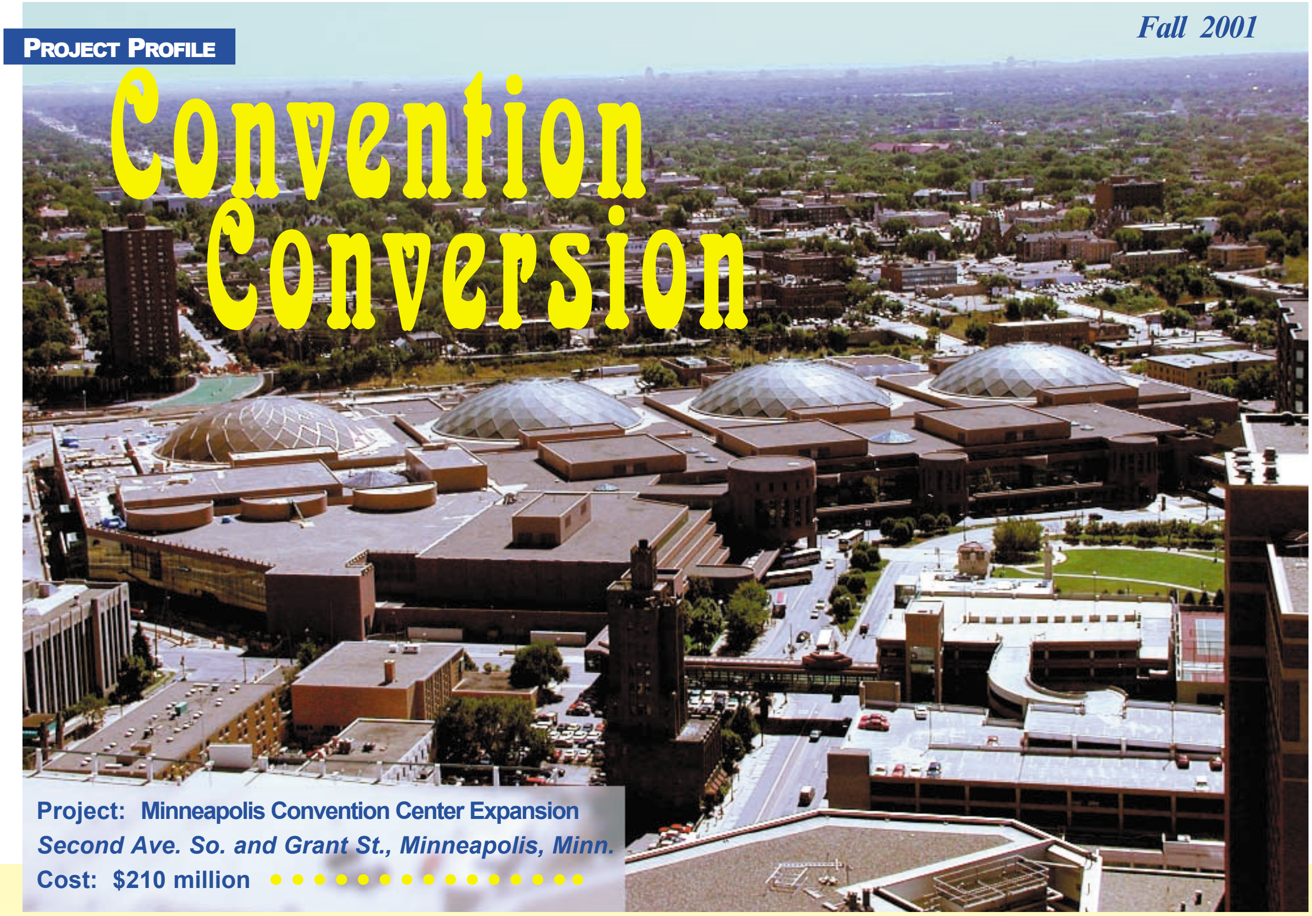
The American Edge

Fall 2001

PROJECT PROFILE

Convention Conversion



Project: Minneapolis Convention Center Expansion
Second Ave. So. and Grant St., Minneapolis, Minn.
Cost: $210 million

Downtown Minneapolis has steadily become one of the leading convention sites in the United States today. This achievement hasn't occurred by chance. Rather, it has been strategically planned by the Minneapolis Mayor and the City Council as a part of their vision for the downtown area. A quick look at downtown Minneapolis reveals numerous tower cranes for construction of new significant projects, tangible signs of the economic strength of the metropolitan area.

However, new construction is only one measure of the vitality of downtown Minneapolis. Another measure is the fully booked status of the existing Convention Center since its inception in 1990. According to Kathleen O'Brien, Minneapolis City coordinator, who has administrative oversight for construction of the $210 million expansion, "Conventions and trade shows are good for the economy of a major metropolitan area. Not only do these events bring in visitors with considerable discretionary dollars to spend, but of equal importance is the introduction of our region to visitors from other states and nations. Many return to do business, bringing their families along to visit here and other parts of the state.

"Having a high demand for new convention and meeting space and little available property adjacent to the existing facility represented a significant challenge," continues O'Brien. The question was, how does one double the facility space and add new high tech features with such physical constraints? The best answer was to purchase the limited property that existed to the east and design usable underground space to double the size of the expansion.

Creating an underground exhibit hall with a clear height of 25', one block long and one block wide, is not an easy feat. The City assembled a team comprised of the Convention Center Design Group (Setter, Leach & Lindstrom and Leonard Parker and Associates); Skillings, Ward, Magnussen & Barkshire; and Mortenson/Thor Construction, to design, engineer and construct the unique facility. Maintaining the architecture of the existing complex, an additional exhibit hall has been built

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Photo: View of the Minneapolis Convention Center from the Foshay Tower.
Photo by Toni Frazier, City of Minneapolis

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immediately atop the underground space. The new hall will complement the southern skyline of downtown Minneapolis with a fourth copper-clad geodesic dome.

The Minneapolis Convention Center expansion is much more than exhibit space. The project consists of two major market exhibit halls, 63 new meeting rooms, a 3400-seat auditorium (with three rotating seat assemblies to accommodate almost any need), 34,000 square feet of column free pre-function lobby and new kitchen and mezzanine space.

Creating a deep excavation immediately adjacent to the existing slab-on-grade exhibit hall presented a design/engineering and construction challenge to the design/construction team. AET was fortunate to be chosen by the City as their geotechnical, materials, and special inspection consultant for the complex project. With competent bedrock at a depth of 55' to 65' below grade, no near surface groundwater conditions, and the construction of a special perimeter tie-back retention wall system, the majority of the property limits were excavated to an elevation just slightly above bedrock.

Two innovative construction approaches were used to create this significantly-sized, deep perimeter foundation wall. The deep walls rely on a permanent tie-back retention system which incorporates several levels of special corrosion-protected soil anchors that restrain the lateral forces imposed by the earth, structures and streets next to the building expansion. Also, walls were slip-formed in 140 long sections with a special concrete mix to improve the efficiency of foundation wall placement. According to Rodney Leibold, project coordinator for the City, "integrating the new building with the old, controlling project costs and meeting the high standards of quality for the modern facility were our top priorities."

"The other priority for the project is to complete the new construction on time," says Ken Sorenson, vice president of Mortenson/Thor. As confirmation of the City's vision, the new spaces are already booked for events at the scheduled completion date.

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Photo below: A fifty-foot-deep excavation was required to provide new below- and above-grade exhibit halls capped by a fourth copper dome.

Photo bottom: Construction, raising, and securing the dome roof proved a technological sight to behold.

Photo courtesy of Brian Kramer, Project Manager, City of Minneapolis

Photo by Erik Forgaard, American Engineering Testing

For the love of Concrete

by Dan Vruno, Saint Paul

1 part cement, 2 parts sand, 3 parts rock

Mix these ingredients with enough water for a workable consistency, place it in a form, let it set, and that's concrete.

To many of us who work at AET, concrete is the most interesting building material that exists. Mankind has made concrete for over 6000 years. In 4000 B.C., the Egyptians used chopped straw in mortar for reinforcement when constructing structures with sun-dried bricks. In 300 B.C., the Romans added volcanic ash to the mixture and constructed buildings and other structures which are still functional today.

The modern day demands we place on concrete have increased significantly and vary with the requirements of the application. They range from high strength, pumpability, high early strength and durability, to name a few. AET has done mix designs requiring 28-day strengths from 100 to 14,000 psi. Our 1-2-3 mix will not meet these demands without proportion adjustment or the addition of chemical and mineral admixtures.

The company's mix design team has batched concrete since the 1970s. In the first half of this year, we created more than 400 trial batches in our laboratory. The team has also participated in several research projects over the years. Recent research involves the interaction between various chemical and mineral admixtures with different cements. Exploring issues such as increasing air content and documenting setting times by combining different ingredients is a much-needed service in today's concrete and construction industries.

Concrete Specialist Tim Suess measures chemical admixture for trial batching.

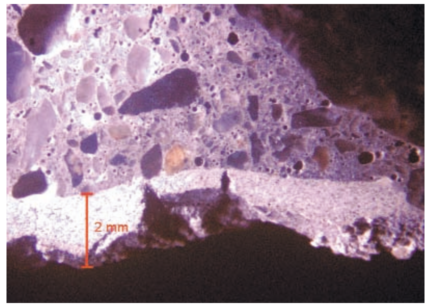
On the cutting edge of concrete technology, the team just finished a 100-batch study on concrete containing ground granulated blast furnace slag (GGBFS). GGBFS is now used as a partial cement replacement material, as the availability of cement has, in the past, been scarce world-wide. To constantly improve the performance of concrete, the industry recognizes a need to study optimizing aggregate gradation for reducing the amount of cement required in a concrete mix design.

The team's favorite studies are those that reveal something new and enable us to give clients valuable information for their construction or investigation projects. The slogan our batching team uses is: *why guess when we can know*, reference to a constant willingness to perform additional batches; batches that ultimately provide clients with the hard evidence. In a time of ever-changing technology and materials, designing concrete mixes to satisfy demanding performance criteria is *not* as simple as 1-2-3 after all.

Concrete Repair Failure:

Discovering What Went Wrong

by Gerard Moulzolf, PG
American Petrographic Services



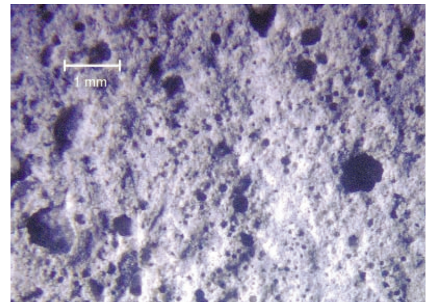


Photo left: Cross section of the slurry which adhered to the base of the repair concrete. Photo right: Numerous air voids on the formed bottom surface of the slurry, at the failure with the substrate concrete.

The success of a concrete repair depends on several factors:[1]

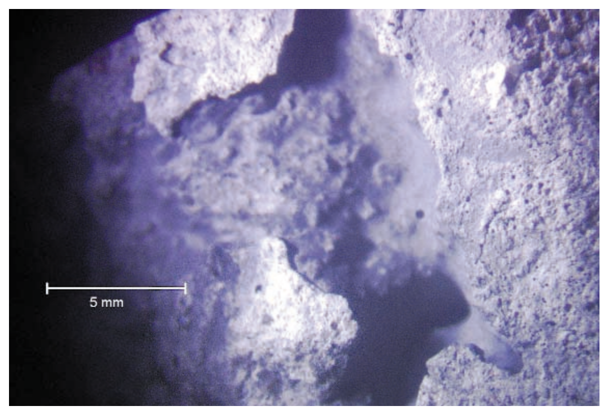
- Removal of unsound concrete before the repair is attempted
- Preparation of the surface to receive the repair
- The bonding method
- Selection of repair materials
- Skill of the craftsman
- Curing

These factors were important in a recent project where American Petrographic Services, Inc. (APS) teamed with a national parking ramp consultant to analyze a concrete repair failure from a parking garage in New Jersey. The repair material chosen by the designer was a silica fume-modified, air-entrained, cast-in-place concrete patch of an elevated slab. The patch, a maximum 45 mm (1 3/4”) thick, had delaminated and a dinner plate-sized piece of the failed repair was submitted to our laboratory for petrographic analysis. Hand samples and thin sections were cut and polished for analysis.

As part of the repair procedure, the contractor applied a cement slurry bonding agent to facilitate the bond between the patch and the substrate concrete (the existing concrete garage slab). Review of the failure specimen indicated the majority of the patch failed at the contact point between the bonding agent and the substrate concrete. Two other failure zones were noted: the patch material located above the bonding agent was poorly consolidated, and separation had occurred within the substrate concrete itself.

Magnified inspection of the failure plane revealed an excess of entrained-size air bubbles in the slurry along the contact point with the substrate concrete. The formation of these bubbles was possibly the result of using a type 1-A cement for the slurry and over-brushing/agitation of the slurry into the substrate. Our observations also disclosed the presence of sand and cementitious paste debris adhered to the bottom surface of the cement slurry bonding agent.

Numerous, large consolidation voids present within the repair concrete suggested poor workmanship or poor workability of the repair material. Also, small pieces of the substrate concrete adhering to the bottom surface of the slurry suggested either localized areas of good bond or a damaged substrate concrete. The latter could have been caused by over-impacting the substrate concrete with a jackhammer used to remove unsound material from the patch area. Excessive energy during the preparatory process probably produced planes of weakness such as microcracking in underlying sound concrete. Using the proper equipment initially, or if necessary, incorporating a secondary, less-aggressive method, may be needed to remove compromised material and other loose debris before effecting the repair.



Large consolidation voids in the repair concrete, at the contact with the slurry and substrate concrete.

Numerous plastic shrinkage microcracks were present at the top surface of the repair, and carbonation (exposure of plastic concrete to carbon dioxide, resulting in a softer paste at the surface) was significant for a silica fume-modified concrete. These characteristics are indicative of ineffective curing. Poor curing may also produce curling stresses from shrinkage of the material, pulling the edge of the repair away from the substrate.

Thus, although the design may have addressed all of the critical factors necessary for a successful repair

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1. *ACI Manual of Concrete Practice*, 546R, Concrete Repair Guide

Convention Center, continued from page 2

Coordination of thirty different prime contractors and fulfilling the EEO goals established by the Minneapolis Dept. of Human Rights fell on the shoulders of Bill Jackson, senior project manager with Mortenson/Thor. Bill served in this capacity for the original construction and therefore brought considerable experience and familiarity to the project. In spite of the large number of individuals working on the project (as many as 2,000 total during the life of the project, with a peak work force of 450), the project has exceeded expectations in terms of safety and with minimizing lost time accidents. Mortenson/Thor, working in partnership with the Minnesota OSHA Consultation Group, performed monthly reviews of the site work practices to establish safety as a primary requirement for the project. A full-time safety director has been on the project since the start date, for training, pre-task planning and refinement of work execution.

The completed space frame for the dome now defines the center's outline. When completed, it will offer facilities and meeting space unparalleled in quality and layout for the growing convention market. The staff of AET is proud of involvement in both the original construction and enhancement of this exceptional facility. *A*

by Terry Swor, PG, Saint Paul

New services

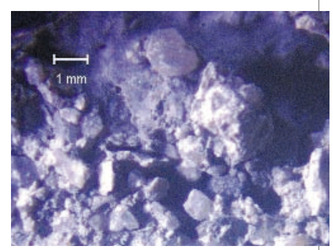
The latest new services offered by AET come from the building technology and NDT divisions. Building technology now provides Ground Penetrating Radar (GPR), a nondestructive test used to detect reinforcing steel, post-tension tendons, conduit, delaminations, and air void spaces in concrete, as well as detection in buried conditions such as underground tanks, utility lines and soil/bedrock interface. Tim Suess, a geologist for AET, notes that the GPR unit acquires and processes data in real time. Unlike radiographic methods, it does not pose a health hazard to individuals.

In July, the NDT division procured a Cobalt-60 radiation source, broadening its service range to clients in the area of evaluating concrete and steel to considerable thicknesses. Cobalt-60, a man-made isotope, will penetrate thicknesses up to nine inches for steel and thirty inches in concrete. The new unit is completely mobile.

Repair failure, from page 3

scenario, work and quality control practices associated with the various steps will control the outcome of the repair. Unknown to many in the construction and legal industries, the distressed repair contains all the forensic information needed to diagnose what went wrong. The science of petrography seeks to answer questions about (in this case) why the repair failed, or in general, resolve construction material-related problems.

In addition to identifying causes of concrete failure, the affiliate company of APS, AET, will assist in mix design options and repair alternatives to maximize the longevity of concrete structures.



Fine sand and cementitious paste rubble adhered to the bottom of the slurry coat at the failure point with the substrate concrete.

For more information on concrete failure, contact Gerard Moulzolf at 651-659-1346 or gmoulzolf@ampetrographic.com. For mix design options and repair alternatives, contact Dan Larson at 651-659-1337 or dlarson@amengtest.com.

Second runestone examined

The recently discovered second runestone, now called the AVM stone, is being examined by APS researchers with regard to its origin and authenticity. This past year, APS has been involved in evaluating the Kensington Runestone, subject of scientific and public interest and debate. Both stones were found in rural Minnesota near Kensington; the first by a farmer in 1898 who is believed by skeptics to have carved the inscription himself.

The AVM stone is approximately 2,200 pounds, 43 inches by 36 inches by 26 inches. The investigation team that is researching the stone discovered this summer by Janey Westin says it may mark the gravesite of Viking explorers from the 1300s. A larger implication of both stones is that our understanding of world history will undergo significant re-evaluation.

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