

An Indian-Australian research partnership

<b>Project Title:</b>	<b>Studies on Cracking Behaviour of Cement Stabilized Material in Flexible Pavements</b>	
<b>Project Number</b>	IMURA0928	
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### Research Clusters:

### Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST <u>one</u>. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>		Highlight which of the Academy's Theme(s) this project will address? <i>(Feel free to nominate more than one. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>	
Earth Sciences and Civil Engineering (Geo, Water, Climate)		Infrastructure Engineering	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Infrastructure Engineering
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Water
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Nanotechnology
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Biotechnology and Stem Cell Research
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Humanities and social sciences
8	HSS, Design, Management	8	Design

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## The research problem

### *Define the problem*

In the wake of depletion of natural available resources, several agencies in India and Australia have recommended to explore and use alternative and local materials for road construction. In this direction, guidelines for the use of cement stabilized materials in sub base and base layers of flexible pavements were developed. However, these guidelines recommend reduced values of moduli for design and is attributed to cracking due to shrinkage and plying of initial construction traffic. Major cause of cracking is observed to be cement content, curing period and compaction method. The possibility of shrinkage cracking is an important factor that needs to be considered in the design of cement stabilized Pavements. Shrinkage cracks are often single isolated cracks, but can branch out to form multiple cracks, particularly under traffic loading. These cracks can deteriorate the pavement performance by reducing the overall stiffness of the pavement system, allowing water infiltration into pavement base and subgrade, and by providing pathways for erosion of cemented materials.

In this project, it is proposed to study the impact of cementation type and degree on the mechanism of deformation of cement stabilized materials. Shrinkage phenomenon of geomaterials is relatively complex because it involves several interrelated processes such as moisture and vapour migration under thermal, hydraulic and chemical potentials and the resulting deformation (shrinkage) of solid particles. Further, it is also proposed to explore the use of geotechnical centrifuge modelling technique for expediting drying. Also, it is also anticipated to explore the use of discrete and randomly distributed geofibers in restraining cracking deformation.

This work will initially focus on naturally available granular material(s) and further explored to substitute with coarse bottom ash materials. Involves geotechnical characterization, understanding cement content, fiber type and fiber content through laboratory tests.

Subsequently, experiments (including with and without of flexural distress) will be carried-out in a geotechnical centrifuge facility available at IIT Bombay for expediting drying, optical data evaluation, Particle Image Velocity (PIV) analysis for establishing mechanism of material interaction at the onset of drying, etc., At Monash university, efforts will be made to evaluate flexural performance of cement-stablized beam specimens with and without fiber dosage at various curing periods ranging from 7 days to 90 days.

Based on analysis and interpretation of model studies in the laboratory and numerical modelling, it is anticipated to contribute to improve existing guidelines for the design of cement stabilized material based flexible pavements.

## Project aims

*Define the aims of the project*

The following are envisaged as aim and objectives of the project

The objective of the present project is to understand the mechanism of cement stabilized materials through laboratory tests and model tests at high gravity using a geotechnical centrifuge technique for simulating full-scale environmental and loading conditions in the field.

The objectives of the proposed project are:

- a) To characterize naturally available granular material(s) and further explored to substitute with coarse bottom ash materials. Involves geotechnical characterization, understanding cement content, fiber type and fiber content through laboratory tests.
- b) To design a test setup for simulating full-scale field conditions for understanding mechanism of cement stabilized materials at high gravities using a geotechnical centrifuge
- c) To perform flexural tests for understanding the response of cement stabilized materials with and without geofibers and the effect of cementation, drying and curing periods.
- c) To perform parameteric study on the above
- d) To evolve guidelines for the use of cement stabilized materials in flexible pavements and contribute in evolving solution for scarce availability of natural gravel materials for road construction.

## Expected outcomes

*Highlight the expected outcomes of the project including likelihood of patents*

Guidelines for the use of cement stabilized materials in flexible pavements and contribute in evolving solution for scarce availability of natural gravel materials for road construction.

## How will the project address the Goals of the above Themes?

*Describe how the project will address the goals of one or more of the 6 Themes listed above.*

The proposed project certainly addresses the research theme and research clusters identified by the academy. The proposed project has an immense potential as solution provide for ever requirement of road construction in the infrastructure engineering.

## Capabilities and Degrees Required

*List the ideal set of capabilities that a student should have for this project. Be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.*

*B.E/B.Tech. in Civil Engineering or equivalent degree in Civil Engineering  
And M.Tech/M.E/M.S or Equivalent Post graduate degree in Civil Engineering with  
Geotechnical Engineering/Soil Mechanics Engineering/Highway Engineering*

### Potential Collaborators

Please visit the IITB website [www.iitb.ac.in](http://www.iitb.ac.in) OR Monash Website [www.monash.edu](http://www.monash.edu) to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

*Australian Road Research Board*

Select up to **(4)** keywords from the Academy's approved keyword list (**available at <http://www.iitbmonash.org/becoming-a-research-supervisor/>**) relating to this project to make it easier for the students to apply.

Cement-stabilized pavement materials; Flexural failure; Centrifuge model tests; Cracking; Geofibers