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QIRT-2024-039
ABSTRACT
PRESENTATION
PAPER

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INFRARED THERMOGRAPHY FOR QUALITY CONTROL OF HMA PAVING – ZAGREB AIRPORT CASE STUDY

A uniform temperature of the newly laid hot mix asphalt (HMA) mat is crucial for achieving adequate compaction and ultimately for the performance of the pavement. If the HMA temperature is not uniform, temperature differentials can lead to sections with inadequate compaction. Compaction of HMA is necessary to achieve optimum air void content (i.e. density). Improper compaction will result in premature failure of the pavement, usually due to permanent deformation, ravelling, cracking and moisture damage.

The compaction of HMA is influenced by numerous factors, some of which are environmental, some of which are determined by the mix and the construction method, and some of which are under the control of the contractor during construction. The most critical factors appear to be those that affect the HMA temperature and cooling rate. These include production temperature, haul time and distance, initial mat temperature, mat thickness, temperature of the surface on which the mat is placed, ambient temperature and wind speed. Due to factors that influence the temperature, HMA is subject to thermal segregation.

The term thermal segregation was introduced by Read and Mahoney in late 1990s during the research on 'cyclic segregation' or 'end-of-load segregation'. They concluded that this type of segregation was result from placing of a cooler portion of HMA generally associated with the crust developed during HMA transport. These areas were observed to have decreased densities and a higher percentage of air voids. Thermal segregation is defined as isolated areas of the mat that differ significantly from the main body of the mat in temperature.

The method commonly used in Croatia to determine the HMA temperature during paving complies with HRN EN 12697-13. According to this standard, the HMA temperature must be measured after mixing and during storage, transportation and placement using contact measuring devices (e.g. thermometers) at each HMA sampling point. The data obtained in this way provides information about the temperature at selected points. If quality control is carried out in this way, it is very likely that areas affected by thermal segregation will not be detected. It would therefore be ideal if the temperatures could be continuously controlled and monitored at multiple points during paving. Since this is not practical with the above-mentioned method, an alternative could be to measure the HMA temperature using infrared thermography (IRT).

The IRT can be used as a means of quality control in all processes that require the involvement of thermal energy. As all objects emit thermal energy in the form of heat, which can be detected by an infrared sensor, IRT makes it possible to obtain a visual image of temperature distribution over large areas. This makes it possible to identify areas with different HMA temperature at load out, in the truck during transportation and prior to dumping, in the paver, behind the paver prior to compaction and during compaction.

The objective of this study was to use IRT for the quality control of HMA paving at Zagreb Airport. Temperature data was obtained using an infrared camera (thermal sensitivity 60 mK, geometric resolution 640 × 480 pixels, FOV 24°) at the paving site. Infrared camera was able to clearly discern temperature differentials of uncompacted and compacted HMA and to determine the temperatures of HMA in trucks and pavers. This made it possible to identify areas of inadequate HMA temperature and, when possible, to take appropriate measures to prevent the occurrence of thermal segregation.