Technologies for Low-Carbon & Lean Construction

NEWSLETTER

SEPTEMBER 2023

Prof. Gettu receiving Lifetime Achievement Award from RILEM Conference Chair Sidney Mindess, Co-chair Prof. Banthia and Secretary Salman Dashtaki, RILEM week 2023 (Photo Courtesy: RILEM)

Greetings from TLC2 @ IIT Madras

The Centre of Excellence (CoE) on Technologies for Low Carbon and Lean Construction (TLC2) has been established at IIT Madras to lead to the true adoption of the concepts of circular economy in construction and minimal impact on global climate change. The centre was established with the following four major objectives:

1.To utilize suitable agricultural and C&D waste materials and thereby enhance the durability, service life, and sustainability of reinforced concrete structures
2. To minimize the consumption of materials, money, and time during the construction processes using lean principles, digital/3D printing tools and precast concrete applications,
3.To develop policies to enable the BEST and NEXT practices in the Indian construction industry, with an eventual goal of minimizing the carbon footprint and enhancing the circular economy of the concrete construction industry, and
4. To develop and suggest organizational practices and policies that help in scaling up the implementation of such technologies and be an eye-opener for policy makers in the country and beyond.

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IN THIS ISSUE

Event

Ravindra Gettu Honorary Sessions in the 77th RILEM Annual Week at Vancouver, Canada, during 4-8 September 2023.

As part of the 1st Interdisciplinary Symposium on Smart & Sustainable Infrastructures, eight Special Sessions were held in honour of Prof. Ravindra Gettu for outstanding scientific work in the field and excellent contributions to RILEM Society.

Journal publications

"Input parameters and nomograms for service life-based design of reinforced concrete structures exposed to chlorides"- research article by Sripriya Rengaraju et al., Structures (2023)

"Development of Waterless Extra-Terrestrial Concrete
Using Martian Regolith"- research article by Snehal et al., Advances in Space Research (2023)

Conference publications

Integrating Machine Learning (ML), Artificial Intelligence (AI), BIM with construction technology, management and safety

- Excerpts from ISARC Proceedings

Recent PhD Graduates

Eleven PhD students working on TLC2 areas got graduated this year!!!!!

Event

Ravindra Gettu Honorary Session in the 77th RILEM Annual Week at Vancouver, Canada, 2023

Prof. Ravindra Gettu delivering Plenary talk in the 1st ISSSI

Some of the speakers in the Ravindra Gettu Honorary Sessions, Vancouver, September 2023

Prof. Ravindra Gettu, the Immediate Past President and Fellow of RILEM, received a lifetime achievement award for his outstanding contribution in various areas of research such as fracture mechanics of concrete and rock, nonlinear behaviour of cement-based materials, high strength, fibre reinforced and self-compacting concretes, sustainability and the effective use of chemical admixtures. He delivered a Plenary lecture on “Technology Implementation as The Key Impact of Research: IIT Madras Approach in The Past Two Decades” during the RILEM week. There was an overwhelming response from young to very senior researchers from India, UK, USA, Canada, Europe, Latin America, Africa, Japan, Australia and other regions, with about 50 presentations on latest findings in the science and technology of construction materials. Renowned Professor Z. P. Bazant gave a talk on “Looking back at the Advancement of the Fracture Mechanics of Concrete in 50 years”. Distinguished senior researchers and professors like Prof. Mark Alexander, Prof. Gopalratnam, Prof. Nele De Belie, Prof. Zerbino, Prof. Manu Santhanam, Prof. Basheer, Prof. Pedro Castro, Prof. A. Mukherjee, Prof. Shakouri, Prof. R.G.Pillai, Prof. Chaunsali, Prof. Burkan Isgor, Prof. Nishant Garg, Prof. N. Neithalath, Prof. K. Subramaniam and Prof. L. Ferrara spoke in the various sessions on fracture of cementitious composites, corrosion and its control, durability and carbonation of cementitious systems, engineering the Microstructure for Macro-Performance, novel and advanced materials, recycling of waste in concrete, circular economy and sustainability. The session ended with an expert talk by eminent professor Surendra P. Shah on “Future of Science and Technology of Construction Materials” respectively.

Students and Professors of TLC2 centre with RILEM organizers and Delegates (Photo Courtesy: RILEM)

Journal Publications

Input parameters and nomograms for service life-based design of reinforced concrete structures exposed to chlorides

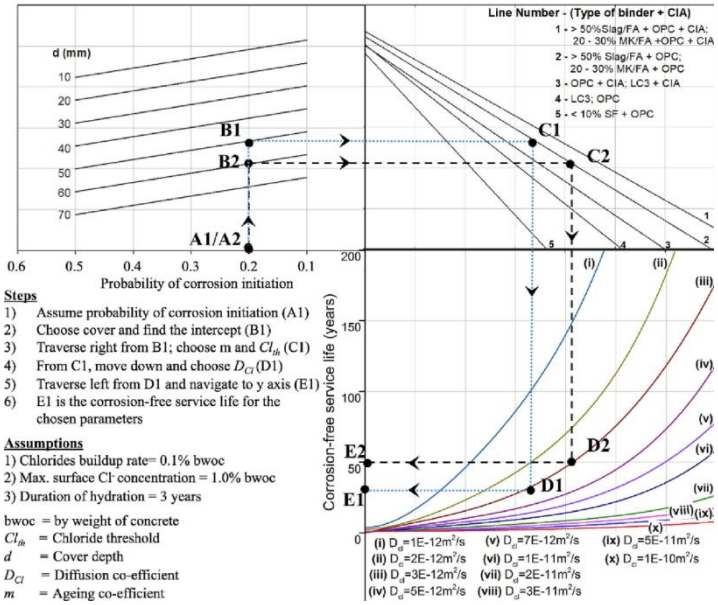
Sripriya Rengaraju, Radhakrishna G. Pillai, Ravindra Gettu [*Structures (2023)*]

- Chloride-induced corrosion of the embedded steel is one of the major deterioration mechanisms in reinforced concrete (RC) structures, leading to frequent repair and rehabilitation works and significant costs.

- This paper reviews various approaches for estimating service life of RC structures and proposed a set of user-friendly nomograms (durability design charts) using a MATLAB® computer program "SL_Chlor".

- The effect of different input parameters on service life is found to be synergistic, in the following descending order of influence: cover depth (d) > chloride diffusion coefficient (D_{Cl}) > ageing co-efficient (m) > chloride threshold (Cl_{th}).

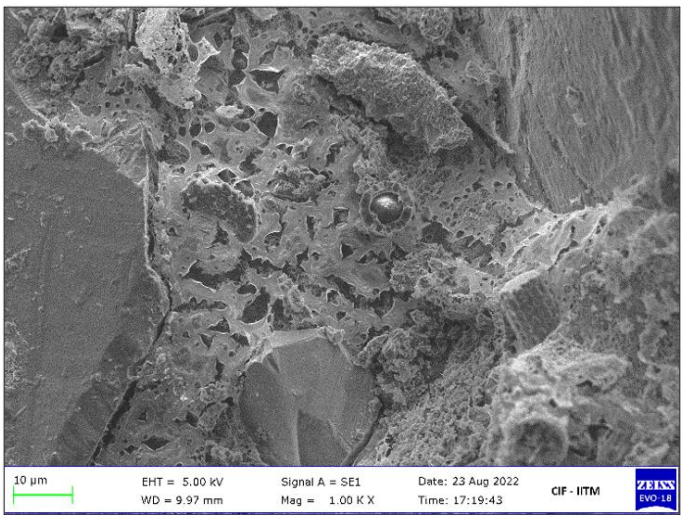
READ MORE



Nomogram for estimating service life of structures located in the spray zone/ severe chloride exposure condition

Development of Waterless Extra-Terrestrial Concrete Using Martian Regolith

K. Snehal, Priyanshu Sinha, Piyush Chaunsali [*Advances in Space Research (2023)*]



Morphology of ETC after exposure to 0 °C for 28 days.

READ MORE

- This research explores the utilization of Martian regolith or Martian soil and sulfur to create extra-terrestrial concrete (ETC) with a property suitable for constructing human habitat on Mars.

- The major components of Martian soil are SiO_2, Al_2O_3, and Fe_2O_3, which account for more than 75% of the overall oxide composition.

- The optimal mixture proportion of ETC had 70% (by weight) of Martian regolith and exhibited a compressive strength of 27 MPa. The formulated ETC could retain up to 25 MPa of compressive strength at 40 ℃ and 50 ℃, and could reach up to 35 MPa at 0℃ temperature conditions.

- The change in compressive strength was attributed to the sulfur sublimation and pore closure brought about by freezing at extreme temperatures.

Conference Publications

Integrating Machine Learning, Artificial Intelligence, BIM with construction technology, management and safety (Excerpts from the ISARC 2023 proceedings)

A pre-trained language model-based framework for deduplication of construction safety newspaper articles

The unavailability of Occupational Health and Safety (OHS) statistics for the construction sector is a systemic hurdle in improving safety, particularly for developing countries. Online newspaper articles are deemed a potential source for OHS statistics. Dr. Nikhil Bugalia and his students developed and evaluated a novel framework based on pre-trained language models for the deduplication tasks for construction safety-related news articles to address the research gap. (Read more and click here for presentation)

Geometric control of short-line match casting using Computational BIM

Segmental pre-casting of prestressed concrete bridges is a technique that offers many benefits to bridge construction in terms of time savings and quality of construction. Accuracy in geometries of the segments during the casting is crucial to the process. Dr. Koshy and Dr. Ashwin proposed a framework/workflow, called the Geometric Error Minimization for Bridge Segment Casting (GEMBSC), for minimizing geometric errors in segmental casting alignment in real-time. Dynamo, a computational BIM tool, was used to extract the coordinates from the BIM model and perform coordinate transformations. (Read more and click here for presentation)

Quality monitoring of Concrete 3D printed elements using computer vision-based texture extraction technique

Concrete 3D Printing (3DP) has the potential to reduce construction time and the usage of labor and material in the construction industry. To fully realize the advantages of 3DP and to develop it into a technology for large-scale construction, a focus on quality monitoring and control is required. To quantify the extrudability changes in the concrete, a new computer-vision-based methodology is proposed by Dr. Benny and his student using a modified Histogram of Oriented Gradients (HOG) texture extraction method. (Read more and click here for presentation).

Our recent PhD Graduates

	**Dr. Divya Rani S** Characterisation of historic mortars and evaluation of repair mortar materials		**Dr. Karthikeyan Manickam** Corrosion of anchorage regions in post tensioned concrete bridges and chemical & electrochemical repair methods
	**Dr. Purushothaman Srinath** Identification and analysis of quality non- conformance in construction project baseline schedules		**Dr. Ram V G** Building demolition waste in india:estimation, environmental impacts, and institutional barriers to recycling projects
	**Dr. Rohit Prajapati** Thermomechanical beneficiation of waste concrete for recycling in structural grade concrete		Dr. Santhosh Loganathan A framework for analysing the influence of teamwork processes of onsite construction trade crews on productivity
	**Dr. Sujatha Jose** The study of long term performance of fibre reinforced concrete		**Dr. Varun Kumar Reja** A hybrid self-supervised approach towards computer vision based construction progress monitoring
	**Dr. Tom Damion** Performance of calcium sulfoaluminate- based binders in acidic environments		**Dr. Selvam M** Framework for simulation of field compaction of roller compacted concrete pavements in laboratory
	**Dr. Resmi G.** Flexural Behaviour of Pre-tensioned Bridge Girders subjected to chloride induced corrosion in strands	**Congratulations**	