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O'Hare Nearing End of Monumental Airfield Initiative

# RUNWAY & RAMP

SPECIAL EDITION

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# Runway & Ramp Special Edition

*Welcome back, my friends, to the show that never ends. We're so glad you could attend. Come inside! Come inside.*

For those of you old enough to know this Emerson, Lake & Palmer lyric from the early '70s, you're welcome for the earworm.

*Airport Improvement* wasn't around in the early '70s, but we have been covering runways in every issue since the magazine was launched in 2008. A huge nomination list of compelling runway stories inspired our annual Runway & Ramp edition, which we've been publishing since 2010. It's a real honor to provide airports throughout North America with an entire issue dedicated to airfield projects. No other magazine does it.

Given that we still have more project nominations for runways than any other category, it's easy to devote an entire issue to this special content. The hard part is sifting through all the great story ideas to select the best ones to share with you.

What's so special or interesting about the airfield projects profiled this year? It's the ingenuity of the airports, their consultants and suppliers. For instance…

Who knew that the shape of runway grooves could be so important? Well, Cardinal/International Grooving and Grinding recommends trapezoids rather than traditional square cuts. See why on Page 33.

The installation of engineered material arresting systems (EMAS) has been a lifesaver. Literally. But did you know that the EMAS available today are quite different from those installed 10 years ago? The SAN story beginning on Page 64 will tell you more.

Lastly, even ordinary walkways can inspire. Look to our Artscapes feature on Page 72. The maintenance staff at Wilkes-Barre/Scranton International painted the floor of a pedestrian tunnel to match the appearance of 4-22, the airport's 7,501-foot main runway. Not only did they paint the runway, but they also installed runway lights on either side.

PAUL BOWERS, PUBLISHER

Please enjoy these and other examples of airport ingenuity in this special edition.

Cheers!

Paul

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McGHEE TYSON AIRPORT
KNOXVILLE

PHOTO: AERIAL INNOVATIONS

## FACTS&FIGURES

**Project:** Airfield Modernization Program

**Location:** McGhee Tyson Airport, Knoxville, TN

**Owner/Operator:** Metropolitan Knoxville Airport Authority (MKAA)

**Project Scope:** Reconstruction & profile adjustments of Runway 5L-23R & impacted taxiway pavements; 500-ft extension of runway at each end; storm drain improvements; new runway & taxiway lighting; new airfield guidance signs & navigational aid facilities

**Enabling Project:** Instrument landing system for Runway 5L-23L

**Total Cost:** $133.5 million

**Funding:** FAA; Tennessee DOT Aeronautics Division; TN Air National Guard; airport authority

**Construction:** 2015–2021

**Design Engineer/Program Manager:** CHA Consulting

**Subconsultants:** Michael Baker Int'l; Cannon & Cannon Inc.; S&ME; Holt Consulting; McGuiness Unlimited

**Construction Contractors:** Eutaw Construction Co. (Projects 1, 2, 5, 6); The Harper Co. (Projects 3 & 4)

**Construction Subcontractors:** DACO; Erosion Solutions; Kimberly; Skilled Services; Airfield Etc.; Precision Approach LLC; McCarthy; Whaley Construction Co.; MDI Contracting & Directional Drilling; APAC; Zebra Striping; American Stripers; Speidel Construction Inc.; Marking Impressions; Antigo Construction; Crush; Loudon County Fence; Archangel Protection Services; Pozzolanic

**Concrete Suppliers:** The Harper Co.; Vulcan Materials; McCarthy; Harrison Construction Co.

**Asphalt Suppliers:** APAC; Rogers Group; Pavement Restorations Inc.

**Lighting & Signage:** ADB SAFEGATE

**Construction Barricades:** OTW Safety

# McGhee Tyson Airport Expands Scope of Simple Runway Rehab

BY JENNIFER DAACK WOOLSON

The internet is full of videos about home improvement projects that mushroom in size and scope. What starts as a simple fix all too often becomes a complete redo. McGhee Tyson Airport (TYS) near Knoxville, TN, experienced a similar storyline when it undertook what was initially envisioned as a simple runway rehab in 2009.

Spoiler alert: TYS installed fresh concrete, but also ended up extending and completely redesigning the runway…and installing a new instrument landing system (ILS) on the parallel runway.

The $133.5 million effort, slated for completion this October, began with modest plans to repave and widen the shoulders of Runway 5L-23R. But an initial concrete survey found that 65% to 75% of the slabs needed to be replaced; and the remaining 25% of the pavement was 35 years old.


ERIC WILLIAMSON

"We knew that within five to 10 years, we were going to be back out there replacing that 25% and breaking some of the new pavement," says Eric Williamson, P.E., senior airport engineer and project manager for the Metropolitan Knoxville Airport Authority.

That's when the simple rehab turned into a full-blown reconstruction project. In 2010, the airport authority worked with CHA Consulting to start outlining a multi-year airfield modernization program. Initial planning led to two big questions: How are we going to pay for the improvements? How will we handle arrivals during adverse weather when our only ILS runway is closed for reconstruction?

Before airport officials could even think about ripping up and replacing Runway 5L-23R, they had to make sure the other runway, 5R-23L, was up to the job of handling *all* the airport's traffic.

## The Domino Effect


BRYAN WHITE

Bryan White, P.E., vice president of Engineering and Planning for the airport authority, notes that both runways were aging out at about the same time. This meant that the project team needed to address several enabling projects to ensure that inboard Runway 5R-23L stayed functional throughout construction. "If we didn't take care of them, we were about to go from a two-runway airport to a zero-runway airport," he jokes. "And we all know that those are not successful."

To make the reconstruction project work, Williamson considered it essential to have an ILS on the airport's most-used approach. But the FAA wasn't willing to fund an ILS system on Runway 5R-23L using the reconstruction of Runway 5L-23R (which has CAT I and CAT II ILS equipment on the respective runway ends) as the justification for the new equipment.

During programming discussions, the airport authority held a forum to gather feedback about the impending airfield work from airlines, local tenants and other aircraft operators. Needless to say, none were thrilled when they heard that TYS could be without an ILS-equipped runway for three to five years during construction. In fact, some airlines indicated they would reduce service schedules without a Category 1 ILS runway.

"It was almost panic mode on our end," recalls White. "But we felt that we could not move the dial with the FAA on this ILS expansion notion."

So the project team looked for state resources instead.

## Chasing the Money

The team succeeded securing a grant from the Tennessee Department of Transportation's Division of Aeronautics to install an ILS on 5L-23L as an enabling project for the rehab of Runway 5L-23R.

But that only solved a small part of the budget issue. The airport regularly receives $4.2 million in annual entitlement funds plus state and local matching funds; and costs for the full project were estimated around $130 million. Officials consequently started looking for other sources, including the FAA Airport District Office in Memphis; and planners split the overall modernization plan into separate projects to help the funding process.


BILL BARLEY

"We really were taking this plan that we knew was going to be over $100 million and trying to phase it into projects that we didn't know the dollar value of, because we were searching for FAA discretionary funds," recalls Bill Barley, P.E., the program manager from CHA Consulting.

When bidding individual projects, the team figured in cost escalation for the inflation, downtime and remobilization of contractors that would occur while TYS completed the full plan.

"We knew that once we finished the first phase of this project, the runway would be down and out of service, and we were not going to get it back until the whole project was over," Barley explains. "So, there was a big push to try to accelerate that as much as possible because the finances were really the limiting factor that drove the schedule."

## Runway Reconstruction

After the ILS for Runway 5R-23L was flight-checked and commissioned in August 2015, the airport almost immediately took 5L-23R out of commission so contractors could start demolishing it.

*Plans for a standard runway rehab expanded into a broad-based airfield modernization program.*

The effort to rebuild it required much more than simply laying down new concrete. Williamson explains that bigger changes needed to be made because the runway was not meeting FAA standards that had evolved over time. For example, it had vertical curves in the last quarter and crossing taxiways within the middle third, a high-energy crossing area where the FAA generally wants to minimize or eliminate access. Plus, there was a significant line-of-sight issue that needed to be remedied.

"We initially thought that this was going to be a remove-and-replace," White says. "But with CHA's programming and interaction with the FAA, we quickly realized we were going to bring the runway to current advisory circular standards."

Now that the fixes have been made, the only thing left from the previous runway is its compass orientation (5-23). The vertical profile changed completely—each threshold was raised about 8 feet, and the center of the runway was lowered 8 feet. In turn, that meant replacing thousands of feet of taxiway leading to the runway to meet the 1.5% grade restriction.

The programming effort also identified the opportunity to add 500 feet on each end of the runway to aid missions of the Tennessee Air National Guard 134th Air Refueling Wing. The National Guard Bureau funded that portion of the project, and Runway 5L-23R is now 10,000 feet long.

Planners divided the overall rebuild into three phases.

During Phase 1, crews demolished and replaced about 3,000 feet of pavement to lower the middle of runway and raise the 23 end. This involved moving about 400,000 cubic yards of earth.

The remaining portions of the runway were removed during Phase 2, and contractors moved another 1 million cubic yards of earth. Officials note that every piece of concrete that workers pulled out was crushed and reused in the base course for the new runway and taxiways, saving millions of dollars in the process.

During Phase 3, contractors built out the rest of the concrete and reinstalled or replaced all electrical and ILS infrastructure, and then remarked the pavement.

The airport also improved its wildlife management plan by altering some of the stormwater management facilities and moving some temporary stormwater storage into the infield area.

Originally, the runway rebuild was expected to last three to five years but is taking longer than anticipated. "We are expecting to finish in October of this year," Williamson reports. "We've had six-plus years of construction. It's just the nature of the game that when you're searching for funding each year, it's going to extend the time you're in construction."

*Crews moved more than 1 million cubic yards of earth during the project.*

When the runway project is completely done, the airport will have a new electrical lighting vault with all new high-efficiency regulators, new LED signage, new LED runway and taxiway edge lighting and centerline lighting, and new controls for the tower and maintenance providers.

Airport officials note that the environmental efficiency of the runway has improved 100%, and thoughtfully designed taxiways will prove incredibly efficient for airlines—thus increasing the usage of exit taxiways and decreasing taxi time, which saves fuel and decreases emissions.

## Collaboration & Relationships

Working together is a prominent thread that runs throughout the narrative of TYS' airfield modernization.

"I'd really define this whole project as partnerships and relationships," says White. "That means relationships and partnerships with the local station managers, Memphis ADO, the

local military and the local FBO. It's partnerships and relationships with CHA. Without their guiding hand throughout this program, we would not be where we are today."

He highlights CHA's relationship with the FAA as a game-changer, adding that the airport authority and its design engineer/program manager made multiple trips to FAA headquarters to smooth friction points and discuss where they needed help to keep the project moving forward.


PATRICK W. WILSON

Adding complexity, the airport authority's previous president retired three-quarters of the way through the project. That's when Patrick W. Wilson, AAE, assumed the leadership role. White credits Wilson for quickly forming partnerships and relationships with all the key players, trusting what the team had done to date and jumping in to help sort out the future.

Looking back, White says that the team has had so much success communicating and collaborating through the years, it changed how the airport authority will approach future projects.

Part of the successful strategy was to create a forum for airport users—from general aviation operators to airline property managers—and for the airport authority to listen to their needs and concerns. Thanks to those efforts, White believes stakeholder relationships are stronger now than before the project began.

He also credits the authority board for entrusting and empowering him and his staff. "When you're a board that's dealing with a $100-plus million project, it needs to be acknowledged that the trust to execute this started with them. If we weren't on the same page with our board, we just wouldn't be sitting here with this successful of a runway project."

Personnel from CHA Consulting are quick to credit lead contractors Eutaw Construction and The Harper Company as well.

"They were big, big partners in helping get this done successfully," Barley remarks. "We need to recognize the contributions that the construction community made to this project—including one equipment operator who has been on site since Day One."

From the first project all the way through the sixth, there has been an attitude of "Yes, we can get this done," says Barley.

*The airport seized the opportunity to improve drainage while performing other airfield work.*

"To me, that's a reflection of the authority's leadership and the fact that it is a very, very strong business partner to the people that they work with—us as a consultant, contractors and every one of their tenants," he explains. "They understand that it's part of their responsibility to help everybody succeed. And when the owner of the project brings that attitude, it's easy for that to trickle down through all participants."

White says that there was concern among the traveling public about how construction would affect service, but it ultimately proved to be unfounded. The airport authority kept travelers and the local community apprised of progress through the TYS website, local public relations efforts, social media and a podcast called *From the Runway Up*.

"There's not any sort of story where customer service has been altered, impacted or deviated," White reports. "For us, that's a pretty important thing, because our board always wants to know if we are impacting or frustrating travelers."

With the project all but complete, officials are confident that the investment, and even slight delay, will be worth it. Wilson notes that the runway extension and other airfield improvements poise TYS for a bright future, including opening longer stage lengths for air carriers. "McGhee Tyson Airport plays a vital role in supporting the business, tourism and leisure transportation needs of the region's economy," he says. "The reconstruction of Runway 5L-23R has prepared our airfield to serve our community's aviation needs for the next 50 years."

# Becoming a One-Runway Wonder

McGhee Tyson Airport (TYS) near Knoxville, TN, had grown accustomed to operating as a two-runway airport. If officials needed to close one runway for maintenance, mowing or painting, it was never a problem to temporarily move traffic to the other. But it was a frightening proposition when a pavement reconstruction project required closing one runway for years instead of hours.

"I think, internally, we questioned how we would survive," recalls White. "Our Operations Department had to go out and talk with other one-runway airports so they could calm us down and reassure us that we were going to make it."

Boosted with newfound confidence, TYS management felt up to the challenge.

Of course, in their minds the challenge would be maintaining the current level of operations with just one runway. But the market dealt them a major surprise. As construction progressed from 2016 through 2019, TYS started breaking every one of its enplanement and total passenger records. The airport experienced 43 months of consecutive growth and hit an all-time high of 2.5 million total passengers in 2019. Then, traffic slowed dramatically in March 2020 due to COVID-19.

The exciting growth was not without challenges. For example, at the start of the project, maintenance crews could work from 10:30 p.m. to 6 a.m. without disrupting any airfield traffic. With the increased capacity, however, their window narrowed to just a few hours per night.

"We went from a mindset of 'How does any airport survive without two runways?' to putting more traffic on one runway than we ever had on two runways combined," White recalls.

Handling the growth without a hitch was the result of planning and cooperation. Everybody at the airport authority, airlines and tenants operations all worked it out together, he explains.


# Regional Municipality Funds Runway Improvements at Fort McMurray Int'l

BY KIMBERLY GIBBS

## FACTS&FIGURES

**Project:** Runway Rehabilitation

**Location:** Fort McMurray (AB) Int'l Airport

**Scope:** Fresh overlay for 7,503 x 150-foot runway; LED airfield lighting & signage; runway end safety areas

**Cost:** $15 million

**Fully Funded by:** Community Investment Program of Buffalo Wood regional municipality

**Initial Planning:** 2017

**Funding Secured:** 2019

**Contracts Awarded:** Spring 2020

**Construction:** June 2020–May 2021

**General Contractor:** E-Construction

**Milling:** A. LeDuc Developments

**Lighting Contractor:** Signal Electric

**Airfield Markings:** Marshall Lines

**Key Benefits:** Enhanced safety & operational efficiency; reduced energy costs from new LED lighting

At a time when some airports were pressing the proverbial pause button on all construction and improvements, Fort McMurray International (YMM) in Alberta was moving ahead with plans for a major runway rehabilitation. The $15 million project was completed in May, funded entirely by the regional municipality of Wood Buffalo.


R.J. STEENSTRA

R.J. Steenstra, president and chief executive officer of Fort McMurray Airport Authority, notes that keeping Runway 8-26 in good condition was a critical need not only for YMM, but also for the surrounding areas that depend on the airport as a key launch pad for food, medicine and people.

"We knew that the runway was due for an overlay, and we needed to find a way to support this strategic investment," says Steenstra, adding that it had been 19 years since the airport's sole runway had been resurfaced.

When YMM began the planning process in 2017, it reached out to one of its strongest partners, the regional municipality of Wood Buffalo. "The airport is not a division of the city, which is why approaching the municipality for funding was so unique," Steenstra explains. "We believe Fort McMurray Airport and the runway are very strategic assets in the community."

The municipality apparently agreed, because it approved YMM's request in 2019, fully funding the project through its Community Investment Program. Specifically, the runway improvements fit the program's

strategic initiatives to support emergency response and safety, economic development and outreach to Indigenous and rural communities.


DON SCOTT

"This was the right capital investment at the right time," says Wood Buffalo Mayor Don Scott. "The airport is a critically important asset for our community, and the new runway will ensure that it continues to support economic development and recovery by facilitating growth opportunities and welcoming more individuals and families to our region."

In particular, many communities in Northern Canada depend on YMM to transport vital goods and oil industry workers. Steenstra notes that the airport is an important access point, even during the current pandemic.

## Making the Case

To secure funding from the regional municipality, YMM developed a compelling submission and provided detailed plans about the airfield project. It also highlighted how the proposed construction would support the needs of Fort McMurray and surrounding areas. Following the written submission, the airport team presented its plan in person to the municipality for approval. But before doing so, executives found an ally in Fort McMurray Economic Development to support their funding request.

Despite strong demand for Community Investment Program grants, YMM secured full funding for its $15 million project. In addition to rehabilitating the asphalt pavement on its 7,503-foot-long, 150-foot-wide runway, YMM was able to improve airfield lighting/signage and add a runway end safety area at each end.


CUYLER GREEN

"Through this support, we have a runway infrastructure that can support us for at least the next 15 years," says Cuyler Green, vice president of Airport Operations at YMM.

New LED lighting and guidance signs were a direct response to requests from passenger and cargo airlines.

During winter, limited visibility can create difficult conditions for pilots landing on snow-covered runways and taxiing around snow berms; so the upgraded lighting and signage helps a lot, explains Green.

In addition to enhancing operational safety, the new lighting is reducing energy costs. Green notes that electricity can be expensive in northern Alberta, but LED technology helps decrease the airport's electricity bill.

The project also satisfies new requirements from Transport Canada Civil Aviation regarding runway end safety areas. YMM added 150 meters at each end of its runway to help aircraft stop safely in case of an emergency. Leveraging LED technology for new and existing approach lighting systems enhances landing safety.

## Proceed with Construction

While flight volume around the world began to take a steep downturn, YMM initiated a competitive tender process for its runway project. By April 2020, it had selected a general contractor.

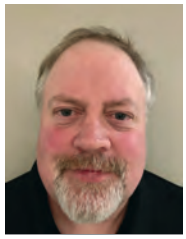
"The challenging decision was whether to move forward with the rehabilitation project or not given the global pandemic," Green recalls. "There was a lot of uncertainty in the industry about contractors receiving materials on time."

The airport considered delaying the project because of changing COVID-19 safety protocols and supply chain disruptions, but ultimately decided to move forward.

As the project team reviewed proposals from contractors, it prioritized factors such as overall experience and the ability to meet the proposed construction schedule despite the complexities of working in an airfield environment.

There was also a prevailing desire to create jobs within the local community, which was ravaged by wildfires in 2016 and experienced historic flooding in 2020. Fortunately, YMM received significant interest from local companies wanting to compete for the significant hometown project.

"We were able to award the project to a local company that created local jobs and made a local economic impact," Steenstra reports.



MICHAEL WHEATING

E-Construction began work as the project's general contractor in June 2020 with at least 50 area residents on its payroll.

"We were very happy to be selected as the contractor to complete this project," says Michael Wheating, North Division manager for E-Construction. "We feel that we were able to draw from our company's wealth of expertise and experience in airport construction throughout Alberta to provide the best value and product possible."

As planning progressed, the airport discovered silver linings associated with completing the airfield work while a global pandemic was decreasing traffic for YMM and the rest of the industry.

"The pandemic offered us a window that we would not have normally had," explains Steenstra. "We had reduced schedules, which allowed us to be more efficient in getting this project completed and have as little impact as possible on the community and air carriers."

Eight-hour runway closures were put in place to keep construction on schedule.

"This major project was designed to not only enhance the runway, but also maintain our focus on safety," notes Green. "For that to happen, we needed to perform the work overnight and closely coordinate with the airlines."

E-Construction and the airport worked together to develop detailed plans and foster collaboration between construction crews and the two main scheduled air carriers operating at YMM.

Choosing an experienced contractor and stressing the importance of planning and coordination paid off, because the project finished on time in May 2021.

"More than 80 tenants depend on the airport for their livelihood, making this runway project incredibly important to the region," Steenstra emphasizes. "It's important to have a runway equipped with the lighting and technology that can support the airport, air carriers, our partners and our community's needs."

*Construction crews worked overnight to minimize disruptions to airline schedules.*

The runway rehabilitation project positively impacted air travel, cargo, oil, tourism and retail for Fort McMurray and the area's northernmost towns. It also allowed the airport to keep capital investments connected to the local economy and improve the quality of life for residents throughout the region.


# Casper Int'l Upgrades ARFF Training Center at Opportune Time

BY PAUL NOLAN

## FACTS&FIGURES

**Project:** Aircraft Rescue & Firefighting Training Facility Enhancements

**Location:** Casper/Natrona County (WY) Int'l Airport

**Total Cost:** $7.4 million

**Building Expansion/Burn Pit Upgrades:** $6.35 million

**New ARFF Vehicle:** $1.07 million (truck & equipment)

**Funding:** $6.95 million from FAA Supplemental Airport Improvement Program grant; $463,400 from state grant & airport funds

**New Facilities:** 24,500 sq. ft. fire staging area; upgraded hardware & software for training facility control; large dedicated classroom; reception area; restrooms

**Full-Size Training Prop:** Based on CRJ 900 & ERJ 175 fuselages to meet Index C requirements (fuselage is 75 ft. long, 10 ft. in diameter; wingspan is 30 ft.)

**New Training Vehicle:** Oshkosh Striker 6x6

**Facility Construction:** May 2020-May 2021

**General Contractor:** GH Phipps Wyoming LLC

**Architectural Design/Project Manager:** Jviation, a Woolpert Co.

**Fire Training Consultant:** Kirila Fire

**Training Offered:** 40-hour Basic ARFF Course (time is split equally between classroom & live burn training); live truck & hand line burns (for annual recertification); 2-day intensive truck & hand line course

Practice makes perfect, and *everyone* wants aircraft rescue and firefighting (ARFF) teams to be as close to perfect as possible when they respond to airfield emergencies.

Recent enhancements to the ARFF training facility at Casper/Natrona County International Airport (CPR) in Wyoming will help emergency personnel from across the region and elsewhere practice their skills and earn/maintain FAA-required certifications. This spring, CPR expanded its existing training center and finished construction of a larger, higher-tech area for live burn exercises. And in June, it took delivery of a new firefighting truck that will be used solely for training.

In total, CPR invested $7.4 million to enhance its ARFF training center—about $6.35 million in facilities and $1.07 million for equipment. Nearly 94% of the costs were covered by a supplemental FAA Airport Improvement Program grant. The remaining portion was covered by a grant from the state of Wyoming and the airport itself.

## Filling a Need

"Both the facility and vehicle were reaching the end of their useful life," notes Airport Director Glenn Januska. "So without these funds to purchase a new vehicle and reconstruct the training facility, we would have been looking at winding down the operations here."

GLENN JANUSKA

That would have made it significantly more difficult for ARFF crews throughout Wyoming and neighboring states to fulfill their annual recertification requirements—especially since a similar facility at Salt Lake City International Airport closed in 2018, and Denver International Airport now only trains crews from Colorado.

Throughout the years, more than 2,700 firefighters from about 75 departments have trained at CPR (totals include repeat participants). So far, most have been from airports in Wyoming, northern Colorado and western Nebraska; but the mix may soon change because Januska has been receiving more inquiries from airports farther away. He attributes the recent spike in interest to a new 140-by-175-foot burn area and larger mockup plane—features that allowed CPR to step up from an Index A training facility to


an Index C facility (with aircraft at least 126 feet but less than 159 feet long).

## Upping the Realism

The new 24,500-square-foot fire staging area replaces an 18,750-square-foot training pit that was constructed in 1995 and had become too costly to maintain and upgrade.

While most other training centers use propane to simulate fires, CPR's new system uses diesel fuel to create more true-to-life fires. So did its previous system. "When we light up the pit and start a fire, it doesn't go out until someone puts it out or it burns out," Januska explains. "We've had departments drive farther to get that more realistic training."

Using diesel fuel required the airport to take extra environmental precautions. The new burn area has two layers of high-density polyethylene (HDPE) liner to prevent diesel fuel from seeping into the ground and potentially contaminating groundwater. In addition, layers of sand were laid under the piping that carries the diesel, and a layer of rock was installed on top of that.

Instructors start and control the training fires from a tower adjacent to the staging area. The same tower was used for CPR's previous fire staging pit, but new technology was added to provide significantly more control over the practice fires.

"We can program different types of scenarios and run them all, or run different ones based upon which way the wind is blowing and how the fuel is dispersing," Januska explains. "With the new system, we can program a 75-gallon spill in one area, ignite it, and then five minutes later start two other spill fires. As the ARFF personnel respond to the other two, we can reignite the one the firefighters just left."

Trainers can also simulate engine fires, which they couldn't do before. And firefighters can now practice entering aircraft fuselages with hand lines. The old fuselage was too tight and could not be set afire remotely.

CPR's new Oshkosh Striker 6x6 adds an additional element for trainees. When fully loaded, it provides firefighters with 3,000 gallons of water to practice their application skills. Departments wanting to practice multiple-vehicle attacks can also use the 1995 E-One 1,500-gallon truck purchased when the original training facility was built.

## Project Logistics

Adding a training room and a reception area to the building was standard work for project contractor GH Phipps Wyoming LLC. However, tearing down the existing fire staging pit and building a new, larger one in its place was new territory. "That was out of the norm of what we typically do, but it's out of the norm of what almost anybody typically does," says GH Phipps General Manager Cris Goldy. "There are not a lot of these around the country."


CRIS GOLDY

As such, the contractor hired Kirila Fire, an Ohio-based specialist in designing and manufacturing fire training facilities, to build the fire ignition system and oversee construction of the fire staging area. Kirila also sourced and installed the software and hardware that is used to ignite the training fires.

## Point of Pride

CPR has offered ARFF training for more than 25 years. Training occurs from May to September, and then the facility is


*Facility improvements include a larger training room.*

winterized until the next training season. Airport employees teach the classes, run the training exercises and clean/maintain the facilities; but airport officials don't really consider the ARFF training center a profit center.

"If you look at the cost to operate the facility and the revenue we generate, it's close to break-even," Januska remarks. "Why do it? It's a point of pride for the airport and for our public safety department. We take a lot of pride in being able to provide training for other departments. Plus, having the facility at the airport, we probably have the best trained ARFF personal anywhere."

As part of an agreement with the state, CPR offers other Wyoming airports a discount on training. In addition to training airport ARFF teams, CPR has also rented the facility to emergency response crews from National Guard units in and around Wyoming.


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PHOTO: ALAN BRANDT PHOTOGRAPHY

# Redmond Municipal Builds New Facility for Snow Removal Equipment

BY KRISTEN RINDFLEISCH

For the past 20 years, the team that maintains the airfield and operates snow removal equipment at Redmond Municipal Airport (RDM) worked out of a 7,000-square-foot building with three modest heavy equipment storage bays. Due to the facility's small size, equipment was stored in several different places across the airfield, some outside without shelter. That led leaders at the central Oregon airport to invest in a much larger 45,000-square-foot facility.


ZACHARY BASS

Airport Director Zachary Bass, C.M., estimates that the $14 million storage and operations building completed earlier this year makes airfield maintenance crews 30% more efficient during winter storms. "It's the simple stuff, like not having to go outside and plug equipment in to warm it up," Bass explains.

Significant increases in RDM's passenger volume and associated additions to its fleet of snow removal equipment reinforced the ongoing need to improve storage. "We recently purchased two MB5 multitask pieces of equipment," explains Bass. "We had nowhere to put them, so it coincided with building this new building and getting the equipment we needed to make sure that we are staying on top of inclement weather."

Pre-pandemic, RDM logged almost 100,000 operations per year and served about 1 million commercial customers annually. "Over the last five years, we have seen about 100% growth in passengers to push us into the small-hub category right before COVID hit," Bass reports. "This May, we were actually 104% above our 2018 numbers."

The city-owned airport is also home to an active flight school. At any given time, 125 to 150 students come to RDM and fly continuously for about 18 months.

## Planning & Construction

"With the tremendous growth of the area, we've got more flights than ever. And the snow removal equipment building was already too small," comments RDM Airport Engineer Fred LeLacheur, P.E. "We just needed to grow; so that's what we did. This project was scheduled several years ago, and we finally went through the design."


FRED LeLACHEUR

The new building consolidates snow removal equipment from three different storage buildings and hangars as well as outdoor locations into one indoor facility with 30,000 square feet for storage alone.

The project began with a site selection study in 2018. Engineer of record Morrison-Maierle Inc. initially considered expanding RDM's existing snow removal equipment building near the terminal, but ultimately chose to construct a new facility on the

## FACTS&FIGURES

**Project:** Snow Removal Equipment Operations Facility

**Location:** Redmond (OR) Municipal Airport

**Size:** 45,000 sq. ft.

**Approx. Cost:** $14 million

**Funding:** About $6.5 million in FAA primary entitlement grants; $200,000 from Critical Oregon Airport Relief Grant Program; roughly $7 million of city bonds

**Planning/Design:** 2018

**Construction:** Dec. 2019-Dec. 2020

**Occupied:** Jan. 2021

**Engineer of Record:** Morrison-Maierle Inc.

**Architectural Design:** BBT Architects

**Construction:** Kirby Nagelhout Construction Co.

**Features:** 2 large bridge cranes to lift heavy bags of deicer; conference room for airport & public use

**Snow Removal Fleet & Supplies:** 2 MB5 Multitask Vehicles; MB3 broom; Tyler deice trailer with Ford 12 yard; 3 Oshkosh vehicles with various broom, blower & plow attachments; Cat loader with box blade; Root plow for Cat Loader; Case loader with box blade; Snow Dozer blower; 2 graders; Schulte blower with Ferguson tractor; 6 E-36 bulk tanks; 18 NAAC Super Sacks; replacement broom segments

*The new 45,000-square-foot facility provides much more room for indoor equipment storage.*

PHOTO: REDMOND MUNICIPAL AIRPORT

northeast side of the airfield. "The existing site ended up being constrained on too many sides," explains Cory Kesler, P.E., a senior airport engineer with Morrison-Maierle. "There were a lot of limiting factors [such as constraints from a nearby taxiway and the line of sight from the air traffic control tower] that affected how far we could expand or how high we could go on the existing site."

CORY KESLER

The new location, previously used for construction staging, presented fewer constraints and provided easy airfield access for snow removal crews. Site prep included demolishing a few small buildings, which required asbestos inspection and mitigation. Crews also relocated overhead utilities and a water main. "It was a pretty clean site, so we were pretty lucky as far as that goes," Kesler remarks.

After choosing the construction site, airport staff and the design team toured equipment facilities at three Montana airports with similar characteristics. "We asked them what they liked, what they didn't like, and tried to incorporate those comments into this facility," says Kesler.

Personnel from BBT Architects, the local design partner, found it helpful to see what other airports had built and ask questions about lessons learned. "I was impressed with the collaboration between airports and their willingness to be fully open and transparent," notes Nathanael Werner, NCARB, project architect at BBT.

NATHANAEL WERNER

As planning began, the architectural firm facilitated a series of discussions to determine the airport's goals and visions for its new building. "Design is an adventure," Werner remarks, "and I think of design meetings as milestone moments that define the adventure."

Five main themes emerged from the meetings:

- circulation and safety
- visibility and transparency
- natural light
- clarity and organization
- snow event meetings and collaboration

Architects distilled the list into design principles and were inspired by the image of a lantern. Werner explains that overall,

the design represents the important role RDM's snow removal and airfield maintenance team serves—keeping the airfield functional in a variety of weather conditions. Translucent windows throughout the facility, even in the storage bays, convey the lantern imagery. "At night, when the lights are on, you kind of get this glow," Werner notes.

Construction began in December 2019 and continued through the end of 2020. A series of gates and fencing that surrounded the project site eliminated the need for Kirby Nagelhout Construction Company and its subcontractors to secure security credentials.

## New Building, Features, Fleet

LeLacheur describes the new snow removal equipment building as utilitarian, but open and bright thanks to ample natural light. Werner notes that natural light can help improve the cognitive ability of people working inside such buildings.

The project team worked with Energy Trust of Oregon to maximize the efficiency of building systems and leverage associated financial incentives for components such as LED lighting and occupancy sensors that reduce energy consumption for lighting.

Beyond adding more storage space for equipment, the new facility includes areas that serve multiple purposes and improve work processes. For instance, the airport wanted a safe, efficient way to load solid deicing materials into trucks, and crewmembers suggested using cranes to lift the metric-ton bags. "But there wasn't really any precedent for that," notes Kesler.

PHOTO: REDMOND MUNICIPAL AIRPORT

*The airport added large 5-ton bridge cranes to lift heavy bags of solid deicer into trucks.*

So the design team planned for the equipment wash bay to also serve as a liquid deicer dispensing area and the storage bay to include a solid deicer loading area—complete with an overhead crane that lifts heavy sacks of NAAC® deicer from storage to dump them into spreader vehicles parked below. "We hadn't seen that at other airports and just wanted to make sure everything we did was as efficient and as multifunctional as we could," Kesler says.

Installing the two large 5-ton bridge cranes inside the building proved to be challenging work for construction crews.

On the environmental front, drainage from both deicer loading positions runs through an oil/water separator before getting discharged to the sanitary sewer. In a similar vein, the equipment fueling area is a concrete pad that is hydraulically isolated from the rest of the stormwater collection area. Runoff from this area is routed to a stormwater manhole with an oil/water stop valve. "That's the initial stopgap we have for leaks," Kesler explains. "Then, that stormwater is also routed to an oil/water separator with coalescing media to get any stray minor hydrocarbons that might make it through before it's discharged to an infiltration basin."

The insulated metal wall panel system in the storage bay is made of thick, robust materials to minimize denting or warping over time. "It's a white, clean surface," adds Werner. "So with the natural light that we bring into that building, it makes the whole space look really clean and highlights the equipment."

Prior to building the new facility, RDM had to send equipment off site for major repairs and maintenance. "In the past, we've taken all of our equipment a couple miles away on public streets to get worked on," Bass says. "Now, we have all the capabilities to do it ourselves."

The building also allows for future growth. "We intend to expand staff as the airport continues to grow," says LeLacheur.

As for the fleet, RDM has been replacing vehicles and pieces of equipment over the last four to five years. With additional storage space in the new building, the airport recently purchased two MB5 multi-function vehicles from M-B Companies. Each unit features a heavy-duty, front-mounted plow and a mid-mounted broom equipped with forced air blowers between the axles. "One of our employees can drive down the runway and do all three of those jobs simultaneously with that one piece of equipment," LeLacheur remarks.

The airport also recently bought an MB3 sweeper and is planning to replace a large dump truck and front loader this year as it continues to update its fleet.

Beyond much-needed space for existing and future equipment, the new facility includes a metal shop and a wood shop. A conference room that was not part of initial plans is proving useful for construction meetings and other gatherings that don't need to occur in the main terminal. Because the design team included two series of security gates, the conference room can also be used for public meetings.

## Overcoming Challenges

As with many projects in 2020, the team building RDM's new equipment building encountered months of delays due to COVID restrictions and associated difficulties procuring materials. Kesler consequently stressed the importance of remaining nimble and adapting to new situations and conditions. "In this case, being able to continue our construction meetings virtually was helpful," he notes.

Kesler credits Kirby Nagelhout Construction Company for managing mask usage and social distancing at the work site.


DAN BRINTON

Dan Brinton, the firm's project superintendent, notes that the RDM project was interesting because it required three different types of construction for one facility: a pre-engineered metal building, a steel-stud frame portion and a section created with concrete masonry units. That said, Brinton ranks COVID-related material delays as the project's biggest challenge.

## Lessons Learned, Opportunities Created

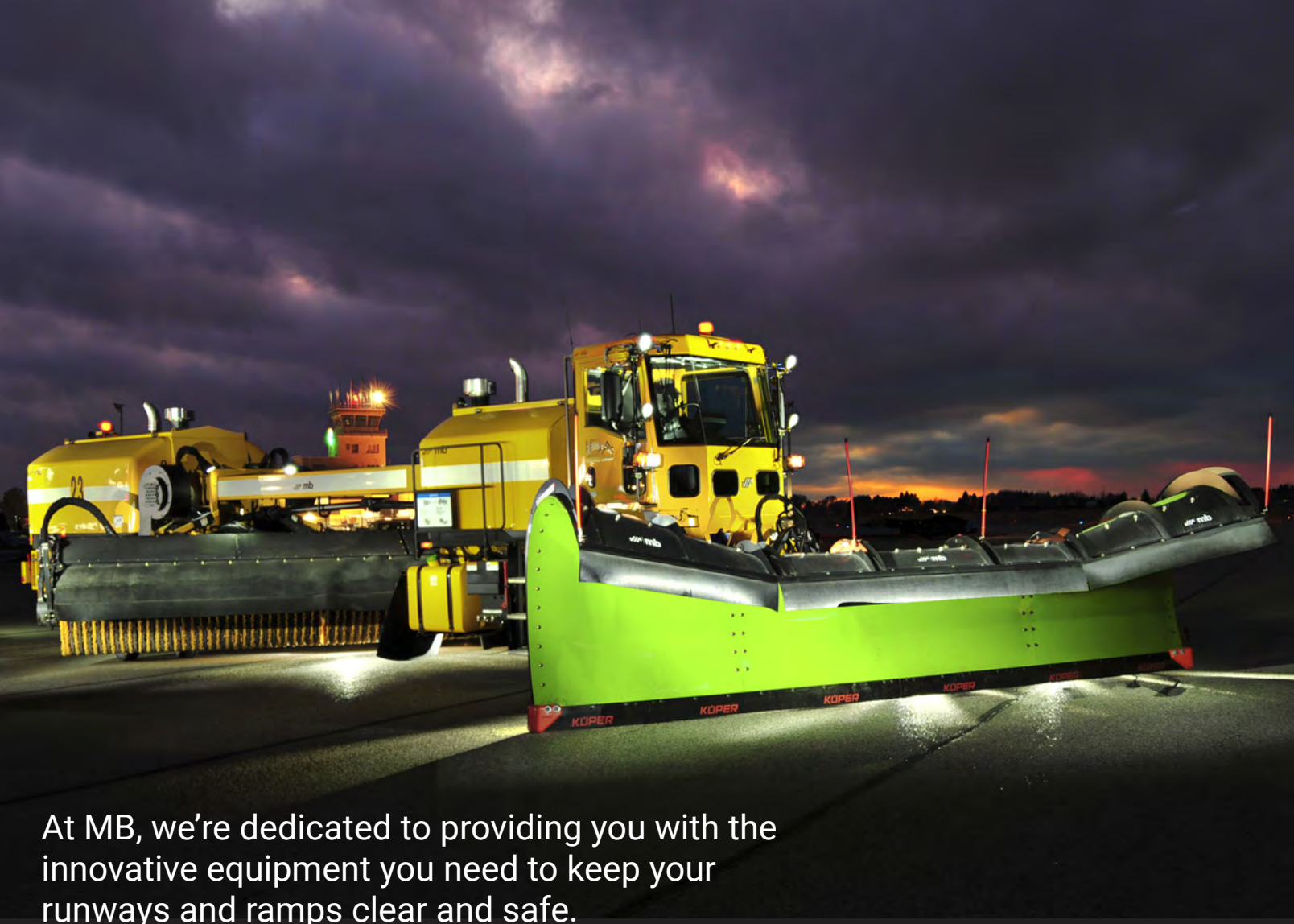
In addition to touring other airports, the design team spent approximately six months during the preliminary design phase gathering insight from the crews who would eventually work in the new facility. "They provided detailed input on their desired building footprint and layout to make their jobs more efficient," LeLacheur says.

Kesler notes that storage facilities for snow removal equipment are inherently large and require appropriate budgets. "Regardless of how much space you have, you'll find a way to use it," he says. Like LeLacheur, he highly recommends visiting other airports. "Everyone has great ideas that they've incorporated that might work well for other people," Kesler relates.

With its new facility complete, RDM is now able to lease the hangars previously used for equipment storage. In addition, facilities and maintenance teams have moved into the former snow removal equipment building. Nearby space was also freed up for a 30,000-square-foot corporate hangar project that is already nearing completion. "It's really opened up what we can do on that side of the airport where the old snow removal operations building was," explains Bass.

Equipment and staff moved into the new building in January 2021, at the beginning of the local snow and ice season. Between the new building's efficiencies and a mild winter, RDM only had to close for inclement weather about three hours last winter. Typically, the airport receives seven or eight large snowstorms that can dump up to 3 feet of snow; freezing fog or freezing rain is much more common.

"They have a great operation staff out there, and they do an excellent job of maintaining the airfield," says Kesler. "I think everybody is really proud of how it ended up, and it's kind of a cornerstone of that side of the airport."

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# Critical Runway at Dallas Fort Worth Int'l Receives New Life

BY JODI RICHARDS


DFW

## FACTS&FIGURES

**Project:** Runway Rehabilitation

**Location:** Dallas Fort Worth Int'l Airport

**Runway:** 18R-36L

**Primary Component:** Keel replacement with bonded structural asphalt overlay (vs. full rehab)

**Other Elements:** Shoulder & drainage improvements; runway lighting upgrades; replacement & reconstruction of connecting taxiways; drainage repairs on another runway

**Estimated Cost:** $130 million

**Funding:** Airport capital funds

**Design Initiated:** May 2019

**Construction:** Feb. 2020-Aug. 2021

**Runway Reopened:** Mid-April 2021

**Designer:** RS&H

**Program/Construction Manager:** AECOM

**Contractor:** Austin Bridge & Road

**Runway Grooving:** Cardinal/Int'l Grooving & Grinding LLC

**Lighting Supplier:** ADB SAFEGATE

**Asphalt Placed:** 180,000 tons

**Pavement Replaced:** 147,000 sq. yards

**Drainage Pipe Installed:** 6,000 ft.

**Under-Drain Pipe Installed:** 49,000 ft.

**New LED Lights Installed:** 3,800

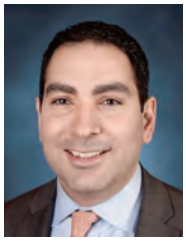
**Wire Installed:** More than 1 million ft.

It's not an exaggeration to say that airfield operations at Dallas Fort Worth International Airport (DFW) impact the entire global aviation system. It is, after all, the fourth-busiest airport in the world. So when officials determined it was time to rehabilitate one of the critical hub's seven runways, considerable care was given to the design, planning and phasing of the estimated $130 million project.

At 13,400 feet long, Runway 18R-36L serves as the primary western arrival runway and primary runway for cargo operations. Overall, it handles fully 44% of daily arrivals and provides critical capacity for the airport. In 2018, Runway 18R-36L logged more than 400 operations per day.

### Ready for Rehab

DFW Executive Vice President Khaled Naja explains that the runway was constructed in 1984 and had consequently begun to show its age. In recent years, management noticed an increase in pavement service requests for the aged runway. In fact, since 2010, 26% of all repair orders were related to Runway 18R-36L.



KHALED NAJA

To ensure continued safety and operational efficiency, the airport initiated a self-funded rehabilitation project and engaged RS&H to coordinate the scope and design. Chad Mathes, a senior civil airfield engineer with the firm, says that 18R-36L was exhibiting obvious distresses, like cracking. "We could see from nondestructive testing that some sort of strategic investment was necessary to keep the runway operational," says Mathes.

CHAD MATHES

Three primary goals guided the rehab project:

- preserving and extending the functional life of the runway,
- enhancing future functional performance, and


- reducing operational impact throughout construction.

In addition to critical pavement improvements, the airport improved infrastructure such as electrical and drainage systems to support safe, efficient operations and enhance the runway's service life.

Lessons learned from a previous runway project proved pivotal to this project. During the rehabilitation of Runway 17C-35C, the project team determined that the base was in excellent shape, and only the keel needed to be replaced. "We pursued a very similar mitigation for this project (Runway 18R-36L)," explains Naja.

Limiting rehabilitation to keel section concrete repair followed by an asphalt overlay provides DFW with the necessary runway improvements without incurring critical operational impact, Naja explains. And, because the base was still in good condition, a full replacement was not required. The base of 18R-36L is comprised of 17-inch concrete slabs on a cement-treated aggregate base.

The recent project also included shoulder and drainage improvements, runway lighting upgrades and replacement and reconstruction of connecting taxiways. Additionally, crews shored up and repaired a few collapsed soil sites on another runway.

Design began in May 2019, and construction kicked off in February 2020. The runway opened to traffic on April 14, 2021 and is slated for full completion in August 2021. The rehab is estimated to cost $130 million, but Naja expects it to come in just under $125 million.

During the design phase, key stakeholders met at least weekly to strategize about planning and phasing to minimize operational impact. Participants included the project management team, aircraft rescue and firefighter personnel, airfield tenants, operations managers, local police departments, airport management and airline representatives.

"We brainstormed and looked at alternatives and design ideas together," says Elliot Neph, an RS&H project manager. "We worked through and evaluated and refined what made the most sense."


ELLIOT NEPH

## Design Details

On this project, the schedule drove the method. "We had to come up with a technical approach that the client and airport users could accept, based on how long they could be without this critical piece of infrastructure," Mathes explains.

Per a mandate from DFW, at least two aircraft crossing points had to be maintained at all times throughout construction. So RS&H designed the project to be built in distinctly separate pieces. "It was almost like doing three runway rehab projects instead of just one," Mathes reflects.

Preparatory work included establishing an onsite batch plant and making sure all aggregate material was on site and ready to go prior to closing the runway.

Next, crews replaced selective sections of concrete and then applied a 6- to 10-inch-thick bonded structural asphalt overlay. This approach allowed DFW to salvage the residual structural capacity of existing pavement and saved a considerable amount of time compared to a full-length, full-depth reconstruction. Because asphalt-over-concrete overlays are prone to reflective cracking, engineers implemented countermeasures like roughening the concrete surface below the asphalt overlay and resealing joints with flexible repair mastic to minimize that potential.

The asphalt overlay used is an FAA P-401 mix with a PG 82-22 binder. Mathes notes that the binder is stiffer than formulas used for highway paving because it is specially designed to support the weight of heavy aircraft without deforming in the Texas heat.

The refurbished runway is designed to handle the heaviest aircraft in the world, including A380s and Boeing 747s. "Our calculations indicate that the Boeing 777, with its triple dual-tandem gear configuration, is the most demanding aircraft on the pavement," says Mathes.

With 23 connector taxiways, raising the elevation of the runway with an overlay added another design challenge because all taxiways were affected.

To decrease the environmental impact of the project, crushed concrete from this and other DFW airfield projects was used as aggregate base to rebuild the shoulders, and some shoulders were recycled directly into aggregate base by pulverizing them in-place and adding cement slurry. In addition, 20% of the virgin aggregate in the shoulder asphalt mix was replaced with ground recycled asphalt.

All 3,800 of the runway and taxiway lights impacted by the project were replaced with LED fixtures, which will save energy and reduce maintenance costs.

When it came time to groove the new pavement, previous experience helped once again. Working closely with the design team, DFW determined that a saw-cut transverse trapezoidal groove would be optimal for Runway 18R-36L.

Philip Zuzelo, president of Cardinal/International Grooving and Grinding LLC, notes that square grooves in asphalt subjected to hot temperatures (which DFW receives in spades) will fold over and close. This limits the effectiveness of the grooves and adversely affects aircraft braking capacity, he explains. In concrete pavement, standard 90-degree grooves that are repeatedly pounded by heavy aircraft can chip and pose foreign object debris hazards.

Zuzelo consequently recommends trapezoidal grooves because they more closely resemble a semicircle, which is the most efficient shape to carry water off pavement. Trapezoidal grooves also experience less rubber buildup because of the oblique angles at the top of the grooves, he adds.

PHILIP ZUZELO

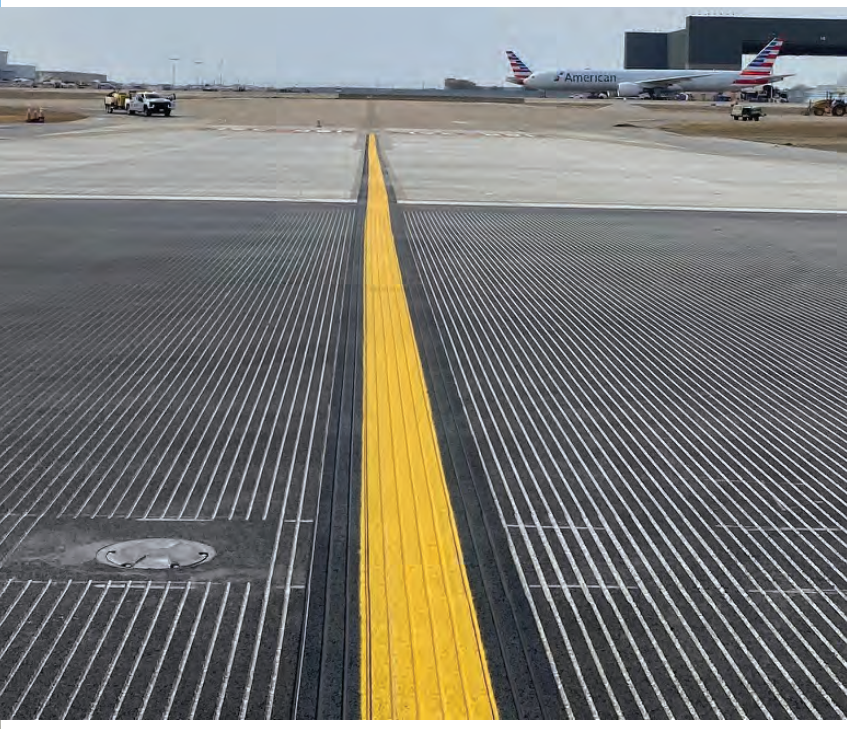
## Mitigating Challenges

Because of the critical role Runway 18R-36L plays at DFW, it was imperative to prevent construction from hampering flight operations. Converting a vast majority of the project zone to landside space proved to be a key strategy. Although this required about 28,000 linear feet (5.3 miles) of temporary fencing, workers did not have to be badged to be on the site.

"Taking that portion of the project out of the secure area expedited the process so they weren't hung up getting through security," says Steve Creamer, vice president of aviation at RS&H.

Due to the timing of the runway rehab, the team also had to contend with implications of COVID-19. "Completing the project

*The airport chose trapezoidal grooves to optimize braking conditions for aircraft.*



during the pandemic was a major challenge for everyone involved," Mathes relates. "I think we will all remember this as the project we were working on when COVID hit."

RS&H was in the midst of bringing the contractor on board when everything suddenly had to change. "To be able to shift on a dime and figure out how to make the project happen with unknowns, that was a tremendous feat by everyone," he reflects.

In addition to the challenges COVID presented throughout construction, the Dallas-Fort Worth metroplex was hit with a massive winter storm in February 2021. Despite the extremely uncharacteristic weather for the region, with historic snowfall totals and freezing temperatures, construction crews carried on.

"The teamwork on this project helped us complete work way ahead of schedule and below budget to upgrade our airfield and help us better serve our customers safely and efficiently for decades to come," Naja concludes. "The vital partnership we have built with the FAA, our airline partners and our contractors drove the success of the project."

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# Smart Runway at Hill Air Force Base Could Change the Future of Airfield Pavement Design

BY KRISTIN V. SHAW

Every time an aircraft lands on the runway at Hill Air Force Base (HIF) in northern Utah, a mountain of data is captured. More than 80 sensors collect information about pressure, temperature, moisture and other key factors for pavement engineers to parse and dissect. There are even wireless sensors shaped like pebbles mixed into the pavement that transmit data about pressure and slight movements within the pavement system.

The goal of this project is to learn more about the way environmental factors and various aircraft affect runway pavements. Ultimately, researchers hope to increase the reliability of runway pavements and improve current and future design methods.

The ongoing military project includes a diverse group of partners from several academic institutions and private industry.

## How it Started

Each year, the U.S. Army Corps of Engineers Engineer Research and Development Center (ERDC) conducts a wide variety of research projects. One of its recent topics of interest was advanced military airfield pavement performance testing and evaluation to support a wide variety of aircraft, environmental scenarios, construction methods and maintenance strategies.

The subject sparked an idea at Woolpert: What if advanced sensors could be installed in active pavement to accurately determine the lifespan of runways? That led a team from the architecture, engineering, geospatial and strategic consulting firm to initiate a collaborative effort with ERDC. The company had worked with ERDC many times before in the development of advanced topographic and bathymetric lidar sensors and algorithms, but this was Woolpert's first foray into research and development with the pavement group.

ED COPELAND

"When ERDC reached out to the industry, we thought smart runways would be an interesting topic," says Ed Copeland, aviation program director for Woolpert. "We teamed up with Dynatest North America and ERDC to figure out what we could do together, and the plan went up to the Hill and Congress for approval."

Woolpert proposed using wireless sensors to collect data about aircraft activity, weather and pavement conditions to help airfield owners make better decisions about operations and maintenance. From a safety perspective, the sensors could also be used to monitor and analyze runway incursions. The focus was on monitoring and analyzing both real-time and historical data.

Once the project got the green light, Woolpert, Dynatest North America and ERDC worked with the Air Force Civil Engineer Center to identify several Air Force bases as possible locations to install the sensors and create a smart runway. Hill Air Force Base, the Air Force's second largest base by population and geography, proved to be their top pick for performing broad, real-world testing.

JEB TINGLE

"Hill Air Force Base has a diverse climate, with hot summers, cold winters and a wide range of temperature cycles," explains ERDC Senior Scientific Technical Manager

## FACTS&FIGURES

**Project:** Smart Runway

**Location:** Hill Air Force Base, near Ogden, UT

**Primary Goals:** Increase understanding of aircraft-pavement interaction; enhance reliability of runway pavements; improve future design methods

**Strategy:** Integrate 84 sensors into & on pavement to provide data about pressure, temperature, moisture, movement, etc.

**Project Cost:** $2.1million

**Timeline:** Research proposed in late 2018; sensors installed in June 2019; data will be monitored for at least 4 more years

**Project Leader:** U.S. Army Corps of Engineers, Engineer Research & Development Center

**Consultant & Software Developer:** Woolpert

**Equipment & Installation Support:** Dynatest North America

**Academic Partners:** University of Illinois at Urbana-Champaign; Penn State University at Altoona; Oklahoma State University; Texas A&M; University of Nevada-Reno; etc.

Jeb Tingle. “The base also has a diverse mission with a lot of different aircraft, from cargo planes to fighter jets, tankers and fire bombers for the U.S. Forest Service.”

Even commercial aircraft, such as 737s and 747s, use the runway to deliver supplies, he adds. Plus, the Air Force Civil Engineer Center had already programed a routine mill-and-overlay project for the main runway at Hill Air Force Base. That project presented the perfect opportunity for researchers to install sensors while the runway would be closed for other work.

“We presented our project plan to the base that described what we wanted to do, and the command structure was receptive to a new innovative project,” Tingle explains. “They do a lot of aircraft testing, and they’re amenable to supporting critical research activities.”

Airfield Manager Tom Murdoch was instrumental in providing access to the runway and an onsite database with information about aircraft operations. Paul Waite and Branko Vitanov from the base’s civil engineering team were key in coordinating activities between the ERDC/Woolpert/Dynatest team and contractors performing the runway rehabilitation project.

“ERDC conducts research and development for the Department of Defense,” explains Tingle. “We conceived of the concept because we wanted to do real-time research, and our role was to lead the concept, design and implementation. Dynatest North America provided instrumentation support and installation assistance, and Woolpert helped us characterize the paving materials and created the web-based platform that houses the instrumentation data. It’s an online database, if you will, in which the instrumentation response data are uploaded directly from our data acquisition system at Hill Air Force Base.”



## SmartRock & Other Sensors

Airfield pavement projects, like airport master plans, are often mapped out in 20-year cycles. Copeland notes that data to prove or disprove the most current hypotheses of pavement lifecycles can help engineer better, more effective plans for the future.

To collect such information at Hill Air Force Base, researchers integrated 84 sensors into the base’s main runway in June 2019. While some sensors sit on the pavement surface, others are buried 10 feet down and at various points in between. The sensors include earth pressure cells, time domain reflectometry moisture/temperature probes, multi-depth deflectometers, bender-element arrays, asphalt strain gauges, laser range finders, infrared thermal sensors and frost depth sensors.

Researchers also receive data from SmartRock, tiny wireless sensors shaped like ordinary pebbles. The high-tech aggregate sits in the ground as part of the pavement; and each time the pavement moves, the SmartRock sensors compute precise measurements and send them to the project database.

Tingle and others involved with the project are encouraged by the information the various sensors are providing. “The smart runway data is being used to monitor the

health of the pavement system by tracking changes in the moisture of the different pavement layers, changes in the measured pressures associated with similar aircraft loads and changes in the modulus of the granular layers over time," explains Tingle. "Matching the pavement response data to the specific aircraft load is allowing ERDC researchers to improve current mechanistic pavement models that will provide an increased understanding of aircraft-pavement interaction and allow better pavement performance predictions. The objective is to use this improved understanding to reduce conservatism in current design methods while improving reliability."

Monitoring and analyzing real-time and historical data improves situational awareness of overall pavement performance, adds Copeland. "Balancing cost, function and reliability, the smart runway system was designed to increase efficiencies and help to properly allocate operational decisions to improve business intelligence," he explains.

*Sensors were installed within various layers of the runway.*

## Big Data

Woolpert was responsible for data acquisition, which was no small task. With sensors providing copious amounts of information about pavement performance, the company was very interested in big data and the applications it could have for this project.

"Once we understood what it was that Jeb [Tingle] and his team of engineers wanted to accomplish and what kind of

data they were collecting, we could tailor the data," Copeland explains.

But collecting the desired data within the constraints of a military installation required finesse.

"Our main challenge was figuring out how to collect the volume of data and information we were getting on a consistent basis without WiFi," says Copeland. "Being on a military base, they're not just going to let you plug into their system. So we decided to use cellular technology, connecting it to hardware that could sit outside in a semi-climate-controlled box."

Woolpert and Dynatest engineers designed "data acquisition vaults" to provide safe repositories for short- and long-term storage. Basically, the vaults are rugged outdoor cellular modems for computer and sensor data. Sensors inside the boxes report the internal temperature and transmit that information to the team via a web-based desktop system with query functions that allow web-based access to Department of Defense researchers. Each vault has a heater to keep it warm when temperatures drop and a fan to cool it down when they rise. Copeland likens their shape and function to utility boxes in residential and commercial neighborhoods.

When an aircraft lands on Hill Air Force Base's runway, it triggers the sensor array that turns on the data acquisition vaults. "We end up with 60,000 to 100,000 data points every time an aircraft lands," says Copeland.

To manage the large volume of data, Woolpert built a web-hosted app that pulls information from the runway every night. The Woolpert team worked with ERDC engineers to develop automated data processing algorithms to generate graphs and models to illustrate how the pavement responded when each aircraft landed: low peak, high peak, how it rebounded, etc. These data help ensure that the design model is accurate and provide information for engineers to study further. Ultimately, ERDC plans to share the information with the FAA.

## Support from Academia

Tingle notes that one of the most challenging parts of initiating the project was the sheer amount of instrumentation it required. Sensors had to be checked, calibrated and tested exhaustively. In addition, the new bender element technology and SmartRock sensors required additional development to support this application. For that phase, ERDC supplemented its own team with graduate students from the University of Illinois and Pennsylvania State University at Altoona.

"There is a lot that goes into the successful implementation of research equipment into an active airfield," says Tingle. "And it takes a lot of coordination. We couldn't get in the way of the construction crews laying the pavement; because if they were delayed, they would be required to pay huge fines."

With sensors generating millions of data points every day, data management and analysis is another other major consideration. Again, ERDC has academic partners to lend a hand.

"Woolpert helped us create algorithms to auto-analyze the information, and Oklahoma State University is helping us parse out the critical data from the raw data and develop specific materials models we used in the pavement reconstruction," Tingle says. "The University of Illinois is helping with mechanistic pavement response models that will allow us to relay the info to all aircraft and extend the usefulness of this information."

Every six months, ERDC runs a series of tests on the pavement, and data about every flight in that period is uploaded via cellular connection. The team then shares the data with other trusted academic partners—including Penn State Altoona, which helped design SmartRock—and Oklahoma State. As a military organization, the Army-based ERDC also partners with the Air Force and Navy, and will soon loop in the FAA. The airfield pavement group is a tight-knit community, Tingle remarks.

*Researchers are collecting huge amounts of load-response data.*

As the research continues, Copeland reports that the team is getting better at identifying various aircraft as the data rolls in. "We're using lasers, wheel-spacings and weights to improve our modeling," he explains. "The idea that we're thinking about the future of pavements and how to improve via technology is important.

"Now we can use those runway models with confidence," he reflects. "It is going to change the way the Department of Defense does pavement analysis and design. It's part of what we're calling Pavement JEDI2D: Joint Evaluation and Design Integrated (JEDI) software."


## FACTS&FIGURES

**Project:** Taxiway Improvements

**Location:** Daytona Beach (FL) Int'l Airport

**Scope:** Rehabbed Taxiway N (10,500 ft. long; 75 ft. wide) & portions of taxiways A & P; updated geometry of 11 adjacent connectors; installed LED lights & airfield signs

**Cost:** $37.4 million

**Funding:** 90% FAA; 5% FL Dept. of Transportation; 5% airport enterprise funds

**Flight School Stakeholders:** Embry-Riddle Aeronautical University; Phoenix East Aviation; ATP Flight School

**Airline Stakeholders:** Delta; American; Sun Country; Sunwing

**Construction:** 2 years/24 phases

**Completed:** Nov. 2020

**Design Engineer:** AVCON

**Resident Inspection Service:** RS&H

**Construction:** Halifax Paving; P&S Paving

**Electrical Subcontractor/Lighting & Equipment Installation:** H.L. Pruitt Corp.

**Lighting & Sign Manufacturer:** ADB SAFEGATE

**New Electrical Vault Equipment:** ADB SAFEGATE

**Airfield Striping:** Better Barricades Inc.; Roads & Runways Striping Service Inc.

**Airfield Barricades:** Neubert Aero Corp.; etc.

# Daytona Beach Int'l Rehabilitates Its Longest, Busiest Taxiway

BY NICOLE NELSON

After decades of continuous use by commercial and student aircraft, the taxiway parallel to the primary runway at Daytona Beach International Airport (DAB) was exhibiting multiple pavement distresses. But it was nothing a thorough pavement rehab couldn't fix.

The most prominent issues were weathering and longitudinal and transverse cracking. Pavement cores revealed that many of the cracks extended completely through the asphalt. The presence of other surface distresses like corrugation and rutting signaled the need for a full rehabilitation of the asphalt.

While the ball was already rolling, management at the Florida airport also opted to improve portions of two other taxiways, execute major geometry updates and install nearly 1,000 LED lights and airfield signs.

When reflecting on the $37.4 million project, Airport Director Karen Feaster is proud to report that not a single safety issue or disruption to airline operations occurred during the entire two years and 24 phases of construction.

KAREN FEASTER


PHOTO: AERO PHOTO

Feaster is quick to highlight the tremendous amount of communication that occurred to achieve the positive outcome. She points to a log of no less than 136 emails to stakeholders—complete with diagrams and revisions upon revisions of ever changing taxi routes—as a key tool. The emails, Feaster explains, served as a unifier that kept all involved parties informed as the coastal airport worked to keep its runways, taxiways, airfield markings and lighting in safe, serviceable condition.

## Performance Under Pressure

The project, which was completed last November, included the complete rehabilitation of asphalt on Taxiway N (10,500 feet long, 75 feet wide) and portions of taxiways A and P. The airport also rehabilitated 11 taxiway connectors. As

a subpart of this project, under the FAA's Runway Incursion Mitigation program, the scope included the complete removal and relocation of Taxiway N5, P4 and P5 to eliminate a direct apron to runway access.

In order to meet new design criteria in FAA Advisory Circular 150/5300-13A and comply with the Runway Incursion Mitigation program, construction affected the busiest section of the airfield. And it all happened while traffic was booming.

"Our airport was the busiest in Florida for aircraft operations for the months of August, September and October [2020], and the second-busiest for November," reports Feaster. "So you can imagine the level of coordination that took place over the duration of the construction period."

In addition to unprecedented growth in commercial traffic, DAB was also experiencing the effects of record enrollment at three pilot training centers on the airfield: Embry-Riddle Aeronautical University (the largest flight school in the state), Phoenix East Aviation and ATP Flight School.

Amid the national trend of declining enrollments, the spikes were noteworthy—and the associated increases in training flights at DAB continued throughout the taxiway project. In fact, student traffic peaked just as the airport was preparing to complete the airfield work. "It was a very tenuous situation in terms of maintaining our construction safety phasing plan, which of course is required by the FAA, and that we followed," recalls Erik Treudt, director of projects and maintenance at DAB.


ERIK TREUDT

Beyond sending email blasts, the airport convened weekly meetings with stakeholders such as airlines, tenants, the FAA and Florida Department of Transportation. The meetings were held in person until COVID-19 restrictions began, and then continued virtually. Treudt notes that both formats proved tremendously helpful for keeping all stakeholders informed.

The project team also regularly distributed bulletins and exhibits that identified upcoming changes to ground traffic patterns for all affected parties.

"With Embry-Riddle as our partner, we met every week to make sure everybody was on the same page," Treudt says. "We understood new taxiway instructions, especially for the new students, were a critical part of keeping this project safe. And we did not have any safety incidents at all during the entirety of this project. The partnerships between the control tower and Embry-Riddle and our other flight schools really made all of the difference on a weekly basis."

Feaster concurs: "Communication was a critical piece of this project, with all of the training pilots and the amount of operations we had throughout the project—but especially in the end, when we were dealing with COVID accommodations, as well, and all of those effects. In addition to weekly meetings, the constant email for all stakeholders with all the details worked really well."

## Collaboration From Start to Finish

Feaster also gives high marks to the design team and its thorough method that served as a means to an end.

"We had several meetings during the design process with all the stakeholders to really go through the phasing plan and

*Construction spanned two years and included 24 phases.*

how it was going to affect people and what we had to do," she explains. Attendees included representatives from Embry-Riddle, Air Traffic Control, flight operations, tech operations and fixed based operators. "We collectively thought through every step of the project and got input from everybody—all the end users, all the stakeholders."

Feaster credits AVCON, the project's engineer of record, for listening to stakeholders and keeping in mind efficiency, time and cost when deciding what made the most sense.

Rob Hambrecht, the senior project manager with the firm, amassed seven years of files and photographs that document the project from pre-planning to completion. He fondly recalls watching the project progress through field meetings and aerial photographs of the busy work site and 11 taxiway connectors, each of which is heavily used on a daily basis.


ROB HAMBRECHT

"Very early on in the process, FAA said the runway didn't need to keep all 11 of the existing taxiway connectors," Hambrecht recalls. So he and the DAB team promptly sat down with personnel from FAA and Air Traffic Control to make the case that the airport's capacity would be crippled if it lost any of the connectors.

After AVCON submitted a report that detailed how each of the taxiway connectors is used for the launch and recovery procedures of aircraft, the FAA ultimately agreed to keep all 11 connectors intact as the airport rehabilitated its primary air carrier taxiway.

"It was pretty monumental because the FAA is all about getting rid of mid-field taxiways, but it was demonstrated that this airport just could not function efficiently without intersection departures from flight school aircraft," Hambrecht says. "Air Traffic Control will stack aircraft up and use each of them all day long."

The design team developed multiple construction phasing and sequencing alternatives, and numerous workshops with airport

users helped narrow the field to a plan deemed to be both safe and economical. Ultimately, the project was divided into 24 construction phases over a two-year construction period; and the result was an incident-free major project on an otherwise uniquely active airfield, notes Hambrecht.

During construction, crews installed more than 115,000 tons of asphalt over 2.8 million square feet on Taxiway N and portions of taxiways A and P. The new surfaces are illuminated by 816 LED airfield lights and include 112 LED guidance signs.

DAB's Treudt characterizes local construction contractors Halifax Paving and P&S Paving as wonderful partners to work with. "They really went out of their way to make sure that we got the taxiway back as quickly as we needed to," he says.

Treudt also notes that the airport's annual economic impact of $2.1 billion is important to the local Volusia County community. "Without this taxiway project, our airport would suffer and the community at large would suffer," he elaborates. "Not only would it reduce the amount of traffic for Embry-Riddle students to be able to use the main runway, but of course it would affect our traveling public because then the commercial service carriers would not be able to function efficiently, appropriately and safely, which is more important than anything."

*Temporary haul roads and staging areas helped expedite trips for construction vehicles.*

*Editor's Note: In late July, Daytona Beach Int'l was named 2021 Commercial Service Airport of the Year by Florida Department of Transportation. Its taxiway project was highlighted as a major safety accomplishment.*

# When Funding Became Available, Harrisburg Int'l Was Ready to Go With Levee Project

BY KEN WYSOCKY

HARRISBURG INTERNATIONAL AIRPORT

## FACTS&FIGURES

**Project:** Levee Rehabilitation

**Location:** Harrisburg (PA) Int'l Airport

**Approx. Cost:** $22 million

**Funding Sources:** FAA; state of Pennsylvania; Susquehanna Area Regional Airport Authority

**Funding:** May 2019

**Initial Design:** 2004

**Construction:** Nov. 2019-June 2020

**Design & Construction Management:** Urban Engineers Inc.

**Consultant Subcontractor:** Navarro & Wright Consulting Engineers Inc.

**General Contractor:** KC Construction

**Geotextile Fabric:** Contech Engineered Solutions (a Quikcrete company)

**Key Benefit:** Continued protection of runway & other critical infrastructure against flooding of nearby river

The recent rehabilitation of an aging levee will help protect Harrisburg International Airport (MDT) from flooding for decades to come. In the meantime, the $22 million project also offers a valuable lesson about the benefits of planning ahead.

Nearly 20 years ago, the Pennsylvania airport began working with a design firm for plans to repair and rehabilitate a levee built by the United States Army Corps of Engineers to prevent flooding from the nearby Susquehanna River.

The 13,000-foot-long earthen structure, which runs along the west side of the airport's 10,000-foot sole runway, faced increasing erosion problems caused by excessive vegetation growth, burrowing animals and damage inflicted by ice jams and other heavy debris.

"It hadn't reached the point where it threatened the integrity of our runway and other critical infrastructure, but we knew it ultimately would reach that point without rehabilitation," says Tim Edwards, executive director at MDT. "We basically had a repair project fully designed in 2004, but there was no funding available from the FAA at the time."

TIM EDWARDS

That changed in 2018, when the federal agency made special supplemental appropriation grants available to smaller airports with shovel-ready projects. With design work already completed, and 50,000 operations/1.2 million passengers handled in 2017, MDT met both major requirements.

"So we pulled the plan from the shelf, dusted it off and updated it," Edwards explains. The airport promptly submitted an application for a $20.2 million grant, which FAA approved in May 2019. It's the largest federal grant the airport has ever received, Edwards notes.

"I guess you could say we were in the right place at the right time," he adds.

Additional funds were provided by the state of Pennsylvania and Susquehanna Area

Regional Airport Authority, which owns and operates MDT and three other small airports.

General contractor KC Construction Inc. started work in November 2019 and completed the project in June 2020, nearly six months ahead of schedule.

Urban Engineers Inc., the firm that designed the project years before, provided final design, bid-phase services, environmental permitting, FAA coordination and construction management services. Navarro & Wright Consulting Engineers Inc. performed materials testing, surveying and additional inspection services as a sub-consultant to Urban.

## Building Blocks

The levee was built in 1958 when the airport, then a U.S. Air Force support base, needed a longer runway to handle larger aircraft including B-47 and B-52 bombers. To gain enough space for the runway, engineers extended the shoreline farther into the river, which required adding a protective levee as well.

DAVID SPAULDING

Dave Spaulding, deputy director of engineering and planning for the regional airport authority, notes that the method selected to rehab the aging levee is somewhat unconventional. Instead of using riprap, or large rocks, to armor the levee, engineers specified mats of articulated concrete block for stabilization and erosion control.

Overall, the project design called for 1 million square feet of articulated concrete block mats. Though they vary in size, a typical mat used on the project measured about 8 x 21 feet and weighed roughly 6,600 pounds.

The mats, supplied by Contech Engineered Solutions LLC, are hand-strung together by a continuous loop of 3/8-inch high-strength nylon rope.

During the project, crews installed about 6,700 mats, sometimes 130 to 140 a day. “We believe this is the largest ACB (articulated concrete block) project in the country,” says Bobby Machiesky, on-site project manager/superintendent for KC Construction.

Spaulding reports that the concrete block mats proved to be more cost-effective and easier to install than riprap. They also are more effective at preventing erosion and controlling vegetation growth and damage from burrowing animals, he adds.

The life expectancy for the mats is about 50 years.

## Layer by Layer

There was more to rehabbing the levee than installing concrete block mats.

First, crews had to restore a riprap road along the “toe” of the levee, adjacent to the river, to provide access for excavators, trucks and other equipment. Then, they removed all vegetation and applied a herbicide to ensure that no live growth remained.

BRIAN PEDA

“We didn’t want the contractor to have to remove large root balls that would impact the integrity of the levee or cause more erosion,” explains Brian Peda, deputy practice leader/construction engineer for Urban Engineers. “There was so much vegetation that it was like a forest in some spots.”

With the thick vegetation cleared, workers laid down a felt-like geotextile fabric to promote water drainage and prevent erosion and plant growth. That, in turn, was covered with a 4- to 6-inch base layer of about 1½-inch stone to further aid drainage.


*It took experienced equipment operators to work on the side and top of the levee.*

Next, crews installed a mesh geogrid with square 1/4-inch openings to reinforce and stabilize the stone layer. "Without that geogrid material, the stone could wash out during a high-water event," Machiesky explains.

After the geogrid layer was in place, the heavy lifting began.

Crews used a large excavator with spreader-bar attachments to set the concrete block mats on top of the geogrid. After a few mats were in place, workers placed concrete into the horizontal gaps between them, effectively grouting the mats together.

Next, crews used a skid-steer loader outfitted with a cylindrical broom attachment to fill the cinderblock openings and the vertical gaps between mats with the same kind of stone used in the base layer. Peda likens this step to brushing in sand between paver blocks when building a patio. "You're packing all that stone into open voids to further lock in the concrete blocks," he explains.

KC Construction opted to begin laying concrete block mats at the bottom of the levee and work upward to get out of potential high-water zones as quickly as possible.

To set the bottom row of mats firmly in place, the contractor dug a 3-foot-deep anchor trench at the bottom of the levee and filled it with concrete to ground level. That formed a solid base that will prevent the heavy mats from moving down onto the toe of the levee, notes Machiesky.

## Exacting Standards

The contractor used a concrete mix designed to withstand 4,500 pounds per square inch of pressure after it cures for 28 days. To ensure the strength and integrity of the concrete, workers filled eight cylindrical molds—6 inches in diameter and about 12 inches long—every time they poured 50 cubic yards of concrete.

Each time, six of the eight cylinders were taken to a lab, where they were load tested in a hydraulic press after curing for 28 days. The other two remained on site for 28 days of field curing. If any cylinders failed the load test, crews were required to remove and replace the associated concrete.

"We had no low breaks in the 3,000 yards of concrete we poured on site," Machiesky reports, noting that the company records every concrete placement using real-time, kinetic-positioning GPS equipment, made by Topcon Positioning Systems Inc., to track pour areas and their corresponding test samples.

Overall, the project also required 24,000 cubic yards of riprap to build the access road, and 22,000 cubic yards of stone to build the base layer and fill holes in the cement blocks and voids between the blocks and mats.

Working on the sloped face of the levee was a job for experienced equipment operators, and not for the faint of heart. The structure is about 30 feet tall when measured from the average river level, and the grade of the slope ranges from 33% to 50%. The top of the levee is only about 12 feet wide.

"Sitting on that slope with a 100,000-pound excavator while picking up a 6,600-pound mat at that angle is difficult," Machiesky emphasizes. "The further you 'boom out' to lay the mats down, the riskier it gets."

## Critical Communication

Construction crews had to communicate frequently with air traffic controllers, especially when working in or passing through restricted areas where their equipment could interfere with the localizer and glide slope systems. As such, the primary areas of concern were the access points at both ends of the 10,000-foot runway.

On days when visual flight rules were in effect, crews were allowed to take equipment near the restricted area when

necessary. But if cloud cover or rain moved in, crews had to vacate those areas quickly to avoid affecting the navigational aid equipment—no easy task with excavators that only travel a few miles per hour.

"That happened three or four times," Machiesky recalls, adding that the project generally enjoyed good weather.

Edwards notes that the project team planned the work near navigational aids only when clear skies were predicted.

"We've worked on smaller airports before," adds Machiesky. "But nothing on this scale, with such a large runway and such big jets landing and taking off."

In 2020, MDT logged 37,720 aircraft operations. It is served by five airlines, including American Airlines, Delta Air Lines and United Airlines, and primarily handles various commercial-service airliners and several wide-body cargo aircraft.

The runway as a whole was not closed during the project, but 393 feet on the south end was closed for five days to allow workers to install articulated concrete block mats at the top of the levee where it wraps around the end of the runway.

"That limited the amount of takeoff run available, but it didn't deter any air traffic," says Spaulding.

## Keys to Success

Airport authority officials credit Fred Testa, MDT's former airport director, for initiating the levee rehab, and Tim Edwards, its current executive director, for his proactive move to secure funding.

"Without their efforts, this never would have happened," says Spaulding. "A big part of our success here was having a levee design on the shelf, ready to go in the event that funding became available. The window of opportunity for submitting a grant application was very small, so having a project design ready for submission was huge."

Spaulding also highlights the value of the comprehensive, daily communication and coordination that occurred among the FAA, Urban Engineers and KC Construction—especially when navigational aid equipment came into play.

"It was a very well-coordinated project," agrees Edwards. "Both KC Construction and Urban Engineers really kept things on track. Sometimes you just get lucky with a contractor, and in this case, we were lucky to work with KC Construction. We'd never worked with them before, but they were wonderful—no delays or constant change orders."

Peda notes that meeting with airport officials at the start and end of each week ensured that everyone knew what work was occurring and what areas of the project were affected. Urban Engineers also emailed a map to key stakeholders every evening, outlining the location of the next day's work.

"That way, we didn't have to call, say, 10 people every day," he explains. "We received a lot of positive feedback for that approach.

"Overall, on a scale of one to 10, I'd give the project a 10," he adds. "Everything went pretty smoothly and according to plan."

*Workers placed concrete into the gaps between mats of articulated concrete blocks to help fuse them together.*

# O'Hare Nearing End of Monumental Airfield Initiative

BY JODI RICHARDS


CDA
CHICAGO DEPARTMENT OF AVIATION

## FACTS&FIGURES

**Project:** New Runway

**Location:** O'Hare Int'l Airport

**Owner:** City of Chicago

**Airport Operator:** Chicago Dept. of Aviation

**Runway:** 9C-27C, on north side of terminal complex

**Stats:** 11,245 ft. long, 200 ft. wide; meets Aircraft Design Group VI standards

**Cost:** $645 million, plus $90 million in enabling projects

**Opened:** Nov. 2020

**Component of:** $8 billion O'Hare Modernization Program (airfield reconfiguration accounts for approx. $6 billion of total program)

**O'Hare Modernization Program Manager:** DMJM Aviation Partners (AECOM)

**Lead Design Engineer/Construction Support Services:** HNTB Corp.

**Runway Prime Construction Contractors:** Walsh Construction; F.H. Pashchen

**O'Hare Modernization Program Construction Manager:** WSP USA

**Electrical & Civil Engineering:** Milhouse Engineering

**In-Pavement Lighting Bolts:** GBA Components LLC

O'Hare International Airport (ORD) is in the final leg of a long journey to completely reconfigure its airfield. Soon, Chicago's primary airport will have six east-west parallel runways and two crosswind runways—and far fewer runway intersections than before.

Last November, ORD moved one major step closer to the improved airfield configuration when officials opened Runway 9C-27C, the airport's first new runway since fall 2015. At 11,245 feet long and 200 feet wide, 9C-27C is engineered to meet FAA Design Group VI standards and can accommodate all aircraft flying today, including the A380 and Boeing 747-800.

This new north side runway was the second-last project in ORD's monumental program to overhaul its busy—and, at one time, chronically delayed—airfield. The comprehensive reconfiguration, valued at approximately $6 billion, is the lynchpin of the $8 billion O'Hare Modernization Program first announced in 2001.

"This is a bold plan to rebuild the airport's airfield on top of itself," explains Robert Hoxie, chief development officer for the Chicago Department of Aviation.


PHOTO: TREY CAMBERN COURTESY OF HNTB

ROBERT HOXIE

In 2019, ORD was the world's busiest airport for total operations and the sixth busiest in the world in terms of enplaned passengers. For decades, delays at ORD caused ripple effects through the National Airspace System, impacting airports throughout the United States and beyond.

In the 1990s, FAA limited flight volume into and out of ORD to curb the negative cascading impact. And in 2001, the city of Chicago and FAA began working together to assess options for other solutions. The Chicago Department of Aviation used Total Airport and Airspace Model, a high-performance computer simulation tool, to help evaluate airfield configuration alternatives and develop a master plan, which served as the blueprint for the airfield reconfiguration. Key elements presented to the FAA included a future airport layout plan and implementation plan. An Environmental Impact Statement for the program was conducted by the FAA, concluding with a Record of Decision issued in September 2005.

In its entirety, the airfield reconfiguration reorients ORD's runway system into a series of six parallel (east-west) runways to eliminate by design the takeoff and landing dependencies typically associated with intersecting runways. A pair of crosswind runways will remain and were rehabilitated through this process. The new configuration also reduces the need for aircraft to taxi across active runways in front of the majority of departing aircraft, thus enhancing airfield safety.

Capital funding to construct Runway 9C-27C was part of a 2016 $1.27 billion funding authorization, comprised of proceeds from airline rates and charges, passenger facility charges and FAA Airport Improvement Program grants. "Operationally, it's a very valuable runway," Hoxie remarks. "But because of all of the facilities that were displaced by its construction, it was also one of the most costly projects in the program."

As a standalone element, the cost of Runway 9C-27C is valued at approximately $645 million with an additional $90 million in enabling projects. Replacement costs for impacted tenant facilities and other enabling projects are not included in these figures.

The addition of the new runway brings balance to the airfield, after runways on the south airfield were completed years earlier. (See Milestones on Page 57 for more details.) Initially, 9C-27C will be used as a departure runway when winds are from the east and an arrival runway when winds are from the west. When the final portion of the airfield reconfiguration—extending Runway 9R-27L—is completed this December, 9C-27C will be used as an arrival runway in both directions, and 9R-27L will primarily be used for departures. This coordinated process is similar to how 10L-28R and 10C-28C currently operate in the south airfield. With equal capability on the north and south airfields, flights can be dispersed and received more evenly to meet ORD's long-term needs for air traffic, Hoxie notes.

Moreover, 9C-27C paves the way for quadruple simultaneous arrivals once FAA completes development of and implements the associated procedures. The ability to land aircraft on four runways at the same time could increase ORD's hourly arrival capacity by up to 33%.

In addition to Runway 9C-27C itself, this aspect of the airfield modernization program entails:

- full-length parallel taxiways adjacent to 9C-27C,
- utility infrastructure,
- building demolition,
- new airfield lighting and signage,
- runway and taxiway pavement,
- navigational aids,
- grading improvements,
- construction phasing, and
- storm drainage management and major collector system improvements.


*Runway 9C-27C is the first new runway to open at O'Hare Int'l since 2015.*

PHOTO: TREY CAMBERN, COURTESY OF HNTB

## Clearing the Way

Adding the new runway and parallel taxiway network required ORD to relocate several existing facilities—an effort that spanned two separate rounds of funding authorization. The first, in March 2011, provided $213 million to relocate the general aviation ramp and facility, expand the North Detention Basin, add a western taxiway connection between 9L-27R and the new runway, and extend Tank Farm Road, an airside service roadway connecting airline maintenance facilities to the passenger terminals. It also authorized partial funding for the extension and modernization of the airport transit system.

The second round, in January 2016, authorized funding to demolish flight kitchens, relocate ground equipment maintenance facilities for American Airlines and United Airlines, relocate one hangar and ramp space for each airline, and relocate employee parking lots and an aircraft rescue and firefighting station.

While construction projects regularly involve challenges, 2020 introduced significant new obstacles, most notably, a global pandemic. Deemed essential, construction of ORD's runway continued under the proviso of strict adherence to guidelines from the Centers for Disease Control and Prevention. Hoxie notes that the runway work did, in fact, experience delays due to COVID-19, even though the city prioritized keeping project teams healthy and productive when the pandemic first began impacting day-to-day life. "Our contractors, subcontractors and construction management team did a great job of workforce education and communication," he relates.

Additionally, there were construction delays associated with challenges acquiring existing infrastructure slated for demolition. "These challenges were met with a dedicated team of program

and construction managers, contractors, designers, planners and schedulers who met each challenge with a plan and delivered a high-quality product on time," says Hoxie.

The project team leveraged technology to take some of the sting out of COVID-related constraints. For example, personnel from Walsh Construction used an imagery website and a digital collaboration portal to track and verify numerous aspects of the project without leaving the office. Project information was updated in real time and distributed to personnel via electronic tablets. Software that merged design changes and superimposed them onto existing maps was pivotal. "This enabled unforeseen or changed field conditions to be evaluated and design changes to be incorporated almost instantaneously," Hoxie explains.

Contractors followed an aggressive phasing schedule for runway and taxiway construction in 2019 and 2020 to ultimately hit the Nov. 5, 2020 commissioning date, he adds. Naturally, that required the close and careful coordination of all stakeholders. "Any time you have that many different entities involved in a project, it's a lot of moving parts that connect to one another in the delivery process," Hoxie remarks.

## Coordination & Flexibility

Even on a good day, the sheer volume of aircraft movements on ORD's airfield poses challenging operational conditions. In 2019 alone, the airport logged about 930,000 flights. Hoxie considers the recent Runway 9C-27C project an example of excellence for construction on top of a live operation.

To minimize operational impact, the city worked closely with stakeholders to coordinate construction activities during the design phase and throughout the project. When unforeseen conditions arose, the Chicago Department of Aviation worked with FAA, airlines, air traffic control and airfield operations to schedule orchestrated closures of taxiways and runways.

Because the FAA and airlines executed portions of the construction of the overall airfield program, the project required close coordination among contractors, designers, etc. But that aspect also allowed the team to capitalize on the experience and expertise of various parties to execute all aspects effectively and efficiently, Hoxie adds. Reimbursable agreements with defined timelines and associated financial conditions also figured prominently.

Hoxie reports that construction of the new runway did not have a substantial impact on day-to-day operations at ORD, and Runways 9L-27R and 9R-27L remained active throughout

*Contractors followed an aggressive phasing schedule to achieve the November 5, 2020, commissioning date.*

the construction of Runway 9C-27C. Additionally, the airport used the project's intersection with existing Runway 4L-22R and the associated short-term closure it required as an opportunity to perform major maintenance on that runway at the same time. Crews rebuilt more than half of 4L-22R with concrete and revived its remaining pavement with milling and an asphalt overlay. "We were able to both get economies of scale and also reduce the overall downtime with that maintenance project," Hoxie relates. "Instead of coming back and closing it (4L-22R) five years from now, we were able to just combine the closures."

But even with careful coordination, the construction posed challenges. "Runway 9L-27R is primarily used for arrivals; thus, throughout construction, we always had to have a way for these arrivals to cross the construction area of the future 9C-27C and get to the terminal," Hoxie explains. In addition, countless aircraft were taxied by mechanics or towed with tugs across the construction zone to and from maintenance hangars every day. And ORD's northeast cargo development, which opened in 2017, added even more aircraft crossings. "So there were dozens of pavement subphases and taxiway closures associated with 9C-27C construction just to maintain operations throughout," Hoxie relates.

## Almost There

BOB McANDREWS

As lead design engineer for Runway 9C-27C projects, HNTB Corporation has a unique perspective about how the major components of the airfield redesign fit together. Bob McAndrews, an HNTB vice president, notes that the huge scope and long timeline of the program required the entire project team to be especially cooperative and flexible. Runway 9C-27C was constructed more than a decade after the airfield reconfiguration program was launched, and throughout this time, several conditions changed. For example, HNTB stepped up to assist the Chicago Department of Aviation with locating a viable site for a replacement United Airlines employee parking lot. It also re-phased portions of the project

following delays on enabling projects and expanded the original work scope to upgrade the existing North Airfield Lighting Control Vault.

"Major projects such as this take time… changes will occur," McAndrews reasons. "Most importantly, you need to create a team that is flexible to changing conditions and ready to react quickly to anything. Your team needs to have intimate knowledge on how the city, airport and airlines operate so you can develop realistic solutions to any challenge that arises during the life of the project."

Looking ahead, the final phase of the airfield redesign involves a 3,293-foot extension of Runway 9R-27L, one of the airport's original runways. Work began in early February, and the runway is slated to reopen in December at 11,260 feet long. In addition to the extension, ORD has tied in a complete maintenance cycle, taxiway resurfacings and reconfigurations. "It will be a busy year for the team," Hoxie observes.

## MAJOR MILESTONES

**2001:** Former Chicago Mayor Richard Daley announces $8 billion O'Hare Modernization Program (OMP)

**2003:** Chicago Dept. of Aviation releases Sustainable Design Manual

**2005:** FAA issues a Letter of Intent funding $337 million for Phase I of OMP

**2008:** Runway 10L-28R extension, New Runway 9L-27R & North Air Traffic Control Tower open; FAA allows mandatory flight caps to expire

**2009:** FAA approves OMP Completion Phase Design PFC Application & remaining OMP Noise Program PFC Application

**2010:** FAA issues Letter of Intent funding $410 million for OMP Completion Phase

**2011:** City of Chicago, American Airlines, United Airlines & FAA announce $1.17 billion funding agreement for OMP Completion Phase 2A

**2013:** New Runway 10C-28C opens (ORD's first Group VI runway)

**2015:** New Runway 10R-28L & South Air Traffic Control Tower open; Crosswind Runway 14L-32R closes

**2018:** Crosswind Runway 15-33 closes; new Airline Use & Lease Agreement provides funding to complete airfield redesign projects (& 1st phase of Terminal Area Plan)

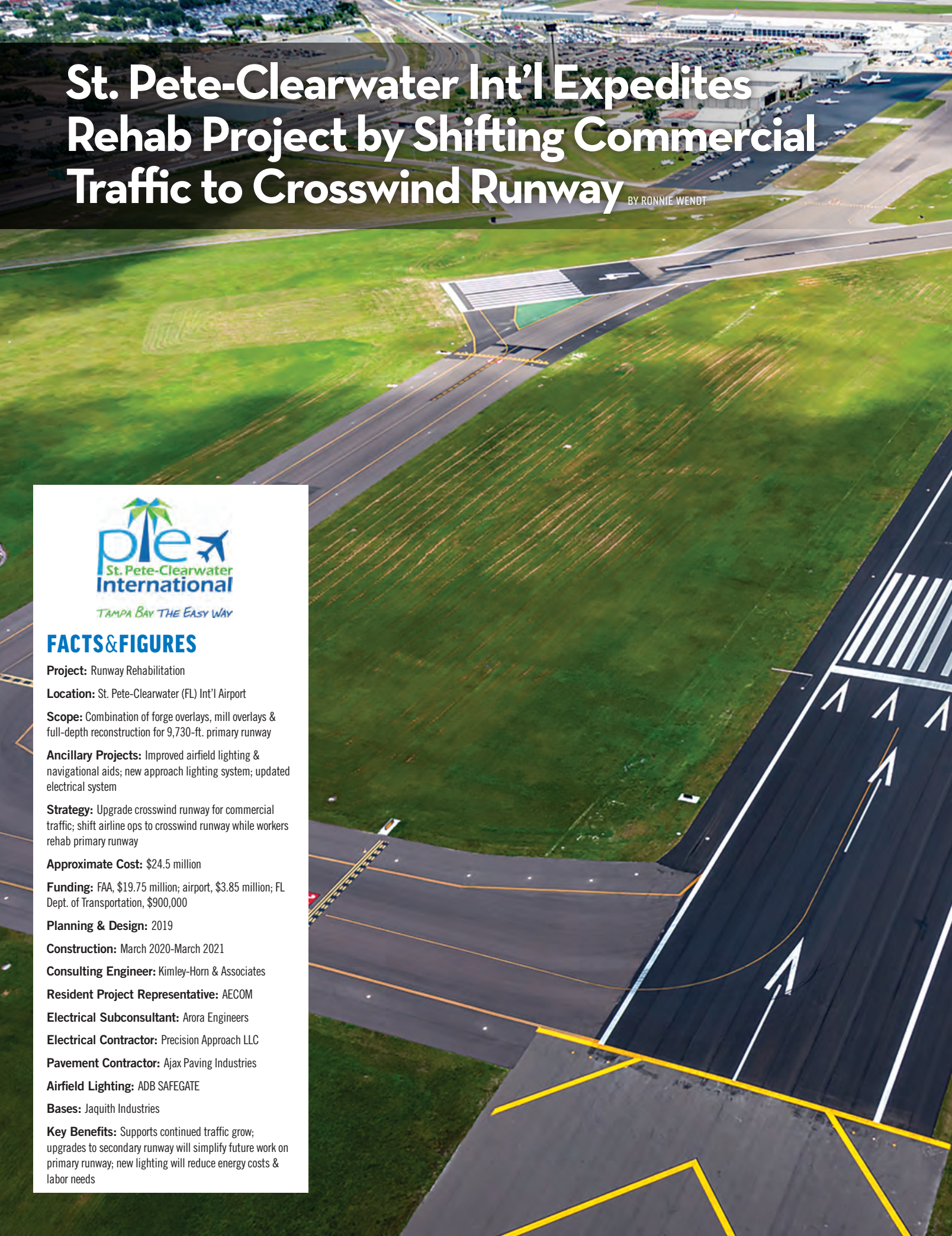
**2019:** Central Deicing Facility opens

**2020:** New Runway 9C-27C opens

**2021:** Runway 9R-27L extension scheduled to open

# St. Pete-Clearwater Int'l Expedites Rehab Project by Shifting Commercial Traffic to Crosswind Runway

BY RONNIE WENDT



St. Pete-Clearwater International

TAMPA BAY THE EASY WAY

## FACTS&FIGURES

**Project:** Runway Rehabilitation

**Location:** St. Pete-Clearwater (FL) Int'l Airport

**Scope:** Combination of forge overlays, mill overlays & full-depth reconstruction for 9,730-ft. primary runway

**Ancillary Projects:** Improved airfield lighting & navigational aids; new approach lighting system; updated electrical system

**Strategy:** Upgrade crosswind runway for commercial traffic; shift airline ops to crosswind runway while workers rehab primary runway

**Approximate Cost:** $24.5 million

**Funding:** FAA, $19.75 million; airport, $3.85 million; FL Dept. of Transportation, $900,000

**Planning & Design:** 2019

**Construction:** March 2020-March 2021

**Consulting Engineer:** Kimley-Horn & Associates

**Resident Project Representative:** AECOM

**Electrical Subconsultant:** Arora Engineers

**Electrical Contractor:** Precision Approach LLC

**Pavement Contractor:** Ajax Paving Industries

**Airfield Lighting:** ADB SAFEGATE

**Bases:** Jaquith Industries

**Key Benefits:** Supports continued traffic grow; upgrades to secondary runway will simplify future work on primary runway; new lighting will reduce energy costs & labor needs


PHOTO: AERIAL INNOVATIONS

When it came time for St. Pete-Clearwater International Airport (PIE) to rehab its primary air carrier runway, closing the airfield was not an option. Officials needed a plan to keep commercial aircraft flying in and out of the Florida airport.


MARK SPRAGUE

"We couldn't do all the work at night," explains PIE Deputy Director Mark Sprague. "We had to figure out how to let the contractor work on the runway during the day."

Airport officials brainstormed with consulting engineer Kimley-Horn and other project partners to devise a way to complete most of the work during daytime hours. The strategy temporarily shifted commercial traffic onto Runway 4-22, the general aviation runway, to provide construction crews with 24/7 access to improve 18-36, the airport's 9,730-foot primary runway.

"We could expedite the entire process and compress the timeframe from 24 months to 12 months. And the work was both achievable and safe," says Sprague.

Designing the plan was one thing; but making it happen was another. The airport had to extend Runway 4-22 to a workable length of 6,000 feet and work through safety-related issues with the FAA. It also had to apply temporary markings and install precision approach path indicators (PAPIs) so airlines could use the runway.


PAUL PIRO

"It is unprecedented for an airport to switch commercial traffic to a general aviation runway," says Paul Piro, lead designer for Kimley-Horn.

PIE Airport Engineer Scott Yarley agrees about the strategic nature of the plan. "This is one of those projects where close coordination, and some operational sacrifice, was needed to complete construction with minimal impacts to all. The stakeholders all worked together to make this project a success."


SCOTT YARLEY

Specifically, Yarley credits the FAA Orlando Airport District Office; PIE Engineering, Operations and Facilities; Kimley-Horn; AECOM; Ajax Paving Industries; Allegiant Air; the Coast Guard; and other airport tenants for making the unusual strategy work.

## Time for Improvements

Officials explain that Runway 18-36 sorely needed the recently completed $24.1 million rehabilitation. The last time it had been repaved was 2009. Though shy of the average 20-year lifespan, longitudinal cracking, raveling and weathering riddled the runway, making repairs necessary.

PHOTO: AERIAL INNOVATIONS

*A temporary lull in traffic due to COVID-19 made last spring an ideal time to perform runway work.*

"In Florida, oxidation and sunshine deteriorates pavement faster," Sprague explains.

The airport abides by the Florida Department of Transportation Pavement Management Program, which classifies pavement distress to determine when runways need rehabilitation. Technicians assess the pavement condition on a scale of 0 and 100, with 30 or lower indicating a need for repair or replacement.

Visual inspections documented distress and earned PIE's pavement a low classification (as low as 52). More than 100 core samples and 20 borings indicated that some areas of the runway needed forge or mill overlays, while others would require full-depth reconstruction. "About 30% of the project was full-depth reconstruction, the rest was mill-and-overlay," notes Sprague.

On the positive side, PIE's low pavement condition classification freed up local, state and federal funds for the project. FAA earmarked $19.75 million, Florida Department of Transportation contributed $900,000, and the airport committed $3.43 million. The funds covered milling and overlay of existing asphalt pavement, reconstruction of the keel area, new centerline line and touchdown zone lighting, shoulder expansion and a new edge lighting system.

Recommendation for repairs came in 2019, just as PIE finished its ninth consecutive year of traffic growth. The airport was on pace

to break its record of over 2.2 million passengers in 2020 when COVID-19 disrupted the Florida travel market and entire airline industry. The associated lull, however, made March 2020 the perfect time for crews to begin work on PIE's airfield projects.

"The pavement is our greatest asset," says Sprague. "If we don't have safe pavements, we are out of business."

As planned, PIE's improved commercial runway opened this March. And 2021 passenger traffic is picking up steam as hoped. In April, Sun Country Airlines announced plans to begin scheduled service at PIE after operating charters there for years. Four flights per week between PIE and Minneapolis-St. Paul International are expected to begin this fall.

## Out-of-the-Box Thinking

If crews had been limited to working around the airport's regular operating hours, engineers estimate that the runway project would have taken twice as long. So Kimley-Horn developed a construction plan that provided workers with around-the-clock access to the project site.

The construction plan called for alternating closures of Runway 18-36 for 12 months and rolling shifts of air carrier flight operations to the shorter crosswind runway, 4-22. But before work could begin, the project team needed FAA approval.

"The secondary runway was not set up to receive commercial traffic," Piro explains. "No one has ever shifted commercial traffic to a reliever runway. We had to think outside the box to get the work done."

First, PIE planners talked to air carriers, corporate pilots and U.S. Coast Guard officials to learn what they would need for takeoffs and landings. The common requirement was at least 6,000 feet of runway. This meant the airport needed to extend Runway 4-22 by 100 feet before construction crews could start work on the primary runway.

Next, the airport hosted an FAA Safety Risk Assessment Panel consisting of representatives from the Air Traffic Control Tower, FAA Tech Ops, the airport, air carriers, project consultants, the Air National Guard and the U.S. Coast Guard. The panel evaluated the proposed improvements, identified risks and discussed project phasing.

In the end, the project had eight phases. The enabling phase extended Runway 4-22 by 100 feet to provide the 6,000 feet needed for commercial aircraft. To address other safety concerns,



the airport staff worked with FAA to implement a temporary modification of standards for runway hold short markings. In addition, it provided full-time communication with the air traffic control tower to monitor vehicle traffic moving through Runway 4-22 safety areas.

The airport also had to install and flight check temporary navigational aids in two locations before work could begin on Runway 18-36. “Without navigational aids installed and approved by the FAA, we could not shift air traffic,” Piro says.

During the first phase, the team moved thresholds on the primary runway as far north as possible to provide a 6,000-foot runway mark on the north. This freed space in the southern part of the runway.

“The first phase of project happened in one night,” notes Piro. “With multiple people on site, we obliterated some runway markings and installed new ones. When the sun came up, we moved all activity to the north, freeing the south portion for construction. When crews finished the south end, they moved operations to the south and worked on the north portion of the runway.”

This type of work schedule kept the airport operational throughout the project, except for a few temporary closures when crews grooved and applied new markings to the “bullseye” where the two runways intersect.

“Any work we did there took a lot of coordination because it shut down the airport,” Sprague says. “When I say shut down, I mean *no one* could take off or land. We even warned critical medical aircraft to make other arrangements, including the U.S. Coast Guard operations.”

## Keep It Down

Shifting traffic to the reliever runway prompted PIE to proactively step up its public relations efforts. Maintaining open communications with neighbors became even more important than usual as changing flight paths affected areas of Clearwater and six other nearby communities.

The airport launched an 18-month campaign to keep businesses and residents informed about when changes would occur and how long they were expected to last. Press releases detailing the project included pictures and maps.

“You will always have people who are not appreciative of extra planes flying overhead, but we lessened negative feelings by keeping people informed,” says Sprague. “They knew it was temporary.”

The airport also worked to engineer out noise issues by phasing the project to minimize use of Runway 4-22.

## Turn Up the Lights

In addition to improving pavement, the project upgraded airfield lighting. Arora Engineers designed and provided construction administration support of the associated electrical engineering, lighting and navigational aids.

DAVID WILLIAMS

During the project, crews replaced traditional centerline and touchdown zone lights with LED fixtures, and upgraded high-intensity edge lights with new incandescent fixtures. “LEDs were not AIP-approved at the time of the grant,” notes David Williams, practice lead for Airfield Electrical at Arora Engineers.

But LEDs burn brighter for pilots and reduce maintenance for airports, adds Piro. “They do not burn out as fast, so you don’t have to replace them as often,” he explains.

Airport maintenance personnel will still need to conduct bolt torque checks and clean lenses, but the new LEDs will reduce time spent replacing lamps.

The airport also replaced centerline and touchdown zone 30-watt constant current regulators with 10-kW regulators, which will further trim energy use. “Just changing out lights doesn’t equate to energy savings,” explains Williams. “If you put in 30-kW regulators and you only need 10-kW regulators, you may still draw up to 30 kW. You must resize the regulators to achieve

maximum energy savings. With LEDs and the right regulators, we typically see an energy savings of more than 50%."

He adds that PIE is one of only 31 airports and one of only 49 approaches in the United States that have runways with displaced thresholds greater than 700 feet and centerline lights without high-intensity approach lighting systems. "This application required coordination with PIE Ops, their air carrier Allegiant's OpSpecs and the FAA," Williams remarks.

The airport, Arora and Kimley-Horn worked through challenges together, adds Williams. "This project was a success because of the continued communication between airport staff, designers and construction staff," he says. "It provided PIE with updated airfield lighting products and infrastructure that will help them continue to improve and maintain their airfield."

From a larger perspective, recent improvements to the crosswind runway are expected to pay dividends years down the road. "This project will simplify future rehabilitations when the current work nears the end of its service life," notes Piro.


PHOTO: AERIAL INNOVATIONS

*Shifting traffic to the crosswind runway allowed crews to work on Runway 18-36 around the clock.*


SAN DIEGO
INTERNATIONAL AIRPORT
LET'S GO.

## FACTS&FIGURES

**Project:** Engineered Material Arresting System

**Location:** San Diego Int'l Airport

**Scope:** Remove 2006 system, install new version

**Cost:** $10 million

**Project Start:** Feb. 2021

**Scheduled Completion:** Mid-Sept. 2021

**Project Design:** Jacobs Engineering

**System Installed:** EMASMAX by Runway Safe

**Size:** 376 ft. long, 200 ft. wide

**Key Benefits:** Enhanced airfield safety

# San Diego Int'l Installs New Engineered Material Arresting System

BY JODI RICHARDS

With a footprint of only 661 acres, San Diego International Airport (SAN) is the busiest single-runway commercial service airport in the United States. As such, management is continually working to improve safety and operational efficiency on Runway 9-27.

In July, SAN was nearing the end of a $10 million project to replace the aging engineered material arresting system (EMAS) at the departures end of its runway with a brand new model. The safety feature is a bed of crushable materials to help stop aircraft overruns. If a plane enters the bed, its tires will sink into the crushable materials to help decelerate the aircraft.

When SAN installed its original EMAS back in 2006, the airport was an early adopter of the then-new technology. The expected lifecycle for the system was roughly 10 years, so SAN began field-testing it in 2015 and received encouraging results from visual inspections and core samples that assessed the material strength of random EMAS blocks. Subsequent testing to monitor the system's operability occurred in 2017 and 2019, and the final test indicated it was time to move forward with plans for replacement.

In short, the original EMAS was "aging out" right on schedule, and airport officials were thrilled that an aircraft had never entered it.

## A Lot Has Changed

Product technology and the airport's traffic have both evolved considerably since SAN installed a first-generation EMAS, notes Airside Operations Manager Dean Robbins.

DEAN ROBBINS

In 2006, SAN handled about 17.7 million passengers. In 2019, the Southern California airport served more than 25 million travelers and posted its sixth consecutive year of record-breaking passenger totals. Moreover, SAN now accommodates aircraft that didn't operate there 15 years ago, such as 787s and 777s.

The airport's new arresting bed is an EMASMAX by Runway Safe, currently the sole manufacturer of EMAS products that meet FAA requirements in Advisory Circular 150-5220-22B. Like its predecessor, the updated bed is a customized cellular concrete block system. But the new EMAS is located closer to the runway and localizer.

Per FAA requirements, SAN's first aircraft arresting bed had to be installed at least 60 feet away from the runway end because the coating could not withstand jet blast. The new EMASMAX could be located 35 feet from the runway. Placing the bed 25 feet closer to the runway end improves its arresting performance without any damage from jet blast, notes David Heald, regional director at Runway Safe Group. And any space-saving change is welcome news to SAN, given the limited size of its airfield.

DAVID HEALD

Design standards for first-generation EMAS beds also required them to be at least 20 feet from localizer arrays. Now, FAA allows the safety feature within 4 feet of a localizer.

Heald notes that new-generation EMAS like the one SAN installed are stronger, longer, deeper and more capable than their predecessors. Case in point: the EMASMAX is designed for a 20-year lifespan, which matches many pavement life standards. "It's an improved product," says Heald.

Runway Safe also produces greenEMAS, a silica foam system made from recycled glass that is contained within a high-strength plastic mesh. That type of system is anchored to the pavement and covered with a poured cement layer and treated with a topcoat of sealant.

Typically, EMAS beds span the full width of a runway, but their lengths vary according to runway configuration and fleet mix. The new full-width arresting bed at SAN is 376 feet long—60 feet longer than the previous system.

## Project Challenges

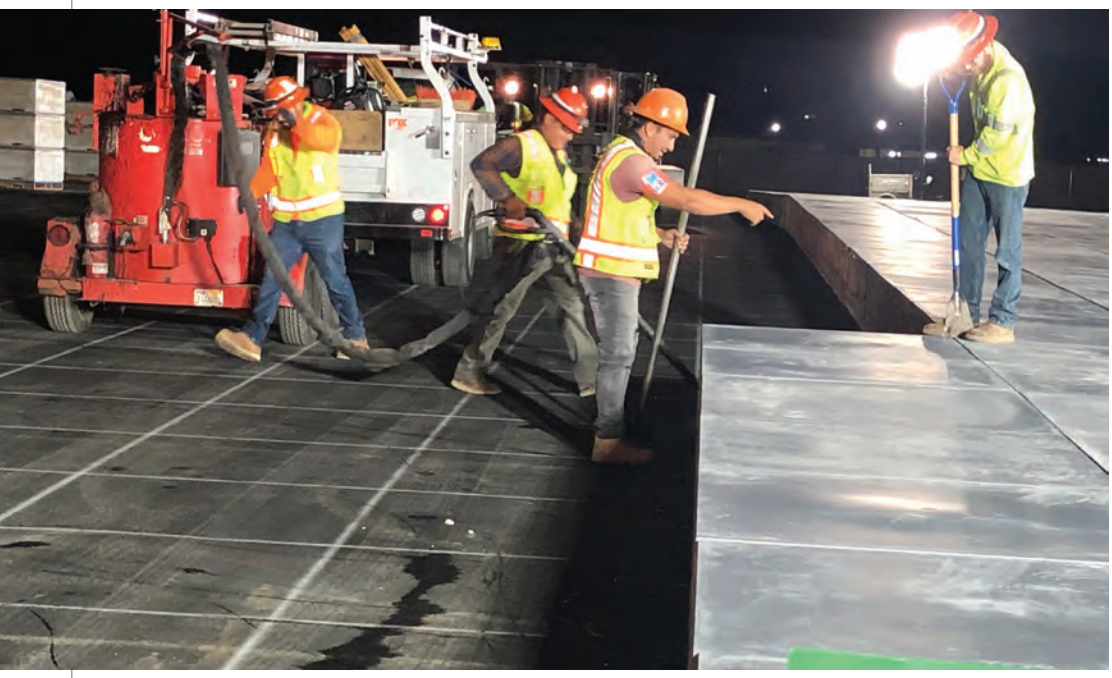
As with its first EMAS project, SAN contracted Jacobs Engineering to design the system. Jacobs, in turn, subcontracted Runway Safe to provide arrestment performance modeling. The EMAS manufacturer also provided onsite technical support during installation, under contract with San Diego County Regional Airport Authority.

Construction began in February 2021 and is scheduled to end by Sept. 11 (but was running ahead of pace in mid-July). Because SAN is a single-runway airport, project planning and execution were particularly crucial. While other airports can temporarily shift operations to another runway during construction, Robbins notes that SAN does not have that luxury.

Per FAA standards, runway safety areas should extend 1,000 feet beyond each end of the runway. However, that's not always possible because of obstacles or lack of available land, as is the case at SAN. Federal regulations also state that standard EMAS should be 600 feet long— yet another challenge for SAN.

"We've got a limited amount of space," Robbins remarks. "So we really challenged Jacobs Engineering on this project to come up with a design that allows us to maintain EMAS function while we were under construction. That was the biggest challenge."

Because of careful phasing implemented by Jacobs, the project did not require any reduction of runway length. "We collaborated and worked with the FAA to develop a safe approach," says Robbins. "To me, that was the biggest success coming out of this—working with the FAA and the airlines to make sure that we can do it safely."



*Most work occurred between midnight and 5 a.m. to keep the single-runway airfield operating smoothly.*

The engineering team considered several options when planning the project and developed a carefully orchestrated three-phase design. "We were especially pleased because it was a very collaborative approach with the FAA," emphasizes Robbins.

Construction crews began with electrical and infrastructure work, and then transitioned to removing and replacing rows of existing EMAS blocks in two separate phases. This allowed the runway to maintain FAA minimum requirements for declared distance for aircraft.

Christopher Bowker, senior project manager at Jacobs Engineering, explains that crews removed and replaced the front two-thirds of the EMAS at first. "That was the biggest piece of real estate we could give

the contractor at a time," Bowker explains. Crews also needed to make some pavement repairs, including a 1.5-inch mill and overlay, once the EMAS blocks were removed.

Much of the removal and replacement occurred overnight between 12 a.m. and 5 a.m., from Tuesday to Saturday. The construction teams became very efficient working in five-hour windows, reports Robbins. But with mobilization, demobilization and clean up—including sweeping the airfield to meet Part 139 inspection standards every morning—crews typically only had about four hours of time to move the project forward. "That, in and of itself, is a challenge," he acknowledges.

Although time constraints definitely posed a challenge, Bowker says his team was prepared. "It slows production, but from our past experience, we knew that between midnight and 5 a.m. we could get the project done in an efficient manner," he remarks.

The bigger challenge was keeping the EMAS functional throughout construction. "If we started demoing the EMAS, we would then need to use declared distance to get the full 1,000-foot safety area," says Bowker. "That would take away runway length and impact operations."

So Jacobs phased the project to always maintain at least a 40-knot EMAS. "That allowed us to construct good portions of the project without taking away runway length during construction," he explains.

While SAN officials had hoped to keep the localizer active throughout the project, it was taken out of service. Because RNAV approaches are now so widely accepted, removal did not pose much of an operational issue for airlines but made construction "significantly easier," notes Robbins. FAA will recertify SAN's localizer after the project is complete.

The COVID-19 pandemic posed additional challenges to the entire project team and delayed material delivery. "Trucking went from a week to two weeks," Heald recalls. Even so, the project remained slightly ahead of schedule. In late June, construction was expected to wrap up by the end of July, with total completion possible in late August.

"This EMAS really helps improve our arrestment performance," Robbins says. "Once completely installed, we'll be capable of stopping a 777-300 ER that enters the bed at 59 knots."

As first-generation arresting systems at other airports reach the end of their service lives, Bowker encourages project teams to learn from the modeling and phasing that occurred at SAN. He also foresees other airports benefiting from improved technology to better accommodate their current fleet mix.

According to FAA records through March 2021, there have been 15 incidents when EMAS have safely stopped overrunning aircraft. None were at SAN.

# Huntingburg Airport Builds Highway Tunnel to Prepare for Next Runway Extension

BY MIKE SCHWANZ

## FACTS&FIGURES

**Project:** Highway Tunnel & Runway Expansion

**Location:** Huntingburg (IN) Regional Airport

**Owner/Operator:** Dubois County Airport Authority

**Annual Operations:** 14,000

**Project Scope:** Building tunnel for nearby highway; extending length of main runway from 5,000 to 5,501 ft., expanding width from 75 to 100 ft.

**Ancillary Projects:** Lengthening taxiway; adding new runway & approach lights; improving runway drainage

**Estimated Cost:** $13.2 million

**Funding:** FAA 90%; state 5%; county 5%

**Design Approval/Land Acquisition:** 2015

**Tunnel Construction:** Fall 2019-Sept. 2020

**Runway Expansion:** June 1 to mid-Sept., 2021

**Associated Runway Closures:** 2 days on & off during tunnel construction; about 3 months for runway expansion

**Engineering Consultant:** Woolpert

**Main Contractor:** Weddle Bros.

**Tunnel Supplier:** Contech Construction Solutions

**Electrical Supplier:** Appalachian Foothills

**Geothermal & Soil Inspection:** CTL Engineering

**Key Benefits:** Tunnel facilitates extension of main runway to accommodate larger corporate aircraft; new runway lights & PAPIs benefit all traffic

**Next Phase:** Extend runway to 6,000 ft. in 4-5 years

When corporate customers expressed a desire to operate larger, longer-range jets at Huntingburg Regional (HNB) Airport, Manager Travis McQueen found a way to provide the extra runway length they would need.

TRAVIS McQUEEN

Keeping an open mind, McQueen and his team entertained a wide variety of strategies, including proposals to relocate nearby railroad tracks or even move the airport itself. In the end, though, they opted to build a tunnel *under* the existing airfield to create a thoroughfare for a nearby county highway, and then extend the main runway *over* that tunnel.

The first part of the project—building the tunnel and partially expanding Runway 9-27—is almost finished. The tunnel was constructed last summer, and the runway work is slated to wrap up in mid-September. When crews are done, the airport will have a runway that is 5,501 feet long and 100 feet wide, with improved drainage and updated lighting.

FAA is covering 90% of the estimated $13.2 million cost, and the county and state are each contributing 5%.

In four to five years, the airport plans to use the land directly above the new tunnel to extend the eastern end of Runway 9-27 to 6,000 feet. For now, the parcel is landscaped and serving as a runway safety area.

### Why a Tunnel?

Located in southern Indiana, HNB logs approximately 14,000 operations a year. Several large companies have hangars and flight departments at the airport, including MasterBrand Cabinets, Jasper Engines and

PHOTO: MICHAEL CUMMINGS

stop to refuel when flying to Seattle, for instance."

Woolpert engineers drew up more than 30 different plans representing a wide variety of strategies to provide a longer runway. Ultimately, the project team opted to build a tunnel and perform two separate extensions on Runway 9-27.

However, before the design was finalized and construction could begin, there were several roadblocks to hurdle—literally and figuratively. First, HNB had to acquire 41 acres of land just east of the current runway from a local property owner. That was accomplished in 2015, shortly after Woolpert's final plan was approved.

Another big challenge was closing the county highway that would eventually pass through the tunnel. That required the project team to coordinate closely with the Dubois County Highway Department and local water, electric and telecommunications companies.

Because the road had to be closed for at least one year, the airport had to accommodate 12 landowners and various emergency departments that depended on it. To meet that challenge, Woolpert engineers designed a temporary seasonal road. Landowners

Transmissions, Kimball International, Best Home Furnishings and OFS Brands. All currently operate small or midsize corporate jets at the airport, but company officials have long wanted to leverage aircraft with more range, which would require a longer runway.

CURTIS BROWN

Therefore, the airport hired Woolpert, an engineering consulting company, to explore ways to make that happen. "Corporate jets using HNB now are able to use less than 65% of their useful load," explains Curtis Brown, the firm's Indiana aviation practice leader. "They have to make a pit

regularly used it to access their property, and emergency personnel had access to it if necessary. Fortunately, that was not the case.

Satisfying all parties affected by the highway closure required close coordination with county officials and local emergency service departments. “I have to applaud everyone involved. The first priority was to serve the community,” says Brown. “We all sat together and hashed this out in 20 minutes! This was one of the best examples of interagency cooperation I have ever experienced in my nearly 30 years of doing this job.”

Once construction of the tunnel began, Woolpert posted full-time inspectors on-site for the duration of the project. Brown, who is based in Indianapolis, visited almost weekly for regular program meetings with the prime contractor, Weddle Bros. “They did a great job meeting all the timelines,” he comments.

## Construction Challenges

Several surprises cropped up during site prep. For example, construction crews discovered an old creek bed that was still partially filled with water. To build over it, they filled the area with soil excavated from the north side of the airfield.

Workers also found a seam of coal, about 9 feet wide and 6 feet deep, running at a 45-degree angle under the headwalls of the tunnel site. Contractors dug up the coal to reach solid bedrock underneath, and struck a deal with adjacent landowners to use their soil as fill. “We took some of their soil on hills, and flattened the land for them after completing the digging,” states Jeff Busing, project manager for Weddle Bros. “This made it easier for them to plant crops.”

Once the site prep challenges were overcome, it was time to install the pre-engineered, precast concrete tunnel. “It was shipped to the site in two pieces, on two huge flatbed trucks. Then, two cranes were used to put it in place,” explains Busing. “This expedited the process significantly and minimized interruptions to airport services.”

It took crews two days to lower the large concrete pieces into a 15-foot-deep hole that was dug ahead of time. During this phase, the runway was closed from 8 a.m. to noon; opened from noon to 1 p.m.; closed again from 1 p.m. to 5 p.m. and reopened until 8 a.m. the next morning. Pilots were required to check in with the airport one day before their arrivals, but the limited operating schedule only lasted two days.

“This worked out pretty well,” McQueen reports. “Smaller prop planes did not have a problem avoiding the tall cranes at the end of the runway. However, the larger corporate jets landing at 130 knots needed the cranes’ booms lowered when they were coming in because these pilots requested that the whole runway be available to them. Overall, it worked out fine.”

After the two concrete pieces were in place, crews welded and sealed them together. Next, they backfilled the area with about 3 feet of stone and topped that with a layer of dirt.

The finished tunnel is 180 feet long, 19½ feet tall at the center point and 37½ feet from wall to wall. It is short enough so interior lighting was not needed, and wide enough to accommodate combines and other large farm equipment common in the area.

The road that passes through the tunnel has two 11-foot wide lanes, plus a 4-foot shoulder and a utility space of 3 feet.

Weddle Bros. crews completed most of the tunnel in June 2020, and finished related embankment and excavation work throughout the summer. Then, they paved and painted the tunnel-covered highway, which reopened for traffic in mid-September 2020.

## Runway Improvements

The second major portion of the current project has required closing Runway 9-27 from mid-June 2021 to mid-September 2021. In addition to adding 501 feet of length and 25 feet of width, crews installed tiles to improve drainage and added new runway lights and precision approach path indicators (PAPIs).

The airport also extended a taxiway to serve the longer runway. During construction, HNB kept a section of the taxiway open to accommodate crop dusters that needed to spray nearby fields during the second week of

July. "We made a portion of our taxiway available to them, but we required 24-hour advance notice of the times they intended to use the taxiway," McQueen says, adding that pilots had to acknowledge/accept the risks associated with using a taxiway instead of a runway.

The taxiway section that remained open for crop dusters was 2,600 feet long, but most needed far less length than that. "They only fly for an hour at most, before returning to the airport for both aviation fuel and the liquid herbicide mixture they spray," explains McQueen.

While aircraft operators eagerly anticipate the reopening of Runway 9-27, airport officials are already looking forward to extending it again.

"Both the tunnel itself and the land over it were engineered and constructed so that the runway could accommodate large corporate jets," explains McQueen. "We just need more funding from the FAA to do it."

PHOTO: MICHAEL CUMMINGS

*The tunnel is made of two pre-engineered, precast concrete pieces that workers welded and sealed together on site.*

If all goes according to plan, that extension will take the runway directly over the new tunnel and bring its total length to 6,000 feet—enough to allow large corporate aircraft leaving HNB to reach almost anywhere in the continental United States without stopping to refuel.


PHOTO: STAN WARUNEK / MONTAGE PHOTOGRAPHY



# Runway Replica

One of the most popular paintings at Wilkes-Barre/Scranton International Airport (AVP) strays far from the predictable fare of regional landscapes and local landmarks. It's the Pennsylvania airport's primary runway painted to scale—complete with centerlines, threshold markers, airfield signs and authentic edge lights that actually light up.

"If they ever go out, we'll have to issue a NOTAM (notice to airmen)," quips Airport Director Carl Beardsley Jr.

The unique project was conceptualized a few years ago by Marketing Director Eric McKitish and spearheaded by Operations Superintendent Pete Payavis, who passed away in 2019. The concept was resurrected after Payavis' death by Assistant Superintendent Matt Gowat and airport maintenance workers, who painted a miniature version of AVP's 7,501-foot runway on the floor of the pedestrian tunnel connecting the terminal and parking garage.

Clearly, Payavis understood the inherent appeal that runways have for the general public, because AVP's painted version quickly became a favorite after it was completed last fall. "It inspires a lot of chuckles, even from people who travel a lot," Beardsley remarks.

Children, in particular, seemed to be "moved" by the painting. Some even spread their arms like airplane wings and run down the tunnel, pretending to take off.

"It's really something," says Beardsley. "Pictures don't do it justice."

# Airport Projects Profiled Here

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# Are You Suffering Transparency & Trust Issues?

From hiring owner's reps to initiating construction management at risk, airports and other facility owners have put various models in place to create accountability during their construction projects. According to a report by Mckinsey & Co., cost and schedule overruns are the norm in the overall construction sector. It is estimated that overruns in capital expenditures for infrastructure projects average above 130% of original quoted capital, and schedules run 20 months beyond original agreements. As a result, there's an overwhelming lack of transparency and trust.

## What's going on?

One problem is data silos. It's not unusual for mega construction projects to involve more than 500 vendors. But even smaller projects have thousands of details and datapoints to manage. Too often, data from owners, architects and contractors is isolated or stored in a way that makes it inaccessible. This creates a lack of transparency, slows down projects, limits communication/collaboration, and decreases the quality and credibility of data.

McKinsey ranks construction as one of the least digitized industries. Knowing that the world will need to spend an estimated $57 trillion on infrastructure by 2030 to keep up with global GDP growth, how will legacy systems for managing construction documentation keep up?

## Hiding Mistakes & Miscalculations

Unfortunately, the issue isn't just the *amount* of data. It's about the manipulation of data happening behind the scenes. We've seen projects that have:

- missing documentation for schedules and inspection logs;
- meeting minutes and schedules that have been changed without approval; and
- closed documents that were opened and amended.

Contractors regularly change specs behind an owner's back or without providing essential information. On one project we analyzed, the contractor told the owner it would have to switch to a particular type of glass that was 70 times more expensive than what was originally agreed upon because of a "shortage of glaziers." There was no shortage, just a contractor who was setting precedents for litigation on the back of this project.

In addition, mistakes are hidden and crucial conversations are avoided. We worked with one government contact that miscalculated the cost of an air-conditioning system. Rather than admit the mistake, the engineer changed the contract without telling the client—upping the bill by $12 million.

Such misdeeds and misinformation create speculation and chaos, not trust. When you don't have complete and accurate information on a project, it's impossible to hold anyone accountable. That doesn't just mess with your budget and schedule; it can affect the safety and integrity of a project.

## Dismantling Data Silos

What is needed to help owners, operators and stakeholders mitigate risks, lower costs and prevent schedule overruns? We must solve the data problem.

While just about every large project claims to be "data-driven" and focused on leveraging new technologies like artificial intelligence, building information modeling and machine learning, evidence suggests that few are backing up this talk with real action. In fact, it can be argued that data is often more of a liability than an asset.

***Shelley Armato*** *is president and owner of Marathon Digital Services, the parent company of a business that designs software to provide airports and other facility owners complete control over their documentation during construction projects. Its software application, MySmartPlans, focuses on creating accountability, transparency and efficiency.*

One step toward solving the problem is for the key players involved in a construction project to have critical conversations. Owners need to ask better questions, require documentation, audit agendas and meeting minutes, and hold contractors accountable.

Contractors need to own up to their mistakes and proactively address schedule and budget miscalculations so everyone can solve issues together, out in the open.

Finally, owners, operators and stakeholders must mitigate the risks associated with insufficient document oversight. Imagine moving construction into the current digital age with information governance where every detail and communication about a project is recorded and stored for instant retrieval.

If our country's crumbling roadways, collapsing bridges and aging airports are any sign of the state of the current construction industry, it's imperative that we put a solid plan in place to create transparency and accountability before the $3 trillion in infrastructure improvements supported by the White House begin.

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