Prediction of compression strength of fresh concrete using moisture sensors

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ABSTRACT

In the construction industry concrete is the widely used construction material and the quality of concrete is initial stage is uncertain and unpredictable because of various loop holes in the process from material selection till production. However, the other construction material can be justified and verified at the time of purchase the structure requires a specific grade of concrete for the structural adequacy. To get a desire durability of structure in its life span to ensure the quality of concrete in structural members and to get the confidence on it the necessary measurement it will help us to understand the quality in better way. At the experiment analysis is based on the water cement ratio and the temperature in its fresh stage help us to predict the strength of the concrete. The relationship between the water cement ratio and the strength will give us the idea about the strength. To establish the relationship between the water content in the fresh concrete and its 28-day compressive strength which will help to estimate the grade of concrete during its production stage. 35 trials were conducted in the laboratory on various grade of concrete ranging from M-10 to M-50 grade of concrete. It was observed that, we can predict the early strength of concrete by using the established equations. The equation is established between the temperature, Water cement ratio and the strength to establish the relationship Base on the equation it Is possible to predict the strength of the concrete at 28 days base on the temperature, ratio 0f the concrete at its green stage.

Keyword : - *Concrete, Compression strength, Moisture*

1. Introduction

Use of ready-mix concrete (RMC) in the construction industry has become common. Now a days the competitive market in (RMC) production is serious concern to the quality of concrete production. The quality of concrete is getting deteriorated if there is poor control on the production. The strength of the concrete is very important factor in the structural stability. The incoming inspection of the raw material use for the production can be controlled. The workability measures on fresh concrete could not be determine the strength parameter during the production of the fresh concrete and for strength prediction it will take 7 to 28 days for the estimation. This time may cause the serious concern in the quality of concrete in the structure. so, by using moisture sensors in fresh concrete during the

production only will give rapid estimation of strength of the concrete. It will help end user to get the confidence on the quality of concrete to avoid further structural consequences. As the maturity of concrete is nothing but the hydration process happened in concrete after attrition of water in it and we know that as water cement ratio is increases strength decreases, also the cementitious material available in concrete is responsible for hydration process. Higher the cementitious material in concrete generate high temperature and strength of concrete can be determine by the sensor with the help of hydration and W/C ratio. The moisture senor can reduce the time to determine the strength and helps to take appropriate decision on concrete at the time of production. Achieving sufficient concrete strength during the curing time is essential for the continuation of concrete and other construction work. Early estimation of concrete strength reduces downtime while waiting for strengthening. Temperature and humidity are the important factors affecting the curing time. We know maturity of concrete serves as an effective way of predicting the strength. But it takes time about 7 ,28 days to get the certain confidence on the quality of concrete. The experimental and modelling study on the influence of temperature (T) and relative humidity (RH) on the compressive strength gain of cement mortars and determined that both parameters affect the strengthening There is no unified method for calculating the complex maturity to date, which would most accurately convey the state of concrete strength during the production stage . The main parameter in the calculations is the internal temperature of the concrete that accumulates during the chemical reaction of concrete maturation. The purpose of this study is to develop a detailed methodology to calculate the complex maturity, accounting for internal and ambient temperature and ambient relative humidity of concrete, which would weigh the influence ratio of each parameter and most accurately convey the relationship of gained strength with the moisture content available in the desired grade of concrete mix.

1. Literature Review

Karthikeyan [] This paper delivers a review of the prediction methods of the early-age strength of concrete. It is divulged that if the rise in temperature of the concrete after the process of blending is not any more than a positive amount, the improved concrete strength fell concerning its maturity before and after treatment roughly in compliance with the same rule as holds for usually cured concrete specimens.

Katelyn Kosar [] The findings of the research are as follows .Ultrasonic testing has a higher accuracy in strength estimation for early age concrete and the external device allows for more data to be easily collected, while maturity testing can use temperature models to predict strength development. Early age concrete properties change rapidly and there is a risk of damage if concrete is subjected to loading prematurely. Onsite concrete testing must be fast and reliable to make proper decisions on procedure timing and scheduling.

Yash Dangi [] Several researchers concluded from their experimental works that type of material used significantly influence the strength hand workability of concrete.

Prachi Sohoni [] The objective of the present work was to identify the opportunities, constraints and means to convert the C & D waste into a reusable construction material. The focus of this study was to reduce the burden on landfill by focusing on the reuse of C & D.

2. Methodology

Test to be performed

- Temperature measurement.
- Moisture measurement by sensors
- Water content by Oven dried method
- Testing of cubes for compressive strength.

Measurement of Compressive Strength of Concrete :

- Cube is been casted for M10 to M15 grade of concrete and compressive strength for different result is been carried out for different grade of concrete by mean of CTM.
- The capacity of the compressive testing machine in above figure is 2000KN.
- The size of the specimen which is used for testing is 15 x 15 cm, so cross section area is 225 cm^2.

- The load on the compressive testing machine should be the grade of concrete x 22.5 in KN which will denote the actual load to be applied on the specimen.

3. Result

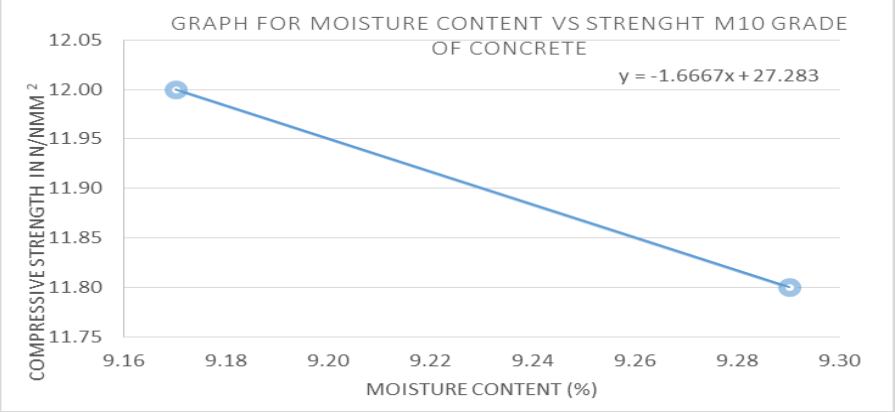

Fig.1- Graph for moisture content Vs Strength for M 10 grade of concrete

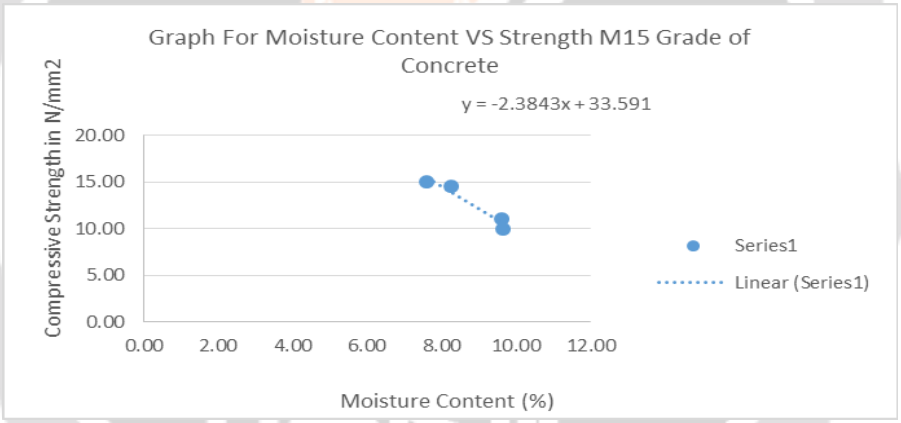

Fig.2- Graph for moisture content Vs Strength for M 15 grade of concrete

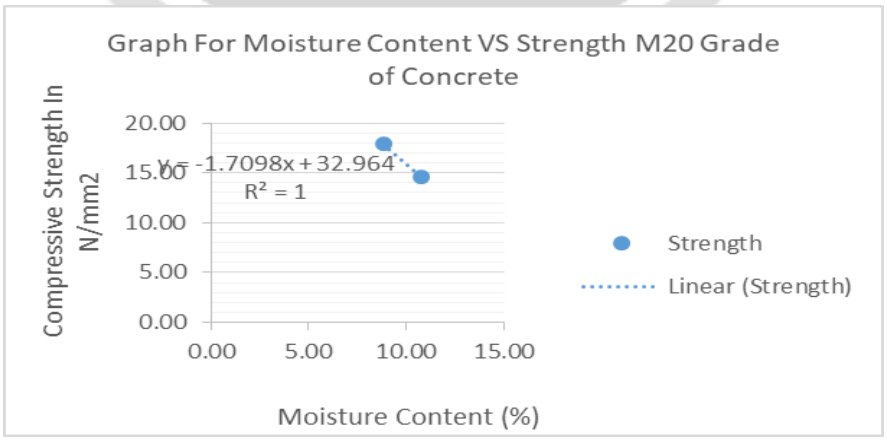

Fig.3- Graph for moisture content Vs Strength for M 15 grade of concrete

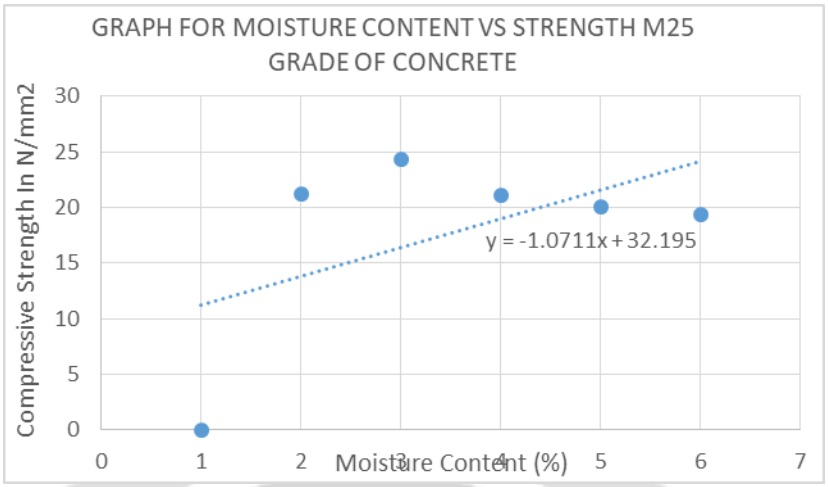

Fig.4 - Graph for moisture content Vs Strength for M 25 grade of concrete

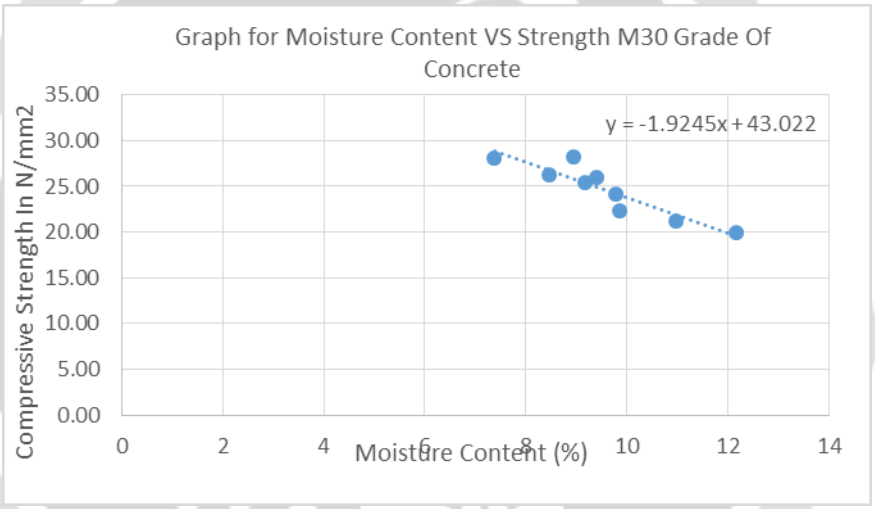

Fig.5 - Graph for moisture content Vs Strength for M 30 grade of concrete

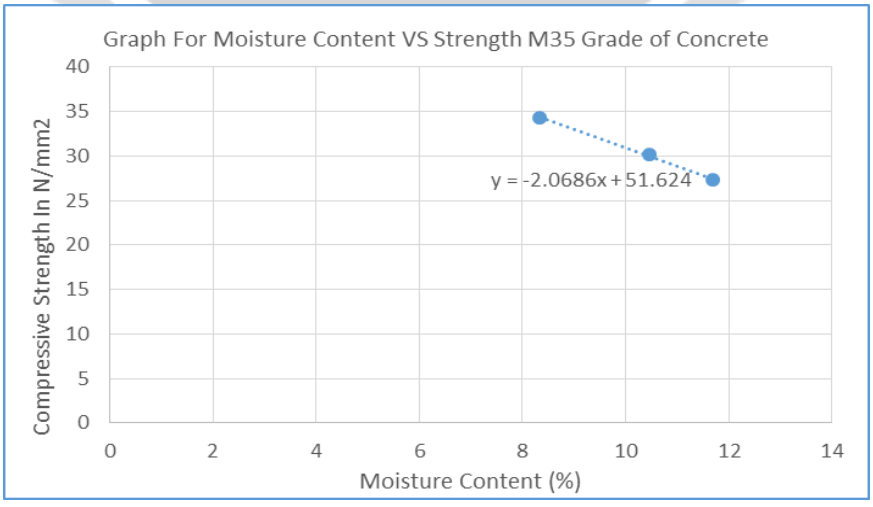

Fig.6 - Graph for moisture content Vs Strength for M 35 grade of concrete

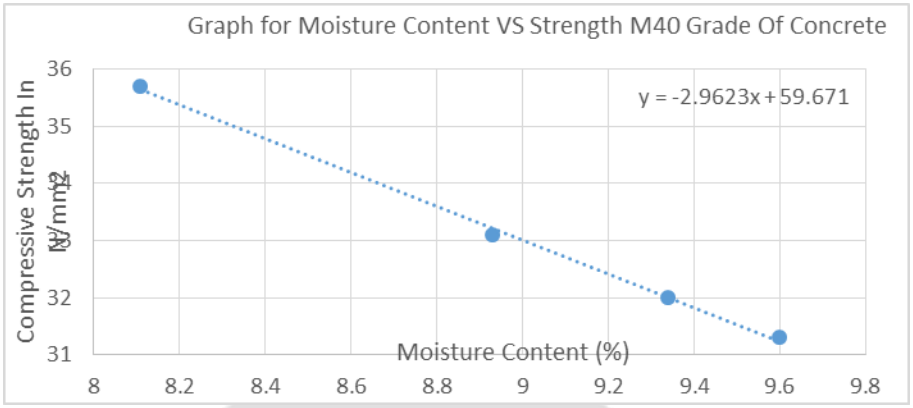

Fig.7 - Graph for moisture content Vs Strength for M 40 grade of concrete

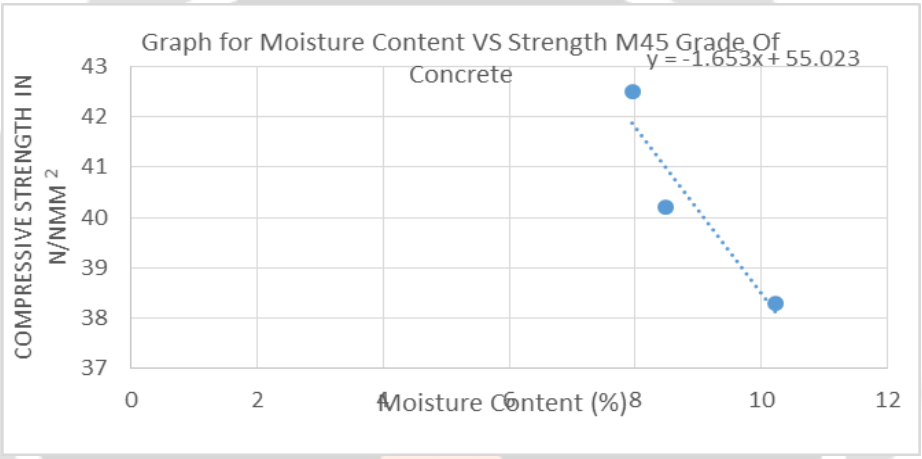

Fig.8 - Graph for moisture content Vs Strength for M 45 grade of concrete

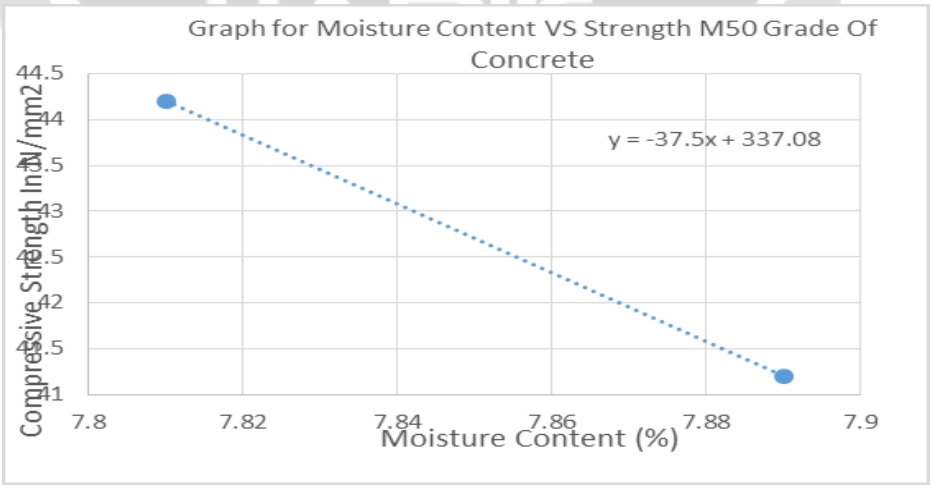

Fig.9 - Graph for moisture content Vs Strength for M 50 grade of concrete

4. Conclusion

35 trials were conducted in the laboratory on various grade of concrete ranging from M-10 to M-50 grade of concrete. It was attempted to establish relationship between the moisture content in fresh concrete and the corresponding compressive strength. It was observed that, we can predict the early strength of concrete by using the established equations. Analysis of concrete at early stage will help user to take the preventive measures if the quality of concrete is not as per the requirement. The concrete mix design has been developed as per IS-10262-2019 guideline for concrete Mix design. The conventional grade of concrete M-20 grade was used to develop the Temperature , moisture and strength model. The cement content and water content used the mix was 340 kg/m*3 and the 186 litres respectively. The trials were conducted and the temperature of fresh concrete was measured. The cubes where casted and kept It in water at 27 °C For 28 days .

5. References

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