Role of Building materials and construction technologies in mainstreaming sustainable & resilient housing

Session-2 on ‘Cities’, Event at India Pavilion
COP-23, Bonn, Germany, 8 November 2017

Professor Rajat Gupta, Oxford Brookes University
rgupta@brookes.ac.uk
Outline of presentation

• About us
• Context
• Project aims and methods
• Progress to date
The Oxford Institute for Sustainable Development (OISD), founded in 2004, is one of the UK’s largest research institutes dedicated to sustainable development research in the built and natural environments. OISD, which consists of eight distinct research groups, addresses the multiple dimensions of sustainable development and the synergies and processes that link them, through a multi- and interdisciplinary approach. OISD is contributing to major Research Council programmes such as Living with Environmental Change, Energy research, Sustainable Urban Environments and Lifelong Health and Wellbeing, through various research grants. 

Contact Us
Professor Rajat Gupta
Director of OISD
rgupta@brookes.ac.uk

The OISD is part of the
Faculty of Technology,
Design and Environment at Oxford Brookes University.

OISD RESEARCH GROUPS

ARCHITECTURAL ENGINEERING GROUP
CONSTRUCTION & PROJECT MANAGEMENT GROUP
IMPACT ASSESSMENT GROUP
LOW CARBON BUILDING GROUP
PLACE, CULTURE AND IDENTITY GROUP
REAL ESTATE & LAND POLICY GROUP
SPATIAL PLANNING GROUP
URBAN DESIGN GROUP

www.oisd.brookes.ac.uk
Low Carbon Building Group, Oxford Institute for Sustainable Development

CARBON COUNTING AND CARBON MAPPING
Urban/Community scale topographical carbon analysis

ADVANCED LOW CARBON REFURBISHMENT
Whole house deep retrofit to achieve more than 70% reduction in emissions

BUILDING PERFORMANCE FEEDBACK AND POST-OCCUPANCY EVALUATION
Evaluating & fine-tuning buildings to meet targets

EVALUATING LOW CARBON COMMUNITIES
Assessing the impact and limitations of community led low carbon initiatives

CLIMATE CHANGE ADAPTATION OF BUILDINGS AND NEIGHBOURHOODS
Future proofing buildings

GLOBAL COMMON CARBON METRICS
Developing a universal method of measuring a building's carbon footprint

http://architecture.brookes.ac.uk/research/lowcarbonbuilding/
A Critical and Comparative Evaluation of Co₂ Emissions From National Building Stocks of Developed and Rapidly-Developing Countries — Case Studies of UK, USA, and India

Rajat Gupta* and Smita Chandiwala

1. INTRODUCTION

In 2002, buildings were responsible for 7.85Gt, or 33% of all energy-related CO₂ emissions worldwide (Price et al. 2006), and these emissions are expected to grow to 11Gt or 15.6Gt by 2050 (IPCC 2007), the two figures are based on different projected scenarios. In developed countries such as the United States and the United Kingdom, energy use in the building stock is responsible for about 50% of national CO₂ emissions (Mazria and Kershner 2008; DOE 2006; EPA 2003). Yet most efforts nationally and internationally have focused on improving the performance of new buildings (WEC 2004). The UK has set a target of making all new domestic buildings ‘zero carbon’ by 2016 and all new non-domestic buildings zero-carbon by 2019 (DCLG 2006). Similarly, in the US the Architecture 2030 campaign calls for the fossil-fuel reduction standard for all new buildings to be increased to 60% in 2010, 70% in 2015, 80% in 2020, 90% in 2025 and carbon neutral by 2030 (Mazria and Kershner 2008). Similarly, the ‘Building Energy Code’ in India is currently voluntary and applicable for new commercial buildings or building complexes that have a connected load of 500kW or greater, or a contract demand of 800kVA or greater (Bureau of Energy Efficiency 2006).

*Corresponding author: rgupta@brookes.ac.uk

Sustainable urban social housing initiative (SUSHI) programme (2009-2014)

• Promotes the use of resource and energy efficient building solutions in social housing programs in developing countries

• UNEP programme
  • SUSHI-I (2009-2011) - Thailand and Brazil
  • SUSHI-II (2012-2014) - India and Bangladesh

Green building interventions for social housing (2015)

http://unhabitat.org/books/green-building-interventions-for-social-housing/
Learn-BPE: evaluating building performance of green buildings

• Two-year research project developed to promote sustainability as an integral part of social housing

• Funded by Newton Fund through RAEng, April 2017 to April 2019

• CEPT University and Oxford Brookes University

• Research and education activities to develop new knowledge, tools and skills amongst researchers, postgraduate students and practitioners of engineering and architecture.

• Evaluate the actual performance of green buildings in India. Develop and validate post-occupancy BPE methodology through field studies.

www.learn-bpe.org
Background and context
Why focus on social housing in India?

- Housing sector in India contributes to 24% of the total CO₂ emissions
- Estimated housing shortage by end of 2017 is 18.78 million
- 95% is this shortage is faced by Economically Weaker Sections (EWS) and Lower Income Group (LIG)
- 50% of India is expected to be urbanised by 2041
- Opportunity to influence design of upcoming housing solutions to embrace a greener development trajectory
Environmental impact of housing in India

- 40-45% of India’s Steel
- 65-70% of Glass
- 85% of Paint Production
- Cement consumes 303 MT of limestone and 30 MT of coal
- Cost of construction materials: ~40-60% of project cost
- Construction sector accounts for 45% of total steel demand
- Cement production increased by 56% in the last decade
- 350 MT of top soil lost to brick making every year
- 2nd largest brick producer, 200 million bricks annually
- Annual material production growth rate of 9.8%
- 300% increase in production in steel from 1994-95 to 2008-09.
‘Housing for all’ programme
Project aims and methods
What is MAS-SHIP?

- Two-year research project developed to promote sustainability as an integral part of social housing
- Funded by UN Environment, October 2016 to September 2018
- Consortium: Oxford Brookes University (Lead partner), Development Alternatives (DA), The Energy and Resource Institute (TERI) and UNHABITAT
- Term social housing refers to housing that serves the housing needs of low-income groups with the provision of ensuring access to physical, social, environmental and financial wellbeing.
Aims and outputs

To enhance sustainability in social housing through adoption of sustainable building materials and construction technologies, as well as operations & management practices.

To achieve this, the project is producing two major outputs.

1. **Sustainability Index (SI)** to evaluate building materials and technologies based on a set of attributes (indicators) for social housing context.
   - Attributes are developed in close consultation with the Government’s Technology mission under *Housing for All* as well as India’s leading experts in the field.

2. **Decision Support Tool (DST)** which will provide guidelines at the conceptual stage of housing projects to enable the adoption of sustainable building practices by housing providers such as government bodies, private developers, and households.
Workstreams

- Background study on scenario of social housing internationally and in India
- Evaluating parameters of sustainability in social housing
- Database building for developing Sustainability Index
- Testing, validation and refinement of the Sustainability Index and DST
- Policy briefs for mainstreaming sustainable social housing
- Stakeholder engagement (project developers/promoters)
Implementation structure

**Project team**

Technical peer reviewers
Experts willing to peer review project deliverables

**Project Advisory Board**
Policy makers, industry experts and practitioners

**Stakeholders**
Developers, architects, policy-makers, supply chain
Invited to stakeholder dialogue events and regional workshops
Findings to date
Progress to date

• Produced a **background study** on Sustainable Social Housing in India: Definition, Challenges and Opportunities
  – [www.mainstreamingsustainablesocialhousing.org](http://www.mainstreamingsustainablesocialhousing.org)

• Selected a comprehensive set of **attributes** contained in a ‘Sustainability Index’.

• Conducted **secondary** and **primary** data collection related to **five case study locations** to populate sustainability attributes

• Team of technical reviewers and advisory board members to guide the project team

• Project website, leaflet and summary available for dissemination
Insights from background study on Sustainable Social housing in India

• **“Social Housing”** rather than **“Affordable Housing”**

• **Urban development and energy and resource efficiency** initiatives not sufficiently linked. Current review of 2007 National Urban Housing and Habitat Policy

• **2017 opportune year** to highlight sustainable social housing for national development frameworks.

• **Fragmentation** of green building certification market. Incentives for **registration** (for certification) rather than certification.

• **Possibly limited impact of existing green incentives** based on regulatory benefits and awards
National tools for assessing sustainability

GRIHA
IGBC-CII
CPWD
ECOnir
man
Sustainability Index (SI)

A Sustainability Index will

• be developed built on a multi-criteria decision support system

• provide the targeted beneficiaries with evidence based performance information

• aid decision making in choice of building materials and construction technologies

• Process of derivation, selection and detailing of the attributes underlying the Sustainability Index.
Attributes of the Sustainability Index (SI)

A short-listed 15 attributes were selected from an initial long list of 29 attributes.

Tier 1- Normalized Data readily available
1. Embodied Energy
2. Carbon Emissions
3. Future Reusability
4. Current Recycled Content
5. Water Efficiency
6. Impact on Cooling loads
7. Thermal Performance
8. Noise Transmission
9. Thermal Mass
10. Modification Ability
11. Ease & Frequency of maintenance
12. Cost per Sq. M

Tier 2- Data can be gathered through desk research
2. Carbon Emissions
4. Current Recycled Content

Tier 3- Field surveys necessary
3. Future Reusability
5. Water Efficiency
6. Impact on Cooling loads
10. Modification Ability
11. Ease & Frequency of maintenance
13. Time of construction
14. Supply Chain
15. Skill Requirement

Tier 4- Data unavailable
Critical Resource Use
Durability
Familiarity of a Material

A short-listed 15 attributes were selected from an initial long list of 29 attributes.
To *present* the MaS-SHIP project – its *aims, methods, expected outcomes*

To gain *insights* from the audience on the project, its outcomes and outputs, dissemination and impact.

To attract interest in getting involved through the *Project Advisory Committee*. 
Stakeholder Dialogue 1
1 February 2017

- Demand Assessment of Housing in India.
- Shortlisting case studies.
- Review of key housing policies in India.
Stakeholder Dialogue 2
4 May 2017

• Identification and development of attributes for developing “Sustainability Index”

• Primary survey questionnaire for various stakeholders. (Developers, Manufacturers and Users)
Regional Workshop 1
21 August 2017

• Discussion on the chosen 15 attributes underpinning the Sustainability Index which will aid to select the most appropriate building materials and technologies from an economic, social and environmental perspective.

• Methodology adopted for measuring or quantifying the attributes.

• Surveys with householders, manufacturers and developers for data collection
Project website

MaS-SHIP Mainstreaming Sustainable Social Housing in India Project

www.mainstreamingsustainablehousing.org
Mainstreaming sustainable social housing in India (2016 - 2018)

Project outputs

- Design Support Tool (DST) for designers, developers and consultants, which lays down the fundamentals and methodology for planning, implementation and operation practices, necessary for achieving sustainability in housing projects and developments.

- Policy/practice briefings for policy-makers and practitioners based on the key findings of the study with respect to mechanisms for mainstreaming sustainability (environmental, social and economic) aspects in affordable housing at national and sub-national levels.

- Technical Reports based on synthesis of primary and secondary data and results from stakeholder consultations.

www.mainstreamingsustainablehousing.org
Thank you.

www.mainstreamingsustainablehousing.org