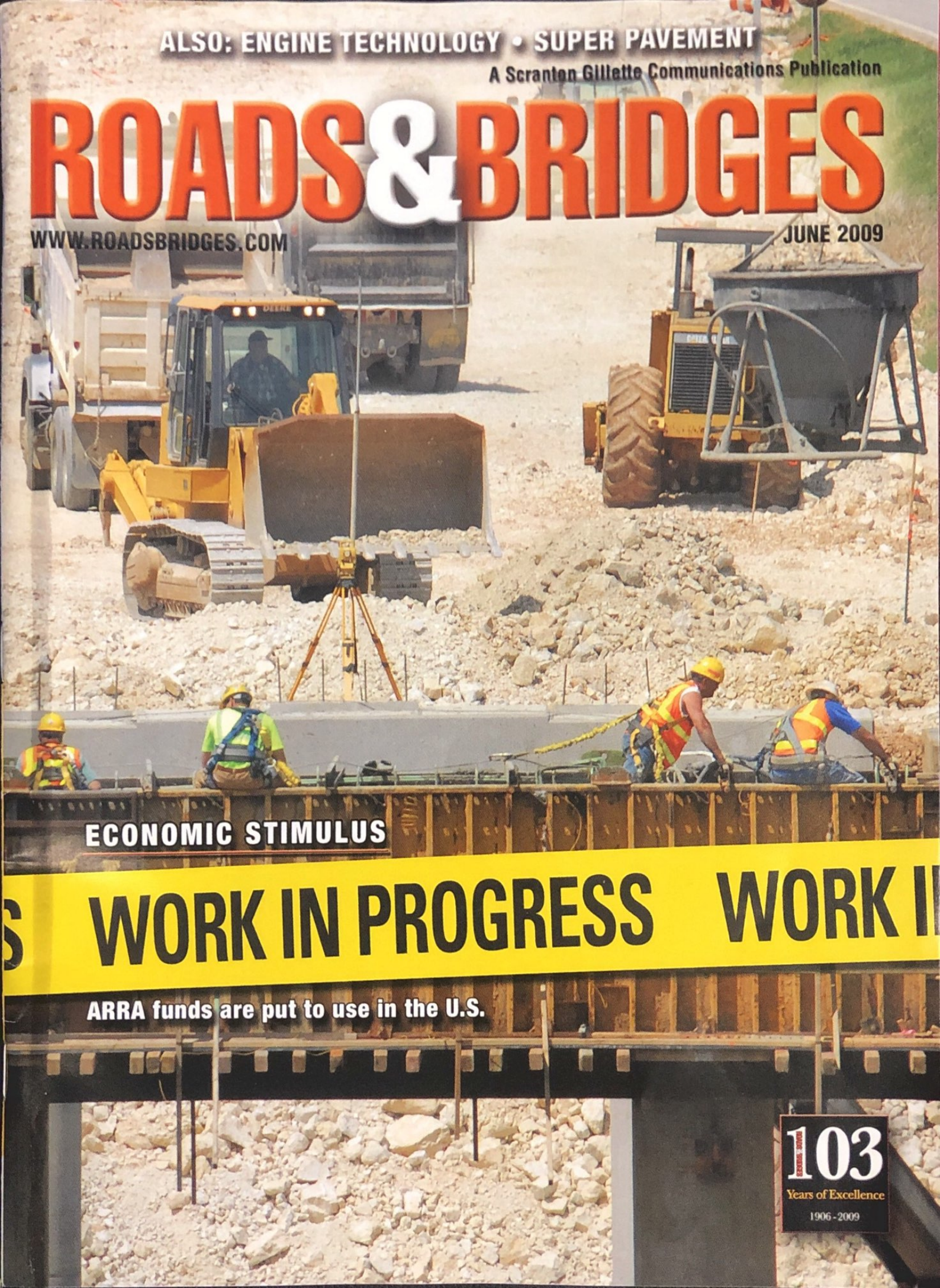
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SUPER PAVEMENT

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# TAMED TO ROAR

*Darlington Raceway is ready to take on the NASCAR heat following reconstruction*

Construction on Darlington Raceway began in 1949, and the first Southern 500 was held Labor Day weekend in 1950.

Instead of a true oval, the 1.366-mile-long track is egg-shaped, with the west end of the track, now Turns 3 and 4, narrowed, so as not to disturb a nearby minnow pond. The four turns have a maximum banking between 23° and 25°. The different turn radii contribute, in part, to Darlington's moniker, "Too Tough to Tame."

By 2007, the track was showing its age. The fines had worn from the surface, leaving projecting granite coarse aggregate "nubs" that were particularly hard on tires. There were numerous sealed joints and age-related cracks as well as a number of patches. The embankment had sloughed in places and showed evidence of water moving under the track. It was time for a repave.

## Talladega taking

North American Testing Co. (NATC) is the design and construction management subsidiary of the track owner, International Speedway Corp. NATC assembled basically the same team that had successfully repaved Talladega Superspeedway two years earlier. The Lane Corp. was the general contractor and supplied a paving crew experienced in racetrack paving from their Justin, Texas, division (formerly Sunmount). John Rauer led that team. Rodriguez Engineering performed mix designs and testing for Lane. The owner's representative was NATC's Director of Engineering Martin Flugger, and he was assisted by paving consultant Bob Harrington and Advanced Materials Services LLC, which provided owner's assurance testing of the asphalt.

NATC wanted to retain Darlington's character while correcting the deterioration wrought by time and the environment. The basic plan called for

milling an average of 3.5 in. and putting back two lifts of hot-mix asphalt (HMA) and the installation of concrete pit stalls. Portions of the apron and gore were overlaid with 1.5 in. of HMA, without milling.

Sounds like an easy job for an experienced team, right? Yet each racetrack, like most paving jobs, seems to have its challenges. For Darlington Raceway, that challenge was the decision to add a new tunnel through Turns 3 and 4 to the project. The two existing tunnels were small and could not serve haulers. In the end, the team found itself at the track in January 2008 with only two test strips on the ground and tire tests, and a May race looming.


**Although the average mill depth was 3.5 in., the actual depth was adjusted throughout the track to remove age-induced bumps. In the turns, a hydraulic stiff-arm, connected to a bulldozer, supported the mill.**

*Preparations*

Although the average mill depth was 3.5 in., the actual depth was adjusted throughout the track to remove age-induced bumps. The milling required extensive survey, approximately a 10-ft grid in the turns. Milling was completed with a tracked Wirtgen W 1200 F. In the turns, a hydraulic stiff-arm, connected to a bulldozer, supported the mill. Because of the banking on the turns, the mill could not load directly into trucks. Instead, a skid steer, fitted with a notched blade, grader and brooms, was used to push the millings down to the apron where they could be picked up with a front-end loader.

Cores indicated that the thickness of the existing track varied from 3.9 to 9 in. It was inevitable that variable-depth milling would transition into and out of different existing pavement layers, potentially leaving scabs or thin layers of HMA, which could be delaminated from the underlying HMA layers. To ensure the track's resistance to the lateral forces generated by a race car, these scabs needed to be removed. Although more sophisticated nondestructive evaluation techniques exist, the scabs and other delaminated areas were identified by walking the track with a length of chain and a hammer and sounding the pavement for hollow spots. Delaminated areas were delineated, removed and patched.

Proper drainage is always a concern with pavements, but particularly with banked ovals. Additional underdrains were installed at the break-in slope between the track and apron to complement the existing underdrain system at the edge of the pavement. Filter-wrapped pipe was placed in clean stone wrapped with geotextile. Porous concrete was used to fill a portion of the trench to provide additional stability while allowing any water moving through the old asphalt layers to be intercepted. Previously, measures had been taken to direct surface water away from the back of the crash wall at the top of the embankment.

*Materials*

Two asphalt mixes were specified for the project: a ½-in. nominal maximum aggregate size (NMAS) generally complying with South Carolina Department of Transportation's (SCDOT) requirements for a Type A surface course and a ⅜-in. NMAS SCDOT Type CM surface course. The leveling-course mix also was used as a base course for the reconstruction of the pavement over the tunnel. The design requirements of both mixes were modified for racetrack use. Both mixes were designed using the Marshall method, with 75 blows per face. The design air voids for the Type CM mix were lowered to 3.5%.

Both dense-graded mixes consisted of 100% crushed-granite aggregate. The granite coarse aggregate had an LA Abrasion loss of 44% and a microdeval loss of 7.9%. One-percent hydrated lime was added as an antistripping agent.

Modern racetracks use heavily modified binders to prevent the hot, sticky racecar tires from raveling the aggregate from the surface of the pavement. A PG 82-22 with a softening point (AASHTO T53) greater than or equal to 180°F was specified for both mixes. An elastic recovery requirement was included to help ensure the use of an elastic polymer (SBS). The binder was produced by Marathon Petroleum Co. and shipped from their Knoxville, Tenn., terminal.

*Paving*

For a racetrack, like any pavement, it is desirable to minimize both the longitudinal and transverse paving joints. Road courses are often paved in echelon to virtually eliminate the longitudinal joint. Echelon paving is generally not possible on steeper banked ovals because they need spe-

Here a surface heater is used to dry the pavement and break tack. Lane combined an old truck and a number of infrared heaters to do the job.

Each racetrack has its challenges. For Darlington Raceway, that challenge was the decision to add a new tunnel through Turns 3 and 4 to the project.

cial equipment to support the paver and rollers.

Darlington's front and back straights are 90 ft wide; Turns 1 and 2 are 79 ft wide; and Turns 3 and 4 are 62 ft wide. Although Lane Construction had previously used their Ingersoll Rand Titan ABG-525 paver to pave widths in excess of 20 ft on tracks in order to minimize joints, at Darlington things were different. The track had previously been paved in eight passes with a slight change in the degree of banking between each pass in the turns. In order to put back the character of the existing pavement, Lane too needed to pave in eight passes.

The track was paved from the top down, placing the unconfined edge of the longitudinal joint on the downhill side. The unconfined edges were cut back using a cutting wheel mounted on a motor grader while the pavement was still plastic. The cut edge was coated with a rubberized asphalt joint sealant prior to placing the adjacent lane. Although good longitudinal joints can be produced with good paving and rolling practices, the team thought the labor-intensive joint cutting procedure was necessary on a banked oval.

For shorter tracks, such as Darlington, each pass is typically paved as a continuous lap, resulting in a single transverse joint. To meet the project schedule, especially considering the fickle winter weather, several sections—pit road, two-thirds of the front and back stretches and Turns 1 and 2—were paved first, while the tunnel and new embankment were completed. This procedure resulted in two transverse joints in each pass to test Lane's skill.

Many contractors have never been exposed to PG 82-22. If asked which months they wanted to pave with PG 82-22, the ones who were experienced certainly would not include January and February, even in South Carolina. The high temperature in Darlington averages 56 and 61°F, and the low temperature averaged 35 and 37°F in January and February, respectively. Problems with the low temperatures included drying the pavement after rain, getting the tack to break and achieving a uniform texture and good density.

Lane's Danny James is experienced at developing equipment solutions for difficult situations. At Darlington, Lane combined an old truck and a number of infrared heaters to help dry the pavement when it was wet and, more importantly, to help break the CRS-1H tack. A good tack application is important on a racetrack to prevent the pavement from sliding under the lateral loads imposed by a racecar.

Warm-mix asphalt technology was used to improve workability and facilitate compaction. Marathon added 1% Sasobit to the PG 82-22 binder. Paving generally began in late morning to allow the pavement to warm up after the overnight lows and was often finished after dark, under the track's lights. Lane set up a small drum plant on-site, which mini-

mized the haul distance. Tandem end-dumps were used to haul the mix to the track. The trucks dumped into a Roadtec material transfer vehicle, which in turn fed a hopper on a crane-mounted slat conveyor and finally loaded a hopper insert on the paver. The Titan ABG-525 paver uses twin tamping bars along with a vibrating screed to precompact the mix. Precompaction aids in achieving density and reduces roll-down, which in turn improves smoothness.

Typical mix temperatures were approximately 320°F immediately behind the screed during the cooler portions of the day and closer to 280°F during the warmer portions of the day. While this temperature may not seem "warm," one must remember the paving was completed in January and February with a PG 82-22 binder. Compaction was primarily accomplished using a single Bomag 202-ADH-2 roller. A small finish roller was added on the straightaways. As temperatures warmed up (into the upper 50s) during the day, the roller pattern was adjusted or mix temperature reduced to prevent over-compaction.

In-place density was monitored with a combination of cores and nuclear density gauges. The nuclear gauges were calibrated to cores. Only gauge readings were used to measure density on the wearing surface of the track. The leveling course averaged 94%, and the surface course averaged 93.8% of theoretical maximum density with standard deviations of 1.44 and 1.49%, respectively.

## Ways ahead

Pavement smoothness is always important when racecars are traveling at speeds approaching 200 mph. The paving specification developed by NATC requires the contractor to utilize a self-propelled inertial surface analyzer to check the pavement for smoothness. The maximum allowable profile index for the surface course is 8 in. per mile, utilizing a 0.1-in. blanking band.


**Tandem end-dump trucks dumped into a Roadtec material transfer vehicle, which in turn fed a hopper on a crane-mounted slat conveyor and finally loaded a hopper insert on the Ingersoll Rand Titan ABG-525 paver.**

**The track was paved top down, placing the unconfined edge of the longitudinal joint on the downhill side. The unconfined edges were cut back using a cutting wheel mounted on a motor grader while the pavement was still plastic.**

Racetracks require a high-performance pavement. Although the axle loads are not heavy, the pavement is exposed to high lateral forces from hot, sticky racecar tires and a lot of horsepower. They are always challenging projects, requiring a great deal of skill and dedication to pave successfully—everything must be right.

NATC's Flugger remarked that "our experience from recent similar repaving projects at Talladega Superspeedway, Richmond International Raceway, Martinsville Speedway and Homestead-Miami Speedway has enabled us to develop a specific project management approach to racetrack paving, and this experience has served us well as we faced the challenges inherent in repaving Darlington Raceway. This year Darlington celebrates its 60th anniversary with the running of the Southern 500. We hope this high-performance pavement sees many more." R&B

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