RCC Pavement Provides Performance and Economy at Denver International Airport

"Once DIA recognized the product durability and the cost savings offered by RCC, it became their pavement of choice in this application."

John L. Edwards, Interstate Highway Construction, Inc.

by Jamie Johnson, P.E., Rocky Mountain Cement Council

Project Focus

While fresh fallen snow is desirable for Colorado's ski tourism industry, for airport operations it can be quite a challenge-especially at airports like Denver International Airport (DIA) where the annual snowfall is more than 61 inches (1.5 m). Removing the snow is one thing, finding a suitable place to store it is another. For the DIA Concourse C RON Project, 20,862 square yards (17,443 square meters) of 8-inch (200 mm) roller-compacted concrete (RCC) was selected for the pavement adjacent to the concourse apron areas. These areas are where snow removal efforts stockpile excess snow from around the DIA concourses during heavy snow events. The City and County of Denver, the owner of this project, originally bid the project with an asphalt pavement section. Englewood-based Interstate Highway Construction, Incorporated (IHC), recommended the replacement of the asphalt section with a RCC pavement section utilizing a value engineering change to help meet the owner's requirements and financial goals. The owner chose the RCC alternative because it brought all of the quality characteristics of an industrial concrete pavement at a price cheaper than both the original asphalt pavement option and a portland cement concrete (PCC) alternative. DIA had never previously specified a RCC pavement alternative in any of its previous pavement applications, so IHC (with support from the Portland Cement Association (PCA) and the Rocky Mountain Cement Council) drafted and presented appropriate RCC plans and specifications for the project. In addition, the consulting firm of DMJM Aviation reviewed and collaborated in the development of the specifications focusing on the constructability and logistical impacts for the project.

High-density paver placing RCC at DIA.

RCC paving operations on snow removal storage area.

Project Details

The pavement design consisted of 8-inch (200 mm) RCC pavement placed directly on top of 6 inches (150 mm) of recycled concrete pavement base. The base utilized on-site waste concrete as an environmentally friendly alternative to virgin base materials.

The RCC material was produced with an Excel pugmill set up on the airport property, with double end dump tractor-trailers feeding an Ingersoll Rand Titan 8820 ABG paver. Project specifications required a minimum compacted density of 96% of the modified Proctor density. Initial in-place density readings taken immediately behind

Compaction of adjoining 8-inch (200 mm) RCC layer.

Completed RCC layer showing protective blankets.

the paver prior to compaction by the rollers consistently yielded densities between 90 and 92 percent. Final compaction was achieved using a 10-ton (9.1 metric ton) dual drum vibratory roller, followed by a combination pneumatic roller and a 2-ton (1.8 metric ton) dual drum roller for surface sealing.

RCC pavement construction began in late fall in conditions where the daytime highs were in the 50's and 60's F° (10's C°) , with overnight temperatures reaching into the low 30's F° (0's C°). Care was taken to ensure that the subgrade soils and granular base material were not frozen at the time of RCC placement. All RCC pavement placed when overnight temperatures were expected to be below 35 F° (2 C°) were covered with paving blankets to protect it from freezing. In-pavement Hi-Low temperature sensors recorded the actual overnight pavement temperatures to ensure compliance with specifications. To verify acceptable strength gain, 4-inch (100 mm) diameter pavement cores were taken within 24 hours of RCC placement and tested for concrete pavement strength. When the unconfined compressive strength (UCS) of retrieved cores demonstrated strengths greater than 2,000 psi (13.8 MPa), protective blankets were removed. Consistently throughout the project, 24-hour UCS test on RCC pavement cores yielded average strengths of 3,325 psi (22.9 MPa). Unlike PCC pavements, control joints in RCC pavements are typically not required for long-term performance and serviceability. However, the owner chose to incorporate control joints on this project. The joints were cut and sealed on a 30' x 30' (9.1 m X 9.1 m) joint pattern. The relief sawing was accomplished with a Soff-Cut early entry saw, allowing the cutting to be performed immediately upon final surface rolling. The sawed joints were then cleaned of any loose debris and filled with a silicone sealant.

Quality Control Testing

In-place density tests were taken at specified intervals behind the finished pavement section using a nuclear moisture-density gauge in accordance with ASTM C1040. The maximum density and optimum moisture content (OMC) were determined using the modified Proctor test method in accordance with ASTM D1557. The dry density was 147 pcf (2,355 kcm) and OMC was established at 5.9%. All tests performed indicated OMC within specified parameters and all density tests exceeded 96% of modified Proctor. Aggregates were selected and blended in accordance with the requirements given in PCA publication *Guide Specification for Construction of Roller-Compacted Concrete Pavements*. Although the project specifications required 4,000 psi (27.6 MPa) UCS at 28 days, average 28-day UCS on cylinders cast in the field according to ASTM C1435 yielded breaks of 6,069 psi (41.8 MPa).

Summary

RCC in this application provided a very serviceable concrete pavement at a significant cost savings to the owner. While the surface characteristics of this industrial pavement varies slightly in appearance and aesthetics from that of a conventional concrete pavement, RCC can prove a very cost-effective alternative to either PCC or asphalt pavements for similar applications. The RCC pavement application provided the owner with a pavement that can stand up to heavy snow plowing and heavy truck traffic during snow events, is strong and durable enough to resist the shoving and rutting common with asphalt pavements, and will not deteriorate under the saturated conditions caused by melting stockpiles of snow.

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