

## UTC Project Information

Project Title	Establishing Percent Embedment Limits to Improve Chip Seal Performance
University	Michigan State University
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Funding Source(s) and Amounts Provided (by each agency or organization)	\$120,00 MDOT \$30,000 MSU
Total Project Cost	\$150,000
Agency ID or Contract Number	DTRT13-G-UTC44
Start and End Dates	April 1, 2017, to September 1, 2018
Brief Description of Research Project	<p>The extent of embedment of aggregate chips is one of the most significant parameters affecting the performance of chip seals. Excessive or insufficient aggregate embedment may result in severe distresses such as bleeding or aggregate loss in chip seal applications. Hence, having proper limits of the percent embedment of aggregates established as a result of performance-based test measures is of paramount importance for the successful use of such treatments. In a previous project (OR15-508), a procedure (and software named CIPS) was developed to directly calculate the aggregate percent embedment of aggregates into the asphalt binder for a chip seal application based on digital image analysis. This procedure can be used as (i) an acceptance test (or part of an acceptance specification) for MDOT, (ii) a quality control measure for contractors and MDOT quality assurance, (iii) an objective tool for forensic investigations, and (iv) future conflict resolutions. However, all these potential applications rely heavily on maximum and minimum limits for percent embedment, which should be determined through performance testing of chip seals. The image-based software (CIPS) developed as part of OR15-508 was able to compute the percent embedment using three different methods, namely; (i) peak-valley method, (ii) surface coverage area method and (iii) embedment of each aggregate method.</p>

Among these methods, the third method, embedment of each aggregate method was found to be the most robust method delivering the repeatability. The CIPS software can compute percent embedment accurately and objectively; however, the appropriateness of the calculated percent embedment cannot be assessed due to a lack of data relating the percent embedment to chip seal performance. There is a need to link the percent embedment to performance measures such as resistance to bleeding (which can impact surface friction and texture) and chip loss — primarily due to extensive snow plowing that takes place during the winter in Michigan. Furthermore, the effect of aggregate types (e.g., blast furnace slag versus gravel) on the limits of percent embedment needs to be investigated and quantified thoroughly.

Describe Implementation of Research Outcomes (or why not implemented)

N/A

Place Any Photos Here

Impacts/Benefits of Implementation (actual, not anticipated)

The results of this project can be used (with the CIPS software) as (i) an acceptance test (or part of an acceptance specification) for MDOT, (ii) a quality control measure for contractors, (iii) an objective tool in forensic investigations, and (iv) future conflict resolutions.

Quality of chip seals constructed in Michigan will be improved. As a result, the performance of chip seals will be enhanced. The beneficiaries of the research findings will be MDOT, county road commissions (departments), contractors and cities

Web Links

<[www.chpp.egr.msu.edu](http://www.chpp.egr.msu.edu)>

- Reports
- Project website