Concrete Runway Built For Smooth Landings

Contractor uses specialized paving equipment to place a 150-foot-wide, 17-inch-thick runway at Dallas/Fort Worth International Airport

By Dan Brown

When airplanes come in for a landing at the Dallas/Fort Worth International Airport this fall, they will be able to glide smoothly onto a new concrete runway that meets demanding construction standards for smoothness. Requiring 425,000 square yards of portland-cement-concrete pavement set on 440,000 square yards of lean-concrete base, the $40 million project is one of the biggest challenges ever faced by paving contractor Granite Construction.

The runway, D/FW's seventh, is 8,500 feet long and 150 feet wide. In most sections, the slab is 17 inches thick, except in some areas where the slab edge is beefed up to 21 inches to carry planes onto future runway expansions. The runway's 7-inch-thick lean-concrete base was placed over a 9-inch-thick lime-treated subgrade. All concrete pavements, including the runway, a 75-foot-wide parallel taxiway, six connecting taxiways, and end aprons, will be reinforced with a grid of #4 rebar. In the runway and taxiways, rebar spacing is 12 inches on-center in the transverse direction and 18 inches on-center in the longitudinal direction. With the site grading and lean-concrete base now completed and the paving well underway, the job is proceeding on schedule toward an October 1996 runway opening.

All photos courtesy of CMI Corp.

Working at a 37½-foot width, a slipform paver places a stiff ½- to 1-inch-slump mix, achieving a sharp, true edge on the 17-inch-thick slab. California profilograph readings of the finished pavement surface to date show an average profile index of 2½ inches per mile.

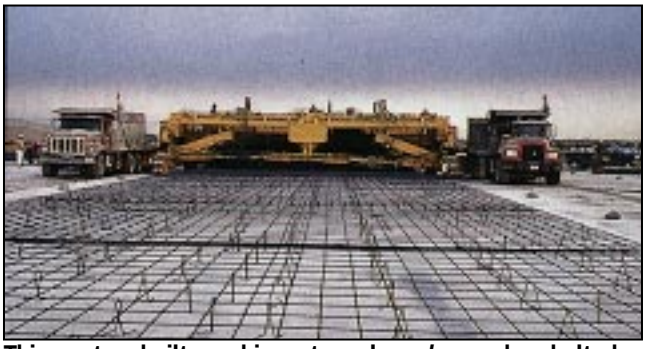
Paving Equipment

Despite the enormity of the project, Granite is achieving exceptional smoothness with the help of some specialized paving equipment, according to paving superintendent Randy Clark. The three machines Granite is using to facilitate placement of both the runway and the lean-concrete base include a four-track slipform paver, a custom-built belt placer, and a rubber-tired material transfer/placer.

For runway construction, the 165,000-pound slipform paver is working at a 37½-foot width to place a superstiff (½- to 1-inch slump) concrete mix. Despite the stiffness of the concrete, Clark says that the paver is achieving a sharp, true edge on the 17-inch-thick slab, and the pavement surface shows no deviation across a 16-foot transverse straightedge. To date, California profilograph readings show an average profile index of 2½ inches per mile, well below the 8-inch maximum permitted by the D/FW International Airport Board.

Paving the runway in 37½-foot-wide lanes is allowing Granite to place the slab in four passes. Equipped with 40 vibrators—about one for every foot of pavement width—the slipform paver is effectively consolidating the high volume of stiff concrete. The machine's hefty weight helps keep the paver on track while it forces the low-slump concrete through the slipform mold and pushes the vibrators through the 17-inch-thick slab.

Perhaps playing an even greater role in increasing productivity on this project is a hybrid belt placer that Granite assembled using two four-track placer/spreaders. Unlike factory-built placer/spreader machines, the customized placer can deliver concrete from both sides



This custom-built machine—two placer/spreaders bolted together with inside tracks removed—is allowing the runway paving contractor to place concrete from both sides of the wide paving lanes. The crew is achieving average daily placement rates of up to 4,000 cubic yards.

of the slab concurrently.

"For this project, we wanted a high-production placer that can reach 37 feet wide," says Clark. Because each placer originally had a capacity of 300 cubic yards per hour, the two combined have a capacity of 600 cubic yards. Granite doesn't let the placer get more than 60 feet ahead of the paver, so the freshly placed concrete doesn't begin to set and become impossible to slipform.

The machine is the brainchild of Granite master-mechanic Dan Molina. To build it, Granite dropped the inside tracks from each of the original four-track placer/spreaders, and the frames and track towers were bolstered to handle the additional clear span. Two large gusset plates, located in the front and rear of the machine, join the two placer frames in the center. Hydraulic systems were re-plumbed, and the two 350-hp engines, one on each side of the machine, were connected to provide hydraulic power for the two tracks on each side.

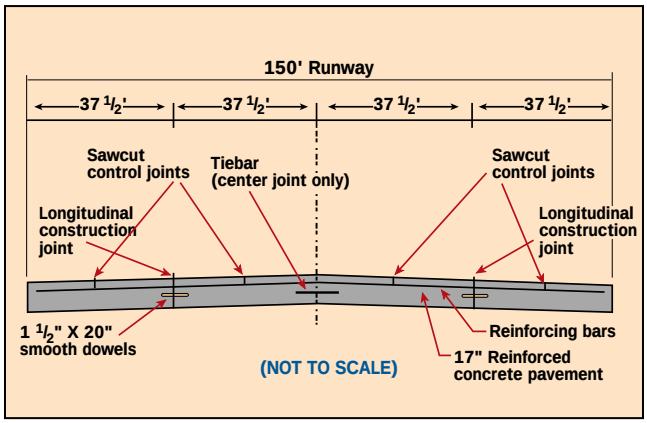
Because the two placer/spreaders are bolted together instead of welded, they can be separated and run independently. The separation requires unbolting the gusset plates and adding the two sets of inside tracks to each unit. "We get three machines from two that way," says Clark. "It's better equipment utilization."

To place concrete in the first and last few feet of paving lanes and in any gaps in lanes, Granite is using a rubber-tired material transfer/placer. A hopper on one end of the transfer vehicle receives concrete from dump trucks and places the material on a conveyor belt. The belt runs under the machine and transfers concrete to a rear-mounted, 29-foot-long conveyor that pivots in a full arc to place the material where needed. Clark says crews are able to quickly move the highly mobile machine anywhere on the job, and its rubber tires allow it to ride on new concrete without causing damage.

Granite's primary concern on this project is accurate paving rather than high-speed production. However, crews are still achieving impressive daily production rates of up to 4,000 cubic yards.

To help ensure accurate slab placement, the contractor is guiding the paver with two string lines, one on each side of the machine. The paver has a patented hydraulic control system that uses sensor wands to glide along the string lines and read line and grade. No electronics are involved, which improves reliability.

Four elevation sensors, one located near each of the paver's corners, transfer grade information to hydraulic cylinders in the track towers. The cylinders automatically and continuously adjust vertical grade. Two steering sensors—riding the string line on the right side of the paver—control paver alignment. Steel cables link both



Cross section of the 150-foot-wide runway. Placed in four 37½-foot-wide lanes, the pavement required only three construction joints. Sawcut control joints are located at the centerline of each paving lane.

sensors to corresponding slave cylinders on the opposite side of the machine. Steering motion, therefore, is simultaneously communicated to each respective set of tracks, front and rear. The sensors steer the machine by controlling the flow of hydraulic oil to cylinders at each track assembly.

After placement, the pavement receives a burlap-drag finish, followed by application of a white-pigmented curing compound, which is sprayed onto the surface from a texture-cure machine traveling behind the paver.

Efficient Design

The design engineer originally located longitudinal rows of landing lights on the runway so that paving lanes could be either 25 or 50 feet wide. Because Granite wanted to pave the runway in 37½-foot widths, the contractor proposed a new layout to avoid conflict between the lights and construction joints placed on 37½-foot centers. The design engineer agreed to relocate the rows of lights so that Granite could pave the 150-foot-wide runway using three construction joints instead of five (see drawing on page 261).

The design engineer also took precautions to prevent any cracks in the lean-concrete base from reflecting into the thick pavement. The entire lean base is treated with two coats of curing compound, which break the bond between the two slabs.

In addition, the engineer specified a weak 28-day compressive strength for the lean base (750 to 1200 psi).

A rubber-tired material transfer/placer with a pivoting, rear-mounted conveyor places concrete in the first few feet of a paving lane.

This low 28-day strength ensures that no shrinkage cracks will transfer upward from the base into the green slab during curing. Any areas of the base that exceed the specified 28-day strength are covered with plastic sheeting, which acts as an extra bond breaker.

Both the lean concrete and pavement concrete are being mixed in Granite's portable batch plant, which the contractor claims is the largest in the world. With twin 15-cubic-yard drum mixers, the plant towers several stories above haul trucks and can churn out 600 cubic yards of concrete per hour.

The mix design for the runway calls for stiff concrete, with a maximum slump of 1½ inches and a water-cement ratio of 0.38 by weight. A water reducer, added at the maximum recommended dosage, is being used to help achieve the low slump.

By design, lean concrete was a bid alternate to a cement-treated base. Because Granite already owned the large batch plant, the contractor found it more economical to go with lean concrete. "Otherwise, we'd have needed a big pugmill to mix treated base, and we'd probably have needed a different paver to place the base," says Brian Ingram, Granite's batch plant superintendent.

Subgrade preparation of the plastic, expansive-clay soil was extensive. Granite first injected the subgrade with water to stabilize soil moisture at 26½% to a depth of 7 feet. Next, a scarifier was used to rip the soil and permit lime slurry to penetrate it. All structural pavement, by design, received an 8% lime treatment to a 9-inch depth. Shoulders will receive 6-inch-thick lime-treated subbases under 4 inches of hot-mix asphalt. In all, the job requires about 500,000 square yards of lime-treated subgrade for the taxiways and runway and 300,000 square yards of lime-treated subgrade for the base beneath the shoulders.

Clyde Husk, project manager, Ralph M. Parsons Co., says that the new pavement is a federally-approved Category 3 runway—one that can be used in virtually all weather. "This runway will be usable 99.9% of the year," says Husk. Thanks to Granite's excellent construction techniques, pilots can look forward to smooth landings on the concrete pavement for many years to come.

Credits

Owner: Dallas/Fort Worth International Airport Board

Designer: Huitt-Zollars Inc., Dallas

Construction manager: The Parsons Team: Ralph M. Parsons Co., Pasadena, Calif.; Paragon Resources, Dallas; Con-Real Inc., Dallas; and Pavement Consultants Inc., Seattle.

Paving contractor: Granite Construction, Watsonville, Calif.

Paving equipment supplier: CMI Corp., Oklahoma City

Batch plant supplier: Erie Strayer Co., Erie, Pa.

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