

# A CORRELATION BETWEEN ULTRA SONIC PLUS VELOCITY TEST AND REBOUND HAMMER

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**Abstract:** This work provides a learn about on the correlation between a few non-destructive/NDT checking out techniques like (Rebound Hammer & Ultrasonic pulse velocity Test/ UPV). Tests achieved to correlate the accuracy between the rebound hammer & UPV pace taking out 5 column sample having size 300X300. The result acquire from the NDT checking out method were correlated with the compressive power outcome which confirmed that the next correlation existed between the rebound hammer and additionally the compressive electricity than the UPV. Here we discovered a compressive energy of concrete using UPV correlate with rebound hammer.

**Keywords:** Concrete, Non-destructive testing, compressive strength, rebound hammer, ultrasonic pulse velocity.

## I. INTRODUCTION

The Non-destructive test is conducted for the purpose of finding the durability of structure with the help of rebound hammer and ultrasonic plus velocity test. Using ultrasonic pulse velocity machine we found few readings and using some equation, we calculate the compressive strength of concrete sample and an also using rebound hammer find out compressive strength of same sample. At that time we calculate the velocity with help of rebound hammer number compressive strength

## II. LITERATURE REVIEW

[1] This study valuation the strong point of concrete, an pastime is moreover made to extent the accuracy of calculating the fort, using the NDT take a look a (NDT) surface hardness rebound value, fabric sketch parameter and multivariate analysis

[2] The literatures on ultrasonic pulse velocity (UPV) as a nondestructive test for evaluating the properties of concrete are reviewed. Here attempted to correlate compressive forte of concrete to (UPV) and that they suggested many equations for this purpose. The worth of (UPV) there's a large range of compressive forte.

[3] The work offers find out about on the between some NDT methods (Rebound Hammer & Ultrasonic pulse velocity Test/ UPV). Tests have been carried out to suit the accuracy between the rebound hammer and so there for the UPV approaching charge methodology estimating the distinctiveness

[4] The find out bout of the usage of NDT assessments to evaluate the serviceability and protection of structures. Schmidt hammer & UPV test are very common in evaluating the concrete forte. In this lookup taken extraordinary concrete area of expertise (Take 150 cubes with which are divers between 3Mpa – 65Mpa).

## III. NDT TECHNIQUES

The various Nondestructive / partial destructive tests are as below

- Non Destructive Tests for Concrete
- Surface Hardness Tests – Rebound Hammer Test.
- UPV Test.

### A. Rebound Hammer Test

As per the Indian code IS: 13311(2)-1992, the rebound hammer test have the following objectives:

- To work out the compressive strength of the concrete though relating the rebound index and consequently the compressive strength
- To examine the uniformity of the concrete.
- To investigate the general of the concrete supported the nice specifications.

- To relate one concrete part with distinctive in terms of quality.

## B. Ultra sonic pulse Velocity Test

The UPV method includes determination of speed of upv through solid material. The pace of those pulses relies upon the density and elastic residences of the fabric The popular of some materials is normally related with their elastic stiffness in order that measurement of UPV in such cloth can regularly be wont to point out their nice also on decide their elastic properties. Material that can be assessed in this way embody in precise concrete and timber on the other hand eliminate metals. The pulse speed is determined by using the equation: -

$$\text{Pulse velocity} = \frac{\text{Pathlength}}{\text{transite time}}$$

### Method of testing:

For assessing the first class of substances from UPV measurement. This is finished with the aid of terrific pulse and accurately size the time of their transmission (through the path length) need to even be measured exploitation greater than formula. The instrument indicates the time taken foe the earliest apart of the coronary heart beat prevail in the receiving electrical gadget measured from the time it leaves from an acceptable motive on the surface of cloth. As per S 1311 (Part I) 1992

No.	U.P.V. (Km/sec.)	Quality of Concrete
1	Above 4.5	Excellent
2	3.5 to 4.5	Good
3	3.0 to 3.5	Medium
4	Below 3km/sec.	Doubtful

**Table- 1:** UPV Test Result Calculation.

**Note:** - Readings of semi direct & indirect methods are less than direct method generally by 1km/sec

No.	Description	Compressive strength(N/mm <sup>2</sup> )	Velocity n m/s
1.	Column H1	16	3.50
2	Column C6	19	3.82
3	ColumnA10	17	3.65
4	ColumnG11	15	3.35
5	ColumnD17	14	3.30

**Table- 2:** UPV and Rebound hammer Result. (Velocity in km/sec)

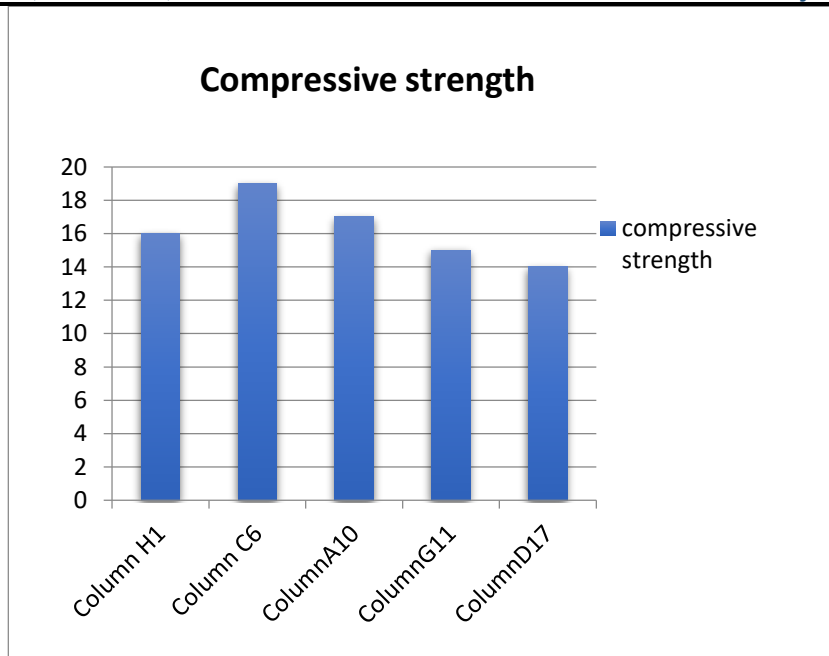


Fig. 1: Rebound Hammer Result.

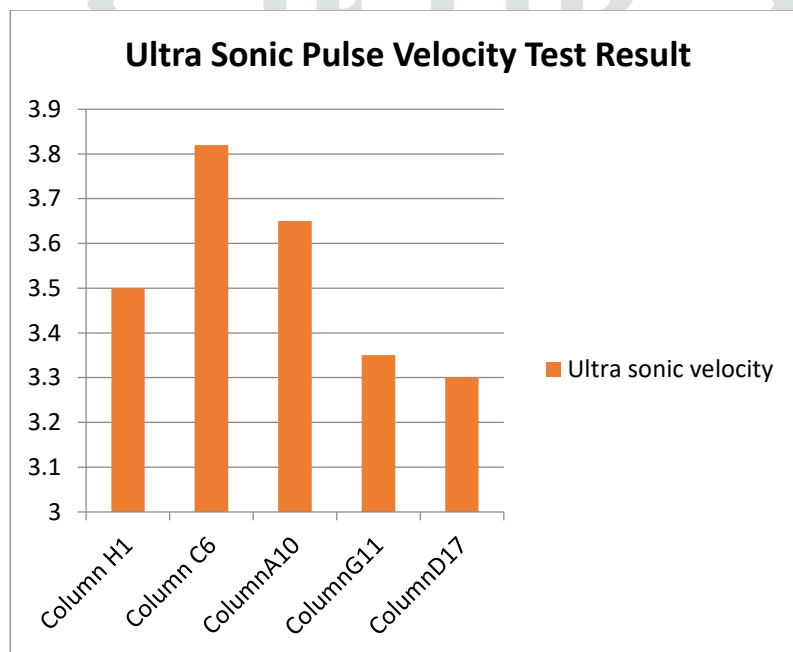


Fig. 2: Ultra sonic pulse velocity test

**IV. METHODOLOGY**

**A. Calculate Compressive Strength with Help of Ultra-sonic Pulse Velocity**

The dynamic young’s modulus of Elasticity (E) of concert may also be decided from the pulse velocity and dynamic poissons ration (μ), using the following relationship.

$$E = \frac{\rho(1+\mu)(1-2\mu)}{(1-\mu)} \times V^2 \dots \dots (1) \text{ S Code 13311 part-II}$$

Where,

E = Dynamic young’s modulus of elasticity n MPa

ρ= Density n kg/m<sup>3</sup>

V= Pulse Velocity n m/Sec

$$\mu = (V_p^2 - V_s^2) / 2(V_p^2 + V_s^2)$$

V<sub>p</sub>= Velocity found n concrete sample.

**Note- 1:** For VP = 2VS, Poisson's ratio  $\nu$  is always 0.33

$$E = \frac{2400(1+0.33)(1-2*0.33)}{(1-0.33)} * 3500^2$$

$$E = 19.842 * 10^9$$

$$E = 19.842 \text{ GPa}$$

$$E = 19.842 * 1000 \text{ MPa}$$

$$E = 19842 \text{ MPa}$$

$$E = 5000\sqrt{f_{ck}}$$

$$f_{ck} = 16 \text{ N/mm}^2$$

**Note- 2:** For velocity of 4.5km/sec Calculated  $f_{ck}$  is 43.00 N/mm<sup>2</sup>.

**Note- 3:** When the velocity between 3.5 to 4.5 There we found moderated  $f_{ck}$  values.

### B. Calculate Velocity with Help of Compressive Strength $f_{ck}$

We have rebound hammer number with the help of this number calculate compressive strength from the graph.

Now putting the face value of  $f_{ck}$  given in table 2 we will get velocity in m/s

$$\frac{p(1 + \mu)(1 - 2\mu)}{(1 - \mu)} V^2 = 5000\sqrt{f_{ck}}$$

.. (2) S Code 13311 part-II

$$\frac{2400(1 + 0.33)(1 - 2 * 0.33)}{(1 - 0.33)} V^2 = 5000\sqrt{16}$$

$$V = 3.5 \text{ km/s}$$

**Note:** -  $f$  necessary due to the carbonation effect on concrete sample 30% reduction factor use in calculated velocity

## V. RESULT

Table- 2: Velocity and Compressive Strength Result Using Correlation Method

No.	DESCRIPTION	fck (N/mm <sup>2</sup> )	Velocity(m/sec)	Calculated fck N/mm <sup>2</sup>	Calculated Velocity (m/sec)
1	Column H1	16	3.50	16	3.52
2	Column C6	20	3.75	19.67	3.70
3	Column A10	18	3.65	18.76	3.61
4	Column G11	15	3.35	13.82	3.45
5	Column D17	14	3.30	12.44	3.39
6	Column D18	13	3.12	11.87	3.15
7	Column H2	15	3.30	15	3.26
8	Column C7	18	3.41	19.67	3.45
9	Column A11	18	3.55	18.41	3.60
10	Column G12	16	3.42	16.50	3.45
11	Column D6	14	3.20	12.44	3.17
12	Column D19	13	3.21	11.87	3.18

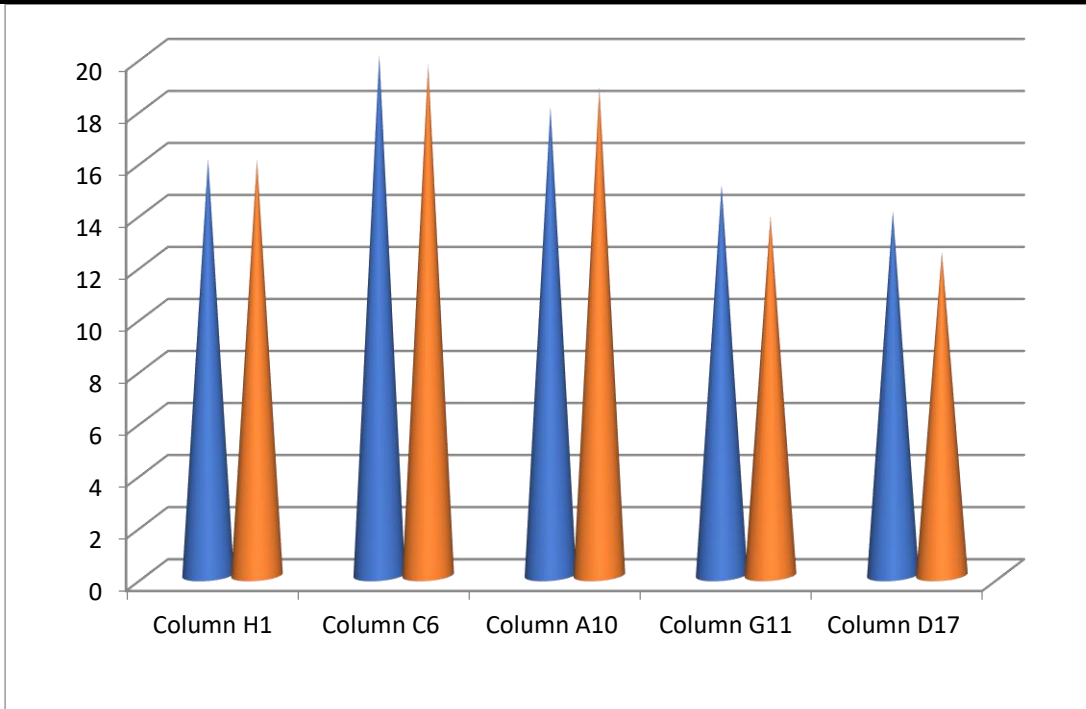


Fig. 3: Fck & Calculated Fck Result

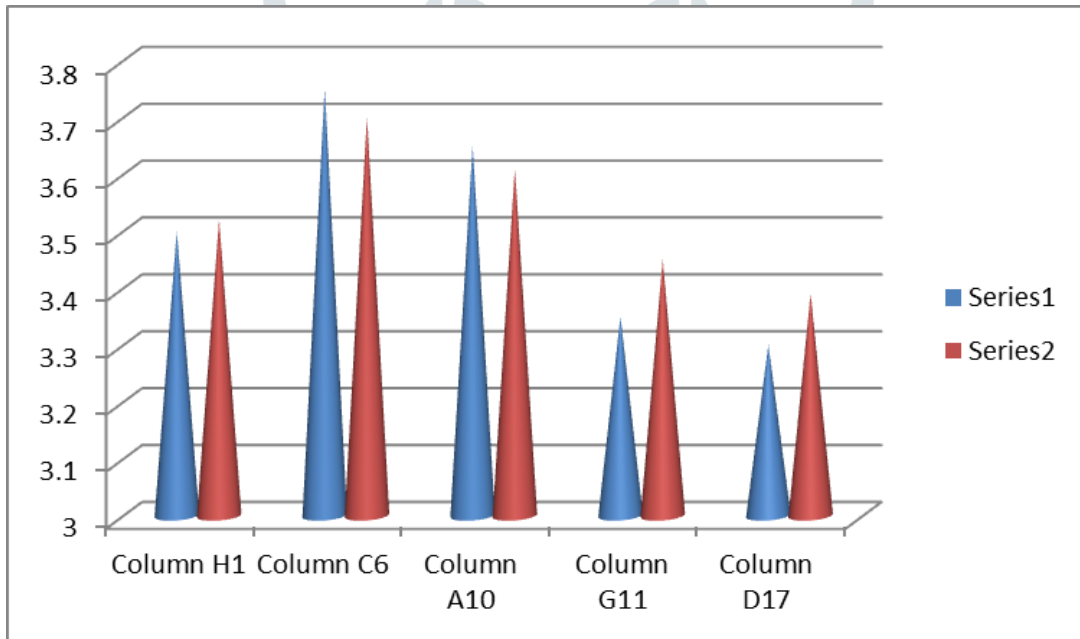


Fig. 4: Velocity & Calculated Velocity Result

**VI. CONCLUSION**

The following are the conclusion drawn from the experimental study.

- From this paper, it can be concluded that we can found moderated compressive strength with the help of ultrasonic readings (velocity) found from concrete sample.
- The comparison between compressive strength calculated by rebound hammer and by using UPV (in m/sec) it was checked.
- Without using any instrument, Compressive strength can be calculated.

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