EXPERIMENTAL STUDY OF PRESSURE GRADIENTS DURING THE EXPOSURE OF CONCRETE TO HEAT AND MOISTURE

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Hardening cement stone contains microcapillaries and colloidal porosity with radii of $15 \cdot 10^{-8}$–$40 \cdot 10^{-8}$ cm. This capillary-porous colloidal structure should predetermine the molecular regime of mass transfer during the heat and moisture treatment of concrete. In contrast to drying processes, it is important to ensure that moisture is retained and destructive processes are minimized.

An installation has been developed which can be used to investigate the connection between temperature and pressure gradients during electrical heating of concrete by coaxial electrodes.

An improved method has been developed for measuring the internal interstitial pressure with the aid of an open elastic capillary. The probe cavity is filled with filter paper and is covered with a plastic grid. Parallel measurements using a closed capillary are then unnecessary. The experiments were carried out for heating rates of 25-27 and 75-80 deg/h, thus producing temperature gradients of 1.3-1.4 deg/cm.

It was established that internal interstitial pressure, due largely to thermal expansion and migration of the air–vapor mixture, is responsible for destructive phenomena, and the pressure gradient disappears at temperatures below 100°C, substantially modifying the mass and heat transfer picture.

The internal pressure depends on the temperature gradient, air content, and density of the mixtures. It varies within the range 100-300 mm water, which is comparable with the change in atmospheric pressure. The particular feature of cement-bonded concrete is that the magnitude and direction of the pressure gradient depend on the contraction and vacuum which appear during the hydration of cement. The predominance of molecular transfer was therefore not detected. For a time-independent temperature gradient the pressure gradient is not conserved. The internal pressure relaxes through an increase in porosity and percolation toward the open surface. Prior to heating, the interstitial pressure in concrete is different from atmospheric. Immediately after mixing, it is higher than atmospheric by 50-90 mm water and then, in the course of hardening, it is reduced to zero. The pressure increases as a result of heating and, depending on the rate of heating and the activity of the cement, its destructive effect can be neutralized by an increase in the internal porosity, using the contraction of the cement. The rate of heating must also be fixed with allowance for the atmospheric pressure, and the heating conditions must be specific for each locality so that the increase in internal pressure is compensated by the contraction porosity, internal stress, and percolation.

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