Overview

A symposium, entitled "Implication of Aggregates in the Design, Construction, and Performance of Flexible Pavements," was held at the Sheraton New Orleans in New Orleans, Louisiana, in conjunction with the 2–5 December 1986 standards development meetings of the ASTM Committee D-4 on Road and Paving Materials The focus of this symposium was on the characteristics of aggregates that influence the performance of asphalt paving mixtures Included were presentations on mixture instability problems (for example, rutting, shoving, bleeding, etc) which are more prevalent today because of increased axle loads and tire pressures. A total of ten papers were prepared and submitted to the D-4 Papers Review Subcommittee in response to the "call for papers" for this symposium Five of the papers were selected for presentation at the symposium All ten papers were considered to contain significant information on the symposium subject and were accepted for publication in this resulting ASTM Special Technical Publication

Crushed stone and sand and gravel are the two main sources of aggregates used in the construction of flexible pavements These natural aggregates are widely distributed and exist in a variety of geologic environments However, although widely distributed, natural aggregates are not universally available for consumptive use Many areas are devoid of sand and gravel In some areas potential sources of crushed stone may be covered by great thicknesses of overburden which makes surface mining impractical In other areas, many aggregates do not meet the physical/chemical property requirements for certain end uses, or they may contain deleterious constituents that react adversely with binding agents used to produce concrete mixtures. Finally, many areas having an abundance of natural aggregate find that the aggregate is not available or accessible because of existing land uses, zoning, or regulations that preclude commercial exploitation of the aggregate. As a consequence, flexible pavements must be designed and constructed with economically available aggregates, possessing quality levels that ensure desired performance of the flexible pavements in which used

Hot-mix asphalt (HMA) mixtures used in flexible pavements contain approximately 90–95 percent aggregate by weight Because of this, aggregates are the principal consideration in influencing the properties of HMA mixtures

The first paper by Abdulshafi and Al-Dhalaan discusses utilization of low quality aggregates in flexible pavements constructed in Saudi Arabia and in the Gulf area. The authors describe use of cement-coated coarse aggregate as one effective solution to rutting, bleeding, and shoving of asphaltic mixtures Results of laboratory testing are provided to support the conclusions of the authors. The benefits of use of cement-coated aggregate include increased stability, improved resistance to stripping, increased tensile strength, increased resilient modulus and increased fatigue life.

The paper by Barksdale and others describes the performance of an experimental pavement constructed as a quarry access road in Georgia. The flexible pavement consisted of a triple surface treatment over 18 inches of well-compacted crushed stone base. This thin asphalt surface-thick crushed-stone base pavement performed in a very acceptable manner without major distress when subjected to heavy truck traffic for more than seven years and in excess of 1.4 million equivalent 18 kip single axle loads.

The paper by Brown and others presents data obtained from various studies that show the effect of aggregate grading on the performance of asphalt mixtures. Factors influencing performance of asphalt mixtures that are discussed in the paper include (1) grading, (2) particle shape, (3) maximum aggregate size, (4) compacted lift thickness, (5) mineral filler content, and (6) aggregate quality. The authors concluded that a well-graded crushed aggregate should be used to provide the highest quality asphalt concrete. In addition, the maximum size of aggregate should be increased to provide higher stability, to improve skid resistance, and to reduce asphalt binder content.

The paper by Dukatz describes one of several recent test roads designed to provide information about the effectiveness of pavements constructed with thin asphalt surfaces over thick aggregate base courses. This test road was a section of SR 1508 in North Carolina constructed in 1985 which also serves as a quarry access road. The section consists of 2 in. of asphalt concrete mix (NC I-2) over 13 in. of well-compacted aggregate base course (ABC). After 18 months of service and achieving 60% of the design traffic, the section is performing as expected with minimal distress. The author states that a back-calculated structural coefficient of 0.20 was appropriate for the crushed stone base used in this test section.

The paper by Dukatz and Phillips describes several problems faced by the hot-mix asphalt engineer in predicting the behavior of asphalt concrete mixtures exposed to moisture. The authors recommend modifications to a test procedure for evaluating moisture susceptibility to permit more accurate interpretation of resulting test data. The authors believe that specimens made for determination of moisture susceptibility (tensile strength before and after conditioning) should be prepared at low (4 to 6%), midpoint (6 to 8%), and high (8 to 10%) air void contents, and that all specimens be used in the analysis procedure. The test results of tensile strength versus air voids for both the conditioned and unconditioned specimens should be plotted separately, and the strength at 7% voids should be obtained by graphical interpolation. The authors also suggest that a minimum conditioned tensile strength at 7% voids in conjunction with a minimum retained tensile splitting ratio (TSR) should be specified.

The paper by Hughes and Maupin addresses the increase in moisture damage that has been experienced in asphalt pavements during the past decade. The authors define moisture damage, and discuss the many factors that may cause the damage. Several methods of evaluating mixtures for moisture susceptibility are reviewed. The need for standardization of a predictive procedure (as also advocated in the paper by Dukatz and Phillips) is emphasized. The authors also discuss several methods for reducing moisture damage potential.

Lee and Al-Dhalaan discuss in detail the pavement distress being experienced in Saudi Arabia as a consequence of changing traffic characteristics due to the crash development programs of the country. A feasibility study was performed to formulate rehabilitation alternatives for pavements experiencing severe rutting problems. Potential solutions include: (1) use of reduced asphalt contents, (2) use of coarser aggregate in the asphalt mixtures, (3) improved quality control, and (4) use of sulfur extended asphalt.

Lundy and others investigated the effects of (1) percent fracture, (2) fines content, and (3) aggregate source on the performance of laboratory prepared asphalt mixtures at a temperature of 10°C (50°F). The repeated load diametral test device was used by the researchers to measure mixture performance. Conclusions drawn by the authors are (1) an increase in required binder content results from increasing fracture levels, and (2) increase in fines content from 3 to 6% reduces required asphalt content. The authors recommend that additional testing be performed at other temperatures to further quantify the effects of fracture level and fines content on asphalt concrete mixtures

The paper by Selim and Heidari describes a procedure for measuring the susceptibility of seal coats to stripping. Details of a newly developed laboratory test called the Seal Coat Debonding Test (SDT) are provided Criteria for evaluating the degree of vulnerability of seal coats to moisture damage are also suggested The test method presented in the paper is simple and may offer a sound quantitative approach for evaluating potential moisture damage in seal coats, and may assist engineers in selecting the "right" materials for use in seal coat construction

The last paper, by Tseng and Lytton, presents a method to predict the permanent deformation (rutting) in flexible pavements The method uses a mechanistic-empirical model of material characterization Material testing is performed in the laboratory to establish three permanent deformation parameters which represent the curved relationship between permanent strains and number of load cycles Equations are provided to permit analysis of how the three parameters are affected by (1) material properties, (2) moisture and temperature, and (3) stress state Permanent deformations calculated from the method are compared with results measured in the field, and "reasonable agreement" is shown

The ten papers in this publication provide excellent information on aggregate factors that influence the design, construction, and performance of flexible pavements The information will be of value to all highway/materials engineers working to improve the performance of flexible pavement systems within current economic constraints

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