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Investigation on Nondestructive (ND) Method of Determination of water Absorption Parameters and Compressive Strength of Concrete Lining of Irrigation Canals

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Extended Abstarct

Introduction

Conveyance and Water distribution irrigation canals are hydraulic structures that transport water supplied from sources such as diversion dams for drinking, agricultural, industry or other purposes. These canals are usually lined by materials such as: concrete, stone with sand cement mortar, asphalt, to prevent water seepage losses along the flow path. Concrete lining that is used in irrigation canals is an unreinforced concrete with a thickness of 5 to 10 cm. Basic requirements of good hardened concrete are: satisfactory compressive strength and sufficient durability (Aba, 2005). After the implementation of each engineering structure, it is necessary to evaluate the project to determine the optimal performance and quality of implementation. Evaluation of the quality of irrigation canal linings is often carried out by the destructive and costly method of coring and carried out various experiments in the laboratory. Although destructive method yields relatively exact and straightforward results from the desired parameters, it also has some side problems that are sometimes difficult to recover. The problems of destructive test (DT) method with coring and destructive method are associated with damage of project, high cost, need the expert group and equipment, time-consuming and sometimes stoppage of project operation. Non-destructive testing (NDT) methods can be used to prevent these complications. Electrical, ultrasonic and Schmidt hammer tests are among non-destructive testing. Nowadays, non-destructive testing of concrete has an effective and practical function in the repair of concrete structures. Non-destructive testing of concrete by providing data on various existing structures allows experts to judge and decide on the performance, needs and methods of repair and restoration of concrete structures. The indicator of evaluation of the quality of concrete lining in irrigation canals in different environmental conditions is the same as the other structures based on the amount of compressive strength (Anon., 2014). The failure of hardened concrete due to repeated cycles of thawing- freezing in cold air in hydraulic structures (such as irrigation canals that

can absorb water and saturated) is more probable than other concrete structures (Ramazanianpour and Shahnazari, 1988).

Methodology

In this study, in order to establish a relationship between non-destructive testing (NDT) of Schmidt's Hammer number with destructive testing (DT) of compressive strength and water absorption parameters, 13 sections from 3 main conveyance canals were studied in Nahre Shaban irrigation network in Nahavand City. At all sections, non-destructive testing of Schmidt's Hammer accomplished for determining the rebound number, then from the same points, 12 and totally 156 cores were provided from 3 canals. Next relationship between rebound numbers (RN) with each of the parameters of laboratory experiments on the linings was investigated. The study area in this study was 6 km from the main canal of the irrigation network of Nahre Shaban in 3 sections of Ghaleqabad, Shaban and Jahanabad in Nahavand City. This canal is divided by diversion dam of Sha'ban with height of 3.5 m which was constructed in a section with coordinates of (X = 262862, Y= 3775625) during 1985 and 2001. Table 1 presents the characteristics of the main canal at the location of the Ghaleh Ghobad river section on the Shaban network. The coordinates of each section of the canal intended for coring were determined using GPS; these coordinates are presented for the 13 points in the selected canals in Table 2.

Table 1- Geometrical and hydraulic properties of studied canal in Nahavand plain

Geometrical properties			Land area (hac.)	Discharge (lit/s)	Cross section type	Lining material	Canal length (m)	Network name
Side slope	Depth (m)	Bed (m)						
1:1	1.5	1.4	2700	3000	trapezoidal	Situ concrete	5000	Shaban river

Table 2. Position and coordinates of canal sections for destructive and non-destructive experiments

Local canal name	Canal Code.	Coordinates (UTM)	
		X	Y
Ghaleh Ghobad	GH1	263046	3775681
	GH2	262772	3776121
Shaban river	NSH1	262411	3776737
	NSH2	262299	3777241
	NSH3	262335	3777606
	NSH4	262086	3778060
	NSH5	261471	3778201
Jahan abad	JNA1	261256	3779031
	JNA2	261431	3779369
	JNA3	261967	3779687
	JNA4	262107	3779580
	JNA5	261656	3779758
	JNA6	261828	3779865

Results and Discussion

Based on the results obtained, Schmidt hammer number and compressive strength values have direct relationship with correlation coefficient of 86%. Also, the Schmitt Hammer and initial, boiled and capillary water have a reverse power relationship with a correlation coefficient of 72, 70 and 71 percent respectively. Considering these relationships with proper correlation, it is possible to estimate the durability parameters in through the non-destructive testing of the Schmidt hammer at the site. There is a direct relationship between the initial and boiled water absorption, with a correlation coefficient above 95%. Therefore, boiled water absorption capacity of cores, w hich requires more than 3 days, can be determined from the results of initial water absorption. There is an inverse relationship with grade of 3 with a correlation coefficient above 96% between boiled water absorption and compressive strength of cores.

Conclusions

Between Schmidt hammer number and compressive strength values in concrete-lined irrigation canals are a direct relationship with correlation coefficient of 86%. So it is possible to estimate the durability parameters of irrigation canal linings in through the non-destructive testing of the Schmidt hammer number at the site.

Keywords: Concrete, Correlation, Evaluation, Field Method, Laboratory Experiment