SUMMARY

The impact of the type and amount of binder in "anti-fatigue" mixtures on fatigue parameters in the tensile test

The main topic of the dissertation is the analysis of the impact of the type and amount of binder in "anti-fatigue" mixtures on fatigue parameters in the straight tensile test. Special attention was paid to mastic-gravel mixtures with an increased content of mastic SMA-MA and "anti-fatigue" asphalt concretes (AC AF), which can perform the functions of anti-fatigue and anti-cracking layers in pavement structures. Due to their rheological properties, their use in pavement construction leads to increased fatigue durability.

Proper design of pavement layers in terms of fatigue resistance is only part of the success in ensuring long-term pavement operation. In addition to this, the road construction must also be resistant to other factors, such as rutting, resistance to low temperatures, resistance to cracking of various origins. The work presents the results of low-temperature tests, stiffness modulus, fatigue resistance, compactability of SMA-MA and AC AF mixtures with different asphalt binders. The impact of the type of mineral-asphalt mixture and asphalt binder on the resistance of the tested mixtures to reflective cracking was also analyzed. Low-temperature tests were carried out in a wide range of negative temperatures, using various straight tensile tests, focusing on resistance to low-temperature cracking and stress relaxation ability. Crack resistance was assessed using the TSRST test, and rheological properties were assessed using TCT and RT tests, using Burgers and Maxwell rheological models. The assessment based on RT and TCT tests was conducted for three temperatures: -10°C, -15°C, -20°C. Based on the results obtained, it was found that the key parameter affecting the behavior of mineral-asphalt mixtures at low temperatures is the type of binder. The research was supplemented by determining the stiffness modulus in the IT-CY and 4PB-PR tests. Using the four-point bending beam scheme, the fatigue characteristics of the tested materials were presented, determining the value of ε_6 for each of them. One of the factors minimizing the risk of reflection cracks is the selection of the appropriate type of binder and mixture composition. The Texas Overlay Tester verified that SMA-MA and AC AF mixtures exhibit the characteristics of mixtures resistant to reflection cracking.

These studies aimed to assess and compare the parameters of two different types of mixtures SMA-MA and AC AF depending on the type of asphalt binder used. It was found

that the use of highly modified asphalts significantly improves the fatigue durability of the tested mixtures, which translates into improved road durability when these mixtures are properly designed, produced, and built. The dissertation also contains a comparative analysis of SMA-MA mixtures with AC AF mixtures in terms of their ability to be built and compacted, which is key to shaping the physical and strength properties of road pavements. It has been proven that the SMA-MA mixture achieves the mechanical parameters of typical AC AF mixtures with improved parameters related to its workability.

The doctoral dissertation is enriched with a case study on the implementation of AC AF technology for the repair of the provincial road No. 265 in the Kuyavian-Pomeranian Voivodeship. The task description, technical and design assumptions, pavement damage issues, and a detailed repair plan are presented. The process of production, laying and compaction of the hot mix asphalt for the anti-cracking layer is described in detail.

Based on the results obtained, specific material solutions were analyzed, and executive and design guidelines were formulated, which can contribute to the protection of existing pavements from cracking and the construction of new structures meeting increased durability requirements

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