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Paving the Crown Jewel

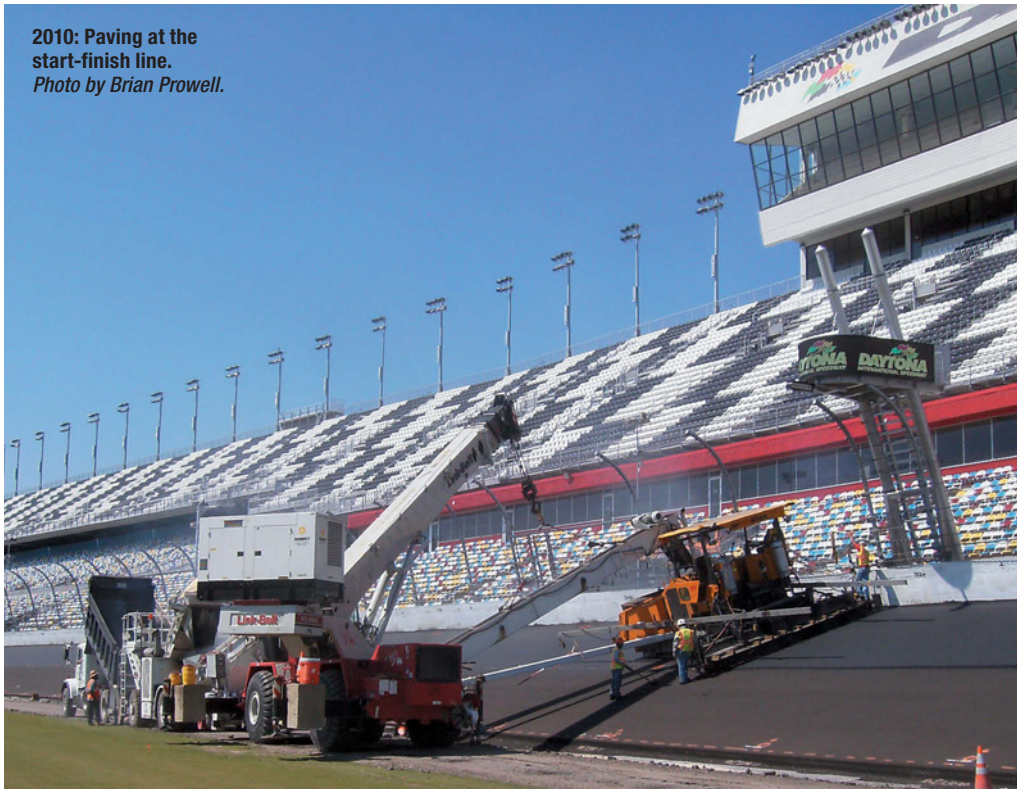
Top-down paving during hurricane season on a 31-degree slope – Daytona repaving was not your routine paving job.

By Brian Prowell, Ph.D., P.E. and Bill Braniff, P.E.

Daytona International Speedway is considered to be NASCAR's crown jewel. The Speedway is unique in racing. The legendary track is a 40-foot wide, 2.5-mile long tri-oval. The tri-oval itself is banked at 18 degrees at the start/finish line. Its 3000-foot long turns are banked at 31 degrees. To put that in perspective, for a passenger car to stay comfortably on Daytona's turns, it needs to be traveling at about 80 mph.

The Speedway was originally constructed in 1958 by Bill France, Sr., founder of NASCAR. Until 2010, the only repaving work done on the track was an overlay in 1978. Daytona's maintenance staff was diligent in crack sealing, but time had taken a toll. Much of the coarse aggregate had polished and sloughing of the embankment resulted in a progressively rougher ride. During the 2010 Daytona 500, cars bottoming out from that roughness fractured the 1978 surface in Turns 1 and 2, resulting in a well-publicized pothole.

The track had previously been slated for repaving in 2012, but International Speedway Corporation (ISC) decided to advance the repaving to 2010. The reconstruction effort included removing all of the existing asphalt down to the original limerock base and reconstructing the track to the original geometry – minus the bumps and dips.



2010: Paving at the start-finish line.
Photo by Brian Prowell.

Paving on a 31-Degree Slope

When paving a race track, conventional equipment will hold itself upright on slopes up to a banking of about 18 degrees; once the slope becomes steeper than that, the equipment needs to be supported. When the banking exceeds about 20 degrees, the paving equipment needs to be suspended from above. With Daytona's slope at 31 degrees, the grader, paver, roller, and broom all needed to be supported from above to prevent them from tumbling downhill.

Danny James, Senior Mechanical Supervisor for The Lane Construction Corp., designed hydraulic arms and cables, attached to bulldozers, to reach over the crash wall to support the equipment. A similar system was previously used by Lane at Talladega Superspeedway. Because the equipment was to be supported from above, the light poles, catch fence, and safety barriers needed to be taken down in the turns. A polyethylene barrier was placed on the existing ring road in the turns before

1958: In this photo snapped during the original construction of Daytona, a crew waits for pavement material to drop onto the surface of the track. *Photo courtesy of Asphalt Pavement Contractors Association of Florida.*

they were built up with fill, both to support the weight of the dozers and to allow the hydraulic arms to reach over the concrete crash wall.

Victory for All

"The Speedway is a venue that is known throughout the world as a place where everyone in motor sports wants to claim a victory," said Speedway President Joie Chitwood III. The same could be said for the contractors, engineers, and surveyors involved in repaving the track.

International Speedway Corporation selected The Lane Construction Corp. for the design-build contract to reconstruct the track. Led by Project Manager John Rauer, Lane had previously demonstrated their track-paving capability on four other ISC tracks, most notably Talladega Superspeedway with its 33-degree banking. Much of the equipment Lane had used at Talladega was modified and reused at Daytona.

Quite a bit of preparation is required to pave a NASCAR oval, particularly one with 31-degree banking. The first step is a thorough survey. At Daytona, a primary goal of the project was to maintain the horizontal and vertical geometry of the historic track while making the riding surface smoother.

A laser scan, supplemented with traditional surveys by Line & Grade Inc., was performed on the entire track, aprons, skid pads, and pit road. HNTB Corp., Lane's designer, took the survey data, along with the original design geometry from 1958, and created a smooth grading plan in three dimensions that replicated the original design of the Speedway.

Some tracks are paved with an existing commercial plant, but this was not an attractive option for Daytona, as Lane did not have an existing plant site close enough to support the project. Typical production rates at the project would not be high enough to fully utilize a local commercial plant. Switching back and forth between specialty racetrack and commercial or Department of Transportation mixes was not an attractive option; nor was siloing heavily modified mixes for extended periods. Lane's solution was to erect a portable parallel-flow drum plant on the backstretch parking lot for the duration of the project. Lime and storage silos were also erected. A lab was set up on site to accommodate both quality control and acceptance testing.

A Family Reunion

The plant was in place and nearly ready to go by the running of the 2010 Coke Zero 400 on July 3. The actual demolition and repaving work wouldn't start until immediately after that race, but for many of the ISC and Lane teams who gathered at the time, it was a lot like a family reunion, as they had worked together on and off since the 2003 reconstruction of Homestead-Miami Speedway.

On July 5, 2010, demolition work began. Milling machines were used on the backstretch and tri-oval to remove the old asphalt. A tracked excavator was used to remove the asphalt in the turns. Some of the existing pavement was reclaimed so that fans could have the opportunity to grab a piece of history.

Once the asphalt was removed, the Line and Grade Inc. team led by Tony Harper began setting grades. Five surveyors were kept busy throughout the project. In the turns, the survey work was conducted from man-lifts. Thirty-one degrees is hard to walk on. Carrying equipment makes it harder yet, and it's nearly impossible if there is any loose material on the surface.

The final step before paving began was fine grading. A grader and a roller, each supported by a bulldozer, were used for this part of the process.

Keeping the Water Out – in Hurricane Season

The track's embankment consists primarily of material excavated from the infield's Lake Lloyd. The old track consisted of about 5 inches (127 mm) of asphalt on about 1 foot (305 mm) of limerock base. There was evidence of significant water damage in the lower lifts of the 50-year-old asphalt. The new pavement added a 2-inch-thick (50 mm) drainage layer, designed to quickly carry any water that entered the embankment at or behind the crash wall as well as through any future cracks away from the pavement structure.

The drainage layer was based on a ½-inch (12.5 mm) nominal porous European mix. The smaller aggregate size was selected to

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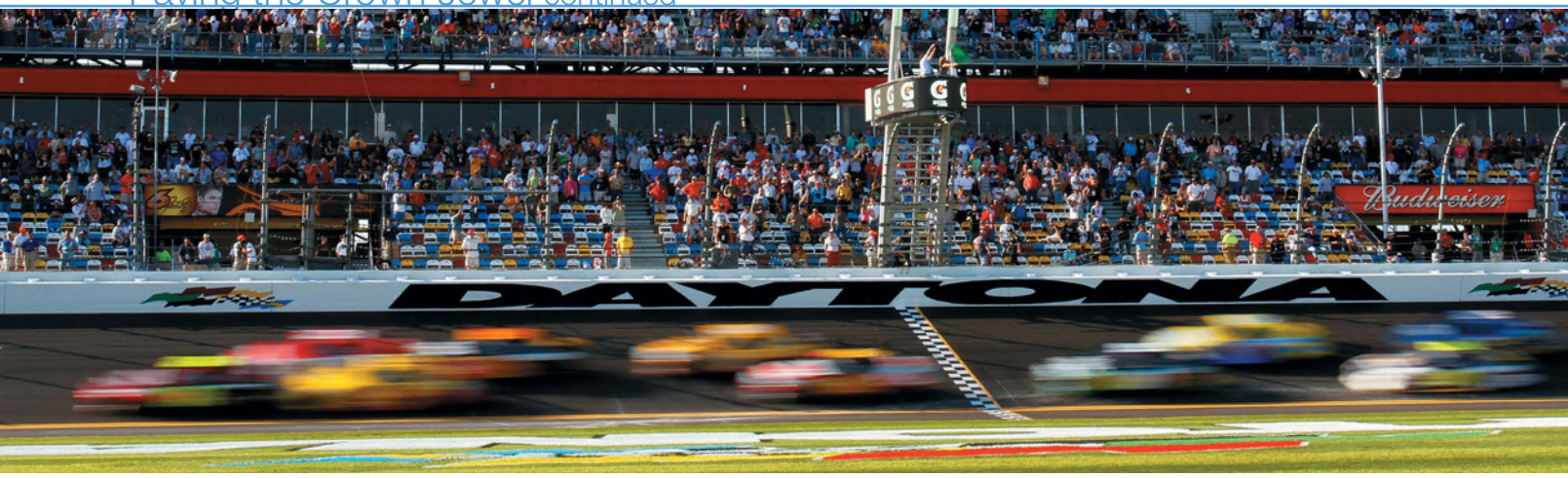

2010: The racecars are a colorful blur as they cross the start/finish line.
Photo: Getty Images

allow a thinner lift to be used as well as to increase stability. The drainage layer was tied into edge drains at the toe of the slope. The drainage layer was topped with a 2-inch-thick (51 mm) layer of ½-inch (12.5) nominal maximum aggregate size (NMAS) dense-graded base mix.

Since much of the construction took place during hurricane season, rainstorms were a concern. Until the dense-graded base mix was in place, the potential for damage from heavy rains was always present. The deadline for completion was an absolute: you can't delay the Daytona 500. All these factors led to an aggressive schedule with the dedicated crews working six- to seven-day weeks for over five months.

Two lifts of a 3/8-inch (9.5 mm) NMAS mix were placed on top of the base mix. On a racetrack, every effort is made to use the same mix for leveling and wearing. This allows the team to become familiar with the production, placement, and compaction of the mix and allows good calibrations to be developed for the nuclear density gauges used for quality control and acceptance. The wearing surface of a racetrack is designed to be durable, to resist raveling and shoving, and to provide good friction for a long period of time under punishing conditions.

Hot Tires on a Solar Panel

Raveling is the primary form of high-temperature distress on a racetrack. One issue is that one or more of the turns on an oval tend to be tilted toward the sun like a solar panel. At Daytona, this is Turn 4. The hot, sticky tires on a pack of 43 race cars have been shown to further elevate pavement temperatures. If the asphalt binder is too soft, those hot tires will pull aggregate out of the surface of the pavement. A polymer-modified binder with a high softening point was used to prevent this. The softening point of each tanker load of binder was tested for compliance before it was unloaded into the plant's tank. A mix

1950s: Watching a race from the infield.
Photo courtesy of Asphalt Pavement Contractors Association of Florida.

with a high enough asphalt content to provide good cohesion also helps to prevent raveling.

Aggregates were selected for their polish resistance and combined to produce a stable, dense-graded mix. Georgia granite was the aggregate chosen. The mix was designed to be compactable, since typically only a single roller can be supported in steep turns. For a racetrack, design air voids tend to be a little lower and in-place density targets a little higher than highways; little if any densification is expected under traffic.

One Dress Rehearsal after Another

The Lane Construction racetrack team thinks of each lift as a dress rehearsal for paving the wearing course, said Lane's John Rauer. "Our goal is to place the wearing course as a uniform thickness layer so the resulting pavement is as smooth as possible. To do so, all the grades need to be correct and any bumps or dips eliminated by the top of leveling," he explained. Spot micro-milling or shims are used as necessary as the lifts are constructed.

The asphalt was hauled from the plant in the backstretch parking lot to the paving train in tandem dump trucks. The mix was dumped into a small material transfer vehicle which does not offer any storage capability and both drops are in open air. The transfer vehicle dropped the mix into a purpose-built

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hopper attached to the front of a crane supporting a drag slat which conveyed the mix to an oversize hopper on the paver. Even in warm weather, a 30 °F (17 °C) drop in temperature was expected.

While a conventional paver may be used for runoff areas and aprons, Lane uses a paver with a dual tamping bar and a wide screed to place the asphalt on the racing surface. The tamping bars pre-compact the mix in front of the main vibratory screed. This pre-compaction provides a higher level of density than would typically be achieved behind the screed and minimizes roll-down, improving smoothness. The paver's fixed screed could easily be set to pave half the track (20 feet +) (6.1 m +) in a single pass, while providing a uniform texture.

"We are often asked why Lane paves from the top of the track down," said Rauer. "It's because the concrete crash walls on most tracks undulate to some extent. By paving from the top down with a fixed screed, you ensure that there is room for the upper pass." Depending on the pass, the paver ran single or dual skis with non-contact sensors, including sensors reading behind the screed on the new mat.

The roller was equipped with a specially built, small-diameter secondary drum to allow compaction closer to the concrete crash wall which leans in towards the track. Both static and vibratory passes were used as needed. For the upper lifts, a grader with a cutting wheel was used to cut back the longitudinal joint while the mix was still plastic. This technique removed the low-density material on the downhill side of the mat. The cut joint was coated with a rubberized joint sealant prior to placing the adjoining lane. The same material was used to seal between the asphalt and the concrete crash wall.

2010: A tracked excavator was used for demolition in the turns.
Photo by Brian Prowell.

It's the People

As much as specialized materials and equipment play a role in paving a speedway, the key element is really the people. John Rauer said, "It was the dedication, the commitment of the people on the project, everybody from Lane Construction, Line and Grade Inc., SCI, Rodriguez Engineering, Advanced Materials Services, and North American Testing Company, no matter what I threw in front of them, they came in every morning and got the job done."

The hard work and dedication paid off throughout Speedweeks 2011 at Daytona International Speedway, culminating in the Daytona 500. The 2011 edition of that fabled race tallied a record number of lead changes. HMAT

Brian Prowell, Ph.D., P.E., is a Principal Engineer for Advanced Materials Services, LLC.

Bill Braniff, P.E., is the Senior Director of Construction for North American Testing Company, a subsidiary of ISC.

2010: It takes a lot of people and a lot of iron to pave from the top down.
Photo by Brian Prowell.