Boosting Pavement Resilience in a Changing Climate
A Concrete Pavement Industry Perspective

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Carolinas Concrete Paving Association

Southern Plains Transportation Center
December 16 2020
Webinar
1. The Need for Resilient Pavements
   a) Current knowledge, gaps and trends?

2. Defining Resiliency

3. Improving a Pavement’s Resiliency
2020
A Very Busy, Record-Breaking Year

- Most Active (30) and 7th costliest, nearly $47B in estimated damages
  - 5th Consecutive year above average activity
  - 12 Storms made landfall in the US
The Future of Transportation and the Role of Concrete Pavements

- Blue-Ribbon Panel of 25 Experts
  - Convened in Sept 2017
  - Diverse group (DOT, FHWA, Consultants, Industry)

- What will transportation look like in 2040?
  - Role of Concrete and Cement Based Solutions?
  - Agencies’ needs for pavement solutions?
    - Pavement Adaptability
    - Capitalize on Current Assets
    - Responsible Stewardship of Resources
    - Safety Goals
    - Instilling Competition
    - Solidified the Need for Resilience
NORTH CAROLINA HAS BEEN HIT BY TWO 500 YEAR FLOOD EVENTS

With Hurricane Florence, NC had over 2500 road closures
HOUSTON (TX) AREA HAS BEEN HIT BY SEVERAL FLOOD EVENTS IN RECENT YEARS – THE WORST WAS HURRICANE HARVEY
EXTREME FLOOD EVENTS ARE INCREASING IN BOTH FREQUENCY AND MAGNITUDE

Source: https://www.epa.gov/climate-indicators
FUTURE CLIMATE CONDITIONS WILL NOT RESEMBLE THE PAST

U.S. severe storms, heavy precipitation events:  
Greater intensity and frequency  
Continued increases expected

Global mean sea level:  
7–8 inches higher since 1900 - about half since 1993  
Expected to rise by 1–4 feet by 2100

Increased Extreme heat events and drought:  
Increased incidence of large forest fires
SEA LEVEL RISE IS ALREADY IMPACTING COASTAL ZONES

Sunny sky flooding is becoming a common or daily occurrence

SR54 East of Fenwick, DE

South Bowers Beach, DE

Charleston, SC

Miami, FL

DE Photos courtesy of Jim Pappas, DELDOT
FL Photos courtesy of Amy Wedel, FC&PA.
FLOODING IN THE PLAIN STATES WAS SEVERE THIS PAST YEAR
Flooding is NOT only a Coastal Issue

Nebraska DOT reported 1,500 road miles were closed

Iowa I-69 Impacts
The Need for Pavement Resiliency
GOOD resources can be found...

Articles & New Polling

How Severe Weather Damages our Roadways  (August 2019)
Extreme Weather and Climate Adaptation  (June 2019)
Federally Funded Infrastructure Must Be Flood Ready
Public Roads - Boosting Pavement Resilience  (Autumn 2018)
Texas Roadways Proven Resilient After Hurricane Flooding
PEW Charitable Trusts Flood Infrastructure Survey  (Feb 2020)

Reports and Publications

LTPP Tech Brief - Impact of Environmental Factors on Pavement Performance  (Dec 2016)
FHWA - Climate Change Adaptation For Pavements  (August 2015)
# Pavement Resiliency

**FHWA – Climate Change Adaptation for Pavements**

## Climate Change Adaptation for Pavements

### Table 1a. Climate change adaptation and pavement design–temperature items (adapted from Meyer et al. 2014).

<table>
<thead>
<tr>
<th>Climate Change Impact</th>
<th>Affected Components and Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flexible Pavement</strong></td>
<td><strong>Increased maximum pavement temperature increases the potential for rutting and shoving, requiring more rut resistant asphalt mixtures</strong></td>
</tr>
<tr>
<td></td>
<td>- May require raising high-temperature asphalt binder grade and/or increasing the use of binder polymerization and/or improved aggregate structure in asphalt mixes</td>
</tr>
<tr>
<td></td>
<td>- Increased use of rut resistant designs including thin, rut resistant surfaces</td>
</tr>
<tr>
<td><strong>Rigid Pavement</strong></td>
<td><strong>Increased potential for concrete temperature-related curling (and associated stresses) and moisture warping</strong></td>
</tr>
<tr>
<td></td>
<td>- Greater consideration of concrete coefficient of thermal expansion and drying shrinkage</td>
</tr>
<tr>
<td></td>
<td>- Incorporation of design elements to reduce damage from thermal effects including shorter joint spacing, thicker slabs, less rigid support, and enhanced load transfer</td>
</tr>
</tbody>
</table>

In addition to strategies listed above:

- Higher extreme temperature may impact construction scheduling, requiring work to more often be conducted at night  
- If accompanied by drought, increased potential for subgrade shrinkage  

### Higher Average Temperatures

- **Flexible Pavement**
  - Increased risk of concrete pavement “blow ups” due to excessive slab expansion  
  - Use shorter joint spacing in new design  
  - Keep joints clean and in extreme cases, install expansion joints in existing pavements  

- **Rigid Pavement**
  - Increased potential for asphalt rutting and shoving during extreme heat waves  
  - See strategies above, but recognizing that the historical basis for selecting binder grades may no longer be valid  

### Higher Extreme Maximum Temperature
### Pavement Resiliency

**FHWA – Climate Change Adaptation for Pavements**

#### Table 1b. Climate change adaptation and pavement design–precipitation items (adapted from Meyer et al. 2014), (continued)

<table>
<thead>
<tr>
<th>Climate Change Impact</th>
<th>Affected Components and Strategies</th>
</tr>
</thead>
</table>
| *More Extreme Rainfall Events* | • Increased need for surface friction meaning potentially more focus on surface texture and maintaining adequate skid resistance  
  - Maintain positive cross slope to facilitate flow of water from surface  
  - Increase resistance to rutting  
  - Reduce splashing/spray through porous surface mixtures | |
| | • Increased need for surface drainage to prevent flooding  
  - Increase ditch and culvert capacity  
  - More frequent use of elevated pavement section | |
| | • Increased need for functioning subdrainage  
  - Ensure adequacy of design, installation, and maintenance of subdrainage | |
| | • Need to improve visibility and pavement marking demarcation | |
| | • High levels of precipitation may threaten embankment stability  
  - Reduction in structural capacity of unbound bases and subgrade when pavements are submerged  
  - Develop a better understanding of how submergence affects pavement layer structural capacity and strategies to address it | |
| *Higher Average Annual Precipitation* | • Reduction in pavement structural capacity due to increased levels of saturation  
  - Reduce moisture susceptibility of unbound base/subgrade materials through stabilization  
  - Ensure resistance to moisture susceptibility of asphalt mixes | |
| | • Improved surface and subsurface pavement drainage  
  - Use strategies mentioned previously  
  - Will likely negatively impact construction scheduling  
  - Investigate construction processes that are less susceptible to weather-related delays | |

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**Nov 2020 rainfall I-95 damage**

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## TOP ISSUES of Concern
- Q1 Poll following 1st Break-out

1. Inundation due to flooding
2. Erosion/washouts/scour
3. Sea-level rise related issues
4. Temperature impacts on pavement materials and pavement design process.
5. Repeated occurrence of extreme events at the same location.

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## Most Pressing PAVEMENT Issues
- Q2 Poll following 2nd Break-out

1. Pavement designs that take flooding concerns into account
2. Making existing pavements more resilient (primarily due to inundation)
3. Pavement-ME calibration for forward-looking climate-related inputs
4. Planning for and rapidly responding to extreme events to maintain and restore operations
5. Uncertainty about structural integrity of base layers.

**Source:** FHWA Pavement Resiliency Peer Exchange
1. Better/simpler models amenable to pavement design to help account for vulnerability and predict impacts
2. (TIE) Rapid evaluation/assessment criteria for pavement damage after extreme event occurs
3. Quantify spending needed to achieve a certain level of resilience and develop performance metrics and thresholds of resilience for pavements
4. Incorporating climate vulnerability issues into asset management process
5. (TIE) National top-down effort to make resiliency a priority.

Source: FHWA Pavement Resiliency Peer Exchange
FLOODING IS THE PRIMARY CLIMATE RISK TO INFRASTRUCTURE
Risk can occur as both sudden shocks & long-term recurring chronic pressures

<table>
<thead>
<tr>
<th>Transportation Asset</th>
<th>Sea-level rise &amp; tidal floods</th>
<th>Riverine &amp; pluvial flooding</th>
<th>Hurricanes, typhoons &amp; storms</th>
<th>Tornadoes &amp; wind events</th>
<th>Drought</th>
<th>Heat (air &amp; water)</th>
<th>Wildfires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airports</td>
<td></td>
<td></td>
<td>Black</td>
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<td>Roads</td>
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<td>Blue</td>
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<tr>
<td>River</td>
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<td>Seaports</td>
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</tbody>
</table>

Climate risk increases operating costs & exacerbates the infrastructure funding gap
Boosting Pavement Resiliency in a Changing Climate

a) The Need for Resilient Pavements

b) Defining Resiliency
   a) An academic and scientific approach relating to pavements

c) Improving a Pavement’s Flood Resiliency
INTRODUCTION TO RESILIENCE

The ability to … anticipate, prepare for, and adapt … withstand, respond to, and recover rapidly…¹

Resilience with respect to an event (eg. Flooding, fire, earthquake, etc.) is characterized by two parameters:

1. Drop in performance, induced by the event (eg. reduced ability to carry load).
2. Recovery time to reinstate or improve performance.

Green is more resilient than Red
• Faster recovery time
• Higher level of service

Blue is a hardened ² system as it has a higher final performance level

¹ FHWA Order 5520: Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events
² Hardening Infrastructure – Elevating, upgrading, relocating assets, flood walls, berms and levees, etc.
FUNDAMENTALS TO CREATING RESILIENT SYSTEMS
Prevention, Protection & Mitigation Strategies have Benefit / Cost Ratios range from 2:1 to 9:1

Hierarchy to Resilient Systems

1. Prevention: stop a … manmade or natural disasters
2. Protection: secure against … manmade or natural disasters
3. Mitigation: reduce …. by lessening the impact of disasters
4. Response: … meet basic human needs after an incident
5. Recovery: … assist communities affected by an incident to recover effectively

Developing a resilient pavements / roadway infrastructure requires an understanding the risk and damaged caused for each climate hazards

1. AASHTO. Fundamentals of Effective All Hazards Security and Resilience for State DOTs, 2015.
3. Estimating the benefits of Climate Resilient Buildings and Core Public Infrastructure (CRBCPI), Institute for Catastrophic Loss Reduction, February 2020
INCREASED FLOODING IS IMPACTING OUR PAVEMENT STRUCTURES
Need to distinguish between Inundation and Washout Impacts

Washout
Rapid flow of flood water / high current that scours and washes out the pavement structure
Pavement type has little impact

Inundation
The rise of water that submerges the pavement.
No rapid flow or current
Pavement type does have an impact
Concrete and asphalt pavements are different due to how they transmit loads to the subgrade.

Concrete Pavements are Rigid

- Load – Carried by concrete and distributed over a large area
- Minor deflection
- Low subgrade contact pressure
- Subgrade uniformity is more important than strength

Asphalt Pavements are Flexible

- Load - more concentrated & transferred to the underlying layers
- Higher deflection
- Subgrade & base strength are important
- Requires more layers / greater thickness to protect the subgrade

Concrete’s rigidity spreads the load over a large area & keeps pressures on the subgrade low.
FLOODING CAUSES THE SUBGRADE TO BECOME SUPERSATURATED
Moisture infiltrates base, pushes the subgrade particles apart and weakens the system

Asphalt Pavements are FLEXIBLE
- Lowered subgrade strength & reduced modulus
  - Reduced load carrying capacity
  - Takes ~1 year to regain strength
- Loading during this times accelerates pavement damage / deterioration
  - Reduced pavement life

Concrete Pavements are RIGID
- Maintains high level of strength / stiffness
- Subgrade is weak, but still uniform
- Spreading of the load means subgrade is not overstressed
- Little impact on the serviceability / life

Flooding does not impact the concrete’s load carrying capacity to the same degree as asphalt’s
SOAKING REDUCES STRENGTH OF SOILS BY 20 TO 40%
Different Soils (clays, silts, sands, clay sands, etc) all react differently but all decrease

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Un-soaked CBR</th>
<th>4-day soaked CBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inorganic Clays (CL Type Soil)</td>
<td>Avg = 32.5%</td>
<td>Hi = 49.1%</td>
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<tr>
<td></td>
<td>Lo = 7.6%</td>
<td></td>
</tr>
<tr>
<td>Clayey Sands (SC Type Soil)</td>
<td>Avg = 21.5%</td>
<td>Hi = 34.7%</td>
</tr>
<tr>
<td></td>
<td>Lo = 2.7%</td>
<td></td>
</tr>
<tr>
<td>Inorganic Silts (ML Type Soil)</td>
<td>Avg = 30.5%</td>
<td>Hi = 48.9%</td>
</tr>
<tr>
<td></td>
<td>Lo = 0.7%</td>
<td></td>
</tr>
<tr>
<td>Silty Sands (SM Type Soil)</td>
<td>Avg = 42.1%</td>
<td>Hi = 65.4%</td>
</tr>
<tr>
<td></td>
<td>Lo = 3.9%</td>
<td></td>
</tr>
</tbody>
</table>

Source: Comparison Between Soaked and Unsoaked CBR, Sathawara Jigar K & Prof. A.K.Patel; International Journal of Advanced Engineering Research and Studies E-ISSN2249–8974
RESEARCH FINDINGS INDICATE IT TAKES UP TO 1 YEAR FOR THE SUBGRADE STRENGTH TO RECOVER FROM FLOODING

After the flood waters recede, the pavements are structurally vulnerable

For this case, this strength loss is a 40 to 60% reduction load carrying capacity and about 3 years of life

Sources:
2. Western Iowa Missouri River Flooding—Geo-Infrastructure Damage Assessment, Repair, and Mitigation Strategies; Center for Earthworks Engineering Research, Iowa State University, Report No. IHRB Project TR-638

US 441 in Alachua County, Florida between MP 7.960 to MP 9.680
WHEN LOOKING AT PAVEMENT’S RESILIENCY, NEED TO RECOGNIZE DAMAGE FROM 2 DIFFERENT SOURCES / TIMES

Impact Types / Timing

1. Primary / Direct Impacts – alters the pavement structural or functional capabilities

2. Secondary / Indirect Impacts – Impacts due to recovery activities or use
   - Rescue and Emergency response during the disaster
   - Recovery activities (clean up and rebuilding) after the disaster

To have a resilient pavement system requires that both aspects be addressed
RELIEF AND RESCUE EFFORTS WILL TAKE PLACE
Loading occurs both during the crisis and long after

Meals that Matter
#MtMFlorence Update

Hurricane Florence
(2018)

(New) Location 1
98 S Trade Way
Rocky Point, NC

Location 2
7701 S Reelford Rd
Fayetteville, NC

Joplin, MO Tornado (2011)

Debris Hauling from Camp Fire, Paradise, CA (2018)
3.66 million tons removed over a nine-month period
DEBRIS REMOVAL CAN TAKE PLACE FOR MONTHS
Further exacerbating the pavement damage while weakened

Hurricane Harvey (2017) resulted in:
• Over 8M cubic yards (CY) of debris in Houston
• Over 2M CY in East Baton Rouge Parish, La.

Superstorm Sandy (2012) led to ~6M CY of debris in New York State

Hurricane Katrina – 38M CY of debris

Capacity = 10 to 17 cubic yards
1M CY ~ 65,000 Dump Trucks
NEED TO ACCOUNT FOR LONG TERM SECONDARY IMPACTS WHEN DISCUSSING PAVEMENT RESILIENCE

Weakened pavement & additional loading can lead to early rehabilitation needs

Pavement Resilience should be characterized by three parameters:

1. Drop in performance, induced by the event (eg. reduced ability to carry load).
2. Recovery time to reinstate or improve performance.
3. Ability to withstand emergency and recovery activities

Green is more resilient than Red
- Faster recovery time
- Higher level of service
- Less Secondary damage
Boosting Pavement Resilience in a Changing Climate

1. The Need for Resilient Pavements

2. Defining Resiliency

3. Improving a Pavement’s Resiliency
   a. Pavement Solutions to improve your flood resiliency
   b. What can be accomplished within pavement selection policies?
APPROACHES TO IMPROVE A HIGHWAY’S / PAVEMENTS RESILIENCE

Adaptive Resilience – Capacity to learn and make decisions to avoid future loss based on the type of disturbance

1) Modifications before disruptive events that improve system performance

2) Repairs after disruptive event to restore system functionality

Adapted from Bruneau, 2003 and McDaniels, 2008
ONE OFTEN DISCUSSED APPROACH IS ELEVATING THE ROAD ABOVE FLOODING ELEVATION

Elevating the roadway is not cheap and it is not possible to raise all roadways

Elevation View of SR54 Viaduct From Old SR54 Alignment, Fenwick DE Cost = $16 M in 2001

Schematic and Photo courtesy of Jim Pappas, DELDOT
ANOTHER APPROACH IS ROAD ABANDONMENT
Old Corbitt Road – Odessa, Delaware

- Overtops daily due to tides
- 340 Avg Daily Traffic (ADT)
- Traveling time will be slightly increased by approximately 2 to 3.5 minutes.

- Alternate - 250’ long concrete structure.
  Estimated cost = $2.5M

Abandoning the roadway is not always possible

Schematic and Photo courtesy of Jim Pappas, DELDOT
STIFFER PAVEMENTS ARE MORE RESILIENT TO INUNDATION FLOODING

Stiffer Pavements are less impacted by subgrade strength loss and recover faster (stiffer = concrete, cement stabilized bases, increased asphalt thickness)

Performance

Time (years)

Concrete

Asphalt

1) Lower drop in performance (Both Short and long term)

2) Quicker opening

3) Shorter recovery time

4) Less Secondary impacts (less dependence on subgrade / base strength)

Early Rehab

Time the road is submerged / not passable

Design Life
KEY FINDINGS FOR PAVEMENTS THAT WERE SUBMERGED BY HURRICANE KATRINA

Submerged pavements were weaker than non-submerged pavements

- **Asphalt pavements**
  - Overall strength loss ≈ two inches of new asphalt concrete
  - Damage occurred regardless of the length of time the pavement was submerged
  - Cost: $50 million to rehabilitate 200 miles of submerged asphalt roads

- **Concrete Pavements**
  - Little relative loss of strength due to flooded conditions
  - Resilient modulus (Mr) is similar for submerged and non-submerged pavements
  - No information given on repairs or repair costs
A rigid pavement performs better than composite and flexible road groups.

- Composite and flexible road groups show similar performance up to 2–3 years.
- Rigid pavement performs the best at any probability of flooding, and flooding effect is not critical.

A pavement’s strength may be enhanced by:

- Strengthening with an overlay.
- Layer stabilization.
- Converting the road into a rigid or composite pavement through granular layers’ stabilization.

"It is settled that a rigid pavement is the more flood-resilient." (p-5)
PAVEMENTS IN HOUSTON HAVE BEEN FLOODED SEVERAL TIMES
But roadways are opened as soon as water has receded

Both sections have been flooded at least three times since original construction
ACTIVITIES THAT CAN BE USED TO “HARDEN THE PAVEMENT SYSTEM”

Adopt & Use Concrete Pavement

Yacht Harbor Manor Neighborhood Improvements, Riviera Beach, Florida

Photos courtesy of Erdman Anthony
https://www.erdmananthony.com/Our-Projects/project/484
ACTIVITIES THAT CAN BE USED TO “HARDEN THE PAVEMENT SYSTEM”
Modify “Design Standards” to be based on weakened subgrade condition

Almost All Pavement Designs in Australia are based on soaked subgrade conditions
SOME RESILIENT CEMENT-BASED PAVEMENT SOLUTIONS THAT CAN BE USED AS HARDENING TECHNIQUES

- Conventional Concrete Pavement
- Thin Concrete Pavement
- Roller Compacted Concrete (RCC)
- Full Depth Reclamation (FDR) w/ Cement
- Concrete Overlays
- Pervious Concrete
Concrete overlay increases both the height and the structural strength of the roadway.

ACTIVITIES THAT CAN BE USED TO “HARDEN THE PAVEMENT SYSTEM”

Use Concrete Overlays

Asphalt
Base
Subbase
Subgrade

Pressure ~3 - 7 psi at the top of the Asphalt layer

Base & subgrade pressures are even lower

Concrete
Asphalt
Base
Subbase
Subgrade

Road Elevation raised the height of the overlay

Pressure ~15 - 20 psi
7000 lbs load.

Concrete overlay increases both the height and the structural strength of the roadway.
NATIONWIDE CONCRETE OVERLAY USAGE IS GROWING

Overlays as Percentage of Total Concrete Paving, SY

- Prior to 2000: 2.00%
- 2000-2004: 2.00%
- 2005-2009: 4.33%
- 2010-2014: 11.27%
- 2015-2019: 12.42%

Source: From data submitted by ACPA chapters/state paving associations and other sources, including Oman Systems, Bid Express and DOT websites.

BCOA Examples

US 69, Pittsburg Co., OKDOT

Colorado
SH-121, Wadsworth Ave
Constructed in 2001
Photo in 2013
Charleston Executive Airport
Johns Island, SC

11-inch Unbonded Overlay (2010 Construction)

2016 PCI Data from Pavement Management Report

2010 LCD-RW Concrete Overlay range from 93 to 96 (weighted average 94, 1 point per year drop)
2010 LCD-TW Connectors (Tie-Ins) Asphalt range from 77 to 86 (weighted average 82, 3 points per year drop)
2008 LCD – Taxiway A Asphalt = 75 (drop of 3.1 points per year)
Resiliency of Concrete Recognized

Reconstruction of Runway 13L-31R at JFK
Port Authority of NY & NJ Press Release (April 2019)

“Use of Concrete will extend runway’s useful life to 40 years, rather than 8-12 years with asphalt.”

“The rehabilitation will provide aircraft a solid concrete runway that is more RESILIENT than asphalt and will increase the useful life of runway by four times”
FULL-DEPTH RECLAMATION (FDR) WITH CEMENT RECYCLES AN EXISTING DETERIORATED ASPHALT PAVEMENT INTO A NEW STABILIZED BASE

The stabilized base can be topped with an asphalt or concrete surface

- Utilizes In-Place Materials (reduces cost)
- Saves Energy by Reducing Trucking Requirements
- Increased Rigidity Spreads Loads
- Minimizes Rutting
- Reduced Moisture Susceptibility
Moisture infiltrates base
- Through high water table
- Capillary action
- Causing softening, lower strength, and reduced modulus

Cement stabilization reduces permeability
- Helps keep moisture out
- Maintains high level of strength and stiffness even when saturated

ACTIVITIES THAT CAN BE USED TO “HARDEN THE PAVEMENT SYSTEM”
FDR w/ Cement increases rigidity, reduces permeability, & reduces moisture susceptibility
In Lauderdale County, Tennessee, just before reaching the Mississippi River, there lies a two-lane road serving a high number of fully-loaded grain trucks. State Route 88 (SR88) has seen its fair share of not only heavy truck traffic but environmental threats as well. For years, sections of SR88 have spent days, if not weeks, under water, as it runs parallel with the Obion River. The Obion River is the primary surface water drainage system of northwest Tennessee and drains into the mighty Mississippi River. According to the U.S. Environmental Protection Agency’s Section 319 Nonpoint Source Program Article written by Sam Marshall, Ph.D., of the Tennessee Department of Agriculture, “In the last century, landowners channelized sections of the Obion River and many of its small tributaries to increase flow efficiency for agricultural uses. Unfortunately, channelizing the waterways also caused increased erosion, downstream flooding, and a loss of wildlife habitat.”

These problems are especially true for this section of SR88 as several banks are right up against the shoulder of the road, and erosion is apparent.

High water, erosion and heavy traffic are a known recipe for road failure. It was no surprise that Tennessee Department of Transportation (TDOT) chose SR88 as its next Full-Depth Reclamation (FDR) project.

In 2019, TDOT awarded a grant study on FDR to the University of Tennessee at Chattanooga (UTC) and Middle Tennessee State University (MTSU). The two-year study will take raw data from either TDOT or county-owned roads and run data points as well as mix designs in hope of preparing a solid platform for TDOT’s materials and test team and the pavement design team to use when determining a road’s candidacy for FDR.

UTC’s Civil Engineering program and MTSU’s Concrete Industry Management program joined forces and collected over 300 pounds of samples from SR88, as well as core asphalt depths and falling weight deflection points.

The Universities then ran all necessary proctor tests, moisture tests, gradation tests and strength tests in MTSU’s CSM lab. Even with a couple of decent-sized pockets of clay, the cement percentage was constant at 5.5% cement, which TDOT rounded up to 6% for the project.

Road Farmers, Inc. was awarded the reclamation part of the project with Pavement Restorations, Inc. (PRI) as the prime contractor. RoadWorx President Barry Wilder and his team started reclaiming the 9.36-mile road on August 27, 2020 with a control strip and immediately jumped into full action on September 1. The reclamation was completed by October 2 with only a couple of days delay due to weather. PRI performed a double induration surface treatment, more commonly known as DRT, and finished on October 5, all of which was on schedule with TDOT requirements.

The mix design was the same 1/3” depth at 6% cement, but due to the materials’ density and moisture levels changing throughout the road, the road was sectioned in three groups with the spread rates changing from 74.9 lb/yr to 73.6 lb/yr to 73.8 lb/yr. The first layer of DBST was a number 7 aggregate with a TDOT chosen CRS/SP emulsion. The second course was the same emulsion but with a number 6 aggregate. The entire DBST was then treated with a DHP-3 High Performance Fog Seal in order to help prevent any additional chip loss. Both Barry Wilder of RoadWorx and PRI Director of Business Development Casey Swan were proud to be a part of TDOT’s largest FDR project to date.

It should also be mentioned that TDOT Commissioner Clay Bright made the long drive to SR88 in order to witness this “new tool” in TDOT’s bag. In a Tweet made by the Commissioner on September 3, 2020 at 9:19 pm, he stated “Great day in Lauderdale County seeing a Full-Depth Reclamation project by PRI. (The) road will be much better and safer for all the truck traffic delivering to the river for years to come.”

State Route 88 was in poor condition

Reclamation in process

State Route 88 is now in better condition

Full-Depth Reclamation (FDR)

Promotion Spotlights : SCPA (secement.org)

Spotlight Excerpts

For years, sections of SR88 have spent days, if not weeks, under water, as it runs parallel with the Obion River.

High water, erosion and heavy traffic are a known recipe for road failure. It was no surprise that TDOT chose SR88 as its next Full-Depth Reclamation (FDR) project.
CONCLUSIONS

1. We are beginning to recognize the need to make our infrastructure “Resilient”
   – Need to define specific actions that agencies should consider when dealing with pavements
   – Need to define how each specific “climate risk” will impact the system
   – Must account for secondary impacts

2. In areas where pavements have a history of flooding (or in flood prone areas)
   – Require pavement designs be based on lowered subgrade strength
   – Use Stiffer or stiffen the existing pavement
   – There are many solutions that are viable that are low costs, such as concrete overlays and FDR with cement that can be used as mitigation / hardening strategies
Thank you

Use chat box for Q&A

gdean@pavementse.com