top10 list

WAYS TO GET MORE DURABLE HMA PAVEMENTS

#7 PROVIDE PROPER PAVEMENT DENSITY

apc
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In pursuit of controlling pavement density and ensuring that in-place voids are kept within acceptable specification limits, numerous considerations and/or processes are involved. These include, but are not limited to creating a proper mix design, understanding material (aggregate and asphalt binder) properties, understanding mix production techniques and challenges, proper coordination of transportation logistics, including any necessary adjustments during the placement and rolling operations to account for environmental variables. Anything and everything that could impact on the durability and stability of the mix, should be considered.

Read the following check list to learn about the practices that will ensure that proper and consistent in-place density is achieved.

UNDERSTANDING THE FUNDAMENTALS

- Compaction is the process by which the volume of an asphalt mixture is reduced, leading to an increase in the materials' density. Controlling pavement density enhances the mechanical properties (stability, flexibility and tensile strength) of the mix, in order to provide a durable, smooth and impermeable riding surface.

UNDERSTANDING MATERIAL PROPERTIES

- The workability of the HMA mix, and the required compactive effort relative to the mix stiffness is significantly influenced by characteristics such as voids in mineral aggregates (VMA), voids filled with asphalt (VFA) and ultimately voids in the total mix. Selecting the correct asphalt cement grade and maintaining an optimum asphalt cement content is central to satisfying these requirements.
- Rheology and the temperature susceptibility of the asphalt binder has impacts on workability and mix stiffness. Variabilities in viscosity properties influences the rate of flow of the binder, thus may result in difficulties in obtaining uniform distribution of asphalt binder throughout the aggregate structure, achieving the desired density, or in the mat not being mixed and compacted properly. To guard against causing damage to the asphalt binder and/or overheating the asphalt concrete mixture, the OAPC's Environmental Best Guide suggests that no mix should be produced above 170°C.
- To maintain stability during compaction, it is recommended that the moisture content of the mix should be less than 0.5 per cent, by weight of the mix, when discharged from the asphalt plant.
- Compactive effort increases with the increase of the aggregate angularity, nominal maximum aggregate size (NMAS), and hardness. Angular aggregates require more densification effort due to its resistance to reorientation. The shape and surface texture are also important factors. Dust content and ratio of mineral fillers to asphalt cement also influences workability and compactability of the mix.

ROLLING OPERATIONS

- Poor rolling practices lead to low densities. Rolling procedures are affected by a number of variables such as; production rate, mix type and lift thickness, roller type, width and mass, mix temperature and ambient weather conditions. The National Asphalt Pavement Association (NAPA) documents TAS-35 and TAS-35E, and Asphalt Institute's MS-22: Construction of Quality Asphalt Pavements, provide good reference for rolling procedures.
- Quality Control (QC) testing is essential to setting up the most efficient roller patterns for each roller and in maintaining good in-place density throughout the paving operation. Nuclear or non-nuclear densometers can equally be used effectively for QC work especially when they are calibrated with cores taken from the site.

PERMEABILITY AND LIFT THICKNESS

- Lift thickness impacts on the rate at which the mat cools, and on permeability of the mix. Permeability varies with the NMAS and fine versus coarse aggregate gradation in the compacted mix. Inadequate lift thickness limits room for reorienting and densifying the aggregates. Lowering the in-place voids by just one per cent can significantly reduce the permeability of the HMA pavement. An adequate design lift thickness should be determined in accordance with the NMAS of the mix. NCHRP Report 531 recommends at least 3:1 and 4:1 ratio of lift thickness to NMAS (t/NMAS) for fine graded and coarse graded mixes respectively.

STABLE SUPPORT

- Roads built on substandard foundations will prematurely fail. The amount of compactive effort needed depends on the type and condition of the pavement base and subgrade. Experts recommend investing in tools such as intelligent technologies to ensure consistency and high-performing pavement support.
- Proper use and application of tack coat is vital to ensure good bonding between the mat, and underlying structural layers. Various NAPA and National Cooperative Highway Research Program (NCHRP) resources detail best practices for selecting and using tack coat products. For additional references on ensuring good pavement bond, refer to the OAPC's Top 10 List Fact Sheet - Ways to Get More Durable HMA Pavements - #6 Ensuring Adequate Pavement Bond.

TRANSPORTATION LOGISTICS AND ENVIRONMENTAL FACTORS

- Mix transportation logistics and other environmental factors (such as air and base temperatures, wind velocity, and solar flux) influence the cooling rate of the mat. Proper coordination of production and delivery of the mix to the project site is critical to ensure that paver stops are minimized, which keeps the mat from excessively cooling.
- Environmental factors out of the contractor's control can be accommodated by changing certain elements of the mix production or lay-down operations.

THE ROLE OF SPECIFICATIONS

- Good specifications play an important role in the ability to achieve the required pavement density by ensuring minimum levels of quality, while discouraging poor performance. Implementing fair material and construction performance incentives will greatly enhance better compaction operations and higher average and more consistent pavement densities.
- Proper inspection, and enforcement of compaction specifications (including joint compaction specifications) is recommended to ensure the desired limits are achieved.

EMPLOYING INNOVATIVE TECHNOLOGIES

- Encouraging the use of innovative technologies such as intelligent compaction, and Warm Mix Asphalt (WMA), and using non-conventional methods mix design that improve mix compactability will promote better compaction operations and experiences.
- Incorporating joint heaters and/or paving in echelon is recommended for obtaining consistent densities when constructing longitudinal joints.

COMMUNICATION, PREPARATION AND PLANNING

- It takes several well-coordinated elements to obtain consistent and good compaction results in HMA pavement construction. Good communication, adequate preparation, proper planning and continuous personnel training are crucial components of achieving proper compaction.

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