BTCM @ IIT Madras

Providing academic leadership in the areas of Building Science, Construction Materials and Construction Management







Department of Civil Engineering
Indian Institute of Technology Madras

BTCM @ IITM - Overview



- First in India to facilitate teaching, learning, and research in...
 - Building Physics
 - Construction Management
 - Construction Materials
- Academic Programs by the Division
 - Dual degree program in BTCM
 - M.Tech. (Building Technology & Construction Management)
 - UoP M.Tech. (Construction Technology & Management)
 - Since 1998
 - L&T sponsors 30 students (Civil, Electrical & Mechanical) each year
- Research Programs
 - MS & PhD
- Faculty Members
 - 14 (full time)
 - 1 Professor of Practice and 3 Distinguished Faculty

Areas of specialization of faculty members



Faculty	Construction Materials	Construction Management	Building Sciences
Prof. K. Ramamurthy	^		A
Prof. Ravindra Gettu	^		
Prof. Manu Santhanam	^		
Prof. Radhakrishna G. Pillai	^		
Dr. Piyush Chaunsali	^		
Dr. Keerthana Kirupakaran	A		
Dr. Aslam Kunhi Mohamed	^		
Prof. Koshy Varghese		A	
Prof. Benny Raphael		A	A
Prof. Ashwin Mahalingam		A	
Dr. Sivakumar Palaniappan		A	
Dr. Nikhil Bugalia		A	
Dr. Murali Jagannathan		A	
Prof. K. N. Satyanarayana*		A	
Prof. N. Raghavan (Professor of Practice)	A	A	

^{*} On deputation to IIT Tirupati as Director

Distinguished Faculty Members



- Prof. Mark Alexander, University of Cape Town, South Africa
- Prof. Mirosław J. Skibniewski, University of Maryland, USA
- Prof. Surendra P. Shah, Northwestern University, USA

A glimpse on the activities by

Construction Management group



- Construction management
- Infrastructure management
- Construction automation



Studies on construction management



Questions we answer

- How do we make construction more 'LEAN' and efficient?
- How do we increase digitalization in the industry? (e.g., BIM, AI, etc.)
- How do we create more integrated processes for project delivery?

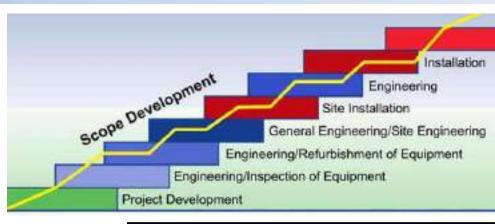






Lean Champions Build India Program Scholarship













Studies on infrastructure management



Questions we answer

- How do we manage Megaprojects better?
- How do we build Sustainable and Resilient Cities?
- How do we build Infrastructure
 Faster, Better and Cheaper?

1.00 0.75 0.50 0.250.00 Institutional **Project Strategies** conditions Communication Regulatory Institutions Control Normative Coordination institutions Stakeholder Cognitive focus Capability of Outcomes **Project Parties** Legitimacy Project Uncertaint Efficiency Sustainability

F(x)

Impacts



TN Infrastructure Development Act

MINISTRY OF FINANCE

PPP Policy Renegotiation Policy





Studies on construction automation



Questions we answer

– How do we improve time, cost and quality of construction through automation and robotics?







Impacts

- New theoretical concepts, technology solutions
- Automated construction methods
 - 3D Printing with Concrete







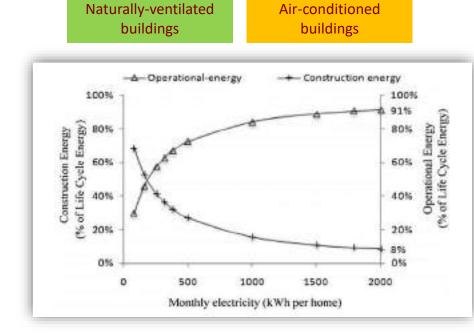


Studies on sustainable construction



Questions we answer

- What is the relative contribution of construction energy with respect to building life cycle energy?
- How to integrate sustainability metrics into construction planning and control practices?
- How do we improve the schedule performance of construction projects in India?



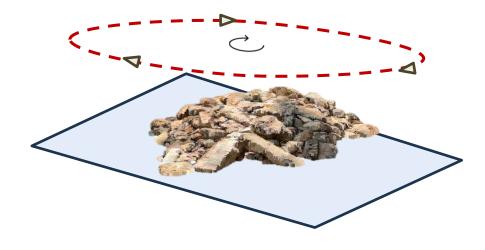
Some recent works – C&D Waste Management



Digitized Quantification

Intelligent Segregation







Some recent works – Safety and Quality



Virtual Reality Training



VR training for workers for Quality

Al-based Risk Assessment



Posture Analysis

Some recent works – 3D printing



Al-based Risk Assessment





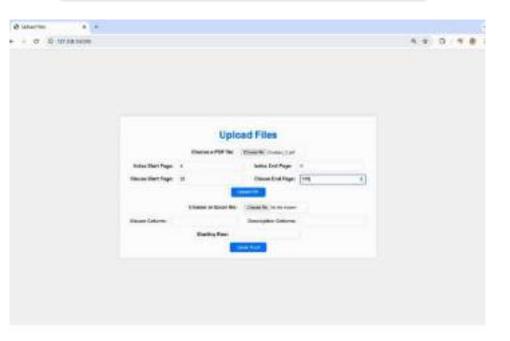


Early Prediction of Failure

Some recent works – Contract Management

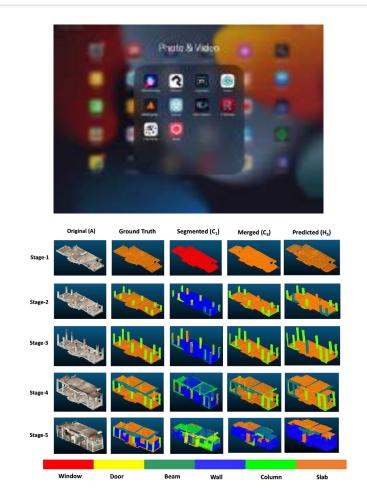


Al-based Contract Risk Assessment



- Cross-Referencing Implicit Clauses
- Contract clauses and their risk potential

Al-based Contractual Progress Monitoring



A glimpse on the activities by

Construction Materials group



- Cement chemistry and concrete microstructure
- Mechanical properties, dimensional stability, corrosion and durability
- Service life estimation & extension
- Sustainability & life cycle assessment



Questions we answer?



- How to design <u>special concretes</u> for various specific needs?
 - SCC, FRC, TRC, LWC, etc.
- How to utilize various by products and alternative materials?
 - Fly ash, slag, limestone, calcined clay, biomass, recycled aggregates, etc.
- What are the <u>material characteristics</u>? How do improve the behaviour of concrete in short and long term?
 - SEM, EDAX, chemical composition, pore structure, etc.
- How to estimate and enhance the <u>corrosion resistance</u> and <u>service life</u> of concrete structures? How can we arrest corrosion?
 - Chloride ingress, carbonation, corrosion rate, cathodic protection, etc.
- How to estimate and enhance the <u>dimensional stability</u> and <u>mechanical properties</u> of material systems?
 - Toughness, bond strength, fatigue resistance, etc.

Studies on mechanical performance



Test frames (5 kN to 1 MN) and prestressing bed



Fatigue, fracture, bond strength





Prestressing bed

Long-term durability performance studies



Environmental exposure chambers



High-temperature, carbonation, humidity chambers

Natural carbonation studies

Long-term shrinkage and creep studies



Large rooms with controlled temperature and humidity environment



Studies on corrosion assessment and service life estimation/extension



• Electrochemical workstation, corrosion cells, prestressing frames





Studies on the transport of water, CO_2 , O_2 , and chlorides through concrete



Suite of testing setups







Studies on fresh properties of concrete



• Walk-in chamber, controlled environment rooms, etc.



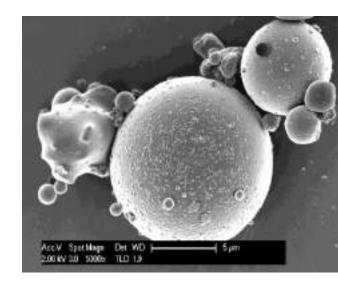


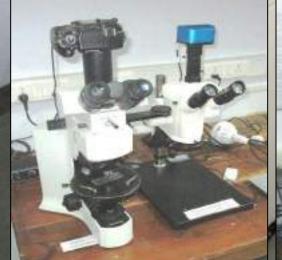
Studies on evolution of microstructure of various cementitious systems



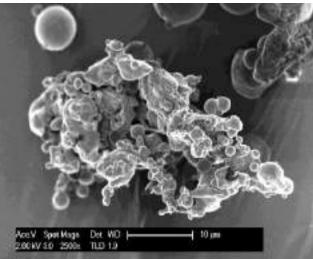
Optical microscopes, SEM, MIP, etc.











Workshop facilities within the department for fabricating research/testing setups

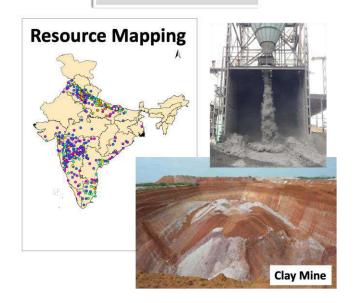




Some recent works – Zero Emission Concrete



Alternative Raw Materials

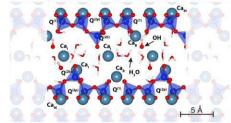


- Low-Grade Limestone
- Biomass
- Overburden Clay

Low-carbon Cements







- Mini cement plant
- Low Energy Cement
- Molecular Modelling

Sustainable Concrete







- LC3 house
- LC3 Tetrapod
- Biomass Ash bricks

Some recent works – Precast Construction



Technology Development







- Tendonfill grout
- TRC Sewage treatment plant
- FRC tunnel linings

Promotion and Implementation



- Completed sports complex
- Upcoming PPVC hostel, designed for deconstruction

Some recent works – Lifecycle Assessments

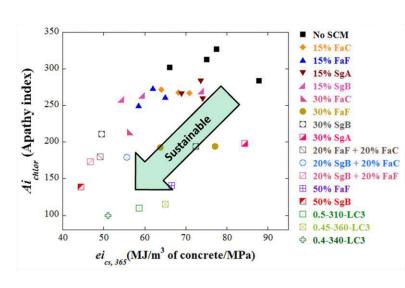


Cement

Low-carbon materials 920 (kg CO₂ eq./tonne of clinker) 1000 -Clinker CO₂ emissions 910 Direct emissions form limestone CO₂ emissions (kg CO₂/tonne) 30% Reduction Fossil fuels (extraction + heating) 400 Pet coke (extraction + heating) Alternate fuels (heating) Electricity 200 OPC PPC PSC LC3 Electricity Clinkerization **Transportation** Others Clay calcination

Process mapping of cement manufacturing

Concrete Mixes



Framework for sustainable concrete design

- Strength and Workability
- Durability

Interaction with the industry





























































and many more...

Current Openings – Construction Management



- Topic (Construction Contracts):
 - Opportunistic Behaviour and Construction Disputes: Measurement and Mitigation
- Topic (Sustainable Construction):
 - A Framework for Implementing Lean and Sustainable Construction Practices in Projects
- Topic (Construction Contracts):
 - Using Al-based Assistive Technology for Contract Interpretation
- Topic (Benchmarking):
 - Coordination and benchmarking for Sustainability in Construction
- Topic (Institutional change):
 - Institutional Change for Sustainability in Construction

Current Openings – Construction Management



- Topic (Construction Safety):
 - Developing Virtual Reality based Construction Safety Training Programs for India
- Topic (Digital twin):
 - C'TWIN: Development of a construction twin for real-time monitoring of project progress and resource allocation
- Topic (BIM):
 - Automatic creation of 5D BIM from construction specification documents
- Topic (Design):
 - Generating design alternatives for circular construction

Current Openings – Construction Materials

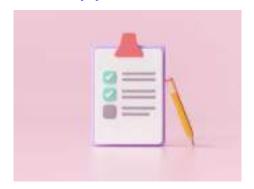


- Topic for PhD (Mechanics and Materials):
 - Thermo-Mechanical Behaviour of Textile Reinforced Concrete
- Topic for PhD (Molecular dynamics):
 - Interaction of chemical admixtures with low-carbon cementitious systems
- Topic for PhD (Concrete pavements):
 - Sustainable concrete pavements using high volumes of construction, demolition, and industrial wastes as constituent replacements.

How to apply: Timeline



Application



https://research.iitm.ac.in Deadline 31 October 2024

Test & Interview



November 18-20 In-person

Joining



January 2025 Begin your research career

- Eligibility details on https://research.iitm.ac.in
- Our websites:
 - https://civil.iitm.ac.in/btcm/
 - https://tlc2.iitm.ac.in/open-position/



Thank you

Questions