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GWT – New Testing System for „in-situ" Measurements of Concrete Water Permeability

Moczko Andrzej[a]*, Moczko Marta[a]

[a] *Wrocław University of Technology, Wybrzeże Wyspiańskiego 27, Wrocław 50-370, Poland*

Abstract

The paper presents principle of a German's Water permeation Test (GWT) and results of experimental study which was carried out to assess a possibility to implement in engineering practice a new testing system (GWT) for assessment of water permeability of concrete with the respect to a new European Standard (EN 12390-8). The testing details and procedure of evaluation of the results obtained by means of GWT have been also described.

Research program consisted of laboratory tests and „in-situ" examinations of three concrete bridges situated along the national road nr 3 in Lower Silesia, Poland, close to Wrocław. Two types of concrete have been considered. Examinations carried out have shown that the results of standard water permeability measurements are with the agreement of „in-situ" NDT tests performed by means of GWT system. Obtained results confirmed that this new method is very useful for engineering practice. The „*average flux of water*" (q_m) has been proposed as an evaluation parameter. It has been shown that concrete can be considered as water permeable if $q_m \leq 0.32$ μm/sek.

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Keywords: concrete; water permeability; GWT; NDT testing

1. Introduction

A new European Standard (EN 12390-8), which has been recently introduced in EU, considerably change procedures used in many European countries for evaluation of concrete ability to resist water penetration under pressure. Testing methodology proposed in this standard is basing on the determination of the depth of water penetration under pressure in hardened concrete. Standard specifies procedure of applying water under controlled

* Corresponding author. Tel.: +48 71 320 37 37; fax: +48 (71) 320 23 65.
E-mail address: andrzej.moczko@pwr.edu.pl

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conditions of pressure to the surface of concrete. As an evaluation parameter the depth of penetration of the water front, which is measured after splitting the specimen, is recommended.

It is necessary to mention that new European Concrete Standard EN 206-1 does not define formal requirements concerning water permeation according to practical applications. As a result, relevant data has to be determined by designer in the technical specifications, what is not so simple because engineers are usually not enough experienced and rather expect to find such information in national standard regulations. Nevertheless, some suggestions can be found in German's national standards (DIN 1045 and DIN 1048) which were used as a base for elaboration of EN-12390-8. According to these documents it can be assumed that tests have to be performed on the at least 3 specimens coming from the same type of concrete. Concrete can be evaluated as water resist if an average of the maximum depth of penetration of the water front, measured in all tested specimens, is not higher than 50 mm.

The most important disadvantage of such measurements is their time consuming „laboratory" character what in engineering practice excludes possibility of relatively fast and „in-situ" evaluation of the actual concrete water permeability. For those reasons in several countries wide research has been performed to find a proper solution of this problem. Among other things, **G**erman's **W**ater permeability **T**est (**GWT**) seems to be one of the best concepts which were successfully implemented [1,2].

Present paper reports author's examination which were focused on the experimental verification of this testing system with respect to standard laboratory procedure specified in European Standard (EN 12390-8). The testing details and procedure of evaluation of the results obtained by means of GWT have been also described. Nevertheless, the main purpose of presented tests was to find relationship between values of the *„average water flux*" recorded by means of GWT and maximum values of water penetration obtained according to EN 12390-8.

2. Principle of the GWT

The principle of the German's Water permeation Test is to measure the amount of water penetrating the substrate under controlled pressure conditions (Fig.1). A pressure chamber (Fig.2) containing a watertight gasket is secured tightly to the surface by two anchored clamping pliers or by means of a suction plate. Alternatively, the gasket may be bonded to the surface with an adhesive. The chamber is filled with water and the filling valve is closed. The top cap of the chamber is turned until a desired water pressure is displayed on the gauge (usually 100 kPa). As water permeates into the concrete, the selected pressure is maintained by means of a micrometer gauge pushing a piston into the chamber. The piston movement compensates for the volume of penetrating into the material. The travel of the piston as a function time is used to characterize the permeation of the test surface.

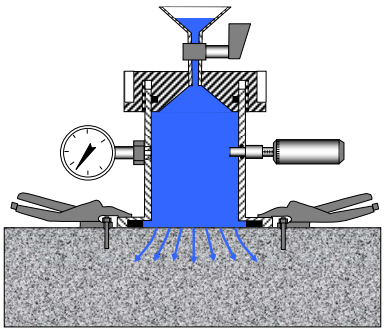

Fig. 1. Testing principle of GWT system

The gauge readings are recorded over time and used to evaluate the water permeation characteristics of the surface tested. The test may be conducted until the micrometer has no more travel. Usually a single test lasts about 5-10 minutes, depending on the concrete quality. For comparative measurements the flux „*q*", using the first mentioned procedure, may be calculated from the equation:

$$q = B\,(g_1 - g_2) / A \times t \quad \text{[mm/sec.]} \tag{1}$$