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Concrete road surface with the use of cement concrete - selected results

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Abstract

The paper presents the technological concepts of the execution of modern concrete with the characteristics of road surface which have been subjected to comparative tests. Modified compositions of concrete mixtures with polymers have been tested that affect the mechanical properties and durability of the topcoat. Changes in strength properties of modified road concrete, also occurring under the influence of cyclic variable loads were investigated. Obtained results can be used to indicate the direction of further research leading to the most effective use of the advantages of polymer admixtures for concrete, mainly to improve economic indicators and reduce the negative impact of investments on the environment.

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Keywords: Concrete pavements, polymer adminxtures, cyclic variable load, concrete strength properties

1. Introduction

For more than a century in the countries of the European Union roads are built with cement-concrete. Starting with Poland's first cement-concrete pavement in Wroclaw, built in 1888, with nearly 80 years of concrete pavement

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in Belgium, existing pavements are noted to have undergone significant evolution in terms of technological and material solutions. It has been also found that one of the most ecological construction materials is concrete, through the possibility of multiple processing. This is especially true in road construction, where increasingly recycled concrete is used on substructures and even as a supplementary aggregate for new blends. Breakthrough in the history of technological solutions has become the introduction of the obligation to use aerated concrete admixtures. One of the problems today is the implementation of a high resistance to cyclical freeze-thawing concrete and obtaining the right tensile strength while retaining the consistency of concrete.

The admixtures, though not always cheap, do not have to be cost effective because their use also provides savings: the cost of labor required to achieve specific concrete concentration, reduced cement consumption and improved concrete stability without the need for additional treatments. In addition, structural elements in road construction are often subjected to repetitive loads. The number of load cycles applied during construction can reach several tens of millions [1]. Such concrete also exhibits an increase in static strength. The rate of damage (fatigue) of concrete is influenced by factors such as: cycle amplitude, load frequency, component humidity, size and level of load, etc. A particular case of multi-variable load is the regular sinusoidal variable load which is the most commonly used form of spectrum in the work. experimental. The final results obtained during concrete undergoing sinusoidal load loading are lower than those in actual concrete work in the building, but the test time is shorter and it can be compared to the behavior of different types of concrete under the same operating conditions [2].

2. Polish requirements for cement concrete used in road pavements

2.1. Strength

Two basic strength parameters are defined for the pavement: compression and bending. The results of determination of strength classes for standard use surface finishes in Poland should be in class C25/30 ÷ C40/50. Tensile strength on bending is tested on 15×15×7cm samples by bending them with a four-point load. Acceptable results of this study are dependent on the category of traffic load:

- KR1 and KR2 – 4,5 MPa,
- KR3, KR4, KR5 and KR6 – 5,5 MPa.

Normal concretes obtain in tensile tests not more than 5.5 ÷ 7 MPa [12]. Reflections on high-quality concretes lead to interesting results. They fulfill and even exceed the above strength requirements. "CEM I 42,5R, CEM II / BS 42,5N, CEM III / A 32,5N, as well as addition of silica dust and manipulation with w/c ratio" after 28 days resulted in obtaining concrete classes from C40/50 ÷ C90/105, and bending tensile strength results in a range of 10÷11.5 MPa [13].

2.2. Frost resistance

European standards unambiguously define the minimum requirements for frost-resistance of concretes. By exposure class (aggressive environmental impact), industrial flooring and surfacing qualify as XF4 (continuous contact with water, high water, concrete contact with sea water or thawing salts):

- maximum w/c is 0,45,
- minimum cement content of 340 kg/m^3,
- minimum compressive strength C30/37,
- aeration at max. 16mm aggregate grain size is 4% [15].

Frost resistance tests are performed by determining the weight loss. Typically, samples are determined by sulphate crystallization after fifteen cycles of temperature change. Weight loss cannot exceed 5% of sample. In case of exceeding the limit value, direct marking after 150 cycles is performed. In this case also the value of 5% cannot be exceeded, and the decrease in compressive strength of the mentioned loss cannot be greater than 20% [14].