Geotechnical Evaluation and Sustainable Resource Management in Construction Projects Along Gabral River, Swat District

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The assessment of geotechnical properties and alkali-aggregate reactivity (AAR) in rock outcrops and borrow areas is vital for construction projects, ensuring material suitability and long-term durability. This study focuses on evaluating the petrographic examination and physico-mechanical properties of materials along the Gabral River in the Swat District, Pakistan, to determine AAR susceptibility. Various composite rocks, including diorites, granites, pyroxene granulites, garnet granulites, quartzites, slates, and green stones, were analyzed from borrow areas along the Gabral River. Through field and laboratory tests, their suitability for construction purposes was assessed. For coarse aggregates, two borrow areas, two quarry sites, and eight rock outcrops were identified. Similarly, two borrow areas were identified for fine aggregates. Petrographic analysis revealed a significant amount of deleterious content in the construction materials currently sourced for Kalam's construction activities, necessitating the use of slag cement for concrete production. However, important physico-mechanical parameters fell within permissible ranges according to international standards. The abundant alluvium present in the Gabral River, comprising sandy gravel with cobbles and boulders, was found suitable for use as coarse aggregates after appropriate processing. Sustainable management of industrial materials sourced from the river and its tributaries is essential to mitigate environmental and community impacts. This research contributes valuable insights into material selection and environmental sustainability in construction projects, highlighting the importance of thorough evaluation and responsible resource management.