NEVADA DEPARTMENT OF TRANSPORTATION
RESEARCH PROBLEM STATEMENT

Internal Submission Form (not to exceed 3 pages with font size 11)

I. PROBLEM TITLE: Design of Surface Treatments with Reclaimed Asphalt Pavement Aggregates in Nevada

II. PROBLEM DESCRIPTION: Surface treatments (ST) which include chip seals and slurry systems (i.e., slurry seals and microsurfacing) represent very effective methods of maintaining asphalt concrete (AC) pavements. Recycled asphalt pavement (RAP) can be used as aggregates for STs, contributing towards the design and construction of sustainable pavements while conserving natural resources. Several issues during the mix design and construction still need to be clearly defined to get this technology to work effectively. National research efforts on the use of RAP as ST aggregates are still very limited and the uniqueness of Nevada's asphalt mixtures, in terms of lime treatment and polymer-modified binders, significantly reduces the applicability of the available literature.

III. OBJECTIVE: The overall objective of the research is to develop test methods and procedures for the implementation of using RAP materials from Nevada as aggregates for STs. The methods and procedures shall cover all aspects of materials selection, mix design, and quality assurance during construction. The following represents the specific objectives of the proposed research:

- Develop and conduct laboratory and field tests/methods for the evaluation of RAP materials as aggregates for ST, using locally available sources from each of the three NDOT districts.
- Develop mix design methods/limits for RAP use for ST with RAP aggregates using locally available sources from each of the three NDOT districts.
- Develop test methods for quality assurance of ST during construction.
- Develop specifications for material processing and construction of ST with RAP aggregates.
- Perform a feasibility and economic analysis to understand the potential use of RAP in STs statewide.
- Produce a final report.

IV. CURRENT PRACTICE and RELATED RESEARCH: Currently NDOT does not allow the use of RAP materials as aggregates for STs of AC pavements. Most of the RAP materials are used either in hot mix asphalt (HMA) or on shoulders. The use of RAP in STs can provide several benefits towards the performance of STs, including; improved resistance to moisture damage and reduced oxidation of the asphalt residue leading to reduced chip loss in chip seals and raveling of slurry seals and microsurfacing. In addition, the use of RAP as aggregate for STs offers economical and environmental advantages, where the cost of RAP is lower, and the need of virgin aggregate is reduced.

A study funded by FHWA documented case studies on the use of RAP as aggregates for STs by the Los Angeles County (LAC), San Bernardino County (SBC), and the New Mexico Department of Transportation (NMDOT) (1). SBC reported that allowing RAP as a substitute for virgin aggregate reduced aggregate costs by up to 30%. The NMDOT concluded that using RAP as aggregates for STs is the most beneficial use of RAP materials. Agencies used RAP in chip seals, slurry seals, and microsurfacing, but the requirements were different for each. Proper material testing and mix design were important in determining whether a RAP stockpile was a viable source. RAP

stockpiles containing soil or geotextile fabric were unsuitable. Benefits of using RAP as a substitute for virgin aggregate included enhanced bonding with the applied binder, darker, more uniform surface color, prolonged resistance to oxidation, less chip loss, and smoother surface texture. Material application rates were similar for RAP and virgin aggregate and costs were lower using RAP instead of virgin materials. The performance characteristics of pavement-preservation treatments using RAP or virgin aggregate are similar. RAP slurry seals are reported to benefit from pneumatic-tire roller passes that seat the RAP particles and seal the treatment surface texture.

A study at Michigan State University compared the performance of slurry seals manufactured with RAP and virgin aggregates in the Hamburg Wheel Tracking Test (HWTT) (2). The HWTT measures the resistance of the slurry mix to rutting under the combined action of traffic and moisture damage. The study concluded that the slurry seal mix manufactured with RAP materials performed similar to the slurry seal mix manufactured with 100% virgin aggregates.

A study published in the Journal of the Transportation Research Board evaluated slurry mixtures with virgin aggregate and RAP (3). The results show that, although the curing time relative to the virgin aggregates increased by 1 h for RAP aggregate, the wear value in the wet track abrasion tester (WTAT) decreased by half. Lateral displacement and the British pendulum test results improved considerably for slurry seals made with RAP aggregates. The results of the sand patch test on WTAT samples showed that slurry seals made with RAP should be lightly rolled after lay-down to improve their friction life. Analysis indicates that the use of RAP as an aggregate in slurry seal decreased costs by up to 14%. Overall slurry seal with RAP performed better than slurry seal with virgin aggregate with lower cost.

V. IMPLEMENTATION POTENTIAL: The results of the proposed research will be immediately implementable by NDOT. The proposed research will produce a manual that covers all the details necessary to conduct the test methods and procedures to evaluate RAP materials, conduct mix design, and quality assurance for STs. The manual will be directly and immediately deployable by the Materials and Maintenance Divisions of NDOT without the need for any supervision. The use of RAP as aggregates for STs of AC pavements is not expected to require any new equipment for the laboratory design nor for the construction activities of the STs. The screening process for RAP in STs would be similar to the screening required for RAP used in HMA. The coarser material screened off from RAP for STs could be used for RAP in HMA or in shoulders.

It is not anticipated that any institutional, political, or socio-economic barriers to implementation of the anticipated research results/products would exist.

VI. URGENCY and PAYOFF POTENTIAL: The proposed research offers great potential for NDOT to use a highly sustainable approach for maintaining AC pavements. There is a significant national effort towards reducing the carbon footprints of road construction. RAP materials are already being produced on every rehabilitation project and their use as aggregates for STs will reduce the carbon footprints generated by the mining of new virgin aggregates.

The current literature shows that most of the experiences in using RAP as aggregates for STs of AC pavements are localized and there is not any national guidance for this application. Therefore, it is critical that NDOT develops design and evaluations techniques for using RAP as aggregates in the three most commonly used STs in Nevada, i.e., Chip Seal, Slurry Seal, and microsurfacing, without jeopardizing the performance of the STs.

The use of the RAP as aggregates for STs represents the highest payoff as compared to wasting the RAP or using it on the shoulders. RAP materials produced in Nevada are composed of high-quality polymer-modified and lime-treated AC mixtures, which are expected to offer great performance when used as aggregates in STs for AC pavements throughout Nevada.

The successful completion of the proposed research offers NDOT the option of using highly valuable RAP materials in the maintenance of AC pavements. Considering that the great majority of Nevada's roads are AC pavements, the potential payoff of using RAP materials in STs could lead to significant annual cost saving.

VII. DATE and SUBMITTED BY: April 11, 2024,

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VIII. ADDITIONAL CHAMPIONS:

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References

1. Gregory Duncan, Luis Sibaja, Steve Seeds, and David Peshkin, "Using Reclaimed Asphalt Pavement in Pavement-Preservation Treatments," Federal Highway Administration Report: FHWA-HRT-21-007, December 2020.
2. Hao Ye, "Innovative Evaluation of Recycled Asphalt Pavement (RAP) use in Slurry Seal Applications," Master Degree Thesis, Department of Civil Engineering, Michigan State University, 2021.
3. Mahdi Saghafi, Nader Tabatabaee, and Soheil Nazarian, "Performance Evaluation of Slurry Seals Containing Reclaimed Asphalt Pavement," Transportation Research Record No. 2673(1), 2019.

FIVE STAGES OF RESEARCH DEPLOYMENT

Based on Caltrans Research and Innovation Stages

1. **Concept Stage**
   - First steps following Problem Statement and Proposal Development
   - Includes detailed literature search
   - Involves experimental design, data collection, analysis, and reporting
   - Assesses results of research
   - Defines barriers to implementation (e.g., policies, specifications, standards)
   - Submits a Final Report and outlines a recommended implementation plan
   - Includes collaboration with outside agencies or other state DOTs and US DOT (Applies to all Stages of Deployment)
2. **Laboratory Prototype Stage**
   - Develops breadboard circuit or computer system modeling
   - Demonstrates operation in laboratory setting
   - May incorporate customized or one-of-a kind components
   - Assesses results
   - Submits Final Report and recommends design of full-scale demonstration
   - Potential end users are enlisted to support the field pilot stage
3. **Controlled Field Demonstration Stage**
   - Prepares for full scale testing of demonstration project
   - Controlled tests at specialized facilities are observed and supported by cooperating agencies, industry, and technical associations
   - Potential end users are enlisted to support the field pilot stage
   - Assesses results
   - Submits Final Report and recommends site/conditions for first application pilot stage
4. **First Application (Contract) Field Pilot Stage**
   - Works with potential end users to select site and to conduct pilot testing under real world operating conditions
   - Test specifications and standards are developed
   - Research assistance given to assure proper installation and operation
   - Problems are corrected and adjustments made, as necessary, to complete pilot testing
   - To the extent possible, potential end users operate the project under careful research surveillance
   - Assesses results
   - Submits Final Report and recommends initial sites for full corporate deployment
   - Potential end users are enlisted to support the field pilot stage
5. **Specification & Standards with Full Corporate Deployment Stage**
   - End users select site(s) and deploy the method/process/equipment using resident management, supervision, staff, and contracting forces (where applicable)
   - Deployment is without research supervision or direction
   - On call assistance is available upon request
   - Assesses results