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Prediction of Compressive Strength of Recycled Aggregate Concrete Using Neural Network

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ABSTRACT: This paper presents Artificial Neural Network (ANN) for prediction of compressive strength of recycled aggregate concrete. ANN is used to solve many design problems that are difficult to solve by conventional methods of engineering mechanics. Software has been developed and the results at various percentages of replacement of micro silica the compressive strength of recycled aggregate concrete has been predicted in this research paper.

KEYWORDS: ANN, Micro-silica, Mechanics, Recycled Aggregate, Natural Aggregate, Construction, Recycled Concrete.

I. INTRODUCTION

Artificial neural network are a form of artificial intelligence that attempts to mimic the functions of the human brain and nervous system. ANN is an information system that connects very simple neurons networks. Neural networks analysis is artificial intelligence has recently provided powerful system that works as a supplement or a complement to such conventional professional system. Concrete could be a heterogeneous material comprising fine mixture, coarse mixture, potable water and also the binder referred to as cement. The presence of coarse aggregates contributes additional to the non-uniformity. Associate mixture consumes regarding to seventy fifth of the volume of concrete. Although, concrete is characterised by terribly advantageous options starting from price effectiveness, durability, outstanding compressive strength, and convenience, the continual use of typical concrete, (that is concrete made with virgin aggregates and standard Portland cement) has tested to be terribly unfriendly to the surroundings, as a results of depletion of the natural resources. Growing disposal issues and big energy consumption in production activities, has affects the character. The increasing demand for infrastructure, As a results of manufacture and urbanization has cause additional consumption of concrete. Concrete is that the wide| most generally consumed resource within the world once water and conjointly the foremost widely used construction material within the previous couple of decades. Throughout the crushing method and because of having loose mortar cowl on surface of mixture, Recycled mixture has small cracks on that. As a results of this, bond between cement and mixture is weak. This is often chargeable for the low concrete strength and low workability. By victimization recycled mixture compressive strength of concrete get reduced as compare to the concrete from natural mixture Researchers found that the replacement up to half-hour, however this replacement offers lower strength than virgin mixture. The utilization of mineral admixture (i.e. small silica) might enhance the physical and engineering properties of recycled mixture concrete. Small oxide contributes each physically and with chemicals in concrete combine. The scale of small oxide particles is smaller than that of cement. This may ends up in reduction of the common size of pores gift in cement paste. Whereas the chemical contribution takes place primarily by acting as efficient pozzolanic material, that permits even distribution and better volume of association merchandise.

II. MATERIALS

Cement

Normally Ordinary Portland cement (OPC) is used as cement. Due to iron oxide the colour of cement, within the absence of impurities, the colour of the cement is gray. Ordinary Portland cement (OPC) 53 grade is employed.

Fine Aggregate

Crushed sand is employed that is additionally referred to as artificial sand that is domestically accessible in near space having specific gravity 2.63.

Coarse Aggregate

Used Natural coarse aggregate, which is normally available in local area. Coarse aggregate having specific gravity 2.79.

Recycled Coarse Aggregate

Aggregate was obtained from school field, the beam & cube casted for testing purpose was crushed & 20mm & 10mm combination were separated by sieving. Aggregates having mortar layer over the surface and having small cracks on that the water absorption, density and bonding with cement paste were low. This might offer lead to low practicable.

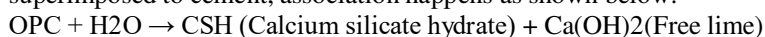


Impurities in Recycled Coarse Aggregate

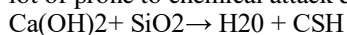
The performance of recycled coarse mixture will be reduced because of the presence of impurities, which emanated from demolition method as well as porous mortar and cement paste connected to the parent aggregate. The result may additionally cause general reduction in characteristics of recycled mixture concrete. a number of the impurities known through visual review from the recycled coarse mixture. The common proportion impurities gift within the recycled coarse mixture amounted to about five-hitter of the full mass of the sample. However, the adhered mortar doesn't appear to be of significant amount however its impact on the characteristics of recycled coarse mixture concrete cannot be neglected.

Micro Silica

Micro silicon oxide used is ASTM C1240 of cetex complete, having relative density a pair of 2.11. Once water is superimposed to cement, association happens as shown below:-



The free lime doesn't contribute to strength, once combined with carbon dioxide; it forms a soluble salt, that leaches through the concrete inflicting effloresce, a well-recognized branch of knowledge downside. Concrete is additionally a lot of prone to chemical attack & deterioration, once it's superimposed, the subsequent reaction takes place.



The reaction reduces the quantity of slaked lime within the concrete.

Water

Water fit drinking is usually thought of fit creating concrete. Water ought to be free from acid, oils, alkalis, vegetables or different organic impurities. H₂O additionally produces weaker concrete. Water has 2 functions in concrete mixes. Firstly, it reacts with chemicals with the cement to make a cement paste during which the inert aggregates are control in suspension till the cement paste has hardened. Secondly, it is a vehicle or lubricating substance within the mixture of fine mixture & cement.

III. CONCRETE MIX DESIGN

This table taken from the paper .Razilpatel, Prof. Rohan, K Choudhary “Standard recycled aggregate concrete incorporate with micro silica” Volume 8, Issue 10, 2020, ISSN NO:0776-3808, aegaeum journal.; The data from the research paper has been taken and using the software based on artificial neural network the values of compressive strength and interfacial transition zone width has been predicted.

Table 1: Concrete Mix

RCA (%)	0%	25%	50%	75%
Cement (Kg/m3)	438	438	438	438
Sand (Kg/m3)	703.48	703.48	703.48	703.48
Gravel (Kg/m3)	1111.5	833.65	555.77	277.88
RCA. (Kg/m3)	1111.5	277.88	555.77	833.65
Water (Kg/m3)	197	197	197	197
Micro silica (Kg/m3)				
5%	0	21.9	21.9	21.9
10%	0	43.8	43.8	43.8
15%	0	65.7	65.7	65.7

Table 2: Result of Compressive Strength (Mpa) Test for Concrete Mix

RCA (%)	0%MS	5%MS	10%MS	15%MS
0	40.38	-	-	-
25	28.49	39.16	39.37	37.93
50	26.92	36.72	38.52	36.16
75	23.47	32.98	34.18	30.05

From the table data has been taken for prediction of compressive strength and Interfacial Transition Zone (ITZ) using Neural Network.

From the software the following results are obtained for various percentages and the values are predicted which are mention below in the following table and this values are not experimented by the researchers.

Table 3: Result of Compressive Strength (MPa) & ITZ (nm)

Description	MS 10% RA 0%	MS 10% RA 20%	MS 10% RA 30%	MS 10% RA 40%
Cement (kg/m3)	703.48	703.48	703.48	703.48
Sand (kg/m3)	438	438	438	438
Course Aggregate (kg/m3)	1111.5	889.2	778.05	666.9
Recycled Aggregate (kg/m3)	0	222.3	333.45	444.60
Micro Silica(kg/m3)	43.8	43.8	43.8	43.8
Water (Kg/m3)	197	197	197	197
Specific Gravity (CA)	2.79	2.79	2.79	2.79
Specific Gravity (FA)	2.63	2.63	2.63	2.63
Compressive Strength	30.35	30.12	30.0	29.89



(MPa)				
Interfacial Transition Zone (nm)	59.66	59.27	59.08	58.89

On the table shows that, using of 10% micro silica give good compressive strength, so here take 10% micro silica and recycled aggregate of 0% 20% 30% & 40%. Natural/Virgin aggregates taken 1111.5 kg/m³.

IV. DISCUSSION AND RESULTS

In this paper to know the properties of hard concrete having recycled aggregates incorporate with micro silica for ascertain compressive strength test and ITZ value.

Usually authors generally used 5% 10% 15% micro silica and 25% 50% 75% of recycled aggregate and gives compressive strength but in this paper find in easy way the values of compressive strength to using another % of recycled aggregates using Neural Network.

Observe that when replace 0-50% micro silica know that 10% using of micro silica give good result and using of micro silica above 50% the compressive strength is reduces that's why here use 10% of micro silica and find the value of compressive strength between 25-50%.

V. CONCLUSION

Micro silica improves the strength as mentioned before. At 10% micro silica with 0% recycled aggregate compressive strength will increases by 30.35Mpa. The increase of recycled aggregates from 0-40% with the help of software it is observed that compressive strength is decreasing 30.35 to 29.89 with the addition of recycled aggregate. The incorporation of micro silica, considerably improves properties of recycled aggregate concrete up to 10% on the far side that it get declines. The end result of analysis suggests potential to extend current suggested fraction of recycled aggregate in concrete. Recommend the use of recycled aggregate is less than 20%.

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