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Proposed Plan To Develop New Testing Methods To Satisfy Unmet Needs

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PRELIMINARY FINDINGS – SUBJECT TO UPDATES

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Types of Projects Proposed:

- Demonstration projects
  - Technology transfer of implemented NDT techniques
- Focused development projects
  - Promising technology where more development is needed
- Experimental research projects
  - DOT need identified and several technologies can be used to address need
- Unfulfilled needs
  - No current NDT technique

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Recommended Experimental Research Projects

- E1: Nondestructive Testing to Identify Delaminations between HMA Layers
- E2: Nondestructive Testing to Identify Bridge Deck Deterioriation

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Recommended Unfulfilled Needs Projects

- U1: New Technologies for Mapping Unknown Bridge Foundations
- U2: Detecting Movement in Structures with Inertial Profile Data
- U3: Mapping Voids behind Tunnel Linings and Retaining Walls (?)

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E1: Nondestructive Testing to Identify Delaminations between HMA Layers

Problem Statement

- Delaminations can result in
  - HMA Damage due to braking or turning of vehicles
  - Paths for moisture, resulting in moisture damage
  - Slippage Cracks
  - Pavement deformation (rutting)
  - Pavement strength reduction
- A rapid nondestructive test method is needed to determine the existence and extent of delamination and/or discontinuities in asphalt pavements.

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E1: Nondestructive Testing to Identify Delaminations between HMA Layers

Proposed Work Plan

- Phase I
  - Literature review of the historical records of pavement delamination failures
  - Methods presently used to identify delamination and discontinuities
  - Proposal of a comprehensive study/experimental plan to validate recommended approaches.
- Phase II
  - Modifications, if needed, to the recommended procedures/equipment
  - Conducting experiments to verify that the procedure is applicable to HMA pavements.
  - Validation will be conducted at either the National Proposed Calibration facility of on experimental test sections specifically constructed by the researchers.
  - For those technologies proven to be successful in the first evaluation full scale testing on field projects will be performed.

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E1: Nondestructive Testing to Identify Delaminations between HMA Layers

Anticipated Products

- Comprehensive review and documentation of existing procedures and equipment used for identifying delamination and discontinuities in HMA pavements
- Development and documentation of a rapid, economical test to be used to determine the presence of delamination of HMA pavements
- Documented field verification of recommended non-destructive testing procedures/equipment.

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E2: Nondestructive Testing to Identify Bridge Deck Deterioration

Problem Statement

- Many bridge rehabilitation projects involve either repairing or replacing existing bridge decks.
- If the deck deterioration is detected early in the process, and if the cause could be established, lower cost preventive maintenance or repair strategies could be used.
- Identify rapid NDT methods that can detect if bridge decks are starting to deteriorate and what is causing the deterioration, such as
  - Insufficient cover of reinforcing steel
  - Corrosion of reinforcing steel
  - High concrete permeability
  - Concrete with ASR problems
  - Debonding of the deck from the girders

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E2: Nondestructive Testing to Identify Bridge Deck Deterioration

Proposed Work Plan

- Phase I
  - Literature review of the historical records of bridge deck deterioration
  - Methods presently used to identify deterioration,
  - Methods that hold promise in identifying deterioration,
  - Proposal of a comprehensive study/experimental plan to validate recommended approaches.
- Phase II
  - Modifications, if needed, to the recommended procedures/equipment
  - Conducting experiments to verify that the procedure is applicable to bridge decks.
  - Validation will be conducted at either the National Proposed Calibration facility or on experimental test sections specifically constructed by the researchers.
  - For those technologies proven to be successful in the first evaluation, full scale testing on field projects will be performed.

PRELIMINARY FINDINGS – SUBJECT TO UPDATES

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E2: Nondestructive Testing to Identify Bridge Deck Deterioriation

Anticipated Products

- Comprehensive review and documentation of existing procedures and equipment used for identifying used for identifying deterioration in bridge decks
- Development and documentation of a rapid, economical test or tests to be used to determine the presence, extent, and cause of deterioriation
- Documented field verification of recommended non-destructive testing procedures/equipment.

U1: New Technologies for Mapping Unknown Bridge Foundations

Problem Statement

- There are approximately 86,000 bridges in the United States where the foundations are unknown.
- FHWA requires agencies to conduct scour susceptibility evaluations for bridges over waterways, and foundation information is needed to conduct effective scour evaluations.
- A recent survey of State DOT's indicate that NDT to characterize unknown foundations is a top priority; however, there doesn't appear to be any nondestructive testing technologies or techniques that are regularly used
- NCHRP Projects 21-5, Determination of Unknown Subsurface Bridge Foundations, and 21-5 (2), Unknown Subsurface Bridge Foundation Testing, investigated the use of various technologies for this purpose, however the project panel indicated that the results were inconclusive.

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U1: New Technologies for Mapping Unknown Bridge Foundations

Proposed Work Plan

- The objective of this project is to generate effective surface-testing based NDT technologies
- Different technologies may be needed based on the construction materials used for the foundations (i.e., timber, steel, or concrete)
- Phase I
  - Establish experimental design criteria for characterizing unknown foundations. In particular, the accuracy level for nondestructive testing needs to be established so that end users can have confidence in the technology.
  - Review of past research to identify promising applications that may have already been investigated by others, including the work conducted by the NCHRP 21-5 and 21-5(2) projects.
  - Recommend technologies to the project monitoring committee for approval.

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U1: New Technologies for Mapping Unknown Bridge Foundations

Proposed Work Plan (continued)

- Phase II
  - Perform the necessary work to develop the new technologies, including modifications, if needed, to the recommended technologies
  - Conduct experiments to verify that the technologies are effective in characterizing unknown foundations (either the National Proposed Calibration facility or on experimental test sections specifically constructed by the researchers)
- Phase III
  - Provide for implementation of the technologies from Phase II.
  - Information dissemination and exchange to make users aware of the new developments.
  - Include tasks to provide training on the technologies developed from Phase II.

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U1: New Technologies for Mapping Unknown Bridge Foundations

Anticipated Products

- Technologies that effectively characterize unknown bridge foundations.
- Recommendations on equipment availability, costs, reliability, capabilities, etc
- Results from field verification testing
- Draft test procedures for any new methods developed, with guidance on equipment needed for the tests.

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U2: Detecting Movement in Structures with Inertial Profile Data

Problem Statement

- There is always the need for additional and better information on the state of structures.
- Considering the current availability and affordability of inertial profilers, profile data of bridge structures can easily be obtained by the use of these systems.
- Through periodic monitoring of structures, changes or movements in the structures that could result in their failures could be noted.
- Monitoring changes can provide highway engineers with additional information useful in preventing major failures.
- Synchronizing video and image processing methods could enhance this process.

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U2: Detecting Movement in Structures with Inertial Profile Data

Proposed Work Plan

- The objective is to develop a method for periodically monitoring profiles from bridges or other such structures by developing a data base of their characteristics. Common characteristics will be identified and then used to compare with data collected in preceding years.
- Task 1
  - Conduct a review of recent development work of network level NDT systems that could be used for characterizing bridge and other such structures in the highway system.
  - Investigate methods of using inertial profile data for detecting earth or structural movement or changes.
  - Provide a list of states using network level inertial profile data and how this data is recorded and maintained.

U2: Detecting Movement in Structures with Inertial Profile Data

Proposed Work Plan (continued)

- Task 2
  - Based on the results of Task 1 and availability of profile data, obtain samples of this profile data from one or more states marking the locations of bridges or other such structures of interest.
  - If possible, obtain both recent and previous profiles of these structures.

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U2: Detecting Movement in Structures with Inertial Profile Data

Proposed Work Plan (continued)

- Task 3
  - Develop methods for identifying the characteristics of these structures.
  - Determine if various classes of bridge structures can be developed.
  - Select a specific set of bridges and acquire current and past maintenance records.
  - Develop a general bridge or overpass template or signature for the selected set.
  - Compare surface profiles from previous years and examine for similarities.
  - Discuss results with state engineers responsible for monitoring and/or establishing maintenance procedures for these structures.

U2: Detecting Movement in Structures with Inertial Profile Data

Proposed Work Plan (continued)

- Task 4
  - Establish initial procedures for periodic monitoring of bridges selected in Task 3.
  - Identify methods for detecting changes in the inertial profile data.
  - If video is included, investigate methods to incorporate image processing methods that could illustrate or further clarify changes.
  - These profiles could then be periodically monitored for surface changes.
  - Procedures would be used for detecting small changes in specific target signatures. These changes could reflect earth movements and provide an early warning of changes that are detrimental to the bridge or other such structures.
  - Discuss proposed tests and results with engineers and contractors.

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U2: Detecting Movement in Structures with Inertial Profile Data

Proposed Work Plan (continued)

- Task 5.
  - Continue Task 4 the following year.
  - As necessary, perform modifications and refinements to the procedure based on the results.

- Task 6.
  - Document the development work in a technical report.
  - Provide the procedures developed from the project, associated software, and an accompanying user's manual.
  - Present recommendations for implementing the methods into existing data collection procedures.

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U2: Detecting Movement in Structures with Inertial Profile Data

Anticipated Products

- A tool to be followed for collecting and analyzing network level bridge profile data for noting changes in these structures and how these changes can be used along with other NDT methods for determining bridge status.

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U3: Mapping Voids behind Tunnel Linings and Retaining Walls (?)

Problem Statement

- NDT is needed to map voids behind tunnel linings and retaining walls
- GPR is considered a possibility for retaining walls, but the thickness of some tunnel linings may be problematic for using this technology
- Interested in European and Japan's efforts in this area
- Feedback and comments are needed