



Request for Proposal

Use of Recycled Materials as Mechanically Stabilized Earth (MSE) Retaining Wall Reinforced Backfills

Problem Statement: To ensure long-term integrity of MSE walls, reinforced backfills consisting predominantly of coarse-grained materials have been recommended and used. This limitation on material type can significantly increase the cost of construction on some projects because of the cost of transporting select material to the construction site when local select fill is not available. At the same time, industrial operations and construction activities create coarse-grained materials that must be disposed. Again, producers of such materials must pay transportation costs, as well as disposal fees, to discard these materials. One solution is to recycle these materials and use them as alternative reinforced backfill. Throughout the U.S., substantial amounts of recycled asphalt pavement (RAP) and recycled concrete aggregate (RCA) are being produced through reconstruction activities as well as granular industrial byproducts such as foundry sand/slag, bottom ash, and iron/steel slag. If these materials were used as reinforced backfill for MSE walls, transportation and disposal costs for these materials could be greatly reduced, translating into significant savings for state departments of transportation. Furthermore, such activities would promote sustainable construction, preserve natural resources, and reduce carbon footprint and landfill disposal in highway construction. There are reports of the use of these materials as reinforced backfill as well as research on their properties relevant to reinforced backfill requirements. Further focused research of recycled materials needs to be done to determine if their use as MSE wall reinforced backfill is considered suitable for a more sustainable and potentially economical design and develop design and construction recommendations.

Background: Coarse-grained recycled materials can come from construction operations (e.g., recycled concrete aggregate, recycled asphalt pavement) or from industries (e.g. foundry sand/slag, bottom ash, iron/steel slag). Traditional sources for MSE wall reinforced backfill such as from crushed rock quarries and gravel pits can be costly and environmentally not desirable. The use of recycled materials would be a potentially cheaper and environmentally beneficial source of reinforced backfill material than traditional sources. However, their suitability and limitations have to be assessed. Various properties of recycled materials (e.g., internal and interface frictional strength, hydraulic conductivity, pullout resistance, durability, creep potential, and corrosivity) need to be investigated. Previous research has shown that RCA is judged as an adequate reinforced backfill for MSE walls, although its marginal hydraulic conductivity requires additional drainage to be provided behind walls and its high pH may need to be kept under consideration. RAP provides good drainage, however, it displays potential for deviatoric creep and thermal sensitivity due to its asphalt content, requiring more attention as reinforced backfill for MSE walls for long-term applications. Similarly, foundry sand/slag, bottom ash, and iron/steel slag have suitable frictional and drainage properties. All of these materials, when compacted, display a friction angle in excess of 34° typically required for MSE reinforced backfill. However, secondary issues such as compatibility with metallic and geosynthetic reinforcement, drainage, creep potential, and interface frictional behavior require more scrutiny.



Research Objectives:

Phase I

- Conduct a thorough literature survey to identify reported relevant properties for suitability of these recycled materials for use as MSE wall backfills (e.g., internal and interface frictional strength, hydraulic conductivity, pullout resistance, creep potential, durability, compatibility with various types of reinforcement).
- Develop an inventory of reinforced backfill applications of recycled materials and their field behavior and potential limitations.
- Based on the findings of the literature survey, conduct necessary experimental research and the relevant analyses to close any knowledge gaps with emphasis on the lesser-known aspects such as compatibility with reinforcement, creep potential, drainage, and environmental durability to develop a matrix of where these materials can be used based on the limitations identified in the research. Identify appropriate index properties of the recycled materials (e.g., grain size characteristics, pH, electrical resistivity, asphalt content, etc.) to assist with appropriate use as reinforced backfill in conjunction with various types of reinforcement (e.g., metallic, geosynthetic).
- Identify project wall(s) that will use one or more of the recycled granular materials considered to monitor by contacting state and private entities or a sponsoring agency of RMRC for the next field phase of this project (Phase II: Field Work under a separate project is not part of this scope). Implementation: The results of the study would alter design guidance given in the AASHTO LRFD bridge design specifications, FDM, CMM and Standard Specifications. Provide implementation recommendations for consideration by the States.