damaged either from impact or weathering were also identified and quantified. Exposure to the elements had also resulted in a dirty or stained appearance. Some of the stone was experiencing a general weathering effect pointing to the need for the application of penetrating water repellents to extend the life of the stone.

Water infiltration was attacking both the top and bottom of the building, seeping in through the foundation and leaking through the original concealed copper gutters. Piezometers were installed at select locations around the building foundation to rule out the possibility of significant ground water sources. The absence of a significant ground water source allowed the design of a below-grade waterproofing system without the need for ground water collection systems. The foundation walls were waterproofed below grade with a self-adhering sheet waterproofing system and a drainage mat that serves to transport surface and below-grade moisture to foundation drains. The foundation drains collect this water and are connected to the storm sewer system.

Leaks through the joints of the original copper gutters had led to rotting of the bottom chord of the main timber roof trusses at support locations. This created great concern for the structural stability of the roof, and it was strengthened by adding structural steel members to each side of the bottom chord and the first panel of the truss members. New steel was then welded to the steel plates embedded in the masonry pilasters. Great care had to be taken during the welding of these structural steel members, which were adjacent to the wood truss members and needed protection against fire.

Sicheluff's front steps were constructed of concrete with limestone treads with walls constructed of brick and stone veneer. Corrosion was so significant that full removal and replacement of the concrete stairs was required. After the new concrete stairs were constructed, a new sheet-applied waterproofing membrane was installed to prevent water and chloride

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*Stair removal and replacement on Sicheluff Hall*



*Cast stone on Carrington Hall prior to repairs*



*Deterioration and discoloration of stone on Hill Hall*

infiltration. During this process, the limestone steps were removed and stored for reinstallation. These steps were evaluated to determine which stones could be reused and which needed replacement due to deterioration from the elements. After the reinstallation, the replacement stones were stained to provide a color match to the original 80-year-old stone steps.

### Carrington Hall

Carrington Hall, the second phase of this project, showed signs of deterioration from the elements. Mortar joints were deteriorated, cracked, or missing and some of the stone showed signs of general deterioration. At one time, space was added to the building by enclosing open-air entry ways. Stone and cast stone were removed from their original locations and reused to clad the addition. This process was not kind to the stone, damaging it and leaving a multitude of small chips in the face of the stone. In addition, one of the cast stone parapet caps had once been replaced with a very poor match.

To repair the mortar deterioration, the building was tuckpointed and sealant joints were replaced. Damaged stone was patched using a stone patch material that was specially formulated to match the existing stone. The end result was stone and cast stone patching that was virtually undetectable from the ground surface.

Carrington Hall features a band of granite stone around the base of the building. This stone became faded and lifeless over time. The application of a stone restorer brought back the brilliance of the beautiful red granite.

The entire building was cleaned and a penetrating water repellent was applied. This repellent was selected to emphasize the grain of the limestone as well as treat the cast stone. After the application, the grain of the limestone was magnified, showing its original and true personality.

The gutters were in relatively good condition with the exception of the joints, which were soldered and sealed. The downspouts had been damaged from impact and freezing water. Copper gutters matching the originals were used. The copper was patined to match the original.

### Hill Hall

Hill Hall was the final phase of the Quad Restoration project. After the initial building investigation, it was clear that the major concern was deterioration of some of the building stone. Signs of moderate deterioration indicated that if steps were not taken, the deterioration, fractures, and spalling could advance to the point where the original beauty of the building could be scarred forever. A stone consolidator was applied to certain portions of the stone that showed deterioration.

Mortar joints were also deteriorated and the building was dirty and stained. Several penetrations had been made in the original veneer for drains and



*Siceluff Hall*



*Carrington Hall*

plumbing. These were repaired by the restoration contractor using a specially formulated stone patch material that resulted in an excellent match.

During the initial investigation, settlement problems were also uncovered at the building's ADA access ramp, which had been added approximately 75 years after the original construction. It had undergone considerable settlement, which was observed by offsets in mortar joint planes and gaps between the original building and the addition. Extensive excavation and underpinning were performed to stabilize and lift the ADA ramp back to its original location.

## Restoration Schedule

The Historic Quad Restoration project was completed in three phases. All three buildings were actively used for administrative and educational purposes during this process. The repairs had to be performed during the summer break from the middle of May to the middle of August. Repairs on Siceluff Hall began in May 2004, with Carrington and Hill Halls being completed in subsequent years with a substantial completion date for Hill Hall of August 15, 2007. Scheduling was critical and required the cooperation of all team members.

## Project Success

The repairs made on the veneers of Siceluff, Carrington, and Hill Halls included most of the repairs typically required on limestone construction. These buildings also illustrate that, in most cases, the repair of masonry buildings requires more than just addressing the masonry elements. Issues such as water infiltration, gutter and downspout issues, grading, and even settlement had to be dealt with to ensure the masonry repairs were effective and would last.

These three buildings represent timeless architecture and the limestone veneer should have a service life for another 100 years and longer. Many of the repairs performed on the buildings could be classified



*Hill Hall*

as maintenance. MSU's approach to the repair of these buildings represents the way care of jewels such as Siceluff, Carrington, and Hill Halls should be executed. Maintenance performed on the exterior envelope at appropriate intervals can ensure the ongoing viability of these structures instead of letting buildings fall into a state of disrepair, jeopardizing their future.

## Missouri State University Historic Quad

### Owner

Missouri State University  
*Springfield, Missouri*

**Project Engineer/Designer**  
Structural Engineering Associates, Inc.  
*Kansas City, Missouri*

**Repair Contractor**  
MTS  
*Springfield, Missouri*

**Material Suppliers/Manufacturers**  
Edison Coatings, Inc.  
*Plainville, CT*

Prosoco  
*Leawood, KS*