International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Experimental Study of Demolished Aggregate on Concrete

Shivam Agrawal,Rahul Sharma

M. Tech Scholar, Department of Civil Engineering, Prashanti Institute Of Technology & Science, M.P.,

Assistant Professor, Department of Civil Engineering, Prashanti Institute Of Technology & Science, M.P.,

Abstract

Concrete is widely employed as a primary construction material worldwide. It consists of elements that naturally occur in the environment, leading to a gradual depletion of these resources. To address this shortage, numerous research efforts have explored the utilization of various waste materials to partially replace cement, fine aggregates, and coarse aggregates in concrete production. Incorporating these waste materials not only aids in environmental conservation by reducing landfill waste, but also contributes to sustainable construction practices.

This study focuses on examining the properties of fresh and cured concrete when a portion of coarse aggregate is replaced with demolished aggregate. The outcomes of the investigation demonstrated that the optimal replacement percentage for Demolished Aggregate was identified as 35%. Subsequently, a concrete mix incorporating 35% demolished aggregate as a partial replacement was formulated, tested, and evaluated. The compressive strength of the mix after 28 days exhibited a 0.57% increase compared to the traditional mix. Similar trends were observed in the split tensile strength and flexural strength of the mixture, mirroring the improvements seen in compressive strength.

These findings suggest that incorporating demolished aggregates as replacements in suitable proportions can yield concrete with strength characteristics comparable to conventional mixes. Furthermore, utilizing the optimal replacement percentages for demolished aggregate is not only environmentally beneficial, but also economically advantageous, with potential cost savings of approximately 12% compared to the original mix..

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Introduction

Concrete, undoubtedly one of the most vital construction materials, has played an indelible role in shaping the built environment of our world. Its widespread use in infrastructure and building projects has led to the constant quest for enhancing its properties and performance. With the increasing demand for construction materials and the environmental concerns associated with their production, it has become imperative to explore sustainable alternatives that not only maintain or improve concrete's performance but also minimize its ecological footprint. One promising avenue in this pursuit is the partial replacement of conventional coarse aggregates with alternative materials, such as demolished aggregates.

The depletion of natural resources and the generation of vast amounts of construction and demolition waste have spurred a global initiative to develop eco-friendly construction practices. Demolished aggregates, which are produced by recycling concrete waste obtained from demolition sites, present a compelling solution. Integrating such recycled materials into concrete production not only reduces the burden on natural resources but also mitigates the environmental impact associated with the disposal of construction waste. Moreover, this approach aligns with the principles of a circular economy, wherein materials are continuously recycled, reducing the demand for virgin resources and curbing waste generation.

Figure 1 Demolished Aggregates Used in Study

Objectives of the project:

This study centers on establishing an environmentally sustainable framework by mitigating the impact of waste materials stemming from industrial and domestic sources. Additionally, it endeavors to address

waste management challenges and minimize environmental pollution. Furthermore, this research endeavors to contribute to cost-effective concrete construction by harnessing the potential of waste materials.

Following are the objectives of this study:

- To find out the effect on strength of concrete by partially replacing coarse aggregates with demolished aggregates.
- To find out the effect on strength of concrete by using optimum percentage of demolished aggregate as substitutes.
- Evaluation of percentage saving of cost in concrete construction.

Result & Discussions

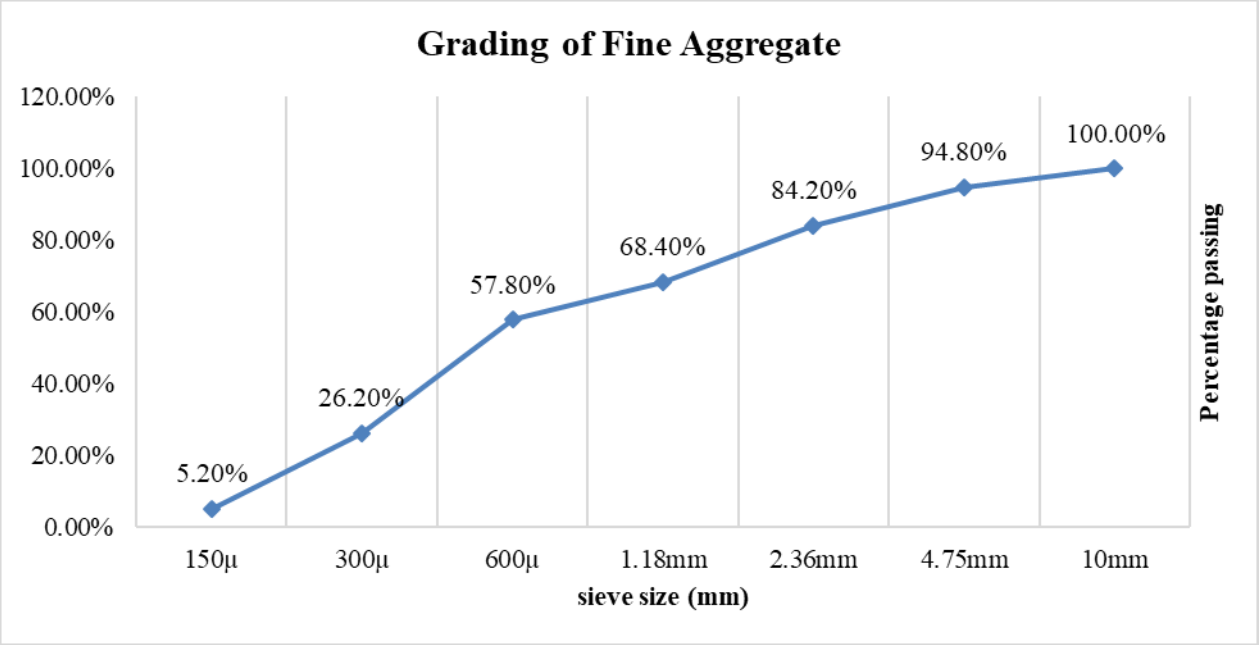

Figure 2 Grading of fine aggregate

Table 1 Test results of coarse aggregate

Test	Result of coarse aggregate	Result of demolished aggregate	IS Code	Permissible limits
Specific gravity	2.91	2.38	IS 2386 part 3	2.5-3

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Water absorption	0.61 %	3.82%	IS 2386 part 3	0.1-2%
Aggregate crushing value	21.9%	28.6%	IS 2386 part 4	Not exceed 30%
Aggregate impact value	18.02%	16.35%	IS 2386 part 4	Not exceed 30%
Aggregate Abrasion value	20.2%	29.39%	IS 2386 part 4	Not exceed 16%
Density	1743.2 kg/m^3	1492 kg/m^3	-	1450 – 2082 kg/m^3

Table 2 Grading of 20 mm aggregate

Sieve	Weight Retained (grams)	% Retained	Cumulative % Retained	% Passing
40mm	0	0%	0%	100.0%
20mm	2610	26%	26%	73.9%
10mm	6980	70%	96%	4.1%
4.75mm	410	4%	100%	0.0%
Total	10000			

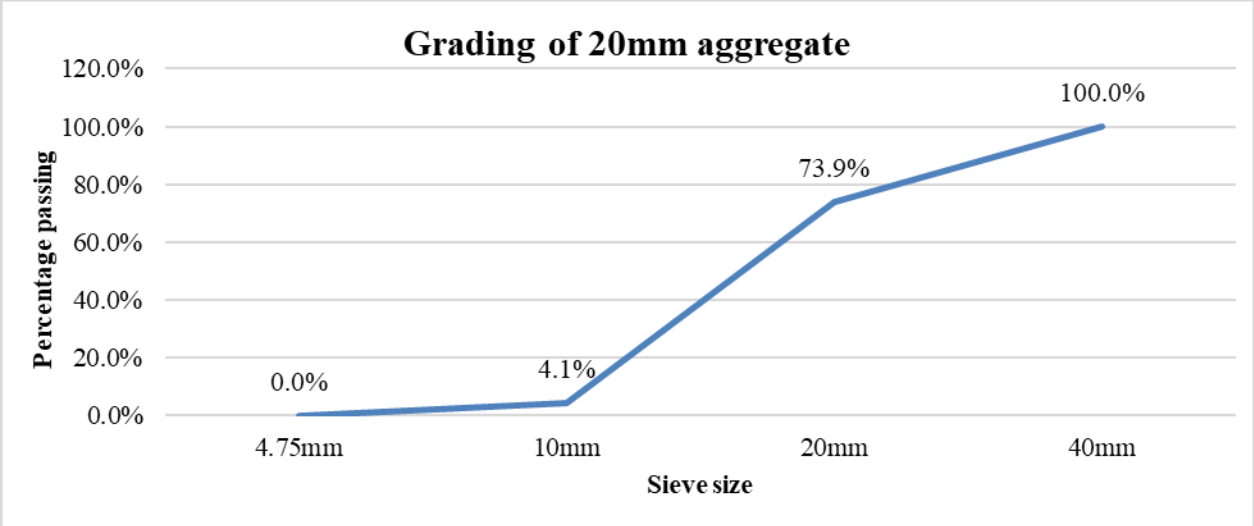

Figure 3 Grading of 20mm aggregate

Table 3 Grading of 10 mm aggregate

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Sieve	Weight Retained (grams)	% Retained	Cumulative % Retained	% Passing
20mm	0	0%	0%	100.00%
10mm	590	12%	12%	88.20%
4.75mm	4096	82%	94%	6.28%
2.36mm	145	3%	97%	3.38%
pan	169	3%	100%	0.00%
Total	5000			

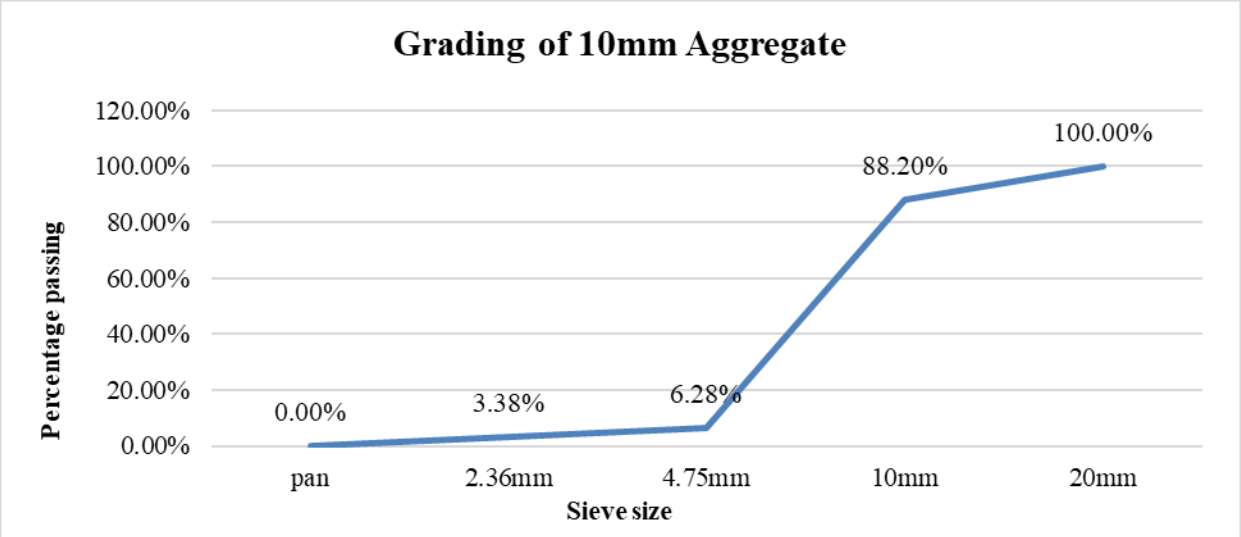

Figure 4 Grading of 10mm aggregate

Table 4 Grading of mixed aggregate

Sieve Size	Aggregate Size		Blended Aggregate	Desired Proportion
	20mm (50%)	10mm (50%)		
40mm	100.0%	100.00%	100.00%	100
20mm	73.9%	100.00%	86.95%	90 to 100
10mm	4.1%	88.20%	46.15%	25 to 55

4.75mm	0	6.28%	3.14%	0 to 10

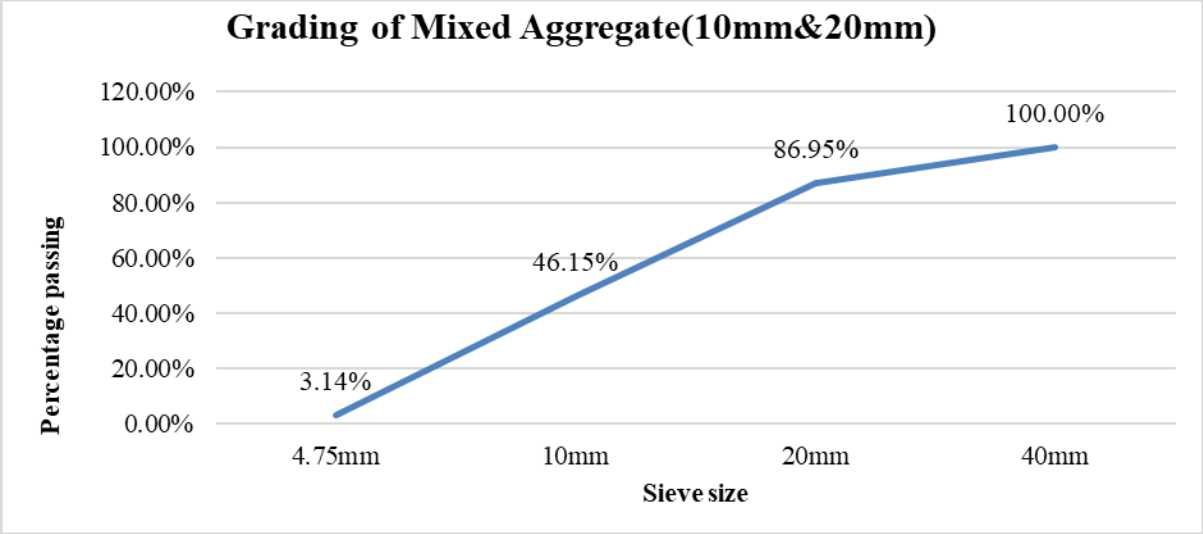

Figure 5 Grading of mixed aggregate 10mm and 20mm

Table 5 Grading of fine and coarse aggregate

Sieve size	Aggregate	Sand	Blended Proportion	Desired Proportion
40mm	100.00%	100.00%	100.00%	100
20mm	86.95%	100.00%	91.39%	95 to 100
4.75mm	3%	94.80%	34.30%	30 to 50
600µ	0%	57.80%	19.65%	10 to 35
150µ	0%	5.20%	1.77%	0 to 6

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

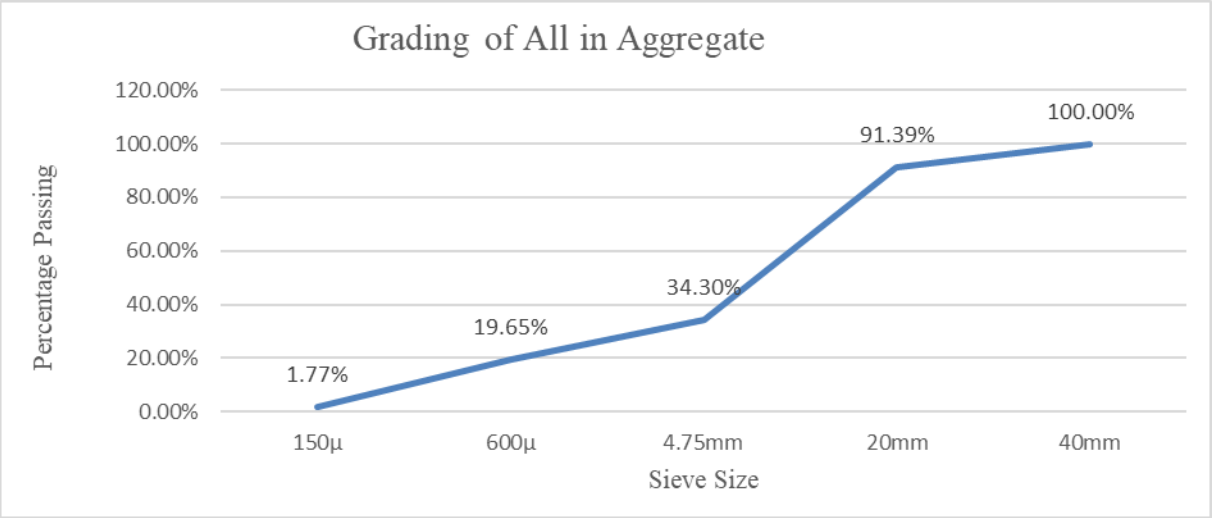

Figure 6 Grading of all aggregate

Table 6 Grading of demolished aggregate

sieve size	weight retained	% weight retained	%cum. weight retained	%passing	Desired Proportion
40mm	0	0.00	0.00	100.00	100
20mm	45	9.00	9.00	91.00	90 to 100
10mm	306	61.20	70.20	29.80	25 to 55
4.75mm	149	29.80	100.00	0.00	0 to 10
Total weight	500				

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

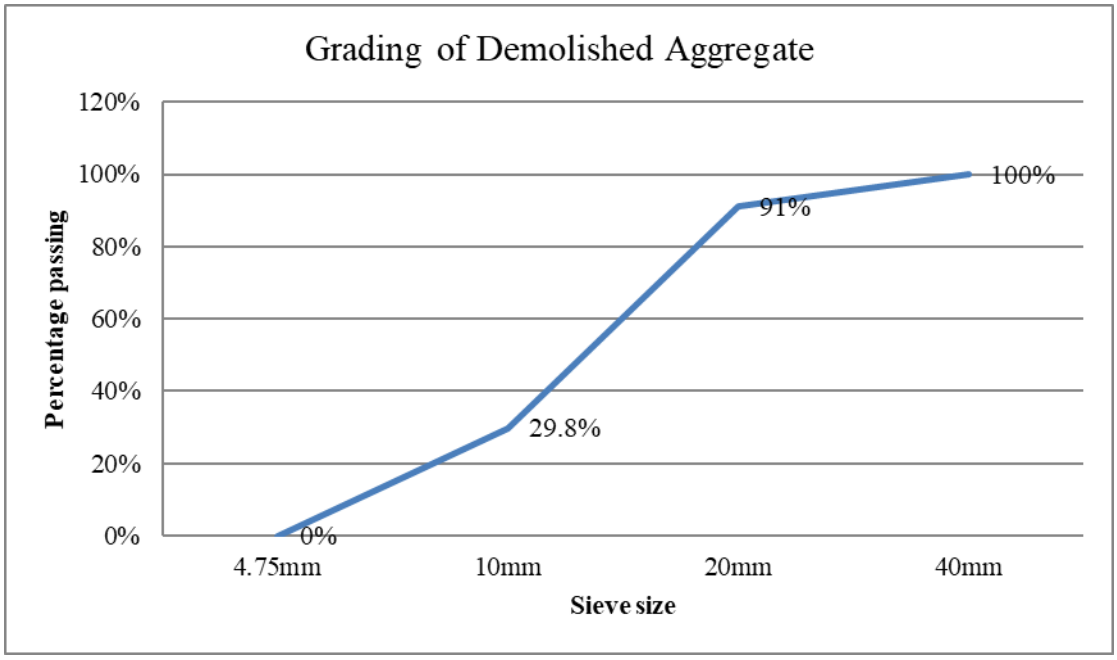

Figure 7 Grading of demolished aggregate

Tests on Concrete

Four primary tests are conducted on concrete specimens:

1. Workability test (slump cone test)

2. Compressive strength test

3. Flexural strength test

4. Split Tensile strength test

Following test results of concrete are discuss below-

.

Table 7 Compressive Strength of concrete with coarse aggregate replacement by demolished aggregate

Type of mix	% Replacement of	Compressive Strength (N/mm^2)

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

	Coarse aggregate by Demolished aggregate		
		7 days	28 days
C	0 %	22.89	36.83
R1	20%	21.43	33.51
R2	35%	19.23	31.02
R3	50%	17.06	28.39

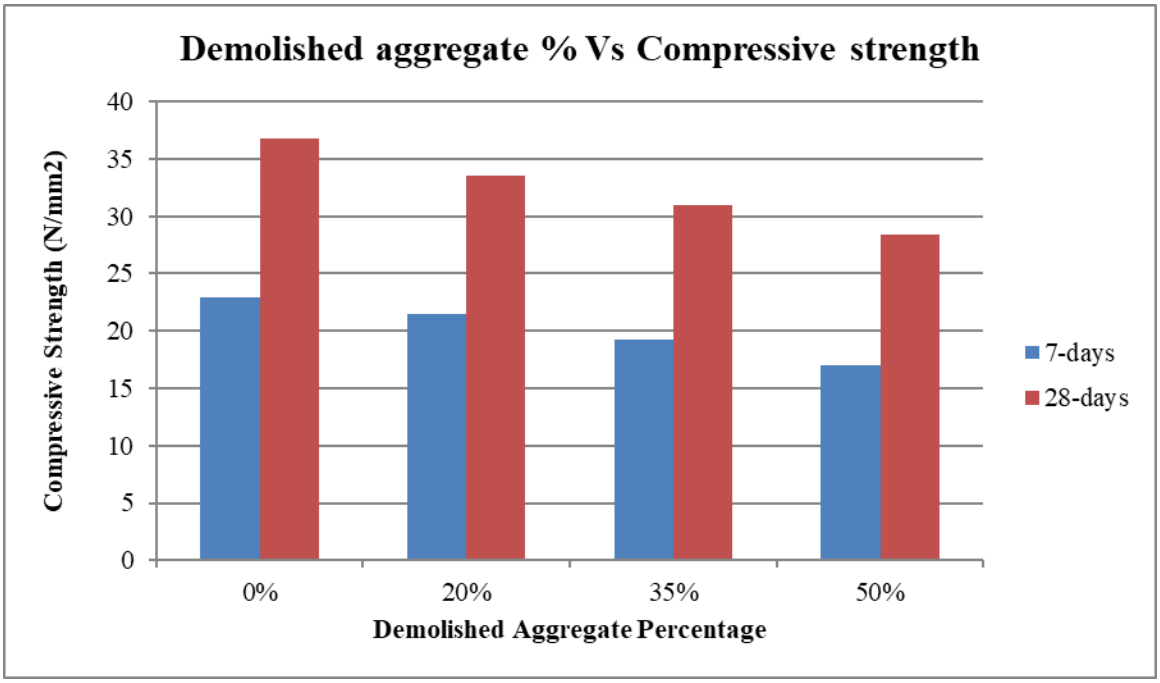

Figure 8: 7 days and 28 days compressive strength at varying percentage of demolished aggregate

Table 8 Flexural Strength of concrete with coarse aggregate replacement by demolished aggregate

Type of mix	% Replacement of Coarse aggregate by Demolished aggregate	Flexural Strength (N/mm^2)	
		7 days	28 days
C	0 %	2.48	3.94
R1	20%	2.86	4.13
R2	35%	2.92	4.28
R3	50%	2.23	3.49

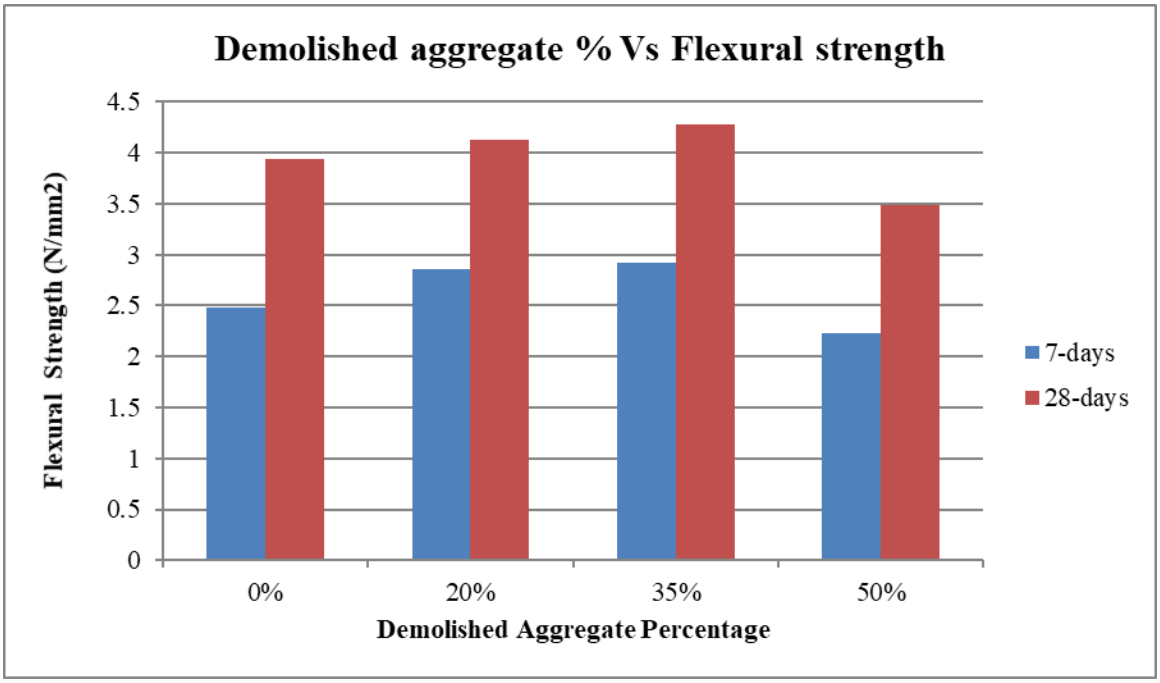

Figure 9: 7 days and 28 days flexural strength at varying percentage of demolished aggregate

Table 9 Split Tensile Strength of concrete with coarse aggregate replacement by demolished aggregate

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Type of mix	% replacement of Coarse aggregate by Demolished aggregate	Split tensile Strength (N/mm^2)	
		7 days	28 days
C	0 %	2.09	3.18
R1	20%	1.93	2.94
R2	35%	1.82	2.86
R3	50%	1.70	2.75

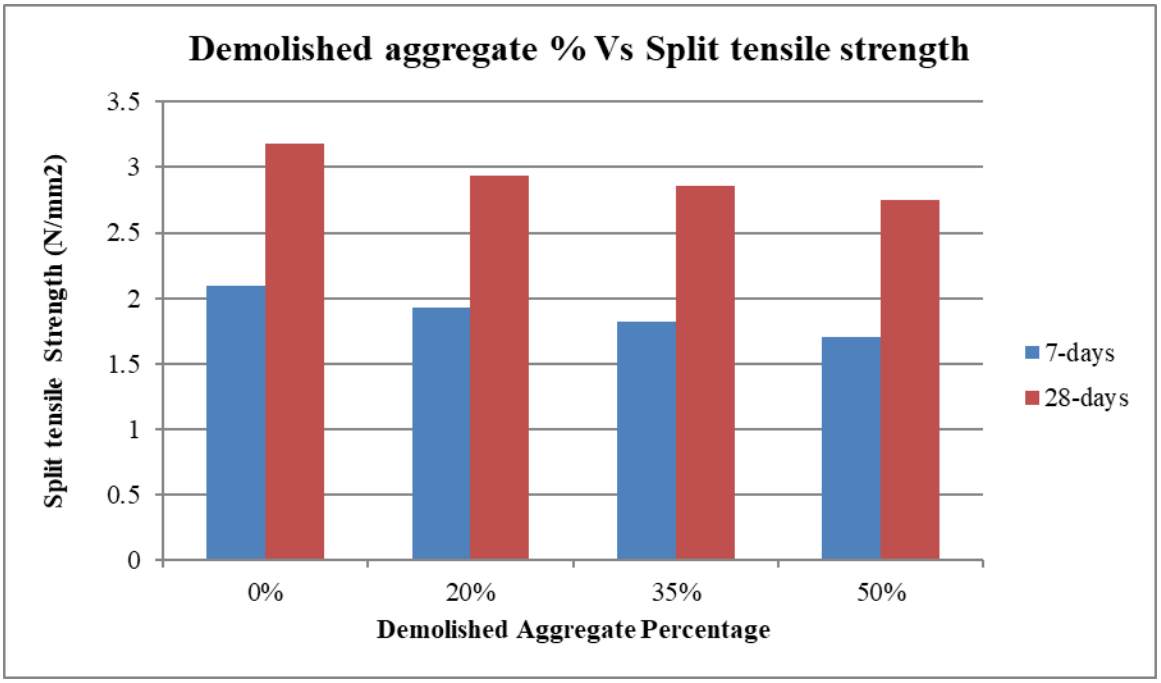

Figure 10: 7 days and 28 days split tensile strength at varying percentage of demolished aggregate

Table 10 Value of slump for different concrete mix

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Type of mix	% Replacement of Coarse aggregate by Demolished aggregate	Slump value (mm)
C	0	78
R1	20	65
R2	35	60
R3	50	52

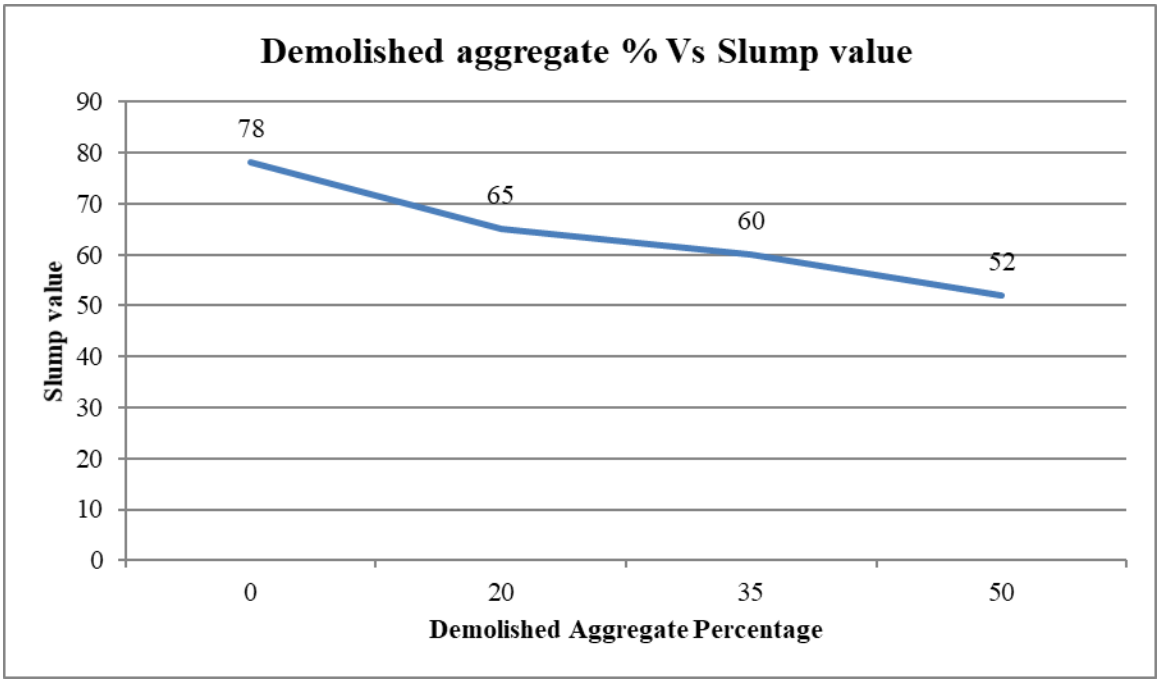

Figure 11 Slump value at varying percentage of demolished aggregate

Conclusions

From the experiment, following conclusions can be drawn:

- The workability of concrete, when replaced partially with demolished aggregate for coarse aggregate, tends to decrease. This can be attributed to the old mortar present on the demolished aggregate, which exhibits high water absorption and low specific gravity.

- Substituting coarse aggregate with demolished aggregate results in a decrease in the compressive strength of the concrete.

- Nevertheless, the strength achieved with a 35% replacement of demolished aggregate meets the minimum strength requirement for M30 grade concrete, which is 30MPa. Thus, an optimal replacement percentage of 35% can be concluded.

- The split tensile strength and flexural strength of the concrete also witness reduction with an increase in the replacement of coarse aggregate by demolished aggregate. The concrete's strength with demolished aggregate incorporation is somewhat linked to the grade of the initial concrete from which the demolished aggregate is sourced.

- The drop-in strength can be attributed to the presence of pre-existing mortar coating on the demolished aggregate, causing weaker cement-aggregate bonding.

- Ultimately, the comprehensive cost after a 35% replacement totals 3547.86₹, reflecting a 12.05% cost reduction compared to the initial expense.

REPLACEMENT OF COARSE AGGREGATE WITH DEMOLISHED AGGREGATE IS POSSIBLE WHEN THE STRENGTH STANDARDS ARE MET. AS A RESULT, IT CAN BE STATED THAT USING DEMOLISHED AGGREGATE AS COARSE AGGREGATE IN CONCRETE IS ADVISED TO SOME EXTENT.

REFERENCES

1. IS:10262(2019).*ConcreteMixProportioning-Guidelines.*NewDelhi:BureauofIndianStandards.https://civiconcepts.com/wp-content/uploads/2020/11/4.IS-10262-2019-New-Mix-design.pdf

2. IS:1199 (1959). *Methods of Sampling and Analysis of Concrete.* New Delhi: Bureau of IndianStandards.

3. IS:2386 (1963). *Methods of Test For Aggregate For Concrete.* New Delhi: Indian StandardsInstitution.https://law.resource.org/pub/in/bis/S03/is.2386.5.1963.pdf.

4. IS:383(2016).*CoarseandFineAggregatesforConcrete-Specification*.BUREAUOFINDIANSTANDARDS.http://skgcgroup.com/wp-content/uploads/2020/02/IS%20383-2016.pdf.

5. IS:516 (1959) *Methods of Tests For Strength of Concrete*.New Delhi: Bureau of IndianStandards.

6. IS:5816 (1999) *Splitting Tensile Strength Of Concrete-Method of Test.* New Delhi: Bureau OfIndianStandards. https://www.iitk.ac.in/ce/test/IS-codes/is.5816.1999.pdf.

7. IS:8112 (2013) *Ordinary PortlandCement, 43 Grade— Specification* Bureau Of IndianStandards.https://www.iitk.ac.in/ce/test/IS-codes/is.8112.2013.pdf.

8. Abishek Kumar A. A, Eveena Stephen, Merin George, Ansafmuhammad, Naveen Charles.2020.*EvaluationofStrengthandDurabilityPropertiesforVariousAmountofBacillusSubtilisBacteria in Concrete*. International Journal of Engineering Research & Technology (IJERT)548-551.http://www.ijert.org.

9. Aditya Tadimeti, Jeff Sutton. 2020. *The Effects of Different Aquatic Environments on the Rateof Polyethylene Biodegradation by Bacillus subtilis*. Journal of Emerging Investigators ll: 1-7.www.emerginginvestigators.org.

10. Ahirwar, Sunil, Pratiksha Malviya,Vikash Patidar, and Vikash KumarSingh. 2016.*"AnExperimentalStudyonConcretebyusingEWasteaspartialReplacementforCourseAggregate*." IJSTE - International Journal of Science Technology & Engineering | Volume 3 |Issue047-13.www.ijste.org.

11. Balde,C.P,Forti,Kuehr,andStegmann.2017.*TheGlobalE-WasteMonitor2017*.Bonn/Geneva/Vienna:UnitedNationsUniversity (UNU),InternationalTelecommunicationUnion(ITU)&InternationalSolidWa

steAssociation(ISWA).https://www.itu.int/en/ITU-D/Climate-Change/Documents/GEM%202017/Global-E-Waste%20Monitor%202017%20.pdf.

12. Bennett, Natalie. 2021. *Twitter*. june 29. https://twitter.com/natalieben/status/1409902839434973184.

13. C. Manvith Kumar Reddy, B. Ramesh, Macrin D, Kanthreddy. 2020. "*Influence of bacteriaBacillus subtilis and its effects on flexural strength of concrete*." Materials Today: Proceedings1-6.doi:https://doi.org/10.1016/j.matpr.2020.07.225.

14. 2019-20.*CentralPollutionControlBoardAnnualReport*.Delhi,India:MinistryofEnvironment, Forest & Climate Change.https://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXMvMTI0M18xNjE2NTYxOTAxX21lZGlhcGhvdG8xMTgzNi5wZGY=.

15. 2021.*CentralPublicWorksDepartment*.Delhi:GovernmentofIndia.https://cpwd.gov.in/Publication/DSR_2021_VOL_I_ENGLISH_Dir.pdf.

16. 2021. *Children and digital dumpsites: E-Waste exposure and child health.* Geneva: WorldHealthOrganization.file:///C:/Users/91942/Downloads/9789240023901-eng.pdf.

17. 2016.*CNNInternational*.February 5.https://edition.cnn.com/2016/02/05/asia/gallery/mumbai-deonar-garbage-dump/index.html.

18. Dawande, Bharat, Devansh Jain, and Gyanendra Singh. 2015. "*Utilization of E-Waste as aPartial Replacement of Coarse Aggregate in Concrete*." International Journal for ScientificResearch &Development6-9.www.ijsrd.com.

19. F. Khademi, K. Behfarnia. 2016. *"evaluation of concrete compressive strength using artificialneuralnetworkandmultiplelinearregressionmodels."*internationaljournalofoptimizationincivilengineering423-432. https://www.researchgate.net/publication/297532369.

20. Forti, Vanessa, Cornelis peter Balde, Ruediger Kuehr, and Garam Bel. 2020. *The Global E-*

WasteMonitor2020.Rotterdam:WorldHealthOrganization,1-120.http://ewastemonitor.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020-1.pdf.

21. Gavhane, Aditya, Dinesh Sutar, Shubham Soni, and Praveen Patil. 2016. "*Utilisation of E -Plastic Waste in Concrete*." International Journal of Engineering Research & Technology 594-601.http://www.ijert.org.

22. HenkM.Jonkers,ErikSchlangen.2008."*Developmentofabacteria-basedselfhealingconcrete."TailorMadeConcreteStructures*–Walraven&Stoelhorst425-430.https://www.researchgate.net/publication/267716612.

23. 2018."IndiaEnvironmentPortal."*http://www.indiaenvironmentportal.org.in/*. March22.http://www.indiaenvironmentportal.org.in/files/file/E-%20Waste%20(Managment)%20Amendment%20%20Rules,%202018.pdf.

24. 2021.*InternationalE-Wasteday14October2021*.October14.https://weee-forum.org/iewd-about/.

25. jogi,PavanKumar,andT.V.SVaraLaxmi.2021."*Selfhealingconcretebasedondifferentbacteria: A review*." MaterialsToday Proceedings 1246-1252.