PLASTIC SHRINKAGE PROPERTIES OF NATURAL FIBER REINFORCED SHOTCRETE

Kyong-Ku YUN, Professor, Civil Engineering Department, Kangwon National University, Korea
kkyun@kangwon.ac.kr
Yoon-Sik BAEK, MS, Civil Engineering Department, Kangwon National University, Korea
Seung-Yeon HAN, Civil Engineering Department, Kangwon National University, Korea
Yong-Gon KIM, Daesang E&C, Korea

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Recently, natural hemp fibers have been developed for use in wet or dry mix shotcrete instead of conventional synthetic fibers made from petroleum. Synthetic fibers, which is mainly in polypropylene, has been used for controlling an initial shrinkage cracking in concrete, however, the effect was poor showing a severe plastic shrinkage cracking.

Plastic shrinkage cracking is a nonstructural crack that occurs due to the surface drying of concrete in a plastic condition due to rapid evaporation of bleeding water. The volume reduction due to plastic shrinkage and the resulting tensile stress exceeds the tensile strength of the concrete. In particular, plastic shrinkage cracking occurs mainly in large surface area members. It may be evolved from the surface to a considerable depth, or in the case of a very thin structure, it may go all over the depth of the member. In addition, since it is long enough to be easily distinguished by naked eyes and cracks are generated widely, it is not aesthetically pleasing and anxiety about the stability of the concrete can be increased. Also, the plastic shrinkage crack accelerates penetration of chloride and moisture, causing corrosion of the reinforcing bar, and durability of the concrete is lowered.

The theoretical effect of natural fibers on plastic shrinkage cracks is that when natural fibers are mixed into concrete, they become wet by absorbing the water. Then, in the pumping, water in the wet natural fiber is supplied to the concrete by the pumping pressure to increase the pumpability. Re-absorbing the water after spraying increases the adhesion and build-up thickness. The absorbed water could be supplied to the shotcrete and resulted in reducing a plastic shrinkage and dry shrinkage. This paper investigates the plastic shrinkage properties of shotcrete containing natural fibers. A series of experimental program were conducted to analysis the theoretical background and to select the optimized natural fiber content.