

# Architecture & Dwelling



A Sustainable Future for Navi Mumbai through Informal Waste Management  
— sustainable livelihoods for slum dwellers, sustainable development for the city

## *REFLECTION REPORT*

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## INTRODUCTION

During the process of my graduation project, I searched for a sustainable future development trajectory for slums founded on informal waste management (IWM) in the area of Turbhe, Navi Mumbai. At present, India's municipal solid waste management relies heavily on the informal sector. In many Indian cities (e.g. Mumbai, Delhi, Pune, etc.), informal waste management (including a network of informal waste pickers, aggregators, and recycling units) are increasingly being integrated into the overburdened municipal waste systems by collecting, storing, sorting, processing and trading waste materials in the recycling value chain. Every day large quantities of municipal solid waste are transported to slums where they are processed for recycling, providing ecological and economic contributions to Indian cities and supporting the millions of people engaged in this business. This situation is exemplified by the Turbhe area in Navi Mumbai, where thousands of small recycling units in six slums process or recycle hundreds of tonnes of municipal solid waste every day, preventing the city from being overwhelmed by it.

However, despite presenting circular economy features, the existing model of IWM in these slums is not genuinely circular as it comes at the cost of workers' health and environmental pollution. While IWM addresses the explosive growth of municipal waste and provides a foothold for many poor people, workers engaged in IWM often faces the most dangerous and worst working conditions across all economic sectors. In addition, IWM has serious negative impacts on the environment and natural resources (e.g. incineration pollutes water and the atmosphere).

This poses a dilemma for slums in urban India. On the one hand, the current situation of slums does not correspond to the aspirations of dwellers and workers for a better living and working environment, nor the expectations of cities for a better urban image and development prospects; on the other hand, the existence of slums is crucial to the informal economy, which contributes significantly to the livelihoods of slum dwellers and the proper functioning of cities. In order to achieve sustainable urban development and sustainable livelihoods for slum dwellers, it is necessary to explore a new sustainable direction for the future development of slums in Navi Mumbai.

## AIM

As the title suggests, the primary aim of this project is to investigate how IWM can operate in synergy with other informal businesses in a spontaneous socio-economic cluster, and therefore to develop design strategies that can be replicated and applied throughout the city and achieve a win-win situation where the city achieves sustainable development and slum dwellers achieve sustainable livelihoods. The study of sustainability is based on the three pillars of sustainability framework, namely economy, society and the environment (which are also informally known as profit, people and planet). The United Nations has explicitly embedded the three pillars of sustainability framework in its diverse set of sustainable development goals (SDGs), assuming that sustainable development can only be achieved through the simultaneous and equal implementation of environmental, social and economic goals. By illustrating three overlapping circles, this framework suggests that the three pillars of sustainability are not mutually exclusive but rather interrelate and reinforce each other. In addition, the built environment is another focus of the study, as it serves as both an input and an output for informal waste recycling. The built environment can affect the operation and efficiency of the industry; and the recycled materials produced through IWM can be used as alternative materials to reshape the built environment and in turn contribute to the prosperity of IWM and urban housing construction.

Based on this, future development for India's slums must go beyond mere "slum redevelopment" or the provision of affordable housing/mass housing. The failure of many slum redevelopment schemes in India over the last few decades has confirmed this - developers have focused entirely on resettlement strategies for slum dwellers, with little consideration of the informal economy's positive externalities, resulting in the brutal dismantling of otherwise thriving informal supporting networks and vibrant social structures in slums. As ecosystems buzzing with activity, slums cannot simply be replaced by neat low-income housing estates unless they allow for the flourishing of many dynamic economic and social activities and new trajectories of resource use that contribute to sustainable livelihoods. The future development of slums needs to be based on four levels of consideration:

**i) Economically Sustainability:**

To develop a sound operating model for IWM in slums to create healthy work mechanisms and sustainable economic returns for those engaged in IWM, and promote connections between IWM and other formal/informal businesses.

**ii) Environmentally Sustainability:**

To promote circularity through recycling of resources/materials and energy conservation, thereby improving the ecological sustainability and resilience of the slums and the city.

**iii) Socially Sustainability:**

To improve the quality of life of residents, enhance social connections, encourage community participation and develop an inclusive and diverse community based on a range of vibrant socio-economic activities.

**iv) Built Environment:**

to positively influence the above aspects, and be reshaped in turn by the outcomes of the above to create a positive feedback loop.

## METHOD

**i) Theoretical Research:**

The theoretical framework can be subdivided into three groups: slum, informal waste management, and sustainability. Firstly, this study is founded on the existing literature which acknowledges the significance of slums in cities and explores the pros and cons of past slum interventions. The socio-economic complexities behind slums make it challenging to be substituted by other forms of housing. On this basis, this study looks into a new direction for slum redevelopment as an alternative to traditional mass housing. Secondly, the study is based on the existing literature examining the mechanisms of IWM and its contribution to the circular economy in terms of housing. There is a general consensus in the literature that the functioning of IWM involves a broad network of actors. With regard to housing, the contribution of IWM to the circular economy lies mainly in alternative building materials. Thirdly, this study is founded on the three pillars of sustainability framework, which have served as the common foundation for a multitude of sustainability standards and certification systems, as it effectively translates complex sustainability issues into applied focus. On this basis, this study identifies the contribution that housing can make in terms of economic, environmental and social sustainability.

**ii) Empirical Research:**

Taking Dharavi in Mumbai as a precedent, this research analyses the socio-economic mechanism of IWM and its potential contribution to sustainability. By means of research through design (drawing, mapping, etc.), the relationship between IWM and the built environment will be identified. Typological analysis and ethnographic research provides further insight into the

working and living patterns of people engaged in IWM, and they are also used to analyse the roles played by different types of spaces and their impact on this business. Other case studies (such as informal settlements or low-income housing in other Indian cities) help to identify how people use indoor and outdoor spaces for living, recreation, production and commercial purposes.

### iii) Technical Research:

Since the project uses an innovative building material, glass fibre reinforced plastic, as the main structure (beams, columns and floor slabs), a technical study was carried out on its structural properties and costs. The tensile strength, compressive strength, elasticity modulus and local material cost are compared with those of steel, glulam, concrete and brick to confirm its feasibility and advantages. In addition, a study by N. John Habraken on Support and Infill helps to define the construction concept and process for this project.

## RELEVANCE

### i) Economic Aspect:

Compared to landfills and incineration, the waste collection and recycling industry provides 25 times more jobs and generates more economic, social and environmental benefits. Based on a study of the socio-economic complex of the existing slum, this project introduces the concept of Micro Aggregation Economy, which aims to realise an alternative combination of living space, industrial space, and commercial space. This would effectively promote cooperation between IWM and other informal businesses and reduce costs, while enabling a close connection between working and living for slum dwellers. In this way, Micro Aggregation Economy helps to develop a vibrant, inclusive, and environmentally friendly community where informal economic activities thrive, thus empowering people's sustainable consumption and production patterns. In addition, the transformation of the three existing warehouses on the site into factories and their integration into the IWM system further drive economic growth, enabling the slum community to not only provide waste recycling services to the city, but also to supply finished products to the open market, thus providing a stable and diversified source of income.

### ii) Environmental Aspect:

Rapid population growth and accelerated urbanisation have led to solid waste generation explosions in Indian cities, causing severe damage to the environment and public health. The significance for the environment is manifested in two aspects. Firstly, the project improves the existing recycling model in a scientific way by incorporating dry waste into technical cycle and wet waste into biological cycle, alleviating the problem of municipal waste proliferation and reducing environmental pollution. Secondly, the recycled products are used to construct buildings and landscapes, reducing natural resource consumption and addressing problems of shortage of building materials.

### iii) Social Aspect:

Despite their significant contribution to urban India, slums and the micro-businesses within them have been neglected by mainstream groups for a long time. The project looks to secure the basic human rights of the dwellers by improving the living conditions, working systems, amenities and achieving a sense of social recognition. In this way, the research will reconcile economic viability with social equity and environmental protection and provide a comprehensive framework for slums redevelopment. This project also acknowledges the importance of IWM as well as other informal businesses in slums to India's cities, drawing public attention to this neglected sector and attempting to unfold an alternative sustainable development direction for

slums. The research will help potentially set a repeatable, deployable, and culturally acceptable guideline for replicating this model across the city, and indeed throughout India or other third world countries. Considering Navi Mumbai Municipal Corporation's Zero Slum Waste programme and the 100% waste segregation target, this study is even more significant and relevant in Navi Mumbai.

**iv) Scientific and Professional Aspect:**

Much literature has examined and summarised the plight of slums and the poor living conditions of the inhabitants, which makes the public see slums as backward and out of step with modern cities. Few studies have explicitly focused on the resources and benefits provided by slums and explored the impact of spatial factors on economic activities within slums. Given the paucity of research that addresses the issues of waste management through a built environment design lens (including scales of city, community, neighbourhood, building, unit), this design research will be an attempt to contribute to this matter. In addition, the application of alternative building materials (glass fibre reinforced plastic, coconut husk panel, plastic lumber, etc.) made from waste to slums in India is a pioneering and innovative attempt. The study of the physical properties, cost and construction management of these materials as well as the stakeholder analysis will fill research and suggest a possible sustainable trajectory for future slum development in India.

## **NEXT PHASE**

At this stage, my concept and position on the IWM-based development of the Indian slums are well established. However there are still details to be worked out in spatial design that are necessary to create a coherent and convincing story, such as the change in the flow of people throughout the day or the specific furniture/street furniture required for indoor/outdoor space. Another challenge is that a physical model may be needed to visualize certain specific spaces for living and working.

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