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EXPERIMENTAL STUDY ON M35 CONCRETE BY PARTIAL REPLACEMENT OF DEMOLISHED CONCRETE AND STEEL FIBER

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ABSTRACT

Demolition of historic shape to make way for new ones are frequent points in metropolitan areas due to fast urbanization. However, very little demolished concrete is recycled or reused. The strict environmental legal guidelines and lack of dumping web sites in city areas, on one hand, are making the disposal of demolition wastes challenging while, on the different hand, the quarrying of uncooked substances is end up difficult. The current work provides the consequences of experimental investigation carried out to consider the impact of partial alternative of cement, coarse mixture and quality mixture by using exceptional components of demolished wastes on power and workability of concrete made. For the study, graph combine concrete of grade M-30 was once organized the usage of IS 10262-2009. Thereafter, the substitute of extraordinary parts of concrete, one at a time used to be carried out by means of changing these with the extraordinary sieved fractions of beaten demolition waste. The compressive energy at 7, 14 and 28 days and workability in phrases of stoop price have been measured. The compressive energy of these mixes used to be measured on 150mm cubes. Tests outcomes exhibit that the conduct of recycled waste concrete. The compressive energy of recycled concrete with 0%, 20%, 25% and 30% coarse mixture alternative by means of demolition waste coarse mixture at 7, 14 and 28 days is related to that of referral concrete. The compressive power of recycled concrete made the usage of 5% of demolition wastes coarse combination is nearly comparable to referral concrete. Further, the outcomes point out that nevertheless greater alternative of the constituent substances is viable barring lots compromising the 28 days energy and workability.

Key Words: *demolished concrete, recycled aggregate, steel fiber*

1. INTRODUCTION

The concrete enterprise faces widespread environmental challenges due to its excessive consumption of herbal sources and era of waste. However, the use of recycled concrete mixture (RCA) from development and demolition waste can assist mitigate this impact. RCA has houses comparable to herbal aggregates, even though its energy is barely lower. Additionally, industrial by-products can be utilized to decorate the homes of concrete. By adopting sustainable practices, such as incorporating RCA and industrial by-products, the building enterprise can minimize its environmental footprint, reduce waste, and limit greenhouse gasoline emissions. This method now not solely helps preserve herbal assets however additionally reduces the want for landfills and minimizes the environmental air pollution related with waste disposal. Furthermore, the use of RCA and industrial by-products can lead to value financial savings and increased sturdiness of concrete structures. As the development enterprise continues to evolve, the adoption of sustainable practices will play a critical function in decreasing its environmental effect and advertising an extra sustainable future. The advantages of sustainable concrete practices are multifaceted, ranging from decreased power consumption and decrease manufacturing fees to superior structural overall performance and prolonged lifespan of structures and infrastructure. By embracing modern and eco-friendly solutions, the development enterprise can make a widespread contribution to world efforts to fight local weather alternate and shield the surroundings for future generations.

OBJECTIVE

- To find out about the have an effect on of partial substitute of coarse aggregates with recycled aggregates and addition of a distinctive proportion of metal fiber on the compressive strength, tensile electricity & flexural electricity of grade M35 concrete.
- Determines the most suitable share substitute of coarse aggregates with recycled aggregates corresponding to minimal cost.
- To advance environment-friendly concrete.
- Durability evaluation of concrete i.e. widespread grade M35 concrete and concrete having a partial alternative of coarse aggregates with recycled aggregates and metal fibers.

2. LITERATURE REVIEW

- **Aderibigbe and A. E. Ojobo (1982)**

Investigations carried out on the pozzolanic homes of a Steel slag published that on the groundwork of chemical ingredients alone, the metal slag should be viewed a pozzolana. Physical tests, however, confirmed that the metal slag exhibited little pozzolanic activity. An enchancment in bodily homes used to be bought through calcining the slag at 700°C for five hr. Without sacrificing considerable power (e.g. a 13.5% discount in strength), up to 20% alternative of Portland cement by using metal slag is feasible in the guidance of cement mortar. This effects in considerable value financial savings in areas the place cement is costly and metal slag is regarded a waste product.

- **A.M. Shende et.al., (2012)**

"Experimental Study on Steel Fiber Reinforced Concrete for M-40 Grade" The power and sturdiness of concrete can be modified through making fabulous adjustments in its substances like cemetitious material, mixture and water and by way of including some exclusive ingredients. The presence of micro cracks in the mortar-aggregate interface is accountable for the inherent weak point of undeniable concrete. The weak point can be eliminated by means of inclusion of fibers in the mixture. Different kinds of fibers, such as these used in common composite substances can be delivered into the concrete combination to extend its toughness, or capability to withstand crack growth.

- **Joseph O. Afolayan and Stephan A. Alabi (2013)**

The compressive energy of the concrete designed the usage of metal slag as a coarse mixture and partial alternative for cement was once investigated. A collection of experimental research have been carried out contain concrete manufacturing in two stages. The first stage comprised of ordinary combination concrete (NAC) produced with everyday aggregates and one hundred percent regular Portland cement (OPC). Meanwhile, the 2d stage concerned manufacturing of concrete comprising of cupola furnace slag an aggregates with a hundred percent regular Portland cement (OPC) and because of this with 2%, 4%, 6%, 8% and 10% cementitious alternative with metal slag that had been grounded and milled to much less than seventy five µm diameter. The results of compressive power take a look at carried out on the slag mixture concrete (SAC) with and except granulated slag cementitious substitute had been fine in contrast to everyday mixture concretes (NAC).

- **P. Jyotsna Devi (2014)**

In their work "A Study on the Flexural and Split Tensile Strengths of Steel Fiber Reinforced Concrete at High Temperatures "mixing with 1% quantity of metal fibers to consider its overall performance at ordinary (M30) and at excessive electricity concrete (M60).They brought top effects with that of metal fibers. By including metal fibers flexural resistance can be increased. The take a look at is carried out for 7, 28 and ninety one days.

- **Mekala Prathap Reddy and Dr. K. Chandrasekhar Reddy (2015)**

This paper investigation on M-30 grade of concrete with water cement ratio 0.45 to learn about the compressive strength, and tensile energy of metal fibers strengthened concrete (SFRC) containing fibers of an interval of 0.5%,1%,1.5% extent fraction of hook stop steel fibers of issue ratio 60 had been used. The special proportion of one or extra mineral admixtures with aggregate of metal fibers is used in this study. After curing this specimen had been examined as per applicable codes of exercise Bureau of Indian standard. A end result information received has been analyzed as in contrast with a manage specimen.

- **Girish Sharma(2015)**

Studied in his work "Beneficial outcomes of metal slag on concrete" with the intention of changing metal slag of M35 grade with aggregates(fine & coarse), the proportion from 0%to 55% and examined on its seventh and twenty eighth day after curing. Their deep evaluation concludes that there is steady increment when changed with that of metal slag and can be used practically. Decrement is stated after 55% in case of coarse aggregate.

3. MATERIAL USED

- Cement
- Fine aggregate
- Coarse aggregate
- Recycled aggregate
- Steel fiber

3.1 Cement

Ordinary Portland Cement (OPC) of grade forty three used to be used for this study. The precise company utilized used to be Shree Ultra-Tech OPC, which is grey in colour and free from lumps. Cement is a binding material, which is the mixture of uncooked cloth known as calcareous and argillaceous materials. The most regularly used is an everyday Portland cement. The kind 1 is desired in accordance to IS 8112-1976, which is used for concrete structures. Out of the whole production, everyday Portland cement money owed for about 80-90%.

FIGURE 1 CEMENT

3.2 Fine aggregate

The material which is passed through 4.75mm IS sieve is termed as fine aggregate. The manufacturing sand is a substitute of river sand for concrete construction. The manufacturing sand is used as fine aggregate. M- Sand is produced from hard stone by crushing. The size of manufacturing sand is less than 4.75 mm. The specific gravity and fineness modulus of this M- Sand where found to be 2.66 and 2.56respectively. The percentage of passing is within the limits as per 1S: 383:1970.

FIGURE 2 FINE AGGREGATE

3.3 Coarse aggregate

The material which is retained on IS sieve 4.75mm is termed as coarse aggregate. The nature of work decides the maximum size of the coarse aggregate, the maximum size of 20mm was used in our work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per Indian Standards Specification IS:2386-1963.

3.4 Demolished aggregate

The razed waste is obtained from a construction site and it has to dried for several days before undergoing manual crushing. The debris that has been demolished and removed from the site is first cleaned, dried, and then manually crushed.

Depending on the crushing process, coarse aggregate exhibits a wide range of variations in size, weight, shape, and colour.

3.5 Steel fiber

For increasing the strength of concrete we are using the steel fiber .Steel fiber is a fiber with the highest elastic modulus and stiffness among commonly used fibers. Therefore, the use of steel fiber can mitigate the brittleness of concrete and greatly improve its compressive, flexural and tensile strength.

Properties of steel fiber

Mix	M1	M2	M3	M4	M5	M6	M7	M8	M9
S.F.%	0	5	10	0	0	5	7.5	10	15
RAC%	0	0	0	5	10	5	7.5	10	15

Length of Fiber	25mm
Diameter of Fiber	1mm
Aspect Ratio	25
Shape	Corrugated
Corrugated	Fe-415

4. Design For M35 Concrete

Characteristic strength (f_{ck}) =35Mpa
Standard deviation: 1.91Mpa
Target mean strength, TMS = f_{ck} + 1.65 × SD
= 35 + 1.65 × 1.91
= 38.15 Mpa

Water cement ratio = 0.43
Water content = 172 kg/m^3
Cement content =172/0.43 = 400 kg/m^3

- Volume of cement = $\frac{weight\ of\ cement}{specific\ gravity\ of\ cement}$

$$= \frac{400\ kg}{3.15} = \frac{400}{3.15 \times 1000} = 0.125m^3$$

- Volume of water =172 kg = $\frac{172\ m^3}{1000} = 0.172m^3$
- Volume of total aggregate

$$= 1 - (vol. of\ cement + vol. of\ water)$$
$$= 1 - (0.126 + 0.172)$$
$$= 1 - (0.299)$$
$$= 0.701\ m^3$$

- Fine aggregate required is 36% of total aggregate = 661.18 kg/m^3
- Coarse aggregate required is 64% of total aggregate = 1197.86 kg/m^3

Material required in kg for 1m^3 of concrete

	cement	water	Fine Aggregate	Coarse aggregate
Wt.	400	172	661.18	1197.86
Ratio	1	0.43	1.65	2.99

Table 1 :Aggregate ratio

Mix design :

Cement: Fine aggregate: coarse aggregate (1:1.6:2.9)

- Material required in kg for casting one cube of dimension (150×150×150) mm^3 with the partial replacement of coarse aggregate by recycled aggregate and partial replacement of cement by steel fiber.

Material	0%	2.5%	5%	7.5%	10%
Cement	1.35	1.316	1.285	1.248	1.215
Fine aggregate	2.23	2.23	2.23	2.23	2.23
Coarse aggregate	4.04	3.94	3.83	3.73	3.63
Recycled aggregate	0	0.101	0.202	0.303	6.69
Steel fiber	0	0.033	0.067	0.101	0.135

Table 2 : MATERIAL PERCENTAGE

TABLE 3: TYPE OF CONCRETE MIX

5. METHODOLOG

- First of all we have to collect all the material like cement coarse aggregate fine aggregate Steel fiber and demolish aggregate.
- We get the demolished aggregate from the used concrete blocks or slab, after collecting these broke into small pieces by hammering, the size of the pieces is about 20 mm to 25 mm.
- After separating the demolished aggregate according to their desired size we need to mix it with desired proportion as given in the above table.
- For this experiment we have to check the strength of the m35 concrete by replacing the coarse aggregate by demolished aggregate and the cement by Steel fiber we need to mix different proportion or percentage of the material like 0%, 2.5%, 5%, 7.5%, 10% and 15%.
- After mixing these materials in right proportion we check the concrete for workability and compaction test there are various type of test that is perform to find these property of the concrete.
- With the increase or decrease in the proportion of the material the workability of the concrete is either decrease or increase according to their need.
- After all these procedures we will start casting the cube of dimension 150× 150× 150 mm^3.
- Cubes are cured up to 7 days 14 days and 28 days after this we will test the strength on the CTM machine.

6. TESTING

6.1 Compression test

The cause it is the most broadly used take a look at for hardened concrete is that most of its appropriate traits are at once correlated with its compressive strength, making it a easy take a look at to conduct. Compressive strengths have been bought from the compressive exams performed on a hundred and 150×150×150 mm^3 dice sample. The dice used to be set up on the compression checking out machine's platform. The weight used to be step by step accelerated till the concrete cubes failed. In accordance with IS: 516-1969, the samples are exposed to compressive hundreds in a compression trying out machine. The crushing load is recorded, presenting the cube's compressive strength. The fraction of the specimens' floor location to crushing load, expressed in N/mm2, is their compressive strength. Consequently, all of the cubes' compression energy values are determined**.** The compressive strength test provides valuable information about the concrete's quality, durability, and ability to withstand various types of loads. By analyzing the compressive strength values, engineers and researchers can evaluate the effectiveness of different concrete mix designs, identify potential issues with the concrete, and optimize the mix design to achieve the desired properties.

FIGURE 3 CUBES

7. OBSERVATION

- On the basis of the test result following observation table is made. These are the values of the compressive strength of concrete block in MPA gain by the concrete block after the curing of 7 days, 14 days and 28 days.
- These reading of compressive strength of concrete is taken by three concrete block of each mix design i.e. M1, M2, M3 …….. M9.
- After taking reading of each block calculating the mean strength of each mix design by finding the average value of each block's compressive strength.

Compressive Strength of Grade M30 as M1, M2, M3, M4, M5, M6, M7, M8, M9

Mix	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**
Strength at 7 days	30	30.2	32	30.3	30	33	31	32	29
	31	30.5	32.6	30.5	30.5	32	33	31	28
	30	30	31	30	30	34	34	32	28
Avg	**30**	**30.2**	**31.8**	**30.2**	**30.1**	**32.3**	**33**	**31.6**	**28.3**
Strength at 14 days	32	32.5	34.4	33.2	33.2	34.2	34.8	33	31.2
	32.2	32	33.6	32.3	31.4	34.3	34.6	32.3	30.4
	32	32.5	34.2	33.3	32.6	34	35.1	34.2	28.2
Avg	**32.0**	**32.3**	**34.0**	**32.6**	**32.4**	**34.1**	**34.8**	**33.1**	**33.2**
Strength at 28 days	37.4	39.2	40	41.6	41	44.2	46.6	40.2	36.2
	37.2	39	40.2	42	40	44	46.2	39	35
	37	38.4	40	42.2	41.3	44	46	39	35
Avg	**37.2**	**38.8**	**40.06**	**41.9**	**40.8**	**44.06**	**46.2**	**39.4**	**35.73**

TABLE 4 COMPRESSIVE STRENGTH

8. Result

The compressive strength test was conducted at curing ages of 7, 14 and 28 days. The average compressive strength test results of all the mixes at different curing ages are shown in Table.

Compressive strength of concrete mixes made with and without demolished aggregate and steel fiber with different percentage were determined at 7, 14 and 28 days of curing the test result are given in the table and shown in figure. The maximum compressive strength was obtained for a mix having a 7.5% Steel fiber and 7.5% demolish aggregate by weight and increase in strength over plain concrete. The seven days compressive strength of demolished aggregate and steel fiber was found to be high as 34.83 make up MPa. Which is more than ordinary concrete . Similarly 28 days compressive strength was found to be about 46.2 mega pascal which is more than the ordinary concrete. The effect of replacement of cement with steel fiber and coarse aggregate with demolished aggregate on the compressive strength of concrete is shown in figure. It is clear that the replacement of cement with 10% of demolished aggregate and steel fiber and coarse aggregate with demolished aggregate reduce the compressive strength of concrete and for particular percentage of demolish aggregate and steel fiber there was a decrease in compressive strength of concrete as the percentage of demolished aggregate and steel fiber from 10% to 20%.However this reduction with edition of Steel fiber and demolish aggregate continue to decrease with an increase in the percentage of demolish aggregate and steel fiber generally presence of Steel fiber and demolish aggregate reduce compressive strength depending up on demolished aggregate and steel fiber content.

9. CONCLUSION

- As the replacement of Natural aggregates by RCA in concrete mix increase, the workability of the concrete mix was found to decrease as compared to control mix and the additional of steel fibers into the concrete mix also decrease the workability.
- The addition of RCA in concrete mix there is reduction in the compressive strength at 50% as compare to control mix whereas further addition of RCA at 100% decrease the compressive strength inclusion of steel fibers into concrete mixes increases the compressive strength at 0.5% fibers content as compared to the control mix whereas further addition of fiber at 1% with RCA there is small increase in the compressive strength for all mixes as compared to control mix.
- The inclusion of RCA and fiber into the concrete mix gives same splitting tensile strength as compared to the control mix.
- Recycled and reuse of building waste has been found to be an appropriate solution to the problems of dumping hundreds of thousands of tons of debris accompanied by a shortage of natural aggregates.

10. SCOPE FOR FUTURE RESEARCH

To promote sustainable development in the protection of natural resources and reduces the disposal of demolition waste from old concrete. Properties such as compressive strength, tensile strength, and flexural strength can be increased using steel fiber at different proportion.

Based on the present trend of using recycled aggregates in concrete, research can be explored in the following areas:

- **Sustainable Development**: Promoting sustainable development by conserving natural resources and reducing the disposal of demolition waste from old concrete. This can be achieved by using recycled aggregates, reducing the environmental impact of concrete production, and minimizing waste disposal.
- **Enhancing Durability Properties**: Investigating the use of steel fiber at different proportions to improve durability properties such as compressive strength, tensile strength, and flexural strength. Steel fiber can enhance the concrete's resistance to cracking, improve its toughness, and increase its overall durability.
- By exploring these research areas, the construction industry can move towards more sustainable and durable concrete solutions, reducing the environmental impact of concrete production and improving the longevity of structures.

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