International Journal of advancement in electronics and computer engineering (IJAECE)
Volume 14, Issue 12, Dec. 2025, pp.137-139, ISSN 2278 -1412

THE EXPERIMENTAL STUDY OF RIVER SAND FILTER TO THE PARTIAL REPLACEMENT OF SAND TO FINE SILICA FUME

Abhishek Payasi [1], Vivek Soni[2], Arpit Saxena[3]
[1]M. Tech Scholar, Dept. of Civil, RCE, Bhopal M.P., India
[2]Asso. Prof., Dept. of Civil, RCE, Bhopal M.P., India
[3]Assi. Prof., Dept. of Civil, RCE, Bhopal M.P., India

Abstract *– The use of alternative materials in geotechnical applications is gaining attention due to environmental and economic concerns. One such material, Recycled Concrete Aggregate (RCA), has emerged as a potential substitute for natural aggregates in earth dam filters. RCA, derived from demolished concrete structures, offers sustainable benefits by reducing construction waste and minimizing the extraction of virgin aggregates. This study investigates the feasibility of using RCA as a filter material in earth dams by evaluating its permeability, grain size distribution, hydraulic performance, and long term durability. A key concern in using RCA for filtration is its ability to meet conventional filter design criteria, including adequate permeability and particle stability to prevent clogging or excessive migration of fines. Laboratory testing and field trials have been conducted to compare RCA's performance with traditional aggregates in terms of gradation, porosity, and durability under different hydraulic conditions. Results indicate that well processed RCA can exhibit comparable or even superior filtration properties, making it a viable alternative for sustainable dam construction.*

Keywords*: Recycled Concrete Aggregate (RCA), Earth Dam Filters, Sustainable Construction, Hydraulic Performance, Permeability, Filtration Criteria, Grain Size Distribution, Porosity, Durability*

I. Introduction

Earth dams are essential infrastructure for water storage, irrigation, flood control, and hydropower generation. Traditionally, the construction of earth dams relies heavily on natural materials such as clay, sand, gravel, and stone to form the core, filter layers, and protective shells. However, the extraction and transportation of these materials have significant environmental and economic impacts. As climate change and resource scarcity become pressing global concerns, sustainable development practices are gaining momentum in the construction industry. Earth dam projects are no exception, and there is growing interest in adopting sustainable material sourcing strategies to minimize the environmental footprint of these large scale projects.

II. Literature Review

Kumar et al. (2023) : Sustainable Materials explored the use of alternative materials, such as (RCA) recycled aggregates, in sand and gravel filters.

Their results showed that crushed concrete aggregates could be an effective replacement for natural gravel in filter layers, with comparable performance in terms of permeability and particle retention. This research supports the growing trend of incorporating sustainable and recycled materials in dam construction.

III. Proposed Methodology

Constructing The application of Recycled Concrete Aggregate (RCA) as a filter material in earth dam construction requires a comprehensive and systematic methodology to ensure its suitability for seepage control, prevention of soil migration, and long-term structural stability of the dam. The proposed methodology consists of material selection, laboratory evaluation, filter design, and implementation procedures, as detailed below.

i. Laboratory Testing of RCA Properties

Prior to its use as a filter material, RCA must undergo extensive laboratory testing to evaluate its physical, mechanical, hydraulic, and chemical properties. These tests are essential to confirm compliance with standard filter requirements and to assess the long-term performance of RCA in dam environments.

a) Grain Size Distribution Analysis

Sieve analysis is conducted to determine the particle size distribution of the RCA. The obtained gradation curve is compared with the gradation of the base soil to ensure compatibility and adherence to established filter design criteria. Proper gradation is critical to prevent the migration of fine soil particles while allowing adequate water flow through the filter layer.

b) Permeability Testing

Permeability tests, such as constant head or falling head tests, are performed to evaluate the hydraulic conductivity of RCA. The objective is to ensure that the filter material permits controlled seepage without causing excessive pore water pressure buildup. The permeability of RCA should be significantly higher than that of the base soil to maintain effective drainage.

c) Strength and Durability Assessment

Mechanical strength and durability of RCA are assessed using standardized tests, including the Los Angeles Abrasion Test, aggregate crushing value test, and water absorption test. These tests evaluate the resistance of RCA to wear, crushing, and degradation under loading and repeated wetting–drying cycles, thereby ensuring long-term stability and performance within the dam structure.

d) Chemical Stability Evaluation

Chemical tests, including pH measurement and sulfate content analysis, are conducted to assess the chemical stability of RCA. These tests ensure that the material does not contain or release harmful compounds that could lead to chemical reactions, material degradation, or adverse effects on adjacent soils and structural components of the dam.

ii. Design of the Filter Layer

The design of the RCA filter layer is carried out in accordance with established geotechnical filter design principles to ensure effective soil retention and hydraulic performance.

a) Gradation Criteria

The RCA filter material must satisfy recognized filter design criteria, such as Terzaghi's filter rules or the US Army Corps of Engineers (USACE) guidelines. These criteria govern the relationship between the particle sizes of the filter material and the base soil to prevent internal erosion while maintaining adequate permeability. The design ensures that fine particles from the base soil are retained, while water is allowed to pass freely through the filter layer.

IV. Conclusion

Lateral displacement profiles are plotted for all cases on a single graph, showing the displacement at each story level versus the building height.

These profiles provide a clear visual comparison of how different structural configurations and slopes affect displacement.

The bare frame building (zero slope) experiences the maximum lateral displacement**,** indicating its higher vulnerability to lateral forces due to the lack of additional stiffness mechanisms like shear walls or sloped designs.

Among all cases, Case 1 **(**bare frame, zero slope**)** exhibits the highest displacement**,** highlighting the significance of structural reinforcements.

Story Drift

Story drift refers to the relative lateral displacement between two successive floors of a structure due to horizontal powers, for example, those brought about by wind or tremors. It is a critical parameter in structural engineering and earthquake-resistant design, as excessive story drift can compromise the stability and safety of a building. Story drift affects the building's deformation, particularly the non-structural components such as walls, partitions, and facades, which are vulnerable to excessive displacement. Excessive story drift can cause damage to structural members, including beams and columns, and may lead to the collapse of the structure. Excessive story drift can cause damage to structural members, including beams and columns, and may lead to the collapse of the structure.

References

[1]. Nandini Naresh Raut1, Nimish Patankar2, Prof. Pallavi Nikhil Bhende "Seismic analysis of multi-storey Building on Sloping grounds with different earthquake resisting echnique using ETABS" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395- 0056 Volume: 11 Issue: 04 | Apr 2024 www.irjet.net p-ISSN: 2395-0072.

[2]. Darshan Ramachandra Todkar 1, U.R. Awari "Study of wind loads on RC building resting on sloping ground" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 11 Issue: 05 | May 2024. www.irjet.net p-ISSN: 2395-0072

[3]. Rizwan Khan , Dr. Samyak Parekar "Effect of Wind on Building Frame Resting on Sloping Ground and Analysis using ETABS" International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 11 Issue V May 2023- Available at **www.ijraset.com.**

[4]. Manduskar, S. and Shingade, V.S., 2023. Effect of wind on RC structure resting on sloping ground and analysis done using ETABS software. World Journal of Advanced Engineering Technology and Sciences, 9(1), pp.193-202.

[5]. Khan, M.K.S.K.I. and Suthar, M.A., 2023. Analysis of Wind Load Effects on RC Structure Resting on Flat and Sloping Ground by Using E- tabs.

[6]. Sivananthan, P., Selvan, S.S., Srinivasan, S.K., Gurupatham, B.G.A. and Roy, K., 2023. Influence of Infill on Reinforced

Concrete Frame Resting on Slopes under Lateral Loading. Buildings, 13(2), p.289.

[7]. Jarapala, R. and Menon, A., 2023. Seismic performance of reinforced concrete buildings on hill slopes: a review. Journal of The Institution of Engineers (India): Series A, **104(3), pp.721-**