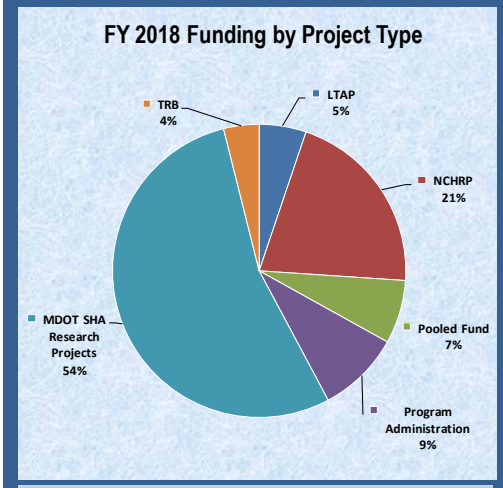
Research Annual Report

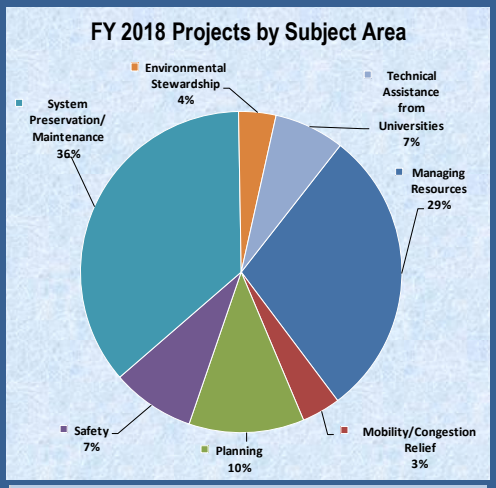
STATE PLANNING & RESEARCH PART II

2018 At-A-Glance JANUARY 1, 2018 – DECEMBER 31, 2018

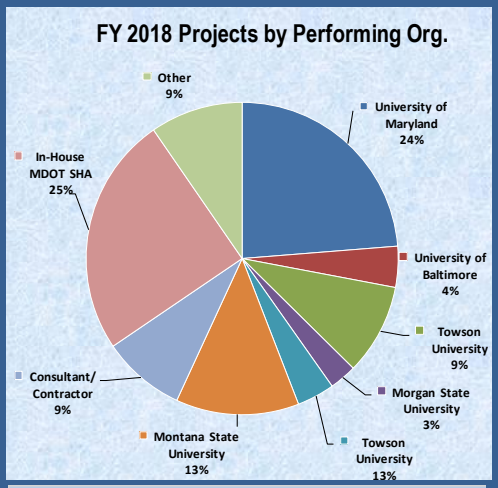
This report presents a summary of the Maryland Department of Transportation State Highway Administration's (MDOT SHA) State Planning & Research (SPR) Part II Research Program. The funding statistics are provided for the FY 2018 Research Work Program in the following charts. The tables on pages 2 through 5 list all MDOT SHA-funded research projects by subject area that were active or completed during 2018. One of the completed projects is highlighted starting on page 6.



LTAP	$ 170,000
NCHRP	$ 685,289
Pooled Fund Studies	$ 230,000
Program Administration	$ 300,000
MDOT SHA Research Projects	$ 1,768,920
TRB	$ 128,364
Total	**$ 3,282,573**



Managing Resources	$ 516,589
Mobility/ Congestion Relief	$ 68,953
Planning	$ 205,234
Safety	$ 148,233
System Preservation/ Maintenance	$ 638,515
Environmental Stewardship	$ 66,396
Technical Assistance from Universities	$ 125,000
Total	**$ 1,768,920**



University of Maryland	$ 419,863
University of Baltimore	$ 75,000
Towson University	$ 166,589
Morgan State University	$ 50,000
University of South Florida	$ 68,953
Montana State University	$ 225,794
Consultant/ Contractor	$ 152,721
In-House MDOT SHA	$ 440,000
Other	$ 170,000
Total	**$ 1,768,920**

In 2018 the Research Division worked with its university partners to reduce facilities and administrative (F&A) cost rates on two new agreements for research services. The F&A cost rate with Morgan State University was reduced from 48.5% to 26% and Towson University's rate was reduced from 46.5% to 26.5%. This reduction helps MDOT SHA maximize its limited research dollars. The Research Division will continue to monitor F&A cost rates.

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MDOT SHA 2018 Research

TABLES ARE ORGANIZED BY SUBJECT AREAS:

ABBREVIATIONS:

MDOT SHA	Maryland Department of Transportation State Highway Administration
FHWA	Federal Highway Administration
MSU	Morgan State University
TU	Towson University
UB	University of Baltimore
UMBC	University of Maryland, Baltimore County
UMCP	University of Maryland, College Park
UMCES	University of Maryland Center for Environmental Science

Research projects that are still active

Completed research projects

Safety

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2018	FY 2018 Expenditures	Spotlight
SP609B4F	Fatigue Resistant Design Criteria for MD SHA cantilevered Mast Arm Signal Structures	UMCP	Sharon	FY 2016	$153,915	100%	$ 18,073.03	
SP709B4M	Transformative Technologies in Maryland	In-House MDOT SHA	Allison	FY 2017	$850,000	100%	$ 4,360.50	
SP709B4N	Red Light Camera Research	UMCP	Hua	FY 2017	$125,000	100%	$ 112,084.00	
SP809B4C	Calibration of the AASHTO ASD and LRFD for Maryland Sign Structure Design	UMCP	Sharon	FY 2018	$148,233	<1%	$ 202.02	
SP809B4H	Emerging Travel Trends in Maryland	University of S. Florida	Allison	FY 2018	$68,953	100%	$ 68,952.69	

Planning

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2018	FY 2018 Expenditures	Spotlight
SP809B4A	Special Event Impact Study at Maryland Casinos	UMCP	Hua	FY 2018	$205,234	100%	$ 205,234.00	

Mobility/Congestion Relief

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2018	FY 2018 Expenditures	Spotlight
SP709B4H	Potential Effects of Composition and Structure of Dynamic Message Sign (DMS) Messages on Driver Behavior and Their Decision to Use Freeway Incident Traffic Management (FITM) Routes	MSU	Sharon	FY 2017	$120,000	100%	$ 71,260.68	
SP709B4K	Analyzing Traveler's Response to Different Active Traffic Management (ATM) Technologies in a Simulated Environment	UMCP	Sharon	FY 2017	$150,000	100%	$ 130,789.40	
SP809B4B	Automated Route Optimization Planning for Maryland Condition Assessment System	TU	Hua	FY 2018	$166,589	40%	$ 66,635.60	

Administrative

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2018	FY 2018 Expenditures	Spotlight
SP809B42	Research Program Development and Implementation	In-House MDOT SHA	Allison	FY 2018	$300,000	61%	$ 182,669.48	

System Preservation/Maintenance

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2018	FY 2018 Expenditures	Spotlight
SP609B4G	Evaluating the Success of Meeting Design Objectives on Previously Constructed OOS Stream Stability Projects	Penn State Univesity	Hua	FY 2016	$125,000	100%	$ 8,463.25	
SP709B49	MEPDG Calibration	Consultant/ Contractor	Allison	FY 2017	$200,000	0%	$ -	
SP709B4D	Best Practices for Placing Concrete Overlays on Prestressed Slab Bridges	UMCP	Sharon	FY 2017	$100,000	100%	$ 55,140.76	x
SP709B4G	Implementation of Non-nuclear In-Situ Devices to Replace the Nuclear Density Gauge, to Meet the Mechanistic-Empirical Pavement Design Guide (MEPDG) Requirement	UMCP	Sharon	FY 2017	$150,000	54%	$ 86,235.87	
SP809B45	LTPP Maryland Performance Data Collection/Monitoring	In-House MDOT SHA	Allison	FY 2018	$30,000	45%	$ 13,635.94	
SP809B4D	Thin Asphalt Overlays in Maryland (Funding included in SP809B44)	In-House MDOT SHA	Sharon	FY 2018		<1%		
SP809B4F	Inventory of Rock Slopes in Maryland	Consultant/ Contractor	Sharon	FY 2018	$152,721	<1%	$ 146.53	

Environmental Stewardship

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2018	FY 2018 Expenditures	Spotlight
SP609B4C	Use of Compost Blankets to Establish Permanent Vegetation	UMCP	Hua	FY 2016	$200,000	90%	$ 59,714.60	
SP709B48	Assessment of Bioswale Performance Phase IV	UMCES	Allison	FY 2017	$197,729	0%	$ -	
SP709B4B	Evaluating Integrated Roadside Vegetation Management Techniques to Improve Pollinator Habitat	UMCP	Hua	FY 2017	$100,000	90%	$ 28,614.34	
SP709B4C	Turfgrasses Suitable for Maryland Right-of-Ways - Phase II Field Tests	UMCES	Hua	FY 2017	$279,192	59%	$ 67,388.58	
SP809B4E	The Effectiveness of Amendments in Promoting Hydric Soil Conditions in Mitigation Wetlands	UMCP	Sharon	FY 2018	$66,396	62%	$ 41,186.83	
SP809B4G	Severe Weather Index	Montana State Univ.	Hua	FY 2018	$225,794	18%	$ 36,354.14	

Managing Resources

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2018	FY 2018 Expenditures	Spotlight
SP809B44	Evaluation of Experimental Features (including SP809B4D)	In-House MDOT SHA	Allison	FY 2018	$230,000	11%	$ 24,576.12	
SP809B47	New Products Evaluation	In-House MDOT SHA	Allison	FY 2018	$80,000	87%	$ 69,777.52	

Technical Assistance from Universities

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2018	FY 2018 Expenditures	Spotlight
SP809B46	Morgan State University Summer Internship Program	MSU	Sharon	FY 2018	$50,000	100%	$ 13,284.34	
SP809B48	MDOT Customer Satisfaction Survey	UB	Allison	FY 2018	$75,000	100%	$ 70,569.00	

National Initiatives

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2018	FY 2018 Expenditures	Spotlight
NCHRP	National Cooperative Highway Research Program	Other	Allison	FY 2018	$669,638	100%	$ 669,638.00	
SP809B41	Local Technical Assistance Program (LTAP)	UMCP	Allison	FY 2018	$170,000	0%	$ -	
SP809C41	Local Technical Assistance Program (LTAP)	UMCP	Allison	FY 2018	$150,000	32%	$ 47,721.09	
SP809B49	AASHTO Technical Services Programs	Other	Allison	FY 2018	$170,000	100%	$ 170,000.00	
SP910B4R	Census Transportation Planning Products (CTPP) Technical Service Program (2020–2024)	Other	Allison	FY 2018	$104,304	100%	$ 104,304.01	

Transportation Pooled Fund Studies

Project Number	Project Title	Lead Agency	Research Manager	Work Program	Funding	Transfer Completed?	FY 2018 Expenditures	Spotlight
TPF-5(347)	MDSS	SDDOT	Sharon	FY 2018	$25,000	100%	$ 25,000.00	
TPF-5(316)	Traffic Control Device (participation revisited on annual basis)	FHWA	Sharon	FY 2018	$10,000	100%	$ 10,000.00	
TPF-5(317)	Evaluation of Low Cost Safety Improvements (participation revisited on an annual basis)	FHWA	Sharon	FY 2018	$30,000	100%	$ 30,000.00	
TPF-5(198)	Urban Mobility Study	TXDOT	Sharon	FY 2018	$25,000	100%	$ 25,000.00	
TPF-5(206)	Research Program to Support the Research, Development, and Deployment of System Operations Applications of Vehicle	VDOT	Sharon	FY 2018	$50,000	100%	$ 50,000.00	
TPF-5(326)	Develop and Support Transportation Performance Management Capacity Development Needs of the State DOTs	FHWA	Sharon	FY 2018	$35,000	100%	$ 35,000.00	
TPF-5(353)	Clear Roads Winter Highway Operations	MnDOT	Sharon	FY 2018	$25,000	100%	$ 25,000.00	
TPF-5(330)	No Boundaries Roadway Maintenance Practices	ODOT	Sharon	FY 2018	$10,000	100%	$ 10,000.00	
TPF-5(351)	Self De-Icing LED Signals	KDOT	Sharon	FY 2018	$20,000	100%	$ 20,000.00	
TPF-5(378)	TRB Technical Activities Service	FHWA	Sharon	FY 2018	$128,346	100%	$ 128,346.00	
TPF-5(418)	National Cooperative Highway Research Program	FHWA	Sharon	FY 2018	$685,249	100%	$ 685,249.00	

2018 Research Highlight

SP709B4D – Best Practices for Placing Concrete Overlays on Prestressed Slab Bridges

To improve the service life of bridge decks, concrete overlays are commonly placed over the deck to provide a safe and durable riding surface and, to protect the deck from adverse environmental conditions. Bonding agents are often used between the underlying concrete and the overlay to create one monolithic structure. The current practice used by the Maryland Department of Transportation State Highway Administration (MDOT SHA) is to place a cement-sand slurry mix over the bridge deck prior to placement of the overlay concrete to serve as the bonding agent. However, there are challenges with using a cementitious bonding agent. They are very tedious and time consuming to construct, especially on long and multi-span bridges. The main objective of this research was to investigate various bonding practices including the slurry method used by MDOT SHA when constructing cast-in-place concrete overlays for prestressed concrete deck slabs. Another goal was to investigate whether the slurry is necessary to achieve a good bond or, if there are better alternatives.

The research team designed and performed laboratory experiments for various test cases with different interface conditions. Seven different test cases were established; one of them was the reference test case that uses application of slurry mix to achieve a good overlay bond. Of the remaining six test cases, four cases simply involved application of different groove configurations along the interface, one case involved use of commercial bonding agent *Enecon Superbond* in addition to grooves, and the last case involved use of four six-inch-long anchors of ½ in. diameter embedded equally in both layers in addition to the grooves. Two sets of tests were designed in this study – Double-L test (see Figure 1) and the Split-Prism test (see Figure 2) to evaluate the shear bond and tensile bond strengths respectively. For both test setups, it was ensured that the load applied by the testing machine was in line with the interface to avoid any additional stresses along the interface. Each specimen was subjected to load until it failed, and the recorded load value was divided by the interface area to get the failure shear and tensile stresses for the bond. In addition, compressive strength tests for each mix were conducted to ensure that the mix strengths were consistent for all test cases. Once the test results were obtained for all cases, they were checked against the values obtained for the reference test case and recommendations followed.

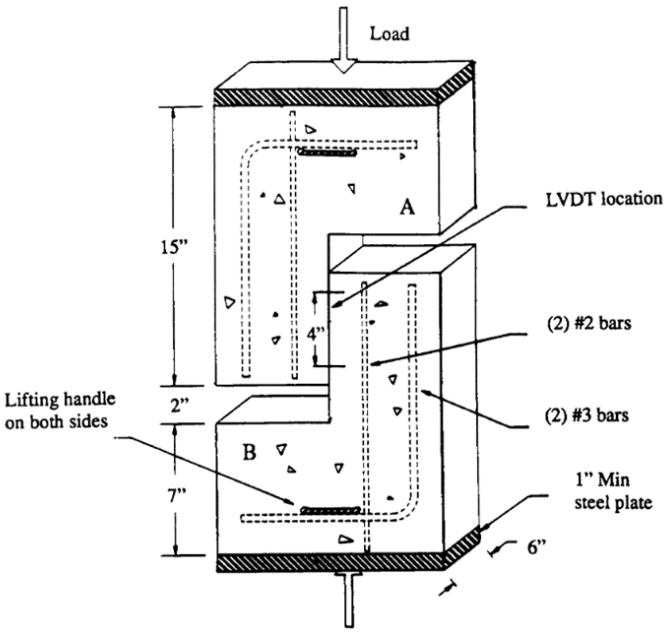

Figure 1: Typical test setup for the Double-L test (Zia et al. 1993)

Figure 2: Slant Shear test format

The results of the use of prestressed slab panels with pre-existing grooves (see Figure 3) over which the overlay concrete can be directly poured, were very positive. The average bond shear strength values for all the four test cases with square-shaped groove configurations (¼ in., 3/8 in. and ½ in. deep grooves at spacing of ½ in. and 1 in.) along the interface were recorded to be higher than the bond shear strength in the reference test case that used the slurry mix. It was found that the interlocking effect obtained through these grooves contributes significantly to the bond shear strength (see Figure 4).

Figure 3: L-shaped underlay half after 18 hours of steam curing

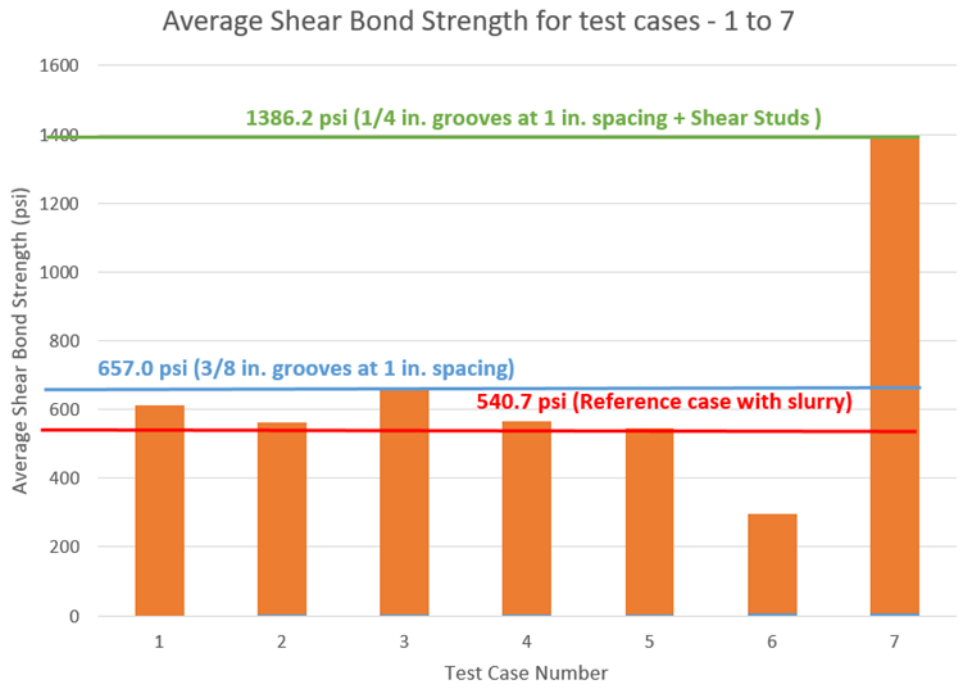

Figure 3: Comparison chart for the average shear bond strength for the seven test cases

Based on consultation with the prestressed precast slab manufacturing plants, precast slabs with standard groove configurations could, theoretically, be manufactured at plants for direct use during bridge construction. The overlay concrete could then be directly poured over these panels eliminating the current process that involves removal of overlay reinforcement cage for spreading the slurry mix, quickly placing the reinforcement cage again and then pouring the overlay concrete. The findings in this study represent an improvement over the existing practice of using a slurry mix to enhance the bond characteristics of concrete overlays. The MDOT SHA plans to eliminate using the slurry and continue with the current finish practice for the top of the slab unit (i.e. roughened raked finish to a ¼" amplitude. MDOT SHA will continue to explore the option of having prestressed precast slabs manufactured with standard groove configurations.

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