

The purpose of this document is to guide decision-makers on how to use the GIS-based mapping of various building materials developed as part of the MaS-SHIP project. The application is intended to assist the decision makers make informed choices on building materials and technologies to be used in their sustainable social housing projects. The mapping provides clear information on existing market and the ease of access to these materials.

The materials and technologies being mapped are especially those that are presently less popular in the housing industry, but have the potential to make considerable changes in the sustainable social housing market.

Assessment based on the availability and distance will guide decision-makers to make informed sustainable choices on building material supply and demand.

## Construction Market

The construction sector in India is very diverse and unorganised in nature. About 98% of the construction companies are small and medium scale enterprises. Unlike the manufacturing industry it is not repetitive and is rather unique, project specific and temporary in nature. Construction supply chain comprises material and service chain, each in varying proportions. The services can be varying from designing, civil works, electrical works, mechanical works or labour supply packages. The material diversity is from bulk material like cement, steel, and aggregate to small electrical wires, door frames etc. (Negi, Ahuja, & Baruah, 2017)<sup>1</sup>.

One of the objectives of the MaS-SHIP study has been to evaluate the building materials and technologies against the sustainability criteria of Resource Efficiency, Operational Performance, Economic Impact and User Acceptance. While significant efforts have been undertaken through secondary research on environmental and operational performance, indicators of economic impacts are based on semi-structured interviews with the manufacturers as well as details provided

in the BMTPC Compendium of Projective Emerging Technologies for Mass Housing.

## GIS mapping

As part of the efforts to ensure informed decision making for choice of building materials or technologies, a key aspect that is always considered is distance from the project site and transportation cost of raw material or finished product.

This GIS-based application is aimed at helping developers and decision makers to locate existing building material manufacturers across the country, with basic information given for each manufacturer, such that they can make an informed decision on the choice of material to be used based on estimated distance of the manufacturing unit to the proposed construction site.

The key sustainability criterion in this regard is 'Economic Impact'. Economic impact is defined as the factor/s that influence the financial viability of the building material and technology. As defined in the project, the sub-criteria for Economic Impact comprise of:

1

Negi, M., Ahuja, V., & Baruah, P. (2017). *Sustainable Supply Chain Management in India Construction Industry*. National Conference on Sustainable Supply Chain Management an Indian Perspective.

- a. Cost of construction
- b. Skill requirement
- c. Supply Chain
- d. Duration of construction
- e. Job creation

These sub-criteria are critical aspects that building practitioners and decision-makers keep in mind when suggesting the use of specific building materials in construction of social housing.

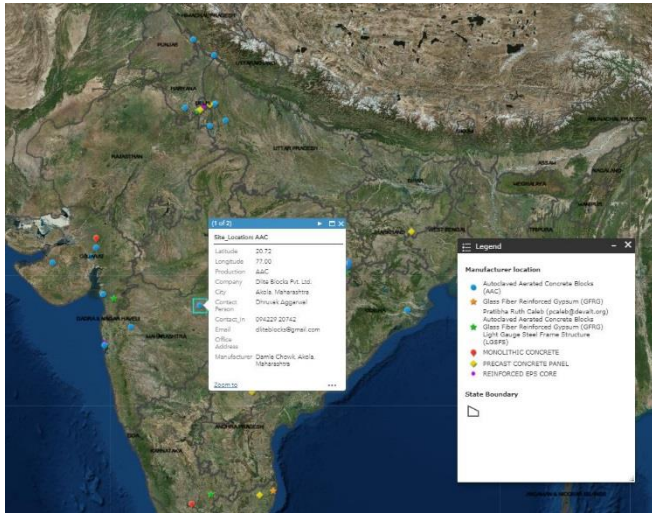


Figure 1: Basic information provided by the building material manufacturer

Based on interviews conducted with manufacturers and information collected from marketing teams of specific manufacturers, a GIS-based application has been developed that provides essential information about:

- Location of manufacturing unit
- Name of product
- Company
- City
- Contact person
- Contact information
- Email id
- Office Address
- Manufacturing unit address

Given the nature of certain technologies (i.e, constructed off-site or on-site), only materials that are manufactured off-site have been mapped.

## Features of GIS Application

### Layers

This widget will provide a list of the materials and technologies that have been mapped. Each material and technology can be removed or put on the map as per the preference of the user.



Figure 2: Layers widget

### Legend



Figure 3: Legend widget

This widget will provide a list of the legend of the materials and technologies that have been mapped.

### Analysis

This widget enables the user to conduct a buffer or influence analysis (Figure 6).

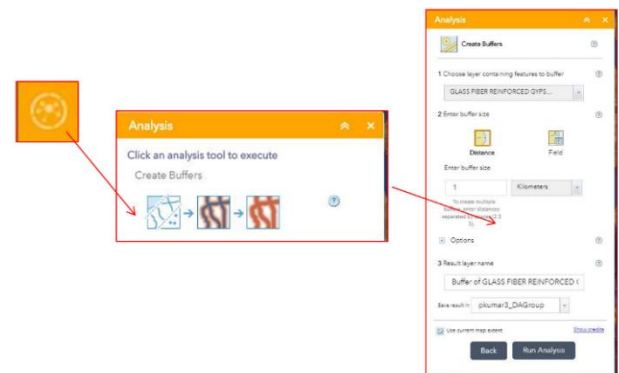


Figure 4: Analysis widget

### Distance and Direction

This widget allows assessing the distance between manufacturing sites and construction sites.

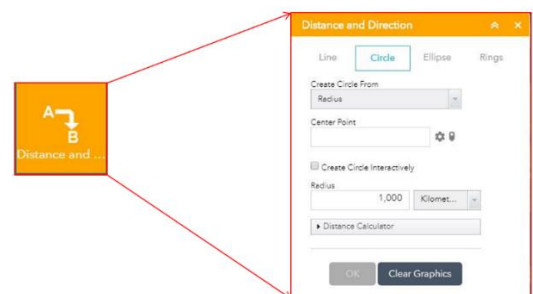


Figure 5: Distance and Direction widget

## Established technologies

These are technologies which have an established evidence of development and practice in the Indian housing market. These include, both the conventional technologies which are most commonly adopted and a few which have been recognized as alternative, environment friendly technologies in the Indian context with some evidence of performance in buildings which may or may not be for housing purpose. Depending on their application process, these technologies can be further categorized as materials available in the market (such as fly ash bricks, AAC blocks, etc.) or technologies practiced through on-site production mostly through semi-mechanized process (such as Compressed Earth blocks, precast RCC plank and joist for roofing, etc.).

Established materials like, fly-ash bricks, hollow/concrete blocks etc., are commonly used materials and a strong market already exists with numerous small manufacturing units setup across the country. Hence, these have not been mapped.

However, a data point incorporated as a part of the GIS application is that of thermal power plants in India. Fly-ash is a waste material from thermal power plants. It has a number of applications in the construction industry, and thus location of manufacturing unit of fly ash bricks as well as distance from source of fly ash is an important factor.

Hence as an indicator for fly ash as a raw material, thermal power plants have been mapped.

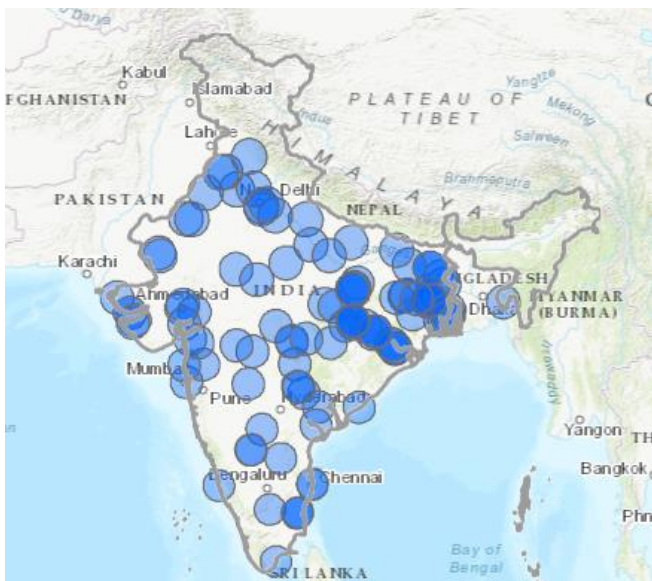


Figure 6: Source of fly ash (Thermal power plants) with a 100km influence shown using the Analysis widget.

Apart from finished products/materials sources from manufacturing units, a number of them are implemented through on-site decentralised production systems mostly at construction sites.

As mentioned in previous reports, it is noteworthy to review these techniques as in certain circumstances they fair better against indicators of resource efficiency, operational performance and economic impacts. Some of these technologies include, ferro-cement roofing channels, precast RCC plank and joist, rat-trap masonry and RCC filler slabs.



Figure 7: Ferro-cement roofing channels (on-site production)

Technologies like precast RCC plank and joist for roofing and ferro-cement roofing channels fall in the hybrid category of semi-mechanised production, as opposed to large centralised production in case of emerging technologies.

## Emerging technologies

These are largely technologies which are being promoted by the Ministry of Housing and Urban Affairs, Government of India, through the Building Materials and Technology Promotion Council (BMTPC) as prospective solutions for faster and cost-effective delivery of houses to meet the target of around 12 million houses by 2022. All technologies in this category are based on a 'production' approach of housing where speed of construction is of prime importance. Hence, the technologies in this category are based on either precast components assembled at site (such as reinforced EPS core panels, large precast concrete panels, etc.) or rapid in-situ processes where large formwork systems are installed at site for rapid construction of houses through casting the entire house in one go.



Figure 8: LGSFS on-site assembly

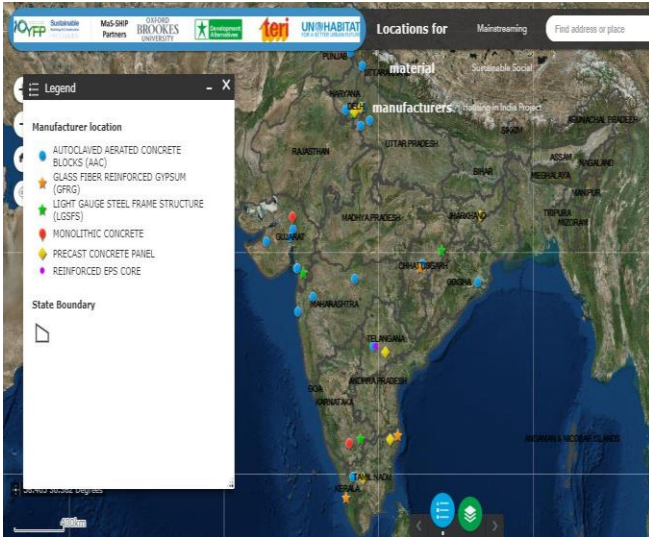


Figure 9: Location of manufacturing units of emerging technologies across India

The key purpose of the GIS-based application is to ensure an active engagement between the manufacturer and the building practitioner in choosing the appropriate building material and technology for any social housing project.

The GIS-based application is aimed to be dynamic and information from verified manufacturers will be fed into the application on a continuous basis.

Link to the GIS- based application:

<https://goo.gl/nVdpz3>

For exclusive access the following details are required:

Username: pkumar3\_DAGroup

Password: pranay@123



## MaS-SHIP

Mainstreaming Sustainable Social Housing Project in India (MaS-SHIP) is a two-year research developed to promote sustainability in terms of environment performance, affordability and social inclusion as an integral part of social housing. Funded by United Nations Environment Programme (UNEP) 10 Year Framework of Programme on Sustainable Consumption and Production (10YFP).

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