Performance of concrete and alternative materials for structures

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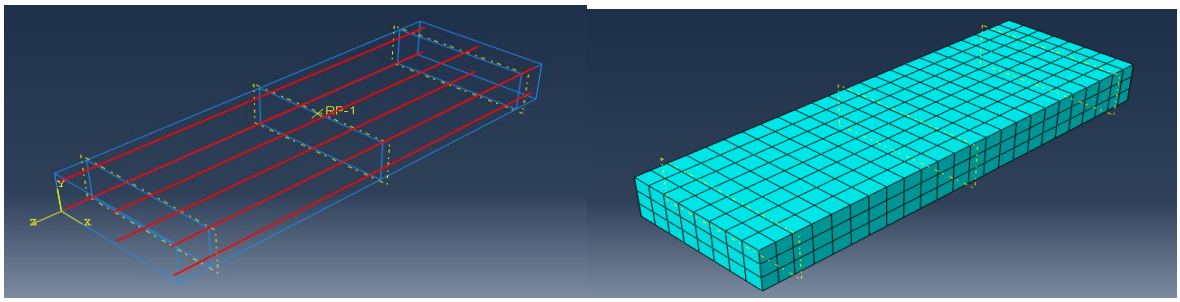


Numerical evaluation of FRP reinforced slabs

- Department is continuously engaged in theoretical and numerical evaluation of corrosion resistant FRP reinforcement materials such as GFRP and BFRP in structural applications as a reinforcing material replacing steel. As an example, current studies evaluate real strength of bridge deck slabs reinforced with GFRP reinforcement.

Testing flowability of fibrous grouts and temperature

Testing of mechanical characteristics and permeability of modified material

- Cement based materials are well appreciated for their compressive strength characteristics. Enhancing their tensile properties and durability remain a challenge due to weak tensile strength and pervious nature of the material. Department is engaged in developing cement-based concrete and grout using natural fibers in an attempt to enhance their tensile strength and improve permeability characteristics, in addition a few more broad structural applications.

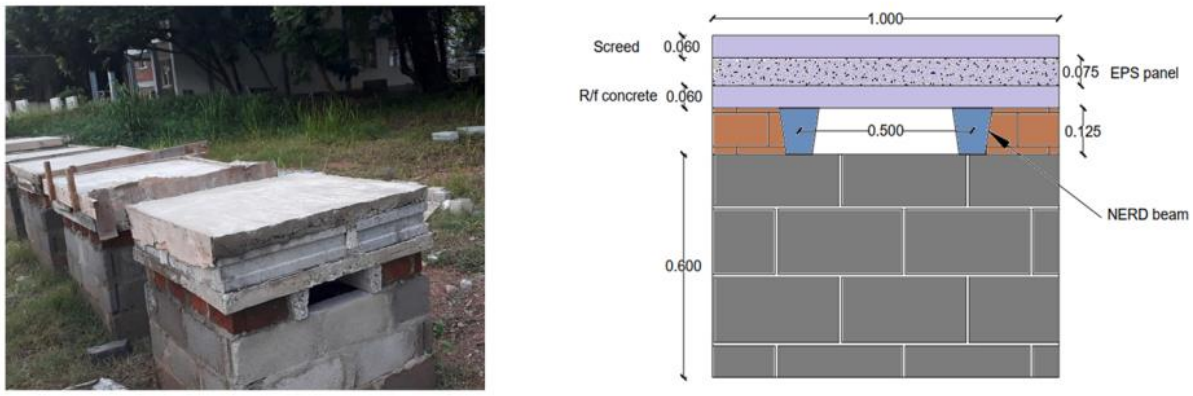
Coconut fiber added cube strength and cylinder splitting strength tests being conducted at lab

- Identifying cost effective construction material is one key research domain in civil engineering and it is vital for Sri Lanka under this economic recession. Natural materials such as coconut fiber, rice husk ash, and coconut charcoal have been experimented to replace the concrete ingredients partially. Also, separately, for improving the compressibility characteristics of clayey soils, rice husk ash has been experimented.

Through these studies, usability of natural materials as replacing agents in low strength concrete will be beneficial for the lower and lower to middle income families to reduce the construction costs. Similarly, addition of rice husk ash in clayey soils and thus improving its compressibility

properties will be advantageous for those who want to build low storey houses in the compressible soils.

- Alkali-aggregate reaction (AAR) occurs in some concrete structures depending on several factors such as the reactivity of aggregates, type of cement, and environmental conditions. It is possible that in some cases this can lead to distress in the affected structures. Some very important large concrete structures including a major dam in Sri Lanka are suspected of being subjected to AAR. Research are being conducted at identifying experimental methods capable of detecting AAR in existing structures and developing finite element simulations to predict the potential behaviour of affected structures in order to devise remedial measures.



Small-scale physical models with insulation and the schematic view

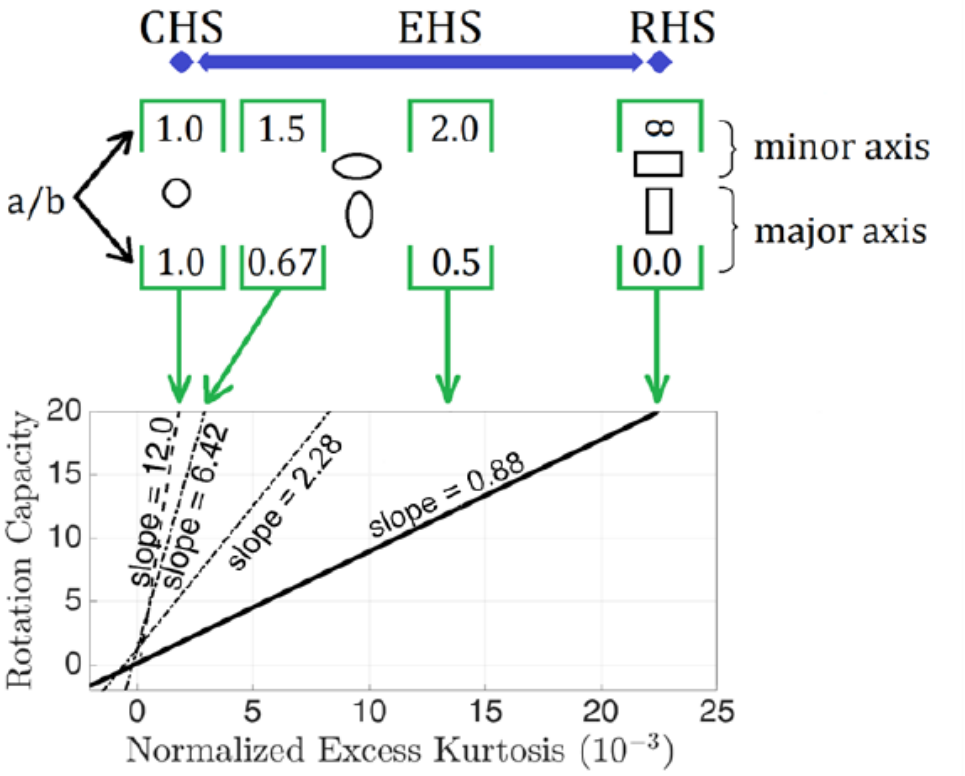
- Heat transfer through roof slabs significantly increases the operational energy consumption of buildings. A novel roof slab insulation using expanded polystyrene (EPS) based lightweight concrete panels is investigated for its feasibility in tropical climates. The workflow consists of field experiments and numerical simulations performed in Design Builder. Moreover, a holistic life-cycle approach is conducted to investigate the economic and environmental feasibility of alternate forms. EPS concrete is eco-friendly since it reduces EPS waste content which does not decay through natural means.

- Using supplementary cementitious materials (SCMs), such as blast furnace slag, fly ash and natural pozzolans, not only reduces the production cost of concrete, but also has technical advantages. Use of SCMs can reduce the heat of hydration as well as enhance the durability of the high-performance concrete (HPC). The SCMs can also improve the particle packing efficiency of HPC. However, incorporation of SCMs can affect the mechanical properties of HPC and therefore, many research projects are studying experimentally and numerically the use optimal amount of SCMs which do not compromise the mechanical properties of the HPC.

LE V. RATIONALIZED RESILIENCE INDEX

Redundancy	Robustness	Ductility		
		Low	*Medium*	*High*
Low	***Low***	1	4	6
	Medium	1.5	4	6
	High	2	4	6
Medium	***Low***	2	6	7
	Medium	3	6	7
	High	4	6	7
High	***Low***	3	7	8
	Medium	4	7	8
	High	6	7	8

A rationalized resilience index derived from structural mechanics concepts



Use of normalized excess kurtosis to estimate the plastic rotation capacity of hollow steel sections

- Analogy has proved to be a powerful approach to scientific discovery. One example of analogy that has arisen from this work is a structural mechanics analogy for developing a resilience index, by applying the concepts of robustness, redundancy and ductility from the former to the latter. Another is the use of the statistical concept of excess kurtosis as an index for plastic rotation capacity of structural steel sections.