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Evaluate the Impact of Using Recycled Aggregates on Place of Natural Aggregates in Concrete

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Abstract: The research involved sieving the crushed concrete to attain the required aggregate sizes before incorporating it into fresh concrete mixes. Various tests were conducted to evaluate the performance of the recycled aggregate in concrete, encompassing aspects such as compressive strength at 7 and 28 days, a crucial parameter in assessing the structural viability of the recycled material. The experimental results demonstrated that high-quality concrete could be produced by incorporating crushed concrete sourced from demolished sites. Comparative analyses between the compressive strength of the recycled concrete and that of conventional concrete were conducted at both 7 and 28 days. The findings revealed that, even when replacing up to 50% of the coarse aggregate with crushed concrete, the compressive strength of the recycled concrete matched that of conventional concrete after 28 days. This indicates the viability and structural integrity of concrete produced with recycled aggregate, providing a compelling case for its use in construction.
Keywords: Recycled Aggregates, Natural Aggregates, Sustainable Construction, Environmental Impact, Construction and Demolition Waste

I. INTRODUCTION

The global construction industry, a vital contributor to economic development, is confronted with the pressing need to adopt sustainable practices in response to the escalating challenges posed by resource depletion and environmental degradation. As the demand for construction materials continues to surge, there is a growing imperative to explore alternatives that reduce reliance on finite natural resources and minimize the environmental impact of construction processes. One promising avenue within this paradigm is the integration of recycled aggregates as a substitute for traditional natural aggregates in concrete production.

Recycled aggregates are derived from the processing of construction and demolition waste, presenting an opportunity to repurpose materials that would otherwise contribute to burgeoning landfills. The utilization of recycled aggregates not only addresses the issue of waste management but also aligns with the principles of the circular economy, fostering a sustainable and resource-efficient approach to construction.

This research paper seeks to comprehensively evaluate the impact of incorporating recycled aggregates in place of natural aggregates in concrete. The study aims to contribute to the understanding of the physical, mechanical, and environmental implications associated with this substitution, providing insights that can inform sustainable practices within the construction industry.

The following sections will delve into the characterization of both natural and recycled aggregates, explore concrete mix designs, and assess the mechanical properties and durability of concrete structures incorporating recycled aggregates. Additionally, a life cycle assessment (LCA) will be conducted to quantify the environmental impact, offering a holistic perspective on the sustainability of utilizing recycled aggregates in concrete production.

II. MATERIALS AND METHODOLOGY

The purpose of this study was to examine the effects of using recycled concrete from demolition in lieu of conventional coarse aggregate on the strength qualities of concrete. Compressive strength of concrete cubes made with concrete components and with some of the coarse aggregate replaced by recycled destroyed concrete was one of several important features of this investigation. Workability was evaluated using the slump cone test and strength was measured using compressive strength when in the hardened condition. The research followed the recommendations of IS 10262:2009 for design and complied with the mix design standards for Grade of concrete-M20. To compression testing, 66 cubes were cast, each measuring 150 mm on a side. Since this study is based solely on experimental work, this chapter details the systematic approach used to carry out the experiments. During the experimental phase, the following procedures were used:

Putting down a solid base is the first step in building anything. Early in the building process, the mix design for M20 grade concrete is also created based on the "INDIAN STANDARDS CODE" IS 10262:2009. Physical characteristics such as specific gravity, nominal size, water absorption capacity, fineness modulus, etc. must be considered at every stage of the mix design process. Conditions of use, methods of material mixing, and the requirement of Indian Standard Code IS 456:2000 are further considerations. After settling on the quality and ratios of various components, the selection of materials is completed in line with "INDIAN STANDARDS." To do so, you must use OPC cement of grade 43 and aggregates that conform to the standards set out in IS 383:1970.

The mix design specifies the proportions of the specified elements to be blended in order to produce the necessary strength. Sampling and testing of concrete are performed in line with the standards set out in IS 1199:1959. IS 2386 (Part 1): 1963 provides the foundation for how aggregates for concrete are tested, specifically with regards to their shape and size.

After the concrete mix is made, it is subjected to critical tests, such as the slump cone test, to assess its physical qualities. Concrete is poured into clean, oiled, standard-sized molds (150 mm x 150 mm x 150 mm) and reinforced with steel bars of varying shapes and sizes. After 24 hours, the concrete cubes are removed from the molds, tagged with water-resistant paint, and cured for another 28 days in a tank of normal water maintained at 27 2°C. After this length of time, the concrete is put through its final strength test. The "INDIAN STANDARDS CODE" IS 516:1959 specifies the procedures to be followed for evaluating concrete, including the compression strength test.

A. *Materials Used*

1) *Cement:* OPC of grade 43 was purchased locally, and in line with IS: 4031-Part 4 - 1988, its physical and chemical parameters were assessed. The findings showed that the cement complied with the different requirements outlined in IS: 8112 - 1989. Table 1 provides examples of the cement's characteristics. In this investigation, Ordinary Portland Cement (OPC) of grade 43 was used as the cement.

Table 1: Properties of cement

Sr. No.	Properties	Value
1.	Standard consistency	33%
2.	Initial setting time	45 min
3.	Final setting time	385 min
4.	S.G.	3.15
5.	Fineness	2%

2) *Fine Aggregate:* The fine aggregate that was used in this experimental inquiry was river sand, which was devoid of any and all types of naturally occurring pollution. The fine aggregate was put through a sieve with a mesh size of 4.75 millimeters, and the sand had a specific gravity of 2.6 and was completely dry. There was no foreign material in the sand. According to the IS requirements, the fine aggregate had a grading zone that was consistent with Zone II. It is now well accepted that the qualities of aggregates, both physical and chemical, have a substantial impact on the properties and performance of concrete.

The Properties of F.A. are given in table 2. (As per IS: 383-1970)

Table 2: Properties of fine aggregate

Sr. No.	Properties	Value
1.	Zone	II
2.	S.G.	2.5
3.	F.M.	3.76
4.	W.A.	0.59%
5.	Surface texture	smooth

3) *Coarse Aggregate:* The production of concrete requires the use of C.A., which might be in the form of stones that have been broken up in an erratic fashion or gravel that has formed naturally through time. Materials that are too massive to be able to pass through a sieve with a pore size of 4.75 millimeters are referred to as coarse aggregates. They may be as large as 20 millimeters at their widest point.

Properties of Coarse aggregate are given below in table 3.

Table 3: Properties of coarse aggregate

Sr. No.	Properties	Value
1.	S.G.	2.94
2.	F.M.	7.07
3.	W.A.	0.40%
4.	Particle shape	angular
5.	Impact value	11.42%
6.	Los Angles abrasion value	8.32%

4) *Water:* Because it participates in the chemical reaction that cement undergoes with water to form concrete, water is an essential component in the production of concrete. It plays an important role in the creation of a gel, which ultimately contributes to the increased strength of the concrete. For the most part, any drinkable water that does not have a very strong flavor or odor may be used in the mixing process. Lakes and streams, both of which often have a healthy population of aquatic life, are good examples of suitable water sources. In most cases, water that is declared fit for human consumption is also regarded suitable for use in the mixing of concrete.
5) *Recycled Coarse Aggregate:* Crushed aggregates with a size of 20 millimeters were utilized for the Recycled Coarse Aggregates (RCA), which were sourced from a neighborhood in close proximity to a building site. The RCA was made up of at least 95% concrete by weight, guaranteeing a safe and clean supply, with normal levels of overall pollution falling below 1% of the entire mass. It is expected that recycled concrete aggregates, which are obtained from all of the original concrete except the lowest grade of original concrete, would be able to fulfill the same test standards that are placed on conventional aggregates.

The physical properties of Recycled coarse aggregates are shown in Table 4.

Table 4: Tests on Recycled Coarse Aggregates

Sr. No.	Properties	Value
1.	S.G.	2.36
2.	F.M.	7.70
3.	W.A.	2.40%
4.	P.S.	angular
5.	I.V.	19.18%
6.	Los Angles abrasion value	25.55%

III. METHODOLOGY

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After 24 hours, the concrete cubes are removed from the molds, tagged with water-resistant paint, and cured for another 28 days in a tank of normal water maintained at 27 2°C. After this length of time, the concrete is put through its final strength test. The "INDIAN STANDARDS CODE" IS 516:1959 specifies the procedures to be followed for evaluating concrete, including the compression strength test.

A. *Test on materials*

1) The OPC 43 (Cement) was tested for physical properties such as:
- Fineness test
- Standard consistency test
- Setting time test
- Specific gravity

2) The Fine and Coarse aggregates were tested for physical properties such as:
- Specific gravity
- Particle size distribution test
- Water absorption

3) The fresh concrete was subjected to the following tests.
- Slump test

4) Properties were tested in the hardened state of the concrete are.
- Compressive strength test

5) Testing of Cement

The physical test results on OPC (43 Grade) are as follows.

B. *Mixing of Concrete*

The performance of concrete is significantly impacted by the mixing process. This underscores the importance of proper and effective mixing practices, which can result in improved concrete performance and overall quality. The quality of concrete is also influenced by the uniformity of the mix materials during both the mixing stage and following the placement of fresh concrete. Effective mixing of concrete enhances its strength and promotes better cement-aggregate bonding.

C. *Casting of Concrete Cubes*

To initiate the process, lubricating oil is evenly applied to all the molds. This preparatory step ensures that when the molds are opened after 24 hours, the concrete cubes can be easily removed without causing any damage. Prior to pouring the concrete mix, it is essential to confirm that all the bolts securing the molds are properly tightened. This precautionary measure not only prevents any leakage of the concrete mix but also facilitates the formation of perfectly shaped cubes, each measuring 150 mm × 150 mm × 150 mm in dimensions.

The concrete mix, designed for M-20 grade, was meticulously prepared within the laboratory of the institute. To assess the workability of the fresh concrete, a slump test was conducted, providing a measurement of the slump value. Subsequently, cubes measuring 150 mm × 150 mm × 150 mm were cast from the designed mix for the purpose of determining compressive strength. These cubes and beams were then compacted using a standard vibration machine. After the casting of the cubes, the strength of the concrete was evaluated at both the 7-day and 28-day marks.

D. *Curing of Cubes*

Subsequent to the cube molds being opened, they are carefully labeled to indicate their respective specifications. This is achieved using water-resistant paint and a paintbrush.

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Following this, the cubes are transferred to a curing tank where they remain submerged in fresh, clean water for a duration of 7 days and 28 days. The specifications assigned to each cube specimen serve as their identifying names.

During the curing period, close monitoring of the curing tank is imperative to ensure that the water level does not drop below the level of the cubes. Concrete has a property of releasing heat as it sets, which can lead to water evaporation. If the water level decreases, it must be promptly replenished to cover the cubes adequately. Additionally, the quality of the water used for curing should be examined every 7 days to maintain its suitability.

Following the completion of the 28-day curing period, the cubes are carefully and gently removed from the curing tank. They are then placed in a tray for a duration of approximately ½ to 1 hour to allow any excess water to drain from the concrete cubes. Subsequently, the cubes are subjected to compressive strength testing using a specialized testing machine, and the resulting values are duly recorded.

E. Curing of Test Specimens

The test specimens were stored in the concrete laboratory of the Civil Engineering Department at MITS, Gwalior. They were placed in an area devoid of vibrations and left undisturbed for a period of 24 hours, with an additional half-hour grace period counted from the moment when water was initially introduced to the other components.

F. Specimen Details

Utilizing the prescribed mix design, concrete specimens were fabricated. The table provided in Table 6; outlines the dimensions and quantity of specimens for the respective tests. The dimensions of the casted cubes were 150 mm × 150 mm × 150 mm.

Table 6: Size of the specimen

Name of the specimen	Name of the test	Size of the specimen (in mm)	Number of specimens
Concrete cubes	Compression	150 x 150 x 150	66

IV. RESULTS AND DISCUSSION

In this study, the designed concrete undergoes various tests to assess its strength and other properties. The primary objective of this investigation is to evaluate the concrete's developed strength at different testing intervals following the curing process. Proper casting and curing procedures are known to enhance the concrete's strength. In this study, we examine the concrete cubes that have been cast to assess their strength and other properties. The main goal of this investigation is to determine the achieved strength of the concrete at various testing stages after the curing process. It is well-known that proper casting and curing procedures can significantly enhance concrete strength.

A. Slump Cone Test

The workability test results, determined through the slump test, were conducted with varying percentages of natural coarse aggregate replacement by reused aggregates. The results of the slump test appeared that workability somewhat decreased as recycled aggregates' proportion of replacement of natural coarse aggregate rose. Figure7 provides details on the exact slump values that correlate to the substitution percentages of R.C.A.

In the early stages of concrete mixing, when concrete primarily consisted of cement, aggregate, and water, the water content was largely influenced by the coarse aggregates, and in turn, the water content determined the slump. During this period, a lower slump value indicated a reduced water content, which was synonymous with higher-quality concrete.

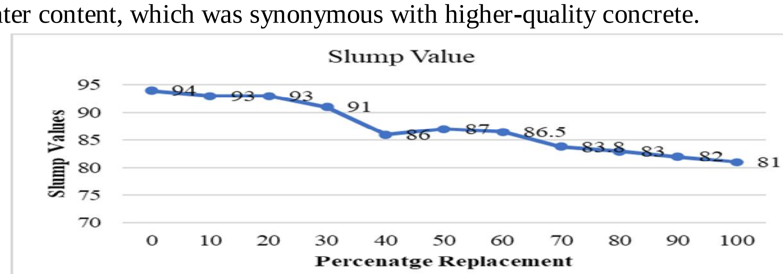


Figure 7: Slump values Variations

The slump cone test results for the M20 concrete mixture with varying percentages of Recycled Coarse Aggregates (RCA) can be interpreted as follows:

1) 0% RCA (Control Mix - M20 Concrete): The concrete mixture with no RCA replacement has a slump value of 94 mm. This indicates high workability and good flowability, typical for well-graded concrete mixes.
2) 10% RCA: A slight decrease in slump value to 93 mm is observed. This reduction is minimal and suggests that replacing 10% of the coarse aggregates with RCA has only a minor impact on workability.
3) 20% RCA: The slump value remains at 93 mm, which is consistent with the 10% RCA replacement. The workability of the concrete is still good.
4) 30% RCA: A further decrease in slump to 91 mm is observed. While the workability is slightly reduced, it is still within an acceptable range.
5) 40% RCA: A more noticeable reduction in slump to 86 mm occurs. This indicates that replacing 40% of the coarse aggregates with RCA has reduced workability, and the concrete may require more effort to place and compact.
6) 50% RCA: The slump value increases slightly to 87 mm compared to the 40% RCA mix. While it is an improvement, the workability is still lower than the control mix.
7) 60% RCA: The slump value is 86.5 mm, which is similar to the 50% RCA mix. The workability remains relatively consistent.
8) 70% RCA: A further reduction in slump to 83.8 mm is observed. Workability continues to decrease, and more effort may be needed for concrete placement.
9) 80% RCA: The slump value is 83 mm, indicating reduced workability. It may be challenging to handle this mixture, and additional measures might be needed for proper placement.
10) 90% RCA: A slump value of 82 mm suggests limited workability. Careful handling and compaction may be required for this mixture.
11) 100% RCA: The slump value decreases to 81 mm, indicating the lowest workability among all mixes. Handling and compaction may be challenging, and additional adjustments to the mix or construction methods may be necessary.
12) In summary, as the percentage of RCA replacement increases, there is a gradual decrease in workability, as indicated by the slump values. However, even with higher RCA percentages, it may still be possible to work with the concrete mix effectively, but extra attention to construction practices may be required.

B. *Compressive Strength Test:*

The comprehensive findings regarding the compressive strength of concrete, considering various percentages of natural coarse aggregate replacement with recycled aggregates, are summarized in figure 4.2. The fluctuation in compressive strength corresponding to different replacement percentages of natural coarse aggregates with recycled aggregates can be visualized through a graph. The results pertaining to compressive strength at the 7th day and 28th day are both presented in Table 4.2 and graphically represented in Figure 8.

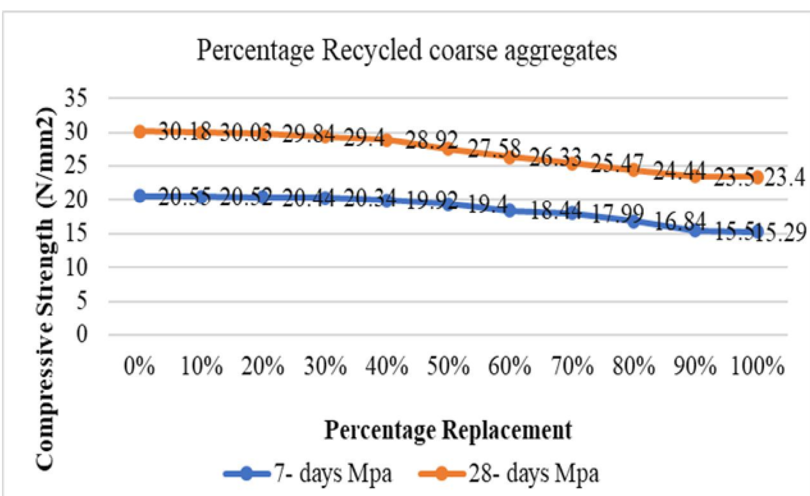


Figure 8: Compressive Strength Variations

The compressive strength test results for M20 grade concrete cubes with varying percentages of Recycled Coarse Aggregates (RCA) at 7 days and 28 days can be interpreted as follows:

1) 0% RCA (Control Mix - M20 Concrete):
- Compressive Strength at 7 days: 20.55 MPa
- Compressive Strength at 28 days: 30.18 MPa

The control mix with no RCA replacement exhibits good early strength at 7 days and further increases in strength at 28 days, which is typical for well-designed M20 concrete.

2) 10% RCA:
- Compressive Strength at 7 days: 20.52 MPa
- Compressive Strength at 28 days: 30.03 MPa

A 10% replacement of coarse aggregates with RCA has a minor effect on compressive strength, with values very close to the control mix at both 7 and 28 days.

3) 20% RCA:
- Compressive Strength at 7 days: 20.44 MPa
- Compressive Strength at 28 days: 29.84 MPa

With a 20% RCA replacement, the concrete still maintains good strength properties, although there is a slight reduction compared to the control mix.

4) 30% RCA:
- Compressive Strength at 7 days: 20.34 MPa
- Compressive Strength at 28 days: 29.4 MPa

At a 30% RCA replacement, the concrete's strength remains acceptable, but there is a gradual decrease in strength, particularly at 28 days.

5) 40% RCA:
- Compressive Strength at 7 days: 19.92 MPa
- Compressive Strength at 28 days: 28.92 MPa

Replacing 40% of the coarse aggregates with RCA leads to a noticeable reduction in compressive strength at both 7 and 28 days. However, the concrete still maintains reasonable strength.

6) 50% RCA:
- Compressive Strength at 7 days: 19.4 MPa
- Compressive Strength at 28 days: 27.58 MPa

At a 50% RCA replacement, the compressive strength continues to decrease, and there is a significant reduction compared to the control mix.

7) 60% RCA:
- Compressive Strength at 7 days: 18.44 MPa
- Compressive Strength at 28 days: 26.33 MPa

With a 60% RCA replacement, the concrete experiences a further decline in strength, which is more pronounced at 28 days.

8) 70% RCA:
- Compressive Strength at 7 days: 17.99 MPa
- Compressive Strength at 28 days: 25.47 MPa

At a 70% RCA replacement, the compressive strength continues to decrease, indicating that the concrete's ability to carry loads is reduced.

9) 80% RCA:
- Compressive Strength at 7 days: 16.84 MPa
- Compressive Strength at 28 days: 24.44 MPa

An 80% RCA replacement results in further reduction in compressive strength, particularly at 28 days.

10) 90% RCA:
- Compressive Strength at 7 days: 15.5 MPa
- Compressive Strength at 28 days: 23.5 MPa

With a 90% RCA replacement, the concrete's strength properties are significantly lower than those of the control mix.

11) 100% RCA:

- Compressive Strength at 7 days: 15.29 MPa
- Compressive Strength at 28 days: 23.4 MPa

A complete replacement of coarse aggregates with RCA leads to the lowest compressive strength values among all the mixes.

In summary, as the percentage of RCA replacement increases, there is a gradual reduction in compressive strength, especially at 28 days. While lower percentages of RCA replacement (up to 30%) have a relatively minor effect on strength, higher percentages result in more significant decreases in strength. Careful consideration and testing are necessary when determining the appropriate RCA replacement percentage for specific construction applications to ensure that the desired concrete strength is achieved.

Conclusion: The compressive strength of concrete made with a coarse aggregate that has been replaced by demolition trash decreases as the proportion of demolition waste aggregates rises. Strength values of concrete cubes made with up to 50% coarse aggregate substitution by destroyed waste aggregates were very similar to those of regular concrete cubes. The concrete's compressive strength precisely achieved 26.58 N/mm2 at a 50% replacement rate, which is very near to the target mean strength of 26.6 N/mm2.

C. Waste Management

Recycled coarse aggregates are incorporated into concrete as a substitute for natural coarse aggregates. Proper disposal of this waste material requires significant space, incurring costs and environmental pollution. The construction industry offers a viable solution for the safe utilization of R.C.A. When used as a substitution substance in concrete, it not only mitigates environmental concerns but also addresses space constraints and reduces concrete production costs. The viability of employing recycled coarse aggregates as a replacement ingredient in concrete has already been proved by several studies. In this experiment, recycled coarse aggregates are used in lieu of natural coarse aggregates in concrete. For this investigation, we have prepared M20-grade concrete and conducted tests for various proportions of coarse aggregate substitution, ranging from 0% to 100%, using demolition waste in conjunction with recycled coarse aggregates.

V. CONCLUSION

This study has contributed to identifying the factors that lead to the substitution of coarse aggregates in concrete with demolished concrete.

1) The current experimental study demonstrates the effective utilization of demolition waste as a viable alternative for partially replacing natural aggregates in the construction sector. This adoption of recycled aggregates in construction not only conserves energy but also reduces the costs associated with the transportation of natural reserves and excavation. Furthermore, this practice directly mitigates the conservational impact of waste materials.
2) Demolished concrete waste, when retained as a replacement for natural coarse aggregates in concrete, can lead to a 50% reduction in the consumption of natural aggregates for M20 grade concrete compared to traditional concrete. This shows to a cost savings of Rs. 340.60 per cubic meter of concrete.
3) Utilizing demolished aggregates concrete as a foundational material for road construction also contributes to a reduction in pollution stemming from the transportation of construction materials. The tests conducted on demolished aggregates have yielded results that align with the standards outlined in IS: 2386, affirming the suitability of this approach.

VI. SCOPE OF FUTURE WORK

It is highly advised to carry out further research and experiments on recycled aggregate concrete, especially to evaluate the strength properties of recycled aggregates for prospective uses in high-strength concrete. Additionally, the following recommendations are provided:

1) *Cost Savings:* Recycling aggregates can lead to significant cost savings for local governments and other buyers.
2) *Business Opportunities:* Recycling initiatives create new business opportunities, promoting economic growth and job creation.
3) *Energy Efficiency:* On-site recycling of aggregates reduces energy consumption compared to transporting materials to recycling facilities.
4) *Resource Conservation:* It helps preserve dwindling reserves of urban aggregates, contributing to sustainable resource management.

REFERENCES

[1] A M. Wagih, Hossam Z. El-KARMOTY, Magda Ebid, Samir H. Okba, "Recycled construction and demolition concrete waste as aggregate for structural concrete", HOUSING and Building National Research Center, 2013.

[2] Aiyewalehinmi E.O., Adeoye T.E., "Recycling Of Concrete Waste Material From Construction Demolition", Volume 2, Issue 10, 2016.

[3] B.Damodhara Reddy, S.Aruna Jyothy, P.Ramesh Babu, "Experimental Investigation on Concrete by Partially Replacement of Ware Aggregate with Junk Rubber", Volume 2, Issue 12, 2013.

[4] construction practices in Australia" ,International High- Performance Built Environment Conference – A Sustainable Built Environment Conference 2016.

[5] D. N. Parekh, C. D. Modhera, "Characterization of Recycled Aggregate Concrete", International Journal of Advanced Engineering Technology, Vol. 2, Issue IV, 2011.

[6] D.V. Prasada Rao, P.L. Sindhu Desai, "Experimental Investigations Of Coarse Aggregate Recycled Concrete", IJAET, Vol. 7, Issue 5,Nov. 2014.

[7] Deng X.H., LU Z.L., LI P., XU T, "An Investigation Of Mechanical Properties Of Recycled Coarse Aggregate Concrete", Archives of civil engineering, Vol. LXII, ISsue 4, Part 2, 2016.

[8] Bassam A. Tayeh, Doha M. Al Saffar, Rayed Alyousef, "The utilization of recycled aggregate in high performance concrete: a review", Journal of material research and technology, Elsevier, 2020.

[9] Esam Hewayde, Alireza Pachenari ,Hussin Al-Eleaj, "Resistance of Recycled Aggregate Concrete (RAC) Subjected to Drying-Wetting Cycles to Attack of Magnesium and Sodium Sulfates", Hindawi, Journal of Engineering, Volume 2020, 9 pages, https://doi.org/10.1155/2020/9746341.

[10] F.R. salehlamein, Mochamad .Solikin, Ir. Sri Sunarjono, "Effect of Recycled Coarse Aggregate on Concrete Properties", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 1, January 2015.

[11] Gargi Kushwah, Kirti Chanadraul, Manindra Kumar singh, "Experimental Study of Recycled Aggregate Concrete", International Journal for Research in Applied Science & Engineering, Volume 4 Issue I, January 2016.

[12] IS 10262:2009 "Guidelines for concrete mix proportioning"

[13] IS 456:2000 "Code of practice for plain and reinforced concrete".

[14] M A Salau, O J Oseafiana, T O Oyegoke," Effects of Elevated Temperature on Concrete with Recycled Coarse Aggregates", 2nd International Conference on Innovative Materials, Structures and Technologies, 2015.

[15] M.Z.I. Bhuiyan, Faisal Hj. Ali, Firas A. salman, "Application of recycled concrete aggregates as alternative granular infills in hollow segmental blocks Systems", ELSEVIER, 2015.

[16] Mirjana Malešev, Vlastimir Radonjanin, Snežana Marinković, "Recycled Concrete as Aggregate for Structural Concrete Production", April 2010.

[17] Mirjana Malešev, Vlastimir Radonjanin, Snežana Marinković, "Recycled Concrete as Aggregate for Structural Concrete Production", Open Access Journal MDPI, April 2010.

[18] Prakash Somani, Brahmtosh Dubey, Lavkesh Yadav, Jitendra Kumar, Abhishek kumar, "Use of demolished concrete waste in partial replacement of coarse aggregate in concrete", SSRG International Journal of Civil Engineering, Volume 3, Issue 5, May 2016.

[19] Preethy K Thomas, Binu M Issac, Deepak John Peter," Assessment Of Demolished Concrete As Coarse Aggregate In Geopolymer Concrete", International Journal of Advance Research and Engineering, Vol. 4, Issue 1, Sep 2015.

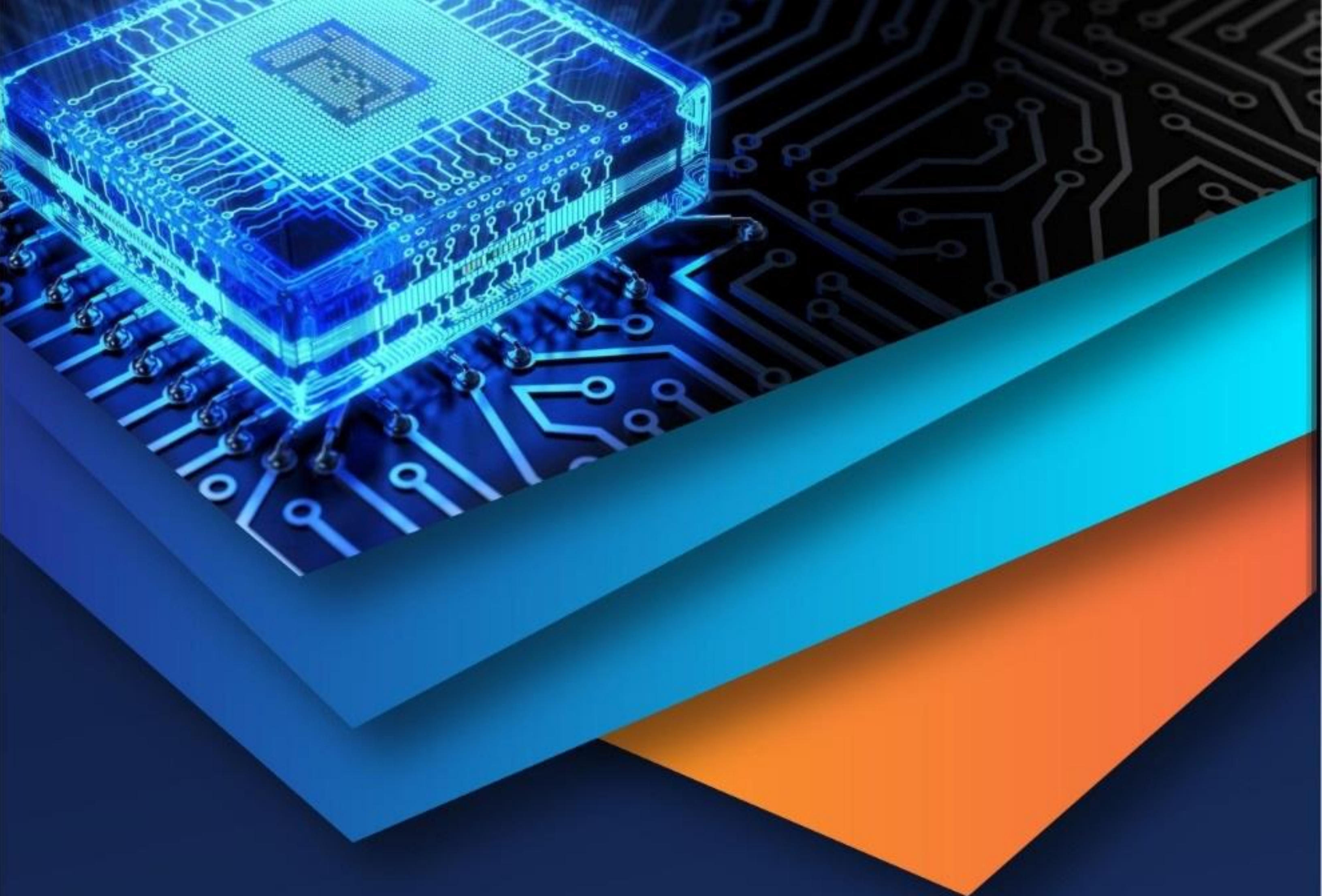
[20] Rajesh Kumar Jain, "Investigation of some Technical Properties of Recycled Materials",Volume XIV Issue VII, 2014.

[21] Roz-Ud-Din Nassar, Parviz Soroushian, "Strength and durability of recycled aggregate concrete containing milled glass as partial replacement for cement", Elsevier, 2012.

[22] S. Muneera, A. Rupa, "Use of Recycled Aggregate in Concrete", International Journal of Science and Research (IJSR), 2013.

[23] S. Muthu Lakshmi, R. R. Nivedhitha, "Effect Of Partial Replacement Of Aggregates By Recycled Concrete Debris On Strength Of Concrete", Malaysian Journal of Civil Engineering, 2015.

[24] Salahuddin S.S.M., M. A.Raoof, S.H.Mohd Kabeer, "Experimental Investigation On Concrete By Partial Replacing Of Coarse Aggregate With Recycled Coarse Aggregate And Fine Aggregate With Crushed Glass", Volume: 04, Issue: 04, Apr -2017.



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