The Quality Test to Tarim River Sluice Concrete

by the Rebound Method

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Abstract

The nondestructive examination (NDE) used for concrete defection is a new method of quality testing for concrete and it is characterized by rapid measurement, high precision and low cost. In this article, we introduce the basic principle and the development application of the rebound method. Taking the engineering project in Tarim Dam as an example, we use the rebound method to test the concrete structure in the Tarim River sluice, introduce the test method and approach of the rebound method, and analyze the test result. The result indicates that the nondestructive examination based on the concrete rebound method is an effective method with simple operation, easy operation, convenient use and high computation precision to test the quality of the concrete with large volume and achieve the requirement of the project.

Keywords: The rebound method, Nondestructive examination (NDE), Concrete, Quality test

1. Introduction

With the process of time, the problems of structure security induced by low standard, aging and the gradual weakening of structure function after long-term using are increasingly serious for old buildings. The repair and strengthening for the existing buildings can not only save their intrinsic characters, but possess considerable economic benefits such as small investment, little influence and quick efficiency and large social benefits. However we should implement the appraisal of reliability for the structure of the existing building before repair, alteration and strengthening, and the intensity of concrete is one of key factors to decide the strength performance and reliability for the structure of concrete (Tang, 2000, p.57-59). The test technology of concrete structure can be divided into the local breakage method and the nondestructive method according to its influencing degree to the structure. The local breakage method would induce local breakages for the concrete structure, and it is restricted by many factors such as high expenses and small range inspection. The nondestructive method is popular by extensive engineering technical personnel because of non-destruction, simple instrument, convenient operation, repetitive test for concrete structure, and the test with large range. So in this article, we mainly discuss the rebound nondestructive test technology of the concrete, and introduce the principle and characters of the test technology combining with the actual condition of the Tarim River sluice, which can offer references for the diagnoses of the bearing capacity and endurance of original structure and prepare for future works.

2. The test of concrete by the rebound method

2.1 Development and application of the rebound method

The rebound method was invented by engineers of Switzerland, and it is the witnessed test technology of structured concrete which calculates the pressive strength through measuring the surface rigidity of the concrete (Wu, 2003). Since the technology came out, it has been applied in the application of construction project for half century. Though for a long time, a series of instruments used in the nondestructive test of concrete had been developed in foreign and domestic practices, and various new test technologies have been deeply studied, but the rebound method has kept its predominant status all along in the nondestructive test domain of concrete because the instrument has simple structure and the economic and applicable test method with high efficiency and high test precision is easy to be grasped. With the development of the rebound method, the technology exerts large function in the quality test of concrete project, and it has been extensively applied in many industries such as construction, highway, traffic, water conservation and railway.

2.2 Test method and principle of the rebound method

The rebound method uses a heavy hammer drove by a spring to strike the surface of the concrete through the resilient pole, and measures the distance of the heavy hammer which is rebounded back, and takes the rebound value (the ratio

between the rebound distance and the initial length of the spring) as the relative index of the intensity to calculate the intensity of the concrete. The rebound value reflects the elasticity and plasticity of the concrete to some extent, and it has necessary association with the intensity of the concrete, and we can establish the relationship equation between the rebound value and the intensity of the concrete, i.e. the strength cure. Usually, because the surface rigidity of the concrete by carbonization increases to make the rebound measured higher, and different carbonization depths have different influencing degrees to the rebound value. Large numbers of researches and locale test indicate that the carbonization depth reflect the comprehensive influence including the age of the age and the environment of the concrete, so we should take the carbonization depth as another parameter for the measuring curve of strength.

3. The test of concrete intensity for the sluice of Tarim River by the rebound method

3.1 Introduction of the project

The Tarim River Sluice Division Pivotal Project is located in the middle reaches of the Akshu River in the town of Baishenairike of the county of Awat, and it is the total diversion pivotal project in the north farming irrigation area and the south farming irrigation area of Xinjiang Corps Farming First Division. The Tarim sluice mainly includes the release sluice, the north in-sluice and the south in-sluice, and the upper reaches and the lower reaches watercourse repair segments. The sluice has 32 holes, every hole is 6 meters, and the total net width is 192 meter, and the span is 223 meters. The project was firstly established in April of 1971, and completed and operated in June of 1972. To enhance the defending ability of the project, the government invested 9.1 million Yuan in 1992 to strengthen the drainage dike, training dike and spur dike. The construction of the project enhances the irrigation rate in the irrigation area of Tarim River, effectively controls the corrosion of flood to shores, reduces much mud and sand, discharge the flood of 2.63 billion m^3 to the lower reaches of Tarim River every year, and exerts large benefits for the ecological construction for the farming development in the irrigation area.

3.2 The concrete test for the sluice of Tarim River

3.2.1 The test of concrete intensity for the sluice of Tarim River

According to the regulations of "Technical Specification for Inspection of Concrete Compressive Strength by Rebound Method (JGJ/T23-92)", the test adopts the @-3000 concrete rebound meter which is inspected by the measure department. We use the rebound meter strikes the pouring face and the side face, and every measured area is about 20cm×20cm, and in all rebound values, we respectively delete three maximum values and three minimum values and get the mean in the surplus 10 rebound values, so we can confirm the pressive strength according to the rebound values and the carbonization depth in the area.

3.2.2 The carbonization depth test for the sluice concrete of Tarim River

We adopt 500ml phenolphthalein solvent of 1% to confect the phenolphthalein alcohol solvent to measure the carbonization degree of the bridge pier. To obtain exact carbonization value, we should measure several groups to get the mean value.

3.3 Data processing

The results of data processing are seen in Figure 1 and Figure 2.

3.4 Test analysis of the rebound method

At the same time and under the same condition, we measure the rebound value by the @-3000 rebound meter with same standard, and from the test result, the maximum value of Tarim River sluice is 57.6MPa, and the minimum value is 33.0MPa, and the former is 1.75 times of the latter, but the mean value is about 47MPa, which indicates the rebound distance is large when the rebound hammer strikes the carpolite (especially for big carpolite), and the distance is small when the rebound hammer strikes the mortar, and the distance would be smaller when pores exist in mortar. When the even values have small differences in the measure area, it proves that the construction quality was better, the construction method was exact, the construction technology was reasonable and the construction level was higher.

4. Conclusions

The nondestructive examination based on the concrete rebound method is an effective method with simple operation, easy operation, convenient use and high computation precision, and it can completely fulfill the requirement of the civil engineering. We adopt the test technology based on the concrete rebound method to evaluate the sluice of Tarim River, and the result can offer references for the diagnoses of the bearing capacity and endurance of original structure and prepare for future works.

References

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Table 1. Concrete test data of Tarim River sluice

Record of concrete test by the rebound method																			
No.	Rebound value Ri																		carbonization depth
measure area	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	Rm	f_{cu}^c	di(mm)
1	55	58	59	53	43	60	53	60	46	49	56	57	46	58	62	55	55.3	57.4	4
2	42	50	49	44	42	48	50	50	48	55	45	46	53	50	47	46	47.9	43.0	4
3	59	57	50	55	53	59	62	61	52	51	59	47	52	41	57	59	55.4	57.6	4
4	48	46	41	48	46	49	56	41	41	48	48	47	49	51	48	46	47.4	42.1	4
5	43	48	47	43	53	54	49	54	50	39	40	40	41	38	48	49	45.8	39.3	4
6	58	54	48	57	54	55	58	51	54	33	64	53	54	51	54	54	54.0	54.7	4
7	55	53	48	61	42	41	39	42	43	45	40	46	44	45	47	48	45.0	37.9	4
8	49	56	61	53	53	57	54	60	53	43	58	58	49	56	45	56	54.5	55.8	4
9	54	59	44	46	52	54	53	51	54	55	52	50	53	52	51	49	52.2	51.1	4
10	55	54	58	52	52	53	55	55	50	52	42	56	54	52	54	43	53.3	53.3	4
11	50	42	42	48	57	44	46	41	40	43	57	42	47	50	43	49	45.4	38.6	4
12	45	40	62	56	47	51	58	54	50	60	44	56	57	52	43	56	52.4	51.5	4
13	47	49	51	44	55	58	51	49	58	53	52	58	56	38	48	51	51.5	49.8	4
14	47	44	44	46	47	55	51	40	52	56	53	60	47	58	50	52	50.0	46.9	4
15	43	38	46	41	41	47	41	36	43	46	43	42	38	36	44	44	42.0	33.0	4

Table 2. Test result of Tarim River sluice

Intensity computation (Mpa)						Intensity evaluation (MPa)
Standard deviation	7.96	Minimum	33.0	Even value	47.5	34.4