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Correlation between Non-Destructive Testing (NDT) and Destructive Testing (DT) of Compressive Strength of Concrete

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ABSTRACT : *This work presents a study on the correlation and comparison between Destructive and a Non-Destructive Method (Rebound Hammer) of testing the compressive strength of concrete. Concrete cubes of 100mm x 100mm x 100mm were produced using concrete mix of grade 20N/mm^2, 30N/mm^2 and 35N/mm^2 and cured for 7, 14 and 28days. A total of 90 cubes were produced and used for the study. Regression analysis was carried out on the data using MINITAB 15 to establish linear mathematical relationships between compressive strength and rebound number. The Compressive strength and rebound number were taken as the dependent and independent variable respectively. The results showed that the coefficient of correlation of all the proposed models ranged between 91.6%-97.9% indicating a perfect relationship between compressive strength and the rebound number. The average percentage of the residual error was determined to be 1.78%, 1.29% and 1.32% for proposed models of concrete cured at 7, 14 and 28days respectively. This implies that all the proposed models are highly significant.*

KEYWORDS : *Compressive Strength, Concrete, Destructive testing (DT), Non-Destructive testing (NDT), Regression.*

I. INTRODUCTION

Concrete is a composite material produced from the combination of cement, fine aggregate, coarse aggregate and water in their relative proportion. It is a ubiquitous building material because its constituents are relatively cheap, and readily available. In addition to that, concrete in its fresh state has the ability to be moulded into any desired shape and size. The strength of concrete is its most important property (especially when needed for structural purposes) alongside its durability. Therefore, it is very important to ascertain the compressive strength of concrete before subjecting it to its anticipated loads. Compressive strength of the hardened concrete can be determined using the destructive and non-destructive testing (NDT) methods. The destructive testing (DT) method is carried out by crushing the cast specimen to failure while the non destructive is carried out without destroying the concrete specimen. The main disadvantage of the destructive testing methods is the length of time it takes for the results to be ready, the equipment and the power required. The rebound (Schmitz) hammer is one of the most popular non destructive testing (NDT) methods used to test the strength of concrete. This is due to its relatively low cost and simplicity in use [1]. Although the non destructive testing (NDT) results are much quicker compared to the destructive methods, they are more of an approximation than exact compressive strength values [2]. In as much as the rebound hammer results are quicker, and do not destroy the surface of concrete tested, there is no established relationship between the compressive strength obtained using NDT and DT [3]. The aim of this research is to compare concrete compressive strengths measured using destructive method and those measured using the NDT and to develop regression equation relating them.

II. MATERIALS AND METHODS

Materials: Ashaka brand of Ordinary Portland Cement (OPC) was used throughout the research work. It was tested in accordance with BS 12:1978 specification. The coarse aggregate used throughout the experiment was from an igneous rock source and procured from a local quarry site in Bauchi, North East Nigeria. It was tested in accordance with BS 882:1983 specification. Fine aggregate used was sharp sand obtained from a stream at Bayara close to Bauchi Metropolis. Portable drinking water was used for the production of concrete and as such no test was performed on it. Table 1 shows the result of preliminary test conducted on the materials.

III. METHODS.

Production, Casting and Curing of Concrete Specimen.

Concrete of grade 20N/mm^2, 30 N/mm^2 and 35 N/mm^2 were used for the study. The mix design was done in accordance with BS 882:1973 specification for normal weight concrete. Batching of concrete