

DEVELOPMENT OF DESIGN GUIDELINES FOR PROPER SELECTION OF GRADED AGGREGATE BASE IN MARYLAND STATE HIGHWAYS

Problem

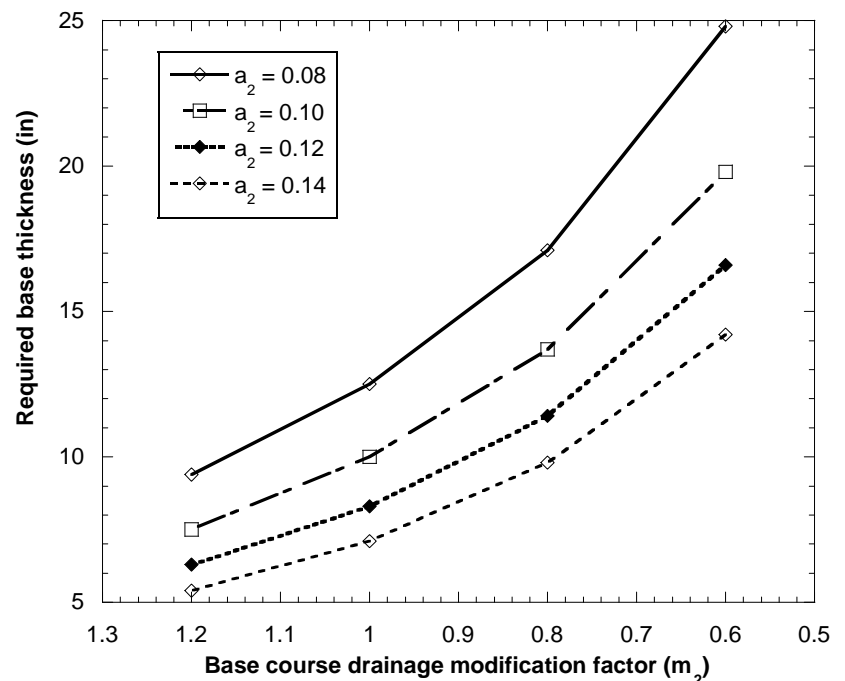
Millions of tons of graded aggregate base (GAB) materials are used in construction of highway base layers in Maryland due to their satisfactory mechanical properties. The fines content of a GAB material is highly variable and is often related to the crushing process, stockpiling in the quarry, transportation and construction at the site. The mechanical and drainage properties of GAB material are the level one input in mechanistic pavement design. The crushing of the stone at the quarry generally does not decrease the mechanical strength and stiffness of the material delivered to the site. However, the Maryland State Highway Administration (SHA) is experiencing difficulties in achieving proper drainage through the base layers due to occasionally high fines content of the delivered GAB materials.

Objective

The primary objective of this study was to develop guidelines for evaluation of stiffness and drainage characteristics of GAB stone delivered at highly variable gradations to the construction sites.

Description

To fulfill the current need, the mechanical and drainage properties of several Maryland GAB materials were evaluated in the laboratory and field. The resilient modulus and hydraulic conductivity test results obtained in the laboratory were compared to the field moduli and hydraulic conductivity. The effect of moisture content on resilient modulus was also evaluated.



Results

Summary resilient modulus (SM_R) values at Optimum Moisture Content (OMC) minus 2% were higher than those at OMC, with few exceptions; however, the permanent deformations increased with moisture beyond OMC. The control of moisture content within 2% of OMC would not significantly affect the resilient modulus and permanent deformation in construction. It was also concluded that an addition of 4-6% fines over the SHA specification limit of 8% resulted in 2-5 times decrease in the laboratory-based GAB hydraulic conductivities and an increase in time for 50% completion of the drainage from the highway base. The required base thickness increased 2.6 to 7 times as a result of fines increased from 2 to 14% for selected GAB materials evaluated.

Two Maryland recycled concrete aggregate (RCA) materials, named A and B, were also included in the laboratory testing program. RCAs were generated from the demolition of concrete structures and stockpiled in Plants A and B located in Maryland. The fines content of materials A and B were measured as 6 and 9%, respectively, and grain size distribution curves of both materials were within the SHA GAB limits (Figure 1). The absorption values of both RCAs were 4.2%; however, the Los Angeles abrasion of A exceeded the specification limit of 50%. The percent losses based on sodium sulfate tests were 15.7 and 14.3% for A and B, respectively, and exceeded the SHA specification limit of 12%, which could be due to a reaction of sodium sulfate with cement contents present in material.

It is recommended that resilient modulus, permanent deformation, as well as hydraulic conductivity of GAB materials, are included in the aggregate bulletin and evaluated for each quarry in designing a highway base with adequate stiffness and drainage performance.

Report Information

Ahmet Aydilek, Ph.D.
Department of Civil and Environmental Engineering
The University of Maryland
Phone: (301) 314-2692
e-mail: aydilek@umd.edu

Link to Report:

http://www.roads.maryland.gov/OPR_Research/MD-15-SP109B4G-1_GAB_Report.pdf