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Foam Concrete as New Material in Road Constructions

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Abstract

The article presents the possibilities of using lightweight concrete - foam concrete in road construction. Principles of sustainable development create the need to develop new building materials. Foam concrete is a type of lightweight concrete that has many advantages compared to conventional building materials, for example low density and thermal insulation characteristics. With current development level, any negatively influencing material features are constantly eliminated as well. This paper deals with the substitution of hydraulically bound mixtures by cement foam concrete Poroflow 17-5. The executed assessment is according to the methodology of assessing the existing asphalt pavements in Slovak Republic. The special calculation was used to estimate the modulus of foamed concrete Poroflow 17-5 based on the results of static load tests conducted using the experimental in-situ stand.

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1. The main advantages and examples of use of foam concrete

In this present day, lightweight concrete (foam concrete) represents a mixture of binder (usually cement), water, admixtures, additives and technical foam what makes concrete a building material with good mechanical strength, low thermal conductivity and with simple, yet highly technologically demanding processing.

The function of a filler in the mixture is to fulfil the air bubbles, making it appropriate to produce foam concrete directly on the construction site using special technological equipment intended for such production. If the foam

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concrete was mixed outside the site and transported there by mobile concrete mixers, it would cause a significant decrease of its volume followed by increased costs. The main advantages of foam concrete structures include:

- Simple and quick pouring - with such pouring it is possible to produce and implement the installation of 400 - 600 cubic meters per day and to significantly reduce construction time and costs.
- Complete filling of cavities and pores without compaction - the advantage of foam concrete is that all cavities get filled, which means that it is also partly self-levelling.
- Good absorption properties - foam concrete has a fine cell structure, which allows it to absorb kinetic energy during compression or settlement of the upper construction, [1].
- Low failure rate - in contrast to some of the synthetically lightened materials, the foam concrete is not susceptible to failure due to the presence of hydrocarbons, bacteria or funguses.
- Environmentally friendly - the usage and manufacturing of the foam concrete directly on the construction site with a dosing device means less traffic disturbing and less manipulation on site. Recycling is also very easy and energy efficient.
- Wide ranges of density, [2, 3] - usually bulk density varies from 300 to 1600 kg.m⁻³.

Foam concrete [4], has been used in highway construction in the United Kingdom (UK) since 1970, yet it took about 10 years for foam concrete to become competitive as well as a recognized building material. The greatest construction suppliers using foam concrete technology in the UK are the Foam Concrete Ltd and The Pump Engineering Ltd. These companies are behind construction of the following constructions works.

- Foam concrete was used as a base material for roads in newly built **Hertfordshire (UK)** industrial zone. The original subbase consisted of peat that caused numerous floods in the area in combination with high phreatic surface. It was necessary to implement drainage before and during construction. It was not possible to use a common structure of the road because repeating wetting and drying of individual construction layers would subsequently damage already finished road structure [3].



Fig. 1. Views of preparation of the underlay, a poured layer of foam concrete, the pyramidal formwork and application of the last layer of foam concrete, [5].

- Another example is from Northwest Highway (Route 14) construction, were utilized over 13,000 cubic meters of density 590 and 410 kg/m³ foam concrete. There were thickness up to 1.20 m, were they installed to supplement pre-existing foam concrete to across soft soils in six areas along Route 14. Filled areas varied from 1 meter to 12 meters wide for both eastbound and westbound lanes, including areas to support new storm water drains. Several low areas were dewatered and carefully constructed to prevent floatation due to rain and groundwater. Upon completion of foam concrete in these low bearable areas, the hardened foam concrete was quickly covered with the designed layer of aggregate subgrade of thickness 300 mm. This layer was then covered with concrete pavement to finishing roadway, [5].
- The Central road, Schaumburg, Illinois overpass in length of 3 km, was reconstructed at full depth of a four-lane road with drainage improvements and installation of curb and gutters. At the east end of the project, the road was constructed over a marsh area with soft organic underlying soils (peat) located at depth of 3 m to 5 m under the surface. This project is typical for the construction of lightweight foam concrete road fills. Soft organic underlying soils with a low bearing capacity, can caused consolidation settlement when there is additional loading or stress change. The general contractor proposed a combination of a 900 mm thick layer of 400 kg/m³ and 600 mm layer

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