



# Research Annual Report

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Prepared by the  
Mississippi Department of Transportation  
Research Division

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State Research Engineer

In Cooperation with:  
U.S. Department of Transportation  
&  
Federal Highway Administration

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# Researchers

## University

Daniel Carruth	Mississippi State University
Dennis Truax	Mississippi State University
Eric J. Steward	University of South Alabama
Hakan Yasarer	University of Mississippi
Isaac Howard	Mississippi State University
Li Zhang	Mississippi State University
Mohammed Sadik Khan	Jackson State University
Seamus Freyne	Mississippi State University
Tulio Sulbaran	University of Texas at San Antonio

## Consultant

Allen Cooley	Burns Cooley Dennis, Inc.
Alvaro Ulloa-Calderon	Applied Research Associates, Inc.
Athar Saeed	Saeed & Associates Consultants Inc.
Brian Hirt	CTC & Associates
Chetana Rao	Rao Research and Consulting
Dave Tomley	Thompson Engineering
Randy Battey	Gresham Smith
Richard Storm	HDR Engineering
Robert Varner	Burns Cooley Dennis, Inc.

# Universities

Jackson State University	P.O. Box 17068	Jackson	Mississippi	39217
Mississippi State University	PO Box 9546	Mississippi State	Mississippi	39762
University of South Alabama	150 Jaguar Drive	Mobile	Alabama	36688
University of Texas at San Antonio	501 W.César E. Chávez Blvd	San Antonio	Texas	78207
University of Mississippi	208 Carrier Hall	University	Mississippi	38677

# Consultants

Applied Research Associates, Inc.	2217 W. Braker Lane	Austin	Texas	78758
Burns Cooley Dennis, Inc.	278 Commerce Park Drive	Ridgeland	Mississippi	39157
CTC & Associates	2323 Woodcrest Ave	Lincoln	Nebraska	68502
Gresham Smith	385-B Highland Colony Parkkway Suite 410	Ridgeland	Mississippi	39157
HDR Engineering	6745 Lennox Center Court	Memphis	Tennessee	38115
Rao Research and Consulting	1601 Mullikin Dr.	Champaign	Illinois	31822
Saeed & Associates Consultants Inc.	13111 N. Central Expressway, Suite 150,	Dallas	Texas	75240
Thompson Engineering	3707 Cottage Hil Rd	Mobile	Alabama	36606

# University Expenditures

<b>PI Company</b>	<b>Total Study Budget</b>	<b>2020 Expenditures</b>	<b>Remaining Funds</b>
Jackson State University	\$496,425.00	\$94,798.18	\$326,548.96
Mississippi State University	\$2,170,010.00	\$360,531.25	\$1,438,667.24
University of Mississippi	\$300,000.00	\$101,356.50	\$198,643.50
University of South Alabama	\$143,282.00	\$22,990.03	\$28,233.15
University of Texas at San Antonio	\$133,131.50	\$22,901.14	\$110,230.36

# Consultant Expenditures

<b>PI Company</b>	<b>Total Study Budget</b>	<b>2020 Expenditures</b>	<b>Remaining Funds</b>
Applied Research Associates, Inc.	\$373,000.00	\$827.15	\$372,172.85
Burns Cooley Dennis, Inc.	\$2,052,827.46	\$331,694.79	\$940,959.60
CTC & Associates	\$99,524.00	\$41,424.47	\$14,446.64
Gresham Smith	\$290,224.42	\$131,799.18	\$158,425.24
HDR Engineering	\$380,494.54	\$255,314.60	\$125,179.94
Rao Research and Consulting	\$232,992.00	\$0.00	\$232,992.00
Saeed & Associates Consultants Inc.	\$200,000.00	\$937.86	\$199,062.14
Thompson Engineering	\$85,926.35	\$24,837.94	\$61,088.41

# University Studies

Project Name	Researcher	PI Company	Total Study Budget	2020 Expenditures	Remaining Funds
Performance Evaluation of Highway Slopes on Yazoo Clay	Mohammed Sadik Khan	Jackson State University	\$196,425.00	\$94,798.18	\$26,548.96
Development Of Advanced Landslide Investigation Protocol Using Geophysical Methods For Mississippi	Mohammed Sadik Khan	Jackson State University	\$300,000.00	\$0.00	\$300,000.00
		<b>Jackson State University</b>	<b>\$496,425.00</b>	<b>\$94,798.18</b>	<b>\$326,548.96</b>
MDOT Specific Design Procedure for Chip Seals	Isaac Howard	Mississippi State University	\$395,639.00	\$10,737.40	\$374,804.00
Soil-Cement Manual of Practice: Interconnected Framework for Pavement Design, Laboratory Mixture Design, and Construction Quality Control/Assurance	Isaac Howard	Mississippi State University	\$350,000.00	\$43,169.32	\$153,496.38
High Quality Simulation Training	Daniel Carruth	Mississippi State University	\$74,534.00	\$8,539.99	\$473.28
Performance Measures for Traffic Signal Systems	Li Zhang	Mississippi State University	\$150,000.00	\$38,594.83	\$59,094.28
CSM Conversion Factors and Regression Parameters to Back Cast CSM Strength and Modulus	Isaac Howard	Mississippi State University	\$150,000.00	\$87,783.38	\$62,216.62
Highway Travel Time Estimation with Captured In-vehicle Wi-Fi MAC Addresses: Mechanism, Challenges, Solutions and Applications	Li Zhang	Mississippi State University	\$199,878.00	\$39,762.72	\$106,671.89
Characterization of Combined Environmental Effects on Bituminous Paving Materials	Isaac Howard	Mississippi State University	\$290,000.00	\$36,588.07	\$249,093.81
A Framework for Determining Value of MDOT Research Projects	Seamus Freyne	Mississippi State University	\$200,000.00	\$38,333.60	\$161,666.40
Mississippi Transportation Research Center	Dennis Truax	Mississippi State University	\$359,959.00	\$57,021.94	\$271,150.58
		<b>Mississippi State University</b>	<b>\$2,170,010.00</b>	<b>\$360,531.25</b>	<b>\$1,438,667.24</b>

<b>Project Name</b>	<b>Researcher</b>	<b>PI Company</b>	<b>Total Study Budget</b>	<b>2020 Expenditures</b>	<b>Remaining Funds</b>
Use of Artificial Neural Networks (ANN) to Predict Pavement Management Data Attributes	Hakan Yasarer	<b>University of Mississippi</b>	<b>\$300,000.00</b>	<b>\$101,356.50</b>	<b>\$198,643.50</b>
Development of a Setup Prediction Method and Implementation into LRFD Driven Pile Design in Mississippi soils	Eric J. Steward	<b>University of South Alabama</b>	<b>\$143,282.00</b>	<b>\$22,990.03</b>	<b>\$28,233.15</b>
Best Practices for Lighting and Marking Maintenance/ Construction Equipment for Safety	Tulio Sulbaran	<b>University of Texas at San Antonio</b>	<b>\$133,131.50</b>	<b>\$22,901.14</b>	<b>\$110,230.36</b>

# Consultant Studies

Project Name	Researcher	PI Company	Total Study Budget	2020 Expenditures	Remaining Funds
Develop ELMOD Backcalculation User Manual for MDOT	Alvaro Ulloa-Calderon	Applied Research Associates, Inc.	\$125,000.00	\$0.00	\$125,000.00
FWD Testing and Backcalculation of Rubblized and Fractured Slab PCC Pavement Moduli	Alvaro Ulloa-Calderon	Applied Research Associates, Inc.	\$248,000.00	\$827.15	\$247,172.85
		<b>Applied Research Associates, Inc.</b>	<b>\$373,000.00</b>	<b>\$827.15</b>	<b>\$372,172.85</b>
Data Collection for Local Calibration of the AASHTOWare Pavement ME Design Performance Models for Mississippi.	Allen Cooley	Burns Cooley Dennis, Inc.	\$695,925.26	\$14,518.20	\$46,001.98
Permeability Reduction of Restrained Concrete in a Chloride-Rich Environment Phase I	Robert Varner	Burns Cooley Dennis, Inc.	\$57,112.00	\$0.00	-\$1.14
Evaluation of Ground Penetrating Radar as a Tool in Designing Maintenance and Rehab Projects in Mississippi	Allen Cooley	Burns Cooley Dennis, Inc.	\$89,996.00	\$22,468.20	\$408.45
Evaluate New Methods to Determine Type and Percentage of Stabilizer in a CSM Layer – Phase I	Allen Cooley	Burns Cooley Dennis, Inc.	\$130,000.00	\$71,654.49	\$37,810.01
Perform Tests on LTS and Fine-Grain Soils and Evaluate CSM Base Layer IDT Gradient	Allen Cooley	Burns Cooley Dennis, Inc.	\$115,000.00	\$43,263.51	\$71,736.49
Lessons Learned from SS 263 Data Collection for Local Calibration of the AASHTOWare Pavement ME Design Performance Models	Allen Cooley	Burns Cooley Dennis, Inc.	\$250,000.00	\$124,080.84	\$125,919.16
Phase I GPR Study – Investigate use of GPR to Evaluate Type and Extent of Pavement Distress	Allen Cooley	Burns Cooley Dennis, Inc.	\$315,000.00	\$5,314.24	\$309,685.76
Development of a Balanced Mix Design Procedure for Mississippi	Allen Cooley	Burns Cooley Dennis, Inc.	\$399,794.20	\$50,395.31	\$349,398.89
		<b>Burns Cooley Dennis, Inc.</b>	<b>\$2,052,827.46</b>	<b>\$331,694.79</b>	<b>\$940,959.60</b>
Research Practices Manual Development	Brian Hirt	<b>CTC &amp; Associates</b>	<b>\$99,524.00</b>	<b>\$41,424.47</b>	<b>\$14,446.64</b>

<b>Project Name</b>	<b>Researcher</b>	<b>PI Company</b>	<b>Total Study Budget</b>	<b>2020 Expenditures</b>	<b>Remaining Funds</b>
Transit Vehicle Specification Development	Randy Battey	Gresham Smith	\$76,502.64	\$39,660.09	\$36,842.55
Risk Assessment of MDOT Utility Coordination Processes	Randy Battey	Gresham Smith	\$213,721.78	\$92,139.09	\$121,582.69
		<b>Gresham Smith</b>	<b>\$290,224.42</b>	<b>\$131,799.18</b>	<b>\$158,425.24</b>
Calibration Factors for Safety Performance Functions	Richard Storm	<b>HDR Engineering</b>	<b>\$380,494.54</b>	<b>\$255,314.60</b>	<b>\$125,179.94</b>
MDOT Implementation of Pavement ME – Phase IV Study 1 of 2 - Update Plan of Implementation of AASHTOWare PMED based on MDOT-Funded Research	Chetana Rao	<b>Rao Research and Consulting</b>	<b>\$232,992.00</b>	<b>\$0.00</b>	<b>\$232,992.00</b>
Recycling Portland Cement Concrete Pavements using Rubblization and Fractured Slab Techniques	Athar Saeed	<b>Saeed &amp; Associates Consultants Inc.</b>	<b>\$200,000.00</b>	<b>\$937.86</b>	<b>\$199,062.14</b>
Data Elements for Bridge Design, Inspection, and Maintenance	Dave Tomley	<b>Thompson Engineering</b>	<b>\$85,926.35</b>	<b>\$24,837.94</b>	<b>\$61,088.41</b>

# In-House Studies

Project Name	Researcher	PI Company	Total Study Budget	2020 Expenditures	Remaining Funds
Research Division Support to Collection and Evaluation of Core Data for the MEPDG for Overlaid and New Pavements	Alex Middleton	Mississippi Department of Transportation	\$550,000.00	\$2,662.45	\$332,013.00
In-House Support to Chetana Rao's SMA/Distress Data Updates	Alex Middleton	Mississippi Department of Transportation	\$25,000.00	\$0.00	\$25,000.00
In-House Support to Rubblized/Recycled Concrete Studies	Alex Middleton	Mississippi Department of Transportation	\$25,000.00	\$0.00	\$25,000.00
<b>Mississippi Department of Transportation</b>			<b>\$600,000.00</b>	<b>\$2,662.45</b>	<b>\$382,013.00</b>

## Ended Studies

Project Name	Researcher	PI Company	Total Study Budget	2020 Expenditures	Remaining Funds
High Quality Simulation Training	Daniel Carruth	Mississippi State University	\$74,534.00	\$8,539.99	\$473.28
Permeability Reduction of Restrained Concrete in a Chloride-Rich Environment Phase I	Robert Varner	Burns Cooley Dennis, Inc.	\$57,112.00	\$0.00	-\$1.14
Performance Evaluation of Highway Slopes on Yazoo Clay	Mohammed Sadik Khan	Jackson State University	\$196,425.00	\$94,798.18	\$26,548.96
Evaluation of Ground Penetrating Radar as a Tool in Designing Maintenance and Rehab Projects in Mississippi	Allen Cooley	Burns Cooley Dennis, Inc.	\$89,996.00	\$22,468.20	\$408.45
Research Practices Manual Development	Brian Hirt	CTC & Associates	\$99,524.00	\$41,424.47	\$14,446.64
			<b>\$517,591.00</b>	<b>\$167,230.84</b>	<b>\$41,876.19</b>

# State Studies

State Study Number	State Study/Line Item Name	Notice to Proceed Date	Total Approved Study Budget	FY 2015 Federal Funds obligated	FY 2015 State Funds obligated	FY 2016 Federal Funds obligated	FY 2016 State Funds obligated	FY 2017 Federal Funds obligated	FY 2017 State Funds obligated	FY 2018 Federal Funds obligated	FY 2018 State Funds obligated	FY 2019 Federal Funds to be obligated	FY 2019 State Funds to be obligated	FY 2020 Federal Funds to be obligated	FY 2020 State Funds to be obligated	Federal Funds Spent Prior to FY 2020	State Funds Spent Prior to FY 2020	Total Funds Spent to Date	Total Funds Left to be Spent
	Mississippi Transportation Research Center	7/1/2018	\$359,959.00							\$287,967.20	\$71,991.80	\$0.00	\$0.00	\$0.00	\$0.00	\$49,999.80	\$12,499.97	\$62,499.87	\$297,459.13
263	Data Collection for Local Calibration of the AASHTOWare Pavement ME Design Performance Models for Mississippi	5/23/2017	\$695,925.26	\$0.00	\$0.00	\$556,740.21	\$139,185.05	\$0.00	\$0.00	\$0.00	\$0.00	\$41,724.64	\$10,431.16	\$0.00	\$0.00	\$550,048.70	\$137,512.18	\$687,560.88	\$8,364.38
265	Research Division Support to Collection and Evaluation of Core Data for the MEPDG for Overlayed and New Pavements	N/A	\$550,000.00	\$16,808.48	\$4,202.12	\$13,997.14	\$3,484.28	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$172,199.82	\$43,049.96	\$215,249.78	\$334,750.22
269	Development of a Setup Prediction Method and Implementation into LRPD Driven Pile Design in Mississippi soils	1/9/2017	\$143,282.00			\$114,625.60	\$28,656.40	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$73,647.06	\$18,411.76	\$92,058.82	\$51,223.18
272	MDOT Specific Design Procedure for Chip Seals	12/21/2017	\$395,639.00			\$316,511.20	\$79,127.80	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$8,078.08	\$2,019.52	\$10,097.60	\$385,541.40
273	Update and Documentation of MDOT Warranty Process and Distress Thresholds	8/26/2016	\$198,992.00			\$159,193.60	\$39,798.40	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$157,450.25	\$39,362.56	\$196,812.81	\$2,179.19
276	Soil-Cement Manual of Practice: Interconnected Framework for Pavement Design, Laboratory Mixture Design, and Construction Quality Control/Assurance	9/20/2016	\$350,000.00			\$280,000.00	\$70,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$64,400.00	\$16,100.00	\$0.00	\$0.00	\$113,503.51	\$28,375.88	\$141,879.39	\$208,120.61
277	Best Practices for Lighting and Marking Maintenance/ Construction Equipment for Safety		\$133,131.50					\$106,505.20	\$26,626.30	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.40	\$0.10	\$0.50	\$133,131.00
278	Calibration Factors for Safety Performance Functions	4/16/2019	\$380,500.00			\$380,500.00		\$240,000.00	\$60,000.00	\$0.00	\$0.00	\$64,400.00	\$16,100.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$380,500.00
279	High Quality Simulation Training	2/14/2018	\$74,534.46					\$59,627.57	\$14,906.89	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$46,933.38	\$11,733.34	\$58,666.72	\$15,867.74
281	Permeability Reduction of Restrained Concrete in a Chloride-Rich Environment Phase I	3/13/2018	\$87,903.07					\$70,322.46	\$17,580.61	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$45,690.51	\$11,422.63	\$57,113.14	\$30,789.93
283	Traffic Signal Performance Measures	1/29/2018	\$150,000.00					\$120,000.00	\$30,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$35,117.11	\$8,779.28	\$43,896.39	\$106,103.61
285	CSM Conversion Factors and Regression Parameters to Back Cast CSM Strength and Modulus	3/1/2018	\$150,000.00					\$120,000.00	\$30,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$31,708.67	\$7,927.17	\$39,635.84	\$110,364.16
286	Performance Evaluation of Highway Slopes on Yazoo Clay	2/27/2018	\$196,425.32					\$157,140.26	\$39,285.06	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$60,062.54	\$15,015.64	\$75,078.18	\$121,347.14
287	Evaluation of Ground Penetrating Radar as a Tool in Designing	10/3/2017	\$89,995.92					\$71,996.74	\$17,999.18	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$48,178.10	\$12,044.53	\$60,222.63	\$29,773.29
293	Highway Travel Time Estimation with Captured In-Vehicle Wi-Fi MAC Addresses: Mechanism, Challenges, Solutions and Applications	1/29/2018	\$199,878.00							\$159,902.40	\$39,975.60	\$0.00	\$0.00	\$0.00	\$0.00	\$19,411.48	\$4,852.87	\$24,264.35	\$175,613.65
294	Research Practices Manual Development	3/13/2018	\$99,524.89							\$79,619.91	\$19,904.98	\$0.00	\$0.00	\$0.00	\$0.00	\$33,218.74	\$8,304.69	\$41,523.43	\$58,001.46
295	Data Elements for Bridge Design, Inspection, and Maintenance	9/5/2019	\$85,926.35									\$68,741.08	\$17,185.27	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$85,926.35
296	Characterization of Combined Environmental Effects on Bituminous Paving Materials	2/28/2019	\$290,000.00									\$232,000.00	\$58,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$290,000.00
297	Transit Vehicle Specification Development	9/25/2019	\$76,502.64									\$61,202.11	\$15,300.53	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$76,502.64
298	Use of Artificial Neural Networks (ANN) to Predict Pavement Management Data Attributes	2/28/2019	\$300,000.00									\$240,000.00	\$60,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$300,000.00
300	Evaluate New Methods to Determine Type and Percentage of Stabilizer in a CSM Layer – Phase I	3/28/2019	\$130,000.00									\$104,000.00	\$26,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$130,000.00
301	Perform Tests on LTS and Fine-Grain Soils and Evaluate CSM Base Layer IDT Gradient		\$115,000.00									\$92,000.00	\$23,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$115,000.00
303	A Framework for Determining Value of MDOT Research Projects		\$200,000.00									\$160,000.00	\$40,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$200,000.00
304	Develop ELMOD Backcalculation User Manual for MDOT		\$125,000.00									\$100,000.00	\$25,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$125,000.00
305	Lessons Learned from SS 263 Data Collection for Local Calibration of the AASHTOWare Pavement ME Design Performance Models		\$250,000.00									\$200,000.00	\$50,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$250,000.00
306	Risk Assessment of MDOT Utility Coordination Processes	9/18/2019	\$213,721.78									\$170,977.42	\$42,744.36	\$0.00	\$0.00	(\$29,022.58)	(\$7,255.64)	(\$36,278.22)	\$250,000.00
307	Phase I GPR Study – Investigate use of GPR to Evaluate Type and Extent of Pavement Distress		\$315,000.00									\$252,000.00	\$63,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$315,000.00
308	Recycling Portland Cement Concrete Pavements using Rubblization and Fractured Slab Techniques--Testing Portion		\$248,000.00									\$140,000.00	\$38,000.00	\$58,400.00	\$14,600.00	\$0.00	\$0.00	\$0.00	\$248,000.00
309	Development of a Balanced Mix Design Procedure for Mississippi		\$523,000.00									\$418,400.00	\$104,600.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$523,000.00
311	Select pavement sections with SMA mixes and provide/update distress history for local calibration of Pavement ME models		\$232,992.00									\$186,393.60	\$46,598.40	\$0.00	\$0.00	\$793.60	\$198.40	\$992.00	\$232,000.00
312	Recycling Portland Cement Concrete Pavements using Rubblization and Fractured Slab Techniques--Main Study		\$200,000.00									\$145,360.00	\$36,340.00	\$14,640.00	\$3,660.00	\$0.00	\$0.00	\$0.00	\$200,000.00
313	In-House Support to Chetana Rao's SMA/Distress Data Updates		\$100,000.00									\$80,000.00	\$20,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$100,000.00
314	In-House Support to Rubblized/Recycled Concrete Studies		\$100,000.00									\$80,000.00	\$20,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$100,000.00
315	In-House Updates to PMS Deterioration Models and Budget Scenarios		\$200,000.00									\$160,000.00	\$40,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$200,000.00
316	Use of Electric Resistivity Imaging (ERI) on JSU Slide Sites for Slope Remediation Design of Yazoo Clay		\$300,000.00											\$240,000.00	\$60,000.00	\$0.00	\$0.00	\$0.00	\$300,000.00
317	UAS Delivery Network Safety		\$42,377.00											\$33,901.60	\$8,475.40	\$0.00	\$0.00	\$0.00	\$42,377.00
	<b>Totals</b>		<b>\$8,303,210.19</b>	<b>\$16,808.48</b>	<b>\$4,202.12</b>	<b>\$1,441,007.74</b>	<b>\$360,251.94</b>	<b>\$945,592.22</b>	<b>\$236,398.05</b>	<b>\$239,522.31</b>	<b>\$59,880.58</b>	<b>\$3,061,598.86</b>	<b>\$765,399.71</b>	<b>\$346,941.60</b>	<b>\$86,735.40</b>	<b>\$1,417,019.29</b>	<b>\$354,254.82</b>	<b>\$1,771,274.11</b>	<b>\$6,531,936.08</b>
	<b>FY 2020 Federal Funds to be obligated</b>																		<b>\$346,941.60</b>
	<b>FY 2020 State Funds to be obligated</b>																		<b>\$86,735.40</b>

# Pooled Funds

<b>Continuing Pooled Fund Studies</b>	<b>SPR Part II 100%</b>	<b>State Funds</b>
Accelerated Performance Testing on the 2018 NCAT Pavement Test Track	\$440,000.00	\$0.00
Superpave Regional Center, Southeastern Region	\$100,000.00	\$0.00
Improving the Quality of Highway Profile Measurement	\$20,000.00	\$0.00
Traffic Control Device (TCD) Consortium	\$15,000.00	\$0.00
Pavement Surface Properties Consortium – A Research Program at the Virginia Smart Road Phase II	\$20,000.00	\$0.00
Enhancement to the Intelligent Construction Data Management System (Veta) and Implementation	\$25,000.00	\$0.00
Performing Forensic Evaluations of LTPP Remaining Sections Before They Leave Service	\$50,000.00	\$0.00
Building Information Modeling (BIM) for Bridges and Structures	\$20,000.00	\$0.00
Connected Vehicle Pooled Fund Study	\$50,000.00	\$0.00
Traffic Safety Culture - Phase 2	\$25,000.00	\$0.00
Improve pavement surface distress and transverse profile data collection and analysis, Phase II	\$20,000.00	\$0.00
National Partnership to Determine the Life Extending Benefit Curves of Pavement Preservation Techniques (MnROAD/NCAT Joint Study – Phase II)	\$50,000.00	\$0.00
Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)	\$45,000.00	\$0.00
Design Guidelines and Mitigation Strategies for Reducing Sedimentation of Multi-Barrel Culverts	\$22,500.00	\$0.00
Roadside Safety Research for MASH Implementation	\$50,000.00	\$0.00
Evaluation of Low Cost Safety Improvements	\$30,000.00	\$0.00
Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)	\$25,000.00	\$0.00
2016 through 2020 Biennial Asset Management Conference and Training on Implementation Strategies	\$6,000.00	\$0.00
<b>Total Continuing Pooled Fund Studies</b>	<b>\$1,013,500.00</b>	<b>\$0.00</b>
<b>New Pooled Fund Studies</b>	<b>SPR Part II 100%</b>	<b>State Funds</b>
Traffic Control Device (TCD) Consortium New Solicitation)	\$75,000.00	\$0.00
No Boundaries Transportation Maintenance Innovations	\$60,000.00	\$0.00
Technology Exchange on Managing Pavements	\$12,500.00	\$0.00
<b>Total New Pooled Fund Studies</b>	<b>\$147,500.00</b>	<b>\$0.00</b>
<b>Rejoined Pooled Fund Studies</b>	<b>SPR Part II 100%</b>	<b>State Funds</b>
<b>Total Rejoined Pooled Fund Studies</b>	<b>\$0.00</b>	<b>\$0.00</b>
	<b>SPR Part II 100%</b>	<b>State Funds</b>
<b>Total FY 2019 Pooled Fund Study Expenditures</b>	<b>\$1,161,000.00</b>	<b>\$0.00</b>

# AASHTO TPSs

<b>FY 2020 AASHTO TSP's</b>		
<b>ITEM</b>	<b>SPR Part II 100%</b>	<b>State Funds</b>
AASHTO re:source	\$20,000.00	\$0.00
<b>Total FY 2020 AASHTO TSP's (November Invoices)</b>	<b>\$20,000.00</b>	<b>\$0.00</b>
<b>FY 2021 AASHTO TSP's</b>		
<b>ITEM</b>	<b>SPR Part II 100%</b>	<b>State Funds</b>
AASHTO Innovative Initiative (All) (Formerly TIG)	\$6,000.00	\$0.00
AASHTO Equipment Management Technical Services Program (EMTSP)	\$5,000.00	\$0.00
AASHTO Load and Resistance Factor Design (LRFD) Bridges and Structures Specification Maintenance (LRFDSM)	\$15,000.00	\$0.00
AASHTO Technical Service Program to Develop AASHTO Materials Standards (DAMS)	\$10,000.00	\$0.00
AASHTO National Transportation Product Evaluation Program (NTPEP)	\$20,000.00	\$0.00
AASHTO Transportation System Preservation (TSP2)	\$20,000.00	\$0.00
AASHTO Safe, Reliable, and Secure Transportation Operations (SAFETY)	\$10,000.00	\$0.00
AASHTO Snow and Ice Cooperative Program (SICOP)	\$4,000.00	\$0.00
AASHTO Transportation Curriculum Coordination Council	\$20,000.00	\$0.00
AASHTO Operations Technical Services Program/ National Operations Center of Excellence (NOCoe)	\$15,000.00	\$0.00
AASHTO Resilient and Sustainable Transportation Systems (RSTS)	\$10,000.00	\$0.00
AASHTO Design Publication Maintenance (DPM)	\$15,000.00	\$0.00
AASHTO Environmental Technical Assistance Program (ETAP)	\$10,000.00	\$0.00
<b>Total FY 2021 AASHTO TSP's (July Invoices)</b>	<b>\$160,000.00</b>	<b>\$0.00</b>
<b>Total Work Program AASHTO TSP Expenditures</b>	<b>\$180,000.00</b>	<b>\$0.00</b>

# Federal Programs

ITEM	SPR Part II 100%	State Funds	Total
NCHRP Mississippi Participation 100% Federal	\$579,972.00	\$0.00	\$579,972.00
TRB Correlation Service 100% Federal	\$130,000.00	\$0.00	\$130,000.00

# Line Item

## Minor Research Studies

Low cost/short duration projects may be done without being put into a process of clearances and competing with other programs. An example of such a project is an experimental feature evaluation. The Research Advisory Committee will establish a resource threshold to be met before requiring any project be put into a centralized clearinghouse/priority setting process. Current operating procedures are to conduct research projects where the expenditure ceiling is expected to be under \$25,000 and the project duration is expected to be one year or less. These are based on selection and approval by the Research Engineer, following an appropriate review of District needs and literature review. Additionally, support for national efforts coordinated by organizations such as AASHTO, will be funded by this line item.

**FY 2020 Budget:** \$50,000.00

# State Studies

**State Study #:**

## Mississippi Transportation Research Center

**Start Date:** 07/01/2018

**End Date:** 06/30/2022

**Total Study Budget:** \$359,959.00

**Total Spent to Date:** \$31,786.48

**FY Expenditures:** \$31,786.48

**Research Agency:** Mississippi State University

**Researcher:** Dennis Truax

### Objective:

The Mississippi Transportation Research Center will function to conduct scholarly research designed to advance current transportation-related technologies in the state of Mississippi. It will serve to support educational opportunities for MDOT personnel, and others associated with the MDOT, to strengthening of their professional expertise, enhancement their work-related effectiveness, and advance their professional careers. MTRC will engage in information exchange with peer transportation centers and other identified organizations and corporate entities as deemed appropriate by MDOT. Finally, this center will develop, execute, and administer work assignments under the Master Agreement. As part of this latter function, the faculty and staff working to support MTRC will provide on-campus administration of awarded research projects while the MDOT Consulting Services Unit maintains overall administration of projects for MDOT.

**State Study #:** 263

## **Data Collection for Local Calibration of the AASHTOWare Pavement ME Design Performance Models for Mississippi.**

**Start Date:** 05/23/2017

**End Date:** 12/31/2021

**Total Study Budget:** \$695,925.26

**Total Spent to Date:** \$635,405.08

**FY Expenditures:** \$292,317.46

**Research Agency:** Burns Cooley Dennis, Inc.

**Researcher:** Allen Cooley

### **Objective:**

The Mechanistic-Empirical Pavement Design Guide (MEPDG) method for designing pavement structures utilizes mechanistic materials properties combined with other inputs to predict pavement performance using user inputs. Pavement performance models are used for this prediction of pavement performance. The pavement performance models are based upon national predictive models that are likely not applicable to Mississippi. This research project is designed to provide the required information for the calibration of these performance models for Mississippi materials and conditions. A number of test pavement sections will be visited, evaluated, sampled, and tested. Following these activities site reports will be prepared for each individual site that provides the information required for this calibration of the pavement performance models to local conditions.

### **Progress:**

#### **FY 2020:**

The original field and laboratory work has been completed. Work is underway on the input forms necessary for the future local calibration efforts.

**State Study #:** 265

## **Research Division Support to Collection and Evaluation of Core Data for the MEPDG for Overlaid and New Pavements**

**Start Date:** 05/23/2017

**End Date:** 12/31/2021

**Total Study Budget:** \$550,000.00

**Total Spent to Date:** \$215,249.78

**FY Expenditures:** (\$22,260.60)

**Research Agency:** Mississippi Department of Transportation

**Researcher:** Alex Middleton

### **Objective:**

The Research Division in-house support to State Study (SS) 263 will provide falling weight deflectometer (FWD) field testing and FWD data analysis to characterize in-situ moduli of pavement layers at each project site used for local calibration of MEPDG performance models. Extensive coordination between principal investigator of SS No. 263 and MDOT District traffic control personnel will be performed via this support study as well as review of site reports generated as a deliverable of SS 263.

### **Progress:**

#### **FY 2020:**

Continued support of SS263 in providing supplemental information and field data.

**State Study #:** 269

## **Development of a Setup Prediction Method and Implementation into LRFD Driven Pile Design in Mississippi soils**

**Start Date:** 01/09/2017

**End Date:** 12/31/2020

**Total Study Budget:** \$143,282.00

**Total Spent to Date:** \$92,058.82

**FY Expenditures:** \$92,058.82

**Research Agency:** University of South Alabama

**Researcher:** Eric J. Steward

### **Objective:**

Geotechnical engineering, and pile driving in particular, contains a significant amount of uncertainties in the design process. At this point in time, a pile foundations' increase in strength or bearing capacity, over time cannot be quantified. Determination of this long-term bearing capacity can influence both the required pile size and embedment depth and, in turn, would lower project costs considerably. This study intends to develop a pile loading database for MDOT as well as calibrate regionally specific resistance factors required for LRFD (Load Resistance Factor Design) for MDOT projects.

### **Progress:**

#### **FY 2020:**

Tasks C4 and C5 have been completed. New Graduate and Undergraduate students have been hired and the LRFD resistance factor calibrations have been completed. Also, half of C6 has also be completed.

**State Study #:** 272

## **MDOT Specific Design Procedure for Chip Seals**

**Start Date:** 12/21/2017

**End Date:** 12/31/2022

**Total Study Budget:** \$395,639.00

**Total Spent to Date:** \$10,097.60

**FY Expenditures:** \$9,996.49

**Research Agency:** Mississippi State University

**Researcher:** Isaac Howard

### **Objective:**

Historically, the Department has used chip seals as a preventative maintenance treatment on low traffic rural routes. Developing a methodology to design and evaluate the performance of the design is important to produce a cost effective and long lasting product. Currently, the Department sets target application rates for the binder and aggregate based on general material properties. In addition, the current specifications do not make allowance for the condition of the roadway at the time of placement of the chip seal. Basic chip seal design procedures are needed to establish the binder and aggregate application rates considering the actual component materials, environmental factors, traffic, and existing roadway surface condition. As a part of the design procedure, a test method or methods are needed to evaluate the chip seal design to help ensure the durability of the chip seal and help establish construction criteria for rolling, sweeping, and opening to traffic.

### **Progress:**

#### **FY 2020:**

Progress was modest in FY2020. This project has yet to get considerable momentum for a variety of reasons. Some of them include diverting efforts to MDOT funded projects that are further along (i.e. SS 276, 285, and 296) that needed experiments to progress to avoid significant setbacks from COVID-19 and an anticipated move to a new facility. Other challenges have included students who were expected to engage in this project choosing not to do so for a few reasons and project delays associated with COVID-19 (e.g. ETF project meeting that occurred in January of 2020 were impossible to execute in the current environment). There have continued to be model data collection, literature review, and the like. Fortunately, spending has been low, so this project is still set to be successful, it is just materializing slower than would be ideal.

**State Study #:** 276

## **Soil-Cement Manual of Practice: Interconnected Framework for Pavement Design, Laboratory Mixture Design, and Construction Quality Control/Assurance**

**Start Date:** 09/20/2016

**End Date:** 12/31/2021

**Total Study Budget:** \$350,000.00

**Total Spent to Date:** \$141,879.39

**FY Expenditures:** \$43,606.80

**Research Agency:** Mississippi State University

**Researcher:** Isaac Howard

### **Objective:**

Develop a soil-cement manual of practice for MDOT that focuses on integrating pavement layer thickness design (MEPDG), laboratory mixture design, and construction quality control/assurance.

### **Progress:**

#### **FY 2020:**

Other than field work as needed on upcoming projects, practically all testing was finished in FY2020. It is possible that a few experiments might be needed as analysis and reporting progress, but most testing is complete. Completing of testing and analysis were priorities for FY2020. COVID-19 and our department's anticipated move to a new facility have complicated progress relative to normal circumstances and have adjusted to some extent the progression of this work. The research team put a very high priority on completing experiments during FY2020, as moving to a new facility is expected to prohibit laboratory experiments for several consecutive weeks. Overall, FY2020 made respectable progress, but it was weighted very heavily toward experiments, which has led to analysis and writing needs to be a priority for FY2021 alongside any needed field projects as those have been somewhat difficult to identify as well.

**State Study #:** 277

## **Best Practices for Lighting and Marking Maintenance/ Construction Equipment for Safety**

**Start Date:** 10/17/2019

**End Date:** 06/30/2021

**Total Study Budget:** \$133,131.50

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** University of Texas at San Antonio

**Researcher:** Tulio Sulbaran

### **Objective:**

MDOT seeks to improve the safety practices of lighting and marking vehicles and equipment to improve safety for its employees and contractors while on a jobsite. Improved lighting and marking on work vehicles and equipment should increase awareness of their presence to the travelling public. Employees' lives are invaluable and putting the best resources towards protecting them is an easy decision. The findings from this study will allow MDOT to implement better standards for marking and lighting its own vehicle fleet as well as for contractor vehicles and equipment that is used on DOT projects. The goal of the improved standards is to make working on the roadways safer for everyone.

### **Progress:**

#### **FY 2020:**

Held-Kick Off Meeting. Hire Student Assistant. Research Literature Review. Started Review of DOTs Standards and Provisions. Held progress meeting with MDOT TAC.

**State Study #:** 278

## **Calibration Factors for Safety Performance Functions**

**Start Date:** 04/16/2019

**End Date:** 06/30/2021

**Total Study Budget:** \$380,500.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** HDR Engineering

**Researcher:** Richard Storm

### **Objective:**

Safety Performance Functions (SPFs) are equations that estimate expected average crash frequency as a function of traffic volume and roadway characteristics (e.g., number of lanes, median type, intersection control, number of approach legs). SPFs are developed through statistical regression modeling using historical crash data and are used to enable the correction of short-term crash counts. MDOT seeks to develop local calibration factors for the Safety Performance Functions used in the Highway Safety Manual (HSM) predictive method. SPF calibration factors tailored for the local conditions and crash frequency within Mississippi will help MDOT identify high-priority locations in which taxpayer dollars will be better utilized to keep the travelling public safe. The development of these SPF calibration factors will help better automate the crash prediction process within the Safety Analysis Management System (SAMS) program used by the MDOT Traffic Engineering Division. The SPF calibration factors will help MDOT prioritize the spending of approximately \$35 million in Highway Safety Improvement Program (HSIP) funds annually.

### **Progress:**

#### **FY 2020:**

This project was kicked off in FY2019 and has been substantially completed. Progress to date includes development of technical memorandums documenting data to be used in the calibration (Technical Memorandums #1 and #3), calculation of calibration factors and model fit tests for HSM Part C safety performance functions (SPF) (Technical Memorandums #2), calibration and testing of model fits for the new NCHRP 17-58 and 17-68 SPF's (Technical Memorandums #4), the development of two new SPF's for rural two-way two-lane segments and rural multilane four-leg minor road stop control intersections (Technical Memorandums #6 and #7, respectively), and a draft of the technical report documenting the project's process and findings. Additionally, the team has provided MDOT with ongoing support for implementation of the SPF's in SAMS II (Technical Memorandum #5).

**State Study #:** 279

## **High Quality Simulation Training**

**Start Date:** 02/14/2018

**End Date:** 12/31/2019

**Total Study Budget:** \$74,534.46

**Total Spent to Date:** \$58,666.26

**FY Expenditures:** \$58,666.26

**Research Agency:** Mississippi State University

**Researcher:** Daniel Carruth

### **Objective:**

Training for equipment operators and transit bus drivers is generally done on the job. Some agencies have begun using simulation training to teach new employees, as well as to train existing employees on new technology, for various types of equipment and buses. Simulation training is already used in aviation, marine transportation, and other industries. MDOT would like to begin looking at the use of simulators and virtual technology to train maintenance and transit staff by doing a synthesis research study. Maintenance simulation would initially focus on mowing because of the risk of turnover and training needed for new personnel to operate in the right-of-way. Transit simulation would focus on buses.

**State Study #:** 281

## **Permeability Reduction of Restrained Concrete in a Chloride-Rich Environment Phase I**

**Start Date:** 03/13/2018

**End Date:** 06/30/2020

**Total Study Budget:** \$87,903.07

**Total Spent to Date:** \$57,113.14

**FY Expenditures:** \$57,113.14

**Research Agency:** Burns Cooley Dennis, Inc.

**Researcher:** Robert Varner

### **Objective:**

MDOT is now requiring waterproofing (permeability reducing) admixtures in bridge deck overlays in an effort to improve the long-term performance of bridges. These admixtures reportedly reduce permeability of concrete by plugging pores and capillaries throughout the entire mass of concrete. These admixtures react with water and cement hydration by-products to either formulate coalescing polymer globules or crystalline structures that seal pores, capillary tracts and micro cracks in hardened concrete. This makes hardened concrete less permeable to water and chemicals that corrode the reinforcing steel and create costly repairs. While some manufacturers note that these chemicals exceed performance requirements of industry standards such as ASTM C494 Type S, limited data is provided to document their performance in a bridge deck. Bridge structures create a restrained system for concrete shrinkage and many Mississippi bridges are exposed to chloride ions when salt is broadcast on the decks in winter months. This laboratory study will use testing equipment and chloride ion exposure to simulate these field conditions. Data compiled from this study will provide MDOT Engineers with information needed to verify that ordinary portland cement (OPC) or portland limestone cement (PLC) combined with these admixtures will reduce the permeability of portland cement concrete (PCC) in bridges. In addition, a testing protocol will be developed for MDOT to use for evaluating and approving future permeability reducing admixtures submitted to MDOT. This study will use forty-one laboratory mixtures to develop data to evaluate waterproofing admixtures that are currently approved for use on MDOT projects. Hardened concrete properties that will be evaluated include: 1) compressive strength; 2) restrained shrinkage cracking tendency; 3) chloride ion profile; 4) rapid chloride permeability; and 5) surface resistivity. The experimental mixtures will include Mississippi gravel aggregates and fine lightweight aggregate. The maximum nominal sizes of coarse aggregate will be No. 57 or No. 67 for bridge deck mixtures and No. 7, No. 78, or No. 8 for overlay mixtures. Mixtures will be developed with a blend of either OPC or PLC and supplementary cementitious materials (SCM's) meeting the requirements of concrete mixtures for bridge decks and bridge deck overlays provided in special provision 907-804-20. Only one source of OPC, PLC, and SCMs will be utilized. Eighteen of these mixtures will focus on bridge deck overlays. The overlay mixtures will include compressive strengths ranging from 2,500 psi to 3,000 psi at 24 or 72 hours. The

remaining twenty-three mixtures will meet requirements for bridge decks and will include both normal weight and lightweight fine aggregates for the purpose of internal curing.

**State Study #:** 283

## **Performance Measures for Traffic Signal Systems**

**Start Date:** 01/29/2018

**End Date:** 06/30/2021

**Total Study Budget:** \$150,000.00

**Total Spent to Date:** \$43,896.39

**FY Expenditures:** \$43,896.39

**Research Agency:** Mississippi State University

**Researcher:** Li Zhang

### **Objective:**

MDOT seeks assistance to define performance measures that can be introduced into system specifications that will allow MDOT to measure the performance of its traffic signal systems. Data is continuously being collected along signalized corridors in the way of travel times (via Bluetooth readers) and traffic volumes. However, there is a need to be able to convert this big data into useful information. These performance measures, as monitored in periodically generated reports for certain periods of the day, will give indication of system deficiencies and failures which will allow MDOT to be proactive in addressing these issues and ultimately improve signal system operations.

### **Progress:**

#### **FY 2020:**

Task 1 Literature Review of Signal Performance Measurement System (Draft)

Task 2 Survey Questions for DoTs and Local Agencies (70% complete)

Task 3 Traffic control system assessment

Task 4 Initial Performance Measures Recommendations

Task 5. Performance measure process development

Task 6. Prototype Demonstrations (60% complete)

Task 7: Travel, Quarterly reports and Final Report (70% complete)

**State Study #:** 285

## **CSM Conversion Factors and Regression Parameters to Back Cast CSM Strength and Modulus**

**Start Date:** 03/01/2018

**End Date:** 12/31/2021

**Total Study Budget:** \$150,000.00

**Total Spent to Date:** \$39,635.84

**FY Expenditures:** \$34,855.16

**Research Agency:** Mississippi State University

**Researcher:** Isaac Howard

### **Objective:**

The AASHTOWare Pavement ME Design software requires a 28-day Modulus of Rupture (MOR) for characterizing the strength, and a 28-day elastic modulus (E) for characterizing the stiffness, of a cementitious stabilized material (CSM) base layer. Cored field samples of CSM will be obtained as part of the data collection effort to locally calibrate the Pavement ME transfer functions. The age of these samples correspond to the period of time from initial construction to time of sampling; i.e., 10 – 20 years, not 28 days as required by Pavement ME. Further, Mississippi DOT has not evaluated the MOR for CSMs typically used in Mississippi. Since laboratory testing for CSM MOR is time consuming, level two correlation factors are required to estimate MOR from either CSM indirect tension (IDT) or unconfined compressive strength (UCS) tests. In this study MOR, IDT, UCS, and E will be evaluated for typical Mississippi blends of CSM. Conversion factors will be developed between each of the three strength characterizations and between UCS and E. Strength and modulus regression parameters will be developed to back cast strength and modulus from age of cored samples to 28 days.

### **Progress:**

#### **FY 2020:**

This project was given a no-cost extension to December 31, 2021 and the scope of this project has aligned with SS 276. As such reporting for SS 276 and SS 285 (technical content) are expected to be combined in at least some cases. As with SS 276, experiments were prioritized due to COVID-19 and our pending move to a new facility. For practical purposes, all experiments are finished. Statistical analysis, writing, back casting equations, and so forth did not receive considerable attention this year but with data collected, this year was successful and puts this project on track to be successful.

**State Study #:** 286

## **Performance Evaluation of Highway Slopes on Yazoo Clay**

**Start Date:** 02/27/2018

**End Date:** 06/30/2020

**Total Study Budget:** \$196,425.32

**Total Spent to Date:** \$75,078.18

**FY Expenditures:** \$75,078.18

**Research Agency:** Jackson State University

**Researcher:** Mohammed Sadik Khan

### **Objective:**

Slope failures are frequent in highway embankments on expansive Yazoo clay in Mississippi due to the rainfall and climatic variation and cause maintenance problems to MDOT. The objective of the current study is to investigate the infiltration behavior of the slope on expansive Yazoo clay during rainfall using field monitoring and evaluate its impact on safety of the slope. Six repaired highway slopes will be instrumented comprehensively to monitor the moisture, matric suction, and temperature variation, and monitoring the deformation using vertical inclinometers and topographic survey. Besides field monitoring, advanced numerical modeling using Finite Element Method (FEM) will be conducted to evaluate the effect of different frequency and duration of rainfall (based on historical rainfall data of Mississippi) on the water intrusion and corresponding change in factor of safety of the highway slope. Finally, the field monitoring data and FEM analysis results will be combined together to evaluate the performance of the repaired slope.

**State Study #:** 287

## **Evaluation of Ground Penetrating Radar as a Tool in Designing Maintenance and Rehab Projects in Mississippi**

**Start Date:** 10/03/2017

**End Date:** 12/31/2019

**Total Study Budget:** \$89,995.92

**Total Spent to Date:** \$60,222.63

**FY Expenditures:** \$32,070.02

**Research Agency:** Burns Cooley Dennis, Inc.

**Researcher:** Allen Cooley

### **Objective:**

A large portion of MDOT's construction budget is spent on maintenance and rehabilitation (M&R) of existing roadways. An important aspect of evaluating existing pavements during the design of M&R treatments is coring. Cores provide the designer an indication of pavement condition. Currently, cores are cut randomly or based upon visual observation of the pavement surface. A tool that assists the designer in selecting more appropriate core locations would provide the designer better data for the design. One such tool that may be of benefit is the ground penetrating radar (GPR). A GPR is equipment that transmits electromagnetic energy into the ground (or pavement). When this energy encounters a discontinuity within the pavement structure, the energy is reflected or refracted back toward the surface. A receiving antenna then records the variations in the return signal. Because of its ability to identify these discontinuities within a pavement structure, the GPR has the potential of identifying pavement distresses or conditions that are not visible at the pavement surface. The objective of this study will be to evaluate whether the GPR can be used as a tool to assist an Engineer design M&R treatments by better identifying questionable areas for further evaluation

**State Study #:** 293

## **Highway Travel Time Estimation with Captured In-vehicle Wi-Fi MAC Addresses: Mechanism, Challenges, Solutions and Applications**

**Start Date:** 02/27/2018

**End Date:** 06/30/2021

**Total Study Budget:** \$199,878.00

**Total Spent to Date:** \$24,264.35

**FY Expenditures:** \$21,010.43

**Research Agency:** Mississippi State University

**Researcher:** Li Zhang

### **Objective:**

This study will investigate the merits of estimating travel time with Wi-Fi versus the in-place Bluetooth method. Wi-Fi can yield a bigger sample size since most people have personal devices and yield more data.

### **Progress:**

#### **FY 2020:**

Task 1: Intersection Inventory and Wi-Fi Antenna test

Task 2: Wi-Fi Sensor development

Task 3 Travel time visualization (70% Complete)

Task 4: Travel time estimation (60% complete)

Task 5 : Sensor upgrade

Task 6: Test and optimize Wi-Fi+PCD system (50%)

**State Study #:** 294

## **Research Practices Manual Development**

**Start Date:** 03/13/2018

**End Date:** 06/30/2020

**Total Study Budget:** \$99,524.89

**Total Spent to Date:** \$41,522.54

**FY Expenditures:** \$26,949.36

**Research Agency:** CTC & Associates

**Researcher:** Brian Hirt

### **Objective:**

The purpose of this study is to develop a set of manuals and training materials regarding the operating procedures for MDOT's Research Division and its processes. In order to preserve knowledge as staff changes and to convey operating procedures to outside consultants, procedural manuals will be updated and/or created, and training materials will be developed. Interactive, electronic training materials along with traditional printed materials will be produced with the goal of being easily understandable for Research division staff as well as those with outside interests.

**State Study #:** 295

## **Data Elements for Bridge Design, Inspection, and Maintenance**

**Start Date:** 09/05/2019

**End Date:** 06/30/2021

**Total Study Budget:** \$85,926.35

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Thompson Engineering

**Researcher:** Dave Tomley

### **Objective:**

MDOT seeks to discover what data elements are needed to optimize bridge life cycles, design, construction, and maintenance. Some elements are already in AASHTOWare; however, there may be gaps that need to be addressed. This study will identify gaps and capture what each element means (i.e., metadata) and how each will be used.

### **Progress:**

#### **FY 2020:**

Work to date has included having the project kick-off meeting on 10/9/2019, performing a literature search, meeting with MDOT District 6 on 11/25/2019, meeting with Technical Advisory Committee on 2/6/2020, meeting with MDOT District 2 on 3/16/2020, and reviewing MDOT's current data elements.

**State Study #:** 296

## **Characterization of Combined Environmental Effects on Bituminous Paving Materials**

**Start Date:** 02/28/2019

**End Date:** 06/30/2023

**Total Study Budget:** \$290,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Mississippi State University

**Researcher:** Isaac Howard

### **Objective:**

Over the past 6.5 years, the Construction Materials Research Center (CMRC) within the Mississippi State University (MSU) department of Civil & Environmental Engineering (CEE) has been active in assessing time dependent and combined environmental effects on paving materials. A considerable amount of this work has been funded by MDOT and supported by industry, and a central component of this work has been a test section in Columbus, MS. This proposal, if funded, would continue the field aging work in Columbus, but would also expand CMRC's efforts and include time dependent assessments on projects in other areas for multiple damage mechanisms. Several areas are envisioned to be monitored for time dependent environmental effects and/or usage pattern effects across MDOT's network. The aforementioned Columbus test section itself would be one of those items. In addition Stone-Matrix Asphalt (SMA) is to be evaluated for mixing temperature and other relevant effects by way of cores or gyratory compacted specimens that would be placed on top of the full-scale Columbus parking lot test sections that have been in place since 2011. Alongside the SMA, cores or gyratory compacted specimens are also to be aged at the Columbus test section that are produced with Dense-Graded Asphalt (DGA) to widen the knowledge base of aging that has already been initiated. A fourth area of interest is monitoring pavement infiltration over time for several types of projects and pavement surfaces of interest to MDOT; infiltration monitoring is expected for Open Graded Friction Course (OGFC) with and without treatments, thin lift joints, and composite treatments such as scrub seals with a thin overlay. The final item to be assessed for time dependent and/or usage pattern effects are shoulder aggregates. This study's objectives are as follows: (1) Improve understanding of field aging of asphalt mixtures; (2) Provide clarity on mixing temperature effects on SMA; (3) Characterize water infiltration resistance over time of several pavement surfaces, and (4) Improve MDOT shoulder aggregate practices.

### **Progress:**

**FY 2020:**

Considerable progress occurred during FY2020. Shoulder aggregate test sections are built and being evaluated, SMA field work is complete and specimens are being field aged, DGA specimens are being field aged, the Columbus parking lot had over 500 cores removed in November of 2019, and all associated lab work progressed as needed. In that SS 296 is fairly time sensitive in several aspects, laboratory and field work was prioritized over some other MDOT projects (e.g. SS 272) due to factors associated with COVID-19 and our pending move to a new facility. SS 296, experiments wise, is doing very well. Field work related to infiltration is behind, but that couldn't be avoided this year, and field projects are to be sought in the future. Analysis and writing was very modest as nearly all efforts focused on experiments.

**State Study #:** 297

## **Transit Vehicle Specification Development**

**Start Date:** 09/25/2019

**End Date:** 06/30/2021

**Total Study Budget:** \$76,502.64

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Gresham Smith

**Researcher:** Randy Battey

### **Objective:**

This proposed study will focus on transit vehicle specification development and review of sample specifications. It has the objective of thoroughly assessing the applicability of various specifications through peer comparison of selected state DOT's. A synthesis will be done on best practices of writing transit vehicle specs and the applicability of the specifications when factors such as various operating environments and maintenance practices are considered. The study will look at vehicle specification attributes such as suspension types, gross vehicle weights, electrical systems, drive train components, body construction etc., and will cover a range of vehicle types from 6 passenger vans to 45-passenger buses.

### **Progress:**

#### **FY 2020:**

Task C1 - Project Initiation - 100% completed. Project kickoff meeting was held with MDOT staff and consultant team on October 10, 2019. Task C2 - Existing Vehicle Specs Development Process - 100% completed. Received and reviewed existing specs and description of existing process. Held subrecipient meeting on December 5, 2019. Task C3 - Literature Review - 100% completed. Completed summary of national best practices, including APTA and FTA. Task C4 – Other State DOT Practices and Procedures - 100% completed. Completed survey of State DOTs and initial review of results, including responses from five surrounding state DOTs. Task C5 - Develop Model Specifications - 100% completed. Completed template of model specifications. Task 6 - Present and Discuss - 50% completed. Held second technical advisory committee meeting on March 3, 2020 and completed draft interim report.

**State Study #:** 298

## **Use of Artificial Neural Networks (ANN) to Predict Pavement Management Data Attributes**

**Start Date:** 02/28/2019

**End Date:** 06/30/2021

**Total Study Budget:** \$300,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** University of Mississippi

**Researcher:** Hakan Yasarer

### **Objective:**

MDOT has a pavement management system (PMS), which began in the late 1980s, for which the University of Mississippi (UM) did the original studies and models. We have collected condition and distress data approximately every two years since 1991, with imaging and other technology changing throughout. We have decision trees, as well as prediction models developed in the form of Markov transition probability matrices; however, we would like to take another look at the models. The models apply to attributes such as various types of cracking, roughness (IRI), rutting, and faulting. Artificial neural networks (ANN) offer a possibility for updating and simplifying these models. This study will investigate the possibility of using ANN to update the PMS prediction models.

### **Progress:**

#### **FY 2020:**

Task 3 (PIs will clean, organize, and cluster the raw data provided by MDOT personnel for ANNs modeling purposes) was completed. Task 4 (Artificial Neural Network Modelling for Asphalt Pavement – Flex Systems) was successfully carried out. 7 Static and 10 dynamic models were developed. 3 models were selected to be utilized in the final version. The task completion is about 90%. The graphical user interface development is in process. There are updates to be made to the models since the new survey data and ESAL data is now fully available. Task 5 was initiated and proceeded about 60%. Further verifications are in process. Task 6 was proceeded about 30%.

**State Study #:** 300

## **Evaluate New Methods to Determine Type and Percentage of Stabilizer in a CSM Layer – Phase I**

**Start Date:** 03/28/2019

**End Date:** 12/31/2021

**Total Study Budget:** \$130,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Burns Cooley Dennis, Inc.

**Researcher:** Allen Cooley

### **Objective:**

The proposed research will evaluate the feasibility of using petrographic analysis, x-ray fluorescence (XRF), and x-ray diffraction (XRD) to determine both type and percent of stabilizer in a given sample of CSM. If this phase I effort proves feasible then a phase II will be recommended for applying these techniques to multiple sections included in the SS No. 263 research effort as well as for future use in estimating requisite CSM inputs to Pavement ME for design of rehabilitation projects. In addition, this proposed work assignment will assist MDOT with the effort to calibrate the Pavement ME performance models. This will include completing the AASHTOWare Pavement ME Design Input form for each of the 65 sample sections included in SS 263.

### **Progress:**

#### **FY 2020:**

Testing of samples of known stabilizer type and percentage has been completed. Work has been conducted on evaluating and inputting data for inclusion in the local calibration efforts.

**State Study #:** 301

## **Perform Tests on LTS and Fine-Grain Soils and Evaluate CSM Base Layer IDT Gradient**

**Start Date:** 10/24/2019

**End Date:** 12/31/2021

**Total Study Budget:** \$115,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Burns Cooley Dennis, Inc.

**Researcher:** Allen Cooley

### **Objective:**

The proposed research leverages work being performed in the ongoing MDOT funded State Study (SS) No. 263, "Data Collection for Local Calibration of the AASHTOWare Pavement ME Design Performance Models for Mississippi," by performing additional tests on Shelby tube samples of fine grain subgrade soils and cores of cementitious stabilized material (CSM) already being collected via SS No. 263. The C-Factor for fine grain soils will be used to convert subgrade soil backcalculated modulus values to equivalent laboratory derived resilient modulus values for input into Pavement ME when performing a rehabilitation design of an existing pavement constructed on fine grain subgrade soils. If the existing pavement also includes a lime treated subgrade layer then the appropriate C-Factor may be applied to the backcalculated modulus of that layer to provide a resilient modulus input value to Pavement ME for that layer.

### **Progress:**

#### **FY 2020:**

All IDT testing has been completed on samples of stabilized materials. Resilient modulus testing has been initiated.

**State Study #:** 303

## **A Framework for Determining Value of MDOT Research Projects**

**Start Date:** 06/03/2020

**End Date:** 12/31/2021

**Total Study Budget:** \$200,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Mississippi State University

**Researcher:** Seamus Freyne

### **Objective:**

A Framework for Determining Value of MDOT Research Projects

### **Progress:**

#### **FY 2020:**

The PI met with TAC members Cindy Smith, Bill Barstis, and Alex Middleton on June 16, 2020 via Zoom to commence the study. Work has started on an extensive literature review that includes several national reports (NCHRP), regional reports (Southeast Transportation Consortium), state reports (from GA, FL, NC, MT, MN, and a few others), and journal, conference, and magazine articles (from the TRR most commonly). The PI virtually attended the AASHTO National Research Advisory Committee (RAC) and TRB State Reps Meeting from July 20 to 23, 2020.

**State Study #:** 304

## **Develop ELMOD Backcalculation User Manual for MDOT**

**Start Date:** 07/23/2020

**End Date:** 12/31/2021

**Total Study Budget:** \$125,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Applied Research Associates, Inc.

**Researcher:** Alvaro Ulloa-Calderon

### **Objective:**

The manual will provide knowledge capture and accelerate training and onboarding for the routine backcalculation process, as well as illustrate some examples of atypical results/situations and how to handle these.

### **Progress:**

#### **FY 2020:**

Conducted the kickoff meeting with MDOT staff. Initiated the comprehensive site report and available related material review. Contacted Dynatest Denmark to identify steps needed to develop an export tool in ELMOD

**State Study #:** 305

## **Lessons Learned from SS 263 Data Collection for Local Calibration of the AASHTOWare Pavement ME Design Performance Models**

**Start Date:** 10/17/2019

**End Date:** 06/30/2021

**Total Study Budget:** \$250,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Burns Cooley Dennis, Inc.

**Researcher:** Allen Cooley

### **Objective:**

The objectives of this study are to evaluate the results of SS263 (the big field study), look at distress formation and progression, look for relationships between material properties and types of distresses, and identify the biggest pavement-related issues for MDOT. The benefits of this study include better data for the study in #1 above and Pavement ME, capture and advance of knowledge of pavement materials/design/construction, and close some of the feedback loop between these areas. This could also be valuable to pavement management in terms of feedback, repair decisions, decision tree tweaking, and performance prediction for optimization. The study proposes a lead-in to a rehabilitation manual, and we could work with Maintenance on this, and could use research funds to revise their preservation manual if they wish to do so. Further, other state DOTs will benefit from this knowledge. Also, this information will aid the local calibration study.

### **Progress:**

#### **FY 2020:**

Work on site reports was initiated. A step-by-step method of evaluating resilient modulus data was developed and submitted to MDOT. Summarization of pavement structures and materials was initiated. A summary of performance data was also initiated.

**State Study #:** 306

## **Risk Assessment of MDOT Utility Coordination Processes**

**Start Date:** 09/18/2019

**End Date:** 06/30/2021

**Total Study Budget:** \$213,721.78

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Gresham Smith

**Researcher:** Randy Battey

### **Objective:**

Relocation of utilities is a complex processes for MDOT and other state DOTs. Utilities are owned by other entities, such as cities, private organizations, or member-owned cooperative associations. Also, the size of utility companies varies from large organizations (such as Entergy) to small, rural utilities who generally have limited resources. MDOT's Right-of-Way Division (ROW) and District Utility Coordinators have oversight of this process; however, utility companies are ultimately responsible for ensuring utilities are relocated. Further, Federal Highway Administration (FHWA) has conducted a national program review on the utility coordination process. While the review team found some noteworthy practices, the team concluded that few States have implemented a comprehensive process with the policies, procedures, and practices stipulated in Federal regulations.

MDOT will have technical advisory committee (TAC) participants from ROW, RWD, Districts, upper management, and Research. The principal investigator (PI) will map out and document MDOT's current processes, perform a risk assessment, recommend improvements, and document implemented improvements.

### **Progress:**

#### **FY 2020:**

Received Notice to Proceed from MDOT on 9/18/19, held project kick-off with TAC on 10/15/19.

Met with Trudi Loflin & Jeff Ely on 10/28/19 to understand MDOT Administration's perspective. Reviewed the utility information in MDOT's Parcel Tracking System.

Performed literature search and summarized available guidance from 10 other DOTs.

Prepared, submitted and recieved completed UC questionnaires from other DOTs.

Began summarizing MDOT's current processes based on available MDOT/FHWA guidance documents.

Prepared interview questions and held interviews with MDOT District UC staff.

Scheduled and performed "follow up" telephone calls with other state DOT respondents.

Interviewed MDOT's Audit Director, Diane Gavin.

Completed summary matrix of MDOT District UC staff responses to interview questions.

Submitted draft risk assessment and recommendations to Scot Ehrgott, Trudi Loflin and FHWA for comments. Addressed comments and met with Melinda McGrath, Brian Ratliff and the District Engineers to finalize recommendations (planned for September 2020).

**State Study #:** 307

## **Phase I GPR Study – Investigate use of GPR to Evaluate Type and Extent of Pavement Distress**

**Start Date:** 07/17/2020

**End Date:** 12/31/2021

**Total Study Budget:** \$315,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Burns Cooley Dennis, Inc.

**Researcher:** Allen Cooley

### **Objective:**

This study will be a collaboration between Burns Cooley Dennis, Inc. (BCD) and Dynatest and have three primary objectives. Relative to the first objective, under SS 287 GPR traces were collected on each of the 64 test sections included in the SS 263 field sampling/testing project. SS 287 also evaluated the set of traces from each of 16 of the 64 test sections. The first objective in this proposed Phase I GPR study will be to evaluate the set of GPR traces that were collected from each of the remaining 48 test sections (64 - 16) to determine if additional potential distresses can be identified. The second primary objective will be to identify a limited number of sections for further investigation in the field via coring to substantiate the hypothesis that anomalies observed within GPR traces can be used to identify distresses present within a pavement structure. Based upon the GPR trace evaluations for each of the 64 test sections, select location(s) within a small subset of the 64 test sections will be cored to prove/disprove the observed GPR anomalies. The final objective will be to recommend whether to conduct a Phase II study which would involve coring GPR anomalies observed within the remaining test sections not cored in phase I. It is envisioned that field coring in both phases would provide sufficient correlation of observed anomalies within GPR traces to pavement distresses to establish reliability in use of GPR as an aid in developing pavement maintenance and rehabilitation projects.

### **Progress:**

#### **FY 2020:**

Work was initiated on the literature review and preparing the GPR traces for evaluating. Some GPR traces have been evaluated.

**State Study #:** 308

## **FWD Testing and Backcalculation of Rubblized and Fractured Slab PCC Pavement Moduli**

**Start Date:** 08/21/2020

**End Date:** 12/31/2021

**Total Study Budget:** \$248,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Applied Research Associates, Inc.

**Researcher:** Alvaro Ulloa-Calderon

### **Objective:**

This study will investigate the material properties of rubblized concrete under HMA layers for design purposes. The project recently done on I55 in Pike County, as well as the project yet to be done on I-59 in Forrest and Jones Counties, will be used for the research on rubblization. A break-and-seat project is to be done on I-55 in Tate County, which will be investigated as part of this study. Dynatest will do field FWD testing and recommend any further test protocols for the rubblized/break-and-seat concrete.

**State Study #:** 309

## **Development of a Balanced Mix Design Procedure for Mississippi**

**Start Date:** 01/08/2020

**End Date:** 06/30/2021

**Total Study Budget:** \$523,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Burns Cooley Dennis, Inc.

**Researcher:** Allen Cooley

### **Objective:**

Superpave design specifications were implemented at MDOT almost 20 years ago. Rutting is not much of an issue anymore in Mississippi pavements; however, cracking and stripping are. This study will investigate 8 mixes typical of Mississippi pavements in different parts of the state and with different material properties (VEA, VMA, etc.). The results are anticipated to be used to improve HMA mix designs.

### **Progress:**

#### **FY 2020:**

Work was initiated this year by collecting materials from two of the four regions of the state. Verification testing and redesigning of mixtures was also initiated.

**State Study #:** 311

**MDOT Implementation of Pavement ME – Phase IV Study 1 of 2 - Update Plan of Implementation of AASHTOWare PMED based on MDOT-Funded Research**

**Start Date:** To be determined

**End Date:** To be determined

**Total Study Budget:** \$232,992.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Rao Research and Consulting

**Researcher:** Chetana Rao

**Objective:**

This study will investigate characteristics of stone matrix asphalt (SMA) mixes, which comprise much of Mississippi's interstate and heavy-truck-traffic four-lanes, and will analyze the most recent years of condition and distress data occurring since SS263 ended.

**Progress:**

**FY 2020:**

Project received a technical proposal with detailed work plan

**State Study #:** 312

## **Recycling Portland Cement Concrete Pavements using Rubblization and Fractured Slab Techniques**

**Start Date:** 08/31/2020

**End Date:** 12/31/2024

**Total Study Budget:** \$200,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Saeed & Associates Consultants Inc.

**Researcher:** Athar Saeed

### **Objective:**

This study will investigate the material properties of rubblized concrete under HMA layers for design purposes. The project recently done on I55 in Pike County, as well as the project yet to be done on I-59 in Forrest and Jones Counties, will be used for the research on rubblization. A break-and-seat project is to be done on I-55 in Tate County, which will be investigated as part of this study.

### **Progress:**

#### **FY 2020:**

Waited on NTP.

**State Study #:** 313

**In-House Support to Chetana Rao's SMA/Distress Data Updates**

**Start Date:** To be determined

**End Date:** To be determined

**Total Study Budget:** \$100,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Mississippi Department of Transportation

**Researcher:** Alex Middleton

**Objective:**

Research Division pavement management system staff will provide in-house support to Dr. Rao's updates to the distress data for SS263 and compile MDOT PMS sections with SMA surface course mixes.

**State Study #:** 314

### **In-House Support to Rubblized/Recycled Concrete Studies**

**Start Date:** To be determined

**End Date:** To be determined

**Total Study Budget:** \$100,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Mississippi Department of Transportation

**Researcher:** Alex Middleton

**Objective:**

This study will provide Research Division support to field work done for the rubblized concrete/break-and-seat studies.

**State Study #:** 316

## **Development Of Advanced Landslide Investigation Protocol Using Geophysical Methods For Mississippi**

**Start Date:** 06/19/2020

**End Date:** 06/30/2022

**Total Study Budget:** \$300,000.00

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Jackson State University

**Researcher:** Mohammed Sadik Khan

### **Objective:**

This study will be a follow-on to State Study 286, wherein Jackson State University (JSU) studied field-instrumented slope failure areas in the metro Jackson area. Since the slope pipes and inclinometers are already in place, MDOT would like to try the use of electrical resistivity imaging (ERI) technology to try to model slope failure and failure plane. This could result in time and cost saving as slope pipes are often difficult to place. Since instrumentation is already in place from SS286, the new study's data could be analyzed alongside that of SS286 to investigate how Yazoo clay slopes behave in the field vs. that of models/predictions.

### **Progress:**

#### **FY 2020:**

**Task 1: Continuation of Field Monitoring From State Study 286 (10% Completed)**

The JSU team has continued monitoring the data from each instrumented highway slopes from State Study 286 at every two weeks. During the monitoring period, all the collected data from moisture sensor, water potential probes, rain gauges, air temperature sensors and slope inclinometers were collected.

**Task 2: Finite Element Analysis (10% Completed)**

The JSU team has conducted Finite Element Analysis on the Highway slopes From State Study 286. During the FEM analysis, coupled flow deformation and safety analysis was performed with Field Observed Rainfall to investigate the effect of the rainfall on each slope.

**Task 3: 2D Electrical Resistivity Imaging (ERI) at the Instrumented Site (3% Completed)**

The JSU team has started the process of purchasing the Multichannel Electrical Resistivity Imaging. It is expected to complete the purchase by Mid October.

**Task 4: Slope Deformation Monitoring using LiDAR and UAV Drones (10% Completed)**

The JSU team has conducted the Photogrammetric Survey using Drone (Matric 200) on bi-weekly basis of all the Six slopes from the State Study 286. The collected image data from the drone survey was analyzed using Simactive Correlator 3D software, to develop the 3D digital model of each slopes. Moreover, the Digital Elevation Model (DEM) and Digital Terrain Model (DTM) of the slopes were developed. Based on the time dependent 3D Digital Model, any surficial movement of the slope is identified.

Task 5: Investigation of the Failed Slope Using Resistivity Imaging and Ground Penetration Radar

(3% Completed)

The JSU team is on process to purchase the multichannel Electrical Resistivity Imaging. JSU team is also working with MDOT Material Division on selecting the slopes statewide for Landslide Investigation.

Task 6: Data Analysis and Recommendation (10 % Completed)

The JSU team has compared the field monitored data (moisture variation, matric suction, rainfall, air and soil temperature) with the FEM analysis results and evaluated the changes in the deformation and factor of safety of the slopes. Moreover, the 3D Digital Model of each slope is compared with the instrumented results from the highway slopes and any change in the slope geometry is compared with the field instrumentation as well as the numerical

**State Study #:** 318

## **Skip Pouring Effects on Prestressed Bridge Beams**

**Start Date:** To be determined

**End Date:** To be determined

**Total Study Budget:**

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Mississippi State University

**Researcher:** Seamus Freyne

### **Objective:**

Skip placements of precast/prestressed concrete bridge girders have been problematic in Mississippi. Occasionally, some producers use skip placements to rotate a set of forms around a bed of stretched strands. It has been observed that beams made first in a sequence are more likely to develop cracks that could impede performance. MDOT opposes the practice of skip placements but the research is not definitive and not specific to MDOT's concerns. MDOT hesitates to be unreasonably restrictive because such change may compel producers to raise prices.

discovered. The PCI Journal, ACI Materials Journal, ACI Structural Journal, and the ASCE Journal of Bridge Engineering would be the main sources to consult, and also conference proceedings, particularly TRB. Equally important are conversations with personnel at the MDOT Bridge Division, MDOT Materials Division, DOTs in Southeastern states, and the beam producers. These questions would help guide the study:

- How significant are the problems caused by skip placements?
- What production schedules and processes contribute to the situation? Of special concern are the locations of the beams in the bed, the time between beam placements, and the steam curing regime. Do the beams exhibit cracking before prestress release?
- Do the strand properties, namely stress and bond capacity, vary along its length?
- What concrete properties, specifically compressive strength and modulus of elasticity, are achieved at the time of prestress release? And how do the actual values compare to design values?

**State Study #:** 319

## **Optimal Bearing Sizes for Economic Prestressed Concrete Girder Bridge Pier Construction**

**Start Date:** To be determined

**End Date:** To be determined

**Total Study Budget:**

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** University of Mississippi

**Researcher:** Elizabeth Ervin

### **Objective:**

The proposed work addresses optimal bearing design and performance evaluation for prestressed concrete girder bridges in Mississippi with the goal of reducing size and construction costs for piers and substructures. A modeling study will be performed in conjunction with an assessment of state-of-the-art bearings. This work will review off-the-shelf products by US suppliers with consideration of service life and maintenance. Initial substructure savings is important but hazard mitigation and operational life-cycle cost also require consideration. QA/QC procedures will be examined to address product performance over time. The UM Multi-Function Dynamics Lab will contact suppliers and other universities to obtain raw test results. While future work could involve full-size onsite testing, UM can perform smaller scale materials testing on both polyurethane products such as bearing pads and polytetrafluorethylene (PTFE) sliding surfaces. Published results from the Transportation Research Board will be mined. Additionally, European suppliers and use of bearings as fuses during extreme loading will be reviewed. Some advances are coming out of their specialty needs, for example, new German sliding materials have been developed for high speed rail.

Three elastomeric types of bearings will be evaluated: plain, steel reinforced, and cotton duck pads. RJ Watson will supply laboratory results for more traditional Disktron bearings. However, most suppliers want to maximize stiffness and then copyright their proprietary material. VOSS Engineering will provide laboratory data for their specialty cotton duck pads, including carbon impregnated, steel laminate, and sorbtex (neoprene). Companies will be surveyed and contacted to request their cooperation and data.

**State Study #:** 320

## **Integrated Technology-Based Design, Inspection, and Maintenance for More Resilient Bridges**

**Start Date:** To be determined

**End Date:** To be determined

**Total Study Budget:**

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** University of Mississippi

**Researcher:** Elizabeth Ervin

### **Objective:**

Efficient development and sustainable life-cycle management of structural modeling and drawing plan information for bridge projects through all stages of design, construction, inspection, and maintenance.

Current responsibilities in the Bridge Division include pre-construction structural design of new and replacement bridges operating on the state highway system as well as design review and in-service inspection of bridges on the State Aid system.

Structural designs are projected to require frequent use of finite element modeling software featuring 3D geometry layout and complex engineering data needed to simulate load-deformation response to loading and checks of performance relative to accepted professional practice criteria. It is desired to use the data from the structural model to facilitate project management from pre-construction to as-built to inspection and, as needed, maintenance operations.

Current design and drafting software do not yet offer a reliable, consistent, and streamlined capability to achieve this goal. Both conceptual and information technology aspects pose real obstacles in work flow that result in expensive duplication of effort and potential loss of key information valuable to both operational and emergency response plans.

**State Study #:** 321

## **Durable Asphalt Study**

**Start Date:** To be determined

**End Date:** To be determined

**Total Study Budget:**

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Mississippi State University

**Researcher:** Isaac Howard

### **Objective:**

This project is being pursued to evaluate the holistic manner in which asphalt is supplied, designed, produced, placed, and accepted. The overarching implications of this evaluation would likely lead to some of MDOT's current practices being removed in favor of other practices that in cases where the adjusted overall protocols are more likely to lead to more durable asphalt that is less prone to cracking at competitive life cycle economics.

**State Study #:** 322

## Open Ended Pipe Pile Study

**Start Date:** To be determined

**End Date:** To be determined

**Total Study Budget:**

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** University of South Alabama

**Researcher:** Eric J. Steward

### Objective:

The Mississippi DOT (MDOT) has begun to utilize open-ended steel pipe piles for more bridge projects throughout the state within the past few years. Open-ended pipe (OEP) piles have a tendency to develop a soil plug within the interior of the pipe, as the pile is driven. This typically occurs when the internal shaft friction becomes high enough to not allow additional soil to enter the piles interior. Once a plug is developed during driving, the overall axial resistance changes, as the end-bearing resistance of the pile increases and the shaft resistance reduces because the mechanism of friction and bearing have changed. Research has shown that the development of the plug in a steel pipe pile is dependent upon many factors, such as the diameter of the pile, the soil conditions, and the rate, energy, and consistency of driving. MDOT is interested in determining a reliable method of predicting the length of plug of open-ended pipe piles driven in the state strata and then utilizing this information to enhance the design procedures to more accurately choose pile size and embedment lengths for the foundational support of bridge projects. Accurate prediction of axial capacity can lead to more efficient designs producing potentially safer and more reliable outcome of bridge projects in the state.

**State Study #:** 323

## **Determine Relationship between IDT based on NCHRP Report 789 IDT Test Protocol and MOR for CSM Pavement Layers**

**Start Date:** To be determined

**End Date:** To be determined

**Total Study Budget:**

**Total Spent to Date:** \$0.00

**FY Expenditures:** \$0.00

**Research Agency:** Burns Cooley Dennis, Inc.

**Researcher:** Robert Varner

### **Objective:**

The Mississippi Department of Transportation (MDOT) is active in the implementation of the Mechanistic-Empirical Pavement Design Guide (MEPDG) procedure for designing both new and rehabilitated flexible and semi rigid pavements. This design procedure is available in a software program AASHTOWare Pavement ME Design (Pavement ME).

The cementitious stabilized material (CSM) layer(s) in a semi rigid pavement structure are typically constructed using either portland cement or hydrated lime, and historically were also constructed using blends of hydrated lime and fly ash (LFA). One of the material characterization inputs to Pavement ME for CSMs is modulus of rupture (MOR). MOR test protocol requires testing beam samples which can be fabricated in the laboratory but not practically extracted from an existing pavement structure. However, CSM cores may be obtained from existing pavement structures and processed to provide indirect tensile strength (IDT) test samples. IDT test results can be used to estimate MOR via a conversion factor.

MDOT State Study (SS) No. 263 is being conducted to sample/test multiple pavement test sections throughout Mississippi to provide requisite information for use in locally calibrating the models included in the MEPDG to Mississippi climate, traffic, and pavement construction materials. To date, SS No. 263 has tested all CSM pavement layers including IDT testing in accordance with the IDT test protocol included in National Cooperative Highway Research Program (NCHRP) Report 789 (IDTNCHRP).

An MOR test procedure for CSM is being developed at Mississippi State University (MSU) via ongoing MDOT SS No. 276 (MORMSU). A research study using laboratory derived test data is required to develop one or more conversion factors relating IDTNCHRP to MORMSU.

# Continued Pooled Funds

## 2016 through 2020 Biennial Asset Management Conference and Training on Implementation Strategies

**TPF #:** TPF-5(335)

**Lead Agency:** Iowa Department of Transportation

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$6,000.00

1. Provide communication and information sharing among member states. Discuss research needs and provide research ideas to TRB.
2. Provide a technology and knowledge exchange forum to enhance the practical knowledge of member states concerning asset management implementation.
3. Enhance the working knowledge of the asset management

FY 2017 - \$6,000 FY 2018 - \$6,000 FY 2019 - \$6,000 FY 2020 - \$6,000

## **Accelerated Performance Testing on the 2018 NCAT Pavement Test Track**

**TPF #:** TPF-5(374)

**Lead Agency:** Alabama Department of Transportation

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$440,000.00

MDOT will construct a test section in the 2018-2020 NCAT test track that will use subgrade and other materials hauled in from Mississippi. The test section will be representative of a four-lane section. NCAT will instrument the section and test it thoroughly, and this performance data will be used to compare with MEPDG-predicted response to traffic loading.

FY 2018- \$440,000 FY 2019- \$440,000 FY 2020- \$440,000

## **Building Information Modeling (BIM) for Bridges and Structures**

**TPF #:** TPF-5(372)

**Lead Agency:** Iowa Department of Transportation

**Project End Date:** 09/30/2022

**FY 2020 Cost:** \$20,000.00

The pooled fund project will provide the primary funding mechanism for AASHTO SCOBS T-19 to perform the duties of governance and stewardship of BIM for Bridges and Structures

FY 2018 - \$20,000    FY 2019 - \$20,000    FY 2020 - \$20,000    FY 2021 - \$20,000    FY 2022 - \$20,000

## Connected Vehicle Pooled Fund Study

**TPF #:** TPF-5(389)

**Lead Agency:** Virginia Department of Transportation

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$50,000.00

The purpose of the Connected Vehicle Pooled Fund Study is to support state, local, and international transportation agencies as well as vehicle Original Equipment Manufacturers (OEMs) in preparing for the deployment of connected vehicle infrastructure and to provide support for the AASHTO Connected and Automated Vehicle working group, USDOT Connected Vehicle Program and other national initiatives.

FY 2019 - \$50,000    FY 2020 - \$50,000

## **Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)**

**TPF #:** TPF-5(443)

**Lead Agency:** Minnesota Department of Transportation

**Project End Date:** 04/23/2019

**FY 2020 Cost:** \$25,000.00

The objective of the proposed pooled-fund project is to establish a research consortium focused on

A) further advancing and improving the system based on experience and needs from participants so that the system can effectively and efficiently support their Quality Assurance Programs;

B) support communication;

C) provide training and technical assistance that includes providing support for specification development and strategies for agency full implementation; and

D) conduct technology promotion and marketing for the system. Specific tasks within this multi-year program will be developed in cooperation with the consortium participants.

FY 2019 - \$25,000    FY 2020 - \$25,000    FY 2021 - \$25,000

## **Design Guidelines and Mitigation Strategies for Reducing Sedimentation of Multi-Barrel Culverts**

**TPF #:** TPF-5(445)

**Lead Agency:** Iowa Department of Transportation

**Project End Date:** 09/30/2022

**FY 2020 Cost:** \$22,500.00

This transportation pool fund (TPF) project will develop guidelines for the design and mitigation for reducing sedimentation at existing and proposed culvert locations. The guidelines will be developed in a web-based program with interactive parameters that will forecast the sedimentation potential along any stream location in the U.S. prone to this process. The guiding principles and best practices for mitigating sedimentation will complete the with current hydraulic design guidelines.

FY 2019 - \$22,500

FY 2020 - \$22,500

FY 2021 - \$22,500

FY 2022 - \$22,500

## Enhancement to the Intelligent Construction Data Management System (Veda) and Implementation

**TPF #:** TPF-5(334)

**Lead Agency:** Minnesota Department of Transportation

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$25,000.00

Intelligent construction data collection systems (i.e., geospatial systems such as intelligent compaction, paver-mounted thermal profiling [infrared radar technology], ground penetrating radar (GPR), and pavement smoothness/profile, etc.) gather large quantities of data each day of production activities. Near, 'real-time', integrated visualization and analysis systems are required so that materials and construction personnel can rapidly evaluate data and make decisions regarding acceptance.

Using ICDM-Veda as a tool/platform, the objectives of this effort are to incorporate features and enhancements such as the following:

- Analysis platforms
- Filtering, computations, modeling, etc.
- Management of database and project files
- Enhancements and additions to existing logic and coding to facilitate efficiency and added features;
- Mapping
- Mapping performance, print feature;
- Correlation analyses
- Correlations between different data sets (intelligent compaction, thermal profiling, GPR, pavement smoothness, FWD, density, etc.);
- Spot tests
- Management of conventional spot test data (import, filtering, mapping,

correlations);

- Data import and mapping
- Import data sets from ProVAL, ground penetrating radar, and delimited text data;
- Contract administration
- Automated items needed to administer geo-spatial technologies during construction for QC/QA);
- Data import/mapping, acceptance, basis of measurement and documentation of quantities;
- Asset management
- Mapping of final project QC/QA data collection for use as a supplement Pavement Management Systems

FY 2017 - \$25,000

FY 2018 - \$25,000

FY 2019 - \$25,000

FY 2020 - \$25,000

## Evaluation of Low Cost Safety Improvements

**TPF #:** TPF-5(317)

**Lead Agency:** Federal Highway Administration

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$30,000.00

This project will encompass safety-effectiveness evaluations of priority strategies from the NCHRP Report 500 Guidebooks, Guidance for Implementation of the AASHTO Strategic Highway Safety Plan. The safety effectiveness of many of the strategies in the guidebooks has not yet been rigorously evaluated. In order to achieve a national goal shared by the USDOT, AASHTO, and GHSA to reduce the fatality rate to 1.0 and save 9,000 lives annually by 2008, these strategies will need to be appropriately implemented. In this project, therefore, data will be collected and before-after safety effectiveness evaluations will be performed at sites where selected safety strategies are being implemented. A steering committee, comprised of pooled fund State DOT representatives, will provide guidance on the strategies selected for evaluation.

FY 2018 - \$30,000 FY 2019 - \$30,000 FY 2020 - \$30,000

## **Improve Pavement Surface Distress and Transverse Profile Data Collection and Analysis, Phase II**

**TPF #:** TPF-5(399)

**Lead Agency:** Federal Highway Administration

**Project End Date:** 09/30/2025

**FY 2020 Cost:** \$20,000.00

Improve the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis by assembling SHAs, the FHWA, and industry representatives to:

- Identify data collection integrity and quality issues
- Identify data analysis needs
- Suggest approaches to addressing identified issues and needs

Based on this information, the SHAs and the FHWA will:

- Initiate and monitor projects intended to address identified issues and needs
- Disseminate results
- Assist in solution deployment

FY 2019 - \$20,000    FY 2020 - \$20,000    FY 2021 - \$20,000    FY 2022 - \$20,000    FY 2023 -  
\$20,000    FY 2024 - \$20,000    FY 2025 - \$20,000

## Improving the Quality of Highway Profile Measurement

**TPF #:** TPF-5(354)

**Lead Agency:** South Dakota Department of Transportation

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$20,000.00

The pooled fund study will enable participants to identify and resolve operational issues common among devices used to measure pavement profiles. The study will focus on data quality issues that arise from the use and operation of inertial profilers and other systems designed to measure pavement profile. Within these broad topic areas, the following issues may be addressed:

- Implementation of American Association of State and Highway Transportation Officials (AASHTO) Provision Protocols for Inertial Profilers
- Establishing pavement profile reference device(s)
- Specifying and establishing equipment certification course(s)
- Pavement profiling certification procedures for Construction Acceptance and Highway Network Monitoring & Reporting
- Operator procedures and training such as NHI Course 131100 "Pavement Smoothness: Use of Inertial Profiler Measurements for Construction Quality Control".
- Performance of components such as accelerometers, height sensors, distance measurement instruments, inertial measurement devices, digital images, LiDAR, global positioning systems, etc.
- Development, maintenance, and training for FHWA ProVAL "Profile Viewer and Analyzer Software"
- Highway system performance monitoring, evaluation, and reporting
- Appropriate data collection, reduction techniques, and use of alternative indices for low-speed, stop and go, urban environments
- Contracting and procurement practices and issues
- The use of inertial profilers for construction quality control and quality

assurance as per 23CFR 637.205

- Filters such as a tire envelopmen

FY 2018 - \$20,000

FY 2018 - \$20,000

FY 2019 - \$20,000

FY 2020 - \$20,000

## **National Partnership to Determine the Life Extending Benefit Curves of Pavement Preservation Techniques (MnROAD/NCAT Joint Study – Phase II)**

**TPF #:** TPF-5(375)

**Lead Agency:** Minnesota Department of Transportation

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$50,000.00

MnROAD and NCAT are seeking organizations to join the partnership for the second phase of research efforts. Main objectives include:

1. Determining the life cycle cost of various pavement preservation alternatives in a highly controlled experiment that will provide state Departments of Transportation (DOTs) with the financial foundation to begin to build a decision tree for their own maintenance program
2. Develop quality assurance QA field testing protocols to correlate construction practices with long term performance of pavement preservation techniques.
3. Technology transfer - Answering practical questions posed by research sponsors through formal (i.e., reports & technical papers) & informal (e.g., one-on-one responses to sponsor inquiries) technology transfer on how these life extending benefits can be best utilized in each state.

FY 2019 - \$50,000

FY 2020 - \$50,000

## **Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)**

**TPF #:** TPF-5(385)

**Lead Agency:** Virginia Department of Transportation

**Project End Date:** 09/30/2021

**FY 2020 Cost:** \$45,000.00

The objective of the proposed pooled-fund project is to establish a research consortium focused on providing participating agencies guidelines on how to specify collection and use data collected with TSDDs for network- and project-level (if feasible) pavement management applications. Specific tasks within this multi-year program will be developed in cooperation with the consortium participants. In addition, the consortium will also provide participating agencies with a mechanism to conduct pilot demonstration testing in their respective networks. The objective of the proposed pooled-fund project is to establish a research consortium focused on providing participating agencies guidelines on how to specify collection and use data collected with TSDDs for network- and project-level (if feasible) pavement management applications. Specific tasks within this multi-year program will be developed in cooperation with the consortium participants. In addition, the consortium will also provide participating agencies with a mechanism to conduct pilot demonstration testing in their respective networks.

FY 2019 - \$45,000

FY 2020 - \$45,000

FY 2021 - \$45,000

## **Pavement Surface Properties Consortium – A Research Program at the Virginia Smart Road Phase II**

**TPF #:** TPF5-(345)

**Lead Agency:** Virginia Department of Transportation

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$20,000.00

Functional pavement considerations are fundamental to the performance and management of pavements. In addition to structural and durability requirements, an optimum pavement wearing surface should provide a combination of a good riding quality, adequate friction and macrotexture, and a low noise level. All these properties are highly influenced by the various components of the pavement surface texture. Phase I of the program demonstrated that a collaborative research program can provide an accessible and efficient way for highway agencies and other organizations to conduct research on pavement surface properties. The collaboration helped the participating agencies explore new technologies, as well as verify the operation and accuracy of the equipment currently used for evaluating pavement function.

The main objective of this pooled-fund program has been to conduct applied research focused on enhancing the level of service provided by the roadway transportation system by optimizing pavement surface characteristics. Phase 2 of the program is expected to continue to support the members' effort to produce high-quality surface property measurements, evaluate new technologies, disseminate research findings, and facilitate technology transfer activities. This second phase will focus on addressing some of the emerging challenges in the evaluation of pavement surface properties and the changes needed to best support the next generation of pavement asset management systems, including support for MAP21-related initiatives. It will also seek participation of industry through traditional membership or an industrial affiliate program.

FY 2017 - \$20,000

FY 2018 - \$20,000

FY 2019 - \$20,000

FY 2020 - \$20,000

## Performing Forensic Evaluations of LTPP Remaining Sections Before They Leave Service

**TPF #:** TPF-5(332)

**Lead Agency:** Washington State Department of Transportation

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$50,000.00

LTPP still has approximately 750 sections in use in 49 states. As these sections reach their useful life, knowing why they ultimately failed must be determined by forensic review. Create a pooled fund to rapidly complete forensic evaluations of LTPP sections before going out of service. Approximately 750 sections remain in service. Investigating LTPP test sections as they prepare to go out of service, capturing data on exactly why the section failed and had to be removed from service. This may entail trenching and coring, measuring lift deflection, and potential lab testing of field samples for materials characteristics. The pooled fund will pay the costs to perform the forensic evaluation in the field and limited lab testing from field samples. Additional work will include building tracking lists of remaining sites, contacting states for updates on site status and planning action for sites about to go out of service.

FY 2017- \$50,000

FY 2018 - \$50,000

FY 2019 - \$50,000

FY 2020 - \$50,000

## Roadside Safety Research for MASH Implementation

**TPF #:** TPF-5(343)

**Lead Agency:** Washington State Department of Transportation

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$50,000.00

The objective of the proposed pooled-fund project is to establish a research consortium focused on providing participating agencies guidelines on how to specify collection and use data collected with TSDDs for network- and project-level (if feasible) pavement management applications. Specific tasks within this multi-year program will be developed in cooperation with the consortium participants. In addition, the consortium will also provide participating agencies with a mechanism to conduct pilot demonstration testing in their respective networks. The objective of the proposed pooled-fund project is to establish a research consortium focused on providing participating agencies guidelines on how to specify collection and use data collected with TSDDs for network- and project-level (if feasible) pavement management applications. Specific tasks within this multi-year program will be developed in cooperation with the consortium participants. In addition, the consortium will also provide participating agencies with a mechanism to conduct pilot demonstration testing in their respective networks.

FY 2019 - \$50,000

FY 2020 - \$50,000

## Superpave Regional Center, Southeastern Region

**TPF #:** TPF-5(228)

**Lead Agency:** Alabama Department of Transportation

**Project End Date:** 02/28/2021

**FY 2020 Cost:** \$100,000.00

The Southeastern Superpave Center has been supported by state agencies through a pooled-fund project that has been largely used to provide training, verify ruggedness of equipment, check equipment calibrations, provide materials research, and aid in keeping agency personnel abreast of changes in asphalt technology. In order to continue the efforts in training, technology transfer, and implementable research, it is essential that the pooled-fund effort be continued.

MDOT is putting additional funding into the Superpave Center to cover the following:

1. Explore strains caused by hot weather at the MDOT funded the construction of an instrumented semi-rigid pavement test section at the NCAT test track.
2. Provide data to locally calibrate performance models in the AASHTOWare Pavement ME Design (PMED) software to Mississippi climate, traffic, and pavement construction materials and practices.

FY 2016 - \$40,000    FY 2017 - \$100,000    FY 2018- \$300,000    FY 2019 - \$100,000    FY 2020 -  
\$100,000    FY 2021 - \$250,000

## **Traffic Control Device (TCD) Consortium**

**TPF #:** TPF-5(316)

**Lead Agency:** Federal Highway Administration

**Project End Date:** 09/30/2020

**FY 2020 Cost:** \$15,000.00

The TCD Consortium will focus on systematic evaluation of novel TCDs, employing a consistent process that addresses human factors and operations issues for each TCD idea. Providing local and state agencies quicker response to their needs and quicker response to new technologies with the right assessment skills and tools will enable consistent TCD idea identification and evaluation. TCD Consortium efforts will address TCD issues identified by local and state jurisdictions, industry, and organizations and aid in the compliance to the MUTCD rule-making process and incorporation of novel TCDs into the MUTCD.

FY 2015 - \$15,000 FY 2016 - \$15,000 FY 2017 - \$15,000 FY 2018 - \$15,000

FY 2019 - \$15,000 FY 2020 - \$15,000

## Traffic Safety Culture - Phase 2

**TPF #:** TPF-5(444)

**Lead Agency:** Montana Department of Transportation

**Project End Date:** 09/30/2025

**FY 2020 Cost:** \$25,000.00

Only through the growth of a positive safety culture can significant and sustainable reductions in crash fatalities and serious injuries be achieved. Towards that end, this pooled fund program will:

- (1) conduct research to identify solutions to specific culture-based traffic safety problems, taking advantage of the implementation opportunities to improve traffic safety;
- (2) develop resources to enhance understanding and application of traffic safety culture strategies; and
- (3) provide technology transfer of best practices in traffic safety culture strategies.

FY 2019 - \$25,000    FY 2020 - \$25,000    FY 2021 - \$25,000    FY 2022 - \$25,000    FY 2023 -  
\$25,000    FY 2024 - \$25,000    FY 2025 - \$25,000

# Rejoined Pooled Funds

## Develop and Support Transportation Performance Management Capacity Development Needs for State DOTs

**TPF #:** TPF-5(326)

**Lead Agency:** Rhode Island Department of Transportation

**Project End Date:** 09/30/2019

**FY 2020 Cost:**

**Total Expended to Date:**

The focus of this pooled fund project will be to research and assess training and educational needs of contributing members, develop and deliver training, and to facilitate the sharing and retention of performance management best practices. Funding will be used to:

- Identify Gaps in TPM Knowledge, Skills and Abilities—Conduct a needs analysis for learning and capacity development of contributing members resulting in a short and long-term capacity building roadmap;
- Develop and Deliver Learning and Capacity Development Resources—Develop training and educational material to meet the gaps identified in the knowledge, skills and abilities;
- Establish a TPM Information Clearinghouse—The TPM Information Clearinghouse will be used to showcase PM best practices, foster collaboration, and serve as a repository for PM resources; and
- Support Knowledge Transfer Among Pooled Fund States

Specifically this pooled fund will: Guide the prioritization of needs for determining training and other educational support for contributing members:

1. Provide and promote communication and information sharing among member States related to learning and capacity development needs in the areas of performance management and provide input on research topics.
2. Develop framework and roadmap for addressing learning and capacity development needs.
3. Identify learning and capacity development resources needed to support the development of PM skills.
4. Develop online and/or blended training courses and materials that are suitable for a wide variety of audiences such as State Departments of Transportation (State DOTs), Metropolitan Planning Organizations (MPOs), Public Transit Providers, and local governments.

5. Support a TPM Information Clearinghouse which will serve as a repository for TPM best practices and other resource information to assist states, MPO's and local government with learning about TPM and their implementation of TPM.

FY 2016 - \$15,000

FY 2017 - \$15,000

FY 2019 - \$15,000

FY 2021 - \$15,000

FY 2022 - \$15,000

# New Pooled Funds

## Accelerated Performance Testing on the 2021 NCAT Pavement Test Track

**TPF #:**

**Lead Agency:** Alabama Department of Transportation

**Project End Date:**

**FY 2020 Cost:**

MDOT will traffic test sections constructed in the previous test period.

## **Assessment and Repair of Prestressed Bridge Girders Subjected to Over-Height Truck Impacts (OHTI)**

**TPF #:** TPF-5(462)

**Lead Agency:** Missouri Department of Transportation

**Project End Date:**

**FY 2020 Cost:**

Having adequate reliable infrastructures, including bridges, has been crucial to the process of economic and social development of any country. Bridges are exposed to man-made and natural hazards such as earthquakes, floods, and impact loads. Vehicles and vessels may impact bridge columns, piers, and girders causing severe damage and yielding losses of human lives and economy. Based on bridge failure incidents occurred between 1967 and 2006, vessel and vehicles impacts are the second highest cause of bridge failure in the U.S. Failure occurred due to damage to bridge girders and columns. This project focuses on the behavior and repair of bridge girders subjected to over-height truck impacts.

FY 2021 - \$45,000    FY 2022 - \$45,000

## **Consortium for Asphalt Pavement Research and Implementation (CAPRI)**

**TPF #:** TPF-5(465)

**Lead Agency:** Alabama Department of Transportation

**Project End Date:**

**FY 2020 Cost:**

As owners and operators of the nation's surface transportation infrastructure, state departments of transportation (DOTs) are striving to design and build longer lasting and more cost-effective asphalt pavements that meet a higher level of sustainability, safety and user satisfaction for the public. To achieve this goal, state DOTs continue to adopt innovative technologies and optimized practices for designing, constructing, and preserving asphalt pavements. The adopted innovative technologies and practices are often developed from the collaborative research efforts supported by the state DOTs, Federal Highway Administration (FHWA), and industry. To continue fostering the development of new technologies and practices, this pooled fund study will identify and address national priority research and implementation needs for asphalt pavements that state DOTs face today and in the future.

CAPRI will operate as a voluntary consortium of flexible pavement stakeholders that is open to all state, local, and federal highway agencies, industry associations, individual companies, academic institutions and research organizations. The Alabama DOT will serve as the lead state and the National Center for Asphalt Technology (NCAT) at Auburn University will handle administrative duties for the project. Each participating entity may appoint one voting representative to CAPRI.

FY 2021 - \$10,000

## **Demonstration to Advance New Pavement Technologies Pooled Fund**

**TPF #:**

**Lead Agency:** Federal Highway Administration

**Project End Date:**

**FY 2020 Cost:**

This pooled fund seeks to support and showcase the implementation of innovative pavement technologies, products, and processes by State DOTs by leveraging of Federal investments with State DOT partnerships.

## **Fiber-Reinforced Concrete with Adapted Rheology for Bridge Construction and Rehabilitation**

**TPF #:**

**Lead Agency:** Missouri Department of Transportation

**Project End Date:**

**FY 2020 Cost:**

Bridge deterioration requiring maintenance, repair, or replacement accounts for significant annual expenditures by state and federal transportation agencies. Concrete bridges should be designed to secure superior durability and extend service life. Greater service life is also required in repair of existing infrastructure. The use of fiber reinforcement coupled with shrinkage mitigating strategies as well as the development of adequate mixture design and construction guidelines can substantially minimize cracking, improve durability, and extend service life of concrete infrastructure. Careful design of the rheological properties of fiber-reinforced concrete (FRC) can further enhance structural performance through efficient alignment of fibers along the casting direction, resulting in substantial cost savings.

The RE-CAST (Research on Concrete Applications for Sustainable Transportation) University Transportation Center led by Missouri S&T has developed fiber-reinforced concrete with adapted rheology (FRC-AR) with superior workability, cracking resistance, mechanical properties, and durability. This novel class of infrastructure material includes fiber-reinforced self-consolidating concrete (FR-SCC) for structural repair, fiber-reinforced super-workable concrete (FR-SWC) for construction of bridge sub-structural elements, thixotropic FRC for bridge deck replacement, as well as high-strength FRC (HS-FRC) for thin overlays for bridge deck rehabilitation. Limited projects implemented in Missouri, New Jersey, and Oklahoma using FRC-AC have demonstrated the superior performance of this new class of infrastructure material. The proposed pooled fund study will investigate field performance of FRC-AR under different traffic and climatic conditions to provide more substantial input to the AASHTO community for the deployment of FRC-AR for the design, construction, and rehabilitation of concrete bridges.

FY 2021 - \$50,000    FY 2022 - \$50,000    FY 2023 - \$50,000

## **National Road Research Alliance - NRRRA (Phase-II)**

**TPF #:**

**Lead Agency:** Minnesota Department of Transportation

**Project End Date:**

**FY 2020 Cost:**

The NRRRA exists to strategically implement cooperative pavement research. State agencies, industry, academia, consultants and associations work together to identify problems, complete research projects and implement results. Our goal is to help agencies nationwide achieve consistent benefits from real world road research. It also seeks to provide members a forum to discuss issues and an outdoor, real-world laboratory (MnROAD) for evaluating cutting-edge pavement technologies. The NRRRA consists of five project teams: Flexible, Rigid, Geotechnical, Intelligent Construction Technologies, and Preventive Maintenance and is governed by an Executive Committee made up of two representatives from each government agency participating in the study.

FY 2021 - \$150,000    FY 2022 - \$150,000    FY 2023 - \$150,000    FY 2024 - \$150,000    FY 2025  
- \$150,000

## No Boundaries Transportation Maintenance Innovations

**TPF #:** TPF-5(441)

**Lead Agency:** Colorado Department of Transportation

**Project End Date:** 05/21/2019

**FY 2020 Cost:** \$60,000.00

Through this pooled fund project, the Colorado Department of Transportation (CDOT) will work with other State Departments of Transportation (DOTs) to facilitate the transfer of knowledge of promising non-snow and ice maintenance innovations and technologies. This project provides a forum for State DOTs to share their maintenance innovations with each other, support technology transfer activities and develop marketing and deployment plans for selected innovations through bi-annual 2-3 day peer exchange meetings at various locations selected by participating members. Resources will be provided for the transfer of knowledge and experience of various innovations that includes travel, training and other technology transfer activities.

It is anticipated that this consortium will become the national forum for state involvement in the technical exchange needed for collaboration and new initiatives, and be a forum for advancing the application and benefit of research technologies. In addition, the project will create a searchable database or warehouse where innovations and research done relating to highway maintenance can be found and showcased. State participation in this process will be through the pooled fund. FHWA, industry and others will be invited to participate in the project discussions and activities.

Workshops will continue to be provided for the states participating in the pooled fund project. This project will help DOTs to save time and money by not investing in the same research that has already been performed by other state DOTs. Rather than having each DOT identify and conduct research separately, DOTs can work collectively through this pooled fund project.

FY 2020 - \$60,000

## **Pavement Surface Properties Consortium: Phase III - Managing the Pavement Properties for Improved Safety**

**TPF #:** TPF-5(463)

**Lead Agency:** Virginia Department of Transportation

**Project End Date:**

**FY 2020 Cost:**

Functional pavement considerations are fundamental to the performance and management of pavements. In addition to structural and durability requirements, an optimum wearing surface should provide a combination of a good riding quality, adequate friction & water handling capability, and a low noise level. All these properties are highly influenced by the various components of the pavement surface texture. Previous phases of the program demonstrated that a collaborative research program can provide an accessible and efficient way for highway agencies and other organizations to conduct research on pavement surface properties. The collaboration helped the participating agencies explore new technologies, verify the operation and accuracy of the equipment currently used for evaluating pavement function, and enhance the methodology developed by FHWA for developing and implementing proactive friction management programs.

FY 2021 - \$20,000    FY 2022 - \$20,000    FY 2023 - \$20,000    FY 2024 - \$20,000    FY 2025 - \$20,000

## Research Project Tracking System

**TPF #:** TPF-5(467)

**Lead Agency:** Kentucky Department of Transportation

**Project End Date:**

**FY 2020 Cost:**

Each state in the U.S. has a transportation research program, typically managed by designated staff in the state DOT (or equivalent agency). While these programs vary substantially in size, complexity, staffing level, and resource availability, there are certain needs that are generally common to all programs. One of these needs is a tracking system for active and completed research projects. The tracking system can be used for numerous functions, including (but not necessarily limited to):

- Tracking of active projects
  - o A centralized source of key information for each project (name of PI and project manager, contact information, start date, planned completion date, budget, account number, etc.)
  - o A centralized source of up-to-date status information for each project
  - o Flagging of issues/problems (behind schedule, work versus spending, problems encountered, intervention required, etc.)
- Tracking of research implementation
- Tracking of submissions and approvals (initial work plan and budget, revisions to work plan and budget, deliverables, etc.)
- A historical record of completed projects
- Reporting
  - o Generating program-wide reports for research program management
  - o Generating periodic progress reports (e.g., quarterly reports) for individual projects
- A repository for key project-related documents (proposals, work plans, budgets, meeting agendas and minutes, interim deliverables, final reports, etc.)

In 2013, the Kentucky Transportation Cabinet (KYTC), in cooperation with the Kentucky Transportation Center (KTC) at the University of Kentucky, initiated an SPR project to develop and implement a web-based project management tool for research projects. This tool would provide easily-accessible, up-to-date information on project accomplishments and milestones,

the current status of each project, and quick links to key project documents and deliverables. In addition to tracking the progress of active projects, the system would track and report the implementation of research results, following project completion. KYTC and KTC formed a Study Advisory Committee, developed functional requirements for the Research Project Tracking System (RPTS), hired a web developer/programmer, and developed the system, going live in July of 2015. The final report for that SPR project can be accessed here:

[https://uknowledge.uky.edu/ktc\\_researchreports/1678/](https://uknowledge.uky.edu/ktc_researchreports/1678/)

Over the past four years, KTC has continually enhanced the online system through a series of task orders issued to the original web developer/programmer. The result is a highly-functional system that is easy to use and meets most of Kentucky's needs. It is accessible from any device with Internet access, and it works with virtually any web browser. However, because the system was internally developed using a single programmer, it is not easily updated to more state-of-the-art software packages, and Kentucky's ability to maintain and upgrade the system long-term is highly dependent on the continued availability of the original developer. Thus, it is Kentucky's desire to redevelop the system from scratch, using the most up-to-date software and industry standards and a stable, well established software development firm.

The primary barrier to redeveloping the RPTS from scratch is the cost. For Kentucky to bear this cost alone would be challenging, perhaps even a show-stopper. However, Kentucky is not the only state that could benefit from such a system. So, we are proposing to carry out this development as a pooled-fund effort. We believe it is possible to develop common functional requirements that will meet the needs of multiple states and then use those functional requirements to guide development of a flexible, state-of-the-art system. With funding from multiple states, it should be possible to hire a top-notch developer without placing a financial burden on any individual state.

FY 2021 - \$3,500    FY 2022 - \$3,500

## **Soil and Erosion Testing Services for Bridge Scour Evaluations**

**TPF #:** TPF-(461)

**Lead Agency:** Federal Highway Administration

**Project End Date:**

**FY 2020 Cost:**

The objective of these pooled funds is to provide and/or support soil and erosion testing services for bridge projects over water crossings managed or coordinated by State DOTs, to provide technical assistance to design, fabricate, and install erosion testing devices to support and seek to broaden the use of erosion testing devices among State Department of Transportations, and to compile and analyze the collected soil and erosion testing data in a broader research effort to more accurately estimate reliable scour design depths given the soil conditions and hydraulic load during a given storm event.

## **Southeast Transportation Consortium - Phase II**

**TPF #:**

**Lead Agency:** Louisiana Department of Transportation and Development

**Project End Date:**

**FY 2020 Cost:**

The current Southeast Transportation Consortium (STC) is nearing its second extension to round out 10 years of productive work. In that 10 year period at least 12 research products have been produced on a wide variety of topics of interest to the AASHTO Region 2 member states. Additionally, the technology transfer and idea sharing between the states has benefited all involved states immensely.

FY 2021 - \$15,000    FY 2022 - \$15,000    FY 2023 - \$15,000    FY 2024 - \$15,000    FY 2025 - \$15,000

## Structural Behavior of Ultra-High Performance Concrete

**TPF #:** TPF-5(468)

**Lead Agency:** Federal Highway Administration

**Project End Date:**

**FY 2020 Cost:**

Ultra-high performance concrete (UHPC) is the next generation of concrete, a concrete whose mechanical and durability properties far exceed those of conventional concretes. UHPC combines together a set of advancements in concrete technology from recent decades to create a concrete with compressive strengths at or greater than approximately 20 ksi, sustained post-cracking tensile strength at or greater than 750 psi, and a discontinuous pore structure that reduces permeability by an order of magnitude. During the past 10 years, UHPC has found significant usage in the US bridge sector as a field-cast grout cast between prefabricated bridge elements; effectively, UHPC enabled novel accelerated bridge construction methods to flourish. As the awareness of UHPC capabilities as grown, interest has turned toward using UHPC for primary structural elements in bridges. The handful of primary structural component deployments in the US so far (e.g., a few pretensioned girders, a few precast bridge decks, a few piles) have been completed as experimental deployments by innovative departments of transportation. Mainstreaming of this technology will require a broader knowledge base and greater standardization of engineering practices. Researchers at the FHWA Turner-Fairbank Highway Research Center have been leaders in advancing UHPC technology for the bridge sector for nearly two decades. The proposed project will allow them to broaden the scope of their efforts and thus provide more substantial input to the AASHTO community as formal guidance for the design of UHPC components is developed.

FY 2021 - \$25,000    FY 2022 - \$25,000    FY 2023 - \$25,000    FY 2024 - \$25,000

## **Technology Exchange on Managing Pavements**

**TPF #:** TPF-5(439)

**Lead Agency:** Iowa Department of Transportation

**Project End Date:** 02/25/2019

**FY 2020 Cost:** \$12,500.00

Iowa DOT seeks to partner with other interested states in developing the format and program for the conference and participate in related workshops along with a technology exchange session dedicated to state DOTs to learn and review issues associated with managing pavements. A technology exchange on managing pavements held concurrently with the 11th International Conference on Managing Pavements represents a unique opportunity for pooled fund members to learn from practitioners and researchers worldwide on new technologies, engineering, practice and research related to managing pavements in their own states. The technical program of the conference is being organized by CTRE, pooled fund members and TRB AFD10(3) - Pavement Management Systems International Conference Subcommittee. The pooled fund will coordinate technology exchange activities concurrently with the conference.

FY 2020- \$12,500

## **Traffic Control Device (TCD) Consortium (3)**

**TPF #:** TPF-5(447)

**Lead Agency:** Federal Highway Administration

**Project End Date:**

**FY 2020 Cost:**

The TCD Consortium will focus on systematic evaluation of novel TCDs, employing a consistent process that addresses human factors and operations issues for each TCD idea. Providing local and state agencies responses to their needs and to new technologies with the right assessment skills and tools will enable consistent TCD idea identification and evaluation. TCD Consortium efforts will address TCD issues identified by local and state jurisdictions, industry, and organizations and aid in the compliance to the MUTCD rule-making process and incorporation of novel TCDs into the MUTCD.

FY 2021 - \$15,000 FY 2022 - \$15,000 FY 2023 - \$15,000 FY 2024 - \$15,000 FY 2025 - \$15,000

## Traffic Signal Change and Clearance Interval Pooled Fund Study

**TPF #:**

**Lead Agency:** Federal Highway Administration

**Project End Date:**

**FY 2020 Cost:**

The goal of the Traffic Signal Change and Clearance Interval Pooled Fund Study is to ensure the application of traffic signal change and clearance intervals maximize the safe transfer or right of way at signalized intersections. The objective of the Pooled Fund Study is to provide a forum for participants and interested observers to collaboratively identify and pursue research needs that extend existing knowledge about the interaction between human factors and traffic signal change intervals and clearance intervals. The research findings of the pooled fund study will clarify existing assumptions and provide supplemental procedures, and methodology to appropriately and consistently apply current and recommended practices for the computation of traffic signal change and clearance intervals.

FY 2021 - \$20,000

FY 2022 - \$20,000

FY 2023 - \$20,000

# AASHTO

## AASHTO Accreditation Program (AAP)

**FY 2020 Budget:** \$6,666.66

The AASHTO Accreditation Program (AAP) was established in 1988 as a means of formally recognizing the competence of testing laboratories to perform specific tests on construction materials. AAP is a voluntary program that is available to all testing laboratories including government, commercial, university, and research facilities. There are nearly 1,500 individual laboratories that are currently accredited through AAP, making it the largest accrediting body of construction materials testing laboratories. AAP utilizes laboratory assessment and proficiency sample services provided by the AASHTO Materials Reference Laboratory (AMRL) and the Cement and Concrete Reference Laboratory (CCRL). AMRL provides administrative coordination and technical support for AAP.

## **AASHTO Cement and Concrete Reference Laboratory (CCRL)**

**FY 2020 Budget:** \$6,666.67

In the early part of the 20th century, various organizations, including the National Institute of Standards and Technology (formerly the National Bureau of Standards), the U.S. Army Corps of Engineers, the American Society of Civil Engineers, ASTM Committee C-1 on Cement, and the Portland Cement Association, began efforts to standardize the specifications and methods for testing portland cement. This eventually led to the establishment of the Cement Reference Laboratory (CRL) in 1929 at NIST with ASTM Committee C-1 as its sponsor. Inspection of laboratories was designated as the primary CRL activity. Until 1947, laboratory inspections were limited to laboratories performing physical tests on hydraulic cements. The inspection activity was gradually expanded to include concrete testing and ASTM Committee C-9 on Concrete and Concrete Aggregates became a joint sponsor in 1958. The name Cement and Concrete Reference Laboratory (CCRL) was adopted in 1960. The CCRL Laboratory Inspection Program has expanded in scope over the years to include cement, concrete, aggregate, steel reinforcing bars, pozzolan, and masonry materials (mortar and solid units). Over 1100 laboratories in the United States, Canada and Mexico currently receive inspections. The second major CCRL activity is the distribution of proficiency samples for interlaboratory testing. The first portland cement sample was distributed in 1936. Samples have been added over the years with the current program including portland cement, blended cement, masonry cement, portland cement concrete, pozzolan, and masonry materials (mortar and solid units). Participation levels varies from 46 laboratories in the masonry mortar program to 1106 in the portland cement concrete program.

## **AASHTO Design Publication Maintenance (DPM)**

**FY 2020 Budget:** \$15,000.00

In 2016, the Board of Directors approved a resolution stating that the current model for developing and maintaining publications related to the design of transportation facilities is unsustainable without a dedicated source of funding. This technical service program was established to provide support for the activities of the Subcommittee on Design and its technical committees in the development and maintenance of the AASHTO publications under their purview.

## **AASHTO Environmental Technical Assistance Program (ETAP)**

**FY 2020 Budget:** \$10,000.00

The Environmental Technical Assistance Program (ETAP) is a critical resource for state departments of transportation that provides cost-effective services and timely information to assist state DOTs with addressing environmental challenges. The goal of ETAP is to supply AASHTO members with the tools and resources necessary to enhance their department's program delivery, environmental streamlining, and environmental stewardship. ETAP allows AASHTO staff to collaborate with the state DOTs and other topical experts to develop comments on relevant proposed federal legislation, regulations, and guidance. ETAP also provides opportunities for partnership building and collaborative problem solving among state and federal transportation and environmental organizations.

## **AASHTO Equipment Management Technical Services Program (EMTSP)**

**FY 2020 Budget:** \$5,000.00

The AASHTO Equipment Management Technical Services Program (EMSTP) was formerly called AETO and can be found at [www.emtsp.org](http://www.emtsp.org). It is associated with the AASHTO Subcommittee on Maintenance and was established in 2008. Equipment fleets comprise a significant asset investment and are a large portion of all public works agencies' budgets and expenses. The effectiveness of such equipment fleet operations affects the public agencies' ability to adequately perform normal activities and successfully respond to emergency events. In addition, the rate of advancement of technology associated with roadway construction and maintenance equipment is so rapid that it is nearly impossible for individual public agencies to stay abreast of the latest technologies, evaluate these technologies, and implement the most cost-effective technologies to gain the advantages that they could provide. The AASHTO Equipment Management Technical Services Program (EMSTP) will keep current data pertaining to new types of equipment along with all advancing innovation and technology directly related to equipment fleet. This technical service program will also help advance asset management principles in the management of these fleets. This information will disseminated throughout the state DOTs to reduce costs of maintenance operations.

## **AASHTO Innovative Initiative (AII) (Formerly TIG)**

**FY 2020 Budget:** \$6,000.00

TIG was established to identify and champion the implementation of a select few “ready to use” technologies, products, or processes that were likely to yield benefits to the users. TIG scans the horizon for outstanding advancements in transportation technology and invests time and money to accelerate their adoption by agencies nationwide. TIG is associated with the AASHTO Standing Committee on Highways, Research Advisory Committee. Each year, TIG selects 3-4 highly valuable, but largely unrecognized procedures, processes, software, devices, or other innovations that have been adopted by at least one agency, are market-ready, and are available for use by other interested agencies. TIG’s objective is to share information with AASHTO member agencies, local agencies, and their industry partners to improve the nation’s transportation system.

## **AASHTO Load and Resistance Factor Design (LRFD) Bridges and Structures Specification Maintenance (LRFDSM)**

**FY 2020 Budget:** \$15,000.00

Load and Resistance Factor Design (LRFD) Bridges and Structures Specification Maintenance (LRFDSM) is associated with the AASHTO Subcommittee on Bridges and Structures. On April 21, 2002, the AASHTO Board of Directors approved policy resolution PR-4-02 endorsing the project, "Long-Term Maintenance of Load and Resistance Factor Design (LRFD) Specifications." In order to continue funding for these purposes, a Transportation Pooled Fund, TPF-5(068) was set up with the Iowa DOT, and states were able to contribute to the fund. This pooled fund has been successfully in place since 2003. The AASHTO Highway Subcommittee on Bridges and Structures unanimously approved the need for continuing to fund this program at their annual meeting in May of 2006. The pooled fund program through Iowa DOT was extended until Fiscal Year 2010, at which point it was closed out. Because the LRFD specifications still need further research and development to maintain quality documents, AASHTO has determined the necessity of keeping this program in place and has now taken over the program as an AASHTO Technical Service Program. In December of 2009 FHWA determined that this program met the criteria for use of 100% State Planning and Research (SP&R) funds. This program continues to support the maintenance and updating of all the LRFD Design specifications.

## **AASHTO National Transportation Product Evaluation Program (NTPEP)**

**FY 2020 Budget:** \$20,000.00

National Transportation Product Evaluation Program (NTPEP) is associated with the AASHTO Subcommittee on Materials and can be found at [www.ntpep.org](http://www.ntpep.org). NTPEP was established by the AASHTO Board of Directors in 1994 to cooperatively test manufactured transportation products that are of common interest to all member departments and share the results from these laboratory and field evaluations. NTPEP is able to provide coordinated evaluations on various products and materials in the areas of traffic, safety, construction, and maintenance. The program is evaluated every four years for financial viability, its effectiveness, the funding mechanisms to support it, and the need for its continuance. NTPEP is run through a joint funding concept between participating industry and AASHTO members, with revenue from industry being used primarily for the testing of and reporting on their products, and with voluntary member dues used primarily for support services to administer NTPEP.

## **AASHTO Operations Technical Services Program/ National Operations Center of Excellence (NOCoE)**

**FY 2020 Budget:** \$15,000.00

A voluntarily-funded technical service program (TSP) to support the new National Operations Center of Excellence (NOCoE) was established by the AASHTO Board of Directors in May 2014. This TSP is an outcome of the MOU signed between AASHTO, ITE, ITS America, and FHWA, which launched NOCoE in January 2015 and formally established an ongoing collaboration between these organizations. Through its technical service offerings, NOCoE was successful in its year-one vision of helping transportation systems management & operations (TSM&O) professionals utilize state-of-the-art, real-time proactive management techniques to improve safety and system reliability, combat congestion, and better serve the traveling public. The services offered by NOCoE include its website ([transportationops.org](http://transportationops.org)), bi-weekly webinars, virtual and face-to-face peer exchanges (seven held in 2015-2016 to date, with another six in planning), a biweekly newsletter to the practitioner community, and an annual summit intended to address challenges and opportunities that the TSM&O community faces. The inaugural Summit, held in June 2016, is themed on workforce development and will facilitate a unified strategic direction within the TSM&O community, to which organizations can look in guiding their own planning. NOCoE has also begun addressing how best it can play a role to support activities in the areas of TSM&O research, connected and automated vehicles, freight operations, and security and emergency management.

## **AASHTO re:source**

**FY 2020 Budget:** \$20,000.00

The primary vision of the AASHTO Materials Reference Laboratory (AMRL) is to be the center for promoting quality and achievement of excellence in construction materials testing (CMT). We do this by providing services and tools through our three major programs: the Laboratory Assessment Program (LAP), the Proficiency Sample Program (PSP), and the AASHTO Accreditation Program (AAP). Through these activities, we evaluate testing competency, promote continual improvement, and instill confidence in the laboratories and specifiers that use our programs. AMRL is part of the Engineering and Technical Services division of AASHTO (American Association of State Highway and Transportation Officials), an international leader in setting technical standards for all phases of highway system development. AASHTO represents all fifty states, Washington D.C. and Puerto Rico and serves as a liaison between the state departments of transportation and the federal government. AASHTO is the voice for transportation and strives to educate the public and key decision makers about the critical role that transportation plays in securing a good quality of life and a sound economy for our nation.

## **AASHTO Resilient and Sustainable Transportation Systems (RSTS)**

**FY 2020 Budget:** \$10,000.00

Securing an energy future that is not tied to the unpredictability of foreign oil markets is vitally important to our national economic security. We need to break our dependence on foreign oil and become energy independent. To assist in enhancing domestic security and addressing the issue of global climate change, transportation policies are needed to reduce dependence on foreign oil while simultaneously reducing greenhouse gas emissions. As federal, state and local governments, industry and the environmental community work to identify strategies to meet energy and climate security goals, it is important to determine what strategies can realistically be expected to achieve. In the transportation sector, opportunities to support energy and climate goals include vehicle technology, alternative fuels, transportation system operation and driver behavior, and reducing travel demand. AASHTO's Resilient and Sustainable Transportation Systems Technical Assistance Program is designed to assist state DOTs understand the potential effects of climate change and the range of strategies and options for climate change mitigation and adaptation. The Resilient and Sustainable Transportation Systems Steering Committee and the tasks being implemented by the Technical Assistance Program are helping achieve these goals.

## **AASHTO Safe, Reliable, and Secure Transportation Operations (SAFETY)**

**FY 2020 Budget:** \$10,000.00

AASHTO member departments coordinate and cooperate with other public safety agencies and highway safety partners to develop and implement programs for improving safety on all public roads. The Highway Safety Policy and Management technical service program will support member departments' and AASHTO's highway safety efforts. This program began as the Safe, Reliable, and Secure Transportation Operations program and is being modified to reflect its focus on highway safety. To work toward the goal of reducing highway fatalities by half in two decades, and reflecting the partnerships state DOTs have, AASHTO participates in the State Highway Safety Alliance to coordinate positions on transportation funding; the Toward Zero Deaths national steering committee to promote AASHTO's perspectives on developing and implementing a national strategy on highway safety, and in efforts with individual safety partners representing the multidisciplinary approach to highway safety. This program supports the role of the AASHTO Program Manager for Safety in these activities and others, such as Highway Safety Manual development and implementation and update of the AASHTO Strategic Highway Safety Plan. It also supports staff efforts to revise and implement safety-related publications, and to coordinate AASHTO input into publications of other organizations. The program supports two AASHTO committees: Standing Committee on Highway Traffic Safety's and the SCOHTS Subcommittee on Safety Management. [Note: This program was established in October 2008 as the Safe, Reliable, and Secure Transportation Operations program]

## **AASHTO Snow and Ice Cooperative Program (SICOP)**

**FY 2020 Budget:** \$4,000.00

SICOP is a pooled fund effort established by AASHTO in 1994 to identify and fund a series of high-priority winter maintenance research and technology transfer projects. Additionally, if warranted, some SICOP participants contribute additional pooled funds to support one or more specific projects in which they have a special interest. SICOP membership includes the AASHTO member departments, APWA, and NACE. The projects chosen thus far have been selected through workshops attended by representatives of the participating states and approved by the Winter Maintenance Technical Services Program Committee. Project details can be found at [www.sicop.net](http://www.sicop.net). SICOP also provides list-serve services to the winter maintenance community through the website. Over 700 winter maintenance enthusiasts from state DOTs, counties, cities, and the private sector use the list-serve. Often answers to difficult operational questions from implementing new and emerging technologies are found by simply posting the question and getting opinions from practitioners. Message strings are archived for easy retrieval and future use.

## **AASHTO Technical Service Program to Develop AASHTO Materials Standards (DAMS)**

**FY 2020 Budget:** \$10,000.00

Technical Service Program to Develop AASHTO Materials Standards (DAMS) is associated with the AASHTO Subcommittee on Materials. The primary function of this AASHTO Technical Service Program is to support the participation of member departments at the Subcommittee on Materials annual meeting, which is convened for the discussion of outstanding ballot items, development of new standards, and revisions and updates to current standards. A secondary role may include the financial support for the involvement of professional writers in the development of new specifications or major revisions of current specifications.

## **AASHTO Transportation Curriculum Coordination Council (TC3)**

**FY 2020 Budget:** \$20,000.00

TC3 launched in summer 2000, with the purpose of improving training opportunities for transportation technical workers, while applying innovative measures to reduce duplication of efforts and costs to state and local transportation agencies. It was developed as a partnership among state departments of transportation (DOTs), Federal Highway Administration (FHWA) and its National Highway Institute (NHI), the American Association of State Highway and Transportation Officials (AASHTO), industry associations and institutes, and academia. It also combined resources and knowledge to develop standardized technical training materials for all stakeholders. The Council's goals included developing a core curriculum to support national priorities that could be used by any agency to improve the skills and qualifications of the transportation technical workforce.

## **AASHTO Transportation System Preservation (TSP2)**

**FY 2020 Budget:** \$20,000.00

Transportation System Preservation Technical Service Program (TSP2) is associated with the AASHTO Subcommittee on Maintenance. Its website is [www.tsp2.org](http://www.tsp2.org). It supports the research, technical, and program needs of the member states in their development and implementation of their own preservation programs for both pavement and bridges. AASHTO, in collaboration with the National Center for Pavement Preservation, has successfully implemented this technical service program to assist states with their pavement preservation efforts, including the establishment of regional pavement preservation partnerships. An Oversight Panel guides the implementation and operation of the TSP2 program, including representation from the AASHTO Subcommittees on Bridges and Structures, Maintenance, Materials, and Asset Management, and Design's Joint Technical Committee on Pavements, as well as members from each of the AASHTO regions. TSP2 has proven to be a successful program for pavement preservation and, with its recent expansion, bridges will be incorporated into the program. In this increasingly tight economy, participation in this program will help state DOTs preserve not only their pavements but their bridges as well.

# Federal

## Mississippi Participation in NCHRP

**FY 2020 Cost Estimate:** \$579,972.00

The Mississippi Department of Transportation contributes to the National Cooperative Highway Research Program (NCHRP). NCHRP is a special-purpose program administered by the Transportation Research Board (TRB) under a three-way agreement among the National Academy of Sciences, AASHTO, and the FHWA. Funding is provided by state highway and transportation agencies at a rate of 5.5% of the agencies' SPR (both Part I & II) funds. Funds for this participation are 100% Federal and thus contain no state match. These pooled funds are used to fund research aimed at solving national or regional problems and can only be spent on problems approved by at least two-thirds of the states. Formal solicitations are made from the states, AASHTO committees, TRB committees and FHWA to develop problem statements. MDOT's annual contribution is paid utilizing both SPR Part I & Part II funds. The amount of funding from each part is based on the 75/25 split (i.e. 75% of the annual NCHRP contribution is funded from Part I funds and 25% of the contribution is funded from Part II funds).

## **Transportation Research Board Correlation Service**

**FY 2020 Cost Estimate:** \$130,000.00

This service provides for subscription to a Research Correlation Service from the Transportation Research Board, a service established and operated in accordance with the recommendation of the Executive Committee of AASHTO. The activities supported by this subscription include the collection of available information concerning past, current and proposed research related to transportation from all sources including federal, state and other government agencies, colleges and universities, research and planning organizations, transport operators and industry, as well as the TRB Annual Meeting and conference programs; the study and correlation of this information through the work of the committees of the Board and dissemination of the useful findings of research and other information by all feasible means including the several TRB publication series, the output of the Transportation Information Services, and through personal contacts during scheduled field visits by the TRB professional staff.