This topic is "practice ready." ☒ **Yes** ☐ **No**

Performance-based design and testing methods for unpaved road surface materials

Cheng Li[1], Jeramy C. Ashlock [2], Bora Cetin[3] and Charles Jahren[4]

Abstract

Unpaved roads and shoulders frequently experience surface damage caused by traffic loads and freeze-thaw (F-T) and wet-dry (W-D) cycles, which increase maintenance requirements. Such damage is typically addressed by covering the entire road surface with virgin aggregate. However, the virgin material often rapidly degrades due to considerable variations in gradation and quality of the materials—eventually resulting in high fugitive dust emissions and unstable road surfaces. This study is focused on determining target gradations and plasticity indices for unpaved road surface materials that provide improved performance in terms of durability. Gradation optimization was determined by mixing the existing surface material with virgin material in various proportions and observing the results of a series of laboratory tests. California Bearing Ratio (CBR) and slaking tests were performed to evaluate how changes in gradation and plasticity affect the saturated shear strength of unpaved road surface materials. Based on the laboratory test results, a performance-based free design method for the gradation of unpaved road surface materials was developed using Fuller's model. To help implement the design method, an Excel-based program was developed to optimize the gradation of the surface material and calculate the corresponding mixing ratios of existing and available materials. To assess the performance of the design method in field, unpaved road and shoulder test sections were constructed in Iowa, and performance-based field tests were conducted over one seasonal freeze-thaw cycle. Lab and field test results will be summarized and methods for the selection of target gradations and plasticity indices of unpaved road surfacing materials will be presented.

Keywords: Unpaved roads—Gradation—Plasticity—Fuller's Model—Shear Strength

---

[1] Postdoctoral Research Associate; Iowa State University; 136 Town Engineering Building, Ames, IA 50010-3232; phone (515) 509-6050; email: cheng@iastate.edu

[2] R.L. Handy Associate Professor; Iowa State University; 474 Town Engineering Building, Ames, Iowa, USA 50011-3232; email: jashlock@iastate.edu

[3] Assistant Professor; Iowa State University; 494 Town Engineering Building, Ames, Iowa, USA 50011-3232; email: bcetin@iastate.edu

[4] Professor; Iowa State University; 458 Town Engineering Building, Ames, Iowa, USA 50011-3232; email: cjahren@iastate.edu