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THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

William Cass, P.E.
Commissioner

David Rodrigue, P.E.
Assistant Commissioner
Andre Briere, Colonel, USAF (RET)
Deputy Commissioner

Bureau of Materials & Research
February 24, 2023

His Excellency, Governor Christopher T. Sununu
and the Honorable Council
State House
Concord, New Hampshire 03301

REQUESTED ACTION

Authorize the Department of Transportation to enter into a **SOLE SOURCE** Cooperative Project Agreement with the University of New Hampshire Sponsored Programs Administration (vendor 315187), Durham, New Hampshire, for a fee not to exceed $190,235, for a cooperative evaluation to develop and experimentally validate concrete mix designs to mitigate cracking in bridge curbs and decks and lower early age cracking potentials, effective upon Governor and Council approval through December 31, 2025. 100% Federal Funds.

Funds to support this request are available in the following account for FY 2023 and is contingent upon the availability and continued appropriation of funds in FY 2024 and FY 2025, with the ability to adjust encumbrances between State Fiscal Years through the Budget Office, if needed and justified.

04-96-96-962015-3036	FY 2023	FY 2024	FY 2025
SPR Research Funds			
046-500464 General Consultants Non-Benefit	$80,000	$80,000	$30,235

EXPLANATION

The following research study will address an immediate Department need; is unique to New Hampshire's environment and conditions, thereby requiring substantial local experience; and is directly aligned with a particular area of University expertise. In addition, the Principal Investigator is a nationally recognized expert in his field. As such, the proposed work does not lend itself to a selection process that includes private industry or out-of-state organizations, and it is in the Department's and the State's best interest to work directly with the University of New Hampshire, therefore requesting this **SOLE SOURCE** agreement.

This work is part of the Department's Statewide Planning and Research (SPR) program. The Department of Transportation and the University of New Hampshire (UNH) have a long-standing cooperative relationship in transportation research. This relationship has been mutually beneficial, culminating in savings to the State while enhancing work force development and maintaining New Hampshire's position on the leading edge of new technology. Research studies conducted by UNH for the Department have led to numerous innovations in the highway and bridge industry, including improved pavement design, increased use of recycled materials, stormwater management evaluation, and rapid construction techniques.

Statewide-SPR 42372M, Reducing Concrete Cracking through Mix Design

The Department is collaborating with UNH to conduct a cooperative research study, "Reducing Concrete Cracking through Mix Design". UNH has performed extensive research for the Department including the evaluation of improved materials in bridge construction. In a previous project (SPR Project #26962P), UNH researchers surveyed and analyzed data collected at several New Hampshire bridges to determine the factors driving early-age cracking in bridge curbs and to develop cost effective and easy-to-implement solutions to mitigate this issue. To further evaluate, there is a need to systematically investigate concrete mix proportioning, specifically cementitious amount usage as well as use of supplementary materials, to determine the lowering of the early age cracking potentials. For a total fee not to exceed $190,235 effective upon Governor and Council approval though December 31, 2025, the primary objective of this study is to develop and experimentally validate concrete mix designs to mitigate cracking in bridge curbs and decks.

The funding is 80% Federal Funds with 20% state match. Turnpike toll credit is being used for the match requirement, effectively using 100% Federal Funds. The Capital Budget Overview Committee approved the use of Turnpike Toll Credits on September 13, 2021.

This Agreement has been approved by the Attorney General as to form and execution. Copies of the fully-executed Agreement are on file at the Secretary of State's Office and the Department of Administrative Services, and subsequent to Governor and Council approval will be on file at the Department of Transportation.

It is respectfully requested that authority be given to enter into these sole-source Agreement for consulting services as outlined above.

Sincerely,

William Cass

William Cass, PE
Commissioner

Attachments

CAP 21-019

New Hampshire DOT
Department of Transportation

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

Victoria F. Sheehan
Commissioner

William Cass, P.E.
Assistant Commissioner

Bureau of Materials and Research
July 13, 2021

The Honorable John Graham, Chair
Capital Budget Overview Committee
State House
Concord, New Hampshire 03301

Approved by the Capital Budget Overview Committee September 13, 2021

REQUESTED ACTION

Pursuant to the provisions RSA 228:12-a, Use of Toll Credits, the Department requests the Capital Budget Overview Committee approve the Department of Transportation's use of Toll Credits to meet funding match requirements for the Department's State Planning and Research Part II (SPR2) Work Program. The estimated cost of annual administrative and research related work is $600,000. Based on the estimated cost, the annual maximum amount of Turnpike Toll Credit needed is $120,000.

EXPLANATION

As part of the Federal-Aid Highway Program, the Federal Highway Administration (FHWA) requires that 2% of the State's apportioned funds be set aside for State Planning and Research activities with 75% dedicated to planning and 25% to research. This is a federally mandated program and these funds can only be used for these purposes. To meet this requirement, the NHDOT's State Planning and Research Part II (SPR2) annual Work Program includes a blend of administrative, in-house, and contracted research work.

Research activities included in the requested action are undertaken in accordance with federal regulations and state priorities. The Department's Research Advisory Council meets biennially to rate and prioritize research needs submitted by Department staff. Annual administrative projects fund implementation of promising results, training and certification the Department's technicians providing inspection and material testing on construction projects, and activities related to technology transfer.

Research studies conducted under the SPR2 program have led to numerous gains and innovations in the state's highway and bridge industry, including such successes as improved pavement treatment, alternative materials and methods for bridge construction and repair, validation of environmental compliance, and forensic analysis of transportation construction activities.

The New Hampshire Division of the Federal Highway Administration is provided our annual SPR2 Work Program for review and approval prior to the start of each federal fiscal year. FHWA funding authorization and Governor and Council approval of research contracts are reliant on Toll Credit approval.

Funding is from the annual State Planning and Research (SPR) program, a mandated federal program set-aside.

The balance of toll credits at the end of Federal Fiscal year 2020 is $202 million.

Your approval of the above action is respectfully requested.

Sincerely,

Victoria F. Sheehan

Victoria F. Sheehan
Commissioner

COOPERATIVE PROJECT AGREEMENT
between the
STATE OF NEW HAMPSHIRE, **DEPARTMENT OF TRANSPORTATION**
and the
University of New Hampshire of the UNIVERSITY SYSTEM OF NEW HAMPSHIRE

A. This Cooperative Project Agreement (hereinafter "Project Agreement") is entered into by the State of New Hampshire, **Department of Transportation**, (hereinafter "State"), and the University System of New Hampshire, acting through **University of New Hampshire**, (hereinafter "Campus"), for the purpose of undertaking a project of mutual interest. This Cooperative Project shall be carried out under the terms and conditions of the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002, except as may be modified herein.

B. This Project Agreement and all obligations of the parties hereunder shall become effective on the date the Governor and Executive Council of the State of New Hampshire approve this Project Agreement ("Effective date") and shall end on **12/31/25**. If the provision of services by Campus precedes the Effective date, all services performed by Campus shall be performed at the sole risk of Campus and in the event that this Project Agreement does not become effective, State shall be under no obligation to pay Campus for costs incurred or services performed; however, if this Project Agreement becomes effective, all costs incurred prior to the Effective date that would otherwise be allowable shall be paid under the terms of this Project Agreement.

C. The work to be performed under the terms of this Project Agreement is described in the proposal identified below and attached to this document as Exhibit A, the content of which is incorporated herein as a part of this Project Agreement.

Project Title: **Reducing Concrete Cracking through Mix Design (SPR Project # 42372M)**

D. The Following Individuals are designated as Project Administrators. These Project Administrators shall be responsible for the business aspects of this Project Agreement and all invoices, payments, project amendments and related correspondence shall be directed to the individuals so designated.

State Project Administrator	**Campus Project Administrator**
Name: Deirdre Nash	Name: Randy Brown
Address: NHDOT Bureau of Materials & Research 5 Hazen Drive PO Box 483 Concord, NH 03302-0483	Address: University of New Hampshire Sponsored Programs Administration 51 College Rd. Rm 116 Durham, NH 03824
Phone: 603-271-1659	Phone: 603-717-1800

E. The Following Individuals are designated as Project Directors. These Project Directors shall be responsible for the technical leadership and conduct of the project. All progress reports, completion reports and related correspondence shall be directed to the individuals so designated.

State Project Director	**Campus Project Director**
Name: Andrew Hall	Name: Eshan Dave, PhD
Address: NHDOT Bureau of Highway Design 7 Hazen Drive, PO Box 483 Concord, NH 03302-0483	Address: University of New Hampshire Civil Engineering Kingsbury Hall, Room W173 Durham, NH 03824
Phone: 603 271-3663	Phone: 603 862-5268

Campus Authorized Official KJ
Date 2/22/23

F. Total State funds in the amount of **$190,235** have been allotted and are available for payment of allowable costs incurred under this Project Agreement. State will not reimburse Campus for costs exceeding the amount specified in this paragraph.

Check if applicable
☐ Campus will cost-share % of total costs during the term of this Project Agreement.

☒ Federal funds paid to Campus under this Project Agreement are from Grant/Contract/Cooperative Agreement No. **NA** from **USDOT Federal Highway Administration**under CFDA# **20.205**. Federal regulations required to be passed through to Campus as part of this Project Agreement, and in accordance with the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002, are attached to this document as Exhibit B, the content of which is incorporated herein as a part of this Project Agreement.

G. Check if applicable
☐ Article(s) of the Master Agreement for Cooperative Projects between the State of New Hampshire and the University System of New Hampshire dated November 13, 2002 is/are hereby amended to read:

H. ☒ State has chosen **not to take** possession of equipment purchased under this Project Agreement.
☐ State has chosen **to take** possession of equipment purchased under this Project Agreement and will issue instructions for the disposition of such equipment within 90 days of the Project Agreement's end-date. Any expenses incurred by Campus in carrying out State's requested disposition will be fully reimbursed by State.

This Project Agreement and the Master Agreement constitute the entire agreement between State and Campus regarding this Cooperative Project, and supersede and replace any previously existing arrangements, oral or written; all changes herein must be made by written amendment and executed for the parties by their authorized officials.

IN WITNESS WHEREOF, the University System of New Hampshire, acting through the **University of New Hampshire** and the State of New Hampshire, **Department of Transportation** have executed this Project Agreement.

By An Authorized Official of:
University of New Hampshire
Name: Karen M. Jensen
Title:Director,Sponsored Programs Administration
Signature and Date:
Karen Jensen Digitally signed by Karen Jensen Date: 2023.02.22 08:47:44 -05'00'

By An Authorized Official of:
Department of Transportation
Name: Peter E. Stamnas
Title: Director of Project Development
Signature and Date:
3/6/2023

By An Authorized Official of: the New Hampshire Office of the Attorney General
Name: EMILY GOERING
Title: AAG
Signature and Date:
Emily C. Goering 3/14/2023

By An Authorized Official of: the New Hampshire Governor & Executive Council
Name:
Title:
Signature and Date:

Campus Authorized Official KJ
Date 2/22/23

EXHIBIT A

A. Project Title: Reducing Concrete Cracking through Mix Design (SPR Project # 42372M)

B. Project Period: Upon Governor and Council approval through December 31, 2025

C. Objectives:

Early age cracking severely reduces service life of bridge curbs and decks and increased cost-burden for maintenance of bridges. Premature failure leads to substantial costs associated with curb and deck replacement as well as closure of bridges that lead to traffic related challenges. Cracks allow the intrusion of water, chlorides, and other debris into the concrete, all of which contribute to further damage through the actions of freeze-thaw cycles and rebar corrosion. In a previous project (SPR Project #26962P), researchers surveyed and analyzed data collected at several bridges to determine the factors driving early-age cracking in bridge curbs, and to develop cost-effective and easy-to-implement solutions to mitigate this issue. Through a systematic approach, the study found that longer span bridges (> 40 ft) tended to have more cracking than shorter bridges. Moreover, it was found that a relationship exists between the level of cracking and the location on the curb with respect to the curb ends. Comparative analysis of curb performance also indicated that curbs constructed with concrete mixes containing a lower amount of cementitious materials and wet cured for a duration longer than the typical 7 days exhibited less cracks. The extended wet-curve practices have been implemented by NHDOT Bureau of Bridge Maintenance. There is need to systematically investigate the concrete mix proportioning, specifically, cementitious amount usage as well as use of supplementary materials in lowering the early age cracking potentials. Considering these outcomes, the primary objective of this study is to develop and experimentally validate concrete mix designs to mitigate cracking in bridge curbs and decks

This study is designed with following objectives:

- Laboratory evaluation of current NHDOT structural concrete classes to benchmark their durability and mechanical performance and to design a lab and field experiment to investigate and validate mix designs for bridge curbs and decks;
- Construction and observation of bridge curbs and decks with trial of different concrete; and,
- Development of practice change recommendations to alleviate early age cracking problem..

D. Scope of Work:

In order to address early age cracking in concrete curbs and decks of New Hampshire bridges, this study will undertake four major research tasks.

Task-1 Review of Literature and Current Practices

A review of the published literature pertinent to cracking in bridge curbs and decks will be conducted to determine existing methods and concrete mixes various state agencies have developed and implemented in their design and construction practices to minimize cracking. The review will also consider published numerical and experimental studies that have been conducted to understand the factors contributing to cracking and to quantify tensile stress demand in bridge curbs and decks. Additionally, site visits will be conducted at the bridges where curbs were constructed with low

cementitious materials concrete mixes during the SPR Project #26962P. The purpose of the visits will be to document the performance of the bridge curbs since the completion of that project. The synthesized data will enable the researchers to identify gaps in the current body of knowledge and develop mix designs, which will be evaluated experimentally in the laboratory and refined as necessary before field application and monitoring. The review is expected to be completed within the first 4 months from the anticipated start date.

Task Deliverables: Memo on review of literature and current practices for lowering cracking potential of bridge curbs and decks through mix design revisions.; recommendations for PCC mix trials to be undertaken in task 2.

Task-2: Mix Design and Laboratory Evaluation

Trials of mix designs will be developed based on the information gathered in Task 1 using a factorial experimental design approach. Laboratory batching of the mixes will be conducted, and samples will be prepared to conduct compression, indirect tension, and flexural strength tests to determine the mechanical properties of the mixes. Simultaneously, durability testing will evaluate the freeze-thaw resistance and permeability (surface resistivity) of the trial mixes. Finally, shrinkage behavior of the mixes (autogenous and drying) will also be evaluated. All testing will be performed in accordance with the applicable AASHTO/ASTM standards or their variations with approval of project TAG. The effect of curing method and duration will also be studied. Statistical analysis will be performed on the experimental data to assess variability and determine any correlation between the various mix constituents and measured performance metrics. The analyses will provide an insight on the behavior of the mixes as their constituents change and enable the researchers to optimize the mix designs for peak performance.

Task Deliverable: Memo summarizing mix designs and laboratory measured properties as well as recommendations for the field trials.

Task-3: Survey of Study Sites for Cracking Performance

Based on the outcome of Task 2, a set of mix designs will be selected to be deployed in the field. The project team will work with the NHDOT Bureau of Bridge Maintenance to select various bridge sites to construct curbs and monitor their short- and long-term performance. Bridges will be selected based on criteria including bridge length and number of spans. Up to 7 bridges will be included in the study. At each site, when possible, side by side curbs will be constructed using the mix designs currently used by NHDOT and the new mix designs proposed by the researchers. This approach will enable a direct comparison of the performance of the proposed mixes relative to that of NHDOT current mixes and to quantitatively evaluate the improvement achieved by the new mixes. The research team will conduct periodic site visits after construction inspect and document the condition of the curbs through the measurement of cracks and photos using inspection protocols developed in the previous study (SPR Project #26962P). It is anticipated that the visits will initially be conducted at 3, 7, 14, 21, 28 days after construction of the curbs. After this initial period, the site visits will be conducted on a monthly basis. The gathered data will be analyzed to develop metrics, which will facilitate assessment of the performance of the curbs including, crack severity, and crack spacing.

Task Deliverable: Memo with analyzed cracking data results in terms of amount, severity and spacing of cracking for each of the study locations. Memo will also document other information collected during site visits.

Task-4: Analysis of Results and Recommendation Development

This final task of the project will utilize data and analysis results from all previous tasks to propose change of practice to lower the propensity of early age cracking in bridge curbs. A comprehensive final report will be prepared at the end of the study and delivered to NHDOT with the recommendations for specification and practice changes. The report will be fully edited for grammar and format prior to submittal and should not be a thesis. A poster (30"x40") will also be prepared for the project, poster will meet guidelines of NHDOT.

Task Deliverable: Final report and a poster for the project to be submitted and accepted by NHDOT by December 31, 2025.

Since this project involves substantial coordination between researchers from University of New Hampshire (UNH) and NHDOT staff, key activities of the research project where research team will need assistance from the NHDOT staff is shown as follows:

Task 1:
- Traffic control for site visits from previous research study.

Task 2:
- Assistance in facilitating sampling of materials for laboratory testing.

Task 3:
- Construction of bridge curbs and decks with various mix recommendations provided by the research team
- Gathering of mix designs, QC and acceptance test results for concrete from study site locations
- Traffic control for site visits to study locations

E. Deliverables Schedule:

Quarterly summary reports will be submitted at the end of each calendar quarter. Researchers will meet with project technical advisory group (TAG) at beginning of the project, end of Task-1, mid-way through Task-2, end of Task-2, mid-way through Task-3 and at the end of the project. At these meeting, researchers will make presentations to TAG summarizing progress on research to date and to present next steps.

F. Budget and Invoicing Instructions:

The total estimated budget for this project is $190,235.

Budget Items

1. Salaries & Wages	$90,318
2. Employee Fringe Benefits	$3,432
3. Tuition	$37,280
4. Travel	$3,050
4. Supplies and Services	$16,500
5. Equipment	0

Campus Authorized Official KJ
Date 2/22/23

Total Direct Costs	$150,580
UNH Facilities & Admin Costs	$39,655
Total Costs	$190,235

Budget Justification: Dr. Eshan Dave will be principal investigator (PI) for the proposed study, he will be responsible for supervision of graduate and undergraduate students working on this study, communications and coordination with NHDOT, coordination of laboratory and field investigation efforts and preparation and submission of project deliverables. One month of his time is budgeted. Dr. Philippe Kalmogo will be co-PI for this study, he will co-supervise graduate and undergraduate students working on this project, help in preparation of project deliverables, oversee structural analysis efforts and help in coordination with NHDOT. One month of Dr. Kalmogo's time is budgeted. One graduate research assistant will be fully dedicated to this project. Graduate researcher will be responsible for conducting literature review, laboratory testing, field data collection and preparation of draft project deliverables. Four semesters of graduate research appointment are budgeted along with 16 weeks of summer term appointments over two years. Funds to support 200 hours of undergraduate hourly worker are budgeted. Undergraduate worker will support laboratory and field evaluation efforts of graduate student. Funds are budgeted for travel to bridge sites by research team members to gather in-situ cracking data. Partial travel costs to cover participation in one conference (Annual Meeting of the Transportation Research Board is used for estimates) to present research findings is budgeted. Lastly, costs associated with materials and supplies to support laboratory and field testing efforts are budgeted. These includes costs associated with procurement of testing materials and consumables.

Invoicing Instructions: UNH will submit invoices to State on regular basis. UNH will not submit invoices more frequently than monthly and not less frequently than quarterly. Invoices will be based on actual project expenses incurred during the invoicing period, and shall show current and cumulative expenses by major cost categories. States will pay Campus within 30 days of receipt of each invoice. UNH will submit its final invoice not later than 60 days after the Project Period end date. State will provide final payment within 30 days of receipt of the accepted final report.

G. Expected Benefits / Implementation

This research has potential for lowering the cost of maintaining NHDOT bridges by preventing early age cracking in concrete curbs and decks. This practical research project will undertake assessment of various solutions to early age cracking trough trials conducted on actual bridges. On basis of the results from trails this study will propose changes to standard practice for implementation in future projects.

Campus Authorized Official KJ
Date 2/22/23

EXHIBIT B

This Project Agreement is funded under a Grant/Contract/Cooperative Agreement to State from the Federal sponsor specified in Project Agreement article F. All applicable requirements, regulations, provisions, terms and conditions of this Federal Grant/Contract/Cooperative Agreement are hereby adopted in full force and effect to the relationship between State and Campus, except that wherever such requirements, regulations, provisions and terms and conditions differ for INSTITUTIONS OF HIGHER EDUCATION, the appropriate requirements should be substituted (e.g., OMB Circulars A-21 and A-110, rather than OMB Circulars A-87 and A-102). References to Contractor or Recipient in the Federal language will be taken to mean Campus; references to the Government or Federal Awarding Agency will be taken to mean Government/Federal Awarding Agency or State or both, as appropriate.

Special Federal provisions are listed here: ☒ None or **Uniform Guidance issued by the Office of Management and Budget (OMB) in lieu of Circulars listed in paragraph above.**

Campus Authorized Official KJ
Date 2/22/23