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Experimental Investigation on Properties of Concrete using Quarry Dust, Copper Slag Ash and Wooden Ash as Partial Replacement of Cement

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ABSTRACT
The scope of this evaluation is to achieve the industry deliberating the feasible use of quarry dust, and to seek out any gaps in present situation. The time period viable use means the usage of quarry dust to their maximum potential to conform up to the demands of this, all of sudden maintaining herbal assets and locating solutions for limit the environmental consequences connected each with quarry dirt advent and its disposal. The utilization of quarry dirt in bond and cement gives capacity herbal further monetary factors of interest for each related industry, especially in zones wherever a considerable amount of quarry dust consists. In this evaluation, the test paintings is completed by means of the use of cement, exceptional aggregate, coarse combination, quarry dust. The examples were casted for M25 grade of concrete by using supplanting the cement 0%, five%, 10%, 15% and 20% by means of quarry dirt and examined for workability with the aid of slump check, compressive energy, flexure power and cut up tensile take a look at on the age of seven, 14, and 28 days. It is seen that the energy effects represents that concrete casted with in M 25 grade of concrete at 7 days are decreases with alternative of five%, 15% and 20% at 10% have increments, and 14, 28 days have decreased with replacement of 5%, 15% to 20% and growth at 10%, when the share of the quarry dirt growth from 0% to 15.

Keywords: Quarry Dust, Copper Slag, Wood Ash, Compressive Strength, Split Tensile Strength, Flexural Strength, Workability.

INTRODUCTION

The essential Ingredients of conventional concrete are cement, sand and mixture. Performance of concrete is laid low with properties of mixture, consequently great mixture is an critical part of concrete. The in most cases used pleasant aggregate is the sand extracted from river banks. Natural sand cost is pricey due to the immoderate price of transportation from herbal sources. Also huge-scale extraction of river banks depletes natural resources. To undertaking this aim , one manner is to move for long lasting answers i.E., To opt for sustainable building materials for construction from the byproducts that are generated through manufacturing industries, mines , as waste is really an excellent ability resource and lots of energy can be recovered from it; and the term 'inexperienced' in the gift situation implies to think about use of long time substances like stone dirt or recycled stone, recycled steel and different merchandise that are not dangerous , can be reused and recycled. In addition to this appropriate substitution for the alternative of natural aggregates in concrete is an issue of concern. As a end result affordable researches with intended answers were accomplished to discover the feasibility of quarry dust in conventional concrete. Quarry dirt is a byproduct that is generated from the crushing plants and that is abundantly to be had to an volume of hundreds of thousands of tons per year associated with disposal troubles and serious environmental consequences. [1]

Mineral aggregate production produces a chief quantity of environmental waste inside the shape of quality cloth (quarry dust powder) that is particularly a situation for the mixture the combination system for factory-made satisfactory combination for use in Portland cement concrete because of requirements and overall performance necessities.

A. Benefits of using Quarry Dust

This paper offers results at the utilization of granite fines as part of the powder content material and discusses their compatibility with excellent plasticizers in SCC applications. These granite fines are regularly known as quarry or rock dust, a by-product within the production of concrete aggregates in the course of the crushing process of rocks. This residue typically represents less than 1% of combination production. In regular concrete, the advent of quarry dust to mixes is restrained because of its high fineness. Its addition to fresh concrete might growth the water call for and therefore the cement content material for given workability and energy necessities. Thus, the a hit usage of quarry dirt in SCC could turn this waste fabric into a valuable resource. [2]

Another potential gain in the usage of quarry dirt is the cost saving. Obviously, the cloth costs vary depending at the supply. In Singapore, the price of limestone powder as added may be as excessive as Portland cement (OPC). In this appreciate, the usage of quarry dirt could play a element in reducing the deliver value of SCC, which is presently some eighty– 150% better than that of everyday concrete. In Sweden, the application of SCC is well hooked up and in keeping with Petersson, the fee of SCC is best 10% – 15% higher, at the same time as in France. The fee is 50% – 100% higher than normal concrete. Although SCC offers many technical and common not pricey advantages, the better furnished fee of SCC over everyday concrete has restricted its programs. Attempt to lessen the price of construction with SCC based totally on a sandwich idea want to be made. [3]

II LITERATURE

Al-Jabri KS et.al [4] was undertaken to study the effect of copper slag (CS) and cement by-pass dust (CBPD) addition on concrete properties Results showed that 5% copper slag substitution for Portland cement gave a similar strength performance as the control mixture, especially at low w/b ratios (0.5 and 0.6). Higher copper slag (13.5%) replacement yielded lower strength values. Results also demonstrated that the use of CS and CBPD as partial replacements of Portland cement has no significant effect on the modulus of elasticity of concrete, especially at small quantities substitution.

B. Felekoglu [5] has found the usability of a quarry dust limestone powder in self-compacting paste and concrete applications was investigated Results showed that, it is possible to successfully utilize high amounts of quarry waste limestone powder in producing normal-strength SCCs. Among its observed mechanical advantages, employment of quarry waste limestone powders improved the economical feasibility of SCC production.

D.W.S. Ho et. al. [3] has deals with the utilization of alternative materials, such as quarry dust, for SCC applications. Results from rheological measurements on pastes and concrete mixes incorporating limestone or quarry dust were compared. It was found that the quarry dust, as supplied, could be used successfully in the production of SCC. However, due to its shape and particle size distribution, mixes with quarry dust required a higher dosage of super plasticizer to achieve similar flow properties.

M. Galetakis et. al. [6] has focused on the development of a simple method for the production of building elements in order to massively recycle quarry dust was investigated at laboratory scale: the production of building blocks by means of compaction mouldings. The optimal mix design, as well as the compaction pressure and water content were determined during the experimental procedure.

The produced specimens were cured and tested in order to evaluate their major mechanical and physical properties. Results indicated that the production of building elements with market-acceptable quality characteristics is feasible.

III METHODOLOGY USED

A. Compressive Strength Test

A. Many of the critical residences of concrete just like the modulus of elasticity, resistance to shrinkage, and creep and sturdiness improve with the increase in compressive strength. This is maximum excessive imperative which offers a idea concerning all the features of concrete. By this single check we will judge that whether concreting has been achieved legitimately or not. For block check two kinds of examples either samples of (15 x 15 x15) cm3 alternately 10 cm x 10 cm x 10 cm size of combination are applied. For the greater a part of the works cubical moulds of length (15x15x15) cm3 are commonly used. This concrete is spilled in the mildew and tempered as it should be in order not to have any voids. Following 24 hours those moulds are uprooted and check examples are positioned in water for curing. The surface of those samples must be made even and smooth. This is executed by putting cement paste and spreading without difficulty on whole quarter of specimen. These examples are tried via strain testing gadget following 7 days curing or 28 curing. Burden ought to be connected gradually at the charge of 140 kg/cm2 every second until the

B. specimens falls flat. Load on the disappointment partitioned by means of area of example gives the compressive quality of concrete. In this paintings the compressive electricity have been examined at the age of seven, 14, 28 and 50 days of the curing.

C. Flexure Strength Test

It is defined as the normal tensile stress in concrete, while cracking occurs in a flexure test. This tensile strain is the flexural power of concrete and is calculated through the utilization of formulas that assumes that the segment is steady.

f = (M/I) y

Where, f = Stress in the extreme fiber.

M = Bending moment at the failure section.

y = extreme fiber-distance from the neutral axis.

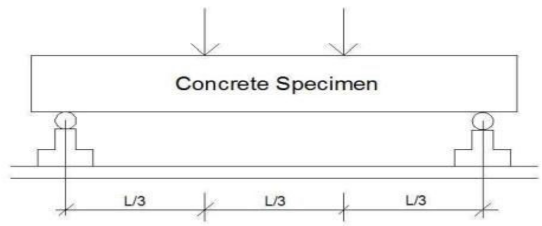

Fig 1: Arrangements of Third Point Loading.

In this work three specimens were casted in the as per the size specified above. And it tested after 7, 14, 28 and 50 days of curing.

D. Split Tensile Test

The elasticity of cement can be obtained indirectly, by subjecting a solid barrel to the activity of compressive drive along to inverse closures of a generator as shown in the Fig. 2.

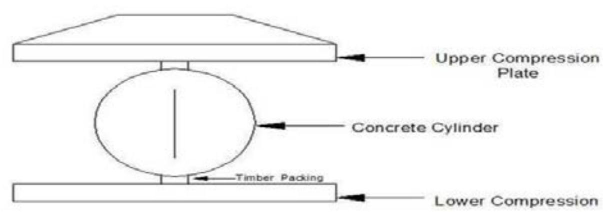

Fig 2: Arrangements for Tensile Test.

Due to the compressive pressure the cylinder is subjected to an outsized value of compressive stress close to the loading region. The huge component is subjected to a uniform tensile pressure acting horizontally. This tensile s tress is taken as an index of the tensile strength of concrete and is given by using the formula.

IV Results and Discussion

In this chapter, dialogue and evaluation of laboratory check results of copper slag, timber ash & quarry dirt for its suitability as cement replacing material are talk and analyzed. The test turned into executed with the distinct percentage of the numerous substances. Wood ash, copper slag, quarry dust is finished with M-25 Grade of concrete combination with the special percentage (zero%, 5%, 10%, 15%, 20%). The special characteristics of the squander materials investigated.

Consistency of Concrete Mix:

The purpose of this test is to see the proportion of water required for preparing cement pastes for different tests. Normal consistency of pastes containing copper slag, wood ash & quarry dust are shown in Table.

Table 1 Normal Consistency of Cement with Different Properties of Different Material

S.No.	Material	Percentage of Replacement				
		0%	5%	10%	15%	20%
1	Wood ash	32	32.5	33	34	34.5
2	Copper slag	32	33	33.5	34.5	35
3	Quarry dust	32	32.5	34	34.5	35.5

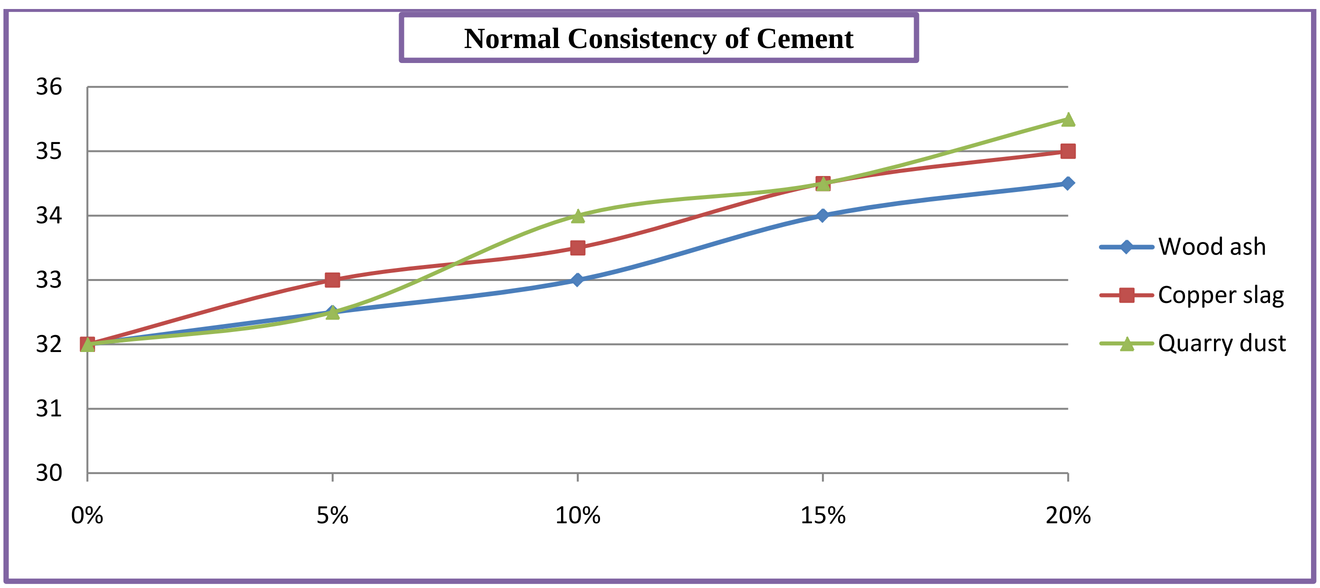

Fig 3: Normal Consistency of Cement.

Table 2 Workability of Cement with Different Properties of Different Material

S.No.	Material	Percentage of Replacement				
		0%	5%	10%	15%	20%
1	Wood ash	65	35	123	148	183
2	Copper slag	65	75	110	135	168
3	Quarry dust	65	88	135	58	182

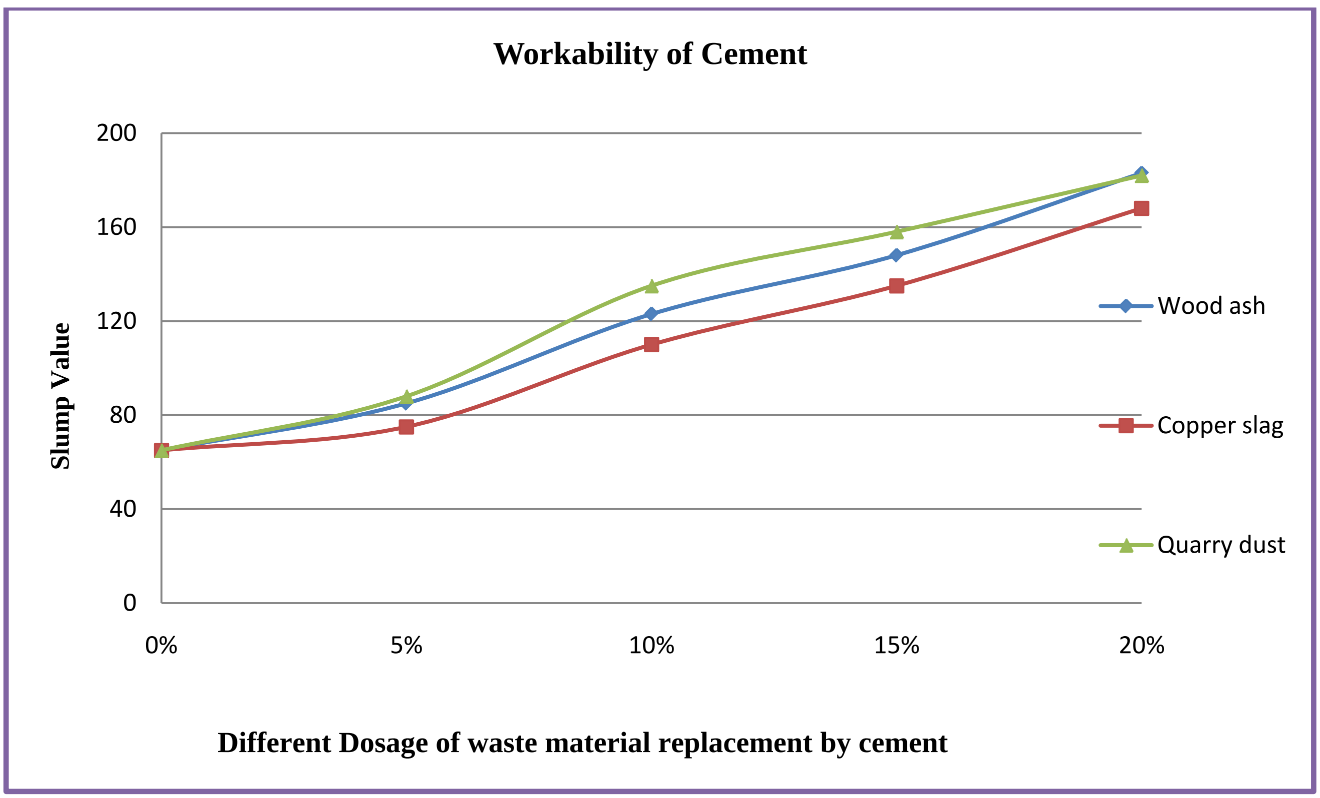

Fig 4: Slump Values of Different Waste Material.

Table 3 Compressive strength of M25 Grade containing Wood Ash

Compressive strength of M25(N/mm2)					
Days/ %	0 %	5 %	10 %	15 %	20 %
7	20.08	17.76	6.11	7.28	12.57
14	26.36	21.89	7.46	10.17	13.06
28	36.30	29.85	8.98	12.51	16.42

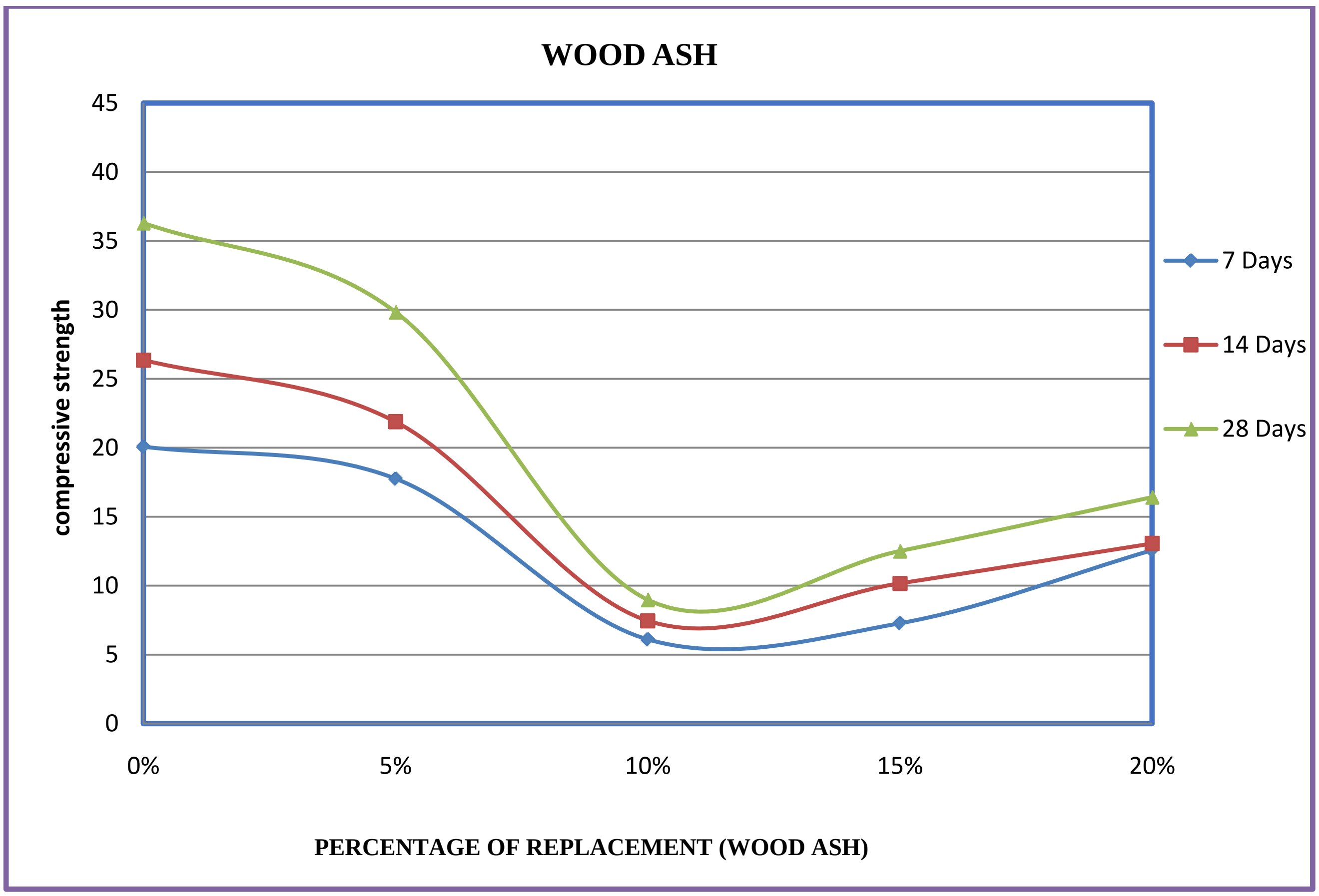

Fig 5: Compressive Strength of M25 Grade Contain of Wood Ash.

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Table 4 Compressive Strength of M25 having Copper Slag

	Compressive strength of M25(N/mm^2)				
Days	0 %	5 %	10 %	15 %	20 %
7	20.08	21.88	20.17	24.27	21.20
14	26.36	24.18	24.31	26.90	22.65
28	36.3	28.89	30.22	36.11	27.35

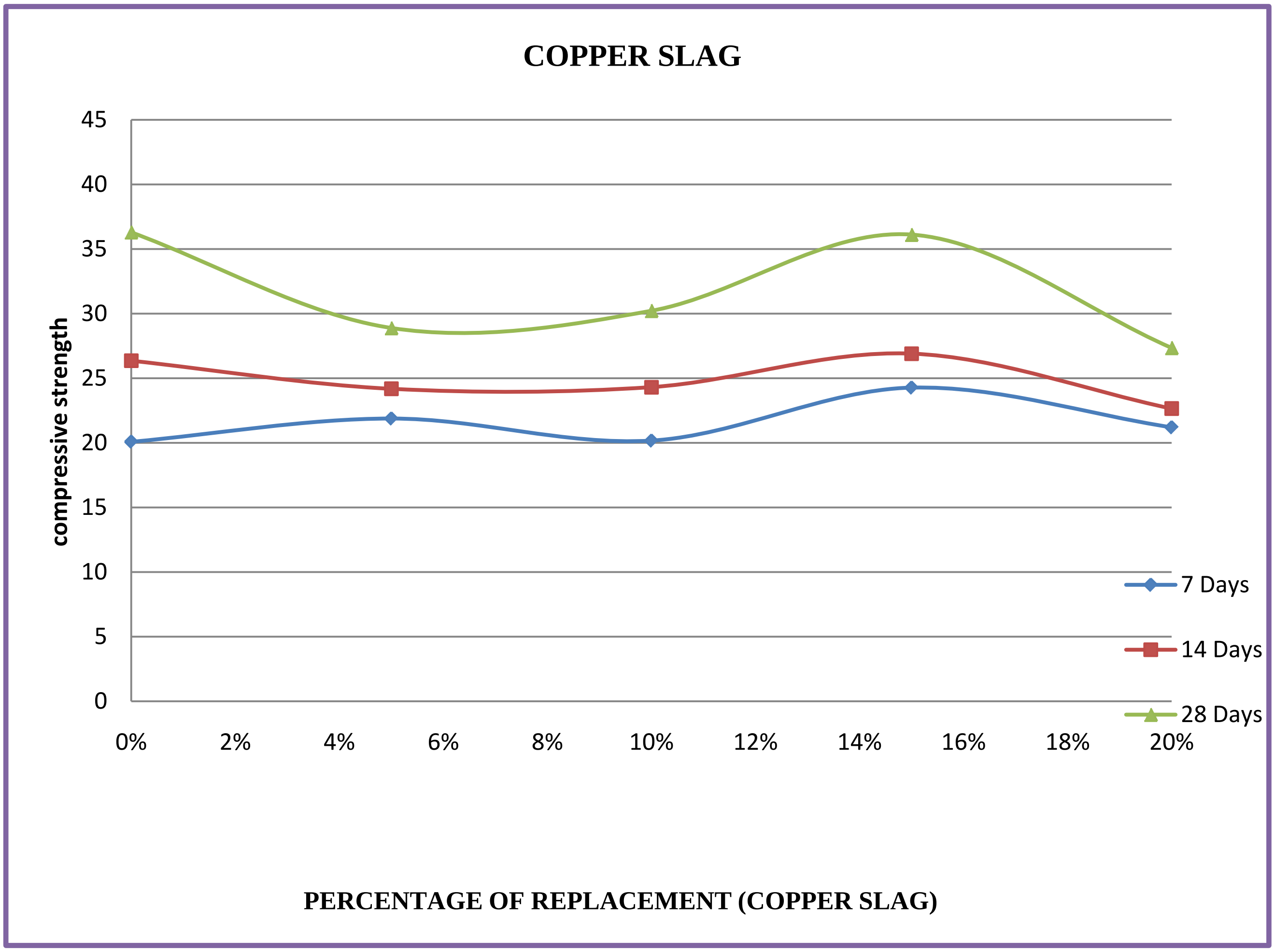


Fig 6: Compressive Strength of M25 Grade Contain of Copper Slag.

Table 5. Compressive Strength of M25 having Quarry dust

Compressive strength of M25(N/mm2)					
Days	0 %	5 %	10 %	15 %	20 %
7	20.08	19.31	22.74	19.78	19.43
14	26.36	24.52	29.36	25.98	23.82
28	36.3	33.20	37.10	31.95	29.22

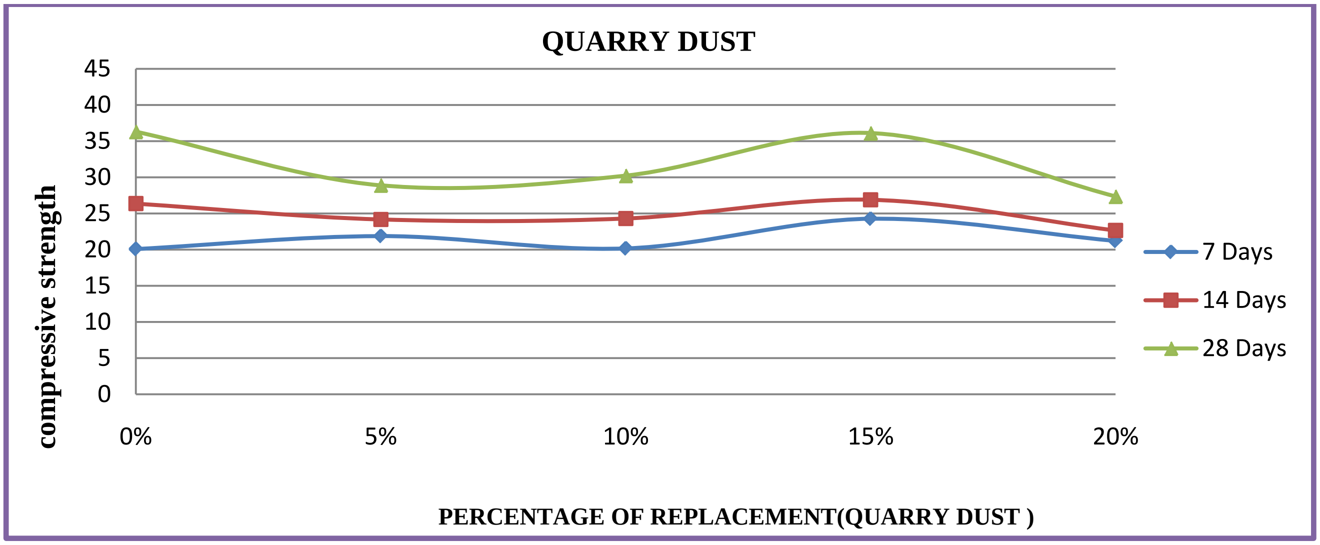


Fig 7: Compressive Strength of M25 Grade Contain of Quarry Dust.

Table 6. Split Tensile Strength of M25 having Wood Ash

Tensile Strength in N/mm2 Contain Wood Ash					
Day's/ %	0%	5%	10%	15%	20%
28	2.17	1.95	1.51	0.81	1.73

From the above table is seen that the tensile strength in M 25 grade of concrete at 28 days are decrease when the percentage of the wood ash increment from 0% to 20%.

Table 7. Split Tensile Strength of M25 having Quarry Dust

Tensile Strength in N/mm2 contain Quarry Dust					
Day's / %	0%	5%	10%	15%	20%
28	2.17	2.40	2.75	2.23	2.51

From the above table is seen that the tensile strength in M25 review of concrete at 28 days are increments when the level of the quarry dust increment from 0% to 20% usage of quarry dust.

Table 8. Split Tensile Strength of M25 having Copper Slag

Tensile Strength in N/mm2 Contain Copper Slag					
Day's/ %	0%	5%	10%	15%	20%
28	2.17	2.67	2.71	2.62	2.43

From the above table is seen that the tensile strength in M25 review of concrete at 28 days are higher than when the percentage of the copper slag are increases from 5, 10, 15 and 20% usage of copper slag.

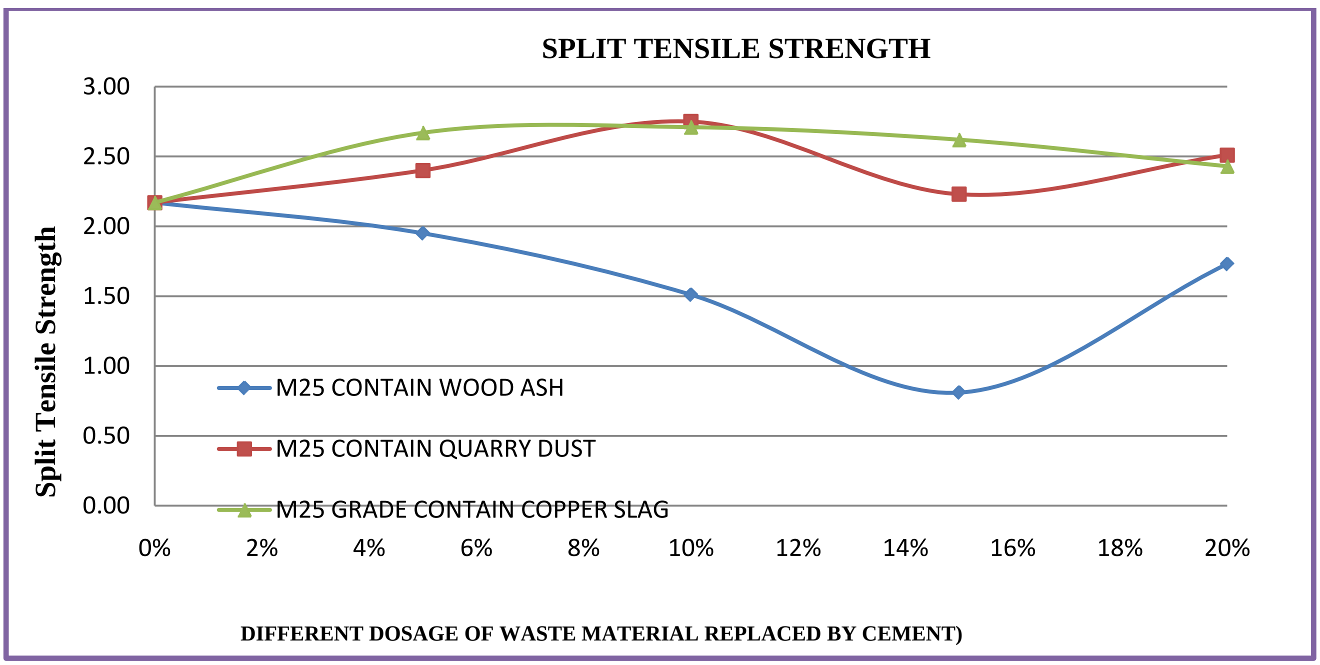


Fig 8: Split Tensile Strength.

Flexural Strength of Beam Contain Wood Ash

The results are determined from UTM with M25 grade of contain wood ash with the substitution of cement as shown in Table 4.14

Table 9. Flexural Strength of M25 having Wood Ash

Flexure Strength in Div. Contain Wood Ash					
Day's/ %	0%	5%	10%	15%	20%
28	15.60	17.30	11.60	11.30	9.30

From the above table it observed that the flexure strength in M25 grade of concrete at 28days. Flexure Strength is increase when the 5% of wood ash increment and abatement from 10%, 15% and 20% used of wood ash.

The results are determined from UTM with M25 grade of concrete contain quarry dust with the substitution of cement as shown in Table

Table 10 Flexural Strength of M25 having Quarry Dust

Flexure Strength in Div. Contain Quarry Dust					
Day's/ %	0%	5%	10%	15%	20%
28	15.60	22.30	19.30	11.00	24.46

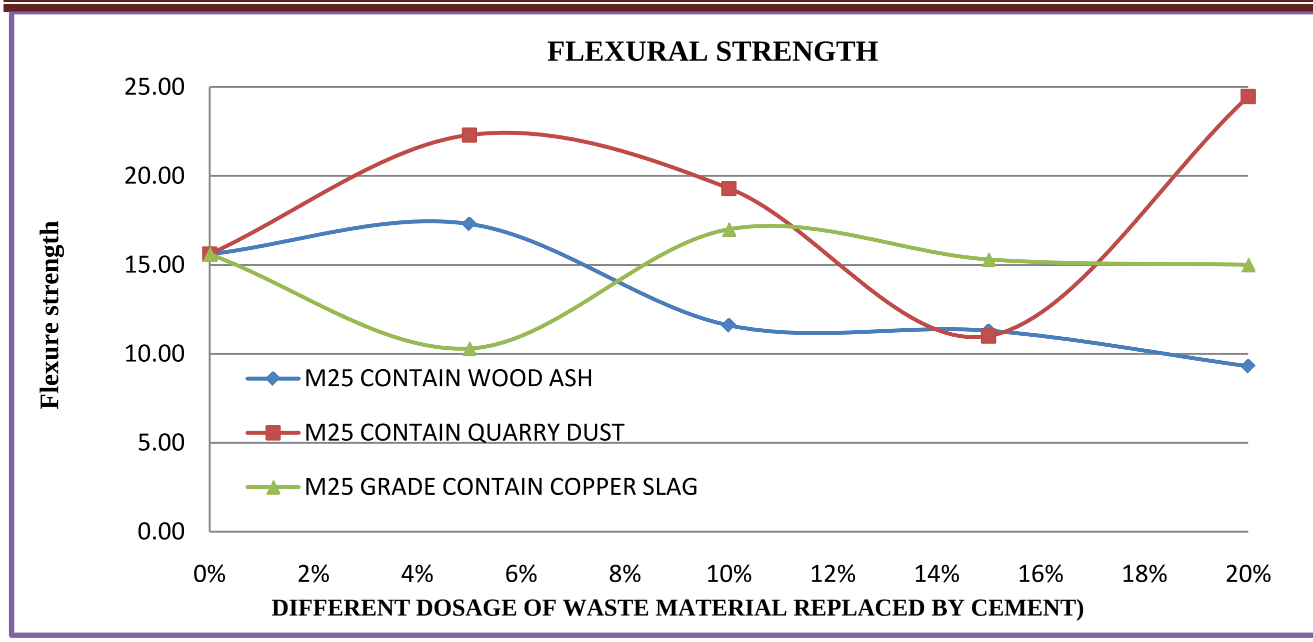
From the above table is seen that the flexure strength in M25 grade of concrete at 28 days. Flexure strength is increase when the 5% 10% & 20% of quarry dust increment and reduction from 15% used of quarry dust.

The results are determined from UTM with M25 grade of concrete contain copper slag with the substitution of cement as shown in Table

Table 12. Flexural Strength of M25 Having Copper Slag

Flexure Strength in Div. Contain Copper Slag					
Day's/ %	0%	5%	10%	15%	20%
28	15.60	10.30	17.00	15.30	15.00

From the above table is seen that the flexure strength in M25 grade of concrete at 28 days. Flexure strength is increase when the 10% and 15% of copper slag increment and reduction from 5% and 20% used of copper slag.



Figu 9: Flexural Strength of M25 Grade Contains of Wood Ash, Copper Slag and Quarry Dust.

V CONCLUSION

- All of the concrete containing copper slag, wood ash & quarry dust showed normal consistency equal and more than the control concrete. Up to 5% 10%, and 15% of replacement the normal consistency was mostly constant minor differences, at 20% replacement the normal consistency had shown a slight increment to 35%.
- Slump shows that the workability increase with the increase in the percentages of contain copper slag, wood ash & quarry dust. All investigated containing copper slag, wood ash & quarry dust mixtures had height slump values and acceptable workability.
- The compressive strength outcome represents that as the proportion of wood ash increases for M25 grade, compressive strength is decreased, when the level of the wood ash increment from 0% to 20%.
- The compressive strength outcome represents that concrete casted with M25 grade at 7th, 14th,& 28th days are decrease with replacements of 5% to 10%, and increments, when the level of the copper slag increment from 15% to 20% at 7th, 14th, and 28th days.
- The compressive strength outcome represents that concrete casted with M25 grade at 7th days are decreases with replacement of 5%, 15%, 20% & 10% have increments, and 14th, 28th days have decrease with replacement of 5%,

  15% to 20% and increments when the percentage of the quarry dust increase from 0% to 15% and slightly decreased with 20% replacement at 28th days.
- Flexural strength is increments when the 5% of level of the wood ash increment and decreasing from 10%, 15% & 20% with the age of 28th days. Flexural strength is increments when the 5% 10% and 20% of level

of the quarry dust increment and reduction from 15% with the age of 28th days. Flexural strength is increments when the 10% and 15% of level of the copper slag increment and decline from 5th and 20% with the age of 28th days.

- Tensile strength of concrete is decreases with the replacement of wood ash. But, tensile strength is expanded with the replacement of copper slag and quarry dust increments with the age of 28th days.

REFERENCES:-

1. Kamlesh Saini, Vijay Chaudhary ,Ankush Bisnohi, Harshit Agarwal, Meghalal Ram,Sandeep Saraswat, (2016). Effect on strength properties of concrete by using waste wood powder as partial replacement of cement." International Journal Of Civil Engineering 3: 172-176.
2. I Rohini, V.Arularasi, (2017). Effect of Fly Ash and Quarry Dust as a Partial Replacement of Cement and Fine Aggregate in Concrete, International Journal of Latest Research in Engineering and Technology, ISSN 2454-5031, 02(08), 15-33,
3. Binaya Patnaik , Seshadri Sekhar.T , Srinivasa Rao, (2015). Strength and Durability Properties of Copper Slag Admixed Concrete, International Journal of Research in Engineering and Technology, eISSN: 2319-1163, pISSN: 2321-7308, 4(1), 158-166.
4. Chavan, R., & Kulkarni, D. (2013). Performance of copper slag on strength properties as partial replace of fine aggregate in concrete mix design. Int. J. Adv. Engg. Res. Studies/II/IV, E-ISSN2249–8974, 95, 98.
5. Dr.suji.D , Narayanan.A.M ,Kartic Kumar.M , Perarasan. M, (2016). Experimental Study on Partial Replacement of Fine Aggregate with Quarry Dust and Saw Dust, International Journals Of Advancement In Engineineering Technology, Management Applied Science, ISSN NO. 2349-3224, 3(6).
6. Jayapal Naganur & Chethan B. A. (2014), Effect of Copper Slag as a Partial Replacement of Fine Aggregate on the Properties of Cement Concrete, International Journal of Research, ISSN 2348-6848, 1(8), 882-893.
7. J. Ramesh Kumar , K. V. Ramana, (2013). Use of Copper Slag and Fly Ash in High Strength Concrete, International Journal of Science and Research, ISSN: 2319-7064, 4(10), 777-781.
8. K.S. Johnsirani , Dr. A. Jagannathan, (2015). Study on Effect of Self- Compacting Concrete with Partial Replacement of Mineral Admixtures Using Quarry Dust, International Journal of Engineering Research and Development, e-ISSN: 2278-067X, p-ISSN: 2278-800X, 11(11), 01-07.
9. Kayathri, K., Vigneshkumar, C., Rani, G., & Karthick, K. (2014). Effect of Copper slag, Fly Ash and Granite Power as a Partial Replacement in Fine aggregate. International Journal of Innovative Research in Science, Engineering and technology, pISSN: 2347 – 6710, 3(5),439-443.
10. Lakshmidevi, K., & NarasimhaRao, A. (2015). Effect of Fly Ash and Quarry Dust on Properties of Concrete. International Journal of Innovative Research in Science, Engineering and technology, pISSN: 2347-6710, 4(9), 8343-8350.