



RESEARCH PROGRAMS USE ONLY
RESEARCH TOPIC STATEMENT NO:
DATE OF RECEIPT:

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I. TITLE (required):

Feasibility of Non-Proprietary Ultra-High Performance Concrete (UHPC) for Use in Highway Bridges in Montana.

II. TOPIC STATEMENT (required):

The objective of the proposed project is to design and test non-proprietary UHPC mixes to determine whether UHPC is a viable option for Montana.

III. BACKGROUND STATEMENT (required):

Ultra-high performance concrete became commercially available in the U.S. in 2000. Since then, UHPC has been actively promoted by the Federal Highway Administration. UHPC has mostly been used in the U.S. for field-cast connections of prefabricated bridge components, but may also be used for precast girders, precast piles, and thin-bonded overlays for bridge decks. UHPC is generally understood to be a concrete with compressive strength at least 20 ksi, post-cracking tensile strength at least 0.72 ksi, and a discontinuous pore structure that improves durability by limiting permeability. These properties are achieved with a low water-to-cement ratio, aggregate gradation optimized for high particle packing density, high quality aggregates and cements, supplemental cementitious materials, high particle dispersion during mixing, and incorporation of fiber reinforcement. A research study recently completed by FHWA demonstrated promising advances in the development of non-proprietary UHPC mixes with material costs ranging from \$355 to \$500/yd³ for non-fiber-reinforced mixes (adding fiber reinforcement increases the material costs by \$417/yd³). Commercial mixes currently cost around \$2,000/yd³.

IV. RESEARCH PROPOSED (required):

This research will be accomplished by first conducting a literature review of UHPC to synthesize information regarding UHPC material characteristics, mix designs and applications. A second task would develop UHPC mixes based on non-proprietary mix designs using aggregates, cements, and supplemental materials from as many locally available sources as possible. The FHWA Tech Brief FHWA-HRT-13-100 (*Development of Non-Proprietary Ultra-High Performance Concrete for Use in the Highway Bridge Sector*) and companion report will be used as a starting point, in addition to other information found during the literature review. The following types of mixes are recommended for investigation: UHPC with fine aggregate only, UHPC with fine and coarse aggregate, and UHPC with fiber reinforcement. The following tests are recommended in this preliminary investigation: compression, flexural strength, splitting tensile, and freeze-thaw resistance.

V. IT COMPONENT (required): Identify if the project includes an IT component (purchasing of IT hardware, development of databases, acquisition of existing applications, etc.) or not. If so, describe IT component in as much detail as possible.

The work proposed herein does not require IT hardware, software or support.

VI. URGENCY AND EXPECTED BENEFITS (required): This section must include a description of how this research will serve the public by providing a transportation system and services that emphasize quality, safety, cost effectiveness, economic vitality and/or sensitivity to the environment.

Aging infrastructure and limited budgets require robust and proven bridge construction, rehabilitation and replacement strategies that are cost-effective and efficient. If non-proprietary UHPC mixes are viable in Montana, more widespread use of these mixes would potentially allow significant cost savings without sacrificing performance.

VII. IMPLEMENTATION PLAN (required): Identify MDT office or entity outside of MDT responsible for implementation. Describe initial implementation plan, include timeframe for implementation.

If preliminary mixes and testing indicate that casting UHPC using non-proprietary mix designs is feasible, then additional research will likely be needed to measure additional mechanical and durability properties, such as early age strength development, long-term creep, chloride ion penetration, alkali-silica reactivity, shrinkage behavior and scaling resistance to deicing chemicals. The first implementation will likely be a demonstration project performed within the MDT Bridge bureau, in conjunction with the MDT Materials bureau and MDT Research Programs.

VIII. SUBMITTED BY: (required)

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IX. CHAMPION (optional): Must be internal to MDT, feel strongly that the research will benefit the Department, and is willing to chair the technical panel.

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X. SPONSOR(S) (optional): Must be internal to MDT (Division Administrator or higher) and willing to ensure implementation occurs, as appropriate.

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Note: Submitter may attach continuation sheets if necessary. All research topics submitted become public property and submitters are not guaranteed to receive a contract for any work resulting from any submitted research topic.