HIGHWAY RESEARCH CIRCULAR

Number 52 Subject Area: Construction Mineral Aggregates, Maintenance, General October 1966

COMMITTEE ACTIVITY
in the
Construction Division
Department of Materials and Construction
Highway Research Board

RESEARCH NEEDS

Research Problem Statements

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HIGHWAY RESEARCH BOARD
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FOREWORD

Construction practices used in the same and in different geographic locations for a given purpose vary considerably. These practices have generally been developed by cut and try methods, and often without benefit of research. Numerous problems associated with construction management, operations, and procedures have been recognized and discussed by committees in the Construction Division. In accordance with the stated purpose and scope of the committees, they have prepared statements of these problems, the titles of which are listed previously.

All of these are directed toward providing an economical and smooth riding pavement surface.

Highway Research Board
Department of Materials and Construction
Construction Division

Research Problem Statement No. 1

Title:

Joints in Concrete Pavement.

The Problem Area:

Concrete Pavement Design, Construction and Maintenance.

The Problem:

Transverse joints are still the weakest links in concrete pavements. Design, construction and materials used for load transfer devices, fillers, and sealers, are not satisfactory as shown by indifferent performance and costly maintenance needed when compared to the rest of the pavement structure.

A jointed concrete pavement is usually the most economical to build, but can be the most difficult to maintain. Ride and durability steadily deteriorate over the years, largely at the joints, leading to earlier resurfacing or reconstruction than might otherwise be needed. All the interrelated aspects of design, construction, maintenance and materials are needed.

Objectives:

Review needs of existing practice and deficiencies in:

(1) Slab length design, including need for expansion joints or not.
(2) Load transference.
(3) Sealing, not only on the top but at edges and along the bottom.
(4) Suitable sealing materials as related to properties of the sealers, anticipated movement and shape factor.
(5) Suitable fillers for expansion joints.
(6) Construction methods:
    (a) installing load transfer devices;
    (b) inducing cracks;
    (c) forming receptacle for sealant;
    (d) installing sealant.
(7) Maintenance practices.

Following this, and probably discarding most of our preconceived ideas, a new look should be taken at the whole question of joints and for each aspect listed above, research and development work should be undertaken to find a foolproof, trouble-free joint capable of performing without maintenance for the life of a concrete pavement in respect of:

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(i) Permitting free horizontal movement in slabs.
(ii) Transferring load.
(iii) Preventing ingress of water leading to pumping and other deterioration
(iv) Maintaining a smooth ride.

References:

There is too much in the literature to survey in this statement. Bibliography possibly needed.

Urgency:

The advent of preformed neoprene or other compression seals, while apparently a great step, are not yet fully proven. Until we have the answer and apply it, several thousand miles of less than the best concrete pavement are being built each year. The urgency is therefore very great.

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Research Problem Statement No. 2

Title:

Smooth Riding Concrete Pavements.

The Problem Area:

Concrete Pavement Construction.

The Problem:

The public demands a smooth riding pavement. The smoother the pavement initially, the longer its life. Yet, we have no standard or satisfactory method of measuring this feature, especially while the concrete is plastic and corrective action can be taken. Standard criteria for acceptability of ride are needed. Construction techniques need refining in the direction of smoothness.

Objectives:

Examine the existing devices used on (i) hardened concrete such as straight edging, hi-lo machines, multi-wheeled profilometers, B.P.R. roughometer, accelerometers attached to vehicles, (ii) plastic concrete straight edging, British wet surface profilometer.

From the deficiencies realized, devise such new methods of measurement as may be needed and apply to achieving smoother pavements by modifying construction techniques as indicated.

References:

Beyond the better known ones, most of which are in HRB publications, the work of British Road Research Laboratory should be seriously studied. Key reference is Dr. R.H.H. Kirkham - "Recent Research into the Construction of Concrete Pavements", Institution of Civil Engineers, Paper No. 6748, which leads to the others.

Urgency:

On most jobs with new types of finishing machines, we get an "acceptable" ride. The ride is still not generally as good as that of asphalt pavements. While the urgency is therefore not of the greatest, a satisfactory outcome of any research would be worth having.

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Research Problem Statement No. 3

Title:

The Development of Improved Methods of Measuring Mixing Efficiency of Hot Mix Bituminous Materials.

The Problem Area:

Bituminous Pavements.

The Problem

Efforts to determine adequate mixing time for asphaltic concrete or other bituminous mixes, or to evaluate the efficiency of pugmill design, mixing procedures, etc. have been hampered by the lack of an efficient, rapid procedure for measuring mixing efficiency.

Objectives:

To develop an improved method for measuring mixing efficiency for hot mix bituminous construction.

References:

Dillard, J.H. and Whittle, J.P., "An Examination of Mixing Times as Determined by the Ross Count Method", Highway Research Board Bulletin 358.

Urgency:

Full advantage cannot be made of improved technology in bituminous hot mix construction procedures until such time as a rapid, accurate, and reproducible method of measuring mixing efficiency is available. Immense savings are possible if mixing efficiency could be improved or even if full advantage could be taken of the efficiency presently available.

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Research Problem Statement No. 4

Title:

Construction Quality Control.

The Problem Area:

Construction Quality Control.

The Problem:

The rapid determination of soils classification, density, and moisture during construction operations.

Objectives:

Determination of a field testing procedure that will enable field inspectors to determine accurately and rapidly:

(1) soils classification as they affect compactive effort,
(2) the maximum density and optimum moisture for each classification,
(3) the degree of compaction and moisture in the embankment.

References:

Current specifications and procedures of the various State Highway Departments and Governmental Agencies.

Urgency:

Urgently needed to enable field inspection crews to exercise quality control on the present day grading operations. Failure to develop better methods can lead to poor control, inferior work and costly delays.

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Research Problem Statement No. 5

Title:

Cost of Operation of Earth Moving Equipment.

The Problem Area:

Cost of operation relative to time and haul distance in regard to payment for determination and payment for overhaul of earth quantities.

The Problem:

A comprehensive study of cost of operation of earthmoving equipment.

Objectives:

Establish equitable cost for different types of earthmoving equipment for variable haul distances.

References:

Equipment companies have some information, but very inadequate.

Urgency:

Moderately urgent for use as a guide to bring our method for paying for overhaul up to date.

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Research Problem Statement No. 6

Title:

Rapid Measurement of Aggregate Quantities.

The Problem Area:

Construction Quality Control.

The Problem:

To determine the most economical, rapid and accurate method of weighing aggregates for highway construction when the pay item is by the ton. The accounting procedure and the method of calibration of the various weighing devices are involved.

Objectives:

There are available on the market several types of new devices that weigh material on the conveyor belt and electronic controls and printers for all weighing devices. The research project would be to study and test various devices to determine their accuracy, suitability and methods of calibration, and acceptable field accounting procedure for each type.

References:

Manufacturers literature. To the best of our knowledge no comprehensive research has been conducted in this area.

Urgency:

A comprehensive research project would be of interest to every highway department and governmental agency letting contracts involving the weighing of materials. It could result in decreased construction costs and therefore it is urgently needed.

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Research Problem Statement No. 7

Title:

Sampling Procedure for Aggregates.

The Problem Area:

Construction Quality Control.

The Problem:

Sampling Procedure for Aggregates.

Objectives:

To determine a sampling procedure that would give results with known degree of confidence and the tolerance that could be expected.

References:

Effects of Different Methods of Stockpiling Aggregates by Miller-Warden Associates.

Urgency:

There is an urgency for such a method throughout the entire aggregate industry.

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Research Problem Statement No. 8

Title:

Evaluation of Pile Bearing Capacities.

The Problem Area:

Foundations for Structures.

The Problem:

Bearing piles are used in an overwhelming preponderance of all structures. The equipment for driving piling has proliferated during the past few years. The means of determining bearing capacities, by means other than test loading, has not kept pace with the development of pile driver types.

Objectives:

(1) To develop methods, other than test loading if possible, to determine bearing capacities of piling driven by methods other than conventional equipment. (Specifically vibratory, sonic, and related equipment)
(2) If test loading should be the only solution, to develop more rapid and economical methods of test loading.

References:

Michigan has completed a program for determination of pile bearing. However, this program does not appear to include the most recently developed type of equipment.

Urgency:

The new equipment gives promise of increasing the speed and economy of pile placement. Failure to have an accurate and economical method of determining capacities penalizes the use of this new equipment on smaller projects.

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