

The reaction to permeability of the strengthening concrete, under dynamic actions

Cristin Teodor Gregorian¹
Design Constructuct, Brasov, Romania

- ▶ Date of submission: (17.03.2006)
- ▶ PhD. Supervisor: LIVIU GROLL, Faculty of Civil Engineering, "Gh. Asachi" Technical University of Iasi, Romania
- ▶ President: NICOLAE TARANU, Dean, Faculty of Civil Engineering, "Gh. Asachi" Technical University of Iasi, Romania
- ▶ Scientific Board:
 - ONET TRAIAN, Faculty of Civil Engineering, Technical University of Cluj-Napoca, Romania
 - ADRIAN CONSTANTIN DIACONU, National Institute for Building Research, Branch of Iasi, Romania,
 - IOAN HARHUI, Faculty of Civil Engineering, "Gh. Asachi" Technical University of Iasi, Romania

Summary

Choosing concrete for an engineering work, we must reconsider its qualities too, such as permeability, resistance to recurrent frost-defrost, resistance to corrosion in aggressive chemical conditions, etc; but decisive are always the mechanical resistances and the deformation qualities of the concrete.

The quick diagnosis, at site, without large expenses or sensitive and/or big machines, of the concrete elements (reinforced concrete, prestressed concrete) is a major preoccupation for now and future. I allow for a realistic diagnosis, got in a short time at site that leads to optimum reconstruction – consolidation – protection solutions.

After including the concrete into the structural designed elements, random factors may appear (during the age of 28 days in standard conditions of temperature and humidity) that can induce dynamic actions in those elements. These can be accidental factors as human errors like blowing those elements (with loading bucket or weights attached to the crane, with equipments by operators' mistake, etc) or natural factors such as earthquakes, waves, wind flurries, etc.



C.T. Gregorian

These dynamic actions have a destructive effect under those elements, which means the changing of some of the mechanical and physical characteristics, like as:

- final mechanical resistances
- the permeability
- resistance to frost-defrost

The significance of the moisture upon the amount of expanding and cracking due to alkaline-siliceous reactions has been confirmed and, even the conditions to treat humidity are necessary in the first days after the concrete strengthening in order to get a maximum resistance and durability, it is better to keep the concrete dry to minimize the risk of damage.

The tensile strength has been the most affected by small amounts of expansion, decreasing 40 % of its value, while the dynamic modulus and the compressive strength of the unlimited samples decrease with more than 65% for an expansion of almost 0.3%.

I want to present in this article some conclusions of the experiments that have been made with two types of concrete, regarding the influence of the dynamic actions on the strengthening concrete, concerning the permeability.

The concrete testing from the permeability point of view wasn't, generally standardized, so the amounts of the permeability coefficient in different journals could not be comparable. In such determinations it is considered the water flow through concrete because of a pressure difference that is measured also for the calculation of the permeability coefficient K , using the equation of Darcy. The US Reform Bureau prescribes the 4913-92 Procedure, for a water pressure of 2,76 MPa; this is the equivalent of a water column of 282 m.

In experiments were used samples of concrete cubes with a side of 14.1 cm, and for results, it was measured the depth of water penetration in concrete, expressed in cm, for different cases. I didn't use the complex methods described above, in order to simplify the experimental conditions.

In order to determine the effect of the dynamic actions over the strengthening concrete permeability, concrete cubes with a side of 14.1 cm of different ages were used, under some dynamic actions, respectively one, two and three blows of the Foppel hammer ram from the height of 52 cm.

The blows have been applied to some samples with ages of 3 days, 7 days and 14 days and the results have been compared with witness samples.

Two concrete recipes have been used, respectively for the classes C8/10 and C16/20. The water pressure for checking the height of penetration was 6 atmospheres.



The reaction to permeability of the strengthening concrete, under dynamic actions

The experimental program pursued the study of the dynamic actions influence over some concrete characteristics; that why there are a lot of samples that are not considered in this study.

A number of 159 cubes have been made using the recipe no. 1 - C8/10 and 159 cubes using the recipe no.2 - C16/20. Series of three cubes have been hit at ages of 3, 7, and 14 days.

We can clearly stand the following:

1. After the age of 7 days, the deteriorations of the concretes structure, that influence the permeability are relatively constant without giving important variations of the studied parameter. This follows to the conclusion that the concrete structure is very sensitive until the age of 7 days, the structure being unable to regenerate after dynamic shocks. Still, we must admit, even relatively constant toward the age when the concrete tolerates dynamic shocks after the age of 7 days, the deterioration of the concrete permeability characteristic is severe going until the double height of the water penetration in samples.

2. The influence of dynamic actions over the concretes permeability is much more severe for the high class concretes.

This fact can be explained by the meaning that the deteriorations of the concretes internal structure are more important for high class concretes, because they have an important dynamic during the first days of strengthening. Analyzing the percentage, we can observe that even at higher ages (but no more than 28 days), the influence of the dynamic actions over the permeability of the high class concretes is much more important. Of course, the researches that have been done are at the beginning, but they can recommend for the concretes used for structures where the impermeability is an important characteristic for certain reasons, to be carefully protected against some dynamic shocks.

3. Until the age of 7 days, the dynamic shocks have an accented negative influence on the final impermeability of the concretes. Depending on the "density" of the dynamic shock it can get a triple height of the water penetration in samples with the known consequences about the durability of the affected elements particularly.

4. A very important aspect, is the fact that for high class concretes, a light dynamic action- a single blow at the age of 3 days, in our case- doesn't have a major influence on the final impermeability of the sample, because the concrete structure already formed can take over the shock. To detail this result we must continue the researches in order to establish the links between the "strength" of the shock, the concrete age and its class considering the evaluation of the induced energy on weight unit (or volume) of the studied concrete elements

The results are a first step of research of this field. Considering the general tendency of accented raise of the concrete classes used in constructions, and the



C.T. Gregorian

fact that durability becomes one of the most important concretes characteristics, the research and the settlement of the dynamic actions influence on the concrete basic characteristics, both physical and mechanical, are of a topical interest.

Keywords: concrete, permeability, dynamic action.

