

OHIO DEPARTMENT OF TRANSPORTATION OFFICE OF PAVEMENT ENGINEERING RESEARCH IMPLEMENTATION PLAN



Title: Permeability & Stability of Base & Subbase Materials

State Job Number: 14512

PID Number:

Research Agency: University of Toledo

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Sponsor(s): Howard Wood, David Humphrey

Study Start Date: 3/2/1992

Study Completion Date: 2/16/1999

Study Duration: 84 Months

Study Cost: \$364,450.00

Study Funding Type: 80 Federal / 20 State from ODOT SPR (2)

STATEMENT OF NEED:

The purpose of pavement base and subbase courses is to provide a means for free water to drain from beneath roadways while providing structural support for the pavement. Problems occur when highway materials which are assumed to have adequate drainage characteristics actually have low permeability and low effective porosity.

It has been observed that some base and subbase materials meeting the gradation requirements provide only fair to poor drainage characteristics. The current gradation ranges permit a broad range of possible permeability and effective porosities. It is necessary to investigate bases and subbases that satisfy the current gradation specifications to determine ranges of their permeability and effective porosities.

RESEARCH OBJECTIVES:

- To investigate the permeability of ODOT 304 aggregate, 310 aggregate, #57 stone, #67 stone, "New Jersey" permeable base, "Iowa" permeable bases, asphalt treated permeable bases and Portland cement treated permeable bases. This will be done for three sources of the materials: natural sands and gravels, crushed limestone and slag. A single mix for stabilized #57 stone and for stabilized #67 stone will be studied for both asphalt and cement binders.
- To investigate the materials to determine the amount of water retained after they are permitted to drain, and consequently, the effective porosities. Resilient modulus and static compression tests will be performed to verify the stability of the materials.
- To construct a permeability device and develop a procedure that will permit determination of in situ base permeability.

RESEARCH TASKS:

- 1- To investigate the permeability of ODOT 304 aggregate, 310 aggregate, #57 stone, #67 stone, "New Jersey" permeable base, "Iowa" permeable base, asphalt treated permeable base and Portland Cement treated permeable base. This will be done for three sources of the materials: natural sands

and gravels, crushed limestone and slag. A single mix for stabilized #57 stone and for stabilized #67 stone will be studied for both asphalt and cement binders.

- 2- To investigate the materials to determine the amount of water retained after they are permitted to drain, and consequently, the effective porosities. Resilient modulus and static compression tests will be performed to verify the stability of the materials.
- 3- To construct a permeability device and develop a procedure that will permit determination of in situ base permeability.
- 4- Prepare final report

RESEARCH DELIVERABLES:

- 1- Final report
- 2- Laboratory permeability test equipment
- 3- Field permeability test equipment

RESEARCH CONCLUSIONS AND RECOMMENDATIONS:

- All of the specifications tested (No. 57, No. 67, New Jersey mix, IA mix, ODOT 304 and ODOT 310) can provide hydraulic conductivities in excess of 1000 ft/day, a widely recommended design hydraulic conductivity for pavements.
- Future construction with ODOT 304 should be restricted to the lower bound of the gradation envelope when it is designed as a layer to provide pavement drainage. It is essential the lower limit of the gradation envelope (coarser) be followed for ODOT 304 and ODOT 310, with the expressed purpose of minimizing particles passing the No. 200 sieve.
- No. 57 or No. 67, whether stabilized or un-stabilized, should be considered when drainage is critical, and when fine materials are present in the subgrade which could migrate to clog finer grained bases. The source material for No. 57 should be gravel when possible, followed in preference by limestone and air cooled blast furnace slag.
- The effective porosity is the appropriate measure of the capacity of a freely drained base to accept new inflow when it becomes available from infiltration or groundwater.
- It is recommended the Moulton nomograph not be used to predict the hydraulic conductivity of the open graded materials tested. Instead, the in situ hydraulic conductivity test developed in this study should be used to assess a broad range of existing pavement bases throughout Ohio. When this is not practical, or for future specifications, the laboratory test developed under the project should be used to assess the hydraulic conductivity and effective porosity of representative specimens at realistic densities.

PROJECT PANEL COMMENTS:

In the early 1990's ODOT constructed several projects, including the Ohio SHRP test road, LOG-33-17.82, and ERI/LOR-2-30.51/0.00, which included test sections for the evaluation of asphalt or concrete pavement on various free draining bases (FDB). Data has been collected on these sites to determine the cost-benefit of the use of FDB. The following are preliminary results of this evaluation

- Moisture probes indicate FDB has little effect on the moisture levels below the pavement structure. Subgrade moisture saturation levels are not affected regardless of base type.
- Rigid pavements on FDB have shown either no difference in performance or, in certain cases, a detriment to performance when compared to rigid pavements placed on dense graded base.
- Flexible pavements on FDB have not shown any difference in performance compared to flexible pavements placed on dense graded base.

Based on the results of these test sections, ODOT issued a moratorium on the use of FDB in an IOC dated March 23, 2001.

An independent evaluation of subgrade moisture by the University of Akron was initiated on April 1, 2002.

IMPLEMENTATION STEPS & TIME FRAME:

Given the March 23, 2001 moratorium, there are no plans to implement the results of this study.

EXPECTED BENEFITS:

N/A

EXPECTED RISKS, OBSTACLES, & STRATEGIES TO OVERCOME THEM:

N/A

OTHER ODOT OFFICES AFFECTED BY THE CHANGE:

N/A

PROGRESS REPORTING & TIME FRAME:

The University of Akron project, "Evaluation of Drainable Bases Under Asphalt Pavements", is scheduled for completion on 12/1/05. Upon review of the final report, a determination will be made as to whether or not to continue the moratorium on FDB.

TECHNOLOGY TRANSFER METHODS TO BE USED:

1. The Final Report of the research has been distributed to 49 state transportation departments, different FHWA offices, selected national libraries, and others.
2. Lab and field testing equipment is being used by the University of Akron for their evaluation.

IMPLEMENTATION COST & SOURCE OF FUNDING:

N/A

Approved By:

Office Administrator:

Signature: David Humphrey Office: OPE Date: 9/23/2005

Division Deputy Director:

Signature: Howard Wood Division: Planning Date: 10/11/2005