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The effect of sample reheating on asphalt properties

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Abstract:

Asphalt is typically designed and tested in small trial batches produced in a laboratory before full-scale production in an asphalt plant. Samples are commonly taken from either the laboratory or production plant, for testing in the laboratory. The test specimens may be manufactured immediately or the bulk sample may be allowed to cool and subsequently re-heated prior to specimen manufacture. It is generally assumed that for practical purposes, the cooling and reheating process has insignificant effect on the asphalt properties. To quantity the effect of asphalt sample reheating on specimen properties, nominally identical asphalt was produced and then either not reheated or was reheated in an open or closed vessel. Specimens were manufactured and tested for dynamic complex modulus, dynamic compressive modulus, wheel track rutting and four-point bending fatigue, as well as the normal Marshall properties. The effect of reheating on the various asphalt properties was evaluated by statistical analysis. Conclusions address the importance of bulk sample thermal loading prior to specimen manufacture and testing, particularly when comparing different asphalt mixtures in the laboratory.

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Innovative tack coats for improving durability of bituminous layers

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BENITO ARNÓ

Abstract:

Layers of a bituminous pavement are never fully bonded or completely separated. A good description of the behavior of the bituminous interfaces and an accurate estimation of their effects on the structural response and pavement's durability must consider not only the maximum interface shear strength as it is measured by Leutner test, but its rigidity and shear fatigue strength. In this paper, the authors will present the results of a research project in which the interface rigidity and shear fatigue strength are improved by spraying hydrated lime over residual tack coat film. A theoretical model is being submitted to verification in both laboratory specimens and cores obtained from a full-scale field experiment. The objective of this research is to determine the model validity, optimum application rates of asphalt binder materials and hydrated lime, and the best application methods. Also, in the frame of this research project, the Civil and Environmental Department of Universidad Politécnica de Cataluña is setting up a new device and new dynamic shear test to measure core rigidities and shear fatigue strength. This new test procedure, further than being used to measure shear fatigue strength should also be able to obtain the correction factors that allow to relate rigidities measured in Leutner test with those corresponding to dynamic test, in which the rate of shear caused by a moving vehicle in a real pavement can be better approached.

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Evaluation of innovative automated systems for monitoring asphalt pavement surface conditions in England. Part 1: Surface Regularity and Texture

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Abstract:

Methods for measurements of asphalt pavement properties play an important role in assessing compliance to work specifications. At the same time, the continuous monitoring of pavement conditions can facilitate improvement in planning or trigger early sign for maintenance. Currently, the conventional methods used to measure and monitor pavement conditions typically require manual handling and operations during various phases of construction works or surveys. These methods inherently carry safety risks for site technicians and operators. These risks could be removed or mitigated if relevant automated technologies currently available for the construction industry would be employed. This paper presents findings from a recent collaborative research commissioned by Highways England, Mineral Products Association, and Eurobitume UK, carried out by AECOM on automated assessment of pavement surface conditions. The scope of this study was to review and explore the possibility of employing systems available for quality control/quality assurance (QC/QA) purposes. This paper focuses on pavement surface regularity and macrotexture detection methods. Two innovative laser scanning technologies (laser systems 1 and 2) have been assessed and compared with conventional methods, i.e. Volumetric Patch and Rolling Straight Edge (RSE). Several survey trials have been conducted in England on motorways, trunk roads and local roads; comparison was made between the innovative and the conventional methods. Results from site surveys indicated that laser system 1 has a strong correlation with the Volumetric Patch results (94%) and a good repeatability. Laser system 2 matched the RSE outcome in the majority of sections surveyed (80%), presenting a fair repeatability. The few discrepancies between systems appear not to affect the outcome on pavement compliance to specifications. Overall, the analysed laser scanning technologies approximated to the conventional methods. Additional work (e.g. reproducibility trials) is expected to improve the confidence on findings from this study for consideration of adopting them for QC/QA purposes.

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Evaluation of innovative automated systems for monitoring asphalt pavement surface conditions in England. Part 2: Automated quality monitoring systems.

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Abstract:

England's road construction sector is facing another leap in technology, particularly associated with pavement assessment and compliance testing. Traditional site testing and data recording involve manual handling, files of paperwork and long-chained approval systems, which can lead to health and safety risk, low productivity and ultimately loss in profit. On the contrary, digitization has been a new norm in industries such as manufacture, finance and commerce, where leaner technologies are frequently emerging and adopted. In response to the new norm, the road construction industry has started adopting the latest advancements in construction and assessment technology. In the last 5 years, the UK industry has started trialling and implementing digitalisation and BIM (Building (Better) Information Management), aiming to improve productivity levels, quality and safety of the industry and to minimise impact on the environment. This paper presents findings from recent collaborative research commissioned by Highways England, Mineral Products Association, and Eurobitume UK carried out by AECOM on automated construction systems incorporating paver recording, intelligent compaction and temperature sensing systems, in addition to surface regularity and texture in Part 1. The submission will provide an overview on opportunities and challenges, as well as lessons learnt from selected local and national road construction schemes in England. Although still in the early stages, the concept of integrating automated construction data into cloud-based asset management tools will be explored. It will also discuss the potential benefits associated with smart automation, predictive intelligent, real-time data exchange and 4D executions.

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Process of Mix Design Based Cold Mix Laying and Paving Road

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Abstract:

In current practice, conventional bitumen emulsion is used which pose different limitations like low binding properties, availability of varied aggregate quality, need of pre-wetting of aggregates, presence of moistures in aggregates, inability to utilise existing hot mix equipment etc. Therefore, a process of mix design based cold mix laying and paving road which overcomes all the barriers of the current “State- of -the -Art” technology is needed. Key Elements are Aggregate, Tailor Made Cold Mix Binder, RCMD (Recommended Cold Mix Design) Process – Simulation of Site Condition, Equipment and Application type. In accordance with the technology, the designed bitumen emulsion (Tailor made) is a key element. The process includes diagnosing characteristic of aggregates, it includes physical properties of aggregates, defining a type of road to be laid and paved, preparing a designed bitumen emulsion, the composition of the designed bitumen emulsion is selected on the basis of the physical properties of the aggregates, available existing modified hot mix equipment, climatic condition, type of road to be laid; and mixing the aggregate with designed bitumen emulsion to pave the resultant bitumen emulsion-aggregate mix for road construction to ensure required lead time of the mix to meet desired workability on transportation to site during laying of the mix. Cold mix as per design is produced in modified hot mix plant to eliminate the need of heating of aggregate in controlled condition, transported to the site, laid by self-propelled mechanical paver. After breaking of the laid mix, it is compacted by the pneumatic roller, a vibrating roller (vibrating option switch off) of 15-30 ton having tyre pressure of 7 kg/sqm followed by a static roller 8-10 ton with speed of maximum 5 km/hr to achieve finish road and to allow the traffic within half an hour time.

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Morpho-chemical characterization of fine and finest rock particles in asphalt

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Abstract:

The granulometry of the rock particles is of particular interest for use in road construction. The granulometric properties of a particle collective can be differentiated depending on parameters such as grain size and grain shape. For the fine and coarse aggregate there are already standardized measur-ing methods for the evaluation of these characteristic values. The filler has especially in dense asphalt concepts high mass fractions in the mixture. An in-depth knowledge of the properties of various fillers would be of great practical importance in terms of the optimum binder requirement, the required compaction regime and the performance characteristics of the asphalt. Sieve analyzes, sedimentation analyzes and innovative test methods such as laser dif-fraction analysis or photo-optical particle measurement can be used to determine the particle size distribution of fillers. Of particular importance in road construction seems to be the specific surface area of the fine particles. The finer the rock, the higher the specific surface area. For the analysis of the grain shape of fillers, there is currently no test method. This should be made testable by photo-optical analysis. In the course of this work, a test procedure will be developed, which will then be used to compare different fillers and fine aggregates. Characteristics such as particle size distribution, specific surface area, roundness and length / width ratio are to be systematically analyzed. In addition to the morphological parameters, the chemical composition of the aggregate can be de-termined by various test methods. One method in this context is the assessment by means of Raman spectrometry. Using a high-power laser, selected rock particles are irradiated and the scattered pho-tons are compared with a database and chemically identified. On the basis of Raman spectrometry, the proportion of different rock particles can be measured by isolated observation of rock particles.

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DEVELOPMENTS IN LINING BINDING APPLICATIONS AND INVESTIGATION OF USAGE ON HIGHWAYS

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Abstract:

ABSTRACT: Before surface coating or bituminous hot mix application, it is applied on granular foundation, plant-mix foundation or similar foundations. Water based emulsion primer binders have been widely used in road superstructure construction, maintenance / rehabilitation and rehabilitation projects. Considering the continuously developing road network in our country and the ongoing coating applications, it is important to investigate and use alternative road superstructure materials with such economic and environmental benefits. The aim of this study is to investigate the use of emulsion primer binders which can be used as an alternative to the traditional primer materials currently used, protect the existing surface from environmental, climatic and traffic conditions, improve the strength properties, provide adhesion between the coating and the base surface, penetrate the base layer and form an impermeable surface. As a result of the study, it was determined that Resin-based water based emulsion primer binders were safely and easily applied, stored, cured, and environmentally friendly, and therefore could be an alternative to traditionally used katbek lining products, and to share the results obtained from this study. Key Words: Emulsion, primer binders, coat, resin, environmentally

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A Simple Test for Quality Control of RAP Piles

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Abstract:

Many State DOTs currently require that contractors characterize the quality and consistency of their RAP pile by chemically extracting the binder from the RAP (TCE or Toluene is generally used) and determining a simple absolute viscosity value or a PG grade. The PG or viscosity data is then evaluated for ten samples to assess the consistency and quality of the RAP pile. However, the use of solvents needed to extract binder from RAP are now being restricted due to environmental and health concerns. FHWA is looking for an alternative to chemical extraction. The research team at Turner Fairbanks Highway Research Center (TFHRC) is evaluating the Dongre Workability Test (DWT) as a potential characterization tool for RAP. The DWT RAP QA Test is being developed to implement a quick and easy test that may be used by State DOT's and paving contractors to assess the quality of RAP available in a RAP pile. In this study, RAP obtained from five States were tested. These RAP samples represent the softest RAP (PG 70-22) to hardest RAP (PG 90-22 and higher) and in between. For example, RAP from Idaho and Washington State will represent soft RAPs and those from Arizona and Nevada may provide some of the hardest RAP available. Data to date shows that the DWT test method in its current format may be successfully used to characterize RAP quality and RAP pile consistency. It was also found that the variability of DWT test results (as determined by testing two replicates per test condition) may also be an indicator of RAP quality and consistency. In this presentation, the results of the RAP quality assessment study using the DWT test will be discussed. The use of a RAP Blend chart for evaluating RAP mixes will also be explored.

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HIGH RESOLUTION MULTI-LANE ROAD SURFACE MAPPING USING 3D LASER PROFILERS FOR 3D PAVING AND MILLING PROJECTS

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Abstract:

Road Transportation and Public Works Departments (DOTs) typically perform annual pavement condition inspections to record cracking, rutting, smoothness, etc., which serve as an important input into Pavement Management Systems (PMS) software. Road surface defects are analysed by PMS software in order to model the deterioration of pavements and to make budget and performance-based recommendations regarding which roads to maintain, what maintenance treatments to apply, and when to apply them. Increasingly pavement condition data are captured using high-speed 3D lasers which acquire the 3D shape of the road surface. These technologies automatically analyse 3D scans in order to detect and quantify pavement defects. There is an untapped opportunity to enhance and repurpose this data in order for it to also be used for the design of reconstruction projects. In the past, designers have relied upon traditional survey to capture elevation data for volumetric estimates as well as Preliminary and Final Designs; however, traditional surveys require lengthy road closures, are costly, limited in resolution, and present dangerous working conditions for survey staff. Alternatively, 3D pavement condition survey scans can be enhanced through the addition high-accuracy Latitude, Longitudinal and Elevation data (via “blended” GNSS + INS systems). When further processed, these 3D scans can provide elevations with comparable accuracy and repeatability to traditional methods, but for a significantly larger number of measurement points (as dense as a 1mm x 1mm grid), without the need for a road closure, in a fraction of the time. Thus, repurposing these data presents a significant opportunity for DOTs to reduce their survey costs, minimize traffic interruptions, decrease turnaround times, improve staff safety, reduce milling, paving and compaction quantities, and deliver superior road surfaces. This paper explores the necessary hardware and software as well as the steps required to generate high-accuracy elevations from 3D pavement scans. Importantly the accuracy and repeatability of this new method is thoroughly evaluated through direct comparison to a large network of surveyed control points.

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Compactibility of asphalt mixtures with highly polymer modified bitumen (HiMA)

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Abstract:

The paper presents the results of research on the compactibility of asphalt mixture with highly polymer modified bitumens (PMB HiMA or HiMA). HiMA is a new type of polymer modified bitumen and is characterised by reversed-phase of polymer-bitumen mixture i.e. polymer phase in the polymer-modified bitumen becomes continuous phase. The influence of temperature and bitumen content on compactibility of asphalt mixes is well known, however the use of such different type of bitumen like HiMA requires a different approach to this issue. In order to determine the effect of temperature and bitumen content on compactibility, some specific tests of SMA with PMB HiMA were carried out. In addition, some tests were performed with warm mix asphalt (WMA) additives. Each variant was analysed as a function of bitumen content and temperature. The mixes were produced at a laboratory and then were subjected to short-term ageing. After conditioning, the compactibility of the mixture was evaluated using Superpave Gyratory Compactor (SGC). The tests were carried out at several temperatures. The obtained results of compactibility show that SMA with HiMA behaves in a different way than mixtures with conventional bitumens. The test results allowed to determine the optimal compaction temperature as well as effectiveness of WMA additives in asphalt mixtures with HiMA. The results also showed that asphalt mixtures with HiMA should be operated in a different way than mixes with conventional bitumens.

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How to avoid road damage with the help of modern transport technology already at the time of asphalt installation

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Abstract:

Some special requirements apply for asphalt paving. The mix in the paver should be uniform in terms of temperature and also in terms of grain structure. These are the basic requirements for durable asphalt pavements. Usually, three major problems occur in asphalt paving. These include mechanical, thermal and binder segregation. The problems with mechanical segregation are coarse grain nests. These are caused by the fact that the coarse grain in the transport vehicle rests on top and on the sides, while the finer grain remains at the bottom. When tipping out a load, a lot of coarse grain flows out at the beginning, thus a uniform distribution of the mix is not given. Grain breakage and frost damage are the result. A second problem is thermal segregation. Even with thermally insulated dump bodies, the mixture is not evenly tempered. The coldest layer can be found on top. When the asphalt is tipped, the upper, colder layer flows into the paver first. As a result, non-uniform temperature distribution during asphalt paving is possible. The push-off technology provides a solution to meet the requirements in asphalt paving. If the asphalt is pushed off, instead of dumped, there is a continuous mixing of the grain structure and temperature during the entire unloading process. The asphalt is unloaded “bit by bit” into the paver due to the push-off mechanism. Thus, both, cool and hot asphalt and coarser and finer grain sizes are evenly paved. This has been confirmed by several studies, including those carried out by the Technical University of Darmstadt and the Vienna University of Technology. In addition, obstacles such as overhead lines, avenues or underpasses represent no problems for transport vehicles with push-off technology because there is no need for tipping the loads.

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Pavement Information Modelling (PIM) – Dutch contractors develop a lifecycle pavement process and performance information system

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Abstract:

The road construction industry is in a transition towards systematic and well-structured data and information management of the whole pavement lifecycle. Therefore, the information system PIM, Pavement Information Modelling, has been developed in the Netherlands. PIM is the core information system for contractors in the road construction industry and provides all stakeholders within the company access to relevant data and information of asphalt pavements, from its raw materials, pavement design and mix specifications, production information and georeferenced on-site construction data, including information about its foundation and the substructure. The development of PIM also aligns with ongoing developments at road agencies, such as functional specifications and contracts, need for BIM, data-exchange between contractors and agencies, digital project delivery (in COINS-containers), tangible fulfilment of the requirement (Systems Engineering). The most important goals of PIM are to manage and support the whole road construction lifecycle from raw materials via production and construction to project delivery. The application systematically documents information, specifications, requirements from material purchase until completion and delivery of the project. This leads to a reduction of failure costs, improved control of the companies desired strategy and policy, more efficient long term monitoring of constructed pavements for purposes of risk control, product development and reduction of the administrative pressure of construction processes. The information system PIM has been developed in a unique consortium of eight road construction companies together with an IT-partner using the scrum-methodology. The paper describes the modules and functionality of PIM, the data-structure and IT-architecture of the system. Also, the paper addresses the information exchange with information systems of road agencies and its relevance. Finally, an outlook and vision is provided on how the road construction industry could deal with information and how PIM anticipates on this future needs.

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Improving Asphalt Pavement Density: Design and Construction

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Abstract:

In-place density of asphalt pavements is one of the most important factors influencing performance. Typically, specified in-place density of an asphalt pavement is achieved through a combination of proper mix design, production, placement, compaction, and quality control of the mixture. The objective of this study was to evaluate the effect of increasing the initial in-place density of asphalt pavements on durability as measured by field in-place density and laboratory high and intermediate temperature properties. Two different approaches of increasing field density were adopted. The first approach included the addition of a chemical type of Warm Mix Asphalt (WMA) additive at a dosage rate of 0.6% by the mixture weight. The second approach included a 0.2% increase to the design optimum asphalt binder content (Plus AC). Field project was constructed with 50.8 mm wearing course (WC) mixtures on a new binder course layer. In this field project, three 1,200 m test sections were evaluated. A control section with conventional hot-mix asphalt (HMA) mixture; a chemical type of WMA additive section; and Plus AC section. Cores from each test section were secured for measurements of density (air voids) as well as high and intermediate temperature properties using Hamburg Loaded Wheel Tracking (LWT) test and Semi-Circular Bending (SCB) test, respectively. Test sections with the two methodologies (i.e., WMA and Plus AC) of improving field compaction and in-situ densities adopted in this project were successful in achieving an increased field density by 1.0% – 2.3% of theoretical maximum specific gravity as compared to conventional section. Further, increased in densities (lower air voids) of the WMA and Plus AC WC mixtures resulted in an improvement in high and intermediate temperature properties as compared to conventional mixtures. Keywords: In-place density, Durability, WMA additive, LWT, SCB