Technology Transfer News
New York State Department of Transportation
Astrid C. Glynn, Commissioner

REPAIR OF FRP BRIDGE DECKS

Fiber Reinforced Polymer (FRP) bridge decks are one possible alternative to conventional reinforced concrete decks. FRP materials are engineerable materials and hence, the deck designs and configurations vary significantly. This fact, combined with relatively less experience with them, means a standard repair method for possible damage in-service is hard to establish. There are also very few documented in-service problems/damages and associated repair methods.

The bridge on South Broad Street over Dyke Creek in Wellsville, NY was built in 1974 as a steel multi-girder with an open grate deck. The open grate deck was replaced in 2000 with an 8” thick honeycombed FRP deck. The FRP deck was originally surfaced with an acrylic modified cementitious overlay, but was later replaced with an asphalt overlay due to cracking and delaminations of the overlay (see Figure 1).

The 2004 bridge inspection revealed two large delaminated areas, one in each span. An attempt was made to pump resin into the deck at affected areas by drilling holes in the top skin, but this was not successful. In 2006, a research project was initiated to design a viable and structurally sound repair method, using materials compatible with the surrounding deck material to extend the life of the FRP deck, that could also be used for future FRP bridge decks of similar design and configuration. The repair method was developed working with “An-Cor”, a company located in North Tonawanda, NY.

The asphalt overlay, the top skin, and the wet cells in the proximity of the two delaminated areas were removed leaving the bottom skin intact. Two plies made of alternating layers of the fiberglass mat and a resin and catalyst mixture were placed on the intact bottom skin. An-Cor’s pre-fabricated cells (See Figure 2) were set into place on a layer of pouring thix, composed of milled fiberglass and a resin/catalyst mixture. The cells were then grouted into place. Expandable foam was placed into each of the cells leaving approximately ¾” gap at the top of each cell. Grout and pouring thix was placed on top of the foam to fill the remaining space. After everything cooled and dried,
Additional plies of the fiberglass mats and the resin/catalyst mixture were placed on top of the cells. Once the repair of the deck was complete, hot patch was applied for the wearing surface.

Some of the challenges associated with the repair included: 1. Protecting the patch area during and after the repair to avoid moisture/water intrusion and making sure that the vehicles on the bridge did not drive over the repair area causing harm to the vehicles and/or the bridge. A steel plate was used to cover the repair area and sealed with a perimeter of cold patch, it was found that this posed a risk if the plate moved due to vehicle pounding. 2. The repair could only be completed in temperatures above 40°F, while temperatures too high may need prolonged cooling time for the resin to accommodate exothermic reaction. 3. The repair also could not take place during any type of precipitation to avoid moisture trapping in the deck. 4. If all of the wet cells are not removed, this can result in further cracking and delaminations due to additional freeze and thaw cycles after the repair.

The inspections conducted in 2007 showed that the bridge deck and wearing surface of the two repair sites completed in 2006 appear to be working well. For more information, contact Stacey Forenz (saforenz@dot.state.ny.us) or Dr. Sreenivas Alampalli (salampalli@dot.state.ny.us)

NEW FULL DEPTH PRECAST CONCRETE PAVEMENT SLAB SYSTEM IN NYS

Roman Stone Construction Company located at 85 South 4th St. in Bayshore, NY has developed a full depth concrete road surface repair system that was added to the NYS Approved List under Standard Specifications §704-15 “Precast Concrete Pavement Slab Systems” (PCCPS). The precast paving panel system marks the second company that will appear on the Department's Approved List. The first was the Fort Miller Company of Schuylerville, NY. On October 29, 2008, Roman Stone Construction Company conducted a trial installation in their yard of the new concrete road repair system. The trial installation was performed as if it was being done on a highway. The purpose of the demonstration was to gain approval for the method under the requirements of §704-15 “Precast Concrete Pavement Slab Systems” (PCCPS). This standard specification first appeared under Engineering Instructions 05-041, EI 05-042, and EI 05-043.

Depending on the customers' need, Roman Stone will offer two types of repair slabs. Roman Stone can provide precast slabs that have eight dowel bar slots cast into each end of the slab along the transverse joint. These slots will be located in the wheel path and be centered on 12 inch spacing. Once the slabs are placed and final elevation is achieved, the contractor will place dowel bars into the slots and use one of the approved hardware backfill materials to fill the slot prior to opening to traffic. Roman Stone can also supply a precast slab that has no dowel bar slots cast into it. In this case the slab is jacked into place and once final elevation is achieved, the contractor does a dowel bar retrofit following the provisions of Special Specification 18502.7001 -Retrofit Dowels in PCC Pavement.

Precast Concrete Pavement Slab Systems are finding increased use in high traffic areas where the Department wants to limit the amount of downtime and inconvenience to the traveling public. With the volume of traffic on the roads around metropolitan areas increasing every year, the amount of closure time of important roadways is becoming shorter and shorter. An advantage of using a precast panel to repair the road surface is that the concrete can be manufactured in the controlled conditions of a precast plant as opposed to pouring rapid set concrete out on the roadway where the finished product may have variable results due to the weather conditions, variability in workmanship and quality of materials. The rigorous controls adhered to by NYSDOT's QC/QA program insures that quality standards are met for the precast products produced by Roman Stone.

But how can you match the grade of the existing road surface? The answer that Roman Stone has come up with is to build a slightly thinner slab than the original roadway then placing the slab in the excavated roadway and
then raising it and leveling it by injecting polyurethane foam through the slab. This accomplishes several things; it is now possible to match the existing road profile and the polyurethane “fixes” any problems to the sub base that caused the road to fail in the first place.

Roman Stone had to submit Fabricator Standard Drawings that included all of the details of fabrication of the slabs and installation of the slabs. They ended up with a page one for the fabrication guidelines and a page two with the installation instructions. Page one is used for inspection purposes in the precast plant to insure that the material requirements are met. The second page is an installation manual that the EIC on the job and the contractor can follow to ensure that the installation is conducted properly in the field. Page two details what kind of equipment is needed by the contractor, who is responsible for doing what and how items are going to be paid for. All of this is necessary in order to ensure that the installation goes smoothly.

The trial took place under the watchful eyes of three of NYSDOT’s pavement engineers, Michael Brinkman, Julian Bendaña and Bill Cuerdon. First Roman Stone had to demonstrate how the slabs are brought to the job site and unloaded and put into the excavated hole. It was learned that it is very important to have the proper lifting devices and that the slab must be completely level otherwise it becomes very difficult to get the slab in the hole. The slabs were fitted utilizing plastic shims to maintain the required 1/4”– 3/8” spacing. The 8” thick slabs were 1” thinner than the existing pavement so they sat 1” below the grade.

After the slabs were installed, a truck containing the polyurethane slab jacking material moved into place and the crew began injecting the material through the 5/8” diameter injection ports. The height of the slab is controlled by the amount of foam injected. As the foam is injected it spreads out under the slab in a 4 foot radius. The foam completely seals the subbase as it spreads. The foam can be seen coming up through the joints in places which is evidence that it has traveled underneath the entire slab. Any material that comes up on the surface is allowed to harden and then it is shoveled off flush to the surface. Once the slab is brought up to level with the existing pavement, the road can sustain traffic on a temporary basis until the dowel bar retrofit can be accomplished. The foam cures completely in 15 minutes so by the time the Maintenance and Protection of Traffic is removed, the surface is ready to drive on. One advantage of this method is that the foam can be installed even if it is raining. This is because the foam is hydro-insensitive, meaning that it is unaffected by water. The foam can also be installed in temperatures where the sub base is above 32 degrees although it might take a little longer to harden. These two factors allow a greater period of the year for contractors to work and get the roads repaired in comparison to rapid set concrete.

Load transfer devices need to be installed next but they do not necessarily have to be installed immediately. So any time the weather is conducive, the next step would be to install dowel bars and tie bars as needed. The State’s dowel bar retrofit method 8502.70001 is utilized to accomplish this.

The use of a precast slab to achieve a repair on a roadway is still a developing technology. Contractors will
no doubt have some good ideas and be able to develop their own installation methods that will make it easier and faster to install. While the use of a precast slab is not the fix for all applications, it will become a useful tool in the tool box where situations warrant a long-lasting repair under extreme traffic conditions.

If you have any questions on the use of precast concrete pavement please contact Julian Bendaña at jbendana@dot.state.ny.us or Michael Brinkman at mbrinkman@dot.state.ny.us or Bill Cuerdon at bcuerdon@dot.state.ny.us.

NYSDOT TO TEST NEW ITS TRAILER AS A DEPARTMENT-WIDE RESOURCE

The Office of Modal Safety and Security (OMSS), with support from Research and Development, procured a trailer unit with a mobile video system which will be available on a Department-wide basis for various transportation and traffic monitoring applications. The ITS trailer, obtained from Trichord, Inc. in the fall of 2008, is equipped with a digital video camera, recorder (DVR) and an acoustic sensor for vehicle detection. The system stores video images and can be accessed in real time via the internet.

The original intent of this effort was to acquire a system to allow for multiple days of surveillance video data collection to visualize and quantify the activities and conditions of a given site. This new ITS apparatus can be used for a myriad of applications within many different areas of NYSDOT, including observation of driver behavior at railroad grade crossings, roundabouts, etc. or the assessment of night-time utilization of commercial vehicle parking at rest areas.

Due to the small footprint and low weight of the system, the portable platform is capable of being transported via a NYSDOT vehicle and deployed for optimum stability at sites with dimension limitations. Ease of installation/deployment was a major consideration/requirement in procuring this equipment. The trailer is equipped with outriggers for stability and to ensure levelness. The mast arm is raised and lowered using a simple pump jack. As such, this new platform can be deployed rapidly with minimal set-up skill/expertise required by the user. Once the trailer is deployed on site, the video feed and the collected real-time highway data can be retrieved/accessed remotely utilizing equipment-specific software via a web interface.

Power for the ITS equipment is provided through two options. The primary power supply for the trailer is the solar system which consists of batteries and two solar arrays. If an outlet is in close proximity, the system can be plugged in
and the batteries charged as a secondary or back-up option.

The camera, a Cohu Model 3960 Series i-view, is fixed to an adjustable mast that can be extended up to 30 feet for proper camera angles, is robust and capable of operating under extreme weather conditions during both day and night settings. The camera can provide video feeds and, most significantly, has remote pan, tilt and zoom capabilities. This allows the user to monitor the output and change views if necessary without going to the site.

A mobile digital video recorder (DVR) is integrated into the system which allows for on-site storage. The DVR uses a compact flash drive that makes recording and transfer of video much more efficient. Based on testing, the frames per minute were adjusted to allow for a week’s worth of continuous video to be recorded.

The system is also equipped with a SmarTek Acoustic Sensor Version 1 (SAS-1). This passive sensor allows for the collection of high level data; volume and average speed of multiple lanes. The SAS-1 is used by the Highway Data Service’s Traffic Monitoring Group which uses them as a non-intrusive solution in situations where temporary data collection is needed and personal safety is an issue when trying to install tubes for short counts.

For more information, please contact Brian Galvin, 518-485-8928 or Chris Scharl, 518-457-5212