

EXECUTIVE SUMMARY (10 pts)

The Runway 18-36 Reconstruction Project has set the standard in the northern tier that all other concrete runway projects will be compared against. The innovations and problem solving that define this project met the owner's demands and laid the groundwork for solving many challenges of airport concrete paving. The project earned the North Dakota Chapter "State Airport Paving Award" and deserves recognition as an ACPA National Award for Excellence in Concrete Pavement.

The project consisted of reconstructing Runway 18-36 and connecting taxiways (164,000 SY), relocation of NAVAIDS, two new aircraft arresting barriers, storm sewer, edge lighting, in-pavement lighting, and perimeter roads.

The challenges that this project faced were many. The owner required that the airport not be shut down or lose commercial flights as a result of the project. This posed a challenge because the main runway would be reduced to rubble and reconstructed. To meet the expectations of the owner, the parallel taxiway was converted to a runway for the duration of the project. Other innovations that were utilized to meet challenges were as follows:

- **Recycled Concrete** - The asset value of the old pavement was recovered by crushing it and using the aggregates in the subbase and the econcrete base.
- **Well graded aggregate concrete mix**- To deliver a smooth, durable pavement to the owner a well-graded aggregate concrete mix was specified.
- **In-Pavement Lighting** - Nearly 400 in-pavement light bases were installed with a method that did not interfere with slip-form paving and guaranteed precise alignment of each light.

Work began in early May and was completed at the end of October. Shafer Contracting understood the implications of this short construction season and the challenge that it presented. Through their embrace of the innovations in the design as well as innovations of their own, they were able to successfully complete the project on time, before the snow came.

The success of this project was not only because of the innovations used in the design and construction, but also because of the efforts and cooperation of the users of the airport. Extensive planning and communication before and during the design phase prepared the users for the impacts from the project and allowed them time to adjust to the temporary conditions during construction. For instance, the airlines were required to fly smaller aircraft because of the smaller temporary runway, but they added more flights to ensure that the same number of seats were available to the community. Through efforts like this, a difficult project was turned into a success story.



Runway 36 – On Approach

PROJECT SCHEDULE AND SCOPE (5 pts)

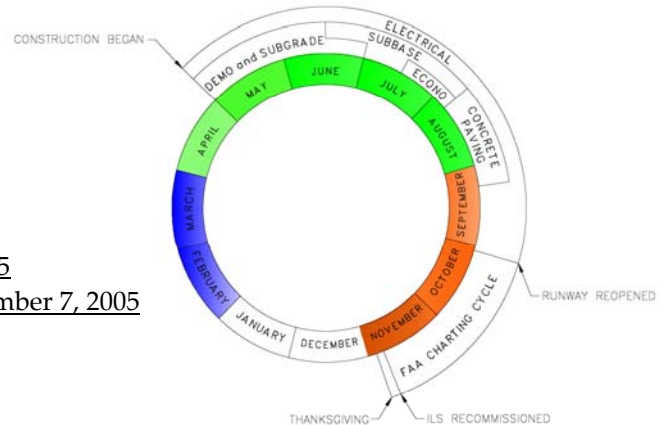
AS A MINIMUM, INDICATE THE FOLLOWING:

Project Schedule

Project Start Date: May 3, 2005
Project Completion Date: October 8, 2005**

Start of Concrete Pavement Construction: August 3, 2005
Completion of Concrete Pavement Construction: September 7, 2005

**Runway was reopened to aircraft on this date.



PLEASE DESCRIBE ANY UNUSUAL CIRCUMSTANCES THAT MADE IT CHALLENGING TO COMPLETE THIS PROJECT IN THE ALLOTTED TIME.

The schedule of the project was bound by three factors:

- Cement supply
- Weather
- FAA charting schedules

Cement supply was predicted to be tight during the summer of 2004. In the middle of paving the runway, Shafer shut down paving for one week because cement was unavailable. Shafer had anticipated the shortage and was able to simply work on preparing base, setting stringlines, and earthwork until the cement supply was available again.

Weather restricted the project by preventing the project to beginning until early May. This was no surprise, but the fact that construction cannot begin until late May cramps schedules in North Dakota.

The FAA charting schedules required the runway to be completed and flight-checked by October 18th to make the charting cycle that would publish the new approach to the new runway end by Thanksgiving. If this cycle had been missed, the airport would not have had an instrument approach until the middle of January. This would have left the airport without an instrument approach for three months, increasing the likelihood that flights would have been lost through the holiday season.

Project Scope

The scope of the project was simply to reconstruct the main runway and three connecting taxiways and construct a new midfield connecting taxiway. The reality was that with the reconstruction of the main runway, many existing systems were affected that had to be reconstructed as well. These systems included new aircraft arresting barriers, perimeter roads, drainage improvements, lighting, and NAVAIDS.

Total Project Cost: \$18,300,000
Total SY of Concrete Pavement: 164,000 SY
Total Concrete Pavement Cost: \$ 5,354,000

Pavement Type

- Jointed Plain
 Jointed Reinforced
 Continuously Reinforced

Joint Spacing 25' x 25'

Concrete Shoulders

- Yes No

Concrete Curb

- Yes No

Dowels

- Yes No

Pavement Description

Runway 18-36 was designed as a 17" thick plain concrete pavement. The panels are 25' x 25', doweled along the longitudinal joints and tied across the transverse joints on the first and last three joints of each lane. The concrete pavement rests on 6" of econcrete, which is on 8" of crushed concrete base.

Nearly all of the connecting taxiways are 16" thick plain concrete pavement, with the same base structure. One of the connecting taxiways is 12" thick plain concrete pavement on crushed aggregate subbase, to handle lighter traffic than the rest of the taxiways.

Project Safety

Airport projects require extensive planning to ensure a safe environment for construction and air traffic to operate. To maintain the air traffic at the airport, the parallel Taxiway A was converted to a runway. This conversion included lighting, marking, and temporary visual approach slope indicators. To avoid confusing pilots, the conversion was completed in one 22-hour work shift. This use of the taxiway as a runway provided the separation necessary to allow the contractor and aircraft to operate safely.



Sandblaster Removing Taxiway Markings for Conversion to a Temporary Runway

To maintain safety and separation, many systems were implemented. These systems included:

- Water-filled barricades across any pavement that linked the work site to the active airfield.



Water Filled Barricades

- Fencing around the entire work site that tied into the water-filled barricades, indicating the perimeter of the work site.
- Lighted yellow X's on the closed runway to alert pilots that the runway was not open.
- Construction access gates closed or guarded during work hours to keep errant vehicles off of the work site.
- Flashing beacons or flags on every vehicle on the site.



Runway Closure Marking

Preventing the public from straying onto the airport is the number one job of the gate guard required by the project. Only authorized personnel were allowed onto the jobsite. To ensure that no one ventured onto the site, the contractor placed a gate guard at the construction gate whenever it was open. This gate guard was given a list of authorized personnel from each organization other than the contractor.



Adrian, the Gate Guard

PAVING PROCESS / SMOOTHNESS (25 pts)

Paving a smooth, durable concrete runway was paramount in the eyes of the Municipal Airport Authority. They recognize that smoothness means more than just a comfortable ride. Smoothness increases the life and the safety of the runway by eliminating dynamic loading and loss of pavement contact from bouncing aircraft. The paving process for this project had the ultimate goal of smooth pavement - literally from the ground up.

BASE PREPARATION

In Fargo, North Dakota, frost is a reality. The soil is fat clay that typically has a frost depth of five feet or more in open areas and under pavement. It is pointless to try to prevent frost. Instead, the design ensures that the pavement system has uniform movement. Scarifying, blending, and recompacting the top 18" of subgrade creates a consistent subgrade, which ensures a uniform response in frozen conditions.

After the subgrade was prepared, the base was constructed in the following layers:

- Woven geotextile fabric
- 8" Recycled concrete base
- 6" Recycled concrete econocrete

These layers acted together to provide a smooth, stable paving platform.

GRADE CONTROL:

Precise grade control at every level of the pavement structure ensured a smooth riding finished concrete runway. The following grade control was used:

- Blue tops were placed for finishing the subgrade
- Stringline grade control was used to trim the recycled concrete base and to pave the econocrete
- Stringline grade control was used for paving the concrete

Surveyors set stringline hubs at every transverse joint line (25'). This allowed the hubs to be used to set the stringline and to mark for sawing. To stay ahead of Shafer's schedule, there were often six survey crews staking at one time.



Smooth Paving on a Stable Platform



Ulteig Survey Crews Setting Stringline Hubs

CONCRETE PLACEMENT TECHNIQUES:

The majority of the concrete and econcrete paving was done with a Gomaco slip-form paver. On initial lanes and lanes with no light bases, the concrete was placed directly in front of the paver. On fill-in lanes and lanes with light bases, a belt placer was used to ensure even distribution of concrete in front of the paver and around the bases. Hand-pours in radii were placed using side forms and a screed.

CONCRETE BATCHING AND HAULING TECHNIQUES:

Shafer Contracting strategically erected a portable concrete batch plant in the plant site. The plant was a Rex Model S double-drum that produced 8 CY/min. To keep up with the huge cement demand of batching that much concrete, the plant was set up so that cement trucks could discharge into the plant while the plant continued to produce concrete. The concrete was hauled to the paver using end-dump and Agitor trucks.

The project called for an off-road haul route to be built. This haul route provided a direct route to the site across only one public road and avoided delays from traffic. The short haul helped Shafer maintain a constant head of concrete in front of the paver to eliminate stops and starts and ultimately resulted in very smooth pavement. The haul road was covered with crushed concrete to help prevent tracking clay onto the runway or into the stockpile area.



Agitor Trucks Placing Concrete

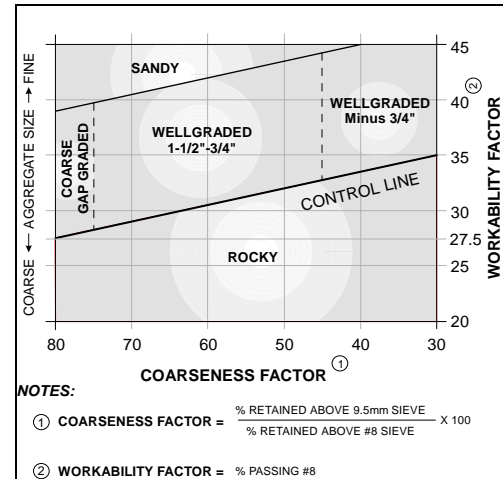


Double Drum Batch Plant

ADDITIONAL/SPECIAL STEPS TAKEN IN CONSTRUCTION:

The success of this project lies in the extra efforts put forth by both the Engineer and the Contractor. Following are some examples of those efforts by both to achieve this success:

- Well-graded aggregate was specified for the concrete mix, utilizing the aggregate proportioning guide. This guide helps predict the physical properties of the mix by plotting the coarseness and workability factors.
- The existing concrete runway was crushed and recycled for use as the base and as the aggregate in the econocrete.
- Maturity monitoring was allowed in the specification to help the contractor maintain the project schedule.
- Shafer Contracting batched and placed econocrete in their yard prior to mobilizing to the jobsite to gain familiarity.



Aggregate Proportioning Guide

- Shafer Contracting distributes and teaches its paving foremen the practices outlined in the IPRF's Best Practices for Airport Portland Cement Concrete Pavement Construction. These practices were discussed in a meeting the night before paving began to make sure that everyone agreed on the proper techniques.
- The contractor scheduled paving to optimize the accuracy of the in-pavement light cans.

By placing the adjacent lanes first, the height of the light bases was set using a straightedge or stringline pulled across the open lane. This resulted in a perfect height for the finished lights.



Perfect In-Pavement Light Installation



Touchdown Zone Light Bases Ready for Paving



Boom-Mounted Vibrator

- The contractor used a specially fabricated, boom-mounted vibrator on a skid steer during hand-pours to reduce foot traffic in the concrete and reduce the time required to place and finish the concrete.

SMOOTHNESS MEASURING DEVICE:

Smoothness was measured with two different devices:

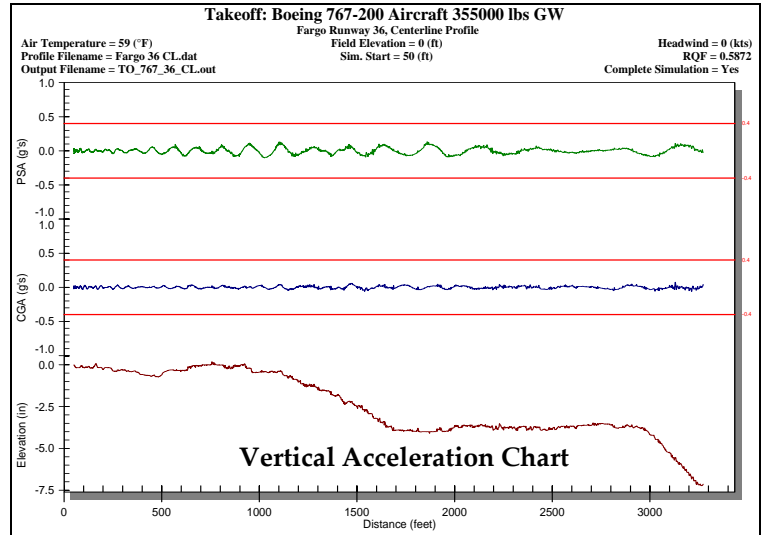
- Auto Rod and Level – data was used to analyze the pavement including a 16-foot straightedge simulation analysis and an aircraft ride analysis
- 16-foot straightedge – as required by FAA

SMOOTHNESS SPECIFICATION CRITERIA:

The FAA smoothness specification is no surface deviations in excess of $\frac{1}{4}$ inch when tested with a 16 foot straightedge, placed in any direction. Deviations between $\frac{1}{2}$ inch and $\frac{1}{4}$ inch would be corrected by grinding. Prior to grinding, the pavement would be subject to an aircraft ride analysis to determine the severity of the deviation.

200' before and after each arresting barrier was subject to a special tolerance to ensure that the tail hook of an F-16 aircraft would not bounce prior to cable engagement. This tolerance was no deviation in excess of $\frac{1}{8}$ " when tested with a 12' straightedge, placed longitudinally, every 5' across the runway.

This chart (at right) shows the vertical acceleration at the pilot's seat (top) and the center of gravity (middle) as a Boeing 767 departs along Runway 36 profile (bottom). The red lines above and below the acceleration graphs are the thresholds where humans feel a sensation. The smoothness of the runway is evident in this graph because neither of the top two graphs approaches the sensation threshold of the red lines. No corrective measures were necessary to bring the aircraft ride within acceleration thresholds. This was one of the smoothest runways that APR Consultants have ever tested.



WERE CORRECTIVE MEASURES TAKEN TO BRING SMOOTHNESS WITHIN SPECIFIED TOLERANCES?

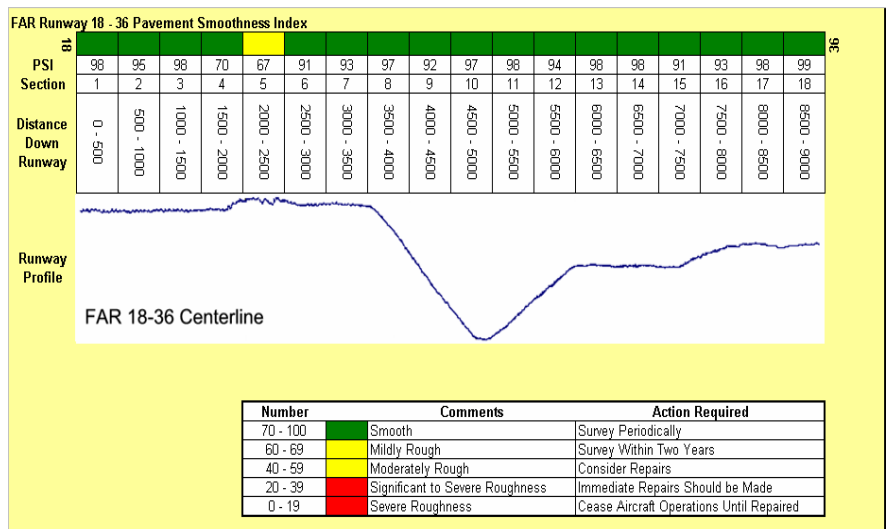
No correction was required.

AVERAGE SMOOTHNESS INDEX:

According to the analysis performed by APR Consultants, the average pavement smoothness index (PSI) was 92.6. The PSI for each 500-foot section of runway is shown in the chart below. Section 5 was the existing crosswind runway that was not reconstructed.

PERCENT OF INCENTIVE ACHIEVED:

The FAA does not provide for a smoothness incentive, however the contractor would have received all of the incentive if there were one.



WHAT SPECIFIC DETAILED STEPS WERE TAKEN TO ACHIEVE AND MAINTAIN PAVEMENT SMOOTHNESS?

Smoothness was the target of each successive layer of the pavement structure. The accuracy in placing each layer translated into the smoothness of the final layer - the pavement.

Pavement Smoothness Index Chart

The specific steps that were taken for this process are detailed in the following bullets:

- Contractor verified subgrade accuracy by stringlining between bluetops
- Aggregate subbase, econcrete, and concrete were placed using stringline grade control
- Shafer designed econcrete and concrete mix designs that matched the characteristics of their paver which reduced required finishing effort
- Shafer batched and delivered consistent mix to the paver



Trimming Aggregate Subbase



Smooth Paving with Consistent Concrete that was Compatible with Shafer's Equipment

QUALITY CONTROL (20 pts)

DO YOU HAVE AN INTERNAL QUALITY CONTROL PLAN? [X] YES [] no

IF YES, PLEASE DESCRIBE SOME OF THE UNIQUE ASPECTS OF YOUR PLAN.

Unique aspects of the Shafer Contracting Co. Quality Control Plan

- Responsible foremen were empowered to make adjustments to maintain consistency
- The foremen are trained with the IPRF's (Innovative Pavement Research Foundation) Best Practices for Airport Portland Cement Concrete Pavement Construction. This is not a common practice, but should become the national standard.
- Additional quality control testing to maintain consistency during mix production
- Developed econcrete and concrete mixes to be compatible with paving equipment
- Paved econcrete test section off-site to gain familiarity

WHAT EXTRA STEPS WERE TAKEN TO ENSURE A CONSISTENT MIX?

Shafer Contracting understood that producing a consistent paving mix would ensure no costly delays from roughness, strength, or thickness problems. The following extra steps were taken to ensure that a consistent mix was produced.

- The contractor designed a well-graded aggregate concrete mix that met specification and was compatible with his paving equipment



- Surfaced haul roads with aggregate to prevent trucks from tracking clay onto stockpiles
- Managed stockpiles for steady plant charging and accurate aggregate delivery
- QC personnel monitored plastic concrete properties at the plant site

This consistent mix was an important tool in ensuring the smoothest of ride performance in the new pavement. The mix was so consistent that no edge slump boards were required at any time. In addition, finishing effort after the paver was minimal.

PLEASE DESCRIBE THE ACCEPTANCE CRITERIA AND PROCESS USED FOR THE CONCRETE PAVEMENT ON THIS PROJECT:

The acceptance criteria of FAA's P-501 specification are based on these six criteria:

- **Strength** - flexural strength of 650 psi in 28 days
- **Thickness** - specified thickness - 1/2"
- **Smoothness** - no deviations greater than 1/4" in 16 feet
- **Grade** - lateral deviation < 0.1', vertical deviation +/- 0.04'
- **Edge Slump** - not more than 15% of each 500' segment shall have an edge slump > 1/4", 0% > 3/8"
- **Dowel Bar Alignment** - alignment deviation shall not exceed 1/4"/ft

FAA specifications analyze the testing results of strength and thickness in a PWL (Percent Within Limits) Analysis and assign incentive bonuses based on that analysis.

PLEASE DESCRIBE HOW THE CONTRACTOR’S QUALITY CONTROL PROGRAM INCORPORATED THE ACCEPTANCE CRITERIA INTO THE OVERALL PROJECT:

The contractor’s quality control program was an important component of meeting the specifications. The six facets of the acceptance criteria are all directly related to the consistency of the contractor’s mix production. For instance, the contractor knew that his mix design would produce a strength that met the specification. If he produced this same mix all day long, he knew that he could expect passing strengths all day long. The same was true for all of the acceptance criteria. Quality control ensured this consistent mix.



Consistent mix is a direct result of a strong quality control program. The trained QC staff was able to recognize trends early, and make adjustments in the mix to maintain consistency. At the start of every day, the QC staff would test all of the properties of the mix at the plant to be sure that it was operating correctly. Empowering the QC staff allowed them to make changes to the mix instantly. For example, to account for variations in aggregate moisture QC staff could raise or lower batch water needed to maintain a consistent slump.

Testing Results

PLEASE PROVIDE A SUMMARY OF THE TESTING RESULTS FOR STRENGTH, THICKNESS, GRADATIONS, ETC. THAT APPLY TO THIS PROJECT. USE THE FOLLOWING TABLE FOR THE LISTED TESTING PROCEDURES.

Project Test	Required	Average Achieved	Standard Deviation
Thickness (Pavement)	12"	12.5"	0.38
	16"	16.5"	0.56
	17"	17.3"	0.36
Flexural Strength at 28 days	650 psi	713 psi	46
Thickness (Econcrete)	6"	6.6"	0.53
Flexural Strength at 7 days	500 psi	689 psi	192.3
Flexural Strength at 28 days	750 to 1200 psi	975 psi	228.4
Air Content	6.0%	6.1%	0.6

TRAFFIC MANAGEMENT (15 pts)

Work Zone Traffic Volume	N/A	Number of Aircraft Operations	See Below
Number of Businesses along project	N/A	Number of Passenger Enplanements	See Below
Number of Intersections	N/A	Other	_____

Due to this well orchestrated traffic management plan, the Municipal Airport Authority achieved its goal of maintaining airport capacity throughout the course of the project. In fact, 2004 numbers for passenger enplanements exceeded 2003 numbers. This was an extraordinary accomplishment for an airport utilizing a visual approach temporary runway as the primary runway.

OPERATIONS DURING CONSTRUCTION

	Itinerant	Local	Total
May	3,924	1,760	5,684
June	4,557	1,582	6,139
July	4,478	1,951	6,429
August	4,394	2,105	6,499
September	4,117	1,200	5,317
October	4,007	1,644	5,651

TOTAL PASSENGER ENPLANEMENTS

	2003	2004	Increase/Decrease
May	19,303	19,576	1.4 %
June	20,647	22,969	11.2 %
July	24,293	24,181	-0.5 %
August	20,730	23,527	13.5 %
September	18,289	18,913	3.4 %
October	20,419	21,112	3.4 %

PLEASE DESCRIBE THE TRAFFIC MANAGEMENT PLAN AND INCLUDE ANY UNIQUE ASPECTS OF THE PLAN?

The Municipal Airport Authority demanded that the project be completed before the onset of winter and without any loss of commercial service. To do so, a well-organized traffic management plan was essential

Temporary Runway

A major obstacle to overcome was maintaining service at an airport while the primary runway is out of service. Hector International Airport is fortunate to have a 100' wide Taxiway A parallel to Runway 18-36 that could be used as a temporary runway. After extensive coordination between the Engineer, Municipal Airport Authority, FAA and airlines, the airlines limited the size of aircraft utilizing the airport to DC-9 sized aircraft and smaller.

Taxiway A was converted to Temporary Runway 18-36 (100' x 8000') with full safety areas. At each end of the runway, an aircraft turnaround area was marked on the existing 115' wide crossover taxiways. A-320's regularly utilize the airport, however the airlines did not feel comfortable having them use the turnaround area, therefore the size of aircraft was limited to a DC-9.

The conversion of Taxiway A to Temporary Runway 18-36 was completed over the course of a 22-hour period and under aircraft movements. The conversion consisted of the following items:

- 14,000 yd² of pavement markings
- 91 Medium intensity runway edge lights
- 2 VASI units (Visual Approach Slope Indicator)
- 40 airfield signs
- 16 runway threshold lights
- 4 REIL's (Runway End Indicator Lights)
- Runway guard lights
- 2000' wiring
- 2 temporary aircraft arresting barriers (for the NDANG F-16 aircraft)



Taxiway A Converted to a Runway

Taxiway A Converted to a Runway... at Left

Airport Rescue & Fire Fighting (ARFF) Access

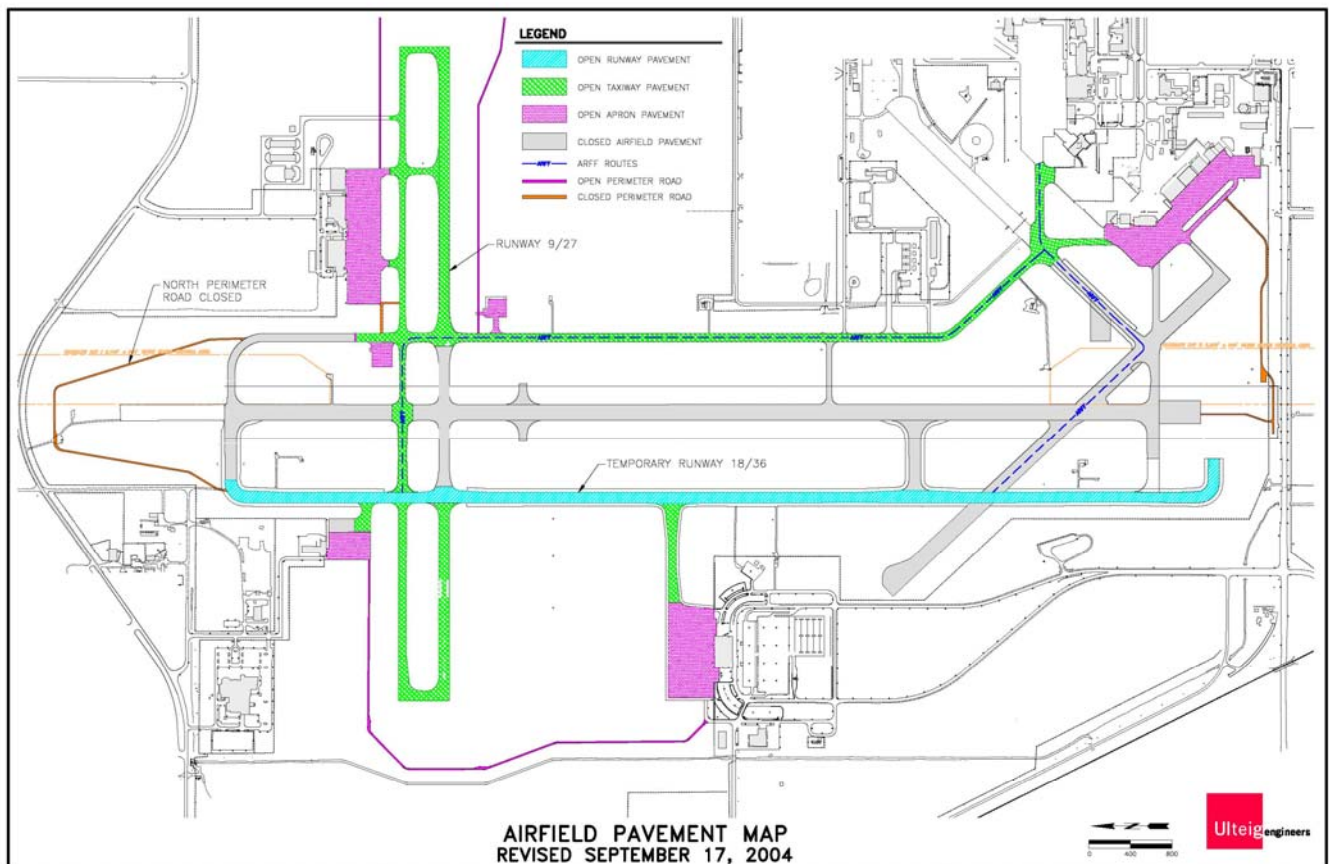
The Hector International Airport receives their emergency airport rescue and fire fighting services (ARFF) from the North Dakota Air National Guard located on the east side of the airfield. The emergency response time to anywhere on the airfield is 3 minutes. With Runway 18-36 removed, the airfield access was essentially cut in half. Temporary aggregate routes needed to be constructed for emergency vehicles to traverse the construction site going east to west. Trial runs were performed by ARFF personnel to verify emergency response time was not compromised by the temporary access routes and construction.



ARFF Vehicle

Airfield Pavement Maps

In an effort to minimize the confusion among pilots and vehicle operators using the airfield, airfield pavement maps were developed to show open and closed sections of pavement and ARFF access routes. These maps were distributed to users of the airfield and also placed on the airport's website.



Airfield Pavement Map

HOW WERE USER COSTS CONSIDERED ON THIS PROJECT?

The costs associated with closing the airport to complete construction were immeasurable and would have had profound effects on the airport, National Guard and the community. Therefore, the Municipal Airport Authority demanded that service be maintained through the use of a temporary runway.

WHICH OF THE FOLLOWING TRAFFIC CONTROL TECHNIQUES WERE USED ON THIS PROJECT?

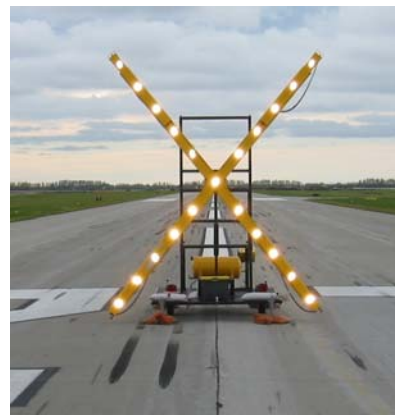
- | | |
|---|---|
| <input type="checkbox"/> Head to Head | <input type="checkbox"/> Slow down measures |
| <input type="checkbox"/> Traffic Detours | <input type="checkbox"/> Pilot Car |
| <input type="checkbox"/> 24 hour project information on radio | <input checked="" type="checkbox"/> Other (See Below) |

Traffic Control Techniques

- ➔ Use of Taxiway A as Temporary Runway 18-36
- ➔ NOTAM's (Notice to Airmen) informing pilots of temporary airfield changes
- ➔ Airfield Pavement Maps
- ➔ Lighted runway closure markings
- ➔ Water filled barricades separated open pavements from work zone
- ➔ Orange plastic fence delineated work area from active airfield



Orange Plastic Fence



Lighted Runway Closure Marking



Water-filled Barricades

WHAT WAS THE ALLOWABLE DELAY SPECIFIED ON THE PROJECT?

There were no allowable traffic delays on this project. Air traffic was simply diverted to the temporary and crosswind runways.

WHAT WAS THE ACTUAL DELAY ON THE PROJECT?

There were no traffic delays experienced on the project. Airlines were able maintain flight schedules and by maintaining temporary ARFF routes; ARFF vehicles did not suffer losses to their emergency airfield response times.

INNOVATION (15 pts)

WHICH OF THE FOLLOWING INNOVATIVE AND CREATIVE PROCESSES WERE IMPLEMENTED AS PART OF THE PROJECT?

- Equipment*
- General*
- Materials*

Innovative and Creative Processes

This project implemented innovation in all three of the above categories. The innovations on this project that have set the standard for all future concrete runway projects are as follows:

- Well-graded aggregate concrete mix design
- In-pavement light base installation technique
- Conversion of a parallel taxiway to a runway
- Maturity testing
- Use of recycled concrete in the subbase and econcrete
- Non-standard smoothness measurement and analysis
- Installing centerline light bases and conduit across an intersection that was not reconstructed
- Constructing the staging area in the prior construction season

DESCRIBE ANY UNIQUE SOLUTIONS TO PROBLEMS ENCOUNTERED ON THE PROJECT.

Ulteig had experience in the past with concrete that met every specification, but still had durability problems within the first year. This was largely attributed to mix incompatibility problems and overfinishing. To enable the contractor of this project to avoid those problems, the technology of well-graded aggregates was implemented. To utilize this technology Ulteig Engineers requested a Modification to Standards from FAA. The innovation paid off. Shafer Contracting developed a mix design with Midwest Testing Laboratory that flowed through their paver, filled all of the voids and held a vertical edge behind the paver without exception.



Smooth Paving with Well-Graded Aggregate Mix

To plan for future approach upgrades, the design required centerline and touchdown zone in-pavement light bases. In-pavement light bases must be installed accurately so that when the light fixture is installed it does not protrude too high or sit down too low. The other problem with the bases is that they are connected with conduits longitudinally and transversely.

To avoid interference with construction equipment and to ensure the accuracy of the installation an extra deep light base was used. This placed the conduits in the crushed aggregate base layer. The contractor installed blockouts at each light location for the econcrete pave and excavated each blockout after the econcrete cured.

The conduits were cut and fit into the base and the base was set with concrete while being held in place with a jig. This system held the bases in the proper position during paving and resulted in a near 100% accuracy of light base placement.



Conduit for Centerline Lights



In-Pavement Light Bases Held Securely with Alignment Jigs



TDZ Light Blockouts

The Municipal Airport Authority set the goal that while the main runway was under reconstruction, commercial traffic had to be maintained without any lost flights due to construction. The solution to this problem was to convert the parallel taxiway A into a runway. This required extensive coordination and planning including a change in the aircraft mix and schedule to accommodate the shorter length (8000' x 100') and installation of temporary arresting barriers for the F-16's, operated by the ND Air National Guard.



Ground Anchor for Temporary Barrier



F-16 Testing Temporary Barrier

To utilize the vast resource in the old runway, the concrete was crushed and used as a crushed aggregate base and as aggregate in the econocrete.

The crushed aggregate base course was placed and trimmed like any aggregate base, but the econocrete required extra testing and monitoring by Shafer's QC staff to maintain consistent moisture contents due to the materials absorptive qualities.

The current FAA specification for smoothness is no deviations greater than ¼ inch when tested with a 16-foot straightedge. The problem is that deviations of this magnitude have no impact on a vehicle with a wheelbase as

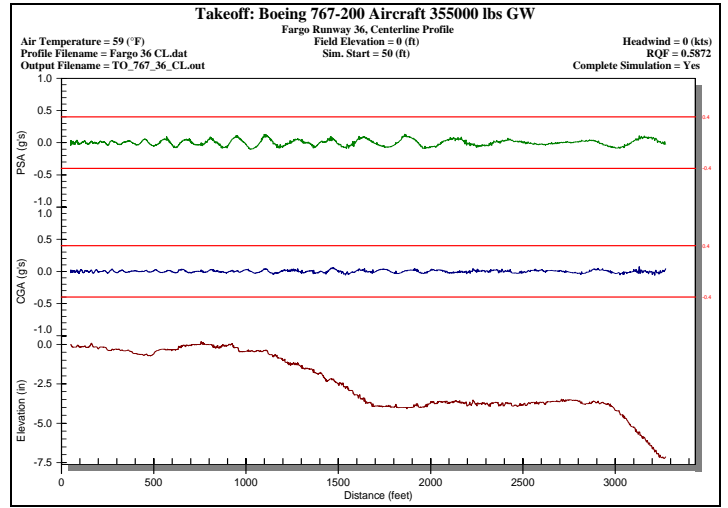
long as most commercial aircraft. To determine an aircraft's response to the pavement, the Engineer subcontracted an aircraft ride analysis with APR Consultants. An aircraft ride analysis measures the profile of the runway and simulates subject aircraft on that profile in takeoff conditions. The analysis gives vertical accelerations at both the pilot's seat and the center of gravity of the aircraft.



Crushed Concrete Stockpile

The vertical accelerations on this project were all well within the smooth rating.

To accommodate the short construction season in Fargo, North Dakota the owner recognized the need to construct the contractor's staging area/batch plant site a year in advance. By having the site in place, Shafer was able to mobilize and begin work on the airfield immediately after contracts were signed.



Smoothness Graph



Staging Area/ Batch Plant Site

DESCRIBE WHAT MADE THIS PROJECT COMPLEX.

Project Complexity

The complexity of this project was in the large number of items that were reconstructed because the main runway was reconstructed. In addition to the main runway and connecting taxiways the following items were constructed or reconstructed:

- Instrument Landing System (ILS) and control building
- Localizer antenna array
- MALSR and control building
- PAPI's
- Centerline in-pavement light bases
- Touchdown zone light bases
- Two aircraft arresting barriers
- Air Traffic Control Tower lighting control



Placing Concrete for the South Arresting Barrier



Localizer Antenna Array

To add to the complexity, one of NDANG's aircraft arresting barriers was shipped from France nearly two months late cramping an already tight schedule to install it. The contractor and NDANG worked together to modify their schedules and work concurrently to ensure that they met the completion date.

PUBLIC RELATIONS (5 pts)

WHAT SPECIFIC STEPS WERE TAKEN TO ENSURE THAT THOSE AFFECTED BY THE PROJECT WERE INFORMED BEFORE, DURING, AND AFTER THE PROJECT REGARDING THE PROJECT STATUS, POTENTIAL DELAYS, ETC.?

The reconstruction of the main runway of the busiest commercial airport in the State of North Dakota required extensive coordination before and during the project to ensure that those affected by the project were kept informed of potential delays, changes to the traffic management, the current project status, and the future schedule.

Preconstruction Coordination

The airport and engineer began discussions with the air carriers (Northwest Airlines and United Airlines) 18 months before the start of the project. These discussions were to work with them to change their aircraft mix and schedule so that the available number of seats to travelers was not affected by the project. Because the temporary runway was shorter, smaller planes were required that used less runway, so NWA had to add two flights and change their schedule accordingly.

The North Dakota Air National Guard (NDANG) operates F-16's and provides the Air Rescue and Fire Fighting (ARFF) service for the airport. The airport and engineer began coordination with NDANG 24 months before the start of the project so that they had ample time to procure and plan for installing temporary arresting barriers for the F-16's and to plan ARFF routes to allow acceptable response times to the airfield.

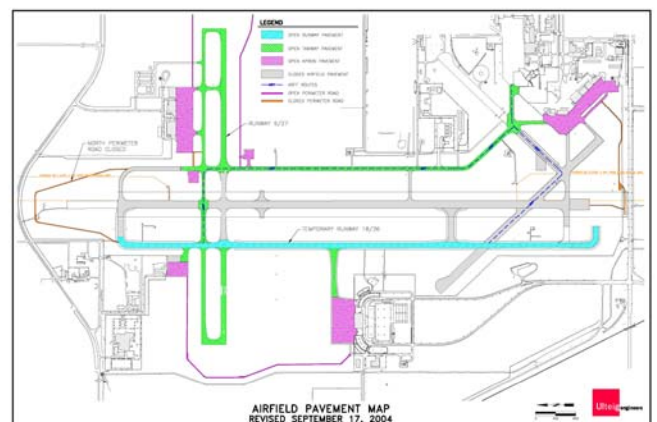
The tenants of the airfield and the Air Traffic Control Tower were consulted at the beginning of Final Design to discuss any issues that they may have with movement of aircraft around the airport.

Weekly Construction Meetings

Shafer Construction and Ulteig Engineers held weekly construction meetings in the airport authority boardroom. The contractor, engineer, subcontractors, airport management, airport tenants, NDANG, and Air Traffic Control Tower representatives attended each meeting. The meetings discussed progress that had been made and what was anticipated in the coming week. This included:

- Changes to the Airfield Pavement Map
- Safety Issues
- Any work that needed to occur with tower communication

The weekly forums gave opportunities for parties like the tower to discuss concerns that they had directly with the people working on the site every day.



Airfield Pavement Map

Project Web Site

The airport maintained a website for the duration of the construction project. The website was a clearinghouse of available information for all of the users of the airport and those directly involved with the project. The website's weekly updates included:

- Current NOTAM's (Notice to Airmen) that described the temporary changes at the airport for pilots planning flights into Hector.
- North Dakota One-Call Information
- Construction photos, including bi-weekly aerials
- Construction meeting minutes
- Latest Airfield Pavement Map, showing open and closed pavements as well as temporary designations of the airfield
- Contact information for those that had questions about the project

Media Exposure

Early in the life of the project, the airport authority and Ulteig Engineers involved the media to get the message out that by using the parallel taxiway as a runway and changing the mix of aircraft that used the airport there would be no loss of service to Fargo's air travelers as a result of the construction. The airport hosted a news conference early in the spring of 2004 to describe what was happening at the airport. Ulteig Engineers distributed maps describing the project and the phone numbers of its on-site engineers to the media so that they had access to the latest information on the project.

The project included removing the existing concrete runway and crushing it. Since the contractor's staging area was along the main entrance to the airport, the growing pile of concrete rubble drew the public's interest and was an excellent backdrop for many news stories about the paving process and the project's progress.

"The media access to the project was great. The engineers on the project were readily accessible by cell phone and always willing to help tell the story about the runway project. We were even escorted onto the runway for live shots the day before the runway was reopened. Access like this is uncommon and really added to our ability to tell the story of the runway."

- Donn Robertson KVLV-TV11

These measures - from the weekly construction meetings with all of the airport users and contractors to the live news stories from the runway - kept the flying public and the users of the airport safe, informed, and virtually unaffected by the largest runway project ever undertaken in North Dakota.

KEY PROJECT PERSONNEL CONTACT INFORMATION

CONCRETE PAVING CONTRACTOR

Shafer Contracting
30405 Regal Avenue
PO Box 128
Shafer, Minnesota 55074-0128

Greg Pelkey – Vice President
Telephone: 651-257-5019
Fax: 651-257-3778

DESIGN ENGINEER

Ulteig Engineers
3350 38th Avenue South
Fargo, North Dakota 58106-9615

Steve Synhorst – Aviation Department Manager
Telephone: 701-280-8596
Fax: 701-280-8739

PROJECT OWNER/SPONSOR

Municipal Airport Authority
2801 – 32nd Avenue NW
PO Box 2845
Fargo, North Dakota 58108-2845

Shawn Dobberstein – Executive Director
Telephone: 701-241-1501
Fax: 701-241-1538

CONTACT PERSON

Ulteig Engineers
3350 38th Avenue South
Fargo, North Dakota 58106-9615

Steve Synhorst – Aviation Department Manager
Telephone: 701-280-8596
Fax: 701-280-8739

PLAQUE INFORMATION

Project Title: Runway 18-36 Reconstruction

Project Location: Hector International Airport – Fargo, North Dakota

Complimentary Plaques Presented to:

Contractor: Shafer Contracting

Engineer: Ulteig Engineers

Owner: Municipal Airport Authority
Hector International Airport