FEATURE

RUNWAY

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SUCCESS

DFW'S FIRST ASPHALT RUNWAY PAVES THE WAY FOR MORE

EMILY ADAMS, DIRECTOR OF MARKETING, TXAPA

Runway 17C/35C at Dallas/Fort Worth International Airport was built more than 35 years ago and after years of heavy use, the concrete surface was in significant need of rehabilitation. DFW is the fourth busiest airport in the world with approximately 650,000 arrivals and departures in 2017 alone. 17C/35C handles approximately 40 percent of arrivals daily. For the rehabilitation of its primary arrival runway, DFW knew it had to find a solution that would require the shortest amount of downtime, deliver the longest pavement life, require minimal interruption for scheduled maintenance, and maintain its status as a carbon-neutral airport. After an extensive rehabilitation, the 13,400-foot runway has been reborn as the first asphalt surface runway in DFW history.

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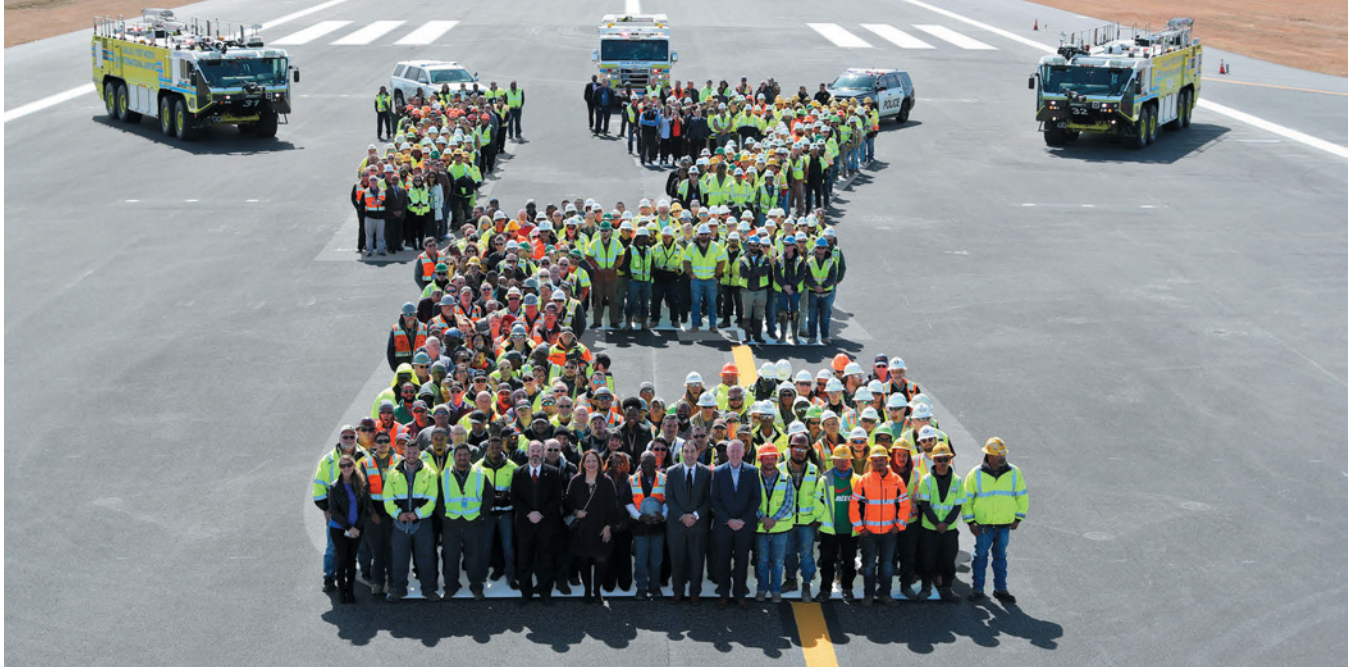


ASPHALT: ECONOMICS, ENGINEERING, ENVIRONMENT

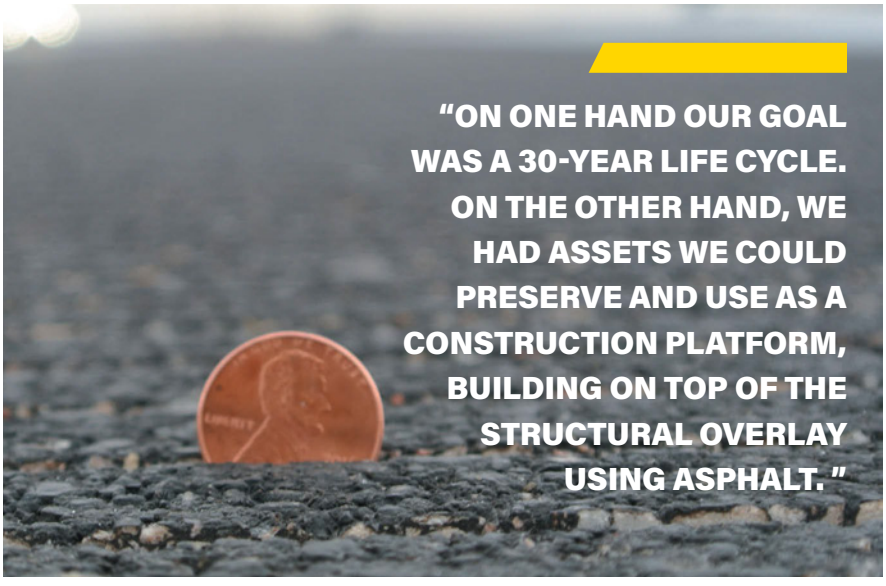
When DFW determined that its busiest runway needed rehabilitation work, it initiated a comprehensive schematic design effort which lasted from December 2016 to May 2017. The engineer of record, Jacobs conducted a project-level analysis of the runway, looking at multiple construction scenarios with different materials and construction timelines. The analysis yielded eight rehabilitation options ranging from full-depth reconstruction in PCC (Portland concrete cement) or HMA (hot mix asphalt), to various alternative partial reconstructions, all the way to asphalt overlays over the full length and width. Based on a 30-year horizon, Jacobs performed a Life Cycle Cost Analyses (LCCA) for each scenario and determined a Net Present Value (NPV) for future maintenance and rehabilitation.

During this process, the schematic design revealed that although the core of the runway, or keel section, had become quite distressed, the outer lanes were in pretty good shape. Below the concrete surface of the runway, the cement-treated base and lime-treated subgrade were also in great condition. Originally, these assets had taken more than a year to construct and couldn't be replicated within an accelerated construction timeline which ruled out full-depth reconstruction scenario almost immediately. The best option for rehabilitation needed to satisfy many requirements. Project Manager for DFW Mohammad Rehman said, "On one hand our goal was a 30-year life cycle. On the other hand, we had assets we could preserve and use as a construction platform, building on top with structural overlay using asphalt. Factoring in the time constraint, asphalt was one of the best solutions because we could preserve more than 70 percent of the underlying layers as well as the surfaces." It was now up to DFW and its airline partners to decide. Said Khaled Naja, DFW's Executive Vice President of Infrastructure and Development Division. "Ultimately, the asphalt advanced our capabilities with weather resistance and operational performance. It also provided us a cost-effective solution that allows us to plan for future rehabilitation projects that return our airfield to full operations in less time than what other products offered. That's better for the airport and our airline partners."

MIX DESIGN: MASTER THE RECIPE BEFORE YOU BAKE THE CAKE

The mix design followed the FAA's P-401 specification and was developed using the Superpave method with a PG 82-22 binder, which can maintain its elastic recovery properties over a wide temperature range. PG 76-22 would have also been acceptable, but the FAA recommends a "grade bump" to increase stiffness and rutting resistance for asphalt pavements accommodating heavy traffic, high tire pressures, and slow or standing traffic such as occurs on airport taxiways.[1]

Eric Johnson, General Plants Manager, Austin Bridge & Road, attributes much of the project's success to the mix design which played a role in everything from meeting production schedules to achieving mat densities. "We designed a mix that would enhance the logistics of getting enough material in a timely manner, and that would enable us to achieve density out on the runway. It was all premeditated." He continued, "Knowing



Asphalt Fulfills Sustainability Requirements

As North America's first carbon neutral airport, DFW is eligible for the FAA's Airport Improvement Program and received roughly 80 million in federal grants for the runway rehabilitation. As a participant in the Airport Sustainability Planning program, DFW fully integrates sustainability into its long-range planning. DFW was able to fulfill FAA sustainability requirements during the rehabilitation project in several ways. Because only a fraction of the runway was demolished, fewer trucks were needed to haul debris to landfills reducing truck traffic on public roadways. Most of the material was crushed and reused with the remainder stockpiled for use on future projects conserving virgin materials. The use of special "cleaner diesel" trucks reduced harmful emissions. Said Johnny Jackson, Program Manager for the Engineer of Record, "The client (DFW), stakeholders and the end user, the FAA were all active in finding solutions. We came together to create what I consider a think tank, to really think outside the box, at what would be the best thing for this airport, and then going forward with what was ultimately selected - asphalt. It was a collaborative effort to achieve our goals and at the same time bring a full green initiative."

the characteristics of all our materials, we focused in on the mix design that would afford us the best success and results." While the P-401 specification is relatively stringent, Austin's mix design plays within the allowable parameters. Johnson said, "You can tweak it because crushed aggregate is not like widgets coming off an assembly line. There are variances. That was another element. We anticipated where the variances were going to be."

Once the mix was designed, TSIT Engineering & Construction, LLC (TSIT), the quality acceptance lab (QA), and Austin's quality control (QC) lab worked closely together to make refinements as needed. TSIT was able to provide expertise in P-401 mixes and experience working with local materials. When the initial test strip needed improvement, TSIT Director of Asphalt Services, Bruce Spracklen asked and received permission from Jacobs, to cross the aisle and work with Austin on enhancements to the mix design. Spracklen recommended a dolomitic aggregate and change to the original JMF (job mix formula), an instrumental change that kept the production on target. Only twice gradations during the entire job. Said Eric Schranz, Plant Operations Manager, Austin Asphalt, Austin Bridge & Road, "We had a pre-construction meeting and it was suggested that QA work very closely with QC as a team. So that's where that relationship was established not only in the lab but on the field, too. The commitment on everybody's part was to make it a huge success. We were striving for excellent."

CONSTRUCTION: QUALITY WINS, SETBACKS OVERCOME

When DFW chose asphalt for their rehabilitation project, speed of construction was a major factor. As the contractor, Austin Bridge & Road knew that controlling the time was key

to meeting the aggressive schedule. In planning for the construction phase of the project, ABR considered many contingencies including supply chain issues, equipment failure and bad weather. There were a few surprises including a major change to the electrical package and the rainiest September and October Dallas had seen in 80 years. These events pushed the paving season back into the colder months and trimmed the paving day from 24 hours to just a few each day.

ABR had several measures in place to mitigate delays. First, when designing the mix, they chose aggregates with low absorption properties that were easily sourced from two of Martin Marietta's nearby quarries, one in Oklahoma and one in Texas. Their plant design incorporated superior stockpile drainage so in the event of rain, wet materials wouldn't be the cause of further delay. The game plan called for three asphalt plants to be available throughout the construction, all three producing the same mix design. The primary plant was on DFW property right outside the Airport Operations Area (AOA) and could produce 400 tons an hour. At its peak, the primary plant produced 3,800 tons in one day. If it went down, operations would shift to one of two nearby backup plants. At one point, for about 10 days, all three plants were running to keep up with the schedule. Together, the three plants produced 5,000 tons in one day. Overall, 220,000 tons of asphalt was produced for the job.

DFW allowed a staging yard next to the runway for prep work, which took approximately one month. There were four QC people onsite and two stationed at each offsite plant daily. Two milling crews removed the existing concrete surface of the runway using 3D grade control on the level up and first layer to achieve an elevation of +/- .25-inch. For the top surface in the central keel, per the P-401 specification, ABR paved in echelon. Four paving trains in two echelon patterns yielded a 75-foot-wide hard mat and eliminated all but two joints. Per FAA requirements, ABR cut back cold joints five to six inches where the taxiways crossed the runway. Proper joint construction is critical to the life of a pavement. It prevents premature failure or raveling, enhances the smoothness of the final riding surface, and keeps moisture from getting into the mat. Austin's joint densities compared to the mat densities were very close.

ABR's choice of aggregate and stockpile drainage design helped tremendously to mitigate time lost due to weather. Even though work was stalled during the rain, ABR was able to resume paving as early as a day after a two-inch rainfall. The electrical scope change presented an equal, if not more challenging delay. When the job was bid, the electric package called for the reuse of part of the existing infrastructure. DFW decided to replace rather than retrofit all the existing runway lighting, a task involving that contributed toward pushing the paving schedule into the winter months. Since the temperature had to be above 40 degrees for successful compaction using a highly polymer modified binder, paving was limited to the warmest few hours of the day. ABR had a Dustrol Milling Heater on site to warm up the paving surface, but unfortunately, heat loss was mostly occurring while the mix was in the trucks and as it was being transferred to the paver. ABR had to consider the wind chill as well as the actual temperature. The delays caused the project to exceed the schedule by roughly three months, however, DFW considers the project to be on time due to scope addition and unexpected wet weather. Said Eric Schranz, "DFW was a great partner. They knew it was an aggressive schedule, and they realized that the change

orders and weather delays prohibited paving time. They knew the planning we'd done and the tools in our toolbox; those surface heaters for example. We never did use them, but if it came down to it, DFW offered to pay for them. The point being the relationship, not only out on the job site, but from the perspective of the owner standing back, knowing that we were committed to the project. They were willing to help out in any way they could."

By all accounts the construction of DFW's first asphalt surface runway is a great success. The project, originally estimated at $180 million, came in significantly under budget despite the extensive lighting package and rain delays. But the real story is how partnership results in exceptional quality. Using a California Profilograph, ABR determined a near perfect ride surface. As Eric Johnson says, "With a final joint density of 98.0 and a mat density of 98.8, the proof is in the pudding!"

DFW RUNWAY 17C/35C Surface - Runway Standard Deviation				
		75 gyrations		
	59 Lots	59 Lots		
	STDV	Average	JMF	Specs
Asphalt Content	0.12	5.88	6.1	5.65-6.55
Lab Air Voids	0.45	3.42	3.5	5.0-2.0
Voids in Mineral Aggregate (VMA)	0.47	16.2	15min	14min
Mat Density 96.3% minimum of lab	1.15	98.8	96.3	96.3
Joint Density 93.3% minimum of lab	1.57	98.0	93.3	93.3
3/4"	0.00	100.0	100	94-100
1/2"	1.09	94.9	95.5	89.5-100
3/8"	2.06	84.6	87.2	81.2-93.2
4	2.06	58.8	58.9	52.9-64.9
8	1.33	35.0	37.7	
16	0.90	22.8	23.3	18.3-28.3
30	0.64	14.9	14.1	
50	0.47	9.3	9.1	6.1-12.1
100	0.34	5.8	6.2	
200	0.31	3.6	3.3	1.3-5.3

LESSONS LEARNED: PARTNERSHIP AND TEAMWORK

With the project now completed, the stakeholders debriefed in a two-hour meeting. Smitha Radhakrishnan, Assistant Vice President of Design and Project Management at DFW said, "This is the first, full runway rehabilitation we have embarked on and that's important because we'd like it to be the archetype for what we're going to do moving forward on the other runways. We have a lot of lessons learned and we must stay fluid as we learn things." Summing up the significance

of the partnership developed among the many stakeholders, Pat McCollom, Program Director for Civil Facilities for DFW said, "From my perspective, I think it was twofold. (Minimizing) the operational impact to the airport, but then ensuring that we continue to get the appropriate and high quality we've asked for … Closing one of our two main approach runways (was) a huge impact to DFW. That alone (was) a challenge but then, how do we route traffic around this runway that's in the middle of our eastern airfield, while reducing the impact overall to our partners, the airlines, the customers and the public? While ensuring that we are getting the product the designers designed as well as the contractor is supposed to put together … all within a very, very, very wet fall? I think without partnership, without teamwork, it would have been far more challenging."

Texas Asphalt would like to thank:

Project Owner: Dallas/Fort Worth International Airport (DFW); DFW Team; Khaled Naja, DFW's Executive Vice President of Infrastructure and Development Division; Mohammad Rehman, Project Manager; Smitha Radhakrishnan, Assistant Vice President of Design and Project Management; Pat McCollom, Program Director for Civil Facilities

Engineer of Record/Construction Manager: Jacobs; Jacobs Team: Brad McMullen, Project Manager; Johnny Jackson, Program Manager

Acceptance Labs: FUGRO/TSIT Engineering & Construction, LLC (TSIT); Primary TSIT Team: Terry Smith, Owner; Bruce Spracklen, Director of Asphalt Services; Justin Macon, Plant Supervision, Inspection, and Testing; Michael Garton, Field Supervision and Testing; Edward Jefferson, Plant Inspection and Testing; Additional TSIT Team: Oliver Johnson, Field Testing; Ernest Maddox, Plant Inspection and Testing; Cam Warren, Field Testing

Contractor: Austin Bridge & Road; Austin Bridge & Road Team: Eric Schranz, Eric Johnson, DJ Meek, QC/QA Manager; Primary Level 1A Plant Production Specialists Onsite: Danny Meek, Andy Isom, Todd Thompson, and Ethan Patton; Primary Level 1B Roadway Specialists Onsite: Anthony Wells, Greg Garza, John Woods, and Spencer Cook; Additional Level 1A Plant Production Specialists: Mitchell Page, Jimmy Johnson, Brent York, Randy Garcia, and William Sadler; Additional Level 1B Roadway Specialists: David Woods and William Shelton

Superpave for Airports, Mark Buncher Ph.D., P.E. and John Duval, P.E., Asphalt Magazine, Spring 2003. ✪