VALLEY PREFERRED CYCLING CENTER—VELODROME TRACK REPAIR AND RESURFACING

BY KEITH EBERHARDT AND BRANDON KEEZER

The Valley Preferred Cycling Center in Breinigsville, PA, is home to a unique sporting arena for track cycling known as a velodrome. Presently owned by Lehigh County, the track was originally constructed in 1974. Since then, it has been a major attraction for top cycling competitors and enthusiasts from around the world. The track hosts various high-profile events, including the Junior World Championships, National Championships, World Cups, and even Olympic trials, yet remains open for use by the general public during the day throughout the cycling season.

Existing conditions of track surface showed surface deviations (waves on the surface) and discoloration

Distressed concrete area at transverse joint—notice the duct tape repairs

Velodromes generally consist of steeply-banked 180-degree circular bends connected by two, less steep, straight portions of track. Directly inside the super-elevated racing surface is a flat apron commonly known as the blue band. Inside this blue band, there is often another apron for entering and exiting the track. All tracks have standard markings including a black line, used to obtain precise length measurements, and the red and blue lines (sprinters line and stayers line, respectively), which each have significance for various types of racing. The Valley Preferred Cycling Center is unique among modern velodromes in that it is outdoors and constructed of concrete. Its 30-degree banked turns and 12.5-degree straightaways, formed of slab-on-grade concrete, combine to form a 23 ft (7 m) wide, 1093.6 ft (333.3 m) long race track.

PROBLEMS THAT PROMPTED REPAIR

After more than 30 years of use, the track had begun to show signs of its age, and riders noticed many flaws on the track's surface. These flaws included small bumps spread throughout the track surface (and dubbed "rumblestrips" by the cyclists), large bumps in various locations, as well as multiple areas of deterioration on the inner/outer perimeter joints. The track had received a new surface coating a little more than 10 years prior; however, the problems that existed on the track would require a more intensive approach to meet the cyclists' demands. According to guidelines from the Union Cycliste Internationale (International Cycling Union) (UCI), the track was way out of spec, that is, UCI specifications call for flatness within 0.16 in. in 6.6 ft (4 mm in 2 m). After receiving feedback from several cyclists, the owners recognized that the 1093.6 ft (333.3 m) track was in need of major repair and resurfacing.

INSPECTION/EVALUATION METHODS

A challenge the repair contractor faced during this process was implementing a quantifiable means of measuring the effectiveness of the procedures because the UCI spec was not attainable within the working budget. The solution was to set up a schedule with experienced riders who were very familiar with the track to perform test rides throughout the process. These riders would provide detailed feedback on what they observed around the track. This method, though subjective, proved to be a valuable means of identifying the noticeable defects. The same riders were requested for each test session, and specific details of their observations were discussed and recorded. Answers such as, "It's better," were not accepted. The repair contractor pressed for information such as "in turns one and two, there is a significant depression at the joint." The process used to identify surface delaminations was a close inspection and chain dragging of 100% of the track. This is a common method that serves to locate damaged concrete by the difference in sound that is created as the chain moves across the surface.

TEST RESULTS

The initial observations made by test riders enabled the repair contractor to clearly identify the areas of greatest concern. As work progressed, all riders stated a noticeable difference in smoothness. Throughout the process, the riders would note where deflections were still felt, allowing the repair contractor to fine-tune the surface. At completion, it was unanimously determined that the repair methods had vastly improved the feel and uniformity of the track surface.

CAUSES OF DETERIORATION

Major deflections in the track surface located at expansion joints were attributed to slab curling, caused by differential shrinkage throughout the slab. The minor deflections present over much of the track surface were the result of various causes, such as reflective cracking of the slab—causing coating failure—and finishing techniques applied during the structure's original construction. Delaminations to the track surface near the inner and outer perimeters were caused by an insufficient joint width to allow for thermal expansion of the slab.

REPAIR SYSTEM SELECTION

The repair contractor worked closely with the client, engineer, and subcontractors to develop a solution—within budget—that would restore integrity to the velodrome. This was accomplished by alleviating the perceptible defects felt on the track's surface, providing a new overlay system to the track and resurfacing the inner asphalt apron. When combined, these approaches improve both performance and appearance, while eliminating safety hazards. In addition, repairs would protect the track and give it greater longevity for future use.

Multiple options were considered for the smoothing process. Hydrodemolition and replacement of up to 2 in. (50 mm) of concrete over the entire surface was presented as a possible method; however, this would have been cost prohibitive for the client. Surface grinding proved to be the most effective method to address the deviations, while providing the flexibility to be applied in increments at any location of the track.

Spalled edges at inside perimeter joint where sloped track meets the interior apron

Multiple options were also provided for the new coating system that was to be applied to 100% of the track. To provide adequate protection, the track required a system that offers excellent abrasion resistance and would reduce harmful chloride and moisture penetration. These characteristics were achieved with a polymer-modified cementitious material that has an increased density over that of a typical deck coating. The system also needed to provide sufficient bond strength to the existing substrate. This was accomplished by creating a substrate surface profile by means of abrasive blasting. In addition, the system needed to be placed with a very smooth finish to reduce friction and yield faster race times. With these criteria in mind, the team narrowed the choices down to three product systems. With all systems displaying comparable performance characteristics, the client was able to make the final selection based on color and texture. The coating system selected contained a leveling mortar and cementitious coating.

SITE PREPARATION, DEMOLITION METHOD, AND REPAIR PROCESS EXECUTION

The team began the repair process by addressing the isolated major deflections and the overall smoothness. This was accomplished by using a planetary floor grinder equipped with diamond grinding stones. To perform work on the incline, a support system had to be built. This consisted of a heavy-duty winch that connected the machine to a sliding track, which was then affixed to the outer wall stanchions. To eliminate the handful of major bumps on the track, up to 0.75 in. (19 mm) of concrete had to be removed by grinding. As for the remainder of the track, the client chose to focus efforts on the inner 9 ft (2.7 m) of the surface (from the blue line down). This decision was made to obtain the greatest value from the work while staying within budget, as the lower portion of the track is where the majority of the competitive cycling takes place. In addition, grinding was performed along all transverse construction joints and miscellaneous deflections that were observed above the blue line. Typical concrete repairs to distressed areas were also completed. Once the grinding and repair processes were complete, crews resurfaced the track using multiple coats of the selected polymer-modified portland cement material. Next, all joints across the track surface and the top and bottom perimeters were sealed with a traffic grade sealant. Finally, new racing and time trial lines were painted and the existing 8 ft (2.4 m) wide asphalt apron was milled and resurfaced with a road super-pave mixture.

Abrasive blasting was performed on the track surface in preparation for the application of the new coating. This created a clean, open-pored surface to ensure a good bond between the coating and the existing substrate. A ride-on shotblasting machine was used for the straight portions of the track; however, the steeply banked turns would not allow for safe operation of this equipment. The remainder of the surface preparation was done by sandblasting, which is a much more tedious process, but yields the same end result.

APPLICATION METHOD SELECTION

The coating phase of the project consisted of applying a two-part system that would act as the final racing surface. To begin, a protective leveling mortar was troweled over areas with minor deviations that were not addressed by the grinding. Next, a cementitious coating with a viscosity similar to a thick paint was applied as a top coat to the entire track surface. Testing was conducted to determine the most effective application method for the top coat. Spraying was ruled out due to difficulties caused by material consistency, and squeegees were ruled out due to the inclined surface. The best solution was to apply the material with rollers in multiple coats and in a cross-hatch pattern to give the track surface a very smooth and uniform finish. The entire coating application was performed at night under the track lights to avoid rapid drying caused by the sun, which could have caused crazing in the thin overlay. Additionally, surface temperatures had to be closely monitored to avoid placing material below the recommended temperature.

CHALLENGING CONDITIONS

Because work had to be completed during the off-season months, the weather presented a challenge on this project. The outdoor, uncovered track made this even more difficult. To apply the coating, the substrate temperature had to remain above 45°F (7.2°C) and not receive rain for at least 24 hours after application of the cementitious materials. For obvious reasons, these conditions can be very tricky to predict in this region between the months of October and April, so precise planning was required. Further complicating this constraint was that all cementitious materials had to be installed at night to prevent rapid curing and color challenges.

Grinding operation—planetary floor grinder operated on a 30-degree slope, while supported by a custom winch and safety cable assembly

Installation of traffic grade sealant for repair of a transverse joint

Application of topcoat (by rollers) over entire track surface. Application performed at night under track lights to avoid rapid drying due to the sun, which could have caused crazing in the thin overlay

Repaired inside perimeter joint

Completed track repair and resurfacing

In addition, crews had to work on an incline of 30 degrees on the turns, and 12.5 degrees on the straightaways. This incline of the track caused many shadows, which made application of the materials challenging. To ensure a safe work environment, specific procedures were implemented regarding the slope, along with a daily discussion of the associated hazards during the Job Safety Analysis (JSA) meeting. The repair team also had challenges keeping the public off the track to allow the cementitious materials to cure.

A truly one-of-a-kind project, this was the first full-scale concrete substrate and surface repair performed on a velodrome that the project team was aware of having ever been completed. Completed in time for the 2008 cycling season, the track reopened in May after working through the winter weather due to the October start date. The owner was extremely pleased with the results. The project team and community felt that the project was a total success. The riders that were involved expressed much excitement about the restored surface, stating that track records were expected to fall as a result of the improvements. In addition, the project's progress and results were being followed by the media as well as other velodrome owners. The repair contractor has been contacted about future repair projects. The end result for the team and company was not only a successful, safe, and profitable project, but an expansion to its capabilities and capacity to take on other new and unique challenges in the future.

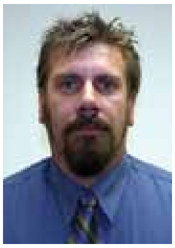
Valley Preferred Cycling Center

OWNER
County of Lehigh
Allentown, PA

PROJECT ENGINEER
Alfred Benesch & Company
Allentown, PA

REPAIR CONTRACTOR
Structural Preservation Systems
Elkridge, MD

MATERIAL SUPPLIER
Sika Corporation
Lyndhurst, NJ



Keith Eberhardt *is Branch Manager of the Baltimore, MD, branch of Structural Preservation Systems. He has 20-plus years of industry experience and has been involved in several significant projects, such as the Alfred P. Murrah Plaza Bombing Memorial Restoration Project in Oklahoma, the New Jersey Performing Arts Center, restoration work on the Chesapeake Bay and Francis Scott Key Bridges in Maryland, and the Calvert Cliffs Nuclear Power Plant Concrete Repair and Cathodic Protection Project, also in Maryland. Eberhardt received his BS in civil engineering from the Illinois Institute of Technology. He can be reached at (410) 796-5000 or at keberhardt@structural.net.*

Brandon Keezer *has recently completed the Project Engineer Program at the Baltimore Branch of Structural Preservation Systems. He has worked on various significant projects such as The U.S. Census Bureau in Washington DC; the FDIC Building in Arlington, VA; Maryland's Chesapeake Bay Bridge; and the Naval Academy's Ward Hall, also in Maryland. Keezer received his BS in civil and environmental engineering from The University of Michigan. He can be reached at (410) 796-5000 or at bkeezer@structural.net.*