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Summary of doctoral dissertation entitled:

"RESISTANCE OF YOUNG CONCRETE ON FROST ACTION AT EARLY AGE"

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The dissertation describes frost action on concrete in early age. The problems were raised a subject in the 1950s, 1970s and 1970s. Despite significant contribution to research, materials and technology of the time used by concrete production and measurement there is no many available publications expanding the questions. This problematic has been described basic in technical reports, standards and pertain rather to curing concrete. Existing information indicate methods preventing concrete damage due to freezing but no available research. Frost action and freezing of concrete can be divided into a few points namely technological problem by production of fresh mix prevented from low temperatures. Generally problem concerns fresh mix as well as young concrete, measurement of young concrete direct after freezing including real construction and specimens and effect of scale, preventing and curing young concrete on building site and higher costs at winter time, formal legal if is considered responsibility for quality and agreement terms.

The aim of thesis was to determine influence of frost on compressive strength, water permeability and absorption, evaluation of concrete modification of fresh mixes for one and repeated freezing cycles. Furthermore, climatic conditions and possibility of freezing at early age of young concrete were analyzed. In the dissertation author proposed also the definition what should be understood as freezing of young concrete.

The scope of thesis involves literature review and its analysis own field and laboratory research divided into 2 parts: preliminary and main research. In preliminary research following points were considered: climatic conditions and amplitudes of temperatures, analysis of fresh mixes which are available in concrete producers at winter time and develop of expedient fresh mixes, using of chemical admixtures especially accelerators and their function as well as polymer microspheres as neutral agent. Finally effects of exposure to direct frost of young concrete were investigated. In the main part non-

destructive method UPV were used to control of increase of compressive strength in time. Utility of measurement on base of exponential function was estimated. Temperature in concrete specimen as well as in freezing chamber were measured. Strength of concrete was checked after 24 hours, 28 days and 90 days by using a Ultra Sound Velocity and next subjected to compressive test. Permeability and water absorption in specimens were also checked.

In preliminary research climatic analysis and validity of conducting research in this direction was carried out. Components to produce of concrete have been verified and compared with information from producers of chemical admixtures also. Air entraining has been considered and polymer microspheres as alternative and possible factor reducing frost damage of young concrete. In winter season it was ascertained that amplitudes can occur within ±5°C very often and the range can reach even ±10°C. The las observations indicate increase in this range. The risk of one time freezing and cyclic freezing of young concrete is highly possible. The main research showed that frozen concrete has revealed high water permeability despite of relatively high compressive strength. All concrete series have also revealed strength loss regardless of modification. Microspheres can prevent concrete in some cases against frost however their role is not evident and unequivocal. Additionally, microspheres solve all problems with compatibility and interactions with other admixtures especially in terms of modification of self compacting concrete. A sulphate aluminate cement as replacement of Portland cement must not lead to improvement of resistance on frost. Concrete series with this cement showed the least durability, compressive strength and high-water permeability.

Finally, wide and advanced statistical analysis was carried out with using Statistica and Excel function. Analysis was described step by step and an appropriate mathematical model was built.

Keywords: Frost, frost action, freezing of young concrete, curing of concrete, cold weather concreting.

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