

ANNUAL REPORT

SCDOT State Planning & Research Program
Part II: Research



South Carolina Department of
Transportation Research Unit
in cooperation with
U.S. Department of Transportation
Federal Highway Administration

Fiscal Year 2023

October 1, 2022 through September 30, 2023

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OVERVIEW

The Research Unit handles the day-to-day operations of the research program. The Unit assists with fulfillment of South Carolina Department of Transportation's (SCDOT's) mission and goals by conducting applicable research, disseminating information, and promoting national research programs. Goals established and achieved for the Research Unit in FFY 2023 were:

- Continued Research Topic Solicitation Process for FY 23-24.
- Balloted RDEC for approval and prioritization of topics for development as research projects.
- Developed research projects approved by the Research and Development Executive Committee (RDEC).
- Hosted research peer exchange.
- Received award for high value research.
- Produced a video to market recently completed SPR high value research project.
- Development of Innovation Program.

This annual report provides a description of the FFY 2023 SPR Research Program that includes the period from October 1, 2022, through September 30, 2023. The report is divided into four parts.

Part 1: Provides a description of the program and project funding and a summary of all items included in the FFY 2023 Research Program.

Part 2: Provides a summary of the Research Unit's accomplishments.

Part 3: Gives a description of each study started during the year.

Part 4: Contains project summaries of studies completed during FFY 2023.



Research Program / Project Funding and Research Program Summary

PART I

PROGRAM FUNDING

In FFY 2023, the SPR Research Program received \$4,243,178.00 in Federal funds. Figure 1 provides a general breakdown all items funded and amounts in FFY 2023 including appropriate matching funds and corresponding carry-over funds from previous fiscal years.

• Research Projects	\$2,690,837.00
• NCHRP	\$933,499.00
• Pooled-Fund Studies	\$459,000.00
• Transportation Technology Transfer Service (LTAP Center)	\$317,334.00
• TRB Core Program	\$167,594.00
• Next Generation AASHTOWare Bridge Management (BrM) Project	\$250,000.00
• AASHTO Technical Services Programs	\$148,000.00

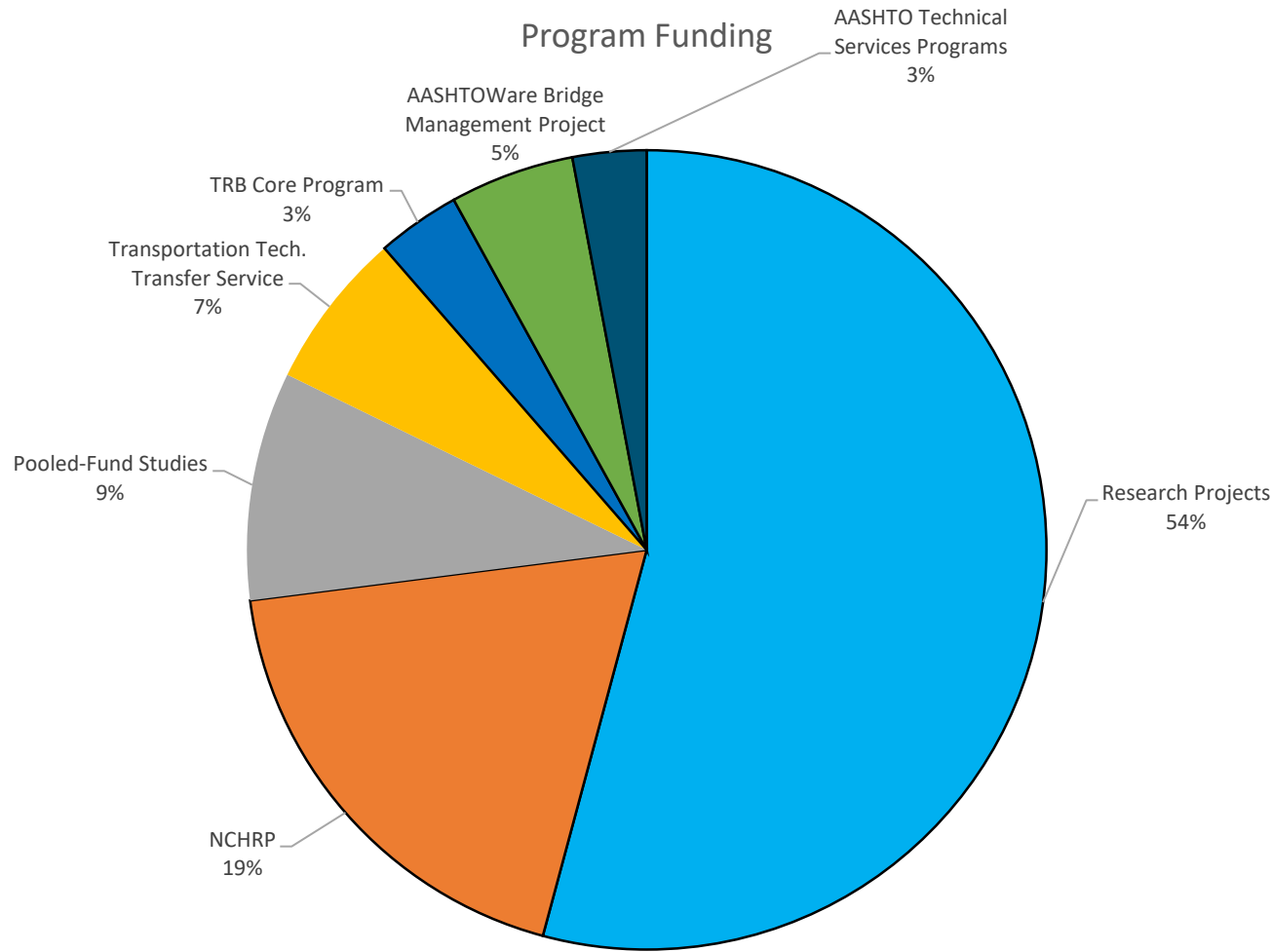


Figure 1. FFY 2023 Research Program Funding

PROJECT FUNDING

A total of twenty-one (21) projects were included in the program. Five (5) research project were initiated in FFY2023. Three (3) studies were completed during the year. Figure 2 shows how the funds obligated for research projects in FFY 2023 were distributed by general area and amounts.

- Construction Scheduling \$199,470.00
- Seismic Design \$1,561,367.00
- Pavement Evaluation \$730,000.00
- Pavement Design \$200,000.00

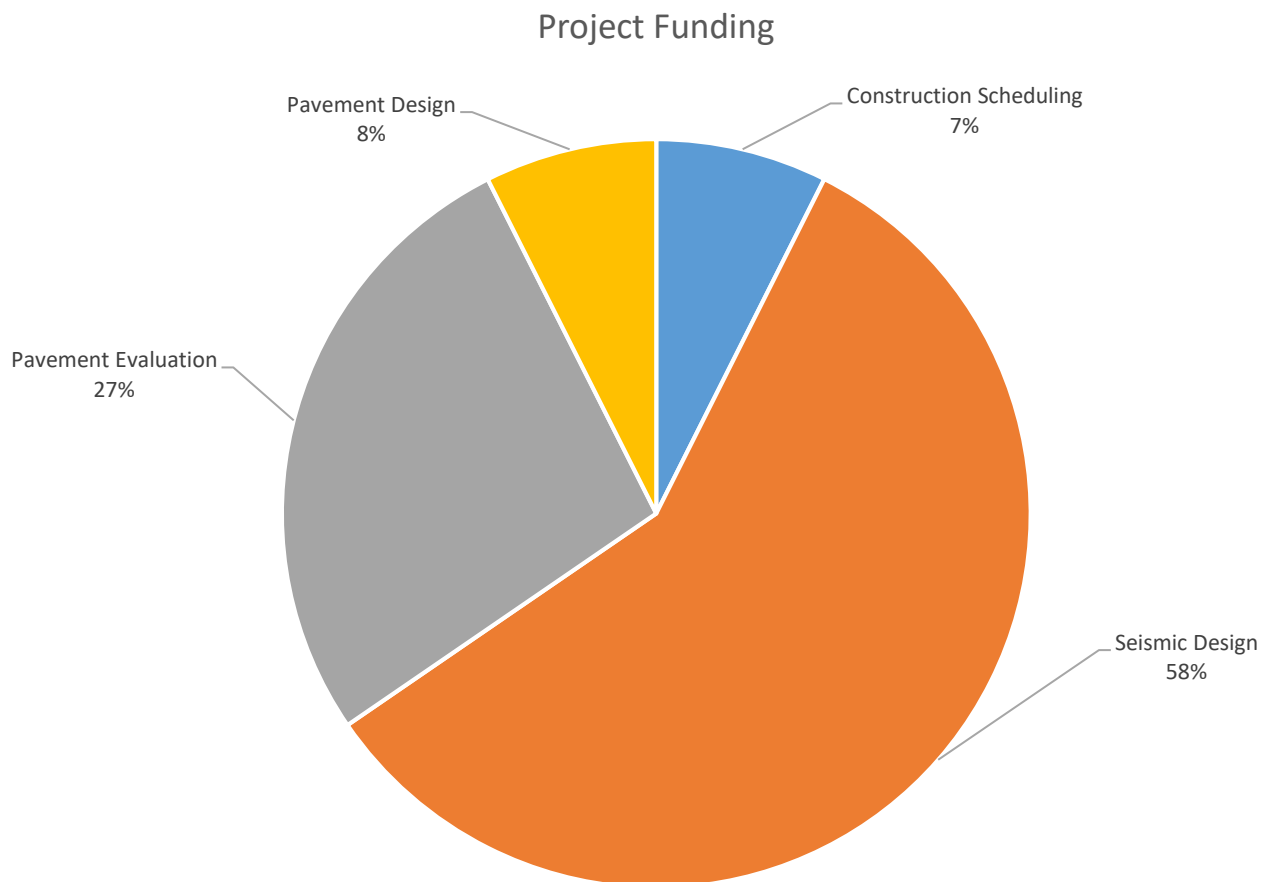


Figure 2. FFY 2023 Research Project Funding

RESEARCH PROGRAM SUMMARY

Table 1 below lists all items included in the FFY 2023 SPR Research Program. The total funding, with amount obligated previously and/or during the year, is given for each item. Also, the percent split between Federal and State funds is shown for money obligated in FFY 2023.

SPR No.	Item	Previously Funded	FFY 2023 Funds	% Split Fed-State
732	Calibration of the AASHTO Pavement Design Guide to SC Conditions - Phase II	\$1,762,300.00		80-20
733	Updating Techniques for Estimating Magnitude and Frequency of Floods for Rural Basins in the Southeastern United States	\$493,612.00		80-20
745	Update to SCENARIO_PC	\$1,274,033.00		80-20
751	SC StreamStats Phase II: Additional Tools and Layers for Enhanced Workflow and Efficiency	\$972,522.00		80-20
752	Safe and Cost-Effective Reduction of Load Postings for South Carolina Bridges	\$487,882.00		80-20
753	SCDOT Scope of Services Template	\$387,051.00		80-20
754	Optimization of Cement Modified Recycle Base (CMRB) Mixture Design	\$320,999.00		80-20
755	Investigation and Assessment of Effective Patching Materials for Concrete Bridge Decks	\$286,493.00		80-20
756	Impact of Utility Delays on Project Delivery	\$414,996.00		80-20
757	A Preliminary Cost Estimating Model for Transportation Projects	\$149,996.00		80-20
758	Field Trials for Cost-Effective Strengthening of SC Load Posted Bridges	\$960,000.00		80-20
759	Best Practices on Collecting Asset Information from the Construction Stage	\$150,049.00		80-20
760	Reducing Crash Risk at Work Zones in South Carolina	\$250,879.00		80-20
761	Streamlining Permitting and Mitigation Processes to Improve SCDOT Project Delivery	\$442,281.00		80-20
762	Ultra-High-Performance Concrete (UHPC) Used as a High Friction Surface Treatment (HFST) on Pavements & Bridges	\$299,822.00		80-20
763	Does Design-Build Always Expedite Project Delivery: Insights from SCDOT's Historical Data from the Past Decade	\$300,000.00		80-20

SPR No.	Item	Previously Funded	FFY 2023 Funds	% Split Fed-State
764	Develop or Improve Construction Scheduling Methods and Models for Construction Projects		\$199,470.00	80-20
766	Evaluate, Update, and Rewrite SCDOT Seismic Design Policy and Procedures		\$1,561,367.00	80-20
767	Development of Rideability Specifications		\$180,000.00	80-20
768	Modernizing SCDOT Pavement Design Tools		\$200,000.00	80-20
769	Utilization of Traffic Speed Deflectometer for Pavement Management Phase-II		\$550,000.00	80-20

Pooled-Fund Studies Funded in FFY 2023

TPF No.	Item	FFY 2023 Funds	% Split Fed-State
5(430)	Midwest Roadside Safety Process Fund Program	\$67,000.00	100-0
5(437)	Technology Transfer Concrete Consortium (FY20-FY-24)	\$12,000.00	100-0
5(441)	No Boundaries Transportation Maintenance Innovations	\$10,000.00	100-0
5(446)	High Performance Computational Fluid Dynamics (CFD) Modeling Services for Highway Hydraulics	\$80,000.00	100-0
5(447)	Traffic Control Device (TCD) Consortium	\$10,000.00	100-0
5(449)	Robust Wireless Skin Sensor Networks for Long-term Fatigue Crack Monitoring on Bridges	\$30,000.00	100-0
5(461)	Soil and Erosion Testing Services for Bridge Scour Evaluations	\$15,000.00	100-0
5(463)	Pavement Surface Properties Consortium: Phase III – Managing the Pavement Properties for Improved Safety	\$20,000.00	100-0
5(464)	Hydrologic and Hydraulic Software Enhancements (SMS, WMS, Hydraulic Toolbox, and HY-8)	\$10,000.00	100-0
5(465)	Consortium for Asphalt Pavement Research and Implementation (CAPRI)	\$107,500.00	100-0
5(469)	NCAT Pavement Test Track 2022	\$100,000.00	100-0
5(480)	Building Information Modeling (BIM) for Infrastructure	\$30,000.00	100-0
5(485)	Consequences-Based Analysis of Undrained Shear Behavior of Soils and Liquefaction Hazards, Phase 1: Filling the Data Gaps	\$20,000.00	100-0
5(488)	Southeast Transportation Consortium - Phase II	\$15,000.00	100-0

Other Items Funded in FFY 2023

TPF No.	Item	FFY 2023 Funds	% Split Fed-State
5(423)	NCHRP - FY 23	\$933,499.00	100-0
5(511)	TRB Core Program Services	\$167,594.00	100-0
-	AASHTO Engineering Technical Service Programs (FY23)	\$148,000.00	100-0
-	Next Generation AASHTOWare Bridge Management (BrM) (FY23)	\$250,000.00	100-0
-	* Transportation Technology Transfer (T3) Service (LTAP Center) (FY23)	\$317,334.00*	80-20

*Additional \$210,000.00 funded by LTAP

Accomplishments

PART II

ACCOMPLISHMENTS

The Research Unit established and achieved the following goals in the FFY 2023 program.

1. Continued Research Topic Solicitation Process for FY 23-24

The SCDOT Research Unit hosted a Research Topic Solicitation Forum on November 10, 2022, in Columbia, SC. The SCDOT contracted with the Transportation Technology Transfer Service (T3S) at Clemson University to provide the logistical and administrative support for the meeting. This meeting, the seventh of its type, was intended to identify a wide array of potentially beneficial research topics for consideration by the SCDOT Research and Development Executive Committee (RDEC) for funding as SPR research projects. Approximately 70 people, including representatives from the SCDOT, FHWA, USGS, academia, and industry participated in the meeting.

The meeting began with a plenary session of all participants during which Research Staff provided a brief overview of the research program and discussed the purpose of the meeting. Each participant then attended one of five breakout sessions, each on a different subject area of potential research interest for the SCDOT. The four breakout groups included:

- Preconstruction/Design
- Construction/Materials
- Maintenance/Traffic Safety
- Planning

Moderators from SCDOT's Office of Materials and Research were assigned to each breakout group. This was the third meeting to require that the solicited research topics be submitted prior to the meeting. Topics were solicited from all research partners, were reviewed by Research Staff, and separated by subject matter corresponding to one or more related breakout group if the subject matter clearly impacted more than one area. The topics were then forwarded to the appropriate Director or Deputy Secretary for their review and recommendation of topics to be included for further consideration in the topic selection and approval process. Review of the topics aided the Director or Deputy Secretary in identifying participants for the meeting from the units they supervise.

All participants were identified and assigned to a breakout group prior to the meeting. All attended the morning breakout session to discuss the topics included in their group. After lunch, only SCDOT and FHWA attendees participated in the afternoon breakout session to determine the higher priority topics to ensure that topics most beneficial to SCDOT were advanced for consideration by the RDEC. Of the 47 topics discussed in the breakout groups during the morning session, 20 were identified as higher priority topics for further consideration. A "Champion" from SCDOT was determined during the afternoon session for each higher priority topic and was responsible for preparing a problem statement for their topic.

2. Balloted RDEC for approval and prioritization of topics for development as research projects.

Topics resulting from the Research Topic Solicitation Forum that were recommended for consideration for funding were balloted RDEC in accordance with the procedures outlined in Section 5.1 of SCDOT's Research Manual. Ten topics were approved by RDEC at its winter meeting held February 6, 2023. The approved projects in prioritized order are shown below:

FY 23-24 Approved Topics for Research Funding

	No.	Title	Champion
1.	23-PD-04/ 23-MB-04	Durability and Cost-Benefit Assessment of Innovative Materials for Bridge Deck Maintenance and Construction	Terry Koon & Sean Futch
2.	23-CM-02	Investigation of Current and New Generation Cementitious and Supplementary Cementitious Materials for SCOOT Concrete	Caleb Gunter
3.	23-CM-01	Field Evaluation and Cost Analysis to Improve Pavement Performance Without Reconstruction (excluding preventative maintenance)	Eric Carroll
4.	23-TS-01	Safety Analysis of Highway Curves Where Crashes Occur in South Carolina	Eugene Taylor
5.	23-MB-02	Cost-Effective Screening, Assessment, and Repair of Timber Piles	Rodrick Tucker
6.	23-MB-01	Cost-Effective Strategies to Meet Retroreflectivity Requirements in Pavement Markings	Cruz Wheeler
7.	23-PD-02	Updating Techniques for Estimating Magnitude and Frequency of Floods for Urban Streams in GA, SC, and NC	Thomas Knight
8.	23-PD-01	Scheduling Software	Adam Humphries
9.	23-MB-03	Herbicide Formulations for Roadside Maintenance	Jennifer Gruber
10.	21-PL-01	Guidance in Addressing Equity in the Context of South Carolina's Highway Transportation System during the Planning Stages	LaToya Grate-Adams

3. Developed research projects approved by the Research and Development Executive Committee (RDEC)

The Research Staff completed development of the twelve (12) projects from the 2020 Research Topic Solicitation Forum that were approved and prioritized by the RDEC on February 9, 2021. During FFY 2023, agreements were signed on three (3) projects. The remaining three (3) projects were assigned to in-house researchers.

4. Hosted Research Peer Exchange

Federal regulations (23 CFR 420 Subpart B) require each State Department of Transportation (DOT) to facilitate peer exchanges of its Research, Development, and Technology Transfer (RD&T2) Program on a periodic basis. SCDOT, along with Mississippi DOT and North Carolina DOT, hosted a multi-state research peer exchange in Greenville, SC. The Southeast Transportation Consortium (STC) Pooled Fund Study, TPF-5 (488), held their annual meeting in tandem with the peer exchange for the first time this year. One of the main objectives of the pooled fund study is to *hold a multi-state peer exchange for up to three (3) STC member states per year on topics of their choosing and invite national experts to participate in conjunction with the STC annual meeting*. The host states selected “Innovation within DOT’s” and “Communicating the Value of Research” as focus areas for discussion. Along with the state’s presentations, Topic Experts presented the following presentation:

Communicating the Value of Research & Innovation

Topic Expert: Brian Hirt, CTC & Associates LLC

“Communicating the Value of Research”

Innovation within DOT’s

Topic Experts: Todd May, Director of Innovation and Process Improvement (Indiana DOT)

“Building a Culture of Innovation”

Dara Wheeler, Chief Division of Research, Innovation & System Information (Caltrans)

“Implementing a Culture of Innovation at Caltrans”

Below are the Key Takeaways for SCDOT:

Communication Takeaways

- Continue producing videos for more popular research projects.
- Refreshing research summary templates (adding quotes and testimonials).
- Take advantage of SCDOT’s Public Engagement Office to create a Research specific YouTube playlist, help update our templates and surveys, and share Research specific updates in upcoming issues of The Connector.

Innovation Key Takeaways

- SCDOT is just beginning the process of establishing its innovation program.

- Gained valuable knowledge from the experts and made great connections to assist with our program
- Learned about different competitions and recognition/award systems
- Become an active member of AASHTO ICOP
- With the knowledge gain at this Peer Exchange, we are beginning a Pilot Innovation Program for SCDOT in 2024.



5. Received award for high value research

Every January, AASHTO's Research Advisory Committee's (RAC) Value of Research Task Force solicits projects for consideration as high value research projects. Each of the four RAC regions selects its top four projects from the submittals to form the "AASHTO High Value Research Awards." SCDOT was awarded an HVR award for recently completed SPR 753, "SCDOT Scope of Services Template." Members of the research unit attended the 2023 RAC National meeting in Chattanooga to present in a poster session and accept the award.



6. Produced a video to market recently completed SPR high value research project

At the peer exchange, the Research Unit was encouraged to continue producing videos to market SPR research. 9/8 Central Studios in Greenville, SC was contracted to create a video showcasing a recently completed project.

The video highlights the findings and deliverables for the award-winning project mentioned above- SPR 753 "SCDOT Scope of Services Template".

Link: <https://www.youtube.com/watch?v=A6oIKmsEBWE&list=PL1No24bVMn8-6U23rpDZzgt1bGwPjVqyS>


7. Development of Innovation Program

A major goal of the research unit was to develop our Innovation Program. From this year's peer exchange, we were able to gather input from Innovation Experts, as well as similar states to build our own program. Many states recognize and award their innovators through a competition and showcase, and one of the major suggestions was to develop an Innovation Challenge and Showcase. With the information gain from other states and internal discussions it was decided that will begin with a Pilot Innovation Program with our Maintenance Units. Working alongside the Director of our Maintenance Office, we have developed a 9 month timeline for our first Innovation Challenge & Showcase. This will include a kick-off starting in January and an Innovation Showcase in July which will be held at the Convention Center. During the development of the Innovation Challenge, the Research Unit has worked with SCDOT's Public Engagement to design logos and discuss a video featuring the program. We have also worked with LTAP/T³S for funding and to develop a website that allows an easy way to submit and share innovations, and also spotlight the winners for each year's Showcase.


Description of the Studies Initiated in FFY 2023

PART III

STUDY STARTED DURING FFY 2023


SPR 764	Develop or Improve Construction Scheduling Methods and Models for Construction Projects	
<p>Organization: <i>Clemson University</i></p> <p>PI: <i>Dr. Tuyen Le</i></p> <p>Start Date: <i>12/15/2022</i></p> <p>Completion Date: <i>12/14/2024</i></p>		
<p>Objective:</p> <p>This project aims at collecting and reviewing data for a large number of completed Design-Bid-Build construction projects and evaluating that data to make a correlation of the pay items involved to the time needed to complete that project. This data could evaluate existing production rates, which could help forecast production rates and construction schedules/completion dates for future resurfacing/preservation, rehabilitation/reconstruction, bridge construction, road construction, and intersection improvement projects.</p> <p>SCDOT currently uses a visual basic model to calculate the number of working days related to construction activities. Ideally, this research would produce an updated model with updated production rates. There is also potential to include historical data discovered from time extensions from previous construction projects. This research could investigate other state transportation agencies to improve on current practices.</p> <p>The study provides SCDOT with an efficient and reliable method or tool to more accurately estimate construction time. This will help provide confidence in construction schedules and justification for established completion dates. This project can help ensure that SCDOT is taking advantage of the best methodology expected to aid SCDOT in making more-reliable decisions in preparing business plans and budgets with more accurate and detailed information about the construction schedules.</p>		

STUDY STARTED DURING FFY 2023

SPR 766	Evaluate, Update, and Rewrite SCDOT Seismic Design Policy and Procedures	
<p>Organization: University of South Carolina</p> <p>PI: Dr. Juan Caicedo</p> <p>Start Date: 8/15/2023</p> <p>Completion Date: 8/14/2027</p>		
<p>Objective:</p> <p>This project addresses the need to revise the Seismic Design Specifications (SDS) for highway bridges that were developed by the South Carolina Department of Transportation (SCDOT) in 1996 and last revised in 2008 (Version 2.0). The SDS is an important tool to provide seismic design policies and procedures for designing bridges that are owned, operated, and maintained by the SCDOT. As earthquake engineering design has evolved in the last few decades and as it will continue to evolve in the future, it is important that the SDS remains up-to-date and effectively addresses the needs and requirements of the SCDOT. There have been significant advances in the field of earthquake engineering as more field data that have been collected from recent earthquakes and advances have been made in research methodologies. There are new paradigms in engineering practice taking into consideration the broader engineering disciplines, new materials and construction technologies, and aspects of social and economic development.</p> <p>Historically, the first version of the SDS in 1996 was developed to account for the effects of large earthquakes (i.e., the 1886 Charleston earthquake) and to define the risk on bridges with a probability of exceedance during a 50-year exposure period of 2 and 10 percent. The latest version of the SDS includes the design earthquake with a probability of exceedance during a 75-year exposure period of 3 and 15 percent. This version introduced the concept of displacement and performance-based design. Performance-based design utilizes an approach to design and build structures in such a way that the service condition following a considered seismic event can be evaluated with an acceptable level of uncertainty. The approach involves the assessment of structural performance, physical damage, and loss caused by a specific range of earthquake induced ground shaking levels.</p> <p>Due to the large uncertainties involved with magnitudes and conditions of seismic loading, as well as the predicted response of structures, probabilistic analysis may be required for the performance-based design. Currently, the SDS requires updating to adequately address the performance objectives and criteria used to assign the levels of seismic loading. In addition, the most recent AASHTO provisions and SCDOT design memos issued have not been incorporated into the current version of the SDS.</p> <p>This project will review, rewrite, and update the current SDS, originally focused only on highway bridges, to become the new Seismic Design Manual (SDM) for bridges, as well as other structures such as retaining walls, other special structures. To improve the performance-based design approach provided in the current SDS, a risk assessment analysis will be performed to account for the new SC seismic hazard (currently being updated by the SCDOT) and detailed information of a</p>		

bridge (e.g., type of bridge, location, traffic volume, etc.). Results will provide the new SDM with the new design philosophy that includes the appropriate performance criteria for bridges and other structures specifically for SC. The new manual will cover seismic design for other structures (e.g., retaining walls, special structures). The procedures will consider not only the most recent AASHTO guidance on seismic design, but also full consideration of west coast methodologies (e.g., Caltrans) and other guidance developed for similar structures (e.g., ASCE 61, MOTEMS) and reflect all seismic related SCDOT design memos.


STUDY STARTED DURING FFY 2023

SPR 767	Development of Rideability Specifications	
<p>Organization: SCDOT</p> <p>PI: Dr. Kimberly Lyons</p> <p>Start Date: 9/1/2023</p> <p>Completion Date: 8/31/2025</p>		
<p>Objective:</p> <p>Pavement roughness is an important indicator of pavement performance. It is estimated that a 10% improvement in ride can result in the deferral of resurfacing by 2 years in addition to other economical and safety benefits. South Carolina like many other states has implemented an incentive / disincentive pay schedule in the rideability specification in an attempt to improve the smoothness of roads in South Carolina for these reasons. This research will examine the cost benefit and historical trends to determine if adjustments need to be made to the current ride specification to improve its cost benefit to the Department.</p> <p>Pavement roughness impacts drivers' satisfaction with the SCDOT, the safety of the driving public, and potential economic loss to the public. An updated rideability specifications can aid the Department in achieving better pavement ride quality. Pavements with better rideability can potentially benefit the state's tourism economy and can increase safety for the driving public through fewer accidents and injuries.</p>		

STUDY STARTED DURING FFY 2023


SPR 768	Modernizing SCDOT Pavement Design Tools	
<p>Organization: SCDOT</p> <p>PI: Dr. Dahae Kim</p> <p>Start Date: 8/10/2023</p> <p>Completion Date: 8/9/2025</p>		
<p>Objective:</p> <p>The SCDOT pavement staff routinely uses the Access-based Pavement Estimator, DOS-based backcalculation tool (to obtain layer moduli), and Life Cycle Cost Analysis tool (Window XP version) for resurfacing projects. These tools are dated in terms of technology, usability, and functionality. Most importantly, they do not leverage current and emerging data sources to expedite and improve pavement design practices. For example, information regarding existing pavement condition may be available based on project location (e.g., LRS), and thus, should auto-populate into the software. This is not possible with the platform in which these tools were built on. Currently, SCDOT pavement staff have to spend an inordinate amount of time locating pavement condition information and maintenance history. Also, the generated output from these tools are stored locally instead of being archived centrally where they can be retrieved at a later time and used by another user. Thus, there is a need to re-implement the Access-based Pavement Estimator, the DOS-based back-calculation tool, and the Window XP version of the Life Cycle Cost Analysis tool using the latest technology.</p> <p>The project will potentially reduce time and effort for SCDOT engineers who routinely involved in pavement designs.</p> <p>The updated pavement design estimator will be heavily used by district engineers when finalizing rehabilitation methods. In doing so, the updated tool would help them make cost effective decisions by picking longer lasting method, which would lead to cost savings for the agency eventually.</p> <p>The back-calculation tool is a main software for OMR pavement engineers when performing Falling Weigh Deflectometer analysis. The updated version would definitely expedite the analysis presses.</p> <p>Life Cycle Cost Analysis is another tool that OMR uses to evaluate the differential costs of alternative investment options for a given project, which can be used not only for new construction projects but also to examine rehabilitation strategies. LCCA analysis is a critical input throughout pavement type selection process as specified in Engineering Directive 15.</p> <p>Also, the manuals along with the software update can benefit engineers by reducing time and effort through the process and potentially improve cost benefit to the SCDOT.</p>		

STUDY STARTED DURING FFY 2023

SPR 769	Utilization of Traffic Speed Deflectometer for Pavement Management Phase-II	
<p>Organization: SCDOT</p> <p>PI: Dr. Srinivasan Nagarajan</p> <p>Start Date: 8/7/23</p> <p>Completion Date: 8/6/2025</p>		
<p>Objective:</p> <p>The first phase of this study proved that Traffic Speed Deflectometer (TSD) is a useful tool for SCDOT to examine structure condition of existing roadways and showed the possibility to assist in current pavement management data collection by adding a structural index parameter. Subsequent in-house projects utilized additional data through the use of Ground Penetrating Radar (GPR), core verification, extra TSD sensors, and temperature to collect layer thickness data and provide temperature corrections for back calculation of structural data instead of a structural index utilized in the first phase. This structural value was then combined with traffic loadings and pavement management data to manipulate the traditional American Association of State Highway and Transportation Officials (AASHTO) design equation and return a remaining service life based on existing structure, surface distresses, and future traffic loadings.</p> <p>The utilization of the TSD data for various projects was successful and the team saw potential benefit of having additional data on primary routes in one of the districts in South Carolina to find ways to apply these data in both project level and network level.</p> <p>Therefore, the objective of the second phase is to build on these previous studies by collecting approximately 1600 miles of primary routes located in the District 4 area of South Carolina with the TSD. This data will then be analyzed to determine Pavement Quality Index (PQI), layer thickness, pavement structural data and ultimately the remaining service life to be used to assist with primary route project selection. Additionally, the previously collected interstate data will be reduced to a usable form to assist with the previous preservation plan that was put together, the Falling Weight Deflectometer (FWD) data will be analyzed and compared with TSD backcalculation data, and ways to utilize this data in an asset management strategy will be examined.</p>		

Summaries of SPR Studies Completed in FFY 2023

PART IV

SPR 733	Updating Techniques for Estimating Magnitude and Frequency of Floods for Rural Basins in the Southeastern United States	
<p>Organization: <i>US Geological Survey</i></p> <p>PI: <i>Toby Feaster</i></p> <p>Completion Date: <i>12/31/2022</i></p>		
<p>Objectives:</p> <p>The objectives of this research project are to: (1) update magnitude and frequency of peak flows for rural, unregulated USGS stations in South Carolina where adequate data are available; (2) when appropriate and based on reviews of the data, update magnitude and frequency of peak flows at regulated USGS gages in South Carolina; (3) in coordination with the USGS South Atlantic Water Science Center NC and GA offices and the USGS Office of Surface Water, update the regional generalized skew coefficient for NC, SC, and GA; 4) in coordination with the USGS South Atlantic Water Science Center NC and GA offices, update the regional rural flood-frequency equations for the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent chance exceedance flows; (5) update the StreamStats application to include the new gage flood-frequency estimates and the new regional regression equations; and (6) develop procedures for updating the flood-frequency estimates for stations on an annual basis with the results being provided through the StreamStats application.</p> <p>Results</p> <p>This project will benefit the SCDOT and the State of SC by providing updated flood-frequency statistics at USGS rural streamgages and updated regression equations that can be used to estimate these statistics on ungaged urban streams. These statistics and equations are used by the SCDOT in the design of bridges, culverts, and road embankments. Improved accuracy in the statistics and regression equations will provide cost savings to the SCDOT associated with bridge and road design along with reduced repair and maintenance costs. Development of procedures and regressions equations will simplify the SCDOT's methods for applying the USGS flood-frequency regression equations and improve the consistency of flood-frequency estimates. The results of this investigation will be used to update StreamStats, an internet-based application, which provides fast, accurate, and reproducible floodfrequency estimates, resulting in a substantial cost savings for SCDOT. The updated statistics and regional regression equations used to estimate flood flows at ungaged urban stream locations in GA, SC, and NC will be published in a USGS report and incorporated into the StreamStats application. This will allow hydraulic engineers to use the products of this project immediately after its conclusion. The project Chairman will provide this section.</p>		

SPR
752

Safe and Cost-Effective Reduction of Load Postings for South Carolina Bridges



Organization: University of South Carolina

PI: Dr. Paul Ziehl

Completion Date: 4/13/2023

Problem:

Precast reinforced concrete flat slabs bridges are very common in the bridge inventory of SC and resolving associated performance issues will therefore have wide-ranging impact. Challenges include a) original structural design loads that are lower than those used today, and b) ages approaching or exceeding expected lifespan in combination with deterioration. A particular challenge with this bridge type is that load ratings are frequently not met as these bridges were originally designed for lower levels of truck loading than those required today. Flexure is the primary mode that presents a challenge for this bridge type.

Objectives:

The research had a two-pronged approach. First, the project investigated the flexural capacity of precast slab components without any modifications. These investigations provided an estimate of the in-situ strength of slab bridges currently in service. With information on the in-situ strength, the SCDOT can make informed decisions regarding removal or maintaining of load postings. Second, the project investigated schemes for strengthening slabs. These schemes can be deployed when analysis and circumstance require the need for increased capacity above and beyond the existing in-situ strength. Strengthening strategies to increase moment capacity of flat slabs were investigated. After a state-of-practice review, four strategies were implemented in the laboratory as proof-of-concept tests.

Results:

The findings are provided below: 1. In general, strengthening from below will increase capacity more than strengthening from above (excluding near surface mounted from above). 2. The two least costly methods were strengthening from above with near surface mounted steel bars and steel channels. 3. The least costly method is associated with the target increase with respect to measured capacity. In the range of 15% increase, strengthening with steel channels from above is the most efficient method. For 15-25%, using near surface mounted steel bars from above to reduce design loads is preferred. Beyond 25% increase, steel plates from below were found to be the most efficient method. 4. The in-situ strength of precast slab bridges is likely stronger than theoretical capacity due to stronger than specified materials, restraints provided by bearings, and/or greater than specified effective depth of steel reinforcement. Recommendations for future work: 1. Deploy selected strengthening methods in the field and monitor performance over time. 2. Further investigate drone inspection, data analysis, and asset management software to further reduce costs and enhance safety.

SPR
753

SCDOT Scope of Services Template



Organization: Clemson University

PI: Dr. Ehsan Mousavi

Completion Date: 3/1/2023

Problem:

Similar to most State Departments of Transportation (State DOTs), the South Carolina Department of Transportation (SCDOT) is responsible for owning, operating, and maintaining an extensive transportation system for the state. SCDOT is under growing pressure for efficient and effective transportation project delivery to address the need and continued expansion. The pressure is due to high demand, limited funding sources, stakeholders' concerns, federal and state policies, and intense public involvement. As a key strategic goal, SCDOT is taking the initiatives to deliver projects as efficiently and expeditiously as possible. One of the efforts undertaken by SCDOT is streamlining its SOS process.

Results:

This work has resulted in recommending 10 specific best practice (BP) items to streamline the SOS process.

BP 1. Development of comprehensive baseline SOS templates for process standardization and to aid the procurement of professional services consultants.

BP 2. Identifying a list of major project variables that affect the overall SOS and project deliverables.

BP 3. Use of comprehensive SOS as a starting point for scope negotiation and the initial development of contract fee.

BP 4. Integrating the Decision Tree Variables with the comprehensive SOS text and developing a program to help generate project-specific SOS.

BP 5. Developing a standard fee estimate tool and integration with the SOS for an efficient and effective negotiation process.

BP 6. Creating a database for negotiated SOS and contract fees for better budget controls and tracking.

BP 7. Increase the frequency of face-to-face/virtual meetings during negotiation process to discuss and resolve SOS issues.

BP 8. Provide adequate training to the DOT personnel and professional services consultants on using the SOS template.

BP 9. Hosting the integrated SOS checklist and program on the SCDOT intranet.

BP 10. Identify a team of experts for regular maintenance and updating the scope of services



2023 SCDOT SPR

Program Part II: Research