Sustainable Construction Materials

Objective: Conduct comprehensive research into sustainable construction materials, culminating in an engineering report that analyzes opportunities for alternative, reused, and novel materials, and includes recommendations and rationales.

Background: As natural resources become scarcer, alternate construction materials that do not rely on these resources are needed. In this context, “resources” should be considered expansively, to include parts of the environment that can provide services (recreational or aesthetic), and the natural systems that operate to support life on earth. A key issue is whether and to what extent the production of construction materials impacts resources in this broad sense. As solid waste exceeds the capacity of landfills, alternate materials that extend the life of existing materials will be needed. An essential question is whether the production of such alternate materials will require a prohibitively high expenditure of energy. Thus there is a need for rigorous analysis of the life-cycle costs of the various alternatives. There is also a need to identify novel building materials, compare their strengths and technical merits with those of standard materials, and conduct thorough life-cycle analyses to numerically evaluate the resource and energy use implications of these novel materials.

Suggested Approaches: Research typical compositions of construction waste streams, noting material types, volumes, and general structural qualities. Investigate current practices in de-construction, i.e., the maximizing of materials recovery with reuse in mind. Research the reuse of construction and demolition materials, e.g., pavement reclamation for asphalt, wood reuse in temporary scaffolding, and concrete reuse as aggregate or road shoulder filling. Review the literature on novel construction materials that do not require mineral extraction (e.g., polymers and fibers). For a selection of these novel materials, assess their strength and technical qualities in light of their intended purposes. Research techniques for enhancing the sustainability of materials now commonly used, with special focus on concrete. For the inventory of materials encountered in the above approaches, conduct life-cycle and cost benefit analyses. For the reused materials, compare conventional removal and disposal with removal, reprocessing, transport, and reuse. For novel materials, compare typical to novel in with respect to production, transport, use, removal, and disposal. Identify the most promising novel and reused materials. Draft an engineering report (with accompanying presentation) summarizing the construction waste stream, opportunities for alternate, reused, and novel materials, recommended materials (with rationales), and a complete bibliography.