

# Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences



## Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners ([Examencommissie-BK@tudelft.nl](mailto:Examencommissie-BK@tudelft.nl)), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Kunzhao Zou
Student number	5263921

Studio		
Name / Theme	AR3AD105 Dwelling Graduation Studio: Global Housing (2021/22 Q1)	
Main mentor	Nelson Mota	Design & Research
Second mentor	Frank Schnater	BT
Third mentor	Vanessa Grossman	Design & Research
Argumentation of choice of the studio	The housing challenge is a global phenomenon as it involves many different dimensions of consideration and affects all regions of the world. For the Global South, housing can take on an even more special significance as it is not only relevant to their lives but also to their livelihoods. In the Global Housing Studio, I want to examine the role and meaning of housing for people in modern society in the Global South through a global perspective, to explore the relationship between individuals and the complexity of urban conditions at different scales, and to look for sustainable design solutions.	

Graduation project	
Title of the graduation project	A Sustainable Future for Navi Mumbai through Informal Waste Management - sustainable livelihoods for slum dwellers, sustainable development for the city
Goal	
Location:	Navi Mumbai
The posed problem,	Presenting features of both the informal economy and circular economy, informal waste management (IWM) in India is faced with the problems of internal vulnerability of slums and external threat from cities.  i. At the slum scale, most informal economy workers (including IWM workers) are placed in a very vulnerable situation due to high occupational

risks, low social protection coverage, and undesirable live-work space conditions.<sup>1</sup> As a result, the existing model of IWM is not genuinely circular as it comes at the cost of workers' health and environmental pollution. In addition, the current chaotic supply and delivery chain leaves workers often exploited by middlemen and without a steady income. The current model also raises collection and transportation costs and reduces the efficiency of the industry. There is an urgent need to improve the undesirable live-work space conditions and the operating model of IWM

ii. At the city scale, urbanisation and rapid urban population growth bring about a shortage of land/building materials, an explosion of solid waste, and the proliferation of slums. Slums have been considered by the mainstream media as spaces that must be cleared because they do not fit in with the image of a world-class city.<sup>2</sup> However, the past slum redevelopment schemes have taken little account of the positive externalities of slums and thus have undermined the informal economy which slums dwellers rely on and cities benefits from.<sup>3</sup> With no space allocated for informal business, the form of high-rise condominiums cuts off the original supporting networks and threaten the vibrant social structure that underlie the flourishing of informal micro-businesses.<sup>4</sup> In addition, the disruption of the supply chains threatens the businesses that employ thousands of slum dwellers and the downstream industries that depend on raw materials and components from the slums.<sup>5</sup> There is a need to find solutions to the urbanisation problems and new strategy to deal with slums.

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<sup>1</sup> International Labour Organization, "Informal Economy: A Hazardous Activity", ILO.Org, accessed 20 October 2021, [https://www.ilo.org/safework/areasofwork/hazardous-work/WCMS\\_110305/lang--en/index.htm](https://www.ilo.org/safework/areasofwork/hazardous-work/WCMS_110305/lang--en/index.htm).

<sup>2</sup> Amitabh Kundu, "Making Indian Cities Slum-Free: Vision And Operationalisation", *Economic And Political Weekly* 48, no. 17 (2013): 15-18.

<sup>3</sup> For example, the redevelopment plan is a disaster for some small businessmen. The shanty factories, which usually avoid tax and regulation, will be demolished and replaced by formal workshops for rent at commercial rates. See: "A Flourishing Slum; Urban Poverty in India", *The Economist* 385, no. 8560 (2007): 92, <https://www.proquest.com/magazines/flourishing-slum-urban-poverty-india/docview/223988167/se-2?accountid=27026>.

<sup>4</sup> This predicament has led some residents to sell their new houses or give them to relatives, and then return to the slums of the city. As architect and urban planner Matias Echanove puts it, "razing Dharavi, or even completely redeveloping it, would only push residents into other slums."

See: Jim Yardley, "In One Slum, Misery, Work, Politics And Hope", *Nytimes.Com*, 2011, <https://www.nytimes.com/2011/12/29/world/asia/in-indian-slum-misery-work-politics-and-hope.html>.

<sup>5</sup> Rina Chandran, "What's A Slum? In India, Dharavi's Thriving Informal Economy Defies The Label", *REUTERS*, 2016, <https://www.reuters.com/article/us-india-landrights-slum-idUSKCN12B28D>.

research questions and

The research question is as follows:  
with the approach of slum redevelopment, how does informal waste management operate (in synergy with other economic sectors) in a spontaneous socio-economic cluster to promote sustainable livelihoods for slum dwellers and sustainable development for Navi Mumbai?

This can be broken down in several sub-questions:

i. Economic Aspect

- How to develop a sound operating model for IWM in slums to create healthy working mechanisms, life-work balance, and sustainable financial returns for people engaged in this business?

- How can IWM positively influence (or be influenced by) other formal/informal businesses, and how do they interact and collectively bring direct and potential economic benefits to the dwellers and the city (generating income or providing inexpensive goods)?

ii. Environmental Aspect

- How can IWM promote circularity through recycling resources/materials and saving energy, thereby improving the ecological sustainability and resilience of the slums and the city?

iii. Social Aspect

- How can IWM improve the quality of life of citizens and slum dwellers (for example, can recycled waste be used as new building materials or daily necessities)?

- How to enable a range of vibrant socio-economic activities grounded in a complex network of IWM and other informal industrials? Furthermore, how can an inclusive community be developed on this basis, increasing its dynamism, diversity, cohesion and interconnectedness?

iv. Housing Aspect

- How does the built environment (including scales of city, community, neighbourhood, building, and dwelling unit) positively impact the above aspects?

- How do the output outcomes of the above aspects in turn reshape the built environment, thus creating a positive feedback loop?

design assignment in which these result.

The internal vulnerability and the external threat have posed a dilemma for slums in Indian cities. 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.

A number of public policies or slum redevelopment schemes that raised massive opposition from current residents (e.g. Dharavi Redevelopment Project in 2004) have suggested that the crude demolition of squatter settlement housing and the relocation of slum dwellers into generic mass housing without taking into account the socio-economic complexities behind the slums need to be challenged.<sup>6</sup> 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.<sup>7</sup>

This design research aims to explore a new sustainable direction for Navi Mumbai's slum redevelopment in which IWM plays a crucial role (but this does not mean eliminating other informal economic activities or excluding the formal sector) in sustainably improving the lives of inhabitants and promoting urban development. The result is a sound waste management system and an economically, environmentally and socially sustainable community which integrate IWM into the circular economy, mitigate the explosive growth of municipal solid waste, achieve technological and biological cycles, and provide inclusive and healthy living environments for slum dwellers.

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<sup>6</sup> Mimi Kirk, "Rethinking India's Slum Resettlement Policy", Bloomberg.Com, 2017, <https://www.bloomberg.com/news/articles/2017-06-09/rethinking-india-s-slum-relocation-policy>.

<sup>7</sup> Chandran, "What's A Slum?".

[This should be formulated in such a way that the graduation project can answer these questions.  
The definition of the problem has to be significant to a clearly defined area of research and design.]

## **Process**

### **Method description**

This study is carried out in four phases, and the research methods used in each phase vary:

#### i. Sustainability

Through literature review, this research will determine the meaning of sustainability in terms of economy, environment and society, and the contribution that housing can make in each aspect. The analysis of precedents will further identify concrete approaches where IWM have a positive economic, environmental and social impact, thereby promoting the lives of slum dwellers and urban development.

#### ii. Mumbai

Taking Dharavi in Mumbai as a precedent, this research will analyse the socio-economic mechanism of IWM and its potential contribution to sustainability. By means of research through design (drawing, mapping, and modelling), the relationship between IWM and the built environment will be identified. Typological analysis and ethnographic research will provide further insight into the working and living patterns of people engaged in IWM, and they will also be used to analyse the roles played by different types of spaces and their impact on this business. The specific impacts of slum redevelopment on IWM will be identified by literature review.

#### iii. Navi Mumbai

By looking at the amount of waste generated per day in each city zone, the proportion of each type of waste, and the number of workers and recycling units engaged in IWM, the contextual research will examine which zones of Navi Mumbai are more relevant. The local policies review will help coordinate between IWM and stakeholders at multiple levels to establish a well-suited operating model.

#### iv. Synthesis

By studying sustainability and the precedent in Mumbai, a mechanism framework for sustainable IWM will be developed to respond to the research question and sub-questions preliminarily. Through a comparative analysis of the urban context of Mumbai and Navi Mumbai, the framework will be modified accordingly and applied to slums in Navi Mumbai, leading to a hypothesis of the future direction for slum redevelopment in Navi Mumbai which will potentially guide architectural practice design.

## **Literature and general practical preference**

The theoretical framework can be subdivided into three groups: slum, informal waste management, and sustainability.

i. Slum

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.

Benjamin, Solomon, and Bhuvanewari Raman. "Democracy, Inclusive Governance, And Poverty In Bangalore". *University Of Birmingham Urban Governance, Partnership And Poverty Working Paper Series*, no. 26 (2001): 250.

Gruber, Denis, Andrea Kirschner, Sandra Mill, Manuela Schach, Steffen Schmekel, and Hardo Seligman. "Living And Working In Slums Of Mumbai", 2005.

Ghertner, D. Asher. "Why Gentrification Theory Fails In 'Much Of The World'". *City* 19, no. 4 (2015): 552-563. doi:10.1080/13604813.2015.1051745.

Hindman, Michelle, Olivia Lu-Hill, Sean Murphy, Sneha Rao, Yash Shah, and Zeqi Zhu. *Addressing Slum Redevelopment Issues In India*. Reprint, International Institute of University of Michigan, 2015.

Andavarapu, Deepika, and David J. Edelman. "Evolution Of Slum Redevelopment Policy". *Current Urban Studies* 01, no. 04 (2013): 185-192. doi:10.4236/cus.2013.14021.

Nallathiga, Ramakrishna. "Slum Redevelopment In Cities: Current Approaches And Alternate Models". *Institute Of Town Planners, India Journal* (2012): 9-2.

ii. Informal Waste Management

This study is also based on the existing literature examining the mechanisms of IWM and its contribution to the circular economy in terms of housing.

Ranede, Shilpa, and Quaid Doongerwala. "'Dharavi-Ground Up': A Dwellers-Focused Design Tool For Upgrading Living Space In Dharavi, Mumbai", 2013.

Veronesi, Mariangela. "Mumbai's Urban Metabolism And The Role Of Waste Management Through Informality", 2016.

Hayami, Yujiro, A. K. Dikshit, and S. N. Mishra. "Waste Pickers And Collectors In Delhi: Poverty And Environment In An Urban Informal Sector". *Journal Of Development Studies* 42, no. 1 (2006): 41-69. doi:10.1080/00220380500356662.

Allen, Cecillia, et al. "On the road to Zero Waste: successes and lessons from around the world." *Global Anti-Incinerator Alliance: Quezon City, Philippines* (2012): 1-88.

Cox, Hugo. "Slumdog Billionaire: Turning Rubbish Into Rupees". RICS, 2021. <https://ww3.rics.org/uk/en/modus/built-environment/construction/slumdog-billionaire--turning-rubbish-into-rupees.html>.

Dey, Sourav. "The Circular Economy Of Dharavi", 2018.

### iii. Sustainability

The research of sustainability is based on the three pillars of sustainability framework, namely economy, society and the environment. And the project BAMB serves as a precedent.

Purvis, Ben, Yong Mao, and Darren Robinson. "Three Pillars Of Sustainability: In Search Of Conceptual Origins". *Sustainability Science* 14, no. 3 (2018): 681-695. doi:10.1007/s11625-018-0627-5.

Barbier, Edward B., and Joanne C. Burgess. "The Sustainable Development Goals And The Systems Approach To Sustainability". *Economics* 11, no. 1 (2017). doi:10.5018/economics-ejournal.ja.2017-28.

"The Three Pillars Of Sustainability And Your Smart City Project". ARC Advisory Group, 2018. <https://www.arcweb.com/blog/three-pillars-sustainability-your-smart-city-project>.

Schroeder, Patrick, Kartika Anggraeni, and Uwe Weber. "The Relevance Of Circular Economy Practices To The Sustainable Development Goals". *Journal Of Industrial Ecology* 23, no. 1 (2018): 77-95. doi:10.1111/jiec.12732.

Braganca, Luis. "SBE19 Brussels - BAMB-CIRCPATH: Building As Material Banks: A Pathway For A Circular Future", 2019.

### iv. Project

The study takes Charles Correa's Artist Village (1986), Raj Rewal's CIDCO Housing (1993), Alison Brooks Architects's Acton Gardens (2015), Ania Jurkiewicz's Urban Super Forest (2016), Metamoorfos Studio's CODHAB Sol Nascente competition (2017), and ISA's Block Party (2018) as precedents.

Chapekar, Priyanka. "Belapur Housing By Charles Correa: A Sense Of Home And Community - RTF | Rethinking The Future". RTF | Rethinking The Future. Accessed 17 January 2022. <https://www.re-thinkingthefuture.com/case-studies/a3735-belapur-housing-by-charles-correa-a-sense-of-home-and-community/>.

"CIDCO Housing – Navi Mumbai -1988-1993 – Raj Rewal Associates". Rajrewal.In. Accessed 17 January 2022. <https://rajrewal.in/portfolio/cidco-housing-navi-mumbai/>.

"Acton Gardens - Alison Brooks Architects". Alison Brooks Architects. Accessed 17 January 2022. <https://www.alisonbrooksarchitects.com/project/acton-gardens/>.

"Urban Super Forest By Super Future Group Imagines Invisible City". Designboom | Architecture & Design Magazine. Accessed 17 January 2022. <https://www.designboom.com/architecture/urban-super-forest-concept-super-future-group-06-22-2016/>.



"Menção Honrosa No Concurso CODHAB Sol Nascente – Trecho 2, Por Metamoofose Studio, Eduardo Martorelli E Bianca De Cillo". Archdaily Brasil. Accessed 17 January 2022. <https://www.archdaily.com.br/br/805831/mencao-honrosa-no-concurso-codhab-sol-nascente-nil-trecho-2-por-metamoofose-studio-eduardo-martorelli-e-bianca-de-cillo>.

"BLOCK PARTY — ISA". ISA. Accessed 17 January 2022. <http://www.is-archite>.

## Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?
2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

1.

My graduation project topic is within the framework of the studio topic 'Mixing Navi Mumbai' which aims to develop an inclusive, sustainable and resilient living environment, but focuses on a more specific and practical issue. The project takes informal waste management as a starting point and seeks to examine and reinterpret the position of this industry in slums and cities through the lens of spatial design. Based on this, the project will explore alternative approaches to deal with Navi Mumbai's housing challenges, attempting to find viable solutions to the proliferation of slums, the explosion of solid waste and the shortage of construction materials in this rapidly expanding city. The result is a new direction for future slum development and waste management in India, which is potentially sustainable for slum dwellers and cities.

By designing solutions crossing multiple scales (city, community, cluster, unit, construction detail), the project will explore the complexity of urban conditions and the relationship between the living environment and the individual. The process will involve consideration of social inclusion, aesthetics, economic efficiency, health, sustainability, and functional needs. This makes my graduation project topic highly relevant to my master track and my master programme.

2.

i. Urban Relevance

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. Compared to landfills and incineration, the waste collection and recycling industry provides 25 times more jobs and generates more economic, social and environmental benefits. In India, where the informal economy is highly thriving, IWM is a viable solution for Indian cities to achieve prosperity and a sustainable urban future. This also responds to Number 12 of SDGs of the UN: ensure sustainable consumption and production patterns.

Taking IWM as a starting point and using sustainable slum redevelopment as an approach, this study seeks to mitigate the conflict between slums and cities and address problems of shortage of building materials and increase in solid waste generation in India. The research will also help potentially set a repeatable, deployable, and culturally acceptable path forward to sustainable development for Indian cities (and cities in other Global South countries in similar situations). 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.

ii. Slum Relevance

Despite their significant contribution to urban India, slums and the micro-businesses within them have been neglected by mainstream groups for a long time. As a result, past slum interventions have always overlooked the livelihoods of the slum dwellers. With IWM as the focus, this study attempts to redesign the model of municipal waste management and develop a vibrant, inclusive, and environmentally friendly community where informal economic activities thrive, thus empowering people's sustainable livelihoods. The study will also look 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 sustainable slums redevelopment.

iii. Scientific and Professional Relevance

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 slum redevelopment, waste management, and sustainability 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.