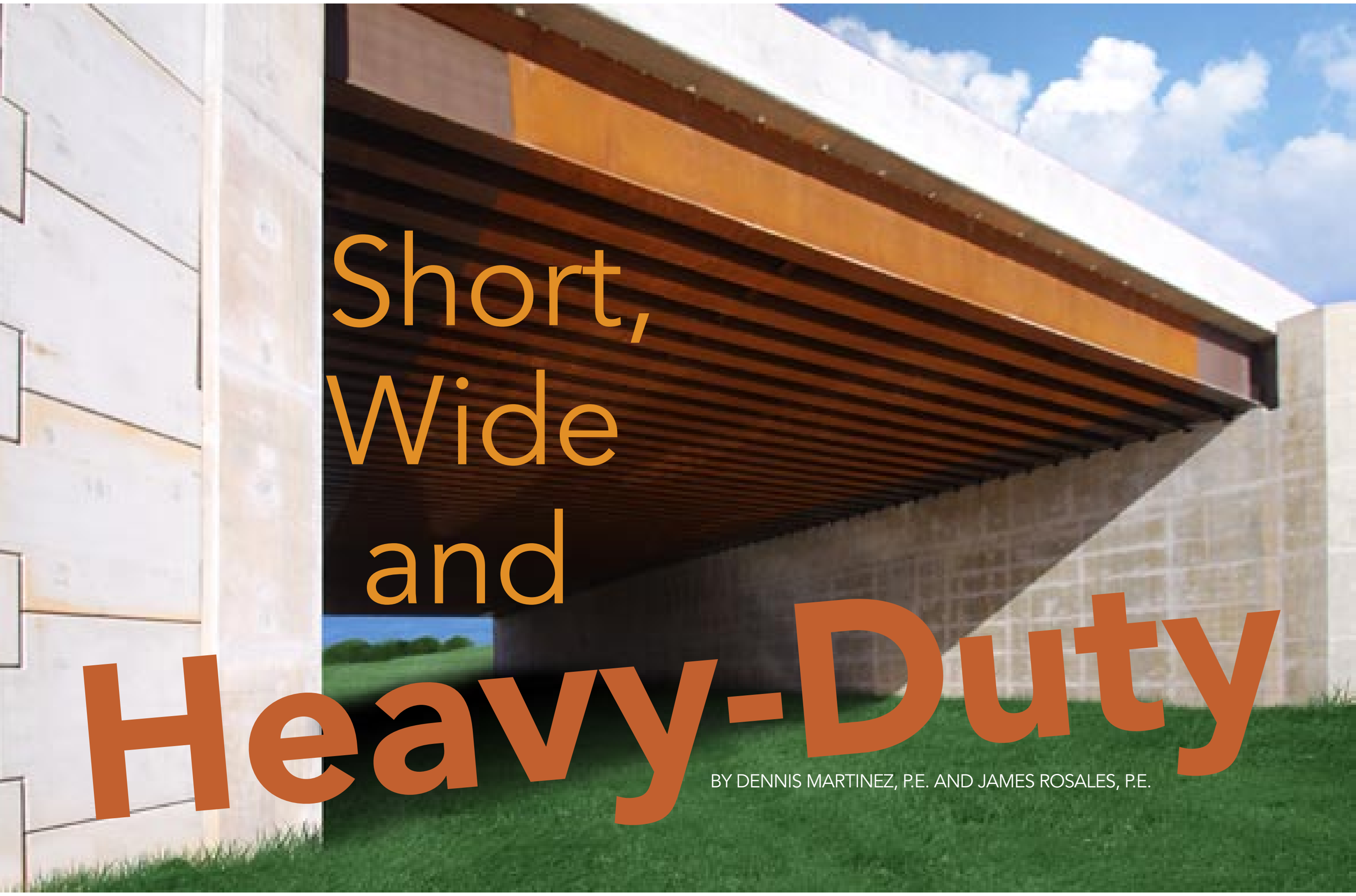

Short, Wide and Heavy-Duty

BY DENNIS MARTINEZ, P.E. AND JAMES ROSALES, P.E.

Weathering steel fits unique need for two new airport taxiway bridges.

TWO NEW STEEL TAXIWAY BRIDGES were opened in January at the Charlotte Douglas International Airport (CLT) as part of the airport's new 9,000-ft parallel runway project. The bridges for taxiways November and Sierra carry aircraft over future railroad tracks and access roads that are part of the future inter-modal facility on the airport.

Two types of superstructures, steel plate girders and prestressed concrete beams, were considered for this project. Aircraft wheel design configurations limited the design beam spacing to 3 ft to account for present and future aircraft landing gear wheel configurations. The major factor in the selection of steel plate girders was attributed to the reduced gross superstructure weight, compared to the concrete option, that consequently reduced the loads on the substructure elements.

And where the steel plate girders provided a simple and conventional design, using prestressed concrete beams would have required a non-conventional approach, such as beam section modifications. To offset maintenance costs associated with steel bridges and in particular the number of steel elements for these bridges, Grade 50 weathering steel was selected.

Approximately 2,100 tons of structural steel was used and total project cost was close to $19 million. Construction began in November 2008. The use of steel plate girders for the superstructure made for quick bridge erection—all structural steel was delivered and put in place in approximately 10 days per bridge, which contributed to the opening of the bridge taxiways three months ahead of schedule. One key factor was the ongoing communication and cooperation between the steel fabricator and the contractor.

Bo Bovard, president of Augusta Iron & Steel said, "This project was a great example of outstanding teamwork between the contractor and our company that gave us the opportunity to finish ahead of schedule. We're also gratified that T.Y. Lin recognized the superior performance of steel in this type of specialized application."

"Thanks to the contractor's continuous efforts to keep us informed of their requirements, we were able to provide the steel when they needed it," said Augusta Steel & Iron executive vice president Al Metzel. "Their professionalism was critical to the success of this project."

Designing airport bridges is much more complicated than designing traditional highway bridges. Designers much consider requirements related to bridge geometry, aircraft loading and the Federal Aviation Administration requirements. The structure was designed to maintain full capacity across the width of the bridge to account for the event of an errant aircraft. Curb and parapets were provided at the edges to help redirect drainage to the bridge ends.

Opposite page: Relatively short compared to their widths, the two new taxiway bridges at the Charlotte (N.C.) Douglas International Airport feature steel girder superstructure that made their construction quick and easy, and enabled their opening three months ahead of schedule.

This page: Opened in January 2010, the new Charlotte Douglas International Airport taxiway bridges are designed to handle today's heaviest aircraft and to maintain full capacity across the width of the bridge.

Taxiway centerline and edge lighting were provided along the deck and approach slabs.

The Taxiway Sierra bridge required a span length of 91 ft, 6 in. and a bridge width of 217 ft. The Taxiway November bridge similarly required a bridge width of 217 ft, but required a shorter span length of 77 ft, 6 in. Plans for an additional future railroad track resulted in the increased bridge length for the Taxiway Sierra bridge. Bridge width geometry required compliance with the taxiway safety area requirements for Design Group V aircraft, which includes aircraft with wingspans up to 214 ft. The Boeing 747-400, Boeing 777 and Airbus A340 are some the heaviest aircraft included in Group V.

For final design, the superstructure for both bridges consisted of a 13-in. reinforced concrete deck acting compositely with plate girders through the use of shear connectors. Framing consisted of 72 lines of plate girders at 3-ft spacing. The girders on Taxiway November and Taxiway Sierra maintained a constant web depth of 72 in. and 80 in., respectively. Intermediate cross frames consist of single angle 4×3×⅜ members located diagonally between girder webs. Use of a single diagonal member provides access for facilitating field inspection.

End diaphragms at support locations consist of W24×68 members for the top bracing and C15×33.9 for the bottom bracing. The end diaphragm configuration provides access for inspection on the back side of the end diaphragms members in front of the abutment backwall. Approach slabs 30 ft long and 30 in. thick were used to help reduce local settlement and provide a gradual transition between the taxiways and the bridge decks.

The substructure consists of concrete abutment walls supported on spread footings for the Taxiway November bridge. The concrete abutment walls for the Taxiway Sierra bridge are supported on battered HP14×117 steel piles. The presence of bedrock under the footings for the Taxiway November bridge provided the required bearing capacity for spread footing foundation. Aircraft surcharge loading including braking forces resulted in concrete abutment walls with a thickness of 4½ ft at the base. Seismic loading was not a controlling factor because the bridges are located in a low seismic zone. Mechanically stabilized earth wing walls were designed at both ends of the abutment walls to accommodate the grading requirements of the project. MSC

Owner
Charlotte Douglas International Airport

Structural Engineer
T.Y. Lin, Miami

Steel Fabricator
Augusta Iron & Steel Works, Inc., Augusta, Ga. (AISC and NSBA Member)

Dennis Martinez, P.E., has been active in a variety of transportation engineering projects including the design of bridges, retaining walls, bridge ramps, bridge restoration, and bridge extension projects. His recent experience has included a vast amount of successful transportation improvement projects including major highways, interchanges and bridge structure design.

James Rosales, P.E., is actively involved in the structural design/inspection and preparation of specifications on various airport improvement projects, including airfield engineering, specialty structures such as passenger loading bridges, tunnels and related infrastructure and utilities.