## BTCM @ IIT Madras

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





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
  - 10 (full time) + Adjunct and Visiting Faculty

## Areas of specialization of faculty members



Faculty	Construction Materials	Construction Management	Building Sciences
Prof. K. Ramamurthy	<b>^</b>		<b>A</b>
Prof. Ravindra Gettu	<b>^</b>		
Prof. Manu Santhanam	<b>A</b>		
Dr. Radhakrishna G. Pillai	<b>A</b>		
Dr. Piyush Chaunsali	<b>A</b>		
Prof. Surendra P. Shah	<b>A</b>		
Prof. Koshy Varghese		<b>A</b>	
Prof. Benny Raphael		<b>A</b>	<b>A</b>
Prof. Ashwin Mahalingam		<b>A</b>	
Dr. Sivakumar Palaniappan		<b>A</b>	
Prof. N. Raghavan	<b>A</b>	<b>A</b>	
Prof. K. N. Satyanarayana*		<b>A</b>	

<sup>\*</sup> On deputation to IIT Tirupati as Director

## 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?

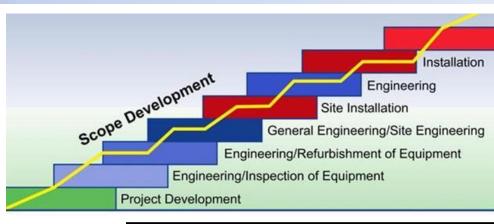






Lean Champions Build India Program Scholarship













## Studies on infrastructure management



#### Questions we answer

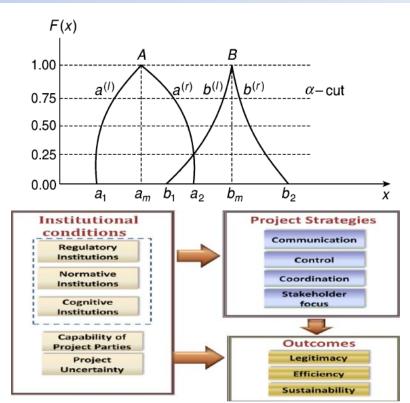
- How do we manage Megaprojects better?
- How do we build Sustainable and Resilient Cities?
- How do we build Infrastructure
   Faster, Better and Cheaper?

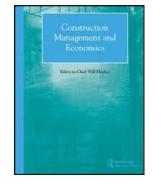
## Impacts



TN Infrastructure Development Act MINISTRY OF FINANCE

PPP Policy Renegotiation Policy





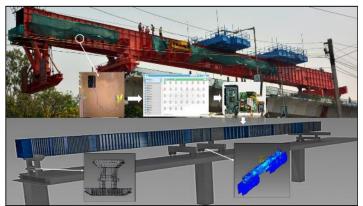


#### Studies on construction automation



#### 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









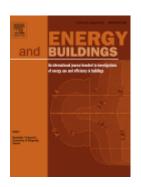
#### Studies on sustainable construction

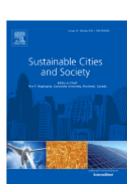


#### Questions we answer

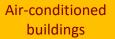
- What is the relative contribution of construction energy with respect to building life cycle energy?
- How to integrate sustainability metrics into construction planning and control practices?
- How do we improve the schedule performance of construction projects in India?

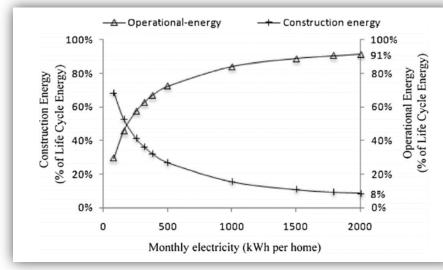
#### Impacts















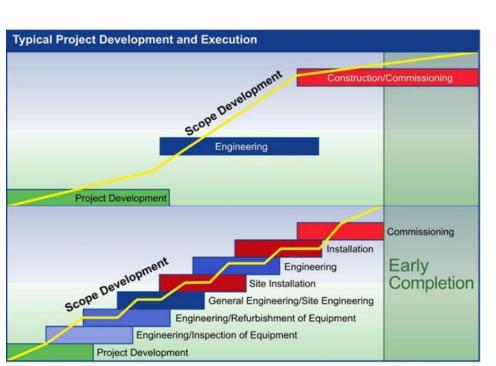


## Dr. Koshy Varghese

Professor; Ph.D., University of Texas



- Automation in Construction
- Fast Track & Concurrent Engineering Projects
- Sustainable Development
- GIS in Civil Engineering Applications



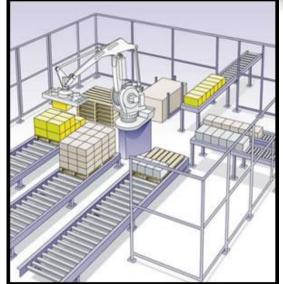


Sustainable Development

Self sufficient and

prosperous communities

Economy Continuous Growth





## Dr. Benny Raphael

Professor; Ph.D., Univ. of Strathclyde, Glasgow

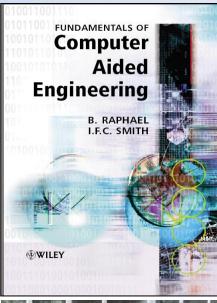


- Construction automation and robotics
- Computer Aided Engineering
  - Modeling, Optimization, Data mining
- Energy efficient buildings
  - Sustainable and smart building systems













## Dr. Ashwin Mahalingam

Professor; Ph.D., Stanford University



- Megaproject Management
- Sustainable and Resilient Cities
- Building Information Modeling and Integrated Project Delivery







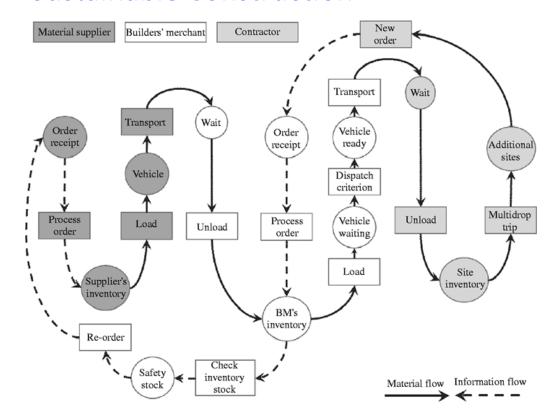


## Dr. Sivakumar Palaniappan

Associate Professor; Ph.D., Arizona State University



- Modelling and Simulation of Construction Processes
- Information Technology in Construction
- Sustainable Construction







## Prof. N. Raghavan

**Professor of Practice** 



- Construction Management Contracts/ Methods
- Repair & Rehabilitation
- Safety Management
- Structural Consultancy







### A glimpse on the activities by

## **Construction Materials group**

BICM Building Technology and Construction Management

- 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.

## **Impacts**

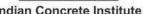


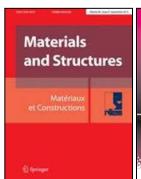
- Research collaborations
  - DST, Lafarge & Indian industry
  - Polimi, UCT, EPFL, MIT, Imperial, OSU
  - Other IITs, NITs & other engineering colleges
- Improved performance with existing materials, and insights into new materials
- Test methods, codes and technical guidelines
  - BIS, RILEM, ICI, & NACE
- Workshops, seminars, conferences



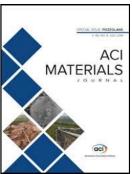


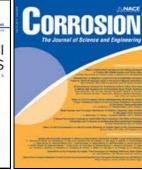
















## Studies on mechanical performance



• 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 fresh properties of concrete



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





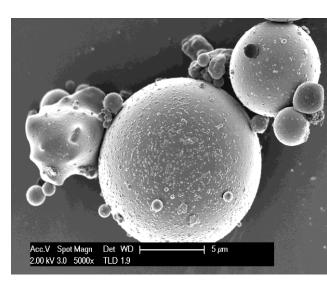
## Studies on evolution of microstructure of various cementitious systems

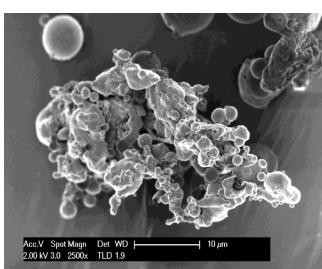


Optical microscopes, SEM, MIP, etc.









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



Suite of testing setups







# Workshop facilities within the department for fabricating research/testing setups







## Dr. K. Ramamurthy

Institute Chair Professor; Ph.D., IIT Madras

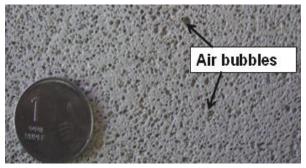


- Light weight and fly ash aggregates
- Aerated & foam concrete blocks/bricks
- Interlocking brick masonry
- Thermal comfort & lighting of buildings













#### Dr. Ravindra Gettu

Prof. V S Raju Chair Professor; PhD, Northwestern Univ., USA

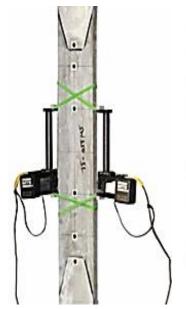


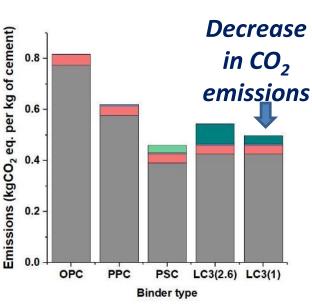
- High performance concrete
- Self compacting concrete
- Fibre and textile reinforced concrete
- Concrete recycling
- Sustainability assessment of concrete systems

















#### Dr. Manu Santhanam

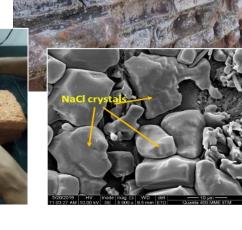
Professor & Head of Department; Ph.D., Purdue University

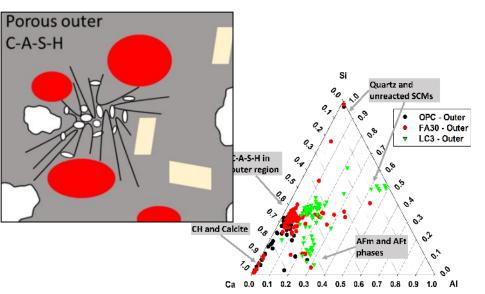


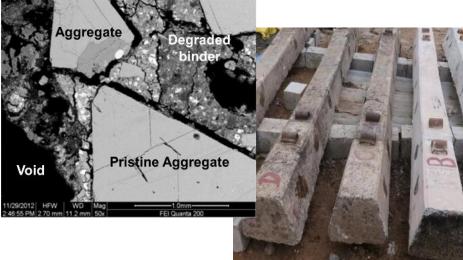
Cement chemistry & microstructure

- Characterization techniques
- Non-destructive evaluation
- Durability of concrete
- Performance specifications











#### Dr. Radhakrishna G. Pillai

Associate Professor; Ph.D., Texas A&M University



- Corrosion assessment & service life estimation
- Corrosion control & service life extension
- Grout materials & practices for prestressed concrete

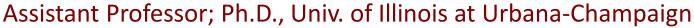








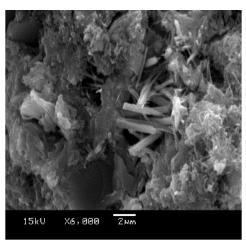
## Dr. Piyush Chaunsali

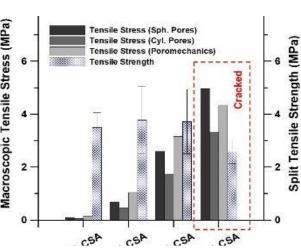


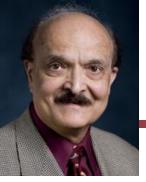


- Cement chemistry and concrete durability
- Processing-microstructure-performance relationships of low CO<sub>2</sub> cements
- Microstructure and thermodynamic modelling of cementitious systems
- Valorization of industrial by-products









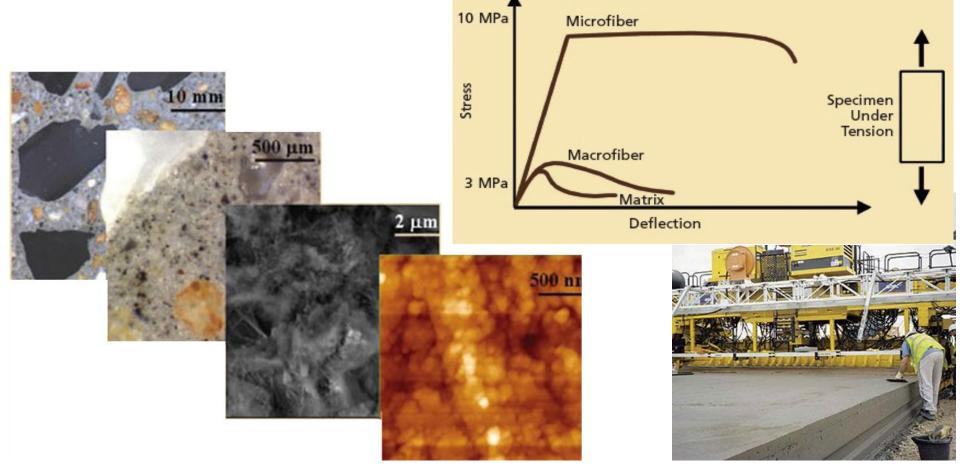
#### Prof. Surendra P. Shah

Distinguished Professor in Civil Engineering



Connecting micro/nano behaviour to structural response of

concrete



### Interaction with the industry











































TATA CONSULTANCY SERVICES

















and many more...

## BTCM graduates are now working as...



#### Faculty members

- IISc Bangalore
- IIT Bombay, Delhi, Guwahati, Palakkad
- NIT Trichy, Calicut, Warangal
- Various other public/private engineering colleges



- USA, Switzerland, South Africa, Germany, Belgium, Italy
- Researchers/engineers
  - CSIR-SERC, Kuwait Inst. for Scientific Research
  - Aditya Birla, Ultratech, etc.
  - L&T Construction, SPCL etc.
  - Public sector Units
- Leaders in various other industrial units



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