Air Bubbles Motion Through Fresh Concrete During Concreting Process

E. Chuta[1], J. Jeong[2]

[1]Université Paris-Est, IRC-ESTP, Cachan, France
[2]IRC-ESTP, Cachan, France

Abstract

Over the last years, the concrete technology has progressed in order to improve the quality of its use and mechanical performances. Despite the technical development known in the context of concrete, the esthetic aspect remains weakly treated. Among the esthetic problems, there is the formation and dispersion of air bubbles (Bugholes) inside the concrete during the concreting process (fig1,2).

Bugholes are surface voids that result from the migration of entrapped air (and to a lesser extent water) to the fresh concrete-form interface. These surface defects manifest themselves mostly in vertical surfaces. Concrete bubble is a common phenomenon in the concrete construction process. Generation and existence of concrete air bubble not only influence the concrete appearance, but also affects concrete service life. Especially for concrete surface with high requirements just as water diversion tunnel [1].

Perhaps the most influential cause of bugholes is improper vibration. A proper amount of vibration sends both entrapped air and excess water to the free surface of the concrete. Improper vibration will either insufficiently liberate the voids or over-consolidate the concrete resulting in segregation and bleeding. Another factor that promotes bughole formation is the form material itself. Nonpermeable forms (i.e. polymer impregnated wood and steel) and the use of form-releasing agents can restrict the movement of the air voids between the concrete-form interface that is necessary for bughole reduction [2].

This work aims to model motion and localization of air bubbles in the concrete matrix during and after concreting process and its impact on the esthetical aspect of concrete surface. The modeling is done via COMSOL Multiphysics® software using the CFD Module. The laminar two-phase flow model is considered in this work, the two phases flow is represented by the motion of air bubble through fresh concrete. This motion due to the density variation of material that guides the air bubble toward concrete surfaces.

An important class of non-Newtonian materials exhibits a yield stress (such as fresh concrete), which must be exceeded before significant deformation can occur [3]. The results show that the concrete density and yield stress, influence on the air bubble motion, more the concrete density increases, more the air bubble motion will be constraint and vice versa.

Reference

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Figures used in the abstract

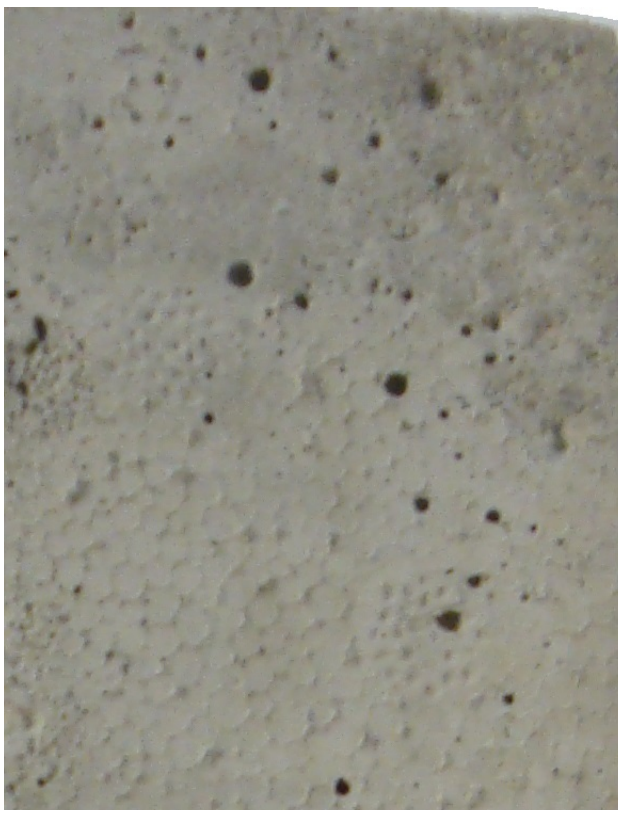

Figure 1: Air bubbles in the mortar surface

Figure 2: Air bubbles in mortar matrix

Figure 3

Figure 4