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Investigation of HMA compactability using GPR technique

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In-situ field density is often regarded as one of the most important controls used to ensure that an asphalt pavement being placed is of high quality. The achieved density results from the effectiveness of the applied compaction mode on the Hot Mix Asphalt (HMA) layer. It is worthwhile mentioning that the proper compaction of HMA increases pavement fatigue life, decreases the amount of permanent deformation or rutting, reduces the amount of oxidation or aging, decreases moisture damage or stripping, increases strength and internal stability, and may decrease slightly the amount of low-temperature cracking that may occur in the mix.

Conventionally, the HMA density in the field is assessed by direct destructive methods, including through the cutting of samples or drilling cores. These methods are characterized by a high accuracy, although they are intrusive and time consuming. In addition, they provide local information, i.e. information only for the exact test location. To overcome these limitations, the use of non-intrusive techniques is often recommended. The Ground Penetrating Radar (GPR) technique is an example of a non-intrusive technique that has been increasingly used for pavement investigations over the years. GPR technology is practical and application-oriented with the overall design concept, as well as the hardware, usually dependent on the target type and the material composing the target and its surroundings. As the sophistication of operating practices increases, the technology matures and GPR becomes an intelligent sensor system. The intelligent sensing deals with the expanded range of GPR applications in pavements such as determining layer thickness, detecting subsurface distresses, estimating moisture content, detecting voids and others. In addition, the practice of using GPR to predict in-situ field density of compacted asphalt mixture material is still under development and research; however the related research findings seem to be promising. Actually, the prediction is not regulated by any standards or specifications, although the practice is considered to be workable.

In view of the above, an extensive experiment was carried out in both the laboratory and the field based on a trial asphalt pavement section under construction. In the laboratory, the study focused on the estimation of the density of HMA specimens achieved through three different roller compaction modes (static, vibratory and a combination of both) targeted to simulate field compaction and assess the asphalt mix compactability. In the field, the different compaction modes were successively implemented on three subsections of the trial pavement section. Along each subsection, GPR data was collected in order to determine the new material's dielectric properties and based on that, to predict its density using proper algorithm. Thus, cores were extracted to be used as ground truth data. The comparison of the new asphalt material compactability as obtained from the laboratory specimens, the predictions based on GPR data and the field cores provided useful information that facilitated the selection of the most effective compaction mode yielding the proper compaction degree in the field.

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