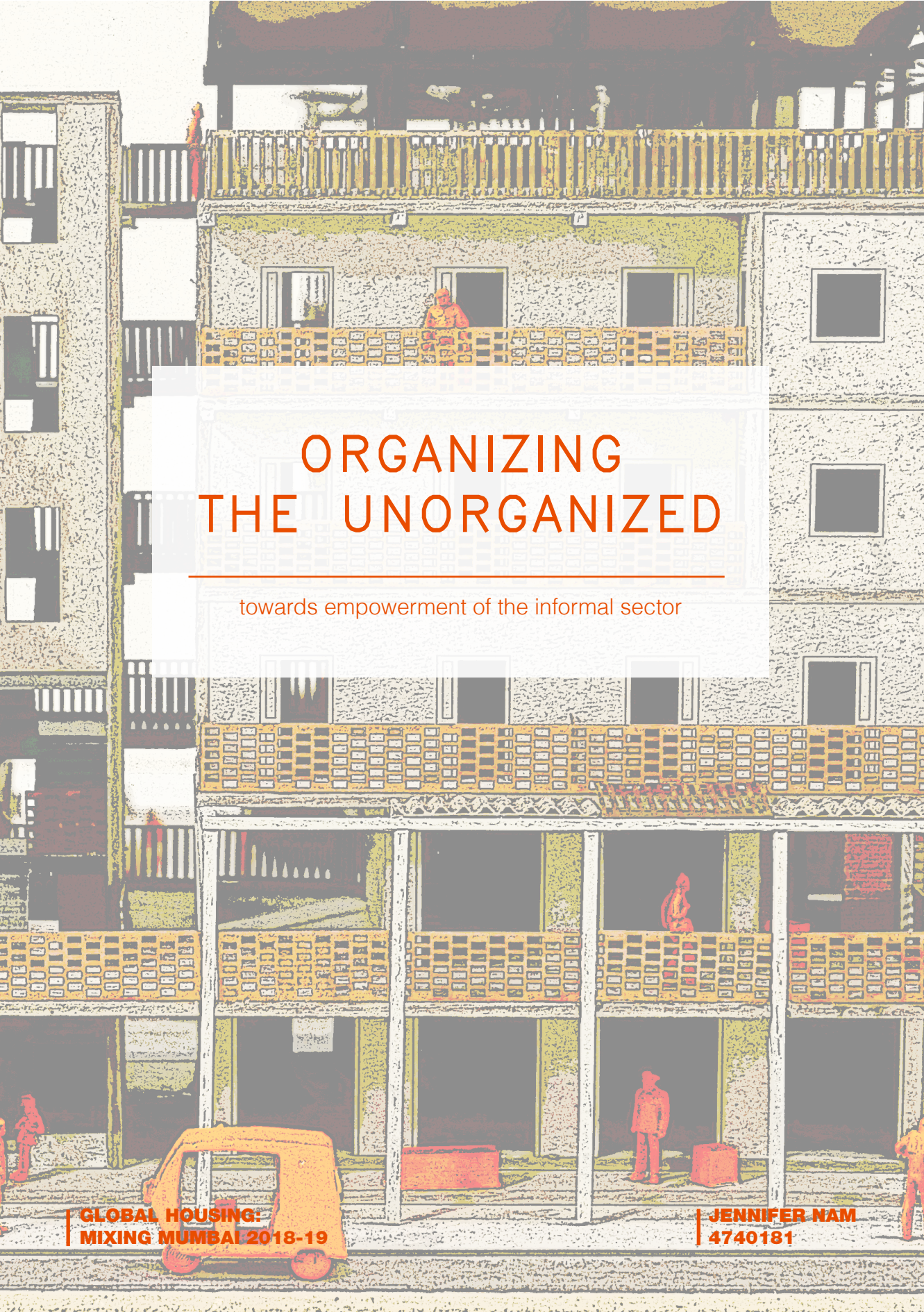


ORGANIZING THE UNORGANIZED

towards empowerment of the informal sector

GLOBAL HOUSING:
MIXING MUMBAI 2018-19

JENNIFER NAM
4740181

ORGANIZING THE UNORGANIZED

towards empowerment of the informal workers

JENNIFER S.W. NAM

Teaching Staff:
Ir. Harald Mooij, Dr. Ir. Nelson Mota
Prof. Ir. Dick van Gameren, Ir. Hubert van der Meel

Delft University of Technology
Faculty of Architecture Urbanism and Built Environment
MSc4 Global Housing: Mixing Mumbai 2018-2019

MOTIVATION

For my final thesis of my architectural study, I wanted to engage myseslf in a project which is not dedicated to a niche group of people but which can make a significant impact on a wider population. In that sense, Global Housing studio was a great opportunity for me to not only broaden my perspectives on what is housing but also what scope of influence housing can have on a community through design. The housing situation in Mumbai--where 42% of the population resides in slums--is so highly complex that it cannot be grasped in few pages and images. Hence I appreciated the fact that the studio is fully grounded in reality and necessitates an in-depth understanding of the current issues as well as historical transformations to establish the foundation of the design process. Though the sitation may be specific to Mumbai in some aspects, what I found fascinating is that much of it is a reoccuring phenomenon relatable to numerous developing countries that face organic growth of formal and informal development in the city, and as a result, blurred territorial edges. As an aspiring architect, my project may just make a small impact in this enormous global issue, yet I am thankful for the amount of awareness I am able to raise through my design.

‘Designs have to be flexible, robust, and ambiguous enough to accommodate *kinetic* qualities’

-Rahul Mehrotra

CONTENTS

1_CITY OF MUMBAI

I. Mumbai

india 10
growth of a city 13
housing situation 19

II. Nalasopara

site location 25
housing forms 29

2_INFORMAL ECONOMY

facts and data 35
preconceptions vs. reality 46
problem statement 47
research question 49
design assignment 50
methodology 51

3_DESIGN RESEARCH

I. Ethnographical Research

patterns of inhabitation 55
stories of informal workers 68

II. Architectural Research

precedents 79

III. Managerial Research

who provides? who decides? 93
community land trust 102
organizational strategy 108

4_DESIGN

design hypothesis 117
site conditions 120
design concept 124
building type 128
development scenarios 138
street conditions 146
urban plan 152
design outcome 158
impressions 168

5_BUILDING TECHNOLOGY

construction in india 195
GFRG construction 197
materiality 214
details 220
comparisons 240
climate 243

6_REFLECTION

future outlook 259
reflection 260

BIBLIOGRAPHY 266

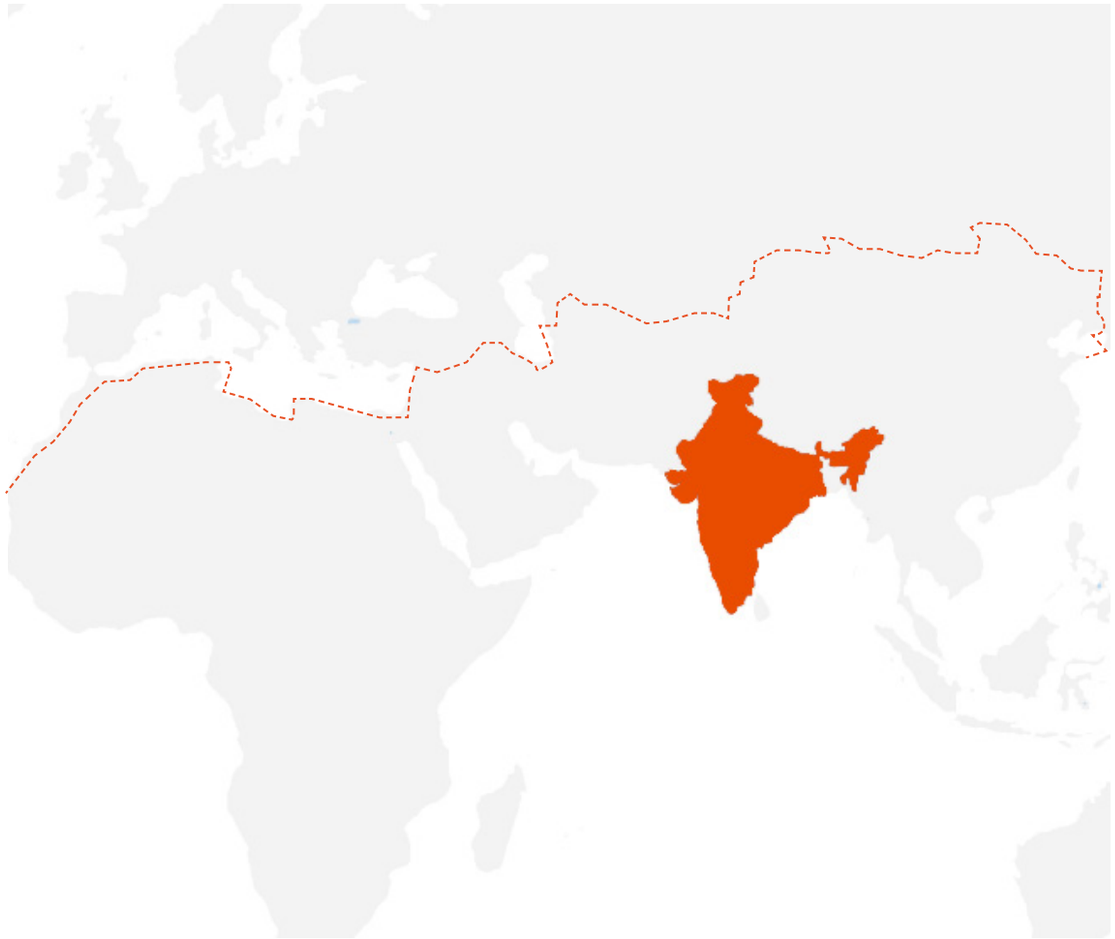


1

CITY OF MUMBAI

INDIA

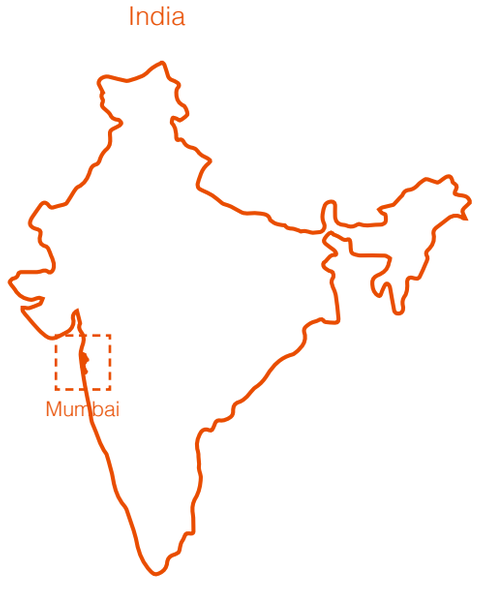
the global south



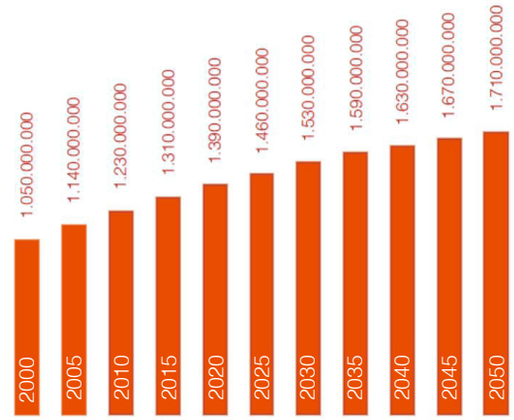
Today, half of the world's population - 3.5 billion people- resides in cities. At this increasingly rapid rate of urbanization, it is estimated that 60% of the world's population will live in urban areas, adding 2,5 billion new dwellers to the current urban population by 2030. In the following decades, striking percentage of 95% of the urban expansion will occur in the developing world in countries like India. To accommodate this overwhelming demographic growth, the world needs to deal with numerous challenges of fair and sustainable urban development. The current urbanization in the Global South is unsustatinable to a large extent. As of 2014, about 850 million people living in slums, which is one-third of all urban dwellers. The current systems of affordable housing production must be urgently revaluated as a major challenge. The stakeholders involved in housing production, in general, and the architecture discipline, in particular, need a critical evaluation of their processes, methods and strategies to answer some pressing questions. Where will all these new urban dwellers live? More importantly perhaps, how will these new urbanites dwell? What will be the role of architects and urban planners in this process? The graduation studio Mixing Mumbai: Affordable Housing for Inclusive Development aims to stimulate the participants to contribute answers to these questions, engaging with pressing dwelling and urban issues in developing territories, as well as with the increasing cross-cultural character of contemporary architectural practice. (Global housing, Course Manual, 2018)

INDIA

population



Area: 3.287.259 km^2
Density: 368 p/km^2



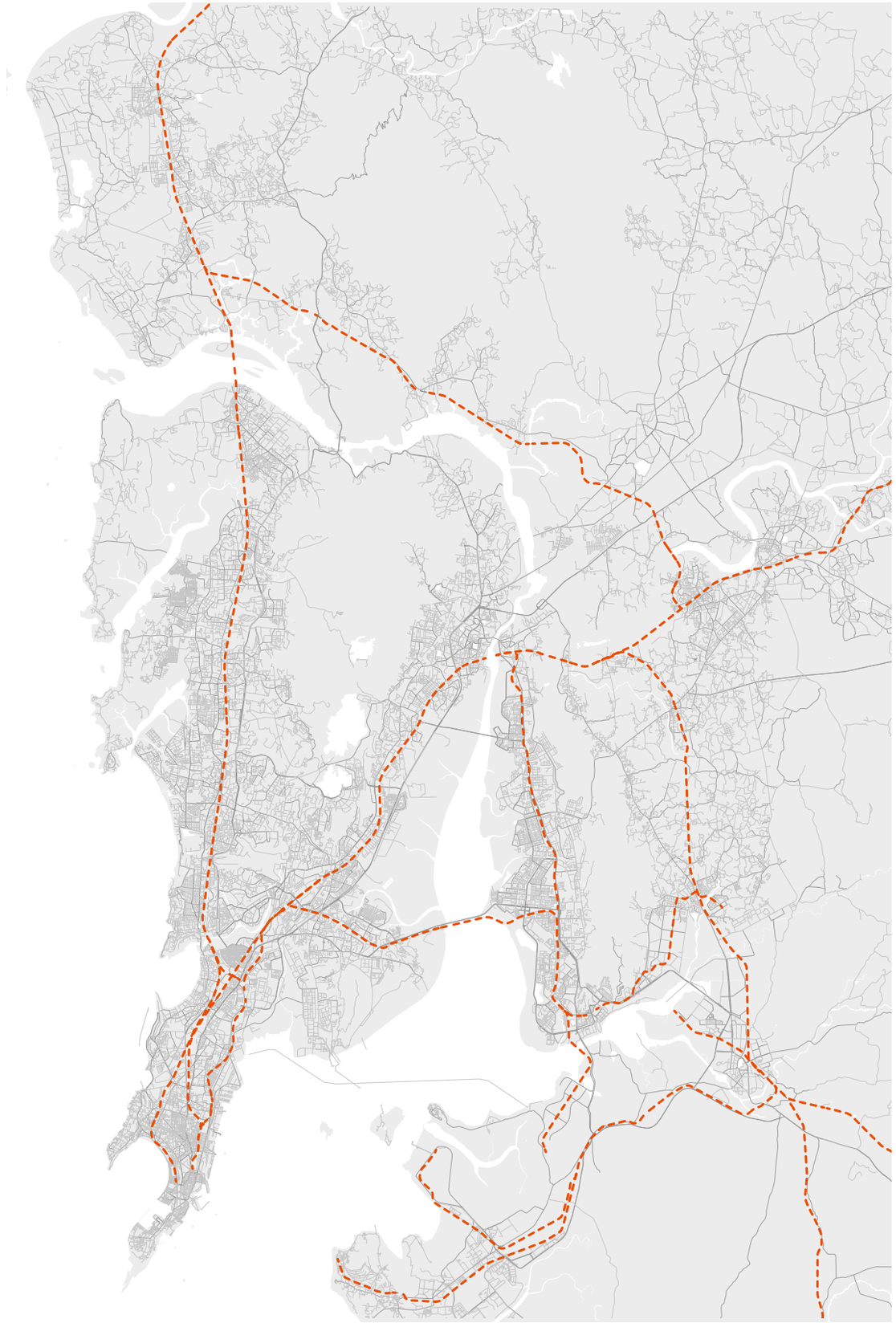
Population of India
Data Source: Class Research (2018)

Cities	2019
Mumbai (MMR)	12.7
Delhi (NCT)	10.9
Bangalore	5.1
Kolkata	4.6
Chennai	4.3

Indian cities by population (million)
Data: World Population Review (2019)

India, located in South Asia, is estimated that its population will reach 1.37 billion based on 2019 UN data. This marks India as not only the world's seventh largest country by area but also the world's second most populous country. 1 of every 6 people on the planet live in India, and between the 2001 and 2011 censuses, the country grew by 17.7%, adding 181.5 million people. The country has doubled in size in just 40 years, and is expected to surpass China as the world's most populated country in the next couple of decades with the yearly growth rate of 1.02%.

India's largest city is Mumbai, with a population of 12.7 million, followed by Delhi, with a population over 11 million. Overall there are more than 50 urban areas in India with a population of more than one million people. (Class Research, 2018, 22)



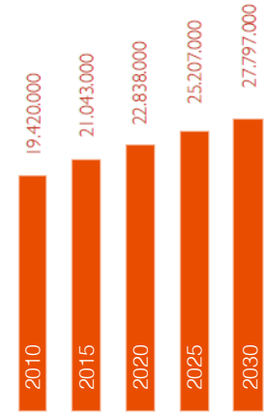
MUMBAI

growth of a city

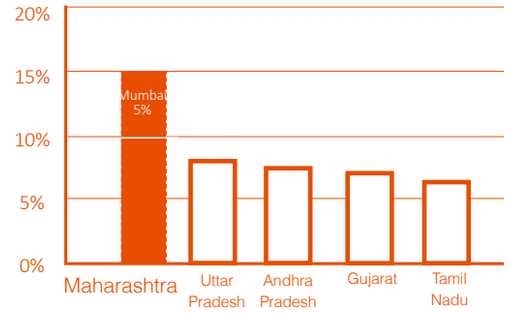
Mumbai Metropolitan Region (MMR)



Area: 4.355 km²
Density: 4793 p/km²



Population of Mumbai
Data Source: Class Research (2018)



Top Five Economies of India
Data Source: Planning Commission of India (2014)

Bombay has established itself as a significant trading post which boosted its economy. Manufacturing and industry became a large component of its economy as they located themselves near the port. American Civil War has led India to become Britain as main source of cotton and the textile industry has expanded quickly as one of the main industries in the city. Economic growth in India was relatively strong during much of 1950s, as the city's manufacturing sector diversified. Bombay textile industry was still prominent, dominated by a small number of large industrial mills, until the late 1950s when the expansion of mills and production was curbed by the policies due to its employment generating capacities.
From the 1970s however, the Bombay's textile industry have declined due to workers' strike and rising operating costs. A new economic model arose during this time from the de-industrialization, and Mumbai has transformed into a center of finance, banking, health care, communications, transport. Despite its transition from manufacturing-based to service-based economy, there was a severe loss of jobs and the informal sector was taking in the remaining mass of previous mill workers who were unable to find jobs in the formal sector. The previous land where mills were located were redeveloped into prime real estate residential complexes and upscale leisure facilities. While the city has grown into a major service provider, the divide between the rich and poor exaggerated as the vast majority of the working class were continuously alienated. (Class Research 2019, 167-9)

HISTORICAL EVENTS



1500-1850
The city founded by the Portuguese empire transitioned to a British rule in 1661. The archipelago was filled in with land and connected in 1838. The nature of Bombay as a a port city with access to global trade boosted its economy and population increased.



1850-1920
Due to the American Civil war, Bombay entered into industrialization period as a supplier of cotton for the British Empire. The textile industry flourished rapidly as one of the major industries in the city. The port and railway system was widely expanded.



1920-1950
Mahatma Gandhi became the leader of the movement of civil disobedience against the British Regime during this period into modernity. Bombay's economy focused on trade and industry, leading to further development of the infrastructure.

URBAN FORM



1600



1920



1909



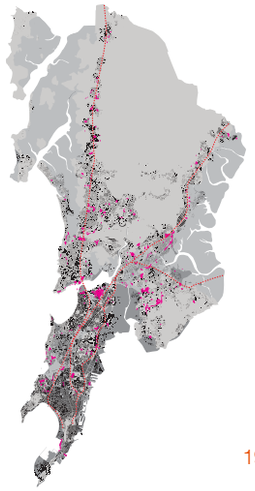
1950-1970
India achieved independence by 1947. The suburbs of Bombay became official part of the 'Greater Bombay District'. Its economy remained strong and manufacutring was diversified. The 5 year's plan was launched to develop agriculture, industry and education among the country.



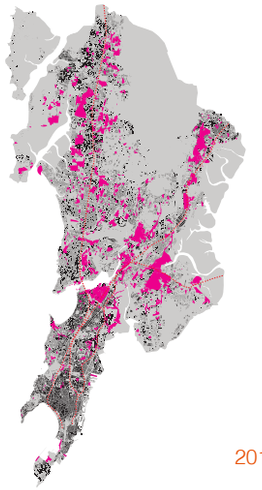
1970-1990
The Shiv Sena party came into power which promoted the Maharashtrians over the migrants. Due to workers' stirikes textile mills declined. Mumbai was transformed into a service-based economy- a center of banking, finance, transport, healthcare and communication.



1990-2010
The city growth was marked by the liberalization and the interests of the private market. Real estate market is stimulated by luxurious developments. Meanwhile slum revelopment schemes were designed to relocate people from the slums in central Mumbai and the city faced a shortage of affordable housing.

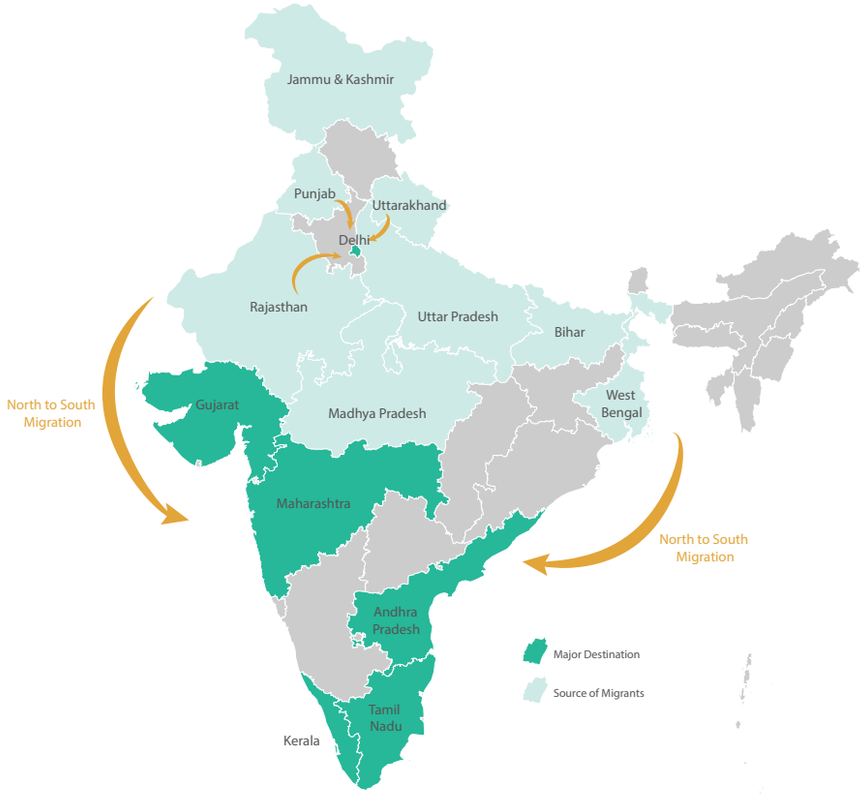


1964



2012

Photo source: Class Research (2019)
Map source: Rohan Varma (2013)



Major Destinations & Sources of Internal Migration in India

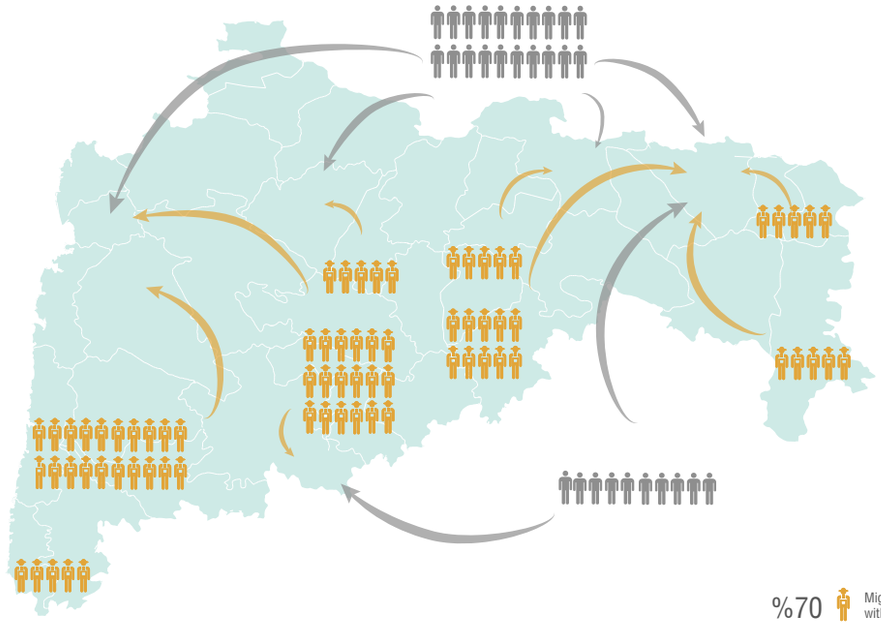
Diagram Source: Class Research 18-19

Mumbai has consistently been an attractive place for work and aspiration due to its recognition as an economic hub and according to different events in history. For instance, a significant number of people migrated to Mumbai as a result of the increase in cotton production. In India at large, there is a significant rural-urban migration and seasonal internal migration due to reasons such as fleeing from poverty, natural disasters, war, religious prosecutions. An example can be found in 1947 when independence of India resulted in an influx of migrants from Pakistan. By 1961, the total population of Mumbai consisted of 64% of migrants. India is about 30% urbanized, while Maharashtra is 45% urbanized (MOHUA, 2019). As shown in the diagram of internal migration in Indi a above, there is a very clear trend of Southward migration, where people from the less affluent Northern states make their way to more affluent states.

The majority of these internal migrants come from rural areas often looking for jobs in the larger cities. Some are part of the group of seasonal migrants who look for work in cities and return to harvest crops in the village, later in the year, while others hope to make the move to the city a longer term decision. These seasonal workers usually work in construction, hotels, textiles and manufacturing, transport and domestic work, to name a few examples, but the lack of provision of dwellings forces them to often live in rented rooms, open spaces, slums, pavements and even their worksites. These trends in seasonal migration persists until today. Zooming into Maharashtra, most of the migrants moving to the big cities are people from within the state, usually living in rural areas. The other 30% are migrants from other parts of the country. (Class Research, 2019, 194)

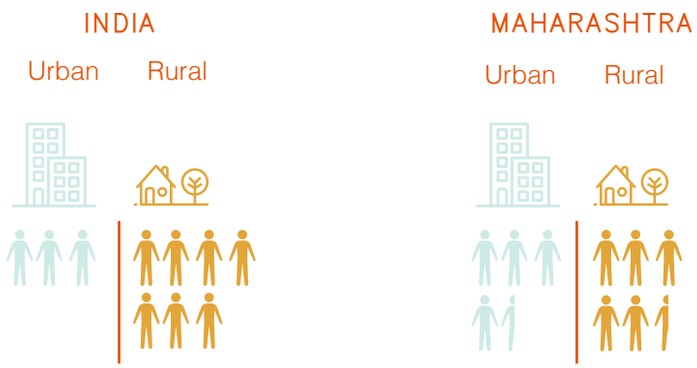
MUMBAI

growth of a city - migration



Migration within and into Maharashtra

Diagram Source: Class Research 18-19

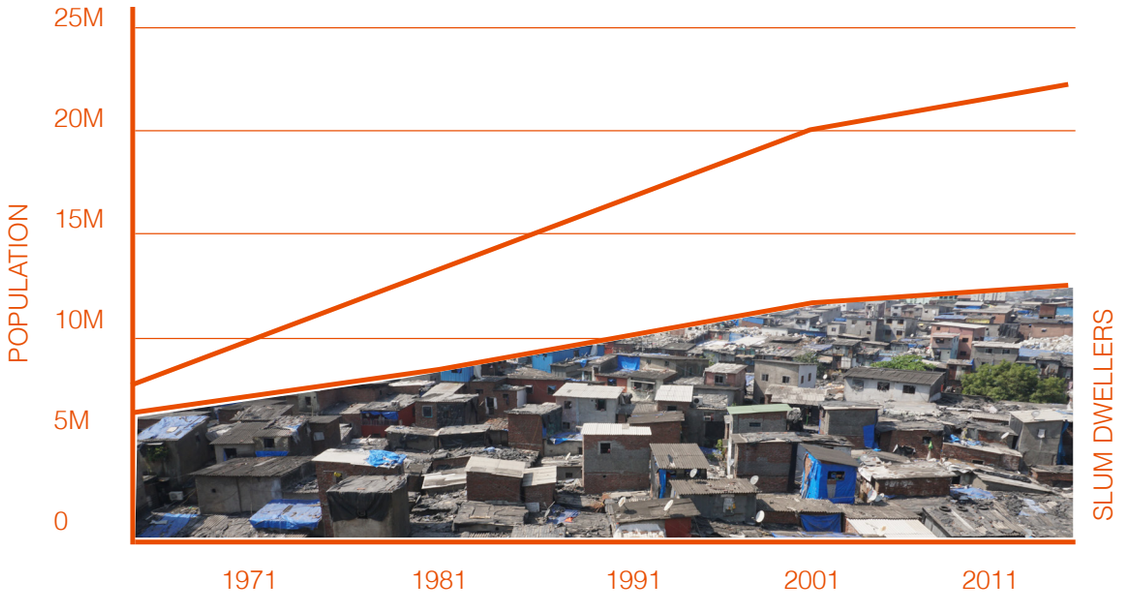


Comparison of Rural and Urban Population in India and Maharashtra

= 10% of Population

MUMBAI

growth of a city - informalization



Population Growth in Mumbai, India
Data Source: Atlas of Urban Expansion (2011)



Labor Division and Income Groups
Digram Source: Class Research (2019)

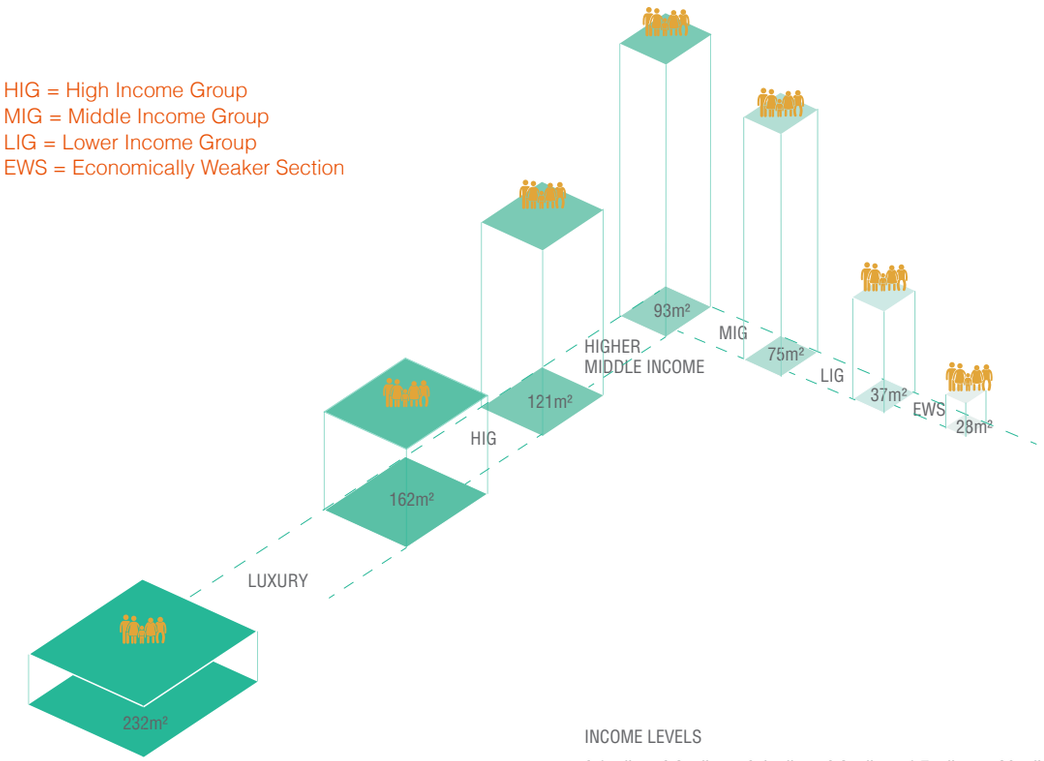
The steady population growth at an annual rate of 2.4 to 3% have resulted in a huge mismatch with the employment growth in the formal sector, which only remained at around 1% rate of increase per year. Because the formal economy was unable to absorb the overwhelming labor pool, this has resulted in a widening gap in the Mumbai's economy that is being filled by the informal economy. The informal sector employment in urban areas is mostly comprised of people who had previously worked in the mills. There is a wide spectrim of occupations that vary from home-based work, driving autorickshaws or petty businesses. The informal or unorganized sector as a source of employment in the urban areas engaged 92% of the total population. (Contractor, 2006, 52)

The land where the mills once stood was turned into prime real estate for residential complexes and upscale leisure facilities (Class Research, 2019, 148). The city transformed from a hub of production to one of services, thereby alienating a vast majority of its working class and skilled labour population. In Greater Mumbai, 42% of the population is living in slums.

MUMBAI

housing situation - income gap

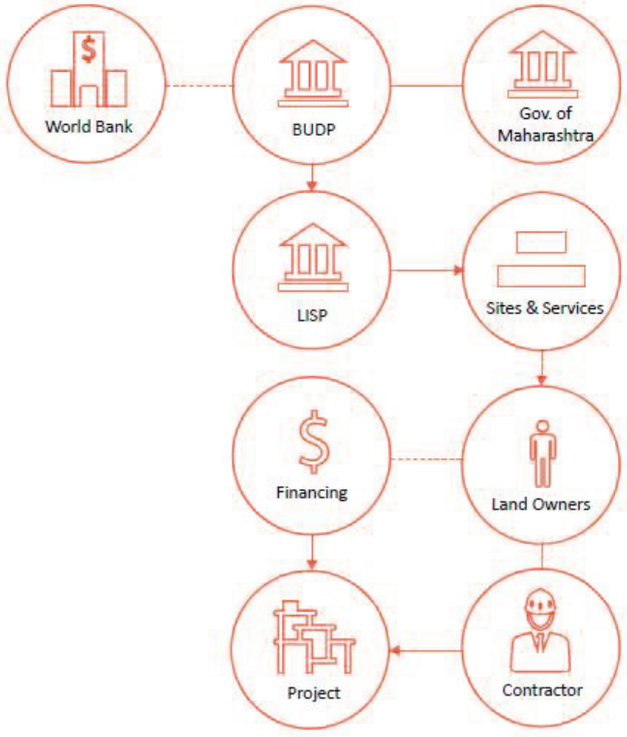
HIG = High Income Group
MIG = Middle Income Group
LIG = Lower Income Group
EWS = Economically Weaker Section



Housing Affordability and Income Group Classification
Digram Source: Class Research (2019)

Affordable housng has become a major policy challenge in urban India over the past few decades. Of the total housing deficit in India 24.7 million in 2007, EWS represents the highest housing need with 21.78 million units. Primarily, the focus has been on fostering private sector participation in providing affordable housing for the EWS and LIG and instituting massing housing for accelerated housing growth. This suggests that the affordable housing sector is rapidly becoming the fastest growing segment in the Indian real estate sector. (Sengupta, 2014, 138)

Since affordability has shifted from a state-led to market provision in the economic reform in 1991 however, it has worsened the widening gap between rich and the poor. It is reflected in the wide range of differences in terms of square meters per household, ranging from 232m² for most luxurious households to 28m² per household in the EWS.



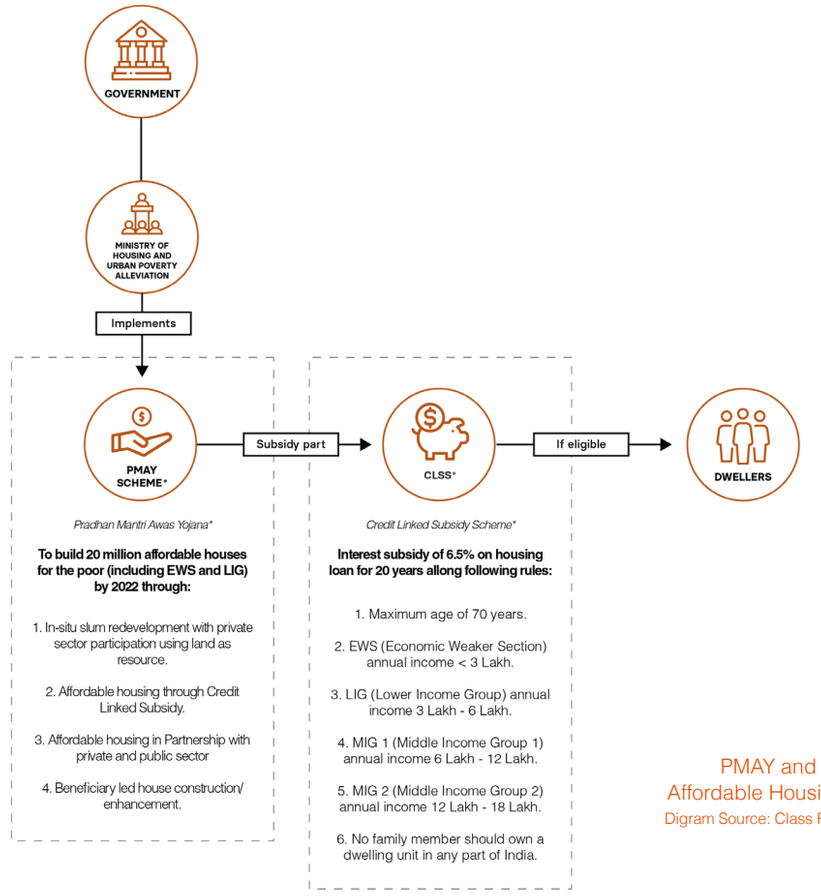
Sites and Services Scheme
Digram Source: Class Research (2019)

Since the economic reform in 1991, the housing sector in India has experienced changes when the affordability has shifted from being *state-driven to market provision*. The following examples show the positives and negative outcomes from the different affordable housing policies from 1947, and after 1991.

Affordable Housing since 1947
Two strategies, sites and services and public housing, which seemingly comprised of contrasting objectives, have defined the social housing landscape in early years. The former *progressive* development was originally pro-poor in concept but in practice, it relied excessively on "neoliberal principles of affordability, cost recovery and replicability to succeed" with World Bank's involvement. (Class Research, 2019, 126) The national output remained lacking as large scale implementation was difficult for its site assembly and local resource mobilization. The principle of progressive development (including those in slum upgrading programs) ran contrary to local building codes and land use regulations, and has been the primary Indian government's approach to affordable housing for many years. Public housing was aimed at income-eligible households at highly subsidized rent. Yet the low overall output, allocation discrepancy and high maintenance cost have proved it not to be an economic approach.
This modernist era is marked by perceiving affordability as a stereotype of how people live in slums. A concept of affordable housing was hence to compress a home into a single room with very basic provision. By the 1980s, National Housing Policy was announced with the government's role as a provider for the poorest group and facilitator for other income groups. (Sengupta 2014: 139-140)

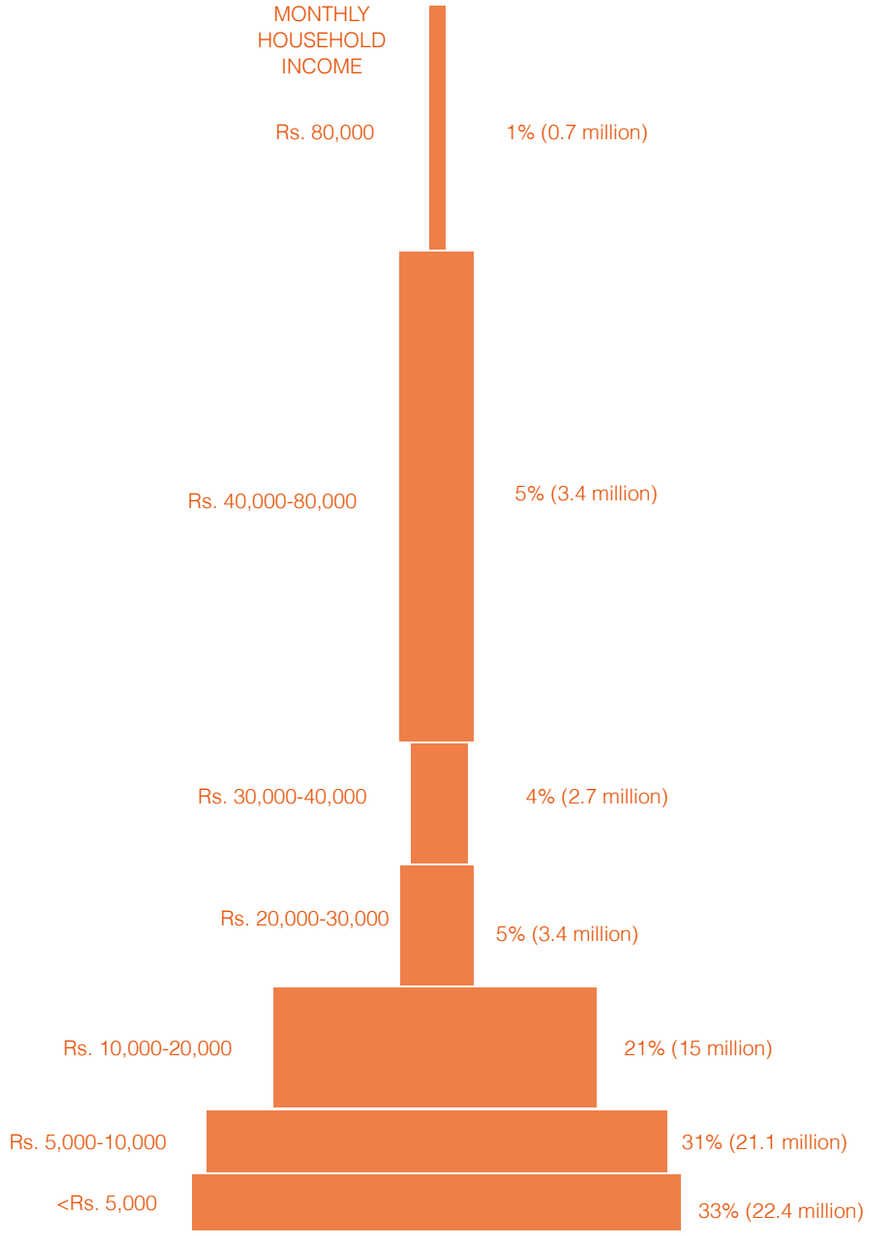
MUMBAI

housing situation - affordable housing



PMAY and CLSS
Affordable Housing Scheme
Digram Source: Class Research (2019)

Housing after 1991
India's housing and real estate market started in 1991 when economic reform led to a multi-dimensional reforms in trade, industry and finance sectors including housing and real estate. With a dramatic rise of GDP from 2000 to 2007, the reform paved the way for relaxing regulatory barriers to encourage private sector participation. A rapid appreciation of property prices led to a higher disposable income raising the purchasing power of a 2 to 5% of the population (60 million). Furthermore as a result of globalization, there has been a dramatic rise of middle class in India up to 30% of the population, which have defined a group of different housing aspirations and lifestyles. Hence the recent housing boom has been accompanied by widening income gap across different income groups and consequent decline in housing afforability for the lowest segment of the population which are up to 54% in majors cities living in slum conditions.
Despite the efforts by the new schemes such as Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Valmiki Ambedkar Awas Yojana (VAMPAY) have led to production of millions of low-cost homes across India aimed at resettling slum dwellers living below poverty line, metro cities in India continue to witness both quantatitive and qualitative housing problems. Public-private partnership (PPP) for example, has been criticized for causing real price appreciation and eventually pricing low-income dwellers out of the system. Due to lack of any normative framework on affordability, private developers are free to determine what constitutes an affordable range. Between 2009 and 2012, developer-initiated affordable housing across indian cities was priced between INR 500,000 and INR 1,000,000. (US$9,090-18,181) (Sengupta, 2014: 140-141)



Urban Income Pyramid in India

Data: MGI (2010) in (Sengupta, 2014)

Recommended Affordability Levels for Different Income Groups

income group	rent to income ratio	cost of housing to income ratio	dwelling size
EWS/LIG	>30%	>4 times household gross annual income	28-56 m^2
MIG	>40%	>5 times household gross annual income	>112 m^2

Housing Categories Scenario in India

housing category	income class threshold in INR	average space consumption per household (m^2)
EWS	<2000	<28
LIG	2,000 - 5,000	37-75
MIG	5,000-10,000	75-93
Higher middle income	10,000 - 200,000	93-121
HIG	200,000-500,000	116-162

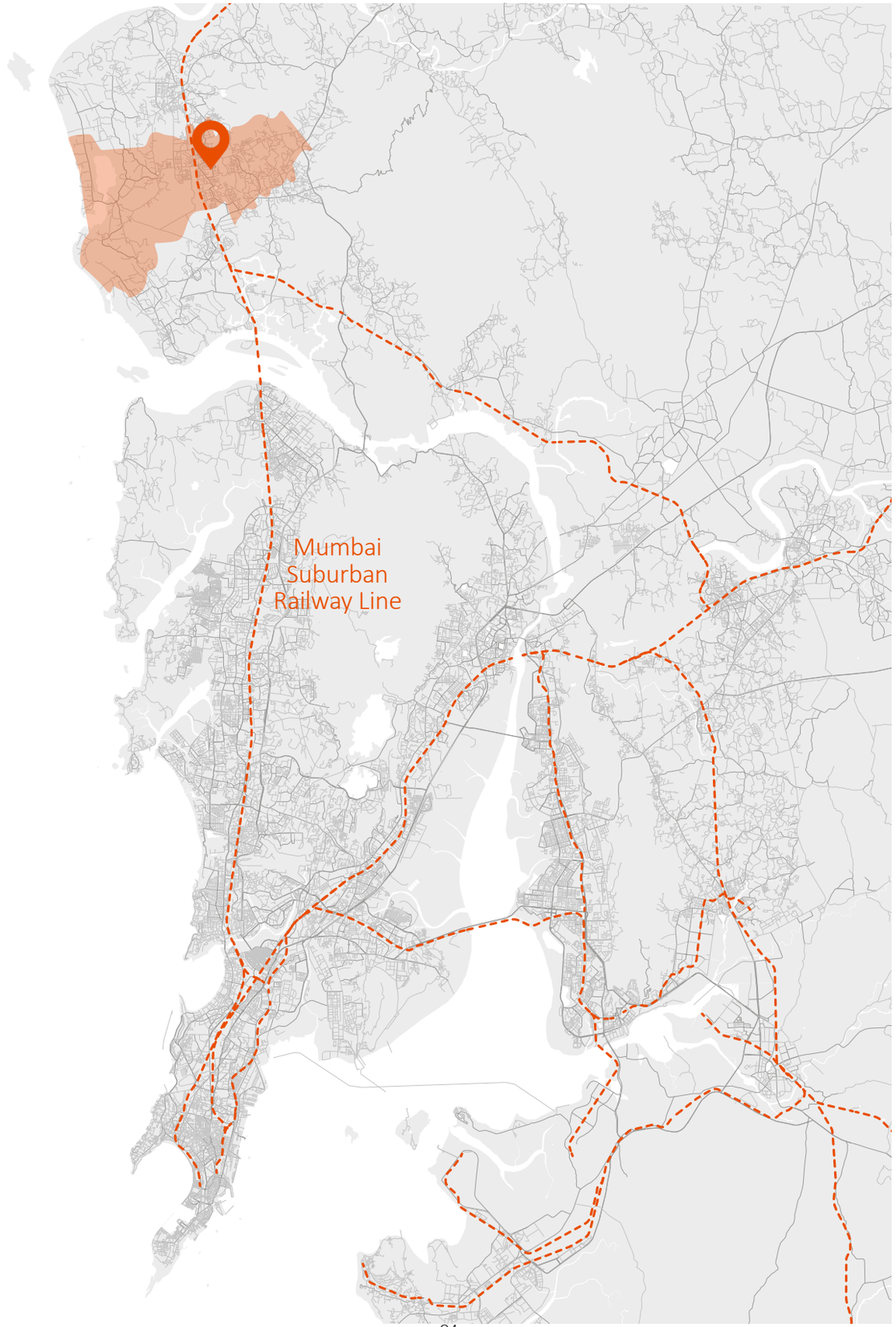
Data: KPMG (2010) in (Sengupta, 2014)

Considering the diverse notions on what comprises affordability and the contextual differences across households in India, there has been efforts to reconstruct perceptions of *affordability* by considering the ratio of price/rent of housing to household income. It prescribes 'affordable housing for all' as keep element to achieve sustainable urban development, taking 'affordability' equation out of the exclusive domain of the 'lowest segment' of the population.

The recommended affordability levels for the EWS, LIG and MIG above recognizes that the housing cost-to-income ratio differs for different income groups and that lower income households pay much less than higher income households.

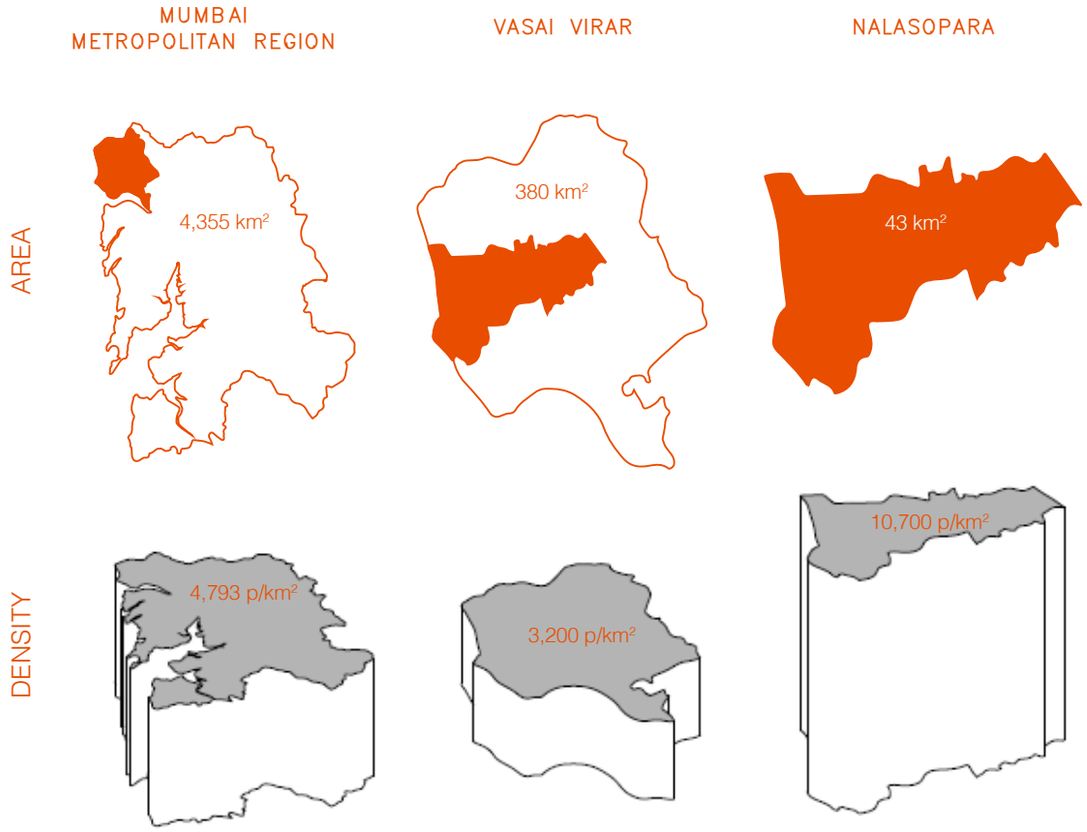
Affordability defined solely as ability to pay ignores the appropriateness in terms of household size, location or different forms of quality such as amenities. It also excludes transaction costs or recurring costs such as maintenance and utility or even cost of commuting to a workplace. Housing for EWS ought to be viewed with the same lens as for the middle or even lower middle glass, but then the remaining sum should be enough for meeting other needs without falling below poverty line.

Household size has been a barometer for affordability in India and the government has shown effort to establish affordability levels. The below chart shows the average size of consumption per household for each income group. These studies offer useful income categories and their market capitalization is based on the size and build costs. (Sengupta, 2014: 142-144)



NALASOPARA

site location



Area & Density

Due to the increasing demand for housing, Mumbai experienced northward urban expansion along the main suburban railway line throughout the years. The project site is Nalasopara, which is governed by the Vasai Virar municipal corporation located in the 57km away from the Mumbai city center. Within an hour of train ride, people in Nalasopara are able to commute to work in the centre of the city. The train is an essential infrastructure which provides great opportunities for the dwellers of Nalasopara to find a place to live which is considerably lower rent price in relation to Central Mumbai while still maintaining their jobs in the city.

As widely known, Mumbai Metropolitan Region is in the top five of the most doest cities in the world. Although the density of Vasai-Virar is lower than that of Mumbai, the density of Nalasopara is astonishingly high when compared side by side. Around 30% of the population of Vasai-Virar is living in an area of Nalasopara, which makes up only 11% of the whole Vasai Virar.

NALASOPARA

site location



WEST



MHADA colony



middle class apartments

EAST



mid-rise redeveloped chawls



low-rise baithi chawls

East vs. West
Nalasopara is divided into the east and west by the railway line. The west has undergone significant infrastructure and real estate and development catering for low to middle income groups. Nalasopara West is being developed mainly by private developers and MHADA. The buildings cater for the low and middle income groups, While the sanitary conditions are adequate, there lacks defined public spaces as well as a general infrastructure of roads and amenities.

The East area is still undergoing a future development. It is currently comprised of low-rise baithi chawls and mid-rise chawls with mostly the low income and economically weaker sector. My site is in the Nalasopara East in the area called Rahmat Nagar which is densely built up.

NALASOPARA

site location



2002



2004



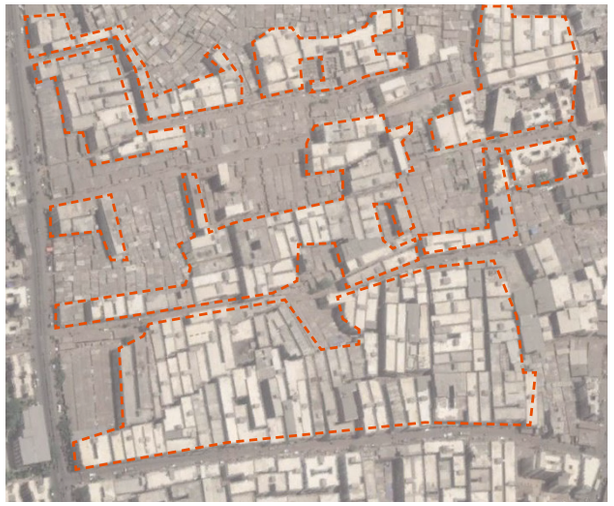
2006

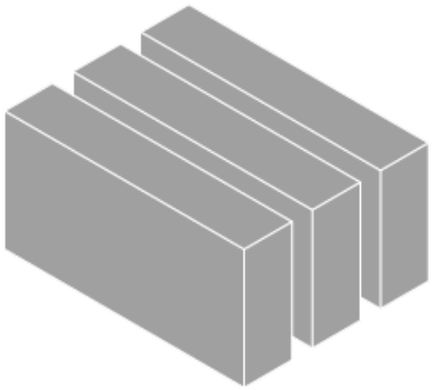


2009

Urban Transformation
Rahmat Nagar area has undergone strong densification in a short amount of time, as majority of the construction has taken place in between 2006-2009. The existing single-storey baithi chawls are part of the formal housing sector, however it is increasingly difficult to distinguish them from the informal housing. As shown above, the baithi chawls have been undergoing a redevelopment into 5 storey slab buildings. This is due to the profit-oriented developers who increase the height and density of the chawls up to 5 times under the same footprint. In consequence, it is left with an urban fabric that is seriously lacking open space in the area. The only seemingly pleasant open spaces are near or part of larger developments. It seems as though the rest is ripe for further development, as it does not appear to hold other agricultural or recreational purpose. These developments contribute dignificantly to the provision of housing for the economically wekaer sector (EWS) and the lower income group (LIG).







Redeveloped Chawls

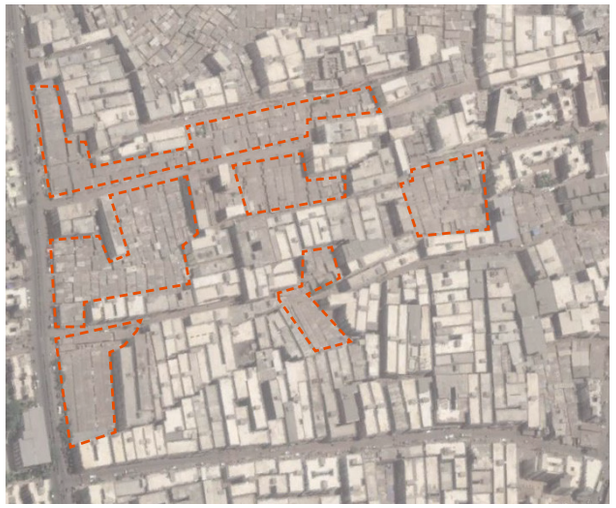
FSI: 3-4
Units per hectare: 1325
People per hectare: 5300
Residents per dwelling: 4
m^2 per person: 3.95m^2
m^2 open space per person: 0.57m^2

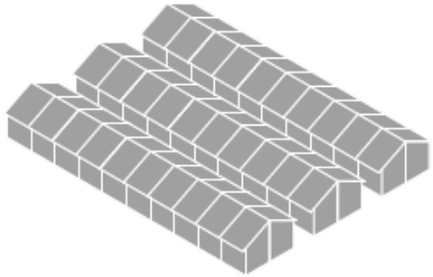
The extrusions visible in the aerial view are the redeveloped mid-rise buildings where the original baithi chawls used to be. They are developed entirely by private groups. These slabs are built extremely close to each other, sometimes with distances of 30cm between buildings. This creates unsanitary conditions of light and ventilation, lacking proper infrastructure and public spaces. The ground floors are mainly used for workshops and storage, and the public space becomes dark, anonymous and repetitive. These dwellings are destined to the economically weaker sector and low income groups who hoped for a better living conditions in a proper concrete ‘buildings’. The level of density up to FSI of 4 is simply unsustainable due to lack of proper open spaces and amenities such as educational, helath and commercial facilities.



NALASOPARA

housing forms





Baithi Chawls

FSI: 0.75
Units per hectare: 325
People per hectare: 1300
Residents per dwelling: 4
m^2 per person: 3.95m^2
m^2 open space per person: 3.0m^2

In between the mid-rise slab buildings there are the remaining ground-storey baithi chawls. Baithi chawl is one of the oldest forms of chawls. Chawl is a very common building type in Mumbai which gained popularity in the 19th-20th centuries to house the textile industry workers. It served as an affordable working class housing which has a strong resemblace to barrack style units: single room tenaments along a gallery or a corridor; they are accessible through small alleys and leaving small ‘shaft-like’ back alleys on the backsides. While chawls were originally permanent housing for male workers in the 1900s, post-colonial chawls were occupied by families who made continuous efforts to transform their units into habitable living space. The alley way serves as a an extension of their small dwelling, as well as a amiable social space. (Chawls and Slums of Mumbai - Tithi Sanyal) Nevertheless the baithi chawl area generally lacks infrastructure, and its low density fails to accommodate the high number of newcomers.



2

INFORMAL ECONOMY



facts and data

Decreased domestic demand
in textile industries

Post-liberaliztion period since 1991

Promotion of labor market flexibility

Rise of competition

Numerical Thresholds

Indian labor laws only apply to enterprises with



10 or more workers

Little incentives for
enterprises to
formalize

Widening productivity gap
between formal and informal
enterprises

higher labor exploitation
and tax evasion

Factors contributing to the expansion of informal economy

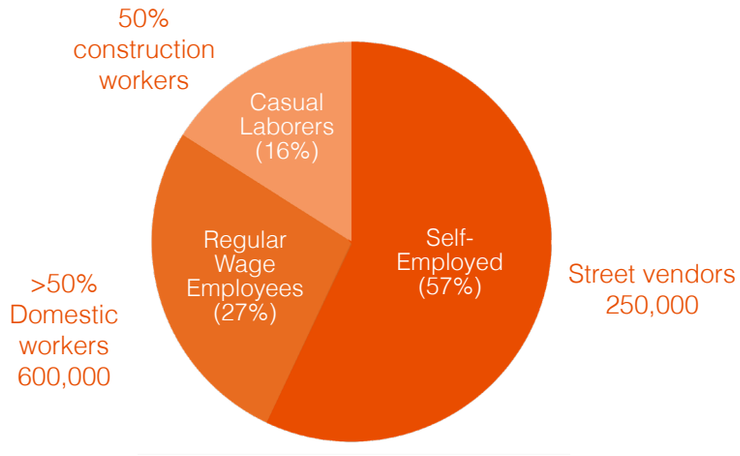
Between 1948 and 1991, economic policies provided incentives for setting up small-scale enterprises through fiscal concessions and reservation policies. Numerical threshold has set up incentives for employers to escape from the provisions of labor regulation by splitting the production into small units, outsourcing into small-scale enterprises in the informal sector or by employing a large number of contract workers. This is because most Indian labor laws are only applicable to enterprises with 10 or more workers for various pensions, health benefits, paid annual leaves, severance pay, etc.

After 1991, economic liberalization policies further deepend the duality of the Indian labor market. During the rise of compeititon in a more liberalized and globalized economy, formal enterprises have increasingly sub-contracted production into the informal sector. Economic reform resulted in the widening of productivity gap between informal and formal manufacturing enterprises, by marking it more difficult for the informal enterprises to compete with formal sector enterprises. This comparative disadvantage created little incentives for informal sector enterprises to formalize, as they would not be able to compete on the basis of productivity once they lose the advantage of higher labor exploitation and tax evasion offered by the informal sector. (Gross & Kharate 2017, 4-5)



INFORMAL ECONOMY

facts and data



Informal Sector Workforce in Urban Areas in Mumbai
Data: NSSO (2014)



Informal Sector Workforce in Urban Areas
Data: NSSO (2014)

Scope

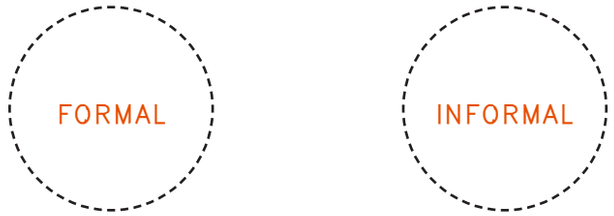
92% of India's total workforce (475 million people) is engaged in informal employment. Informal sector. Informal economy is seen as comprised of all forms of 'informal employment' - that is employment without formal contracts (covered by labor legislation), worker benefits or social protection - both inside and outside informal enterprises including:

- self-employment in informal enterprises
- wage employent in informal jobs
- employees or informal enterprises
- other informal wage workers (ex. casual laborers)
- industrial outworkers or homeworkers.

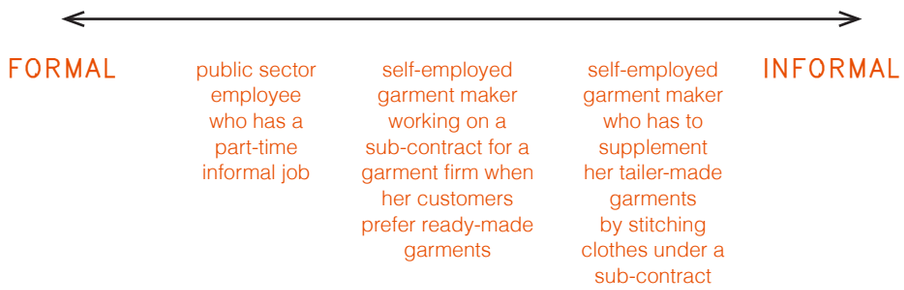
In the informal sector workforce in urban areas, 57% are self-employed, 16% are casual laborers and 27% are regular wage employees.

Informal employment relationships are particularly widespread in the form of contract work, an employment relationship in which workers are not directly employed by the company for which they work but by an external party serving as a contractor. Rise of contract work translates into an informalization of the workforce as most contract workers do not receive any social security benefits and receive much lower pay. (Gross & Kharate 2017, 2-8) Outside agriculture, manufacturing (87%), construction (97%), wholesale and retail trade, transportation (84%) and storage constitute the biggest employer in the informal sector. In the urban areas, 75% are employed in these industries (Raveendran,, Sudarshan, & Vanek 2013)

past
definition:
separate entities



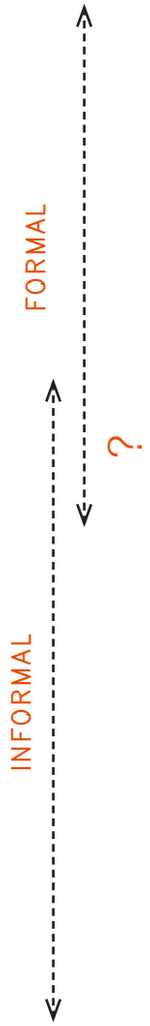
current
definition:
economic continuum



public sector employee who has a part-time informal job

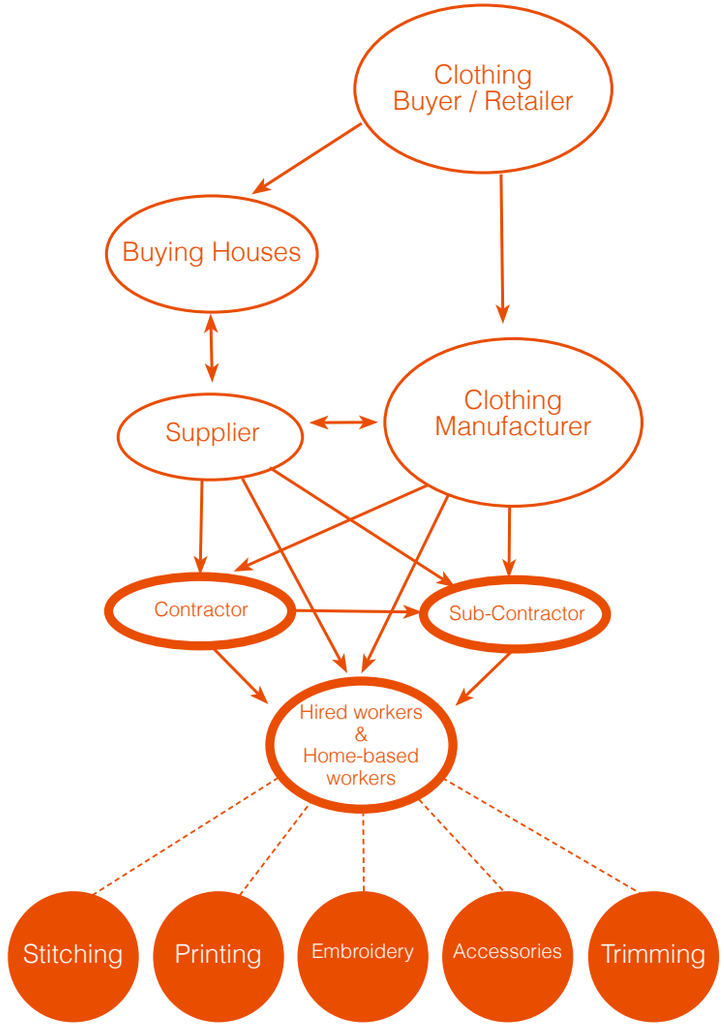
self-employed garment maker working on a sub-contract for a garment firm when her customers prefer ready-made garments

self-employed garment maker who has to supplement her tailer-made garments by stitching clothes under a sub-contract



INFORMAL ECONOMY

facts and data



Significance and Permanence
The informal economy is recognized to be growing and it is not a short-term but a permanent phenomenon. Also it is not just a traditional or residual phenomenon but a feature of modern capitalist development, associated with both growth and global integration. For this reason, the informal ecoomy needs to be seen not as a marginal or peripheral sector but as a basic component of the toal economy. (Chen 2006)
In the past the informal and formal sectors were considered based on the dualistic theory that they are two distinct economic sectors without direct links to one another. The reality however, is far more complex. To begin with, production, distribution and employment relations tend to fall at some point on a continuum between pure ‘formal’ relations at one pole and pure ‘informal’ relations at the other. Depending on their circumstances, workers and units are known to move with varying ease and speed along the continuum and/or operate simultaneously at different points on the continuum.
Moreover, the formal and the informal ends of the continuum are often dynamically linked--it produces for, trades with, distributes for and provides services to the formal economy. For instance, many informal enterprises have production or distribution relations with formal enterprises, supplying inputs, finished goods or services either through direct transactions or sub-contracting arrangements. Also, many formal enterprises hire wage workers under informal employment relations. For example, many part-time workers, temporary workers and homeworkers work for formal enterprises through sub-contracting arrangements. (Chen 2016)

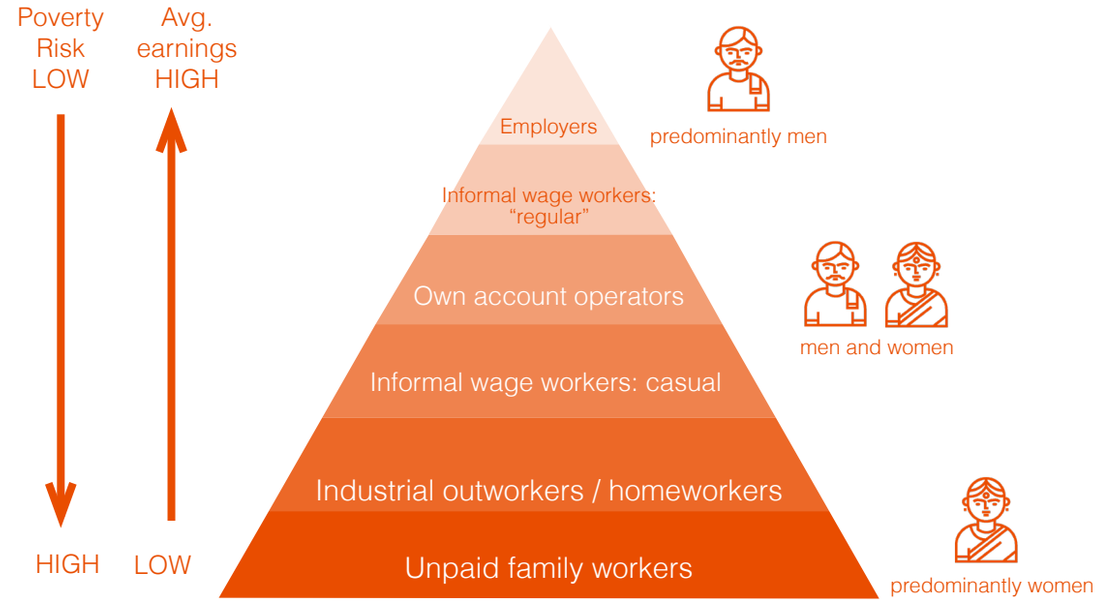
Characteristics of Informal Garment Workers
Take the garment industry for example, is one of the sectors with “almost complete informalization of work force with only a tiny section of formal workers”. (Gross & Kharate 2017, 9) Textile and garment industry in India directly and indirectly employs more than 45 million people: it is country’s second largest employer after agriculture (Unni & Scaria 2010). Outsourcing of orders by a large garment manufacturers have led to a growth of small-scale garment units in urban slums. (Gross & Kharate 2017, 14)





INFORMAL ECONOMY

facts and data



Informal Employment: Hiearchy of Earnings & Poverty Risk by Employment Status & Sex

Data: WIEGO (2004)

Segmentation

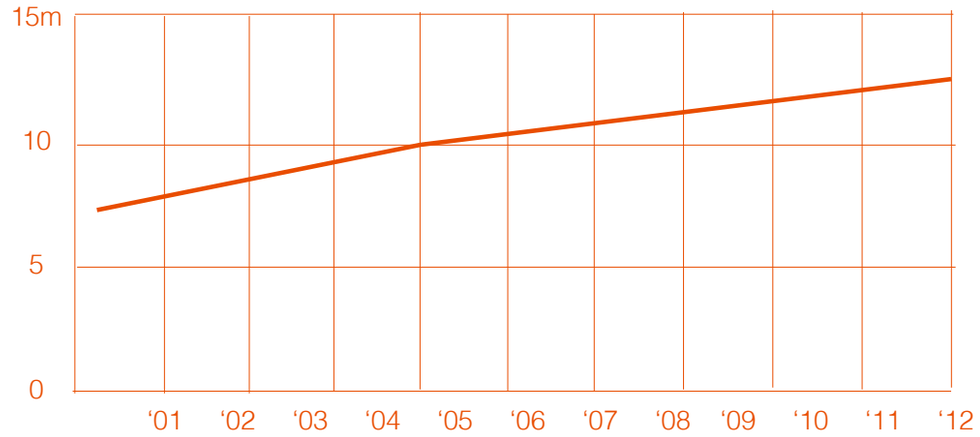
The informal economy consists of a wide range of informal enterprises and informal jobs. The diagram above graphically classifies the universe of informal employment. The shape of the pyramid is supposed to depict the 'visibility' of the various segments of the informal economy. From the top of the figure is the most visible and well-known segment of employers/microentrepreneurs, and at the base is the least visible and least understood segment--homeworkers. It is a global fact that there are significant gaps in wages or earnings within the informal economy around the world; on average employers have the highest earnings; homeworkers have the lowest, and own account workers and wages workers earn somewhere in between, depending on the economic sector and country.

The net result is a significant gender gap in earnings within the informal eonomy, with women earning less on average than men. Adding on to this point is that men tend to be over-represented in the top segment and women tend to be over-represented in the bottome segment. The shares of men and women in the intermediate segments tend to vary across sectors and countries, yet women tend to be over-represented as unpaid family workers. One of the reasons for this gender segmentation is that men and women are employed in different type of acticities and associated with different levels of earning. This can be explained by the fact that men tend to have better tools of the trade, operate from better work site/spaces and have greater access to productive assets and financial capital. In addition, or as a result, men often produce or sell higher volume or a different rage of goods and services. (Chen 2016)



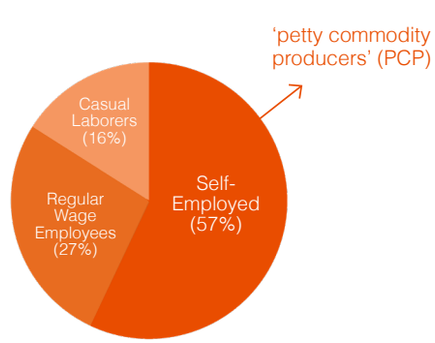
INFORMAL ECONOMY

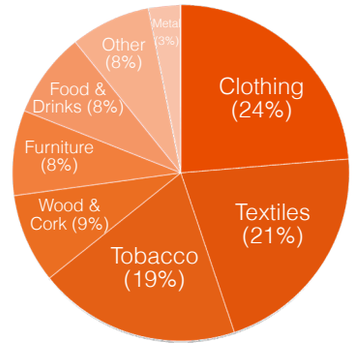
facts and data



Est. Number of Home-based Workers in India

Data: WIEGO

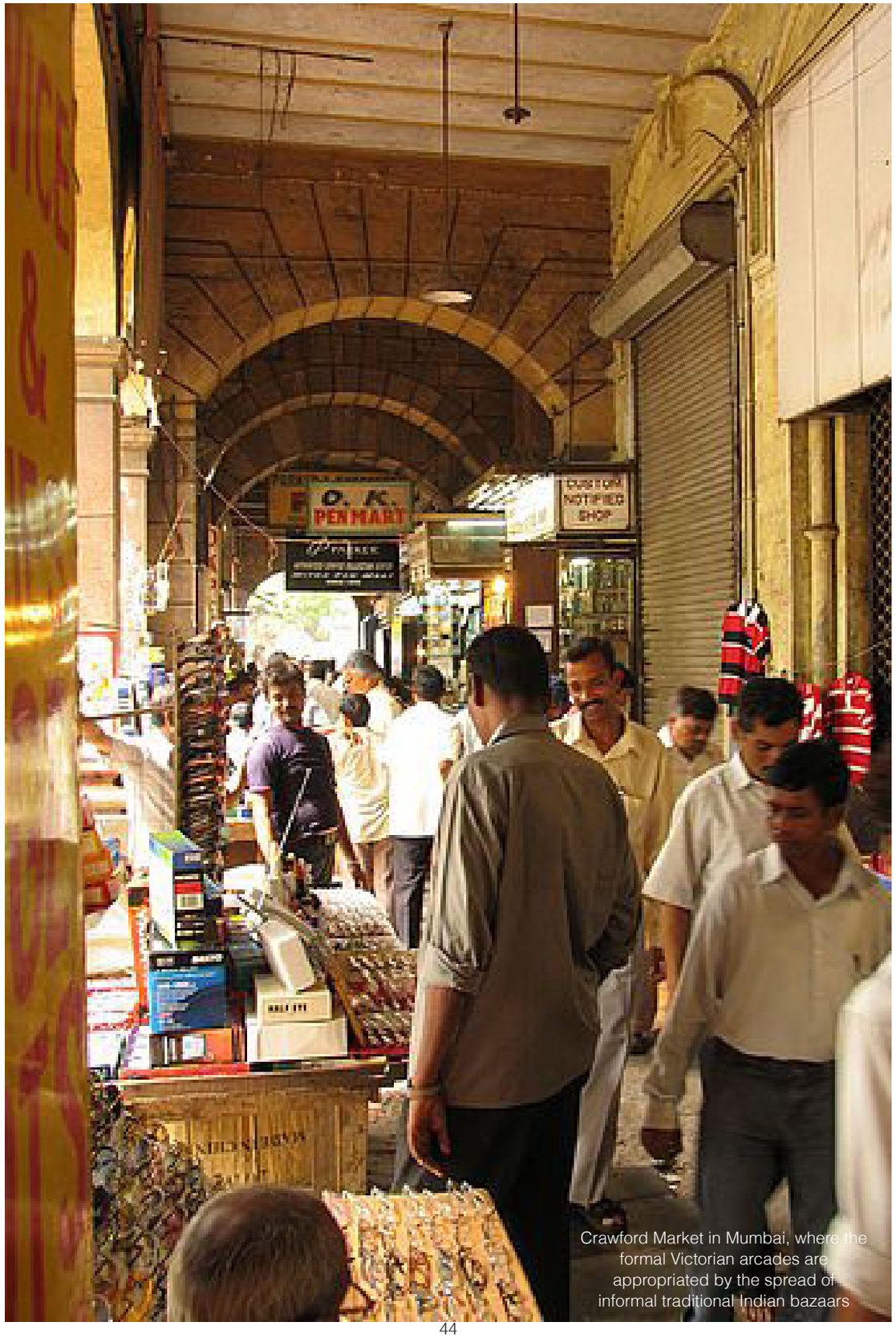




Top Manufacturing Jobs among Home-based Workers in India

Home-based workers are category of workers who carryout remunerative work in their own homes or adjacent grounds or premises. Some home-based workers are independent self-employed workers who take entrepreneurial risks. Other home-based workers are dependent on a firm or its contractors for work orders, supply or raw materials and sale of finished goods.
Second category of home-based workers is referred to as sub-contracted workers, also nown as homeworkers. Since they are not directly supervised by an employer and provide their own workspace and equipment, they are often classified as self-employed. At the same time they are dependent on a firm or its contractor for work orders, raw materials and sale of finished goods, and thus sometimes classified as wage workers. (Raveendran,, Sudarshan, & Vanek 2013)

During the 12 year period, the number of home-based workers increased significantly, from 7 million in 2001 to 13 million in 2012 as shown in the figure above. Home-based workers are thus a significant and increasing part of the Indian labor force. Especially for women, home-based work is an important source of employment. Nevertheless, women do not see themselves as ‘workers’ as home-based work becomes part of housework. Hence the toilsome production work they do become as invisible as housework does. Women’s work is for a supplementary income for the family which often gets missed out. Women are invisible workers receiving no economic returns from their labor and the inadequate working conditions result in ruined eyesight, backache or even tuberculosis. (Contractor 2016: 53-55)



Crawford Market in Mumbai, where the formal Victorian arcades are appropriated by the spread of informal traditional Indian bazaars

INFORMAL ECONOMY

co-dependence of formality - informality

INFORMAL ECONOMY + FORMAL ECONOMY = ONE ECONOMY

According to Rahul Methora's The Kinetic City, Indian cities include two components occupying the same physical space: static and the kinetic city. While the static is a monumental two-dimensional entity on conventional city maps, kinetic is a three-dimensional construct of incremental development, temporary in nature, not perceived as architecture but in terms of spaces which hold associative values and supportive lives. Kinetic city presents a compelling vision that enables us to better understand the "blurred lines of contemporary urbanism", context of increasingly inequitable economic conditions and the changing roles of people and spaces in urban society. (Mehrotra 2008, 205-18)

Informal economy of the city illustrates the intertwined existence of static-kinetic cities. Working in the Kinetic City is an autonomous and oral process that demonstrates the ability to fold the formal-informal into a symbiotic relationship, as the formal and informal are dependent on one another. These networks together can create a synergy that depends on mutual integration without the obsession of formalized structures. For economies for any countries, formal and informal sector should be both considered for sustainable economic growth.

PRECONCEPTIONS VS REALITY

Informal sector is the tradition-al economy that will fade away with modern, industrial growth	Informal economy is permanent and expanding with modern, industrial growth
It is only marginally productive	It is a major provider of employment, goods and services for lower-income groups. It contributes a significant share of GDP
It exists separately from the formal economy	It is linked to the formal economy - it produces for, trades with, distributes for and provides services to the formal economy.
It represents a reserve pool of surplus labor	Much of the recent rise in the informal employment is due to the decline in formal employment or to the informal-ization of previously formal employ-ment relationships.
It is comprised of mostly street vendors and very small-scale producers	It is made up of wide range of informal occupations - both ‘resilient old forms’ (ex. casual day laborer in construction and agriculture) and ‘emerging new ones’ (ex. part-time jobs and home work for high-tech industries)
Most of those in the sector are entrepreneurs who run illegal and unregistered enterprises in order to avoid regulation and taxation	It is made up of non-standard wage workers as well as entrepreneurs and self-employed persons producing legal goods and services.
Work in the informal economy is comprised of mostly survival activities and thus not a sub-ject for economic policy	Informal enterprises include not only survival activities but also stable enterprises and dynamic growing businesses and informal employment includes not only self-employment but also wage employment. All forms of informal employment are affected by most economic policies.

Source: Chen (2006)

DOMINANT NARRATIVES OF

”ILLEGALITY”

”POVERTY”

”TEMPORALITY”



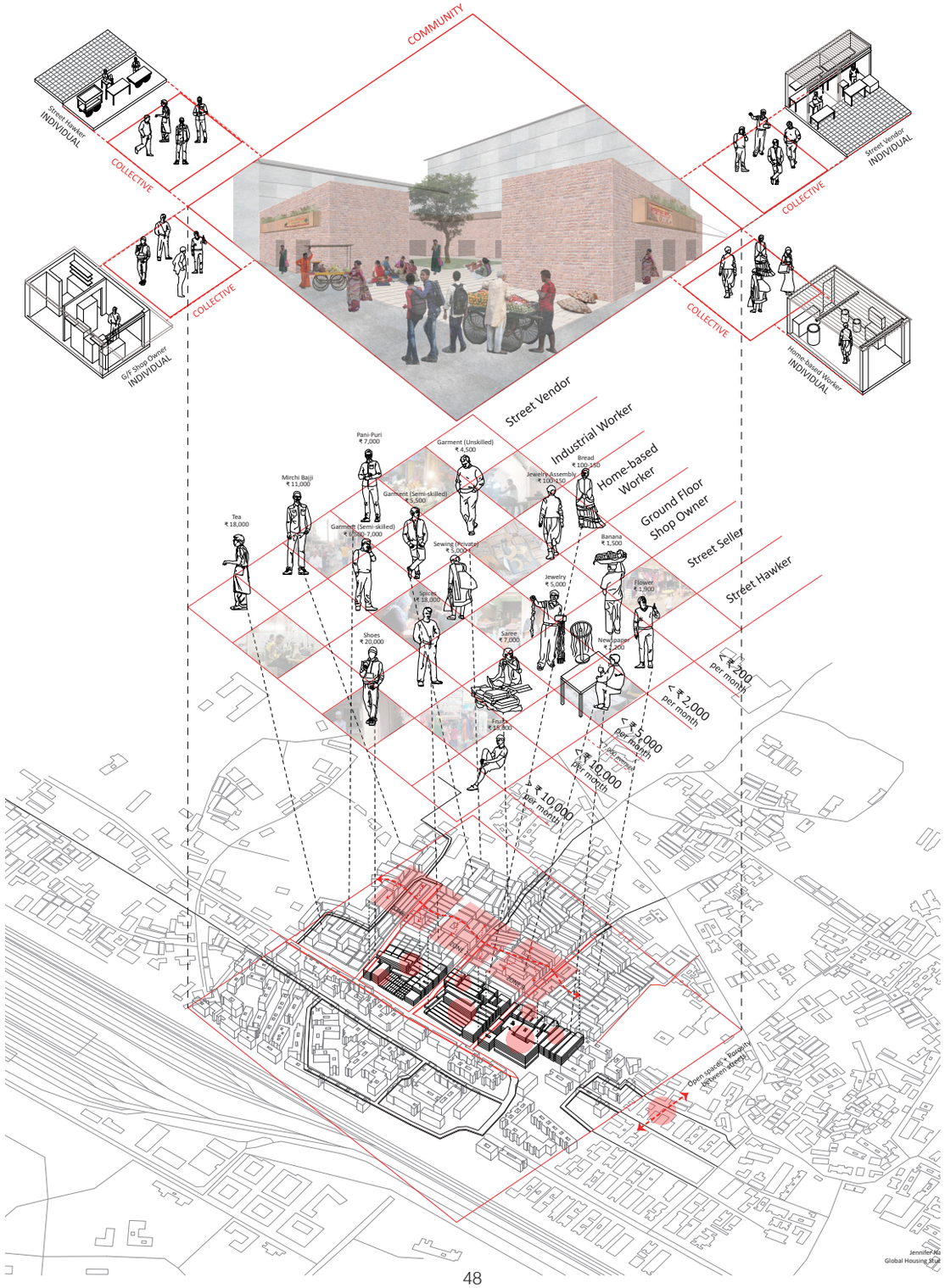
LACK OF IDENTITY



ECONOMIC HARDSHIPS



STANDARDIZED DWELLINGS



RESEARCH QUESTION

How can the informal workers' diverse socio-economic pursuits be achieved by affordable housing which incoporates controlled participation and efficient construction to improve both density and quality?

subquestions:

How can income-generating space and habitable space coexist in low-income housing?

What are the qualities of communal space that can encourage a sense of community and empowerment among the informal workers?

DESIGN ASSIGNMENT

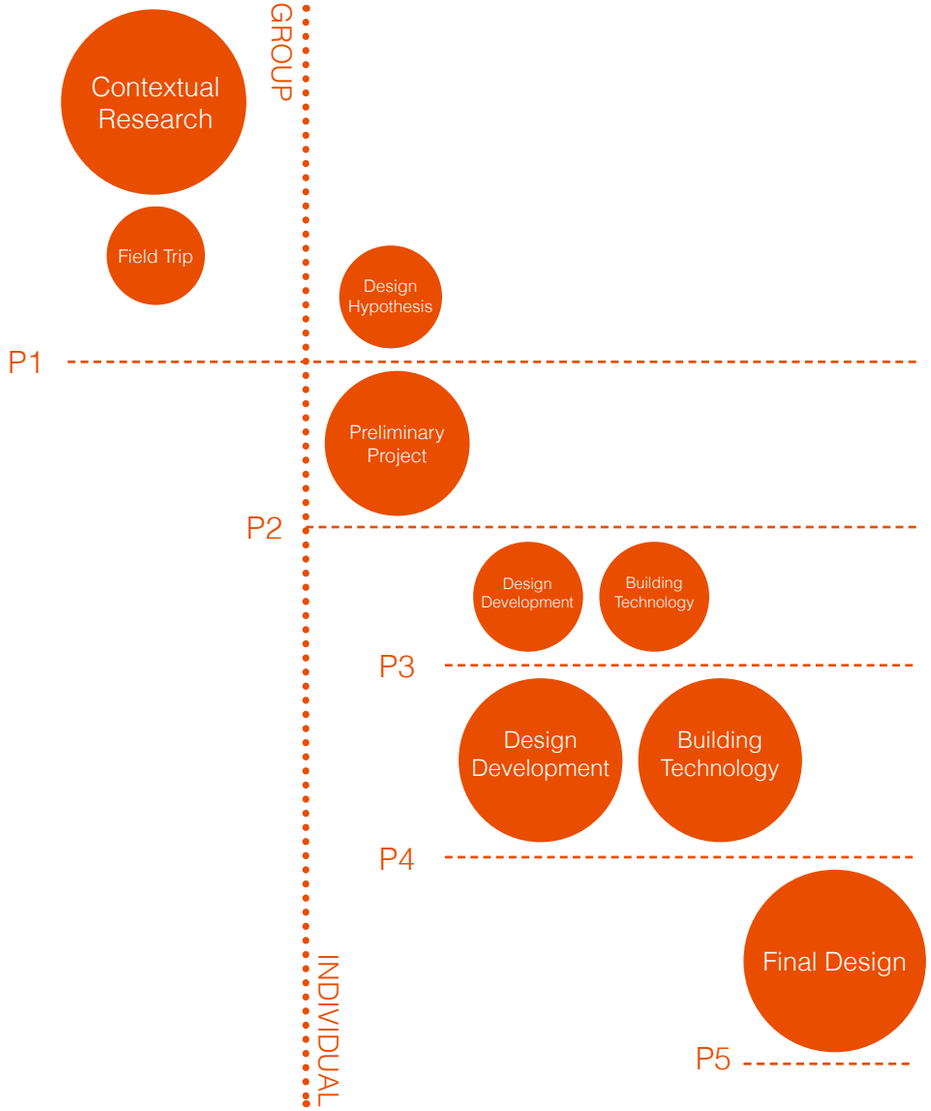


Nalasopara East, a representative case of chaotic urban fabric in Mumbai, is comprised of people engaged in diverse means of income generation in both the buildings and the streets. This context leads to immense spatial implications as well as design challenges. In order to improve the complex and unorganized network of informal economic activities, the existing vibrancy of the area became my core interest in the site selection. My specific area of focus is the remaining pockets of Baithi chawls in the midst of the dense redeveloped mid-rise chawls along the Virar-Nala Sopara Link Road. The intention is to put forth a new micro-scale development scheme in the area which not only increases the density of inhabitants, but also creates a flexible live-work typology dedicated to different groups of the informal sector from self-employed workers to regular wage earners. Throughout the course of time, the goal is to apply the design strategy to various communities and sites in Nalasopara.

Through a structured grassroots approach, the process will involve two main parties: Firstly the trade union to reach out to informal workers in the existing community and elsewhere in the region, and secondly a labor NGO to provide formal networks with the public officials and housing experts. Then the community-focused housing and commercial developments will be proceeded via Community Land Trust28 to provide affordable housing to the lower income groups on the urban land it owns in perpetuity. Through the help of the two helping hands, the top-down and bottom-up approaches can be negotiated. Consequently the informal workers will be able to come together, raise awareness in their rights and actively participate in the housing design process with the construction team to realize the project.

The impact of the collectivity of the worker will be two-fold: The first is economic benefit especially for the production-based workers as they physically stay in contact to reduce the cost of middleman and travel. Second is the sense of empowerment as they will work together in designated areas with sufficient space, light and ventilation, as well as acquire the rights to make adjustments to the dwellings for their individual needs.

METHOD



The research stage in Global Housing studio is structured into two main branches. In the beginning is a *context-led approach* through literature for a comprehensive background information of Mumbai and India at large. This involves organizing the quantitative hard data, qualitative soft data, spatial mapping and housing case studies. This phase is a collaborative group work which aims towards producing a comprehensive booklet as a final product. Second branch is a *methodology-led approach*, which is a qualitative research through site visits and analysis. In this visual ethnographical process we were to observe, conduct interviews and create visual representations of the patterns of daily lives of the inhabitants. For a direct comparative analysis, a housing case study in the Netherlands was also incorporated before the field trip to India.

After the completion of the group research phase, each of us were to formulate a design hypothesis that is based on problem statement and research question. The transition into this phase also necessitated various research involving literature and case studies to formulate a particular area of interest within the realm of affordable housing in the context of Mumbai. From my personal experiences in Mumbai and the subsequent analysis of the situation through literature, I have been keen on improving the living quality of the informal workers who were so prevalent in not only Nalasopara East but also all over India. Hence creating housing that specifically cater for socioeconomic needs of the low income informal sector became my overarching concept which I persistently pursued throughout my design development and also building technology.



3

DESIGN RESEARCH

part one
ETHNOGRAPHICAL RESEARCH

patterns of inhabitation
stories of informal workers

HOW CAN THE INFORMAL WORKERS'

DIVERSE SOCIO-ECONOMIC PURSUITS

BE ACHIEVED BY AFFORDABLE HOUSING

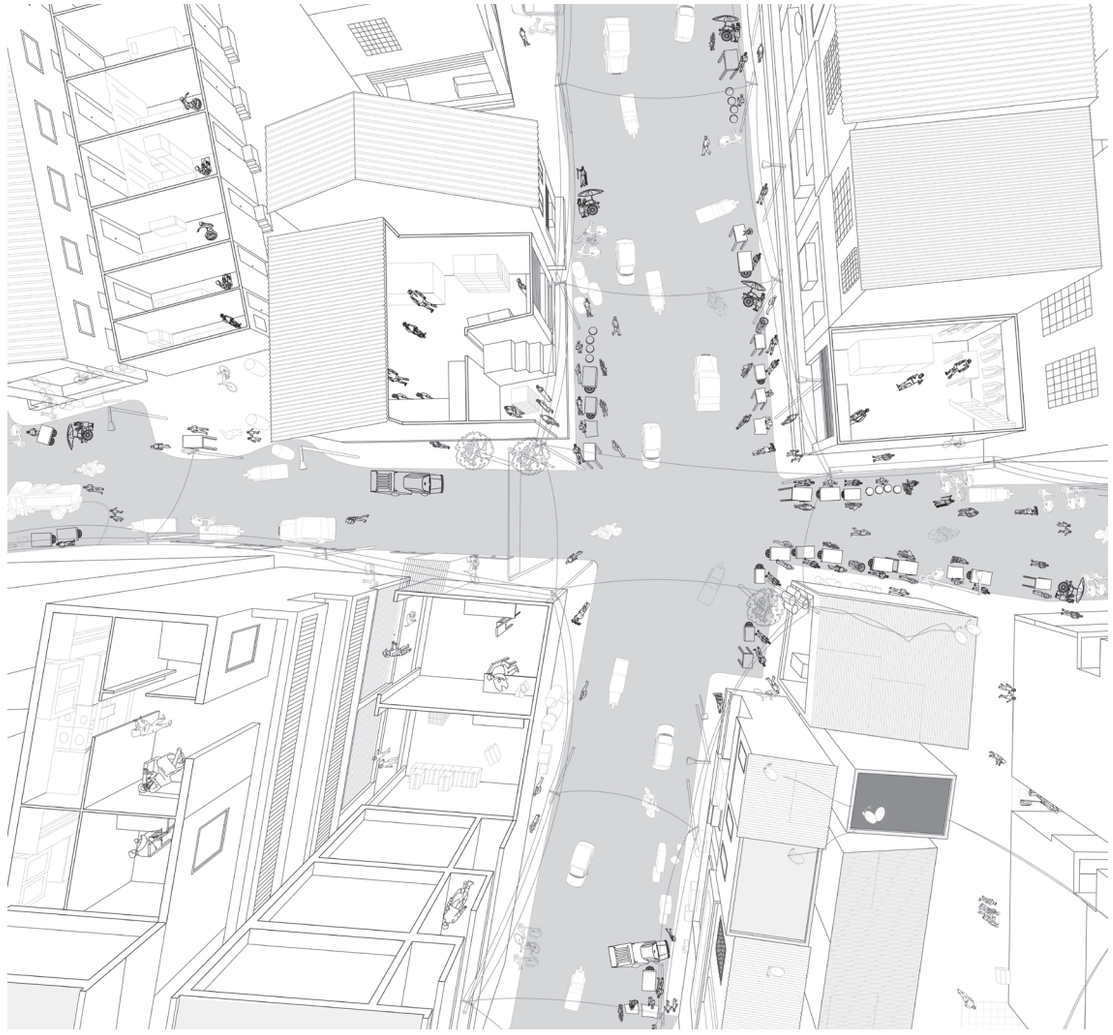
WHICH INCOPORATES CONTROLLED PARTICIPATION

AND EFFICIENT CONSTRUCTION TO

IMPROVE BOTH DENSITY AND QUALITY?

PATTERNS OF INHABITATION

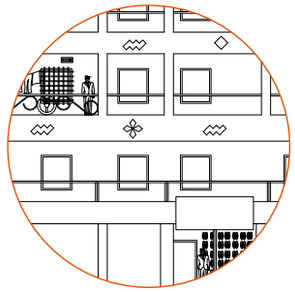
visual ethnography



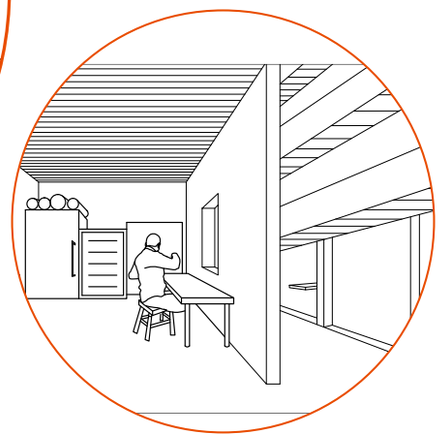
Architecture in the case of a dwelling, or *a place where people live in*, is to be understood as a production and consumption of social practices. This way architecture can be considered as an extension of one's life, and reflect one's needs. The practices of certain group of people thus become the core of the investigation. For a proper proposition a designer is required to approach the topic with an awareness that there exists subtleties of life from habits to problems. Qualitative research is an appropriate method when responding to such specificities of context.
My primary methodology of qualitative research which I have applied in my project is ethnography, which is "the process of inquiry that involves the description and interpretation of the cultural and social practices of people". While during the typical ethnographic approach the researcher is engaged in a thorough observation of a particular setting for a long period of time, I am specifically conducting a micro-ethnography, which shares the same charactersitcs but focus on a site for a shorter time frame. Moreover the documentation was done by visual representations of the buildings and activites, which further articulates the term into a visual ethnography, or architectural ethnography.
During the few days of the site visit in Nalasopara East, our studio have gathered extensive amount of information via sketching, mapping, conducting interviews and more. In the following Patterns of Inhabitations, the daily livelhoods of the people living in Nalasopara East were organized into the research categories: income generation, social spaces, building techniques, borders and amenities.



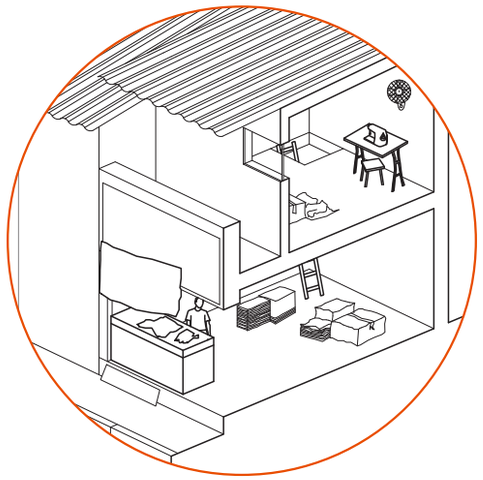
COMMERCIAL EXTENSIONS



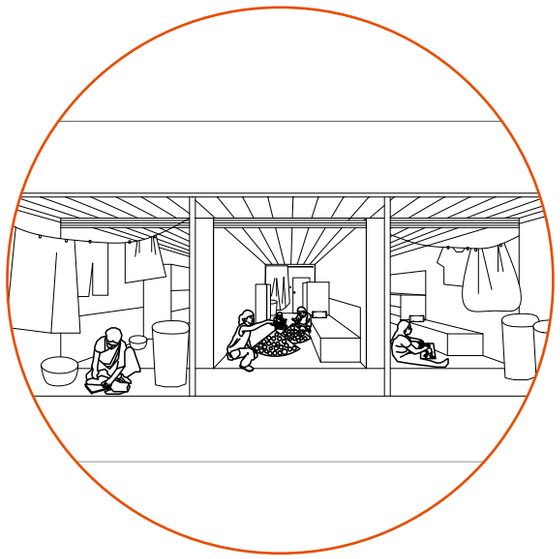
INTIMATE WORKING AND LIVING



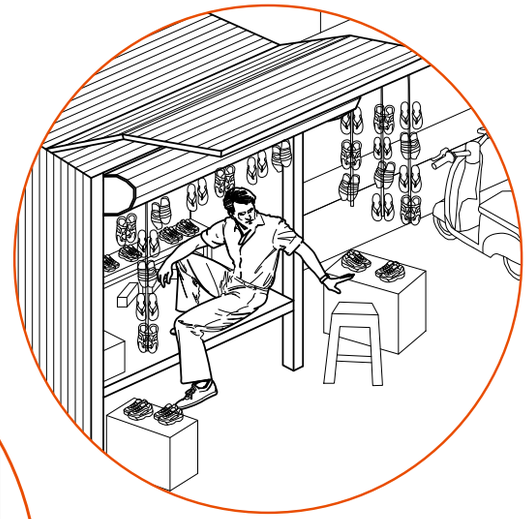
DECENTRALIZED INDUSTRY



INTIMATE PRODUCTION AND CONSUMPTION



FEMALES WORK AT HOME



LICENSED LOCATION



THE INFORMAL CORNER



GROCERIES AT THE NIGHT MARKET

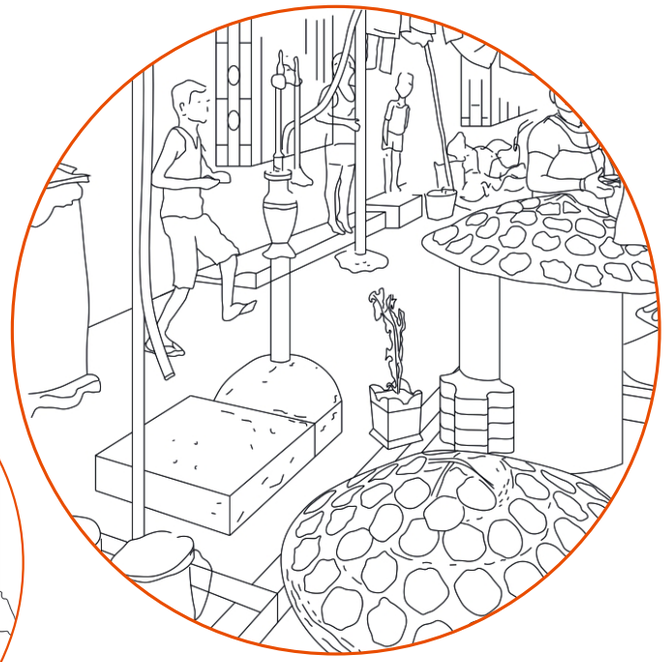
People in Nalasopara East engage in myriads of income generating activities in both formal and informal setting. In a dedicated commercial space such as ground floor units on the main street, it is mostly shops selling products.
As you turn to the internal street, ground floor units are utilized as subcontracted enterprises where people are engaged in production activites to be supplied to the city. In some cases there is a intimate flow of production and consumption where producing and selling are in proximity.
Moreover, an astonishing finding was that for low income residents, home is often not just a place for living but also a place of work which takes place invisibily. Majority of the women at home produces garments or other petty goods as an extension of their housework for a supplementary income.
Then there are the bustling street activities which are concentrated in areas where there is a high flow of people in traffic. While there are street vendors who can easily change their location in different time shifts, there are also licensed stalls where the location is more permanent.
Some people open temporary extensions to their shops based on seasonal demand.



MULTIPURPOSE ALTAR



SOCIAL CORRIDOR



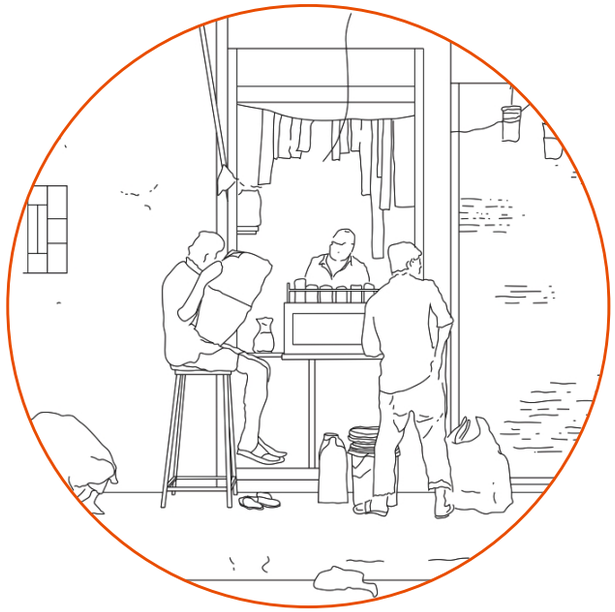
PRODUCTIVE INTERSECTION



ALLEY OF INTIMACY



SOCIALIZING ON THE GO



WINDOW CHAT

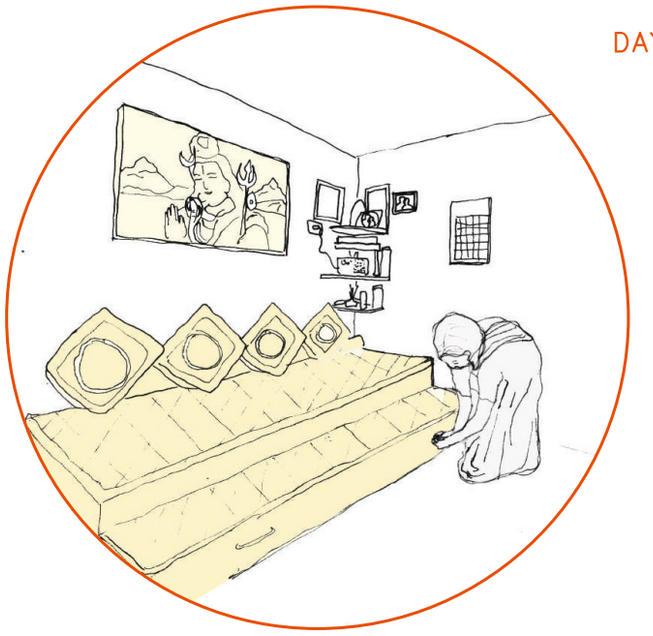
Spatial Flexibility in Social Spaces
In the dense context of Nalasopara, the lines determining the perimeter of a social space are not clearly defined. Social spaces do not have identifiable layouts that would facilitate a specific function for the space. In this undetermined condition of physical space, people are the ones who determine the activities. In these examples above, the activities can coexist and take place in a flexible manner all throughout the day. In a network where all the spaces have similar physical characteristics, the small objects such as stairs, plinth or altar gain high significance and define the way in which people use space.



WAITING PLINTH



DAYTIME WORKING



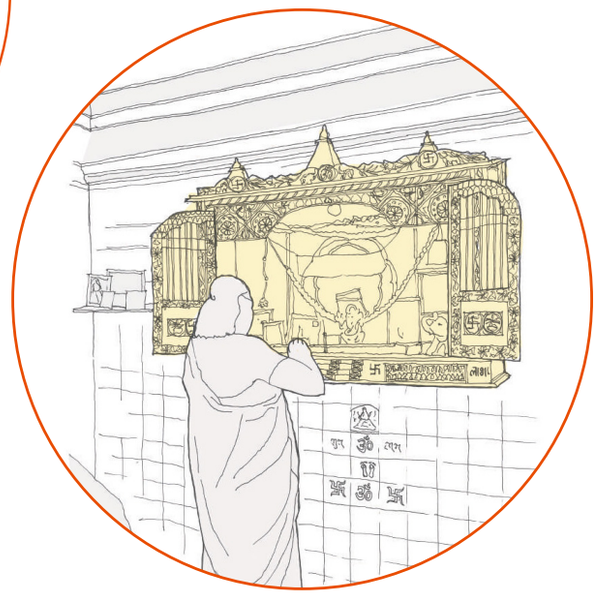
NIGHTTIME SLEEPING



FOOD PREPARATION

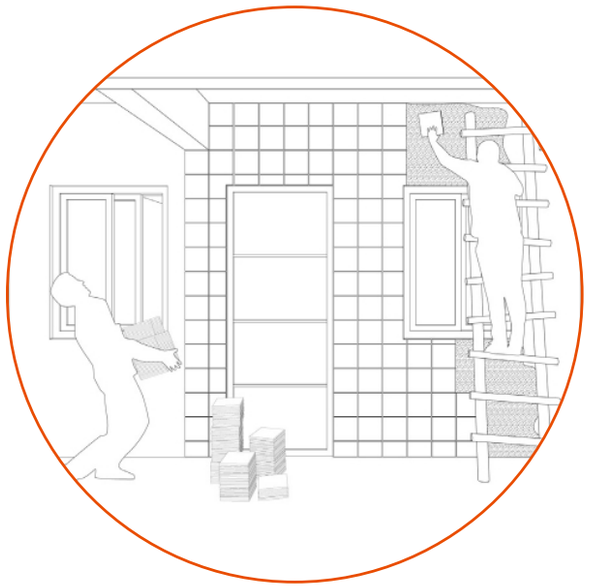


INVITATION DOORSTEP



DAILY RELIGIOUS RITUAL

Spatial Flexibility in Domestic Spaces
The observation of domestic activities shows how residents (mostly women who stay home most of the time) utilize their extremely limited space for all kinds of necessary functions in the course of the day. The dwelling changes from early prayer, morning food preparations, income generation activities, resting, dinner time to sleeping. Just the few steps outside the door also function as an essential meeting place as the dwellings are so close to one other. This way, every square meter plays a significant role for the low income families who need the spatial flexibility in their designated spaces.



TILING THE WALLS



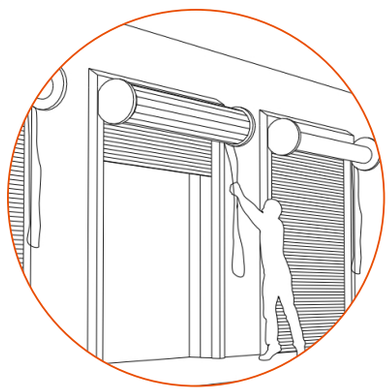
INSTALLING WINDOW GRILLS



GATES AND FENCES



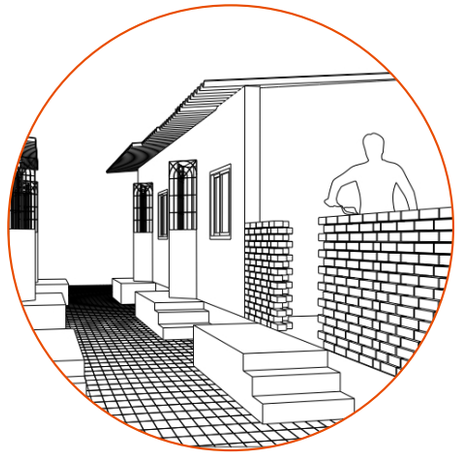
REPLACING DOORS



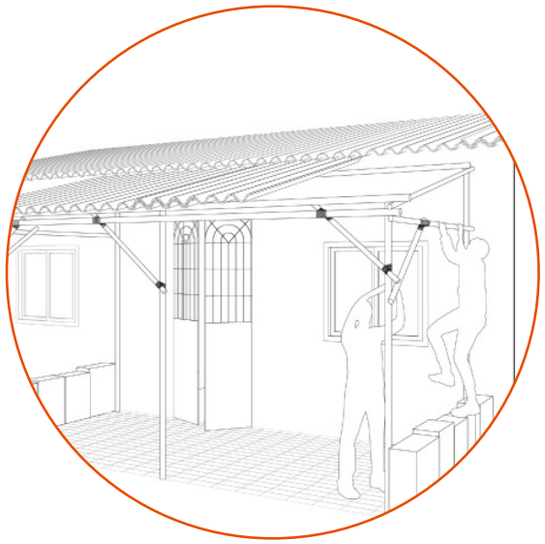
ROLLING SHUTTERS



TILED PAVEMENTS



LOADBEARING BRICK



HORIZONTAL EXTENSIONS

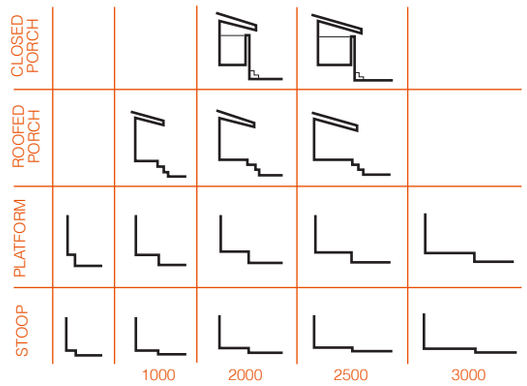


Diagram Source: (Rybczynski 1984)

Adaptations in Building Techniques

My specific interest in the current building techniques in Nalasopara was the type of adjustments people make to their dwellings. In low income housing, the overall process can be seen as flexible as people can expand their spaces horizontally or vertically based on their change of function or financial status. The external apperance is also changed by replacing doors, installing window grills, or decorating with wall tiles. This high level of appropriation transforms a standardized building in just a few years time as a result.

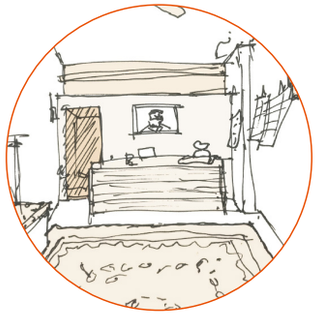
House Extension Possibilities

The horizontal extensions can vary in its function by the number of steps and dimensions. The simplest and the smallest of the extension made of stone, concrete or beaten earth is called the ‘stoop’, usually less than one meter wide, and used as a step, seat or a workbench. Next, the ‘platform’ is the most common form of extension up to two metre deep. Platform extension can be elaborated to become a ‘roofed porch’, which can be both temporary and permanent material. It is similarly used as a platform and often additionally as a storage space for both household goods and vehicles. Further elaboration of roofed porch is an outdoor room, which achieves a level of privacy through the use of walls on one or two sides.

amenities



CHAWL SCHOOL



TUTORING



SMALL CLINIC



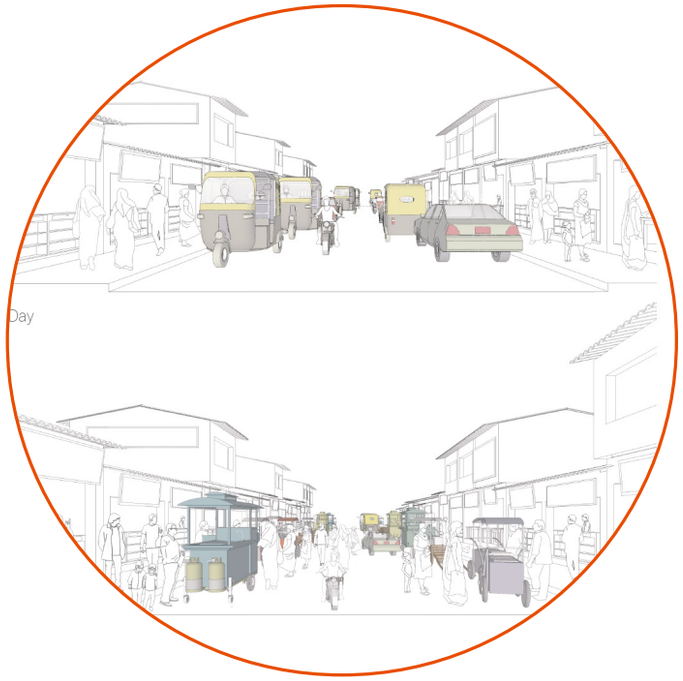
SHRINE

Varied Scales of Amenities
The existing amenities in Nalasopara East shows that there is a well balanced mix throughout the area as a whole. While commerce activites takes place along the main streets, amenities for religion, education and health care facilities are more distributed in varied scales from large public buildings to a small neighborhood shop. Because of the diverse makeup of the inhabitants in the area, the size and location of the amenities give an idea of the number and the type of people each place is dedicated to.

borders



OBJECTS BETWEEN SHOPS TO CLAIM TERRITORY



FLEXIBLE STREET BORDER



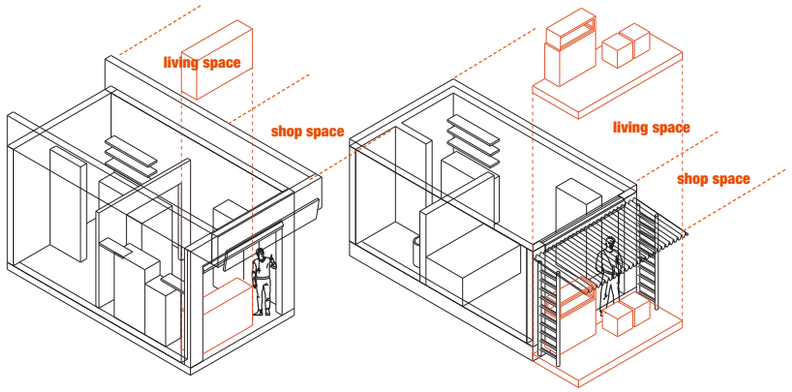
PLINTH, OBJECTS, FACADE MATERIALS TO IDENTIFY INDIVIDUAL UNITS



SHUTTER DOORS FOR MULTIPURPOSE SHOP SPACE

Expression of Territory in Borders
The study of borders portray that a border can be both tangible or implied based on its context. In residential area, the dwellings are designed homogenously yet each unit demarcates the space outside through objects or decorations for both functional and aesthetical reasons. In the lens of income generation in the commercial street, the shops also claim territory, however the border is highly flexible and blurred in the street profile due to rapid movement of people and vehicles throughout the day.

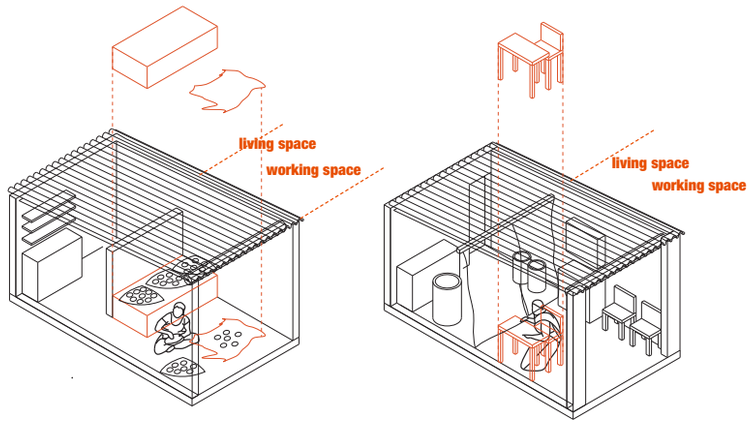
SHOPS



Combination (ex. front room)

Extension (ex. stoop)

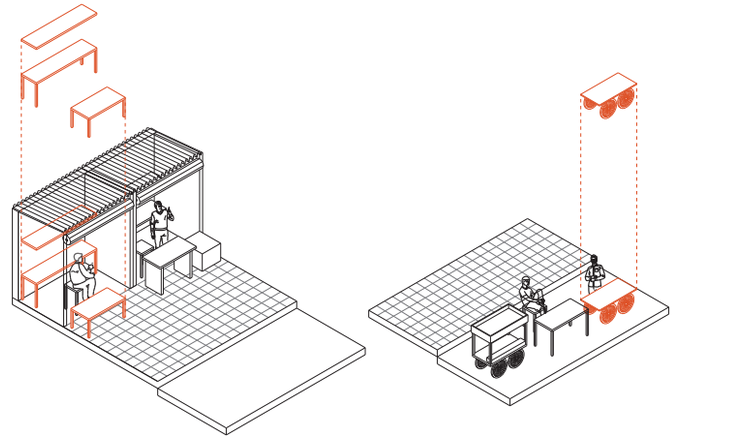
HOME-BASED PRODUCTION



Work on the Floor

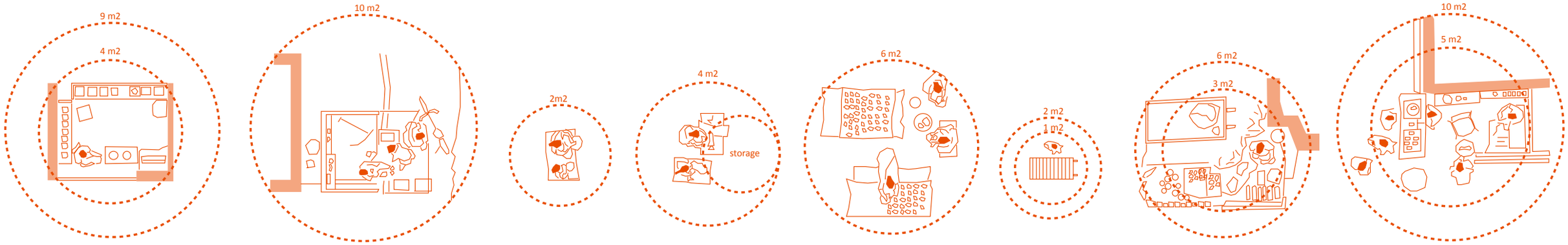
Work on the Table

HAWKER SHOPS



Small Shops

Mobile Shops



Mini Store

Bicycle Repair

Bracelet

Clothes

Bread

Hawkers

Fruits and Vegetables

Tea Stall

Diagram Source: (Rybczynski 1984)



MRS. AMITA

HOME-BASED WORKER

AVG. HOUSEHOLD INCOME

₹ 600

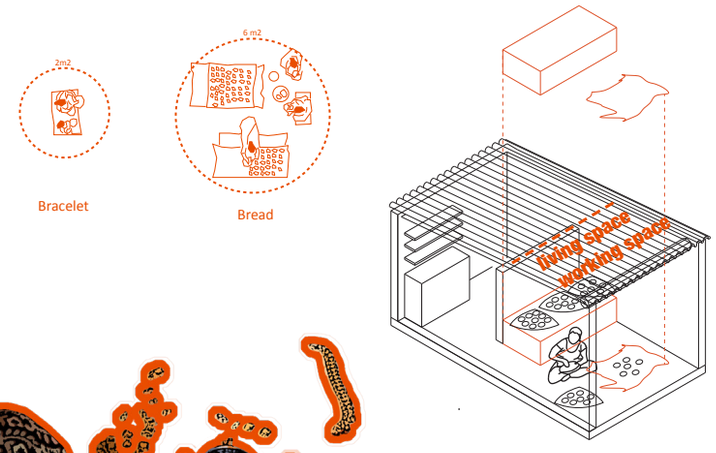
CURRENT RESIDENCE

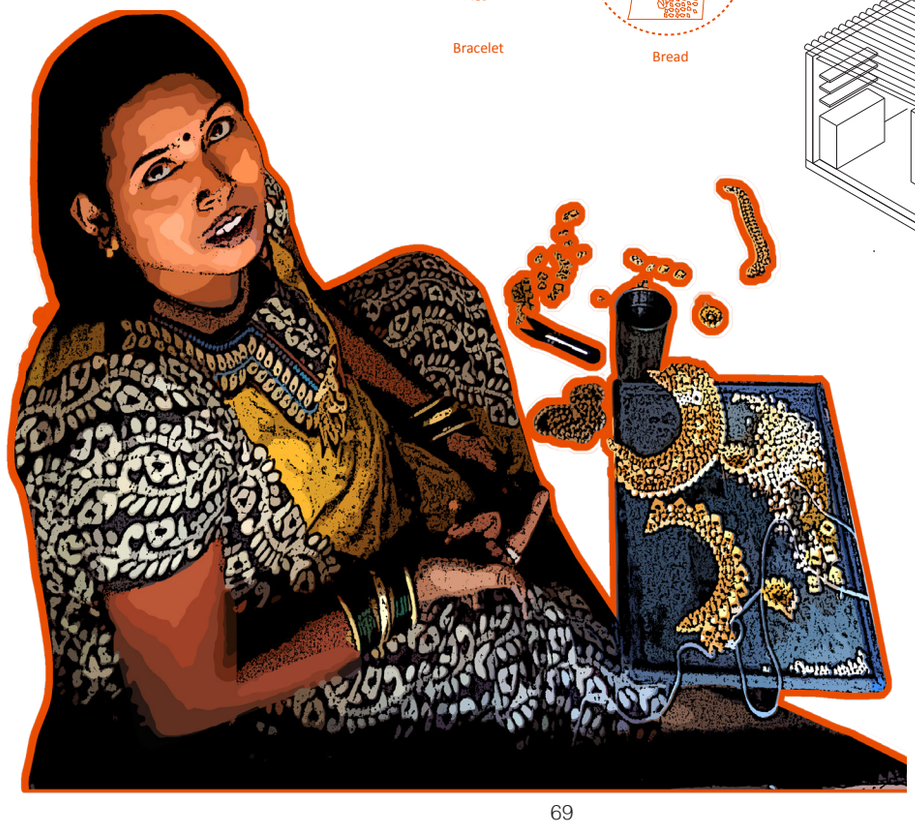
SAME AS WORK

NUMBER OF OCCUPANT IN DWELLING

5

Mrs. Amita is a homebased worker who assemble jewelry after her housework and earn only about 20 rupees a day at piece rate. She does the jewelry assembly as a supplementary income to the house. Her husband works in the city, but has to spend a big part of his income on traveling everyday. She works on the floor like this, and these days her eye-sight is getting blurrier as inside the house doesn't have much light, and also have headache from lack of ventilation. And although her mother lin law comes sometimes, she mostly feels quite lonely as she does her job.













MR. AMARNATH

CONVENIENT STORE OWNER

AVG. HOUSEHOLD INCOME

₹ 30,000

CURRENT RESIDENCE

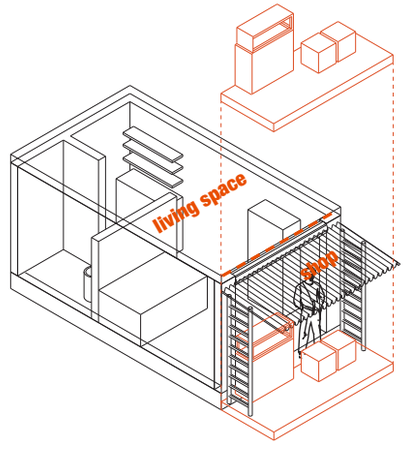
SAME AS WORK

NUMBER OF OCCUPANT IN DWELLING

4

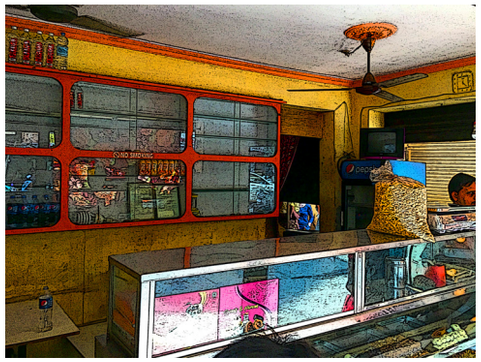


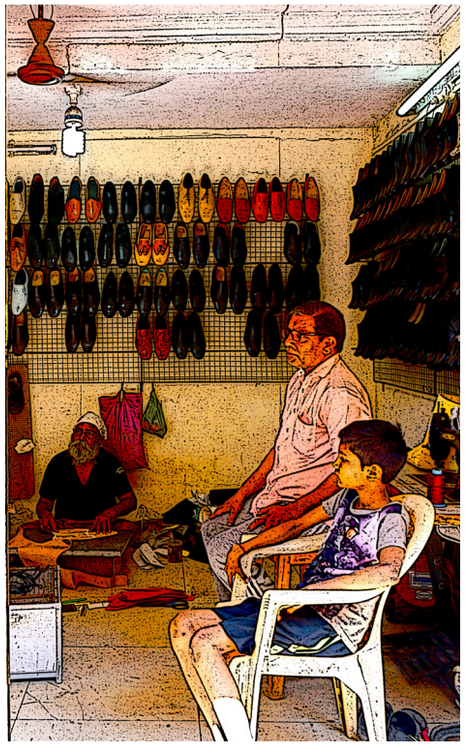
Mr. Amarnath is a small convenient shopowner on the ground floor who has a shop at the front of the house and also on an outdoor plinth where he puts out his goods every morning, and puts it inside the house at night with a shutter gate. He wishes that he has a more proper space to put out the goods, and not having to fight for space with nextdoor shops, and also a street where people can walk in front his shops.



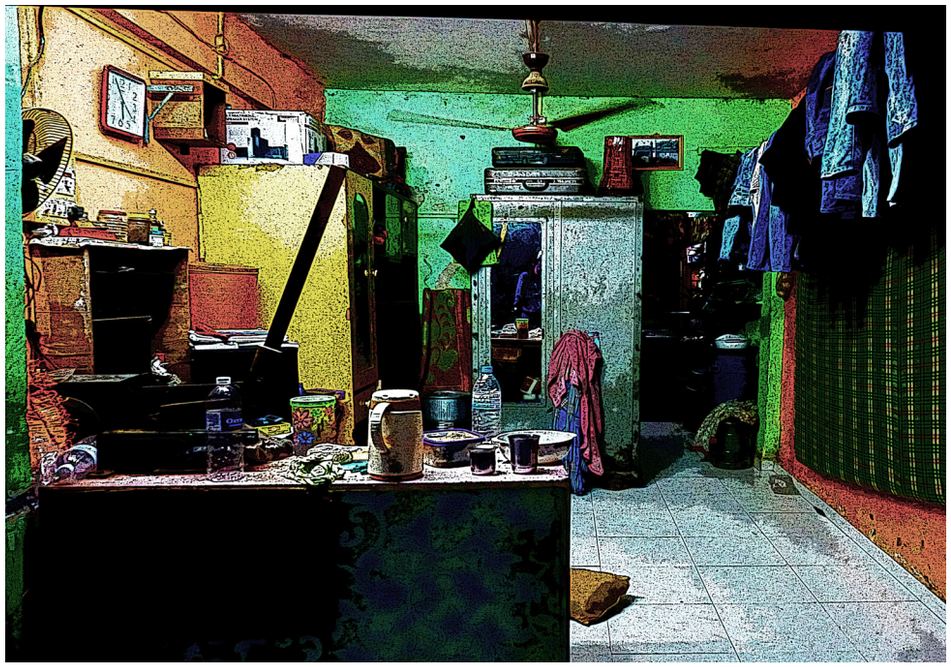


Bicycle Repair









MR. TANAJI

TEA STALL OWNER

AVG. HOUSEHOLD INCOME

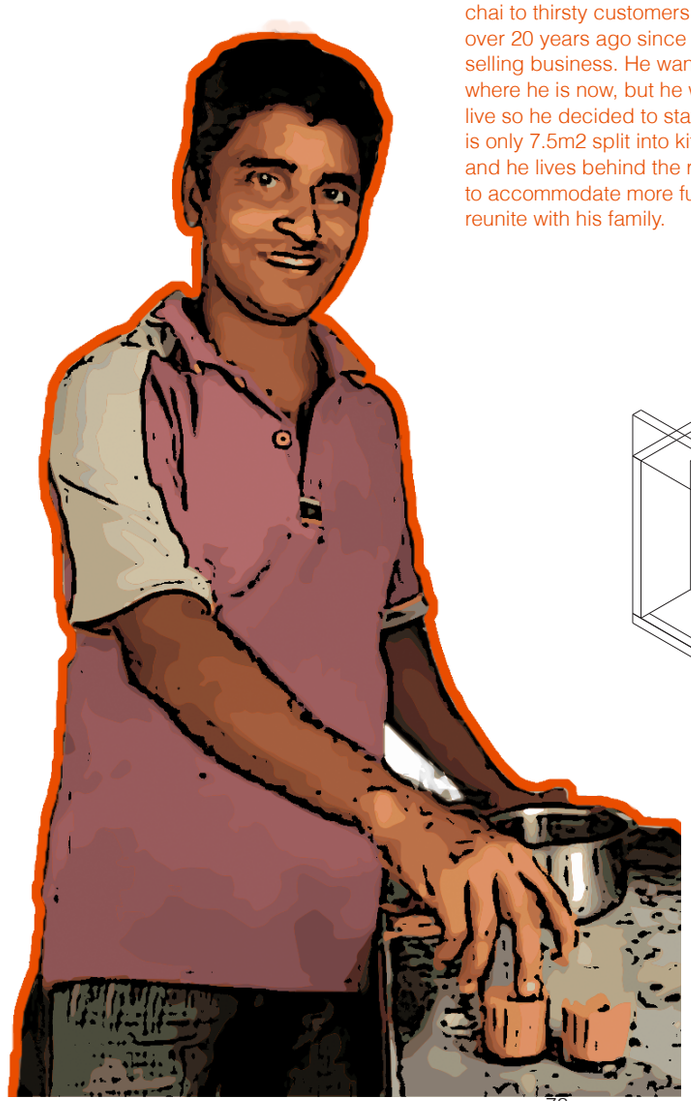
₹ 20,000

CURRENT RESIDENCE

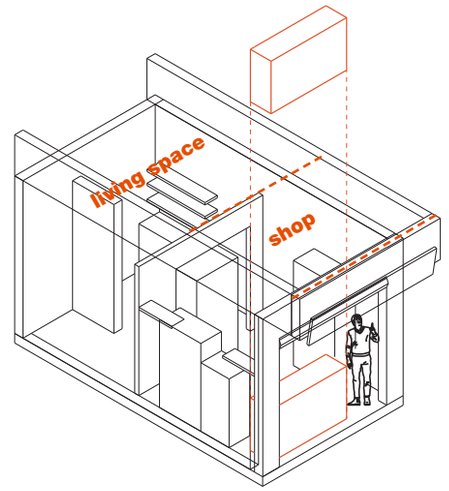
SAME AS WORK

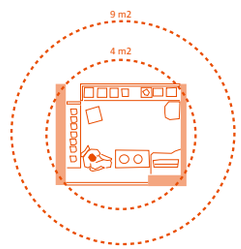
NUMBER OF OCCUPANT IN DWELLING

2



Meet Mr. Tanaji, a tea stall owner who delivers around 200 cups to chai to thirsty customers in the neighborhood everyday. It has been over 20 years ago since Tanaji arrived in Mumbai and started his tea selling business. He wanted to bring his family in the countryside to where he is now, but he was unable to afford to rent another place to live so he decided to stay in the shop itself with his cousin. His shop is only 7.5m2 split into kitchen and tables at the front of his house, and he lives behind the room. He would like to have a larger shop to accommodate more furnitures, or ultimately buy a bigger flat to reunite with his family.





Mini Store







MR. BADRI

BARBER

AVG. HOUSEHOLD INCOME

₹ 20,000

CURRENT RESIDENCE

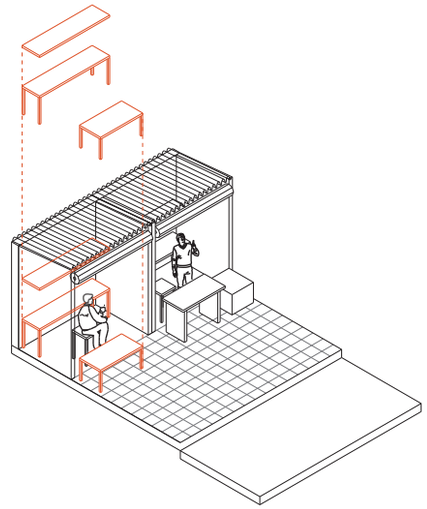
<1 HOUR DISTANCE

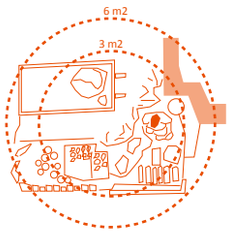
NUMBER OF OCCUPANT IN DWELLING

5

Mr. Badri has a small barber stall in the inner street where his regular customers come and go.He feels that his shop is insecure, as it can be easily vandalized or damaged from rain. He wants to eventually open a proper barber shop so that he can support his growing family.







Fruits and Vegetables









MR. JALINDER

NEWSPAPER MAN

AVG. HOUSEHOLD INCOME

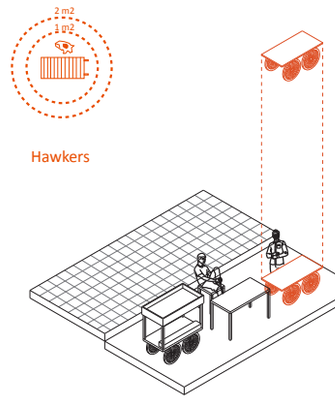
₹ 15,000

CURRENT RESIDENCE

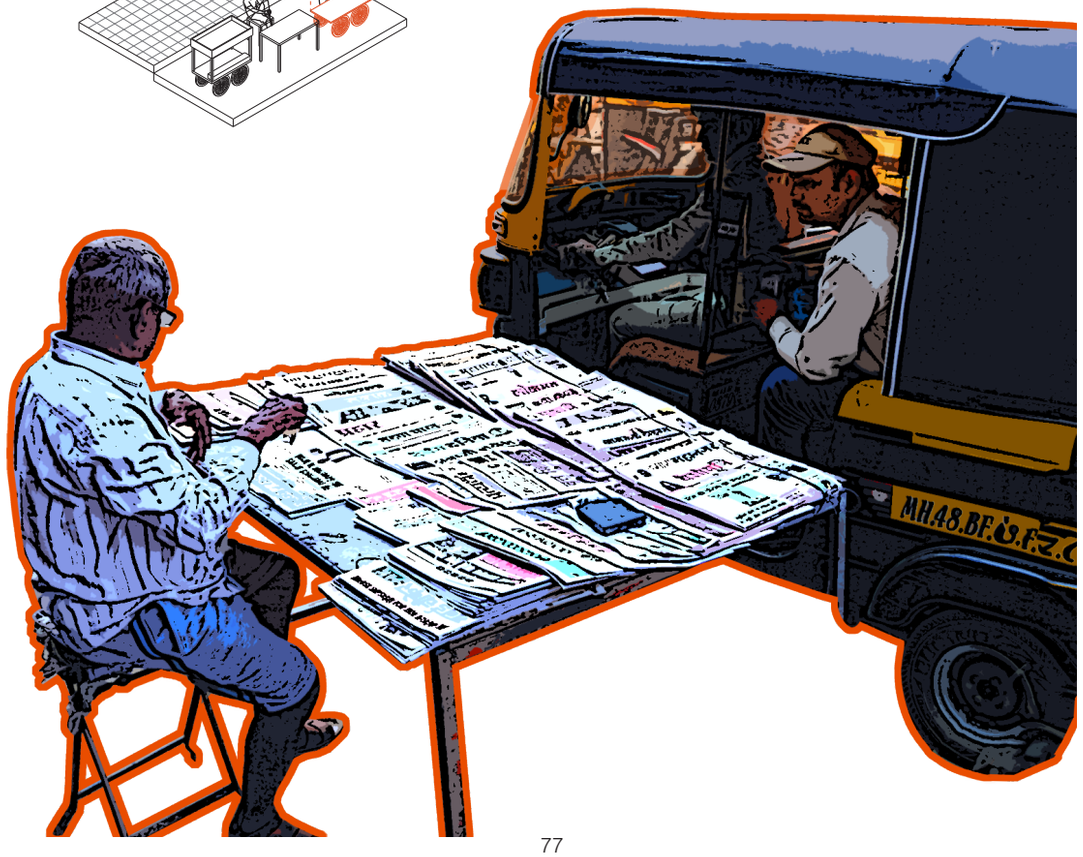
1 HOUR DISTANCE

NUMBER OF OCCUPANT IN DWELLING

6



Mr. Jalinder is a newspaper hawker who comes out on to the street front every morning and wait for customers and tuktuks to stop by. He lives inside the secluded area and it is hard to find customers in his neighborhood. He wishes he can sell near where he lives.



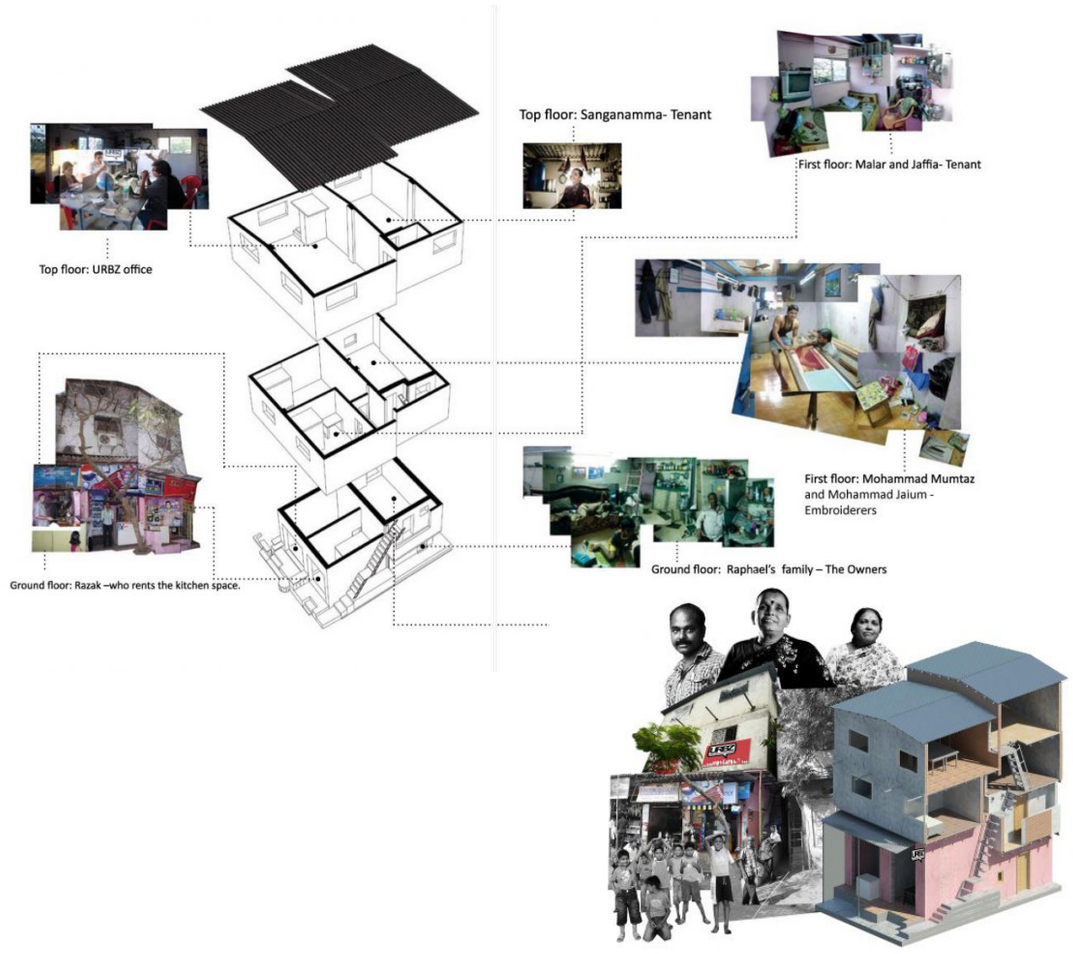
part two
ARCHITECTURAL RESEARCH

precedents

HOW CAN THE INFORMAL WORKERS'
DIVERSE SOCIO-ECONOMIC PURSUITS
BE ACHIEVED BY **AFFORDABLE HOUSING**
WHICH INCOPORATES CONTROLLED PARTICIPATION
AND EFFICIENT CONSTRUCTION TO
IMPROVE BOTH DENSITY AND **QUALITY**?

PRECEDENTS

multi-programmatic house



Learning through Precedents
A number of case studies have been explored in order to get the grip of the key aspects in low income housing that is mixed use and urban in nature. Each example has inspired me in different aspects, such as urban strategy, programmatic mix, architectural language and customization.

Tool-house by urbz
shows a dynamic appropriation of economic and living needs by occupying a family, shopowner, textile owner, tenant and an office. (Matias 2012)

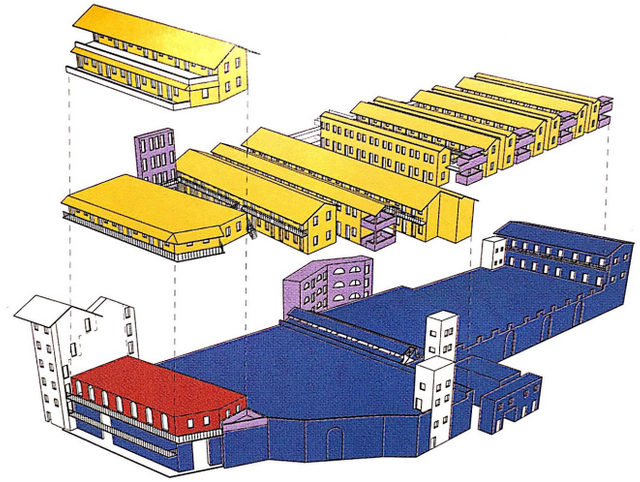


walkable market street on ground level


residential uses on upper level

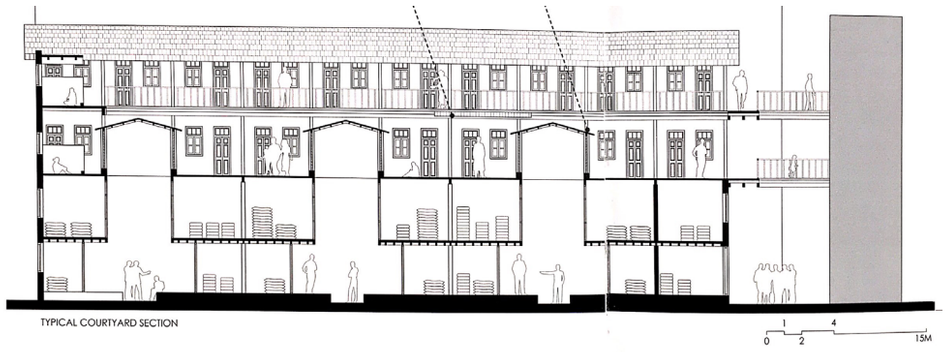
PREC EDENTS

porous market housing



Initial programs
built in 1909

- RESIDENTIAL
- COMMERCIAL
- SHARED SERVICES
- INSTITUTIONAL



Swadeshi Market Chawl, Mumbai
Swadeshi Market Chawl is a monumental mixed-used building constructed in phases since 1909. The ground and first floor is occupied by the cloth trading wholesale market. On the ground level, the nature of the activity through the building is clearly a result of its built form: narrow streets and tightly packed shops creating bazaar receding from the activity of the main public streets. The subsequent phases involved the podium or upper ground with residential chawls. Above, the broad courtyards and connecting corridors allow the potential generation of a neighborhood social fabric.
Despite being a mass that covers the entire plot, its building form is characterized by its porosity, drawing in people from the surrounding roads. The internal streets - some of which stretch for up to 120m - together with the shops are covered by a slab that forms the podium for the chawls above. The perpendicular east-west arrangement of the structural system creates double height roofs that break out of the surface of the residential courtyards and bring light and ventilation to below. Primary and secondary north-south passages and three east-west passages running through the structure at the ground level are used for the circulation.
Swadeshi Market Chawl, one of the oldest cloth markets in Mumbai crowded with thousands of shoppers and traders on a daily basis, serves as an important typological model for mixed-use development in the city. (Padora, Maitri, & Mythili 2016)



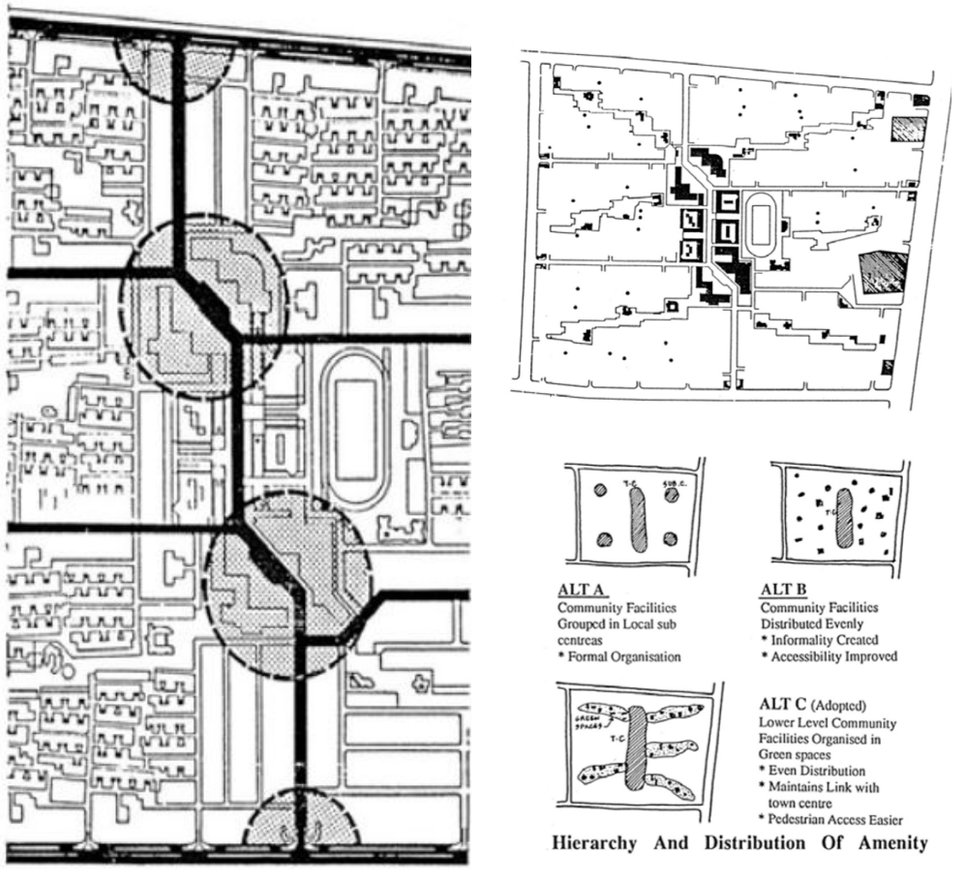
Aerial view of Aranya Township



pathways leading to the central spine

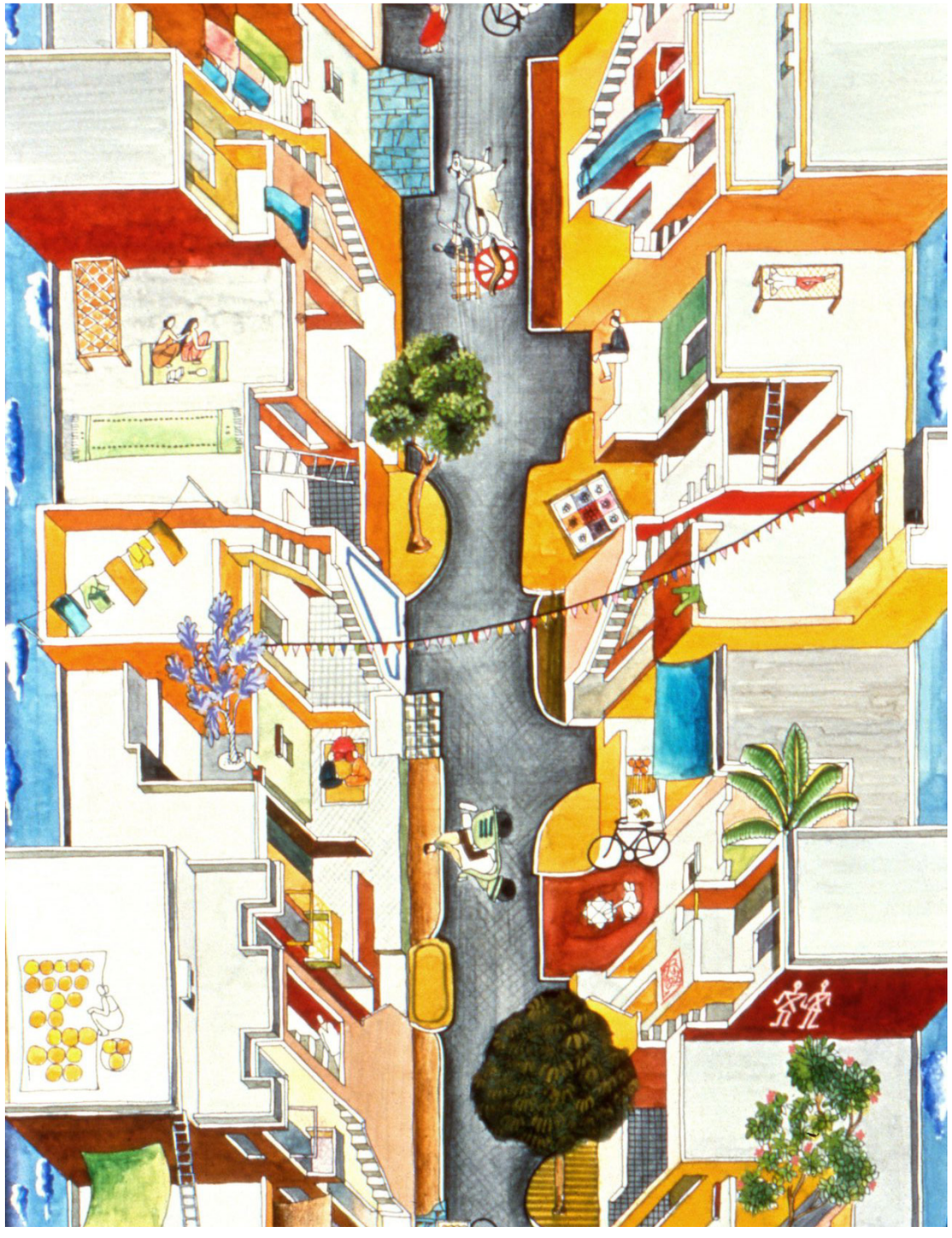
PREC EDENTS

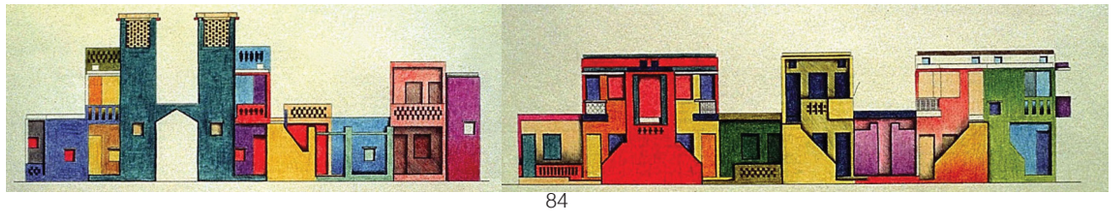
hiearchy of streets and activities



Aranya Low Cost Housing, Balkrishna Doshi
Arayna, located 6 km outside previous center of Indore, was commissioned in 1983 by the Indore Development Authority in response to an acute shortage of housing, and co-funded by World Bank and India's Housing and Urban Development Corporation (HUDCO). The 86 hectares of rectilinear site was designed by Balkrishna Doshi to accommodate over 6500 families, a majority from the low to middle income groups. The master plan of the Aranya Township was designed as a site and services project spread laid out in 6 sectors that intersect at the central spine, known as the central business district. Various income groups have been arranged in a concentric rings of plots, and each dwelling is comprised of its terriroty which encourages social interaction and supports a way of life of the user group. For the housing units, the key concept was to create hiearchy of open spaces that includes small courtyards to be shared by 3-4 families.

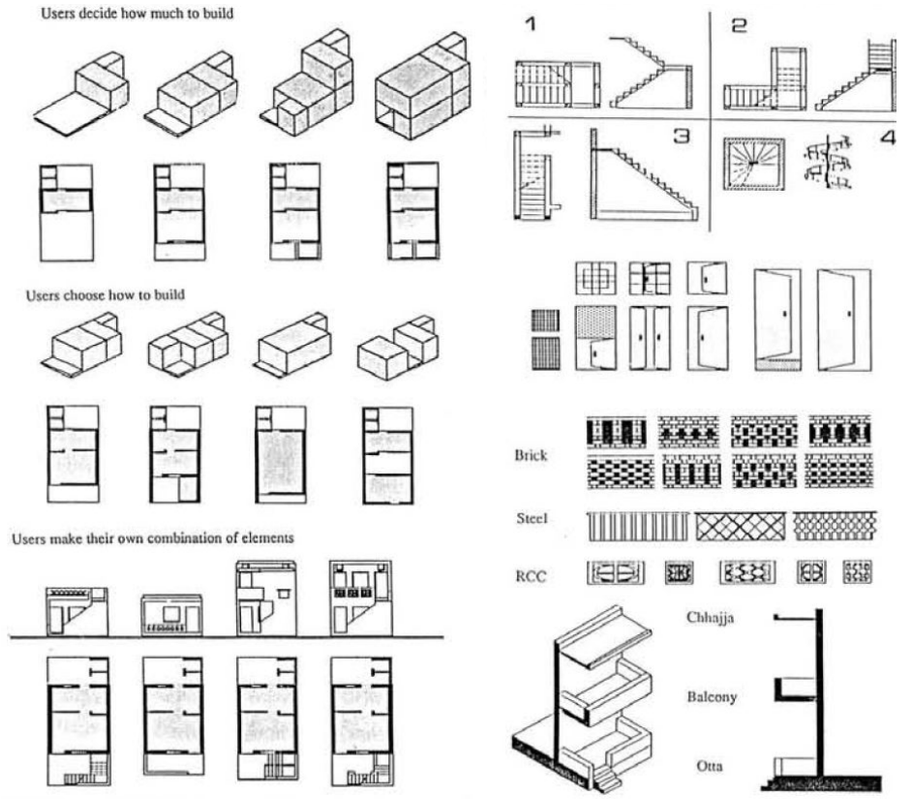
Larger green spaces are provided for each sectors pedestrian pathways connect the clusters to the central spine. While the formal street network draws vehicular traffic outward to the perimeter, the pedestrian traffic on informal paths flows in the opposite direction to achieve segregation of different speed of circulation. Irregular alignment of streets with varying widths, widenings and bends are provided to accommodate a range of spontaneous human activities. This urban planning is based on the principle that hierarchy of commercial activities coincides with hiearchy of street. The formal commercial roads are positioned in major streets, whie informal shopping areas take plae in narrow streets and pockets of open spaces throughout the settlement. Based on this notion of street, amenities are also accordingly distributed so that the facilities are evenly organized in green spaces and maintains linkage with the town centre with easy pedestrian access.





PREC EDENTS

form variations on a standardized plan



Doshi believes that 'building homes is about creating a sense of belonging, about participatory involvement and about expression of aspirations, relationships and desires'. This integrated approach for a sustainable society was reflected in form variations on a standardized plan, providing the future inhabitants a selection of 80 models which range from one-room unit to a larger house depending on the different needs and incomes. Flexibility of design is a challenge for a mass housing where the end user is uncertain. Therefore a catalogue of meaningful building elements is provided so that the residents have an array of form and material options to choose from. Variations in ottlas, entrances, staircases, verandah, balconies and fenses within a standardized layout, help each house gain a unique charactor. These variations do not only enrich the street facade but also help users express their idenity. This triggers a sense of belonging in the user, an essential factor in healthy development of any living environment and its subsequent maintainence. At Aranya, the emphasis was made on creating a sense of family and neighborhood, while striving to encourage adaptation and personalization according to individual needs and resources. ("Aranya Community Housing, Indore, India")



Elevation, before and after



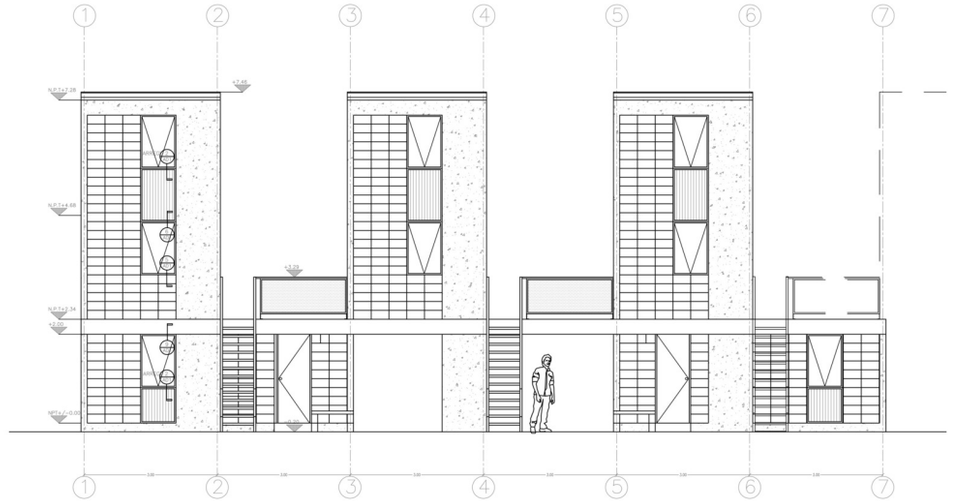
Existing framework of the unit

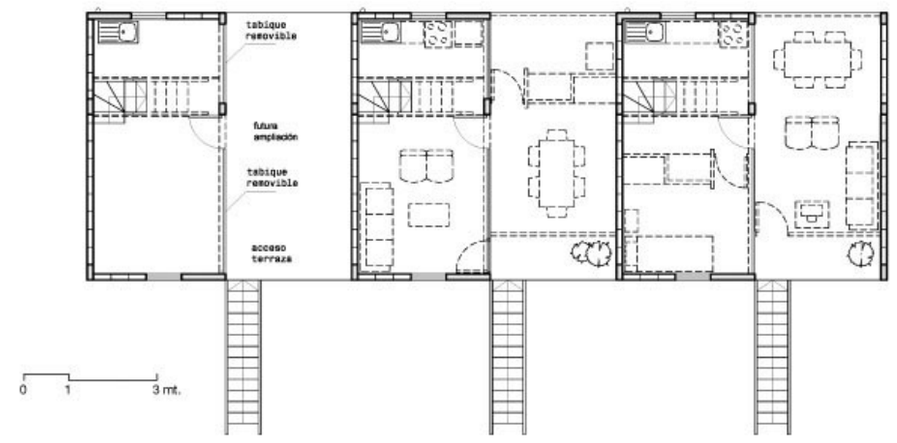


Transformation of the unit over time

PRECEDENTS

building the other half





Quinta Monroy, ELEMENTAL

The aim of the project was to resettle the 100 families of Quinta Monroy located in center of Iquique in Chile, the site of which has been an illegal area for the last 30 years. Working with the housing policy and the subsidy of the land, ELEMENTAL's aim was to make a more efficient use of the land without overcrowding and promiscuity. Social housing was viewed more as an investment rather than an expense, so that people can make use of the initial subsidy that can add value over time.

First, the density was the goal to be able to pay for the site. Maintaining its good location with network of opportunities that the city offered was an important to strengthen the family's economy as well as to increase a property value. Second, the development of the extensive family was understood as a nature of a poor family that is also a key issue in the economical take off. Hence the collective space - common property with restricted access - was provided for flexibility in spaces. Lastly, 50% of the building volume was dedicated to be eventually self-built. This meant that the intial building had to be porous enough and provide supporting framework which avoid negative effects of self-construction over time in the urban environment. Hence, instead of building a small 30m2 house, unit with final vision of 72m^2 was constructed with a change of standard to middle income house. The parts of the house which cannot be achieved by the individual residents were provided such as kitchen, bathroom, and stairs. Various workshops are held before and after construction of the building to provide the residents technical insights on how to expand in the framework with restrictions. Over time, the other half is transformed at different levels based on the family's financial status, while maintaining a uniformity of the overall community. (Mori & Iacobelli 2016)



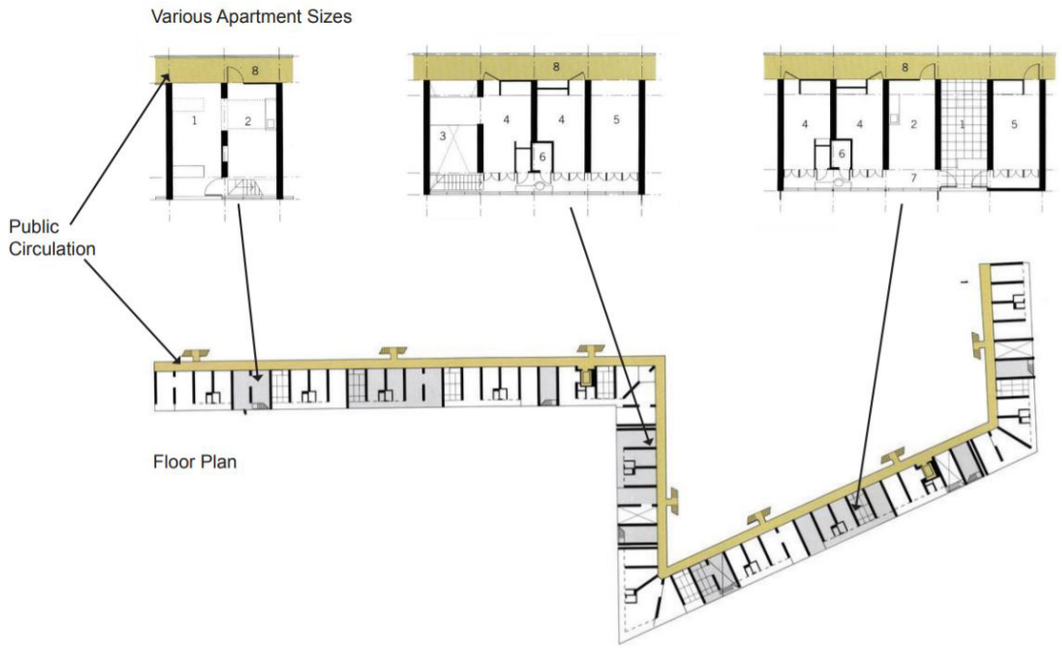
view of perforations on slab building

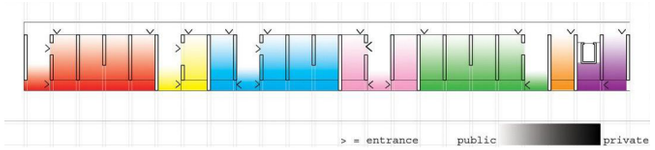


side terraces provided for each unit

PREC EDENTS

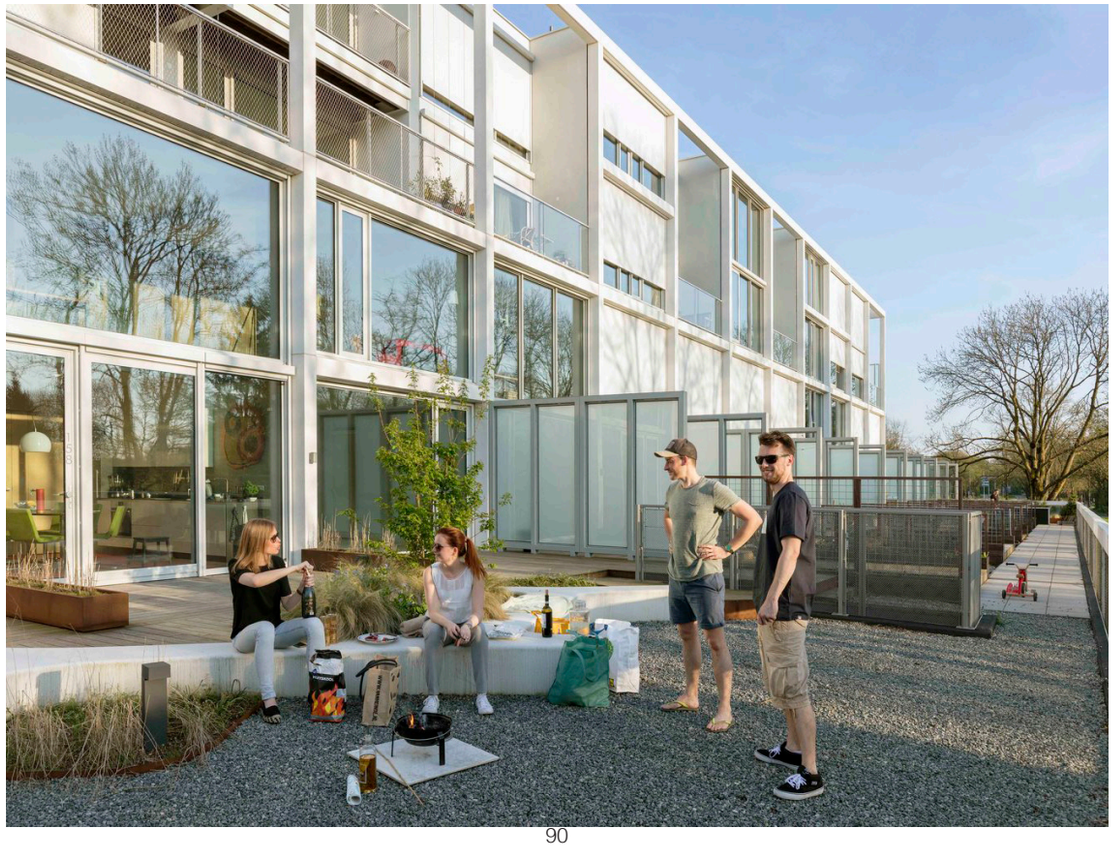
intermediate perforations





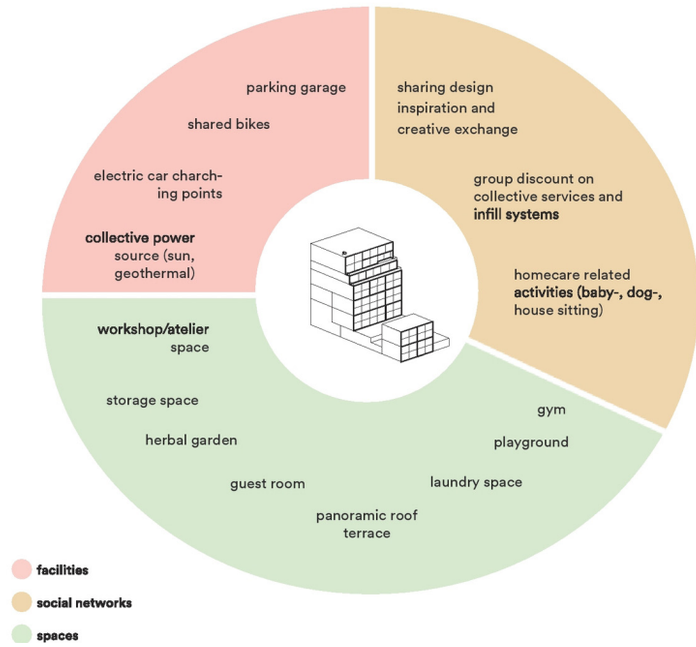
Kitagata Apartment Building, SANAA
Kitagata Apartment is part of a masterplan development for the new Kitagata Housing Complex in Gifu, Japan.
In a ten-storey high building, each unit is made up of a terrace, dining kitchen bedroom and a Japanese tatami room. all of these rooms linked on the front by a narrow corridor. In this project, the individual room is regarded as a planning unit. The different arrangement of the units create different unit types with various sections emerge, catered for different lifestyles.
With a linear alignment of the units, there is an opportunity to leave an empty unit in between to serve as a semi public space that creates units on the side of the facade. Unlike a general mid-high-rise apartment where the entrance door is the only element that directly accesses the interior to the outdoor space, this design can accommodate at least three entrances and up to five. Each entrance would be used in a different way based on the occupant's needs. This terrace space is provided for every apartment unit, and it is planned as one of the rooms, with the intension of introducing as much exterior space into the living space as possible. These voids in the building are random yet planned by the architect to be distributed in the built volume in order to maintain its massiveness. As a result, the thin slab building have perforated holes which allow the glimpses through the building to the landscape beyond. ("Gifu Kitagata Apartment Building" 2011)

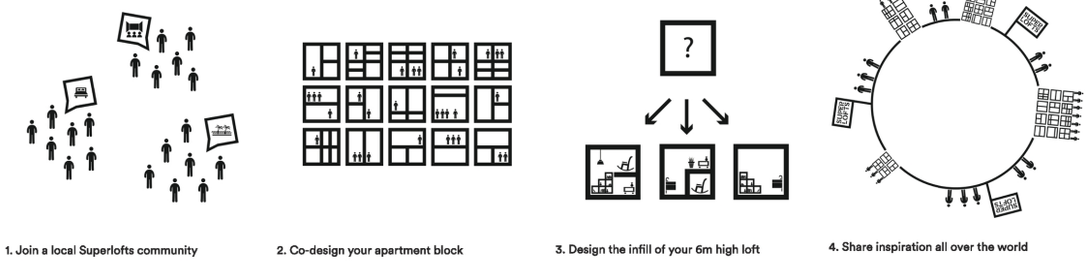




PREC EDENTS

support and infill





1. Join a local Superlofts community
2. Co-design your apartment block
3. Design the infill of your 6m high loft
4. Share inspiration all over the world

Superlofts Blok Y, Marc Koehler Architects
Superlofts initiated in Utrecht, the Netherlands, is an open building project by Marc Koehler Architects under the goals of flexibility, participation, and adaptability. It is a collective of 20 owners provided with a blank canvas to customize, design and built their apartment based on their needs. Active engagement is also contributed to the shared spaces of the building from the outset.
The five-story building comprises of a base framework (‘support’) that is independently fitted out (‘infill’) by the inhabitants. Blok Y includes 30 superlofts in five types, ranging from 70 to 145 m^2, resulting in dwellign diversity and mixed community.

In the Superlofts Blok Y design, its facade is a simple uet strong expression of the concept. Fixed concrete grid and the variations of customized facade is an interest-ing interplay that results in a lively composition of the exteriors, with varied entrances, balconies and window configurations. (Tapia, 2018)

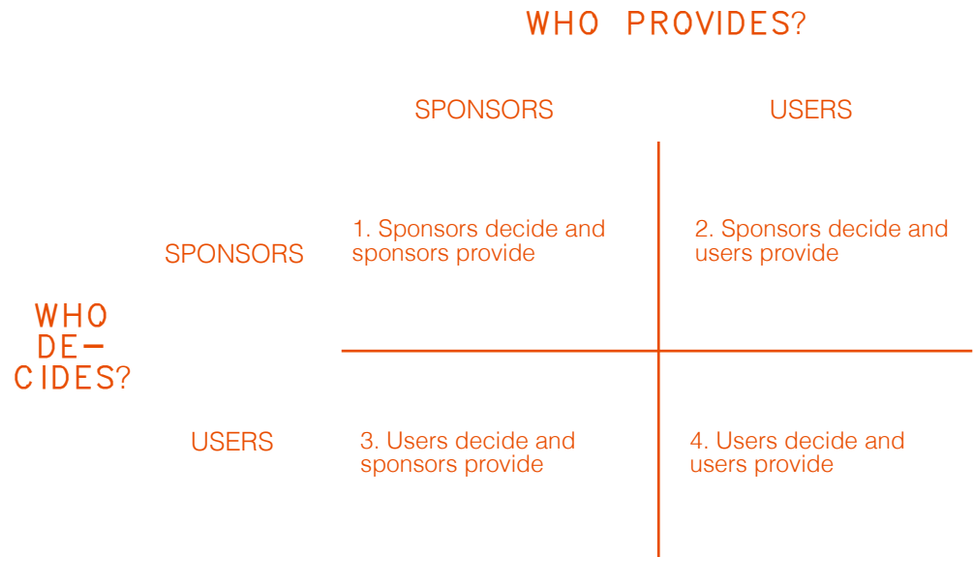
part three
MANAGERIAL RESEARCH

who provides? who decides?
community land trust
organizational strategy

HOW CAN THE INFORMAL WORKERS' DIVERSE SOCIO-ECONOMIC PURSUITS BE ACHIEVED BY AFFORDABLE HOUSING WHICH INCOPORATES CONTROLLED PARTICIPATION AND EFFICIENT CONSTRUCTION TO IMPROVE BOTH DENSITY AND QUALITY?

WHO PROVIDES? WHO DECIDES?

roles of sponsors and users



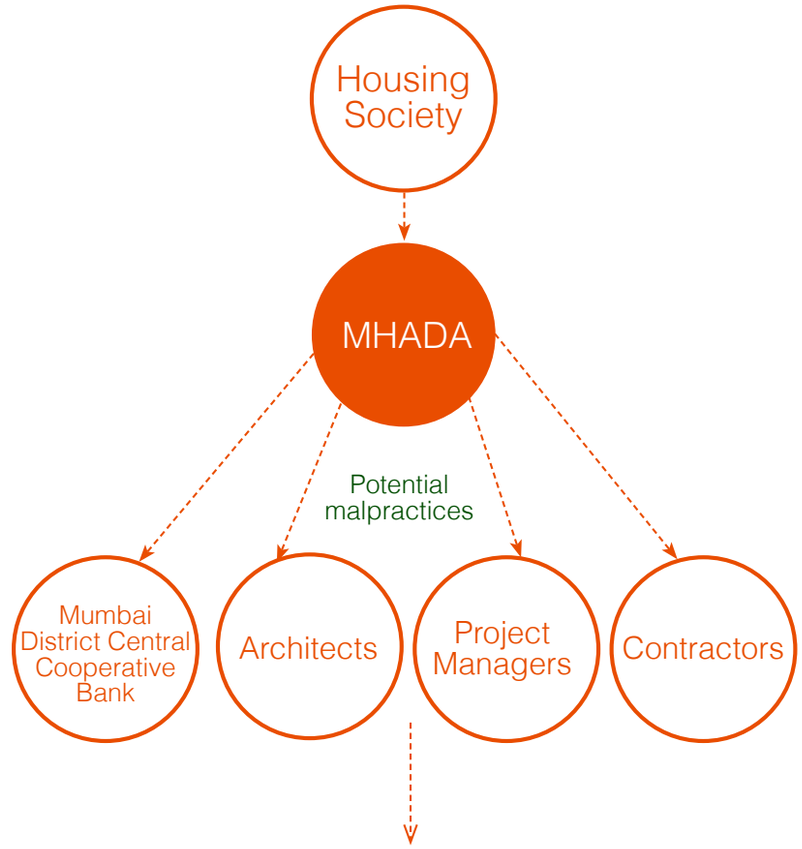
In John Turner's book <Housing by People>, he introduced this diagram to highlight the different roles sponsors and users can have in the citizen participation. This idea was my guiding framework in analyzing some of the case studies of organization strategy.
The issue of the *desirability* of local participation in housing depends on the answers to the following open-ended questions: 1) What are the resources that the housing provision depends on?; 2)What sectors or levels of organization have access to and effective control over those resources? 3) What is the necessary degree of variety in housing for the various socio-economic and cultural sectors? 4) Which organizations are capable of sufficiently providing the variety in the controlling system? 5) To what extent will participation increase tolerence for mismatches between users' pritorities and housing actually obtained?

While there are many possible answers to the central question - whose participation in whose decisions and actions - John Turner's conclusion after the quoted cases is that the most effective and necessary forms of participation are: 1) Central authorities' participation in local housing development through actions that ensure personal and local access to essential resources; and 2) Citizen's participation in the planning resources and infrastructure (on which local housing development depends) by central authorities.
In addition to the critical matching of appropriate levels of authority and action, and the selection of the consequently appropriate form of participation, it is also essential that the right control system is adopted. Prescriptive planning and administration are essential for the design and installation of major utility systems. (Turner 2017, 142-159)



WHO PROVIDES? WHO DECIDES?

self-redevelopment scheme in mumbai



Feasibility of current housing goals in Mumbai

The current self-redevelopment scheme in Mumbai is supervised by the Maharashtra Housing and Area Development Authority (MHADA). Under this scheme, the MHADA is required to provide a single window system for all the necessary permissions required for self-redevelopment of the housing society. This process ensures that the requisite permissions are given quicker than it would take otherwise. MHADA is also required to create a panel of architects, project management consultants and contractors, to provide choices to the housing society, to select the requitie professionals needed for self-redevelopment. The Mumbai District Central Cooperative Bank will provide the loan for self-redevelopment of the buildings of the housing society.

Self-redevelopment scheme in Mumbai is considered to be SPONSORS decide and SPONSORS provide as MHADA, the Maharashtra Housing Board is the sponsor which both decide and carry out the tasks, and there is no participation in any stages. Despite its intentions for quick process through authority, there are often numerous malpractices which consequently leads to insufficient completion in the affordable housing scheme by the PMAY ministry of housing. (Jain 2019)

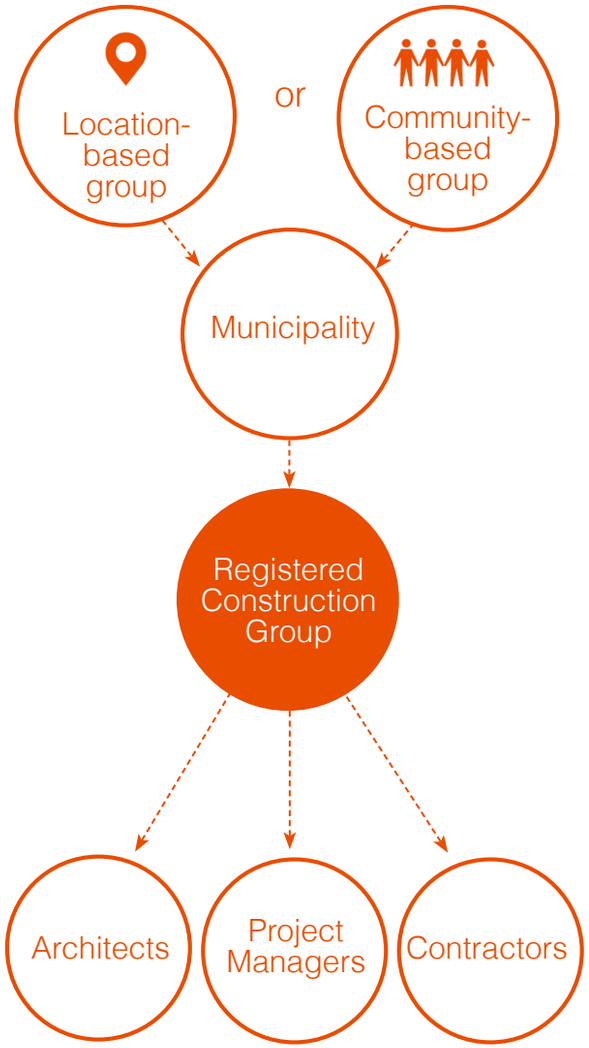
Den Haag



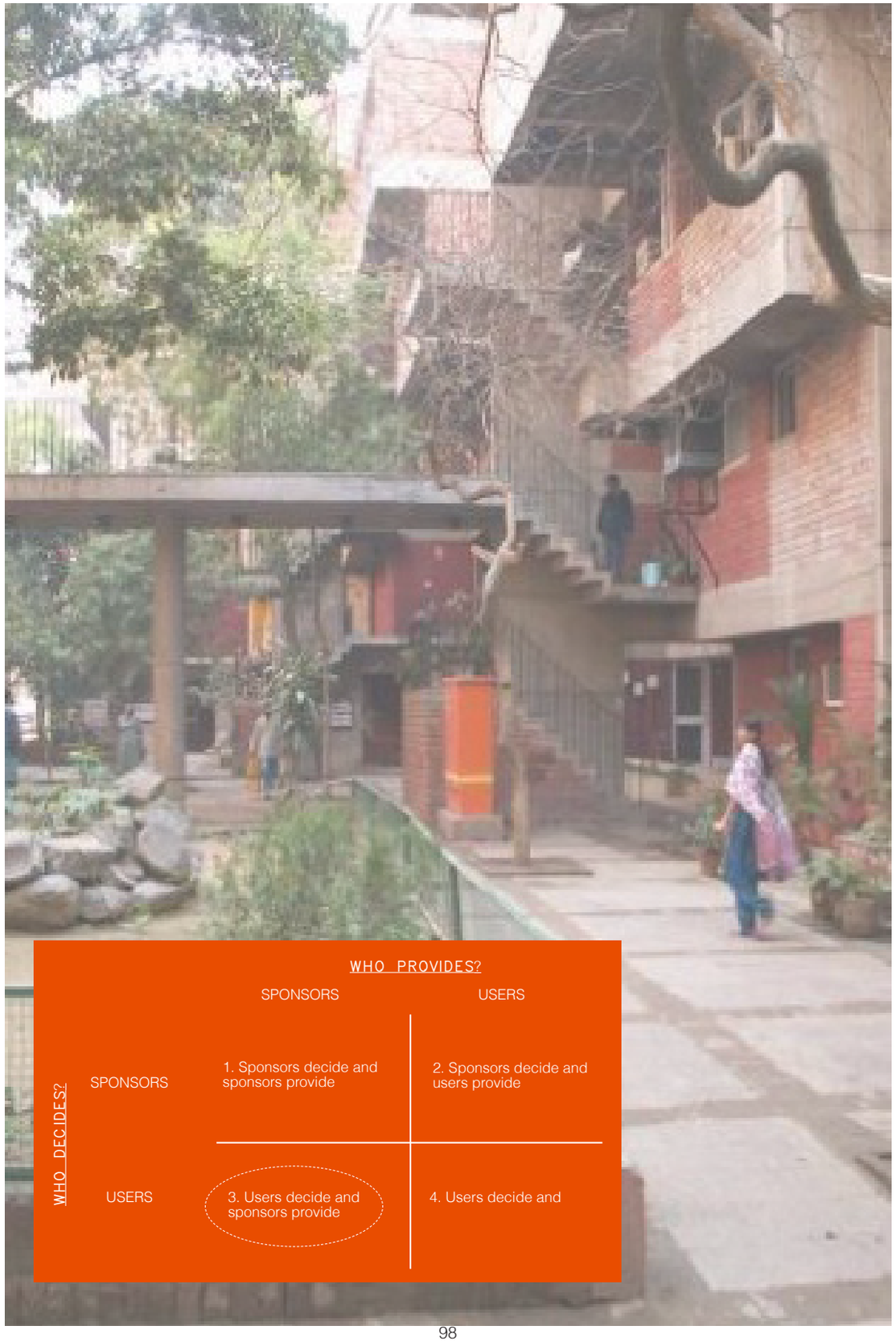
WHO DECIDES? \ WHO PROVIDES?	SPONSORS	USERS
SPONSORS	1. Sponsors decide and sponsors provide	2. Sponsors decide and users provide
USERS	3. Users decide and sponsors provide	4. Users decide and users provide

WHO PROVIDES? WHO DECIDES?

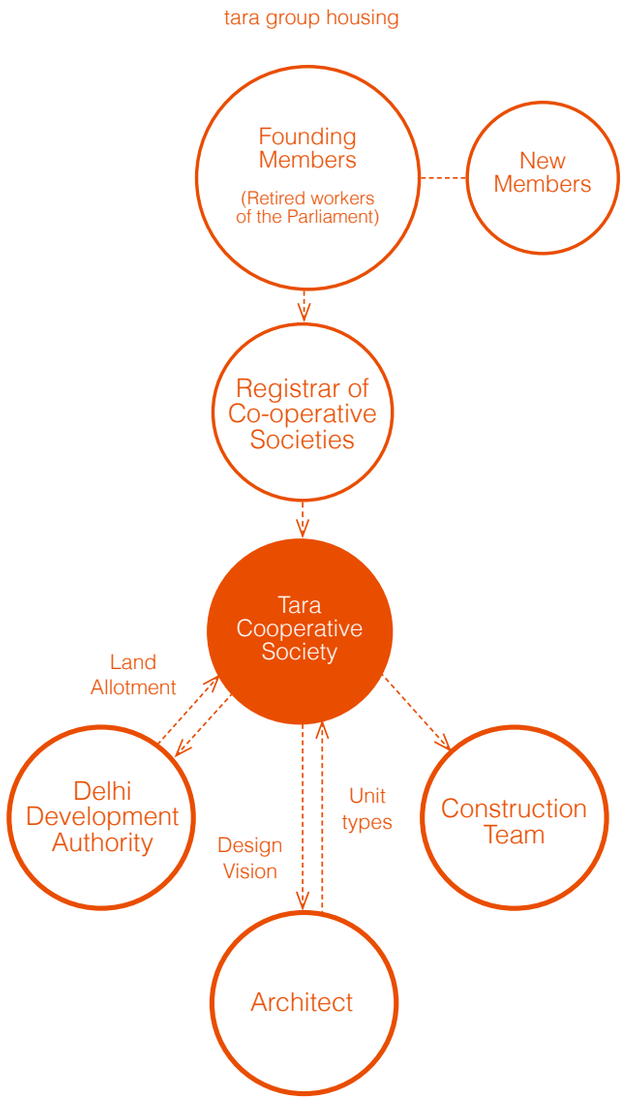
collective private commissioning (cpo)



In contrast, a self-redevelopment scheme implemented in Holland is a very different approach in that a group of people become a collective client. The group can be either formed based on your existing community or social group, or an individual resident can apply for a certain location to find a people with the interest in the same plot of land to form a location-based group. After applying to the municipality and becoming a registered construction group, they can reach a consensus and hire architects, project managers, contractors of their choice to get their community built. Some of the key goals for this process is to engender social involvement that brings positive influence in the neighborhood, to target group actively invests and enterprises in the neighborhood and to realize the general facilities such as communal garden and parking. CPO is an example of where USERS decide and USERS provide, as a group of people registered as a construction group can manage the entire process. The usual diversity of residents for Users Decide and Users Provide would consist of mix of owner-occupiers, leaseholders, tenants and subtenants. The influence was made to not only the house but also the jointly owned semi-public access paths, garden and parking space. the development could not have taken place without the sympathetic reporting of the local press and the active support of the local health and planning authorities, nor of course without the unified demand of the residents themselves.
Due to having nurmous demands of the highly varied households only way to keep the costs down is for participants to act as their own general contractor and deal with each job and operation separately so that adjustments could be made as the work proceeded and all the unforseeable problems arose. (“Bouwgroepen (CPO)”)



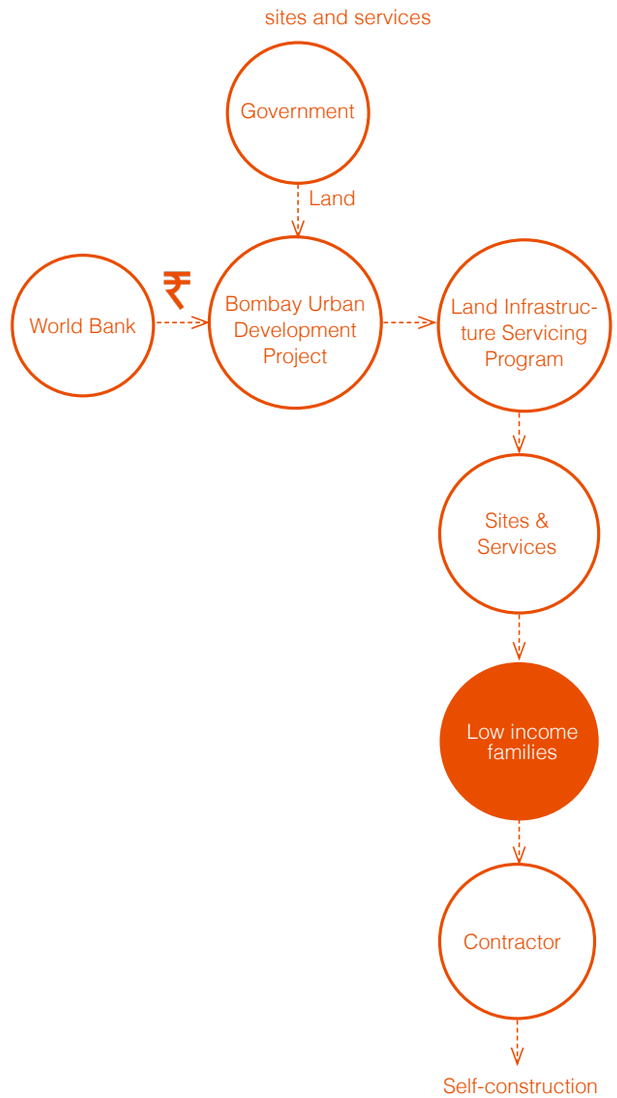
WHO PROVIDES? WHO DECIDES?



In India there also have been some successful cases by the users themselves take a role in the process in a housing society. It was the first group housing commissioned by Tara Cooperative Society for rehabilitation of people who had nowhere to settle down their retirement from their professional lives since they have been affected by the 1947 partition. Hence Tara group housing is one kind of social project that was intended for middle-class of Nehru center designed by the most famous Indian architect at the time, Charles Correa, who came up with unique design concept dedicated to them.
This example applies to number 3, where USERS decide and SPONSORS provide, because a registered cooperatives can apply to the development authority to be alloted with the land, and then decide on the design and construction. The principle of user decision and sponsor provision has been well-established by private developers and higher income owner builders or new home buyers whose properties are publicly serviced. (Turner, 156) Although I was inspired by this balanced process, affordability was not the key aspect to the project as it was dedicated to mostly the MIGs. (Sarwal 2011)



WHO PROVIDES? WHO DECIDES?



Sites and services scheme in Charkop, Mumbai is a part of the World Bank-assisted Bombay Urban Development Project (BUDP) in 1985. Within BUDP was the Land Infrastructure Servicing Program (LISP). Through the LISP, the government provided subsidized land to economically weaker sections (EWS) and low income groups (LIG) to build their own houses. In 1980, the Maharashtran Government released a Five-Year plan, which stressed the need for providing affordable shelter, safe water supply and adequate sanitation to the urban poor. In the case of Charkop, appointed contractors would build homogeneous houses and the landowners themselves would build additional floors and modifications later if the finances are in place. (Class Research 2019, 126-7)
In the case of sites and services program, it is the example of SPONSORS decide and USERS provide, which is the most common among the self-help housing projects. This is because the roles of the government changes from a “provider” to an “enabler” by initiating the project, laying the infrastructure and providing the standardized units to the low income sector at a low-price. It also enables them to save scare resources by “sharing” the responsibility of housing with the intended beneficiaries. The participants can become owner-occupiers or tenant-managers but i, the participants are still more or less passive contributors to the sponsor’s enterprises.
The positive aspect of sites and services is that it recognizies the ability of people to house themselves by providing flexibility with a little backing from the government agencies. A drawback however is that at 30 years later from today, the sites are no longer considered affordable, because the land value increased too much over the years. This aspect of land price is an issue which I would like to tackle in my process.

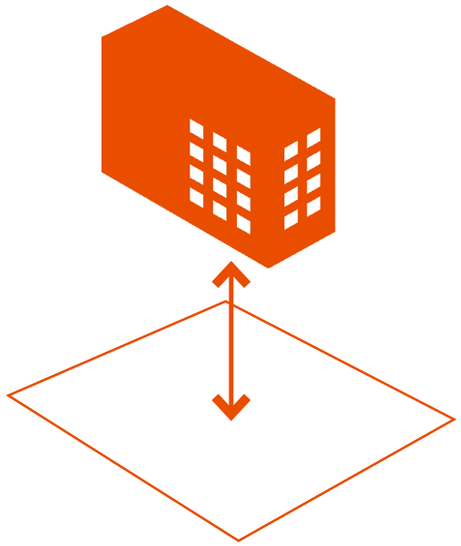


BUILDING PRICE

LAND PRICE
(value increases over time)

existing situation

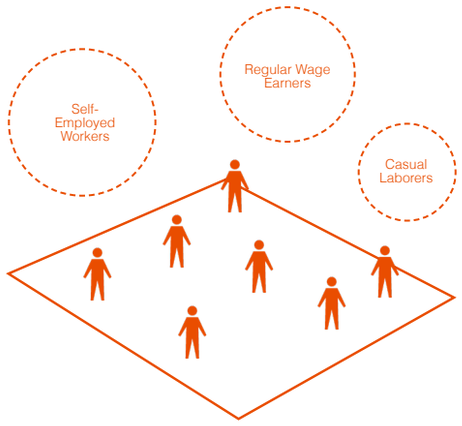
proposal



RESIDENT BUYS THE PROPERTY AT
BELOW MARKET PRICE

LAND IS TAKEN OFF THE PRIVATE REAL
ESTATE MARKET,
PERMANENTLY OWNED BY

COMMUNITY LAND TRUST



Membership is open to people who
LIVE or WORK
within their geographically defined areas

preserves locality

COMMUNITY LAND TRUST

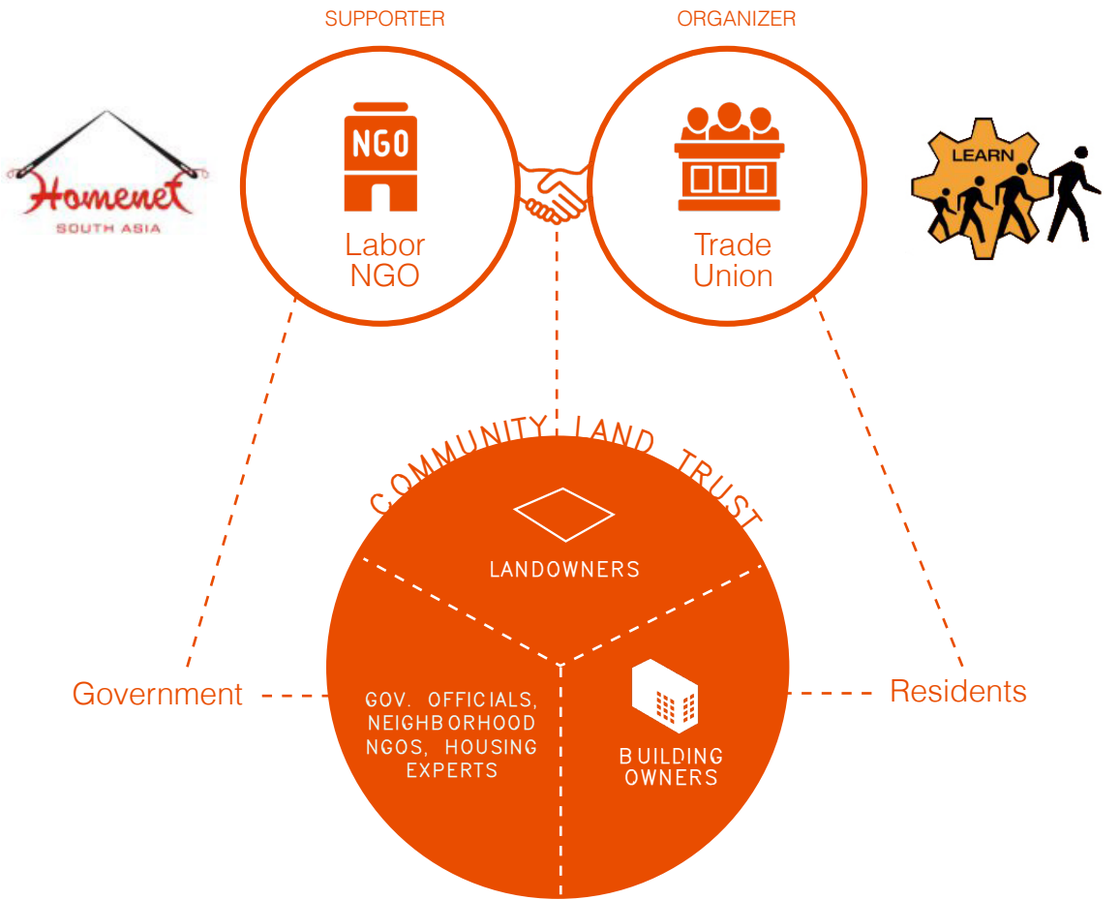
benefit of the community over the individual



As shown in the case of Charkop, appreciating land price over time is an important factor to consider for regeneration of urban areas. The community is not sustainable if low value housing continuously becomes replaced with higher value housing as a result of the high land price. In order to accumulate the appreciation in land values for *the community rather than to an individual*, proposals of Community Land Trusts (CLT) emerges. The core purpose of the CLT is to provide perpetually afforable housing that stands below market value. The larger significance is also to keep the geographical location of the communities in the urban area, thus retaining the value of mixed income development.
According to Shirish B. Patel, there are four main aspects for a successful CLT:
1) There needs an legal entity that can own assets that belong to the community. In India, this can be a Trust, or a Society, making it into a “non-profit organization”.
2) The land is held by the CLT, on which individual members (shareholders) are assigned to individual parcels where they are allowed to build their homes under the restrictions that CLT may impose.
3) The capital gains are shared between the CLT and the owner of the articular property being sold.
4) The respective roles of the owners and the CLT in regards to maintenance is clearly defined.
When a property within the CLT is sold, it could be less than market rates, which keeps the locality at an affordable price, or the CLT could sell the property at market rates to a new higher income resident and use the funds to benefit the community in some other way. (Patel 2010)

COMMUNITY LAND TRUST

founding members



In order to establish a legal entity of non-profit organization, the core CLT members will be a Labor NGO and a membership-based organization, or a trade union. These two roles are important in different ways: the Labor NGO is a *supporter* that builds networks with other like-minded civil society organizations, raises funds for programs, enables formal negotiations with connection with the government, and provides labor education; the Trade Union is an *organizer* which keeps a close contact with informal sector workers, organizes campaigns and collects first-hand datas.
After these two initiators establish the community land trust and accumulate residents who are interested in the redevelopment, the three groups who equally govern this entity withh be comprised of CLT members (landowner), residents (building owner), and professionals and government officials. Then the CLT will be able to legally obtain land through various fundings and eventually take land off the market.
In Mumbai, a similar collaboration of and NGO and trade union occurred during the mapping studies in 2011 which was commissioned by Homenet India and conducted by Labor Education and Research Network (LEARN), a trade union of the informal sector of female workers in Mumbai. The in-depth research was to increase the understanding of the working class and raise awareness of their rights to fair treatment as workers. Furthermore, this collaboration was able to bring together a dispersed workforce and registering individuals as trade union members, thereby providing them with identities of workers. Trade union is called LEARN Mahila Kamgar Sangathana (LMKS), registered as a state level trade level in Maharashtra.
a result of being in a collective

COMMUNITY LAND TRUST

significance of collective voice



educational activities at LEARN Mahila Kamgar Sangathana (LMKS)



ELEMENTAL's "Recommendations for a Participatory Design"

1. Communicate the constraints - to participate is to inform
2. Open the decision making process to families - to design is to prefer
3. Transfer technical knowledge and criteria - to address family-led home additions

The aim of the mapping studies was to collectively tackle the common issues of work and life from the bottom up. In a larger perspective, the ultimate goal is to induce an elevated 'sense of selfhood' as well as expressing the significance of collective voice. Notion of elevated self-hood is understood here as the enhanced self-image of an individual as a result of being in a collective.
I was impressed by the collaboration of Homernet and LEARN which was able to bring great level of empowerment for the invisible part of the society by reaching out to them and creating the collective. I became interested in collective participation in decision making process also in my housing design. However, the informal workers and their families are simply unable to initiate the redvelopment themselves due to lack of awareness. Therefore a balance of top-down and bottom-up approach is most effective in this condition by providing the resdients the possible choices to choose from.

According to ELEMENTAL's experiences with Quinta Monroy and their other social housing projects, they provide the following recommendations for a participatory design: 1) communicate the constraints, 2) open the decision making processes to families 3) transfer technical knowledge and criteria. This approach can be seen as a controlled participation, as the project promises affordability and efficiency through the planning by the architect as well as the residents' inputs in the process, such as desgining the shared spaces. This is achieved by various workshops which are held to educate the residents about the regulations and the appropriate ways of transforming the given framework. The result is a regularity of the building and accentuated individuality achived at once. (Gartenberg & Bhowmik)



REINVENTING Dharavi

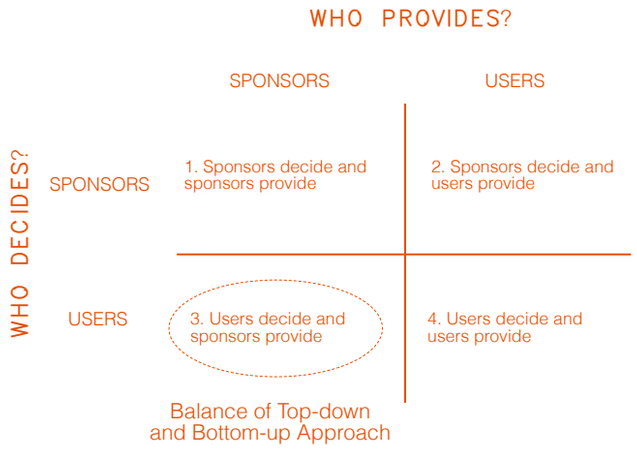
AN IDEAS COMPENDIUM

URBAN DESIGN RESEARCH INSTITUTE

ISBN 978-93-81444-16-0

COMMUNITY LAND TRUST

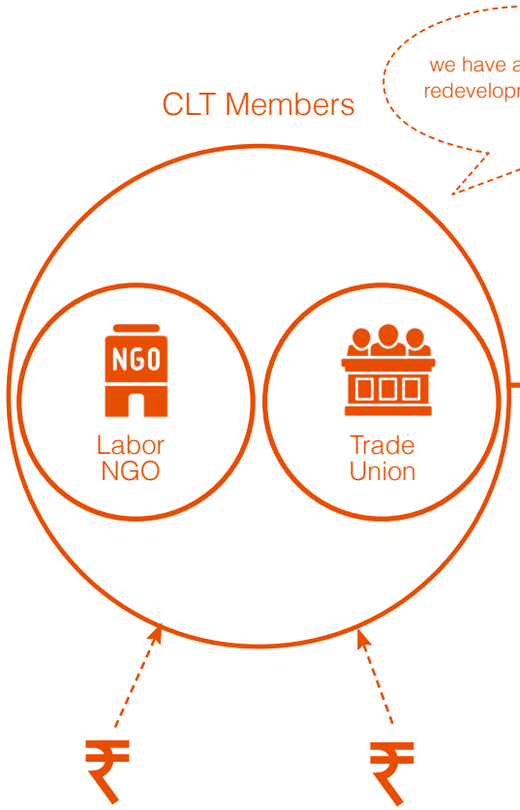
potentials and credibility



+	-
- Transparent collaborative process aimed for quality - Low-cost in perpetuity - Give credibility for EWS / LIG families when mortgage is in need - Prevent speculative buying & selling - Foster community growth and investment from the homeowners	- Time-consuming decision-making process in respect to current practices - CLT lease restrictions that limit resale value prevent the home-owners from appreciation of land value - Lack of implementation experience in India

In conclusion, I believe USERS decide and SPONSORS provide through controlled participation is most effective and successful approach to affordable housing in the context of India, regarding the current lack of identity and knowledge of the workers in carrying out the process. Realizing the growing concern that *management* and *maintenance* are equally or even more significant factors in housing than initial design, construction or even capital financing, preserving the locality and sense of belonging of the residents will be able to ensure a better maintenance of the community projects in the long run.
To implement community land trust concept, both its pros and cons must be considered. As aforementioned, CLT is different from the majority of the current housing process in India in that it is a transparent and collaborative process that aims for not only quality but also perpetual low-cost for EWS and LIG families by giving them credibility. Because CLT prevents any speculative buying and selling, it can foster community growth and investments from the homeowners. A critical disadvantage however, is that CLT is comparatively a time-consuming process due to its egalitarian decision making process. Secondly, CLT lease restrictions limiting resale values prevent the home owners from appreciation of land value. Nevertheless these points should be accepted as an outcome for its long-term quality for the residents. Lastly, another con is that there is a lack of implementation experience in India. However the concept of community land trust by the urban research group PLURAL has recently been a winning entry for the international competition by Urban Development Research Institute (UDRI) to generate viable solutions for redevelopment of Dharavi, India’s largest slum. This relatively new idea of land ownership therefore shows great potential in its effect in Mumbai in the future. (“Community Land Trust Model” 2017)

COMMITTEE ESTABLISHMENT



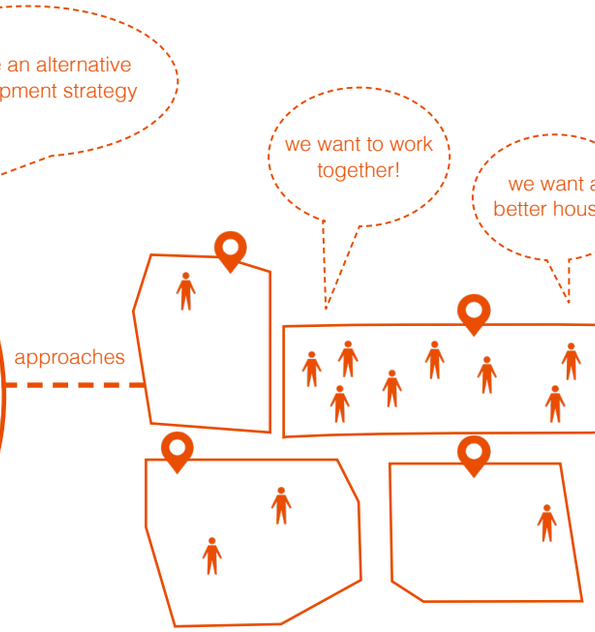
MORTGAGE LOAN:

Housing Finance Corporation

FUNDING:

- Private Donors
- Federal Housing Subsidies
- City owned property
- Community foundations

REDEVELOPMENT INTRODUCTION

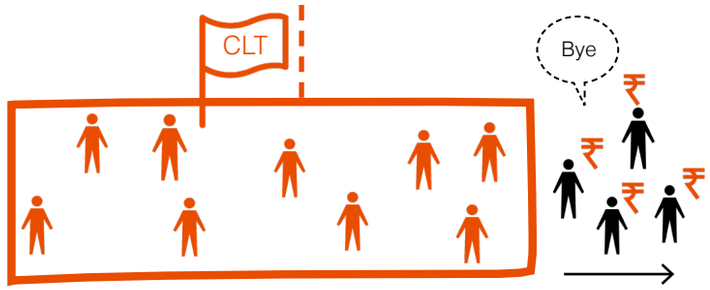


TARGETED BAITHI CHAWL REGIONS

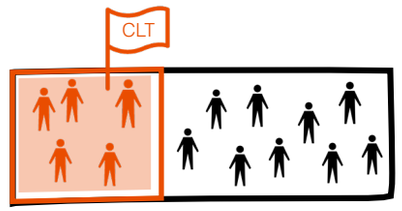
LAND ACQUIREMENT



EQUAL GOVERNANCE OF THREE PARTIES

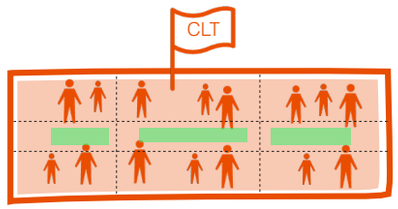


BUY OFF UNWILLING OWNERS AND ESTABLISH COMMUNITY OWNED LAND



SCENARIO I:
ACUPUNCTURAL DEVELOPMENT

faster decision making processes



SCENARIO II:
MASTERPLAN DEVELOPMENT

higher degree of participation in larger communal spaces and desired community density



ORGANIZATIONAL STRATEGY

COMMUNICATION OF CONSTRAINTS

I. PROJECT WORKSHOP

SHOP UNIT

GROUND FLOOR
- 3M SHOPFRONT
- 4.5M SHOPFRONT

FIRST FLOOR
- EXPANDABLE SPACE
- CO-WORKING SPACE
- ENCLOSABLE END UNITS

RESIDENTIAL UNIT

SECOND FLOOR
- RK — LARGER CORRIDOR
- 1BHK

THIRD FLOOR
- RK
- 1BHK — LARGER BALCONY, LARGER LIVING ROOM
- 2BHK — LEASABLE ROOM

FOURTH FLOOR
- RK
- 1BHK — LARGER BALCONY, LARGER LIVING ROOM
- 2BHK — LEASABLE ROOM

OPTIONAL UNIT

GROUND FLOOR — 3 x 4.5M PLOT

III. ADAPTATION WORKSHOP

- UNDERSTANDING THE LEGAL TOOLS
- APPROPRIATE MATERIALS & CONSTRUCTION
- DECORATION KNOW-HOW

OPEN DISCUSSIONS

DESIGN PROPOSAL

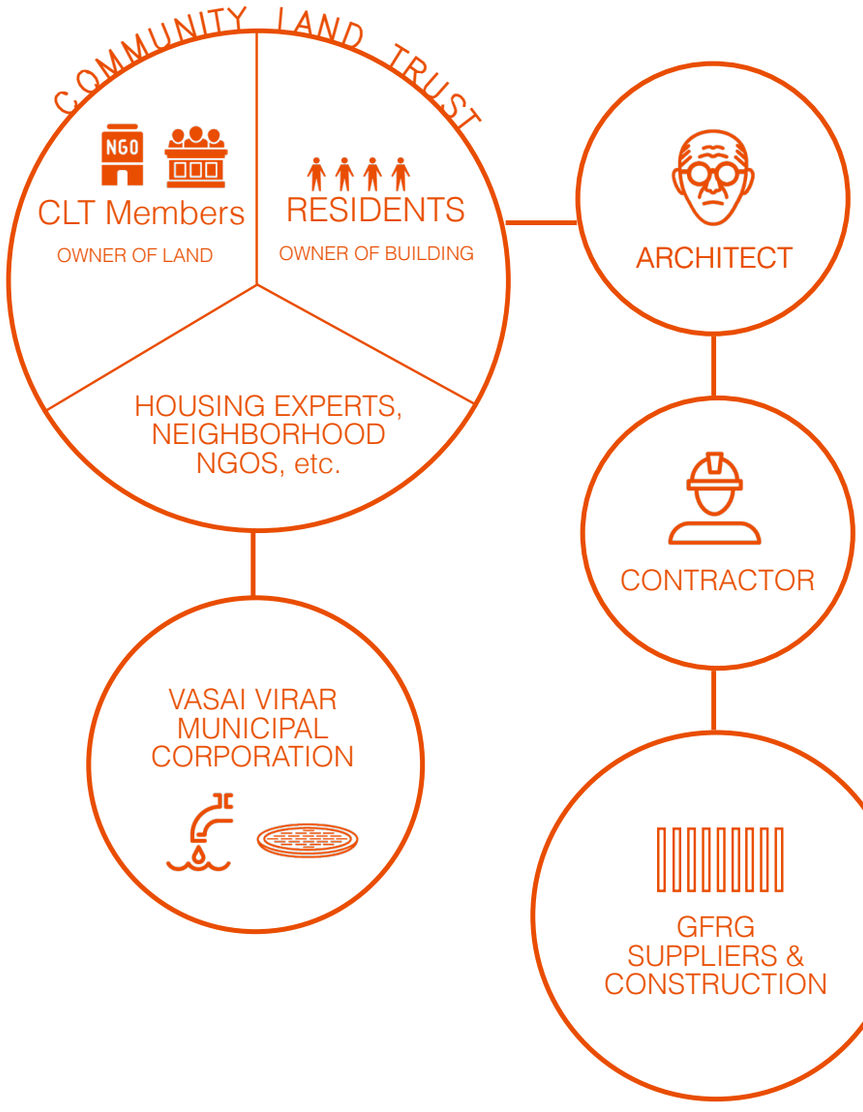
II. COLLECTIVE SPACE WORKSHOP

PROPOSALS ON COURTYARD

DENSITY GOALS

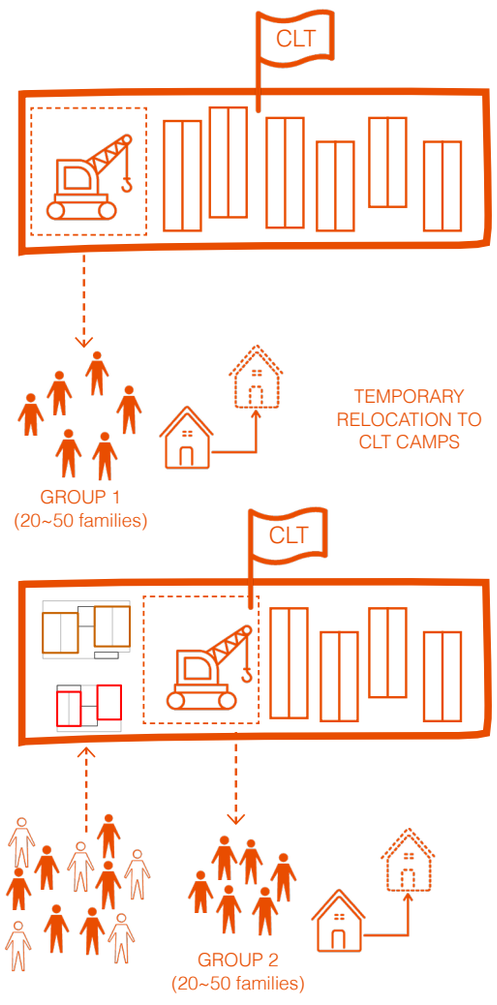


DESIGN EXECUTION

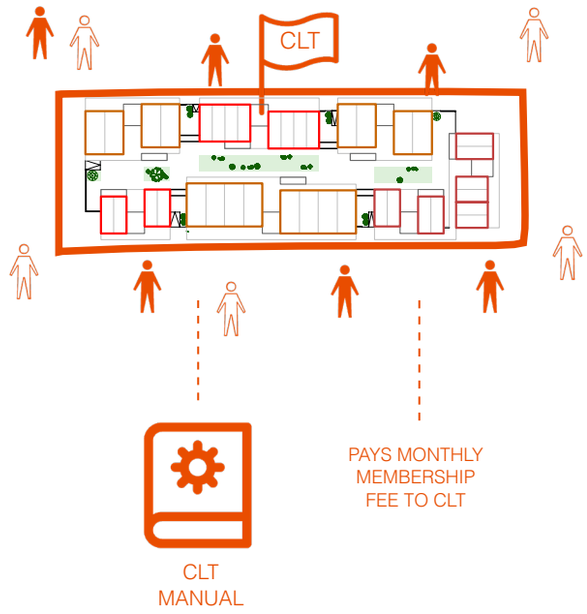


ORGANIZATIONAL STRATEGY

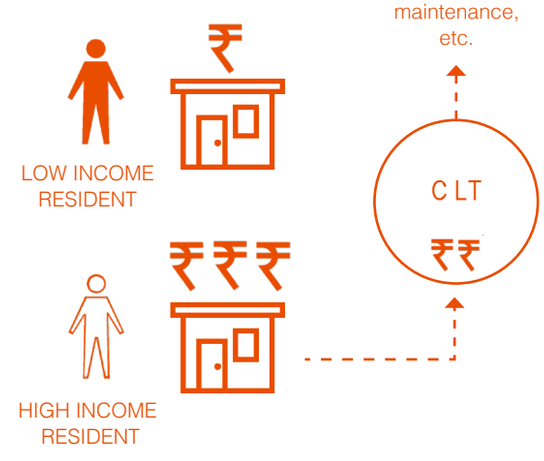
CONSTRUCTION



HABITATION & ADAPTATION

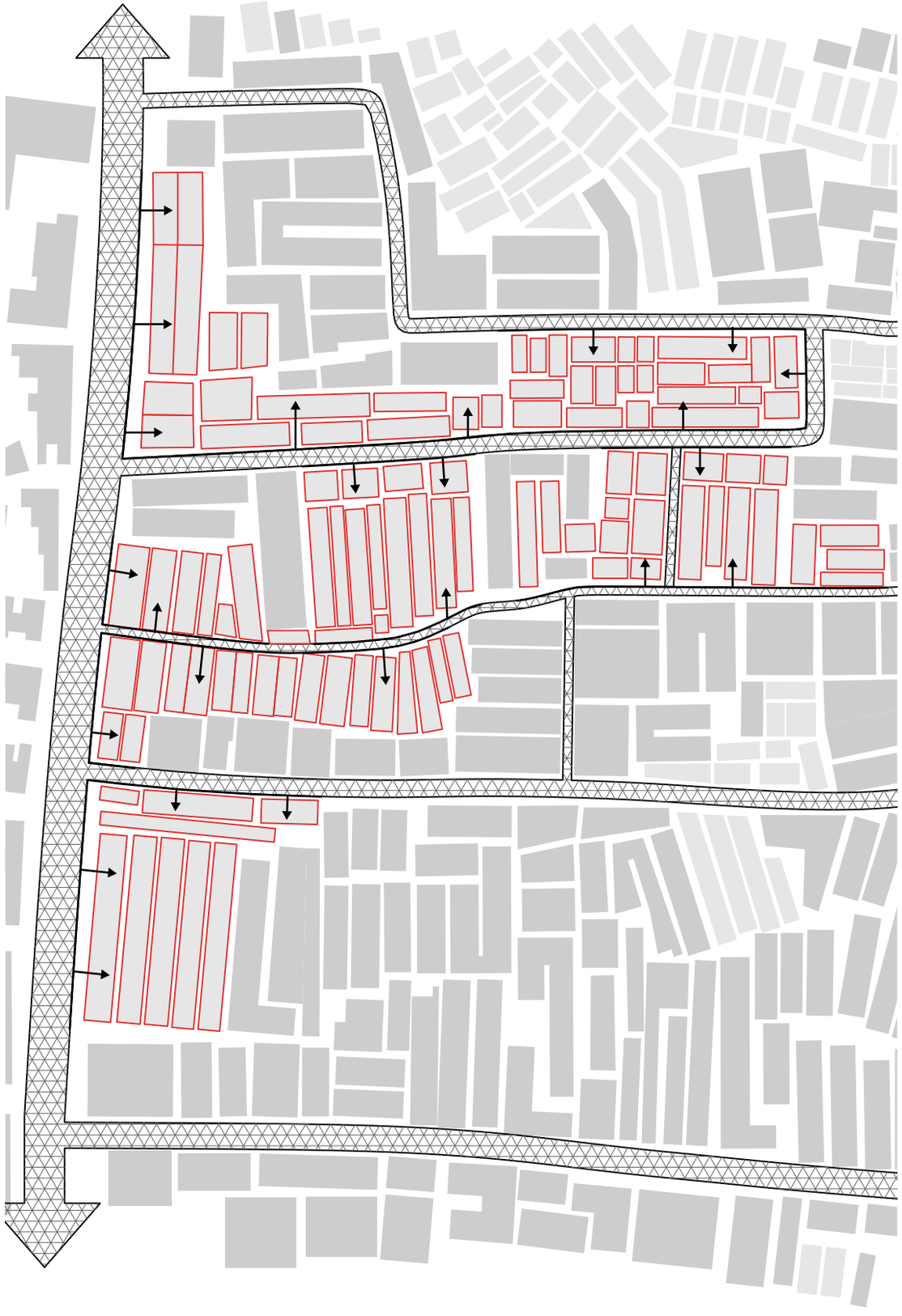


RECRUITMENT OF NEW RESIDENTS



4

DESIGN

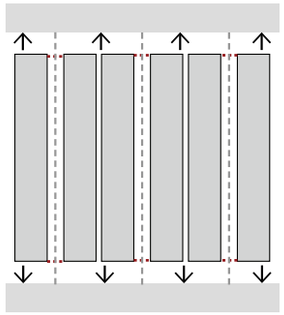


DESIGN HYPOTHESIS

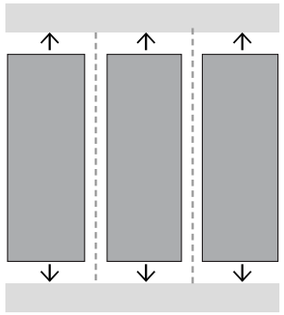
linear form generation - creating the commercial front

street-based income generation

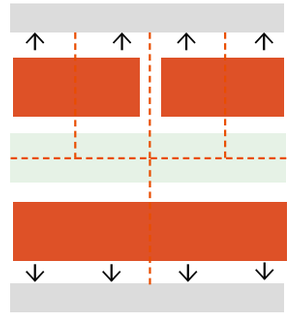
BAITHI CHAWLS



MID-RISE CHAWLS



INTERVENTION





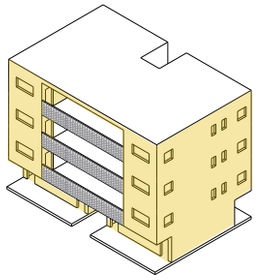




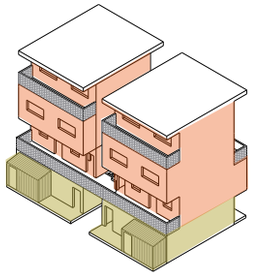
For the informal workers, street is an essential place for income generation. In informal settlements, the Location of small shops follows a commercial principle by locating them at convenient nodes and with wider exposure to the passerby. So the design concept of my massing is a result of a very simple idea of aligning the long side of my building where the commercial activities take place, unlike the majority of the existing buildings which face the shorter side. While creating the commercial front, the idea is to create community space behind where residents gather, socialize and work together.

DESIGN HYPOTHESIS

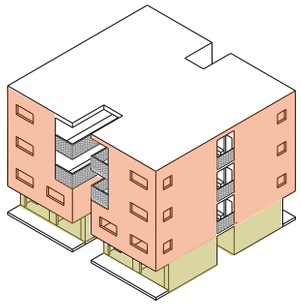
approach I: pavilion typologies dedicated to each worker groups



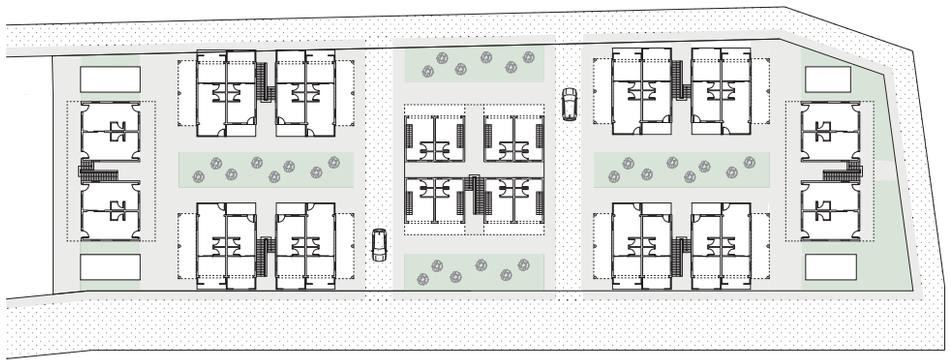
Housing for Home-based Production



Housing for Mixed-Occupancy (shopowners and tenants)



Housing for Mixed-income groups



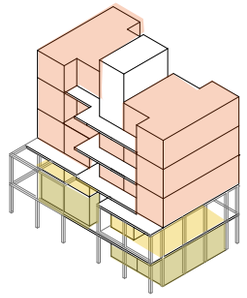
key improvement criterias:

residential space	yes
commercial space	no
communal space	yes
appropriate density	no
scalability	yes/no

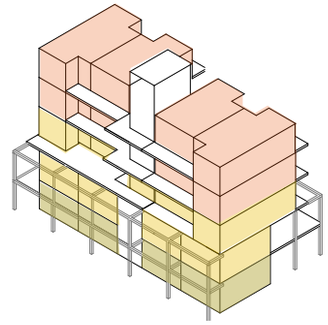
There was two phases in my design process, first was a separate typology dedicated to different groups of workers. Housing dedicated to home-based workers was characterized by a large central communal work space on each floor for every 4 units. Housing for mixed occupancy, namely shopowners and tenants had shops for ground level and duplex units on top. Lastly for housing for mix-income groups was to provide diverse units. These three types are to be located in a certain type of locations, such as inner neighborhood, along the street, or at the corner.
Reflecting back, this design was most problematic in terms of tackling the density issue of the area, as it left numerous unplanned open spaces which are questionable in use. Secondly, there were also too many variables that has to fit into these frameworks of which may limit the application in diverse site conditions.

DESIGN HYPOTHESIS

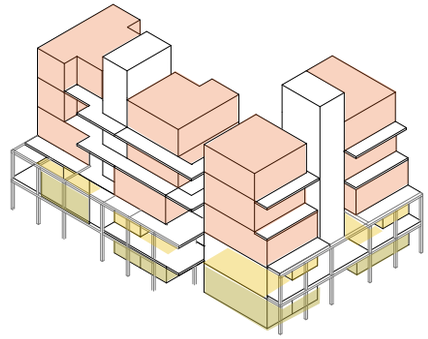
approach II: linear typology in different forms for all worker groups



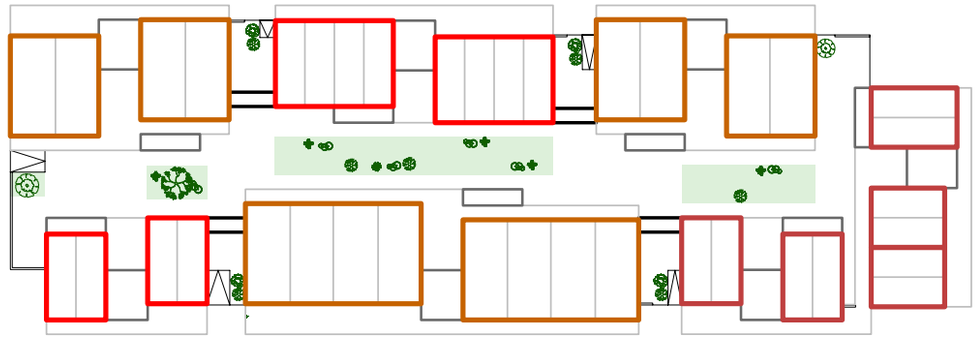
3M MODULE



4.5M MODULE



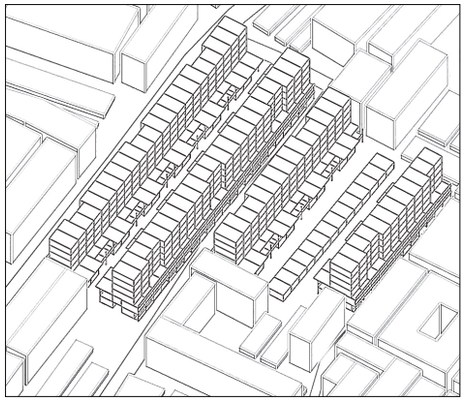
CORNER MODULE

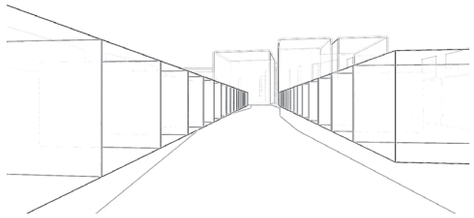


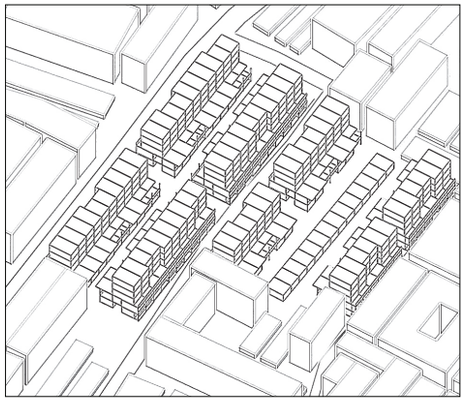
key improvement criterias:

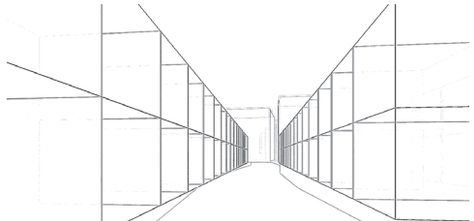
residential space	yes
commercial space	yes - **street exposure**
communal space	yes
appropriate density	yes
scalability	yes

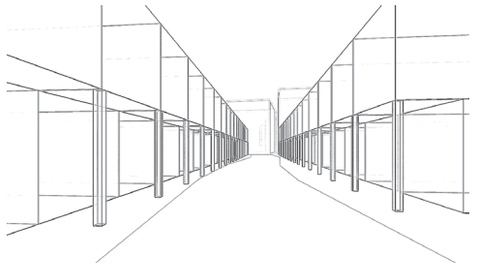
The second phase of my project attempts to resolve the shortcomings of the first design hypothesis. Rather than creating multiple typologies with different concepts, I created one concept in multiple forms. The most important design feature of this attempt is the linear form which aligns with the street to allocate shops on the first two levels, defined as ‘communal plinth’. Considering the hiearchy and length of the street as the main variable in setting the approximate number of units would be the first step in any type of plots. Each building then have residential units on third to fifth floor, as units below merge to become bigger units. Although the concept is consistent, the typologies are different in the module sizes such as 3M or 4.5M, or the same building turns around the corner to demarcate the plot. In this attempt, the density is increased far more than its existing baithi condition, and the design is flexible to fit various conditions due to its adaptable form.





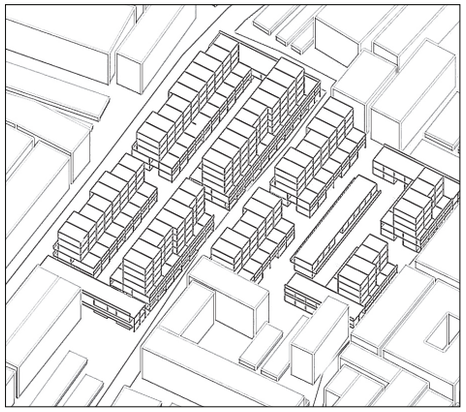


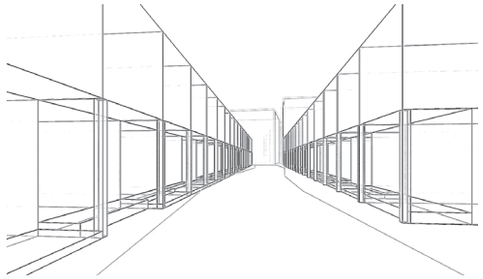


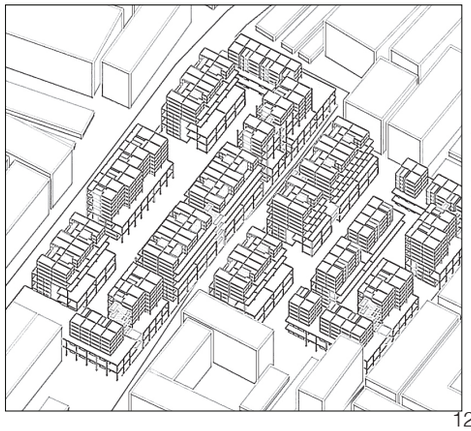


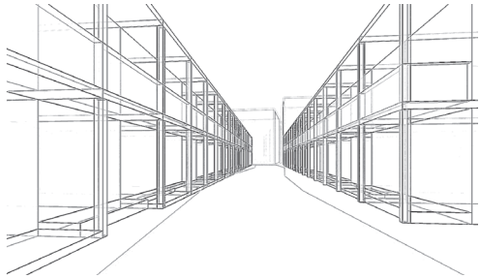
massing process

main street perspective











SITE CONDITIONS

massing in site context

existing baithi chawl unit



3 x 6m unit

new unit type



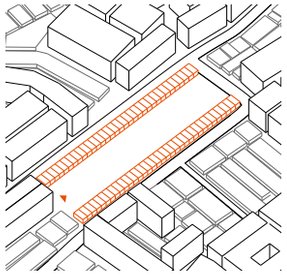
3 x 7.5m unit

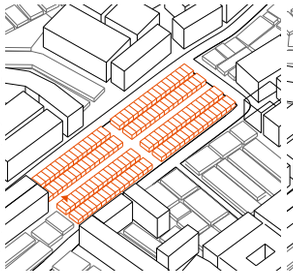


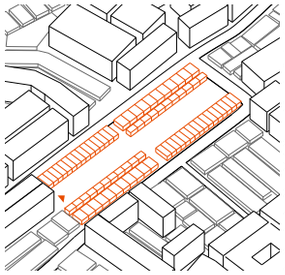
4.5 x 6m unit

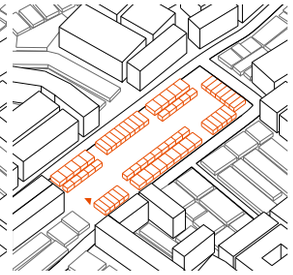


3 x 4.5m unit









street alignment



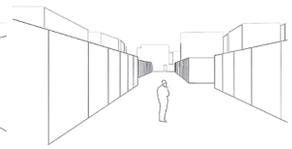
double-sided street alignment



both single and double-sided



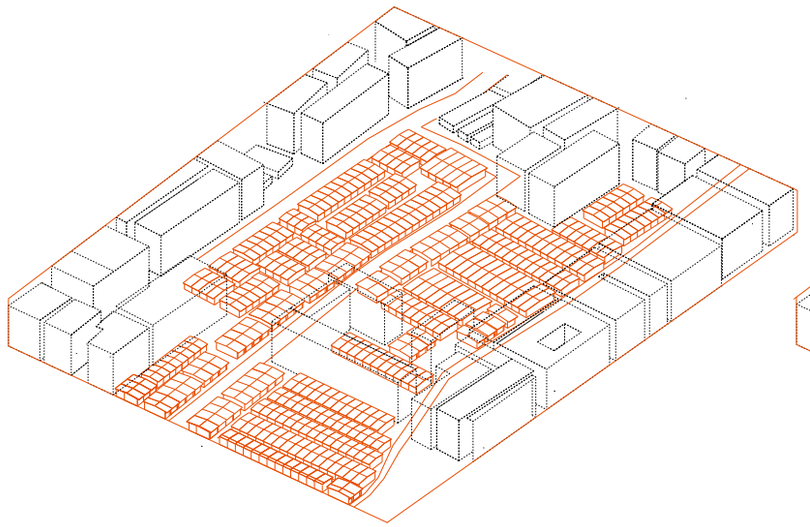
varied length and accessibility

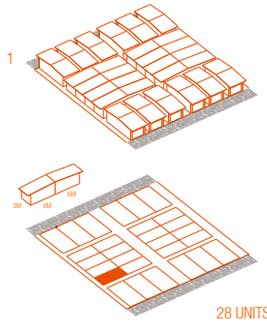


Taking the narrowest plot of the site as a starting point, massings were tested to find the appropriate size of the units to allow at least two strips of buildings with inner space creatd. The standard size of the baithi chawl unit of 3 x 6m unit was also considered as a way to provide an alternative unit size.
After the studies, the interplay of two ground floor unit types of 3 x 7.5m and 4.5m x 6m created most interesting spatial conditions in the inner community space where the space is intimate and not too crammed. From the perspective of the main street, offset away from the pedestrian path by a concrete frame created a nice visual effect of straight alignment of shop fronts. Then, the linear strips of ground floor units are divided at appropriate openings to define the length of the blocks. Then the residential units above were tested to find a form that breaks down the scale from the community plinth.



BAITHI CHAWL (EXISTING)

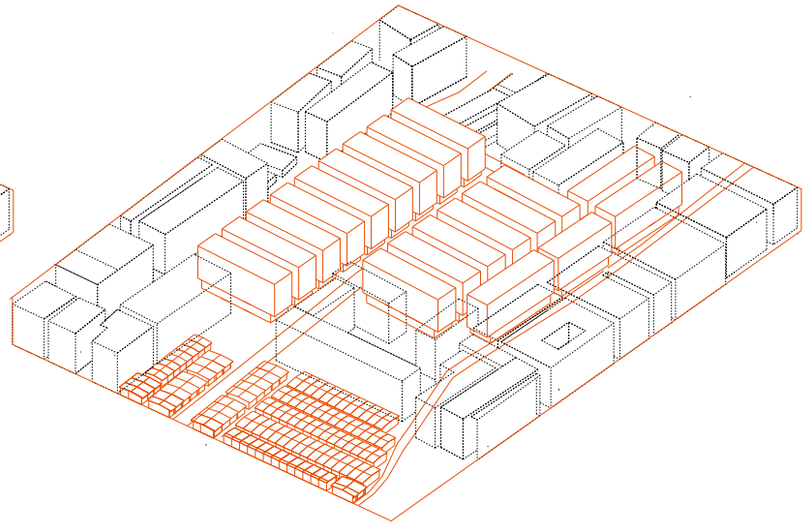


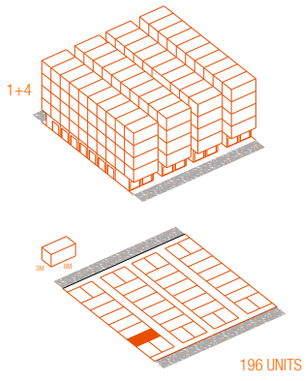


372m² LIVE-SELL UNIT

288m² BASIC UNIT

MID-RISE HANDSHAKE CHAWL





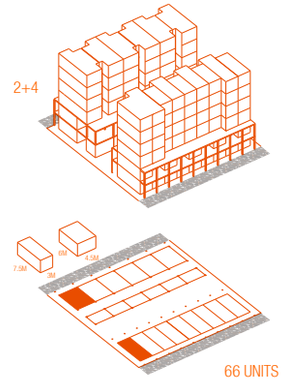
2880m² BASIC UNIT

486m² SHOP UNIT

PROPOSED

?

+ DENSITY
+ DIVERSITY
+ QUALITY



1676m² BASIC UNIT

639m² SELL-LIVE UNIT

293m² EXPANDABLE SPACE

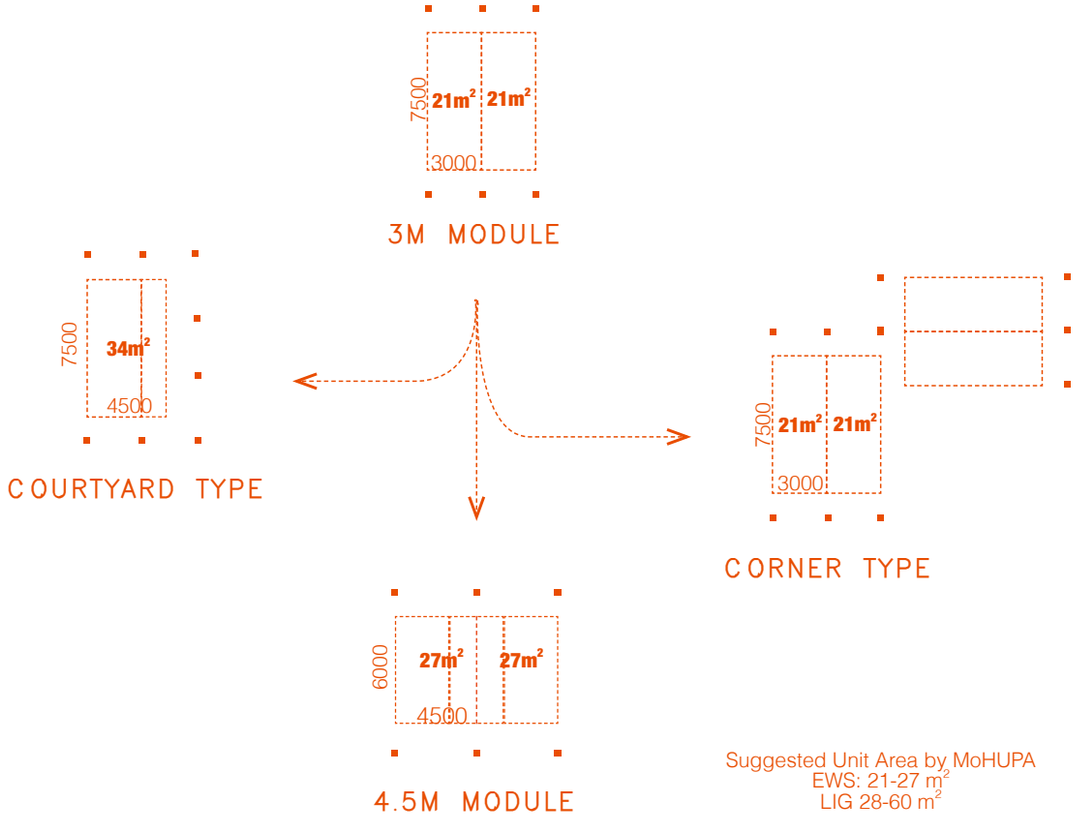
477m² COMMUNAL WORKSPACE

SITE CONDITIONS

density scenarios in site

DESIGN CONCEPT

building type variations



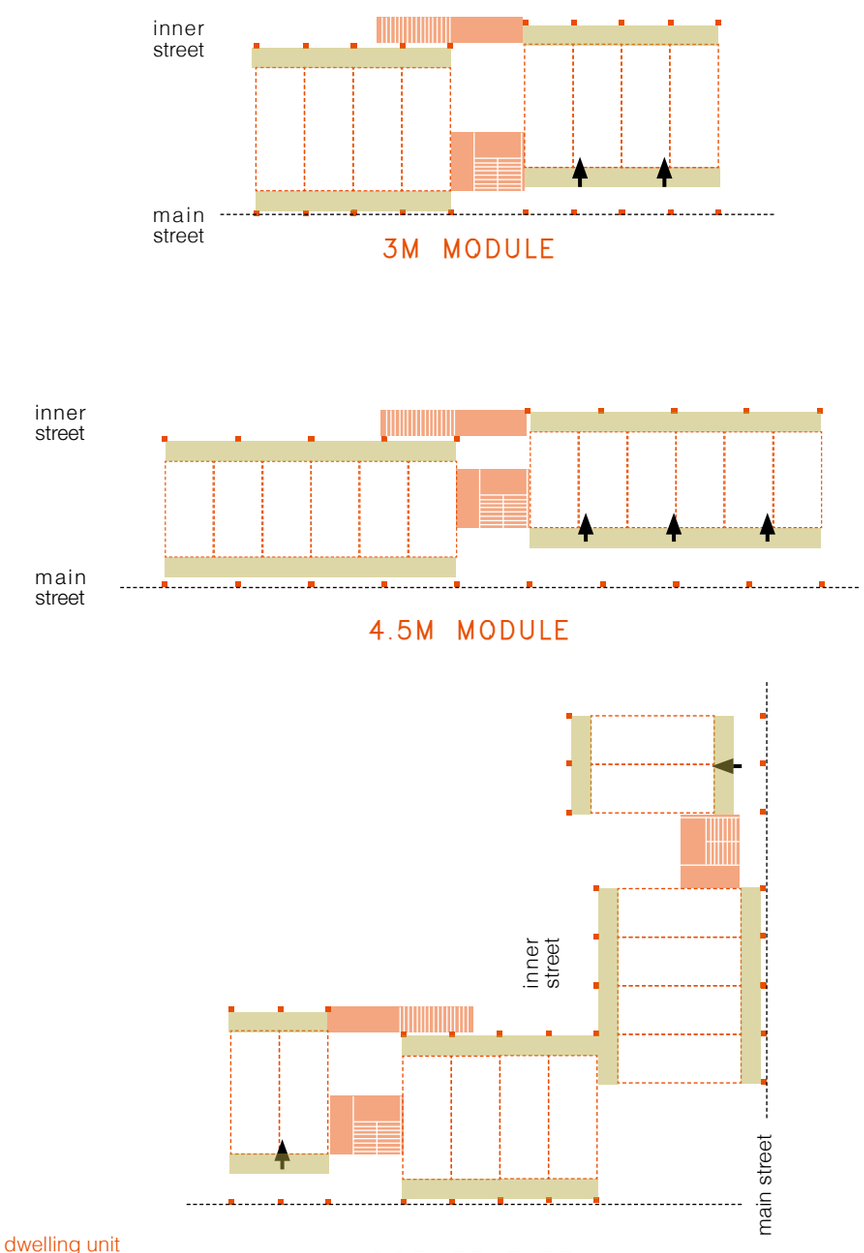
Suggested Unit Area by MoHUPA
EWS: 21-27 m^2
LIG 28-60 m^2

While the existing baithi chawl units are 3 by 6 meters, I try to create a slightly larger unit by setting the base unit to 3 by 7.5 meter, creating 21 sqm as my smallest unit. I have decided to keep the 3 meter as a module for an efficient use of my building material which comes in the standardized size of 3m width, which I will explain in the next chapter.
By placing three modules together for two units, it can create a 4.5m module type which has a wider shop frontage of 4.5m but keeping the length to 6m, creating a 27 smq unit. A corner type is essentially the same module as the 3m module type, but one side is rotated as a form of an enclosure of the community ground. An building type of 4.5m module is created for buildings which is located inside a courtyard of a plot.

Other than the dimensions of the panels, 4 types essentially share the same design, as the circulation is placed in the middle of the building. Then, they have 1.5m of extension spaces, both front and back where residents can freely appropriate. Each types can vary in length by doubling the length of each block. And the blocks can shift 1.5m so that it creates a more permeable ground on the outer street, but the order is still maintained by continuing the columns in a straight line. At the backside, it creates a space for a staircase leading to the first floor. Each of the types will have brick balustrade on the front facade, and bamboo balustrade at the back.

DESIGN CONCEPT

building type variations

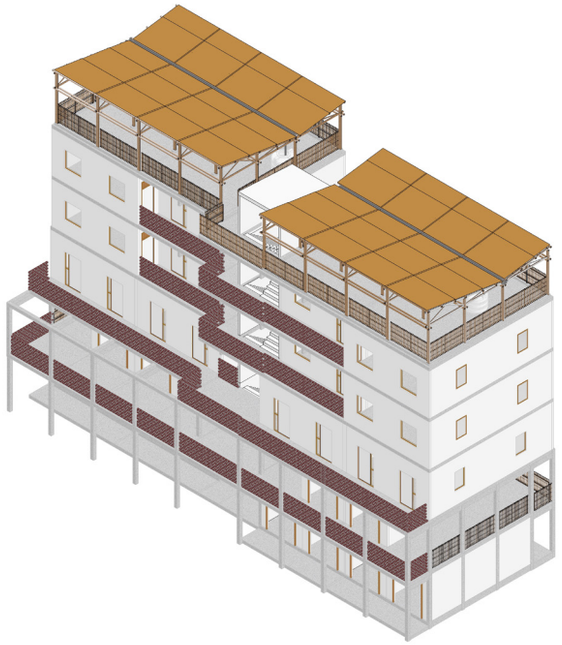


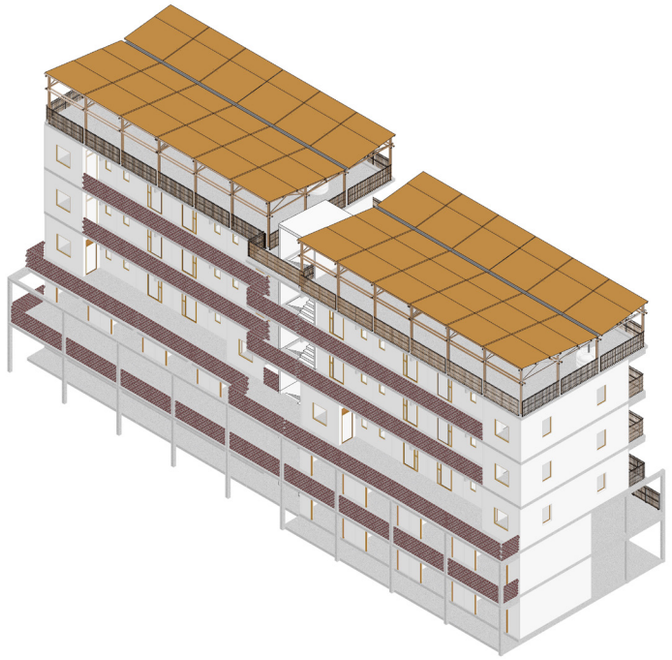
3M MODULE

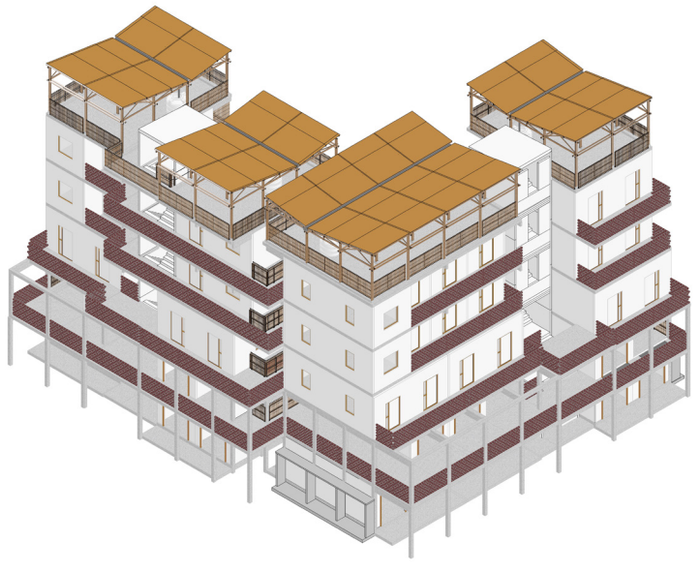
4.5M MODULE

CORNER MODULE

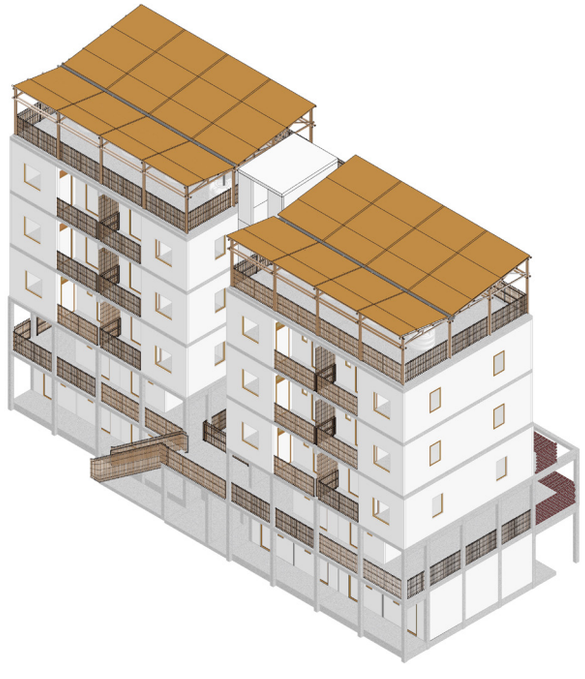
FRONT

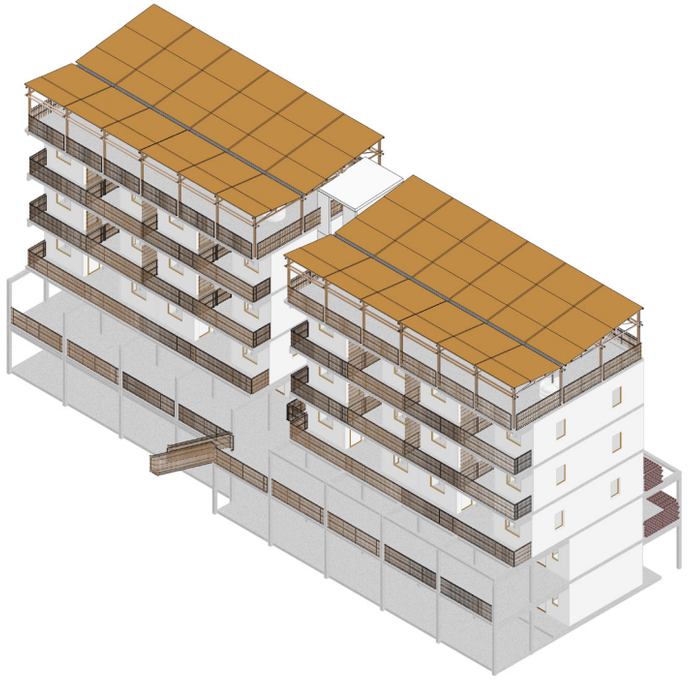


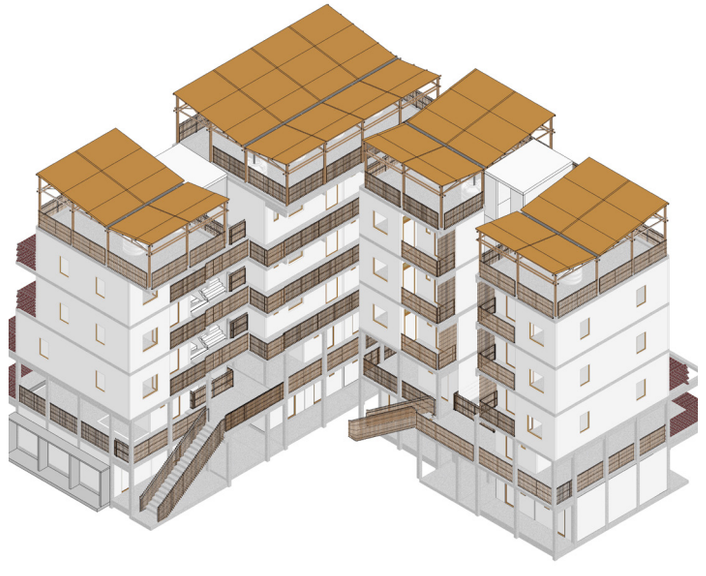




BACK

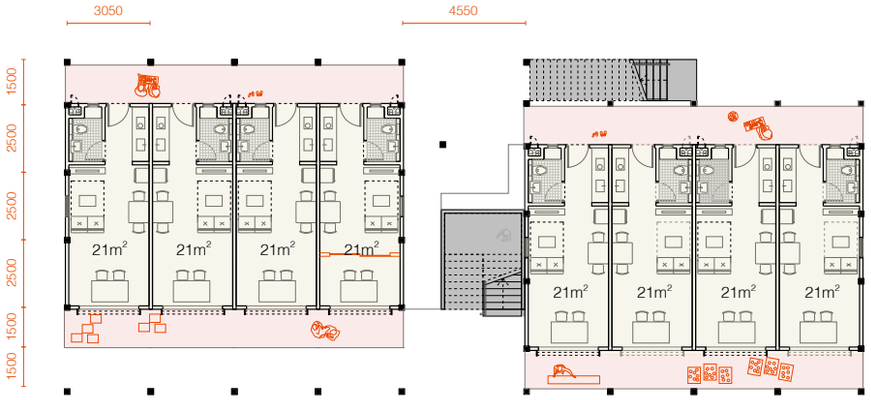




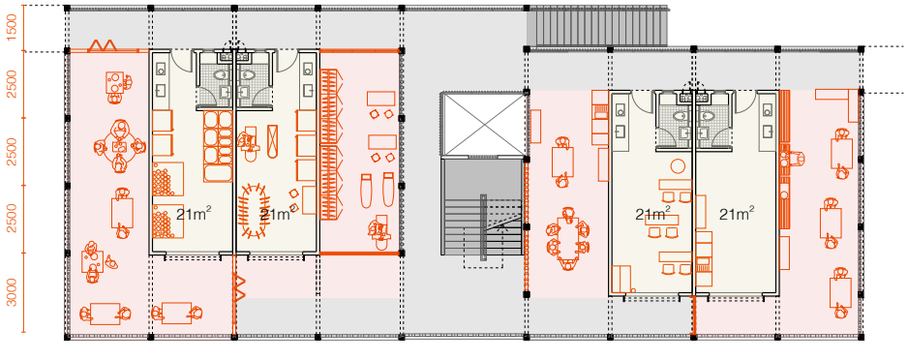


BUILDING TYPE

3m module



G/F PLAN



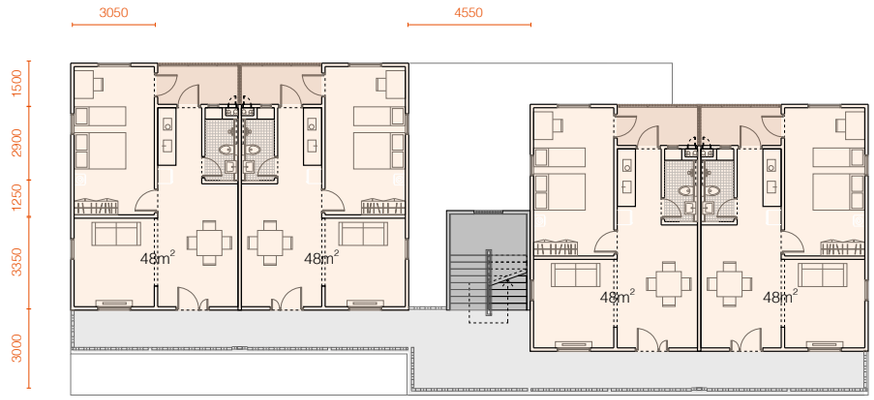
1/F PLAN

The base unit of the 3M module type is in the width of 3050mm and length of 7500mm units. The ground floor is comprised of all shop units which can incoporate living in the backside. On the first level, half of the shop units continue up so that half of the units are left empty. This empty plot is to be owned by the resident who owns the enclosed unit and will have the the right to make enclosures or leave it open as a semi-outdoor space. The first floor units are can still function as a shop unit but do not have a direct street contact, so it would be an appropriate condition for a shop which is run on a contact-based customers, or have a shop which requires larger space, such as a canteen, classroom or laundry shop. The units on the end of the building can potentially occupy the space until the line of their door front, thus will have a higher value than the unit next to the staircase.

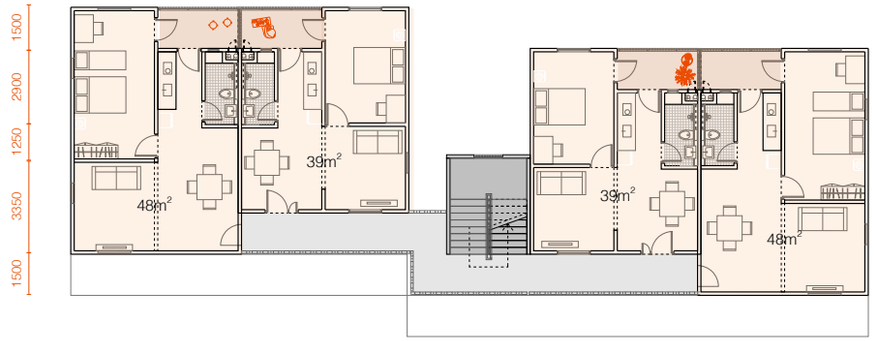
From the 2nd floor onwards is residential use, and you can see that the four 3m modules merge to create two 48m2 units, while still keeping the position of the bathrooms and kitchens. Second floor is comprised of larger units (48m2) as it is an intermediate zone between the commercial plinth that is extruded outward and the residential floors above. The third and fourth floor are offset back to have a shorter corridor and create smaller units.

BUILDING TYPE

3m module



2/F PLAN



3-4/F PLAN

work units

units

circulation

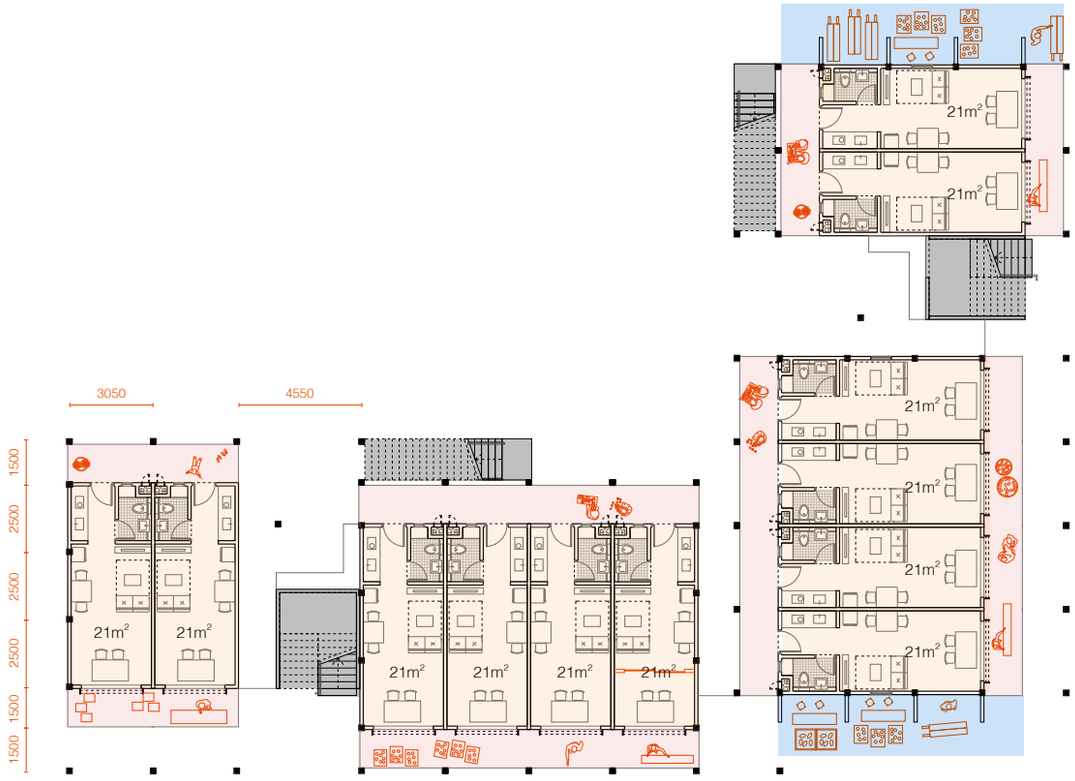
extension spaces

communal spaces

balcony

BUILDING TYPE

corner module



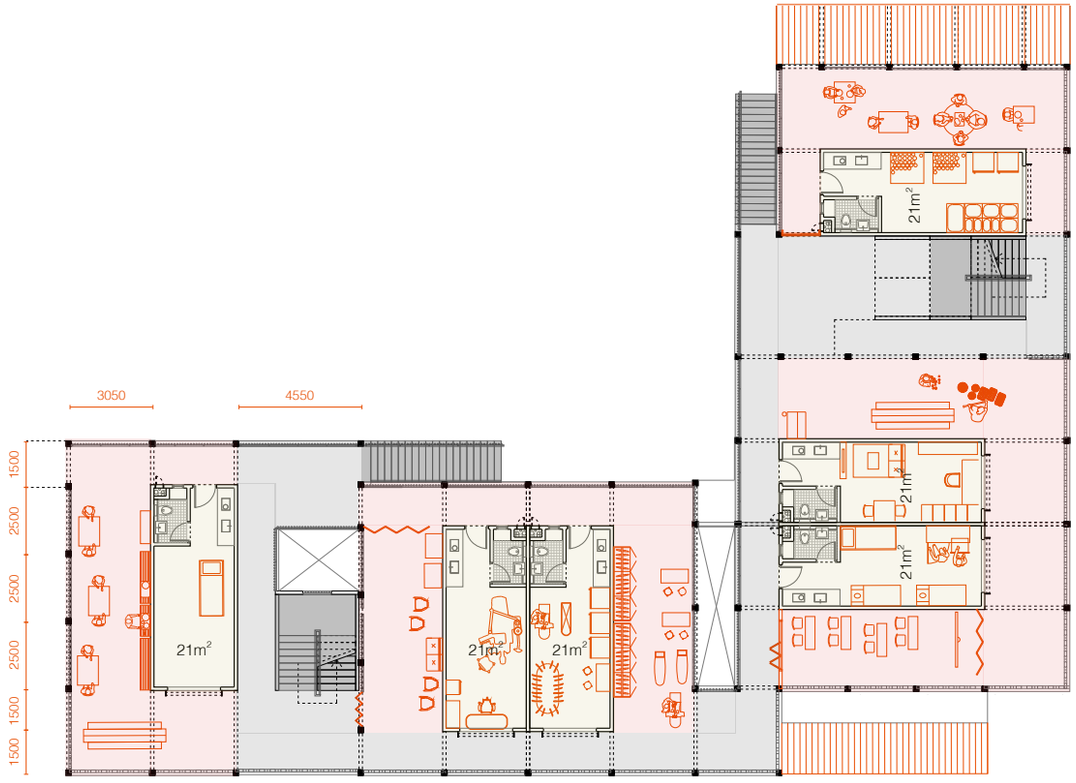
G/F PLAN

Corner module is essentially the same composition as the 3m module type, but on two perpendicular sides. The two 3m module blocks are connected around the corner point so that the corridor is continious throughout the units on the same floor. On the ground level the distance between the two perpendicular plots are preserved as a back alley going into the community ground.

One of the main purpose of this type is to function as an enclosure of the plot, so that an intimate inner courtyard atmosphere can be generated. Another characteristic of the corner module is to create an offset in the corner so that it allows the hawkers to occupy the space, creating a small market zone on the ground level.

BUILDING TYPE

corner module



1/F PLAN

work units

units

circulation

hawker spaces

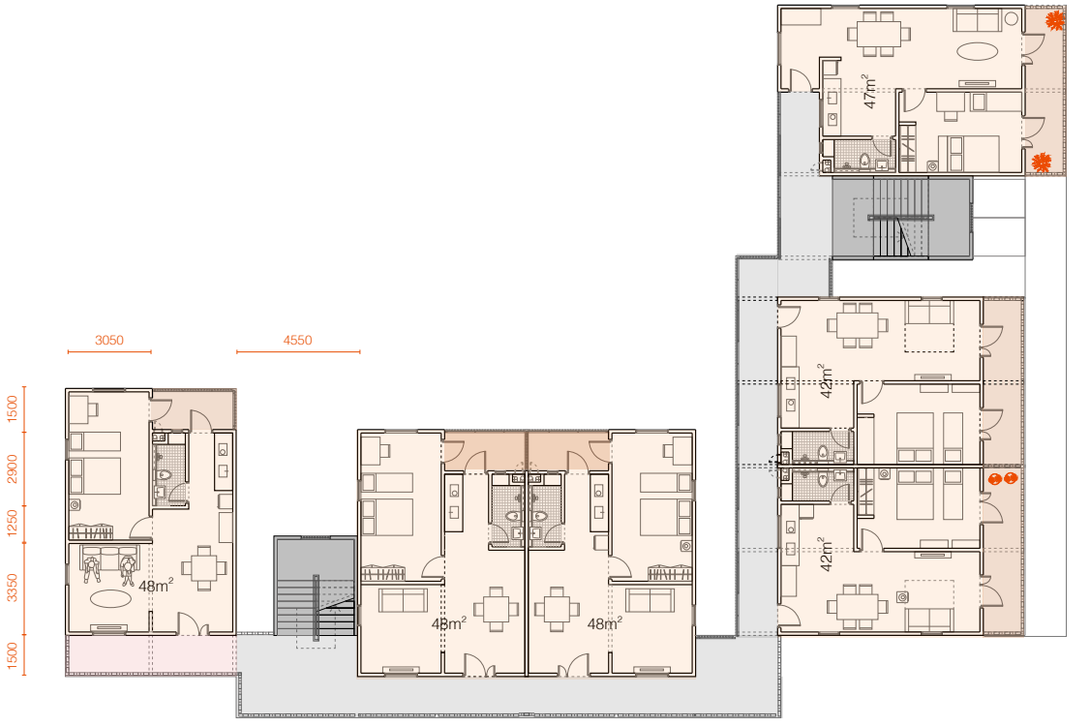
extension spaces

communal spaces

balcony

BUILDING TYPE

corner module



2/F PLAN

The logic of the first level is also identical to the 3M module. From second level onwards, the units are also merged, but the difference is that half of the corner module type will have units which have bathroom facing the corridor, but instead have a wider balcony towards the street front. he offset of the third to fourth floor create variety of units from 34 to 42m2

BUILDING TYPE

corner module



3-4/F PLAN

work units

units

circulation

hawker spaces

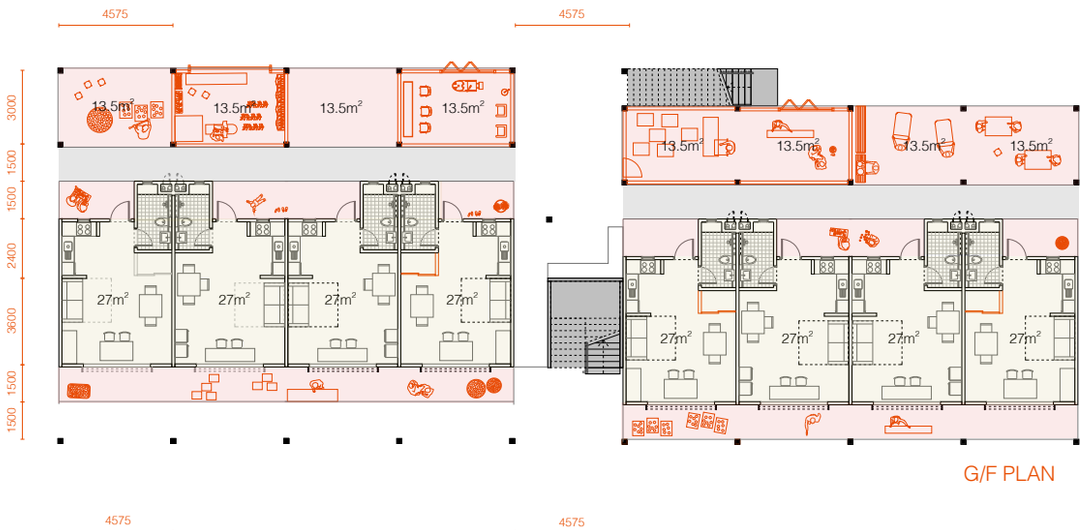
extension spaces

communal spaces

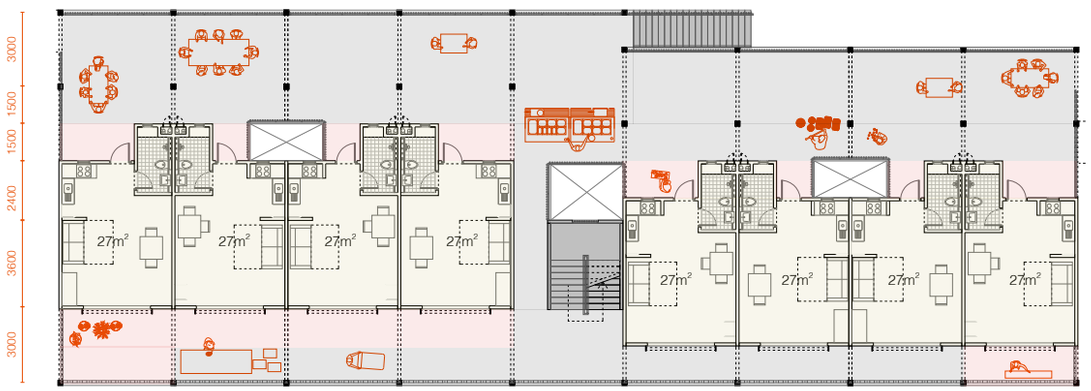
balcony

BUILDING TYPE

4.5m module



G/F PLAN



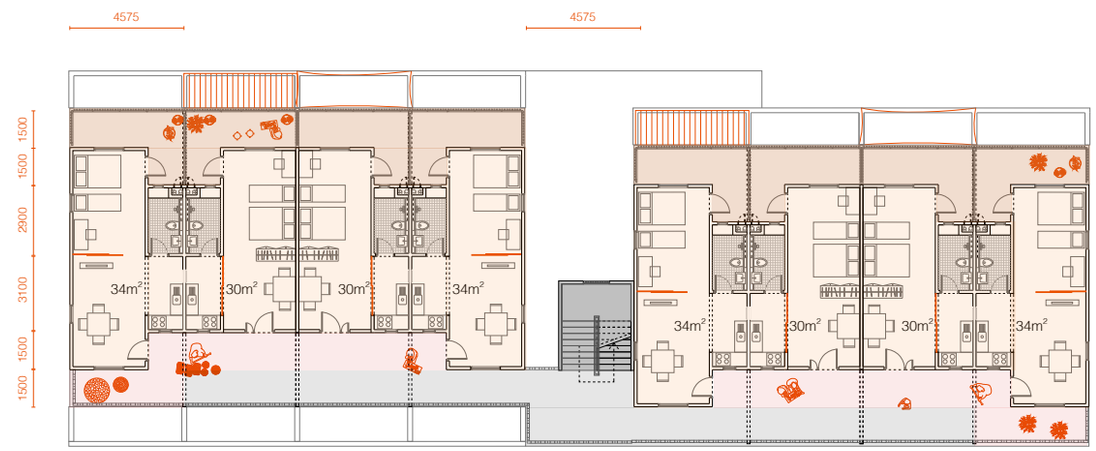
1/F PLAN

Last is the 4.5M module type which consists of a base unit of 4575mm width and 6000mm length, creating one pair of 27m² units using three panels. 4.5M module type additionally have a 3m extension of concrete framework on the back side, which is left empty for a future appropriation by residents. The ones who buys the this 13.5m² optional plot will have ownership right to make enclosures and use it as a shop or their personal use. If the optional units do not become purchased, it will be a communal space for the residents where they can put out their furnitures and work together. On the first level the floors on top of these optional units are utilized for residents to produce goods together or do their house chores. Spaces on this floor are not meant to be enclosed, as it is a communal plinth level for for all the buildings and they are to have visual connections and also physical connection by bridges on the side. The residents however do have an option of enclosing the roof on the framework which is left open for better sunlight.

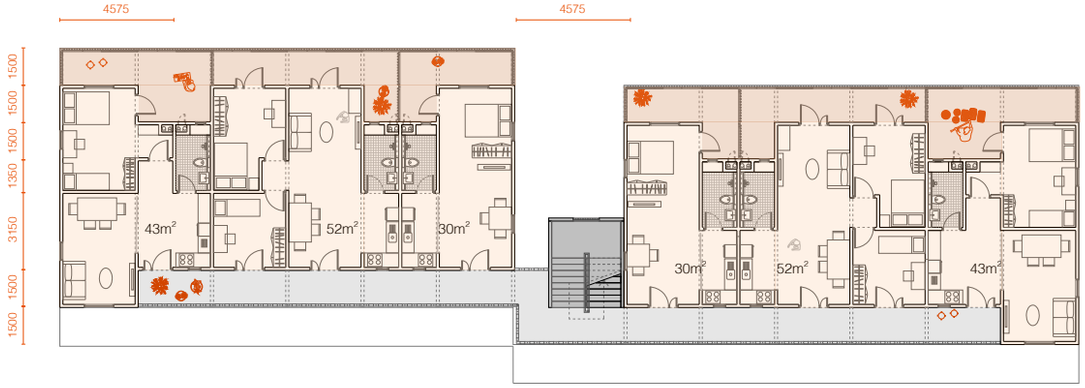
The residential floors basically extend by following the grid of the walls and the columns below and become bigger units. The second floor has an extra corridor space from the plinth below, and can form also communal workspace among those who live on this floor. Lastly the 3rd to 4th floor create different unit types by merging the four units into three, ranging from 30m² to 52m².

BUILDING TYPE

4.5m module



2/F PLAN



3-4/F PLAN

work units

units

circulation

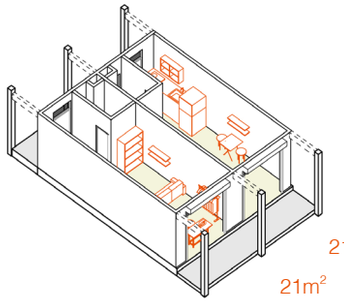
extension spaces

communal spaces

balcony

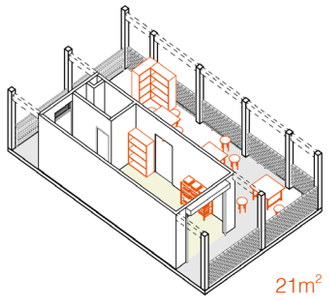
GROUND FLOOR

1ST FLOOR



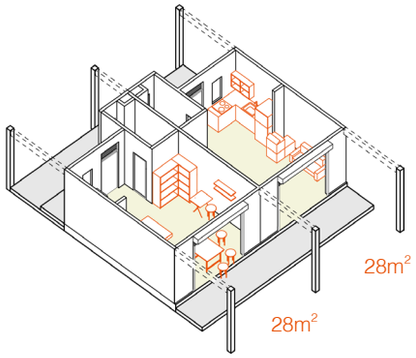
21m²

21m²



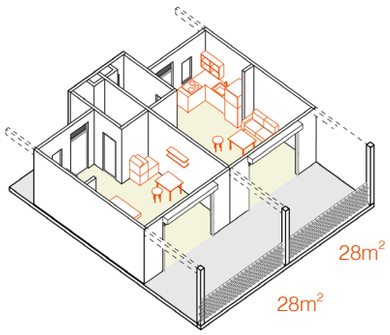
21m²

21m²



28m²

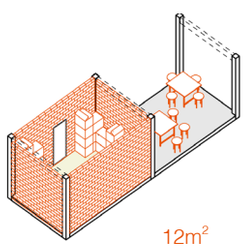
28m²



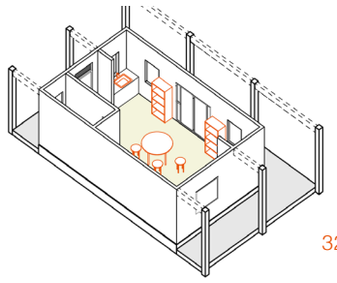
28m²

28m²

SHOP UNIT



12m²



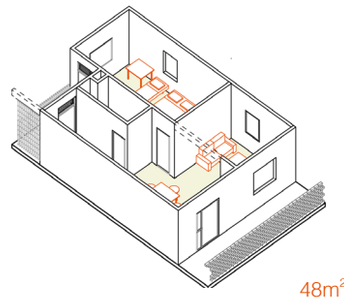
32m²

COMMUNAL UNIT

BUILDING TYPE

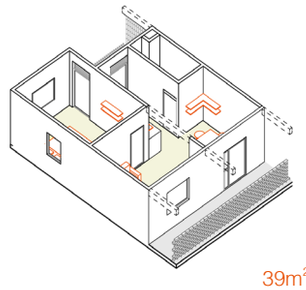
dwelling catalogue

2ND FLOOR

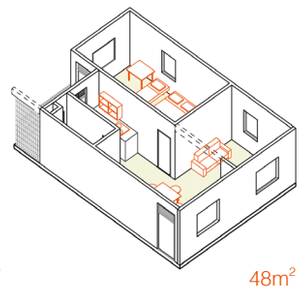


48m²

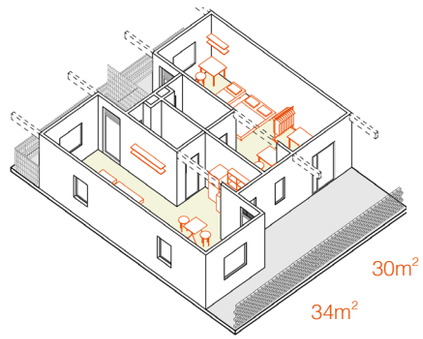
3-4TH FLOOR



39m²

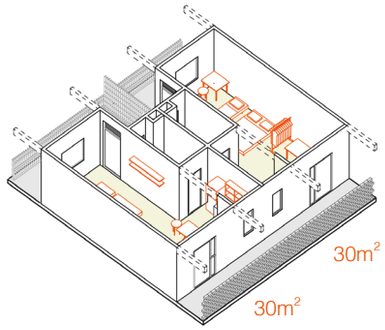


48m²



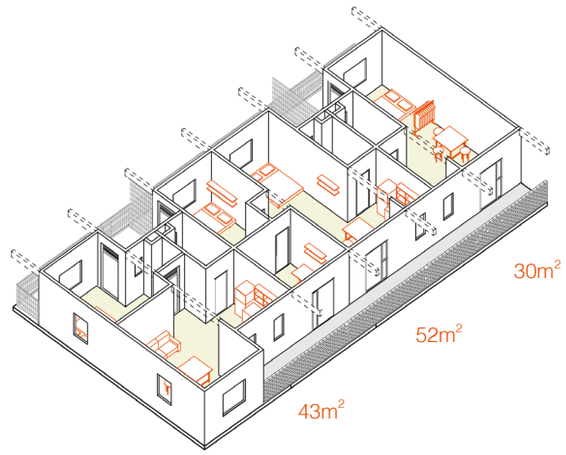
30m²

34m²



30m²

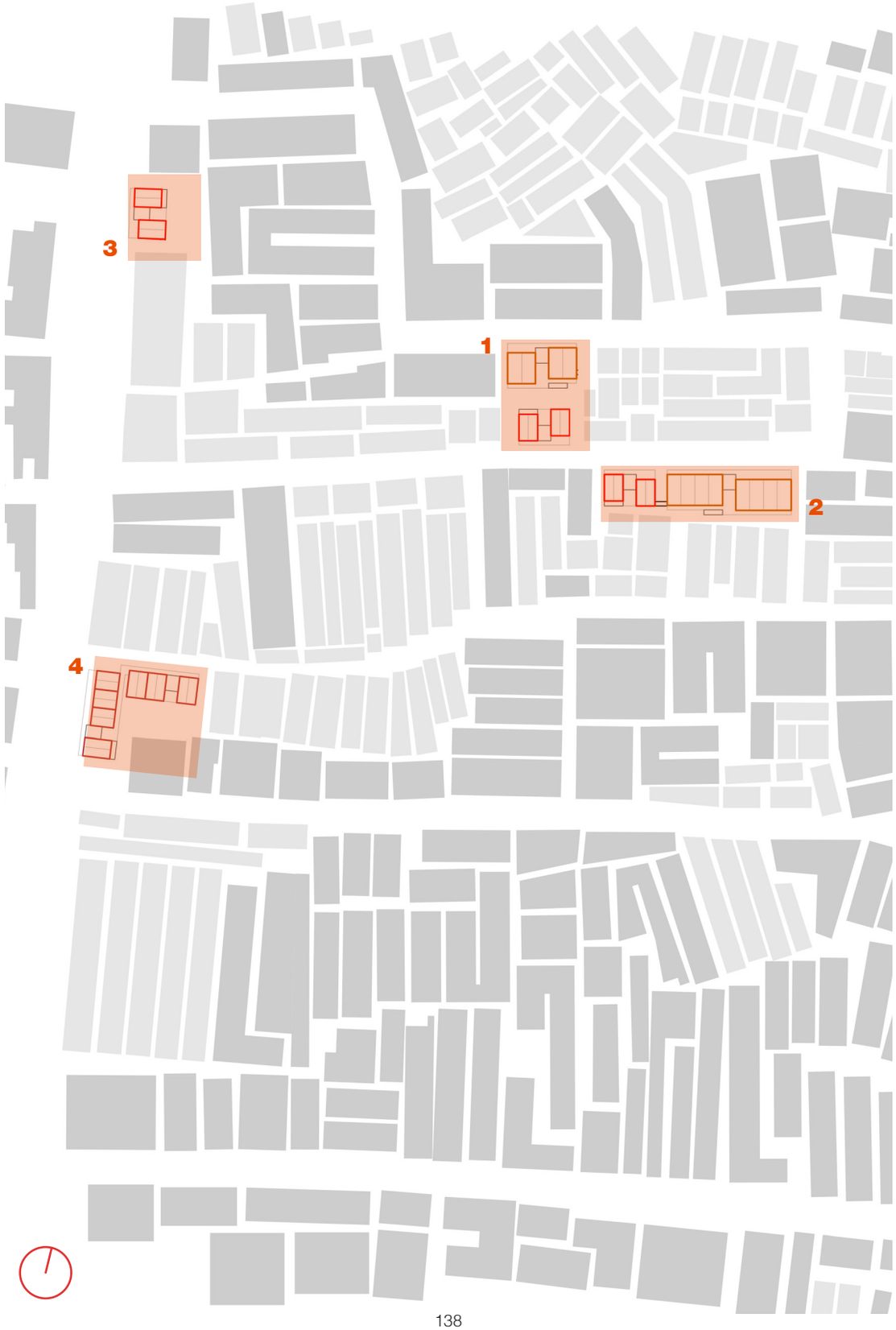
30m²



30m²

52m²

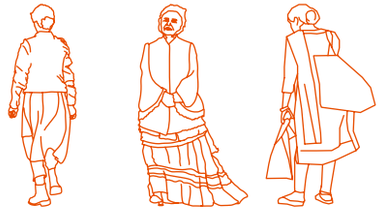
43m²



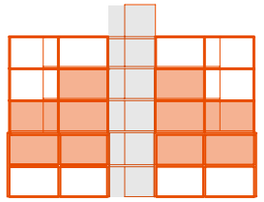
DEVELOPMENT SCENARIO

accupunctural approach

1



social-tied home-based workers

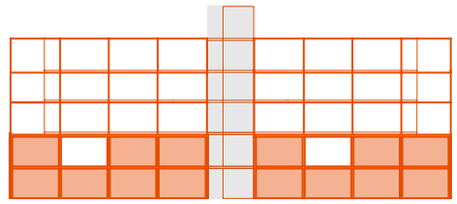


creates 32 units for 19 existing families (+13 units)

2

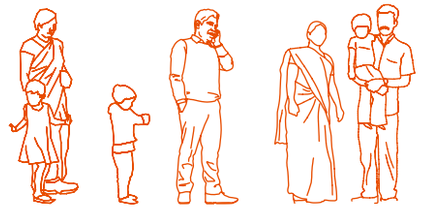


family-tied shopowners (shoe seller, sari seller, tailor)

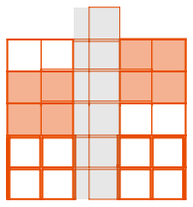


creates 52 units for 30 existing families (+22 units)

3

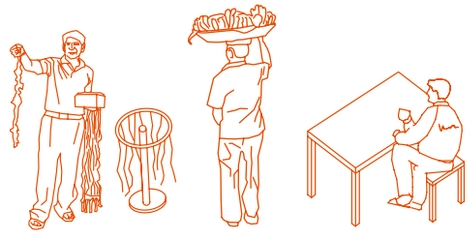


social-tied families

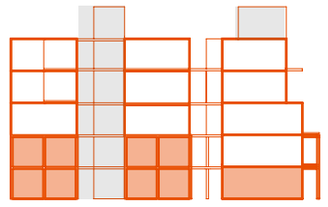


creates 12 units 8 existing families (+4 units)

4

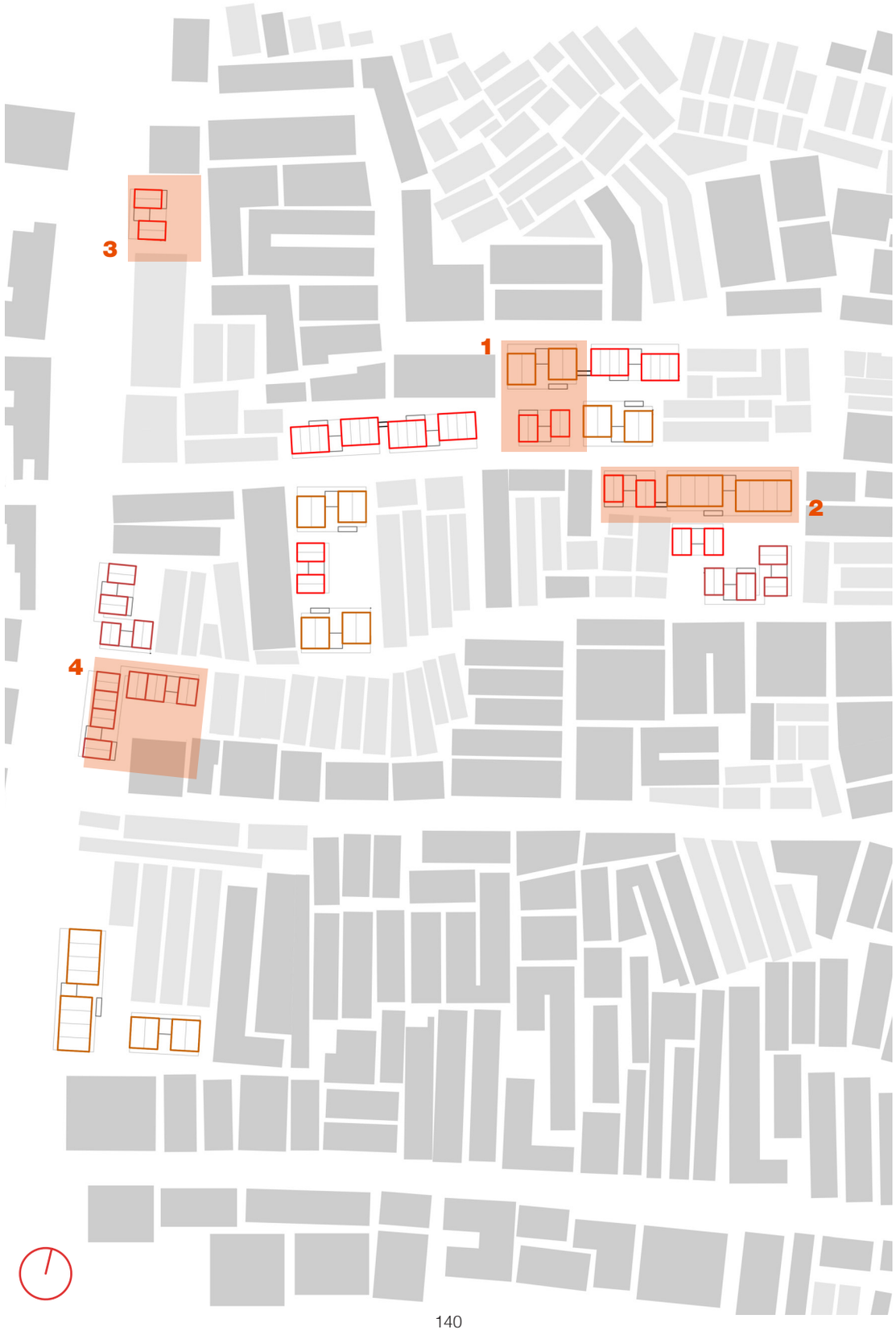


geography-tied hawkers



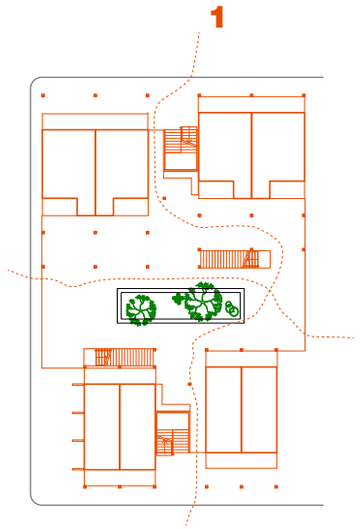
creates 42 units 35 existing families (+7 units)

The best way to increase the value of a home is not necessarily making the improvements directly to the home itself but rather taking care of the neighborhood in which it is located. For this to happen, the community must be *organized*. Different from more traditional housing programs, the community land trust will allow the owners themselves to define the criteria for their home distribution. This can happen in a smaller groups of people making the development *accupuntural* in the context. Once organized in committees based on familial or social ties, certain building type will be preferred by them or assigned by the CLT, and the owners will be able to lay out a system by which the apartments would be distritbuted to themselves. For instance, a group of home-based workers who are friends in the neighborhood will prefer to have a communal workspace on the first or second level of the building (1). A group of shopowners who know each other from the same street would prioritize occupying the ground floor shop units of the building (2). Hawkers who also move around in the nearby area will prefer to have a corner module tyology specifically for the hawker zone, or also occupy the first two floors (4). For a normal group of families that would just like to have a better housing will mostly prefer to live in the upper residential units where they have more privacy (3). The extra units created from their developments will be gradually occupied by the new residents over time as CLT manages the marketing of the units.

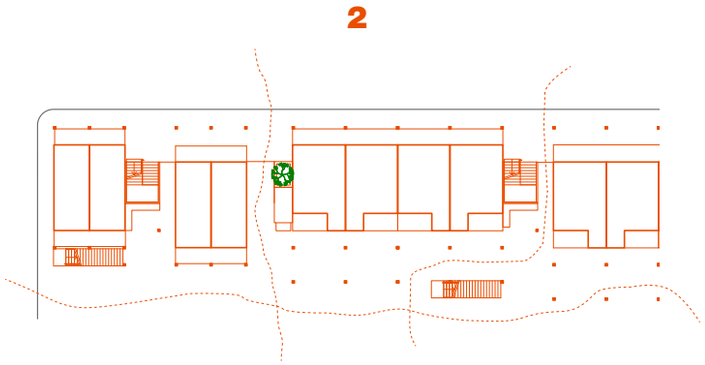


DEVELOPMENT SCENARIO

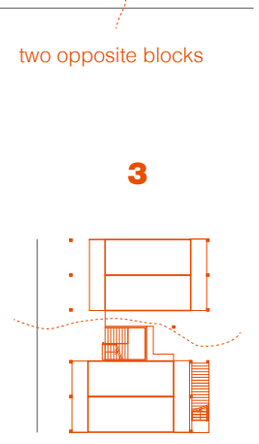
accupunctural approach



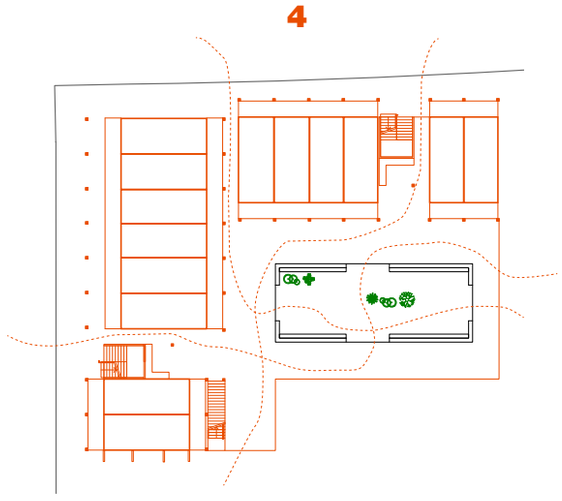
two opposite blocks



two linear blocks



single block



corner block

The spatial consequence of this socialization process can vary depending on numerous factors, namely the geographical context, number of owners and type of buildings. At times the site itself will limit the amount of open spaces around, and the result will be a simple building block (3). When the acquired site area allows for more than one building block, the space in between them will create a proper inner courtyard (1), or a corner block will be able to create a generous open space in the community (4). At times the development will directly face the existing baithi chawl community and the communal space can be shared with the other original residents (2).
In creating these scenarios, workshops will always take place to get input from the residents as well as get professional advice from the housing experts and architects.



In an ideal scenario when all the baithi chawl residents in each pocket of baithi chawl are interested in the redevelopment, it will become a masterplan development. The decision-making process will be more time-consuming one compared to the small-scale accupunctural approach, yet there are far more benefits on the outcome as it is better controlled: more flexibility in arrangement in the units and more possibilities of communal space. Moreover, as every resident in the designated area would have engaged in the workshops to a certain extent, the sense of community and collectivity will be much stronger compared to a mirco-scale development that is situated closely to the remaining baithi chawls. It is hence CLT's ultimate goal to strive for a more comprehensive development in every plot, so that the envisioned atmospheres can be achieved.

DEVELOPMENT SCENARIO

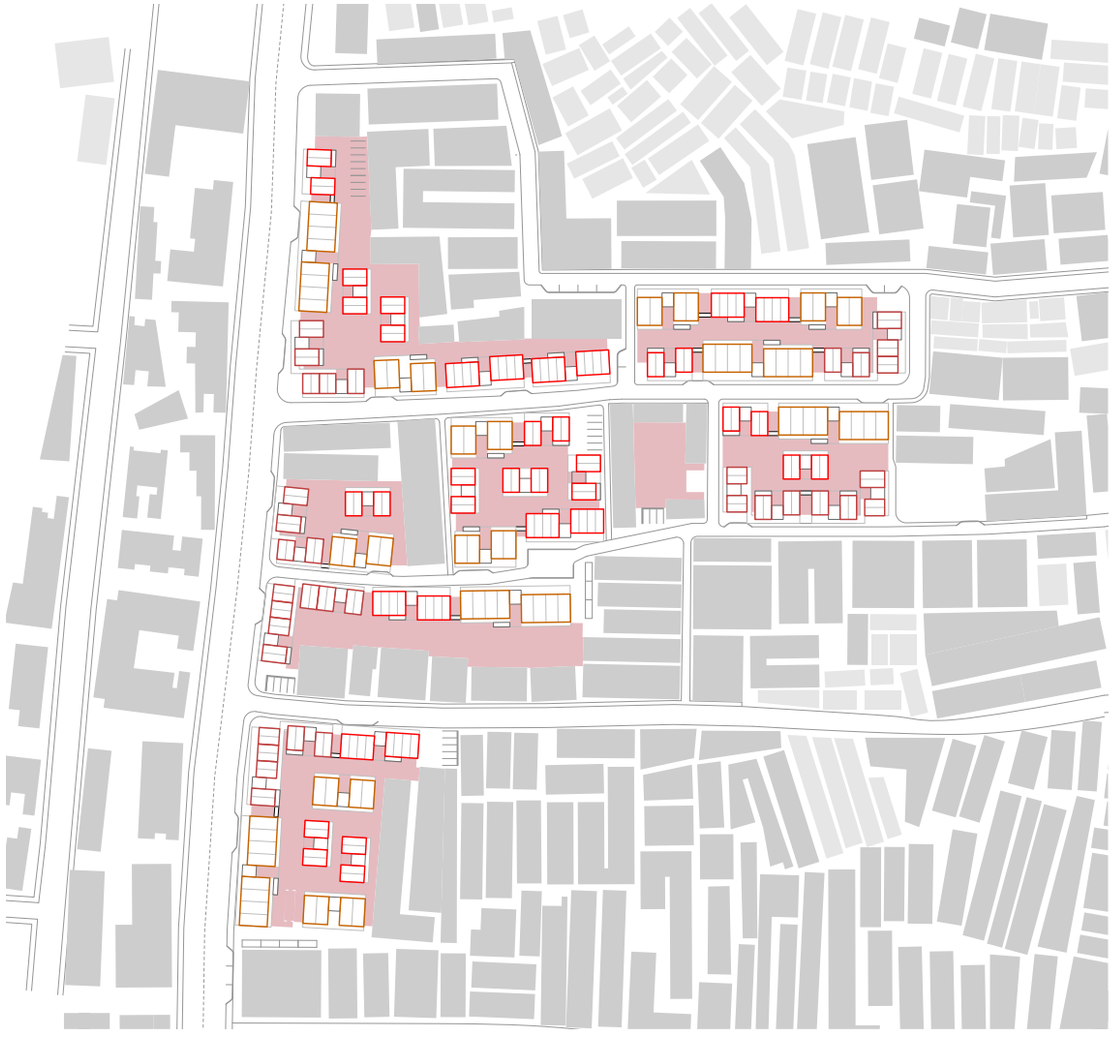
masterplan approach



In the masterplan development, the first step would be to estimate the basic number of ground floor units based on the street length measurement. Then, the different arrangements of the three building types will be tested considering the number of existing residents and the density goals proposed by them. After reaching a conclusion of the number and type of building blocks, they will be accordingly allocated into the plot, and make bridge connections on the first level if possible. So based on these three types the buildings are to be placed in the plot divisions. For the ease of accessibility during construction, the innermost part of the plot will start building, then from that area the construction will continue, then lastly the outermost part of the plot along the main street will be built. The road and pavements of the plot will also be defined, with a few linear parking spaces.

DEVELOPMENT SCENARIO

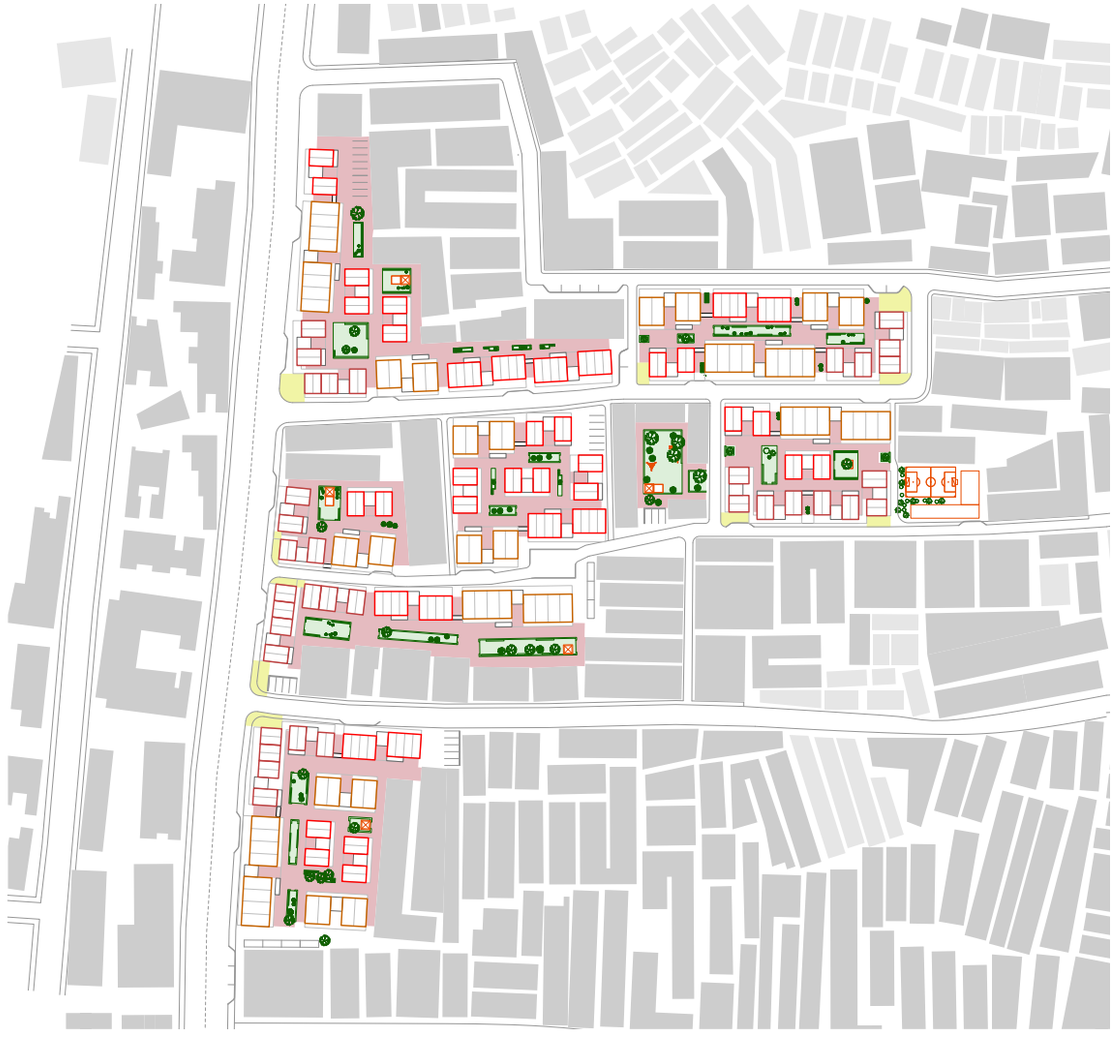
masterplan approach



the clusters of buildings will define the community ground and this will be emphasized by a slightly elevated pavement from the pedestrian street. Within the communities, sunken courtyard will be created to generate a more intimate feeling, and will comprise of greenery or it will also occasionally have a small shrine, or a playground in an open field. Bigger schools will be placed in an open area, and lastly the hawker zone in yellow is created in every part of the plot.

DEVELOPMENT SCENARIO

masterplan approach

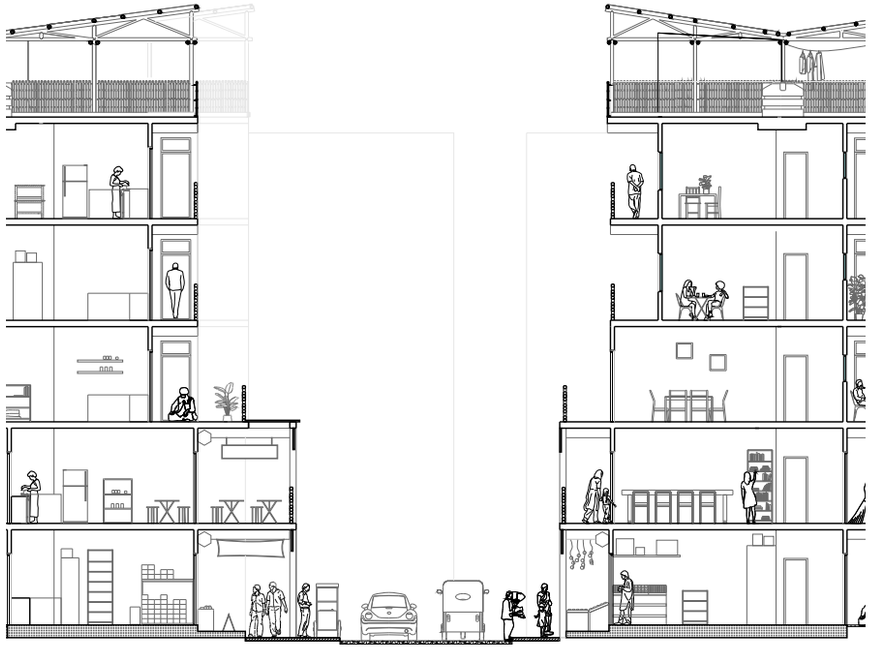


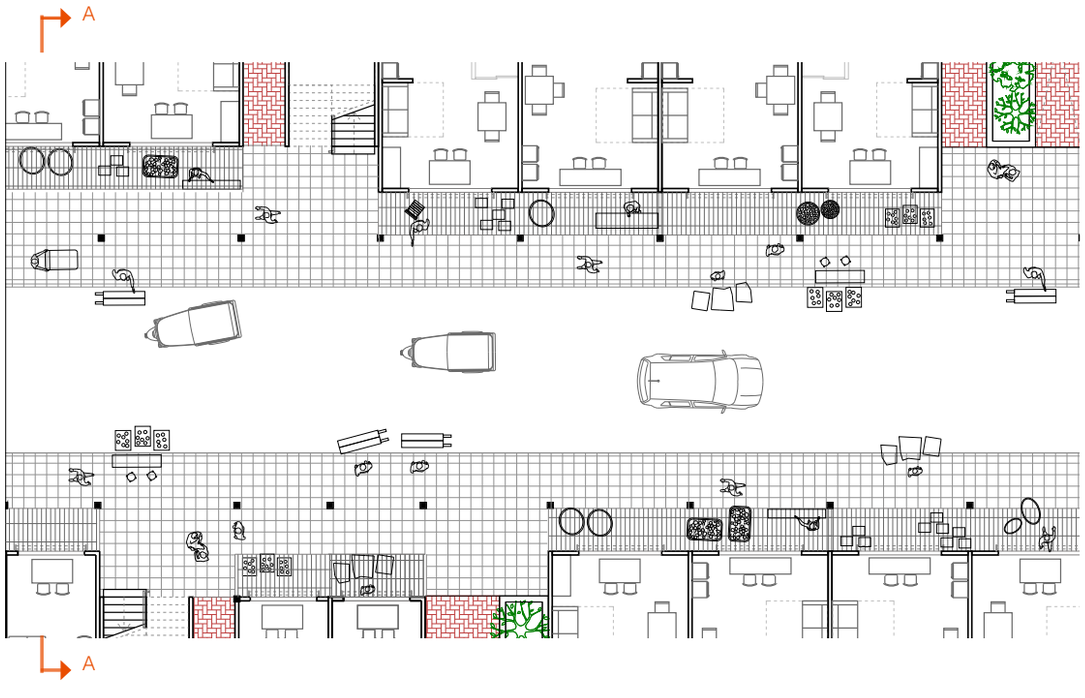
LEGEND

- 3M MODULE
- 4.5M MODULE
- CORNER MODULE
- STAIRCASE
- 1/F BRIDGE
- COMMUNITY GROUND
- GREEN POCKETS
- AMENITIES
- HAWKER ZONE

STREET CONDITIONS

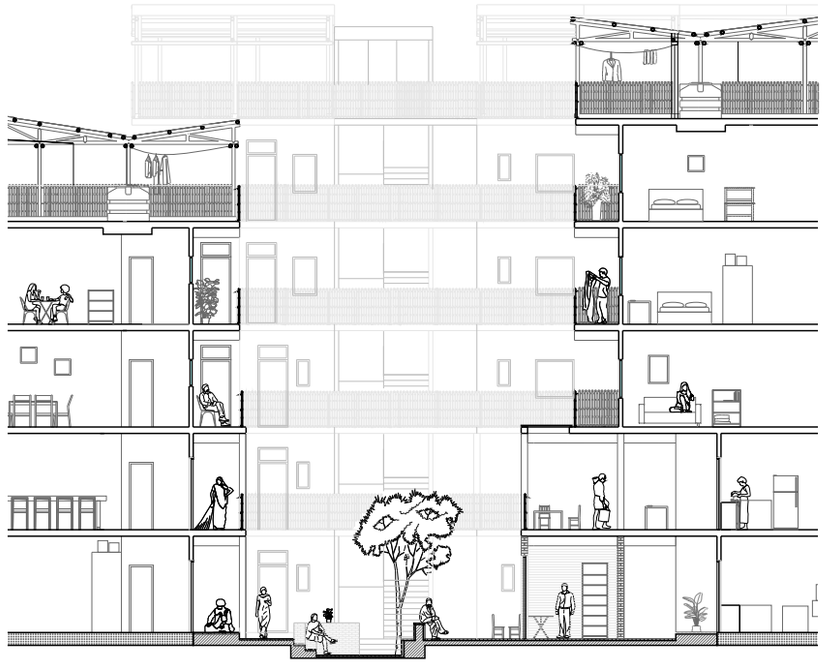
main street

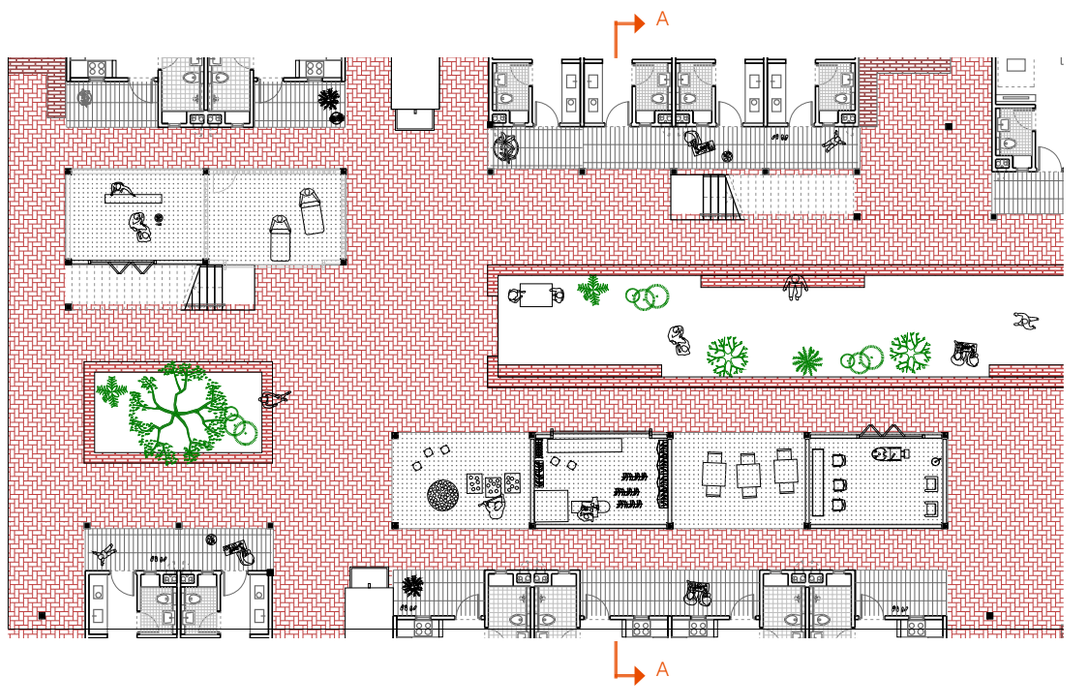




STREET CONDITIONS

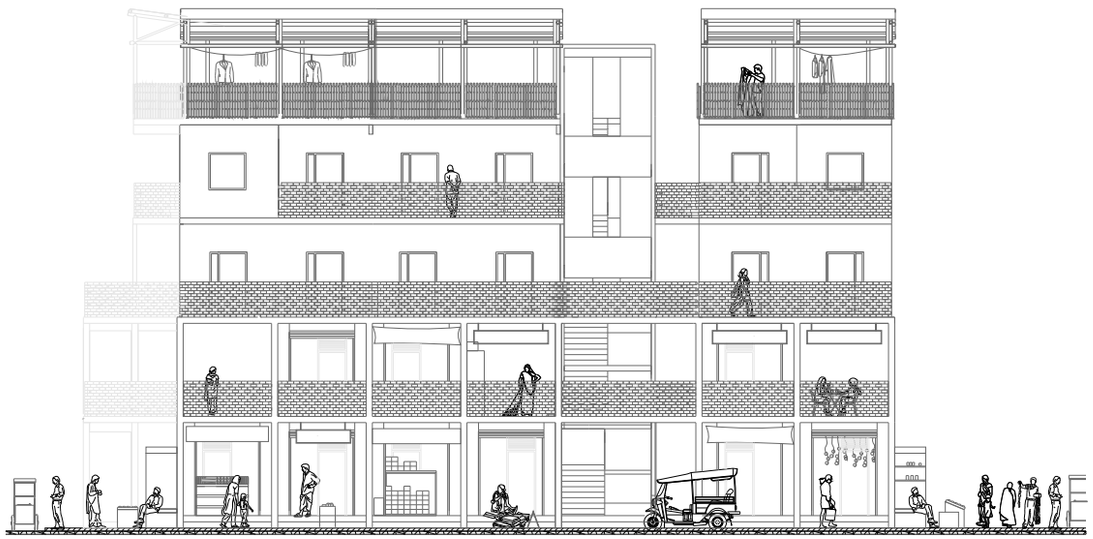
inner street

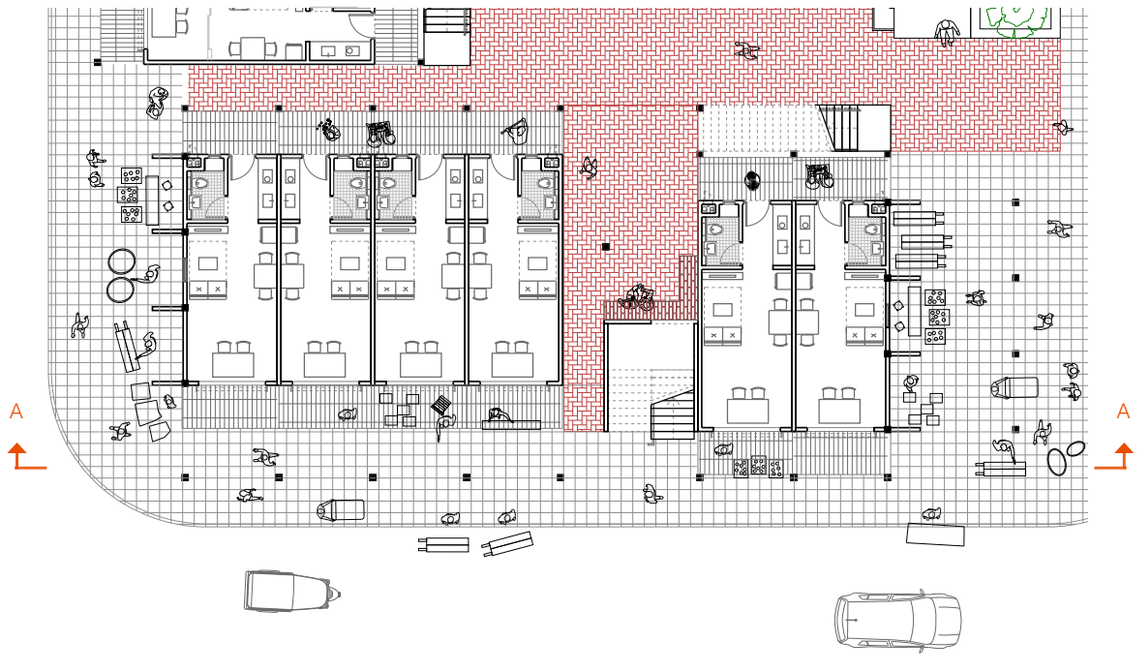




STREET CONDITIONS

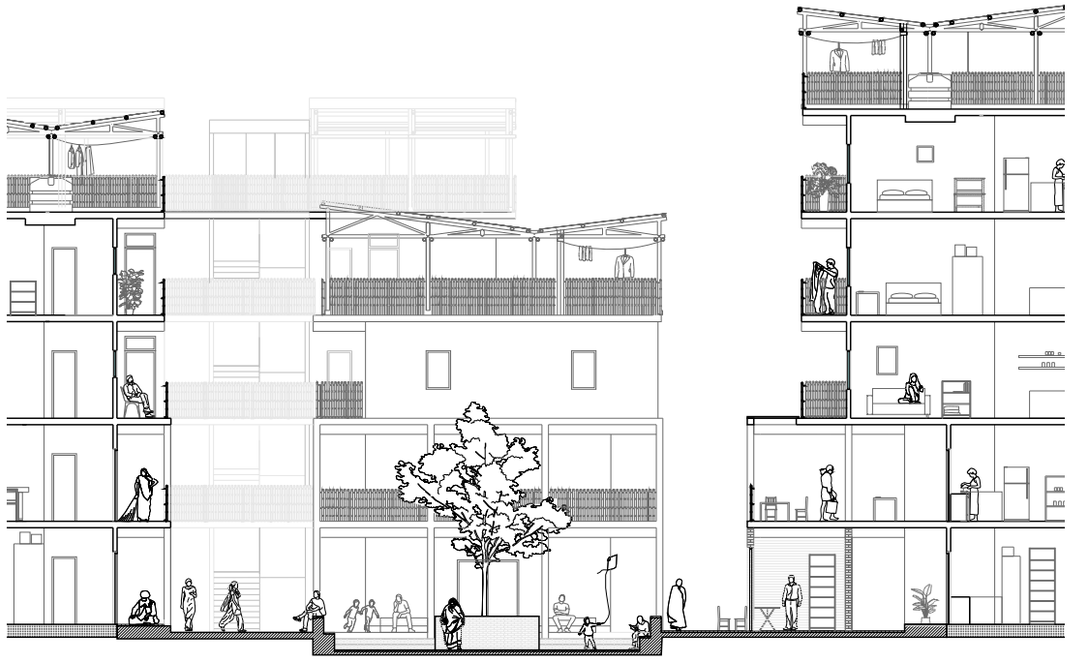
corner zone

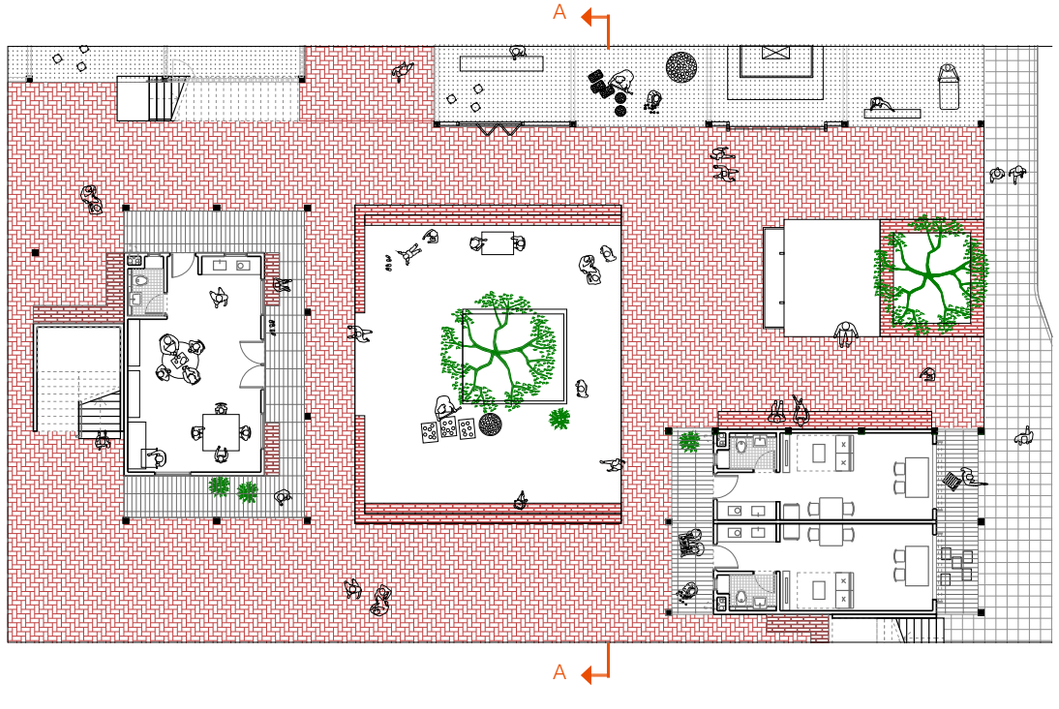




STREET CONDITIONS

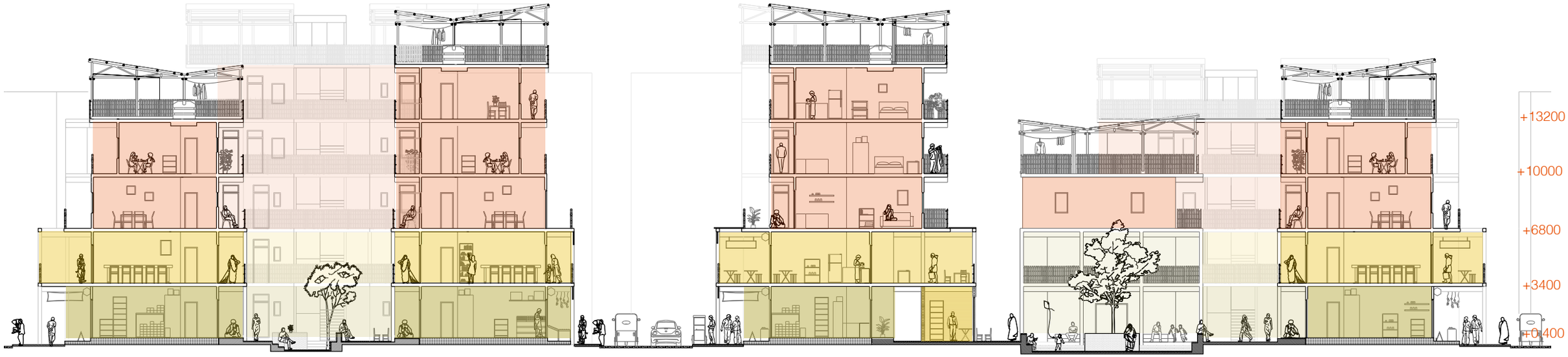
courtyard





STREET CONDITIONS

urban section



The urban strategy for the masterplan development strives to create a different range of atmospheres based on the street conditions. In the relatively wider main street, the buildings will be at the highest of five-storey and will be full of shopowners and hawkers engaged in commercial activities. Cars and rickshaw will be passing by along with a rapid flow of people. As you turn around the corner, the inward offset of the corner module create opportunities for the small shopowners or hawkers to naturally occupy the space. As a resident living there, you will be spending most of your time in the inner streets, where the sunken courtyard and the openness to first level allow them to look up, and chat with your neighbors. When these inner streets are spacious enough, it creates a larger courtyard space for more diverse activities. The courtyard typology will house a communal function such as library or workshop and it will be three storey high to decrease the scale of the building inside the plot. With these conditions combined, it creates an urban section as shown above. The buildings will have a relation to one another based on the different layers, from market street, communal plinth, and residential zone on top.

residential units

communal plinth

market street

STREET CONDITIONS

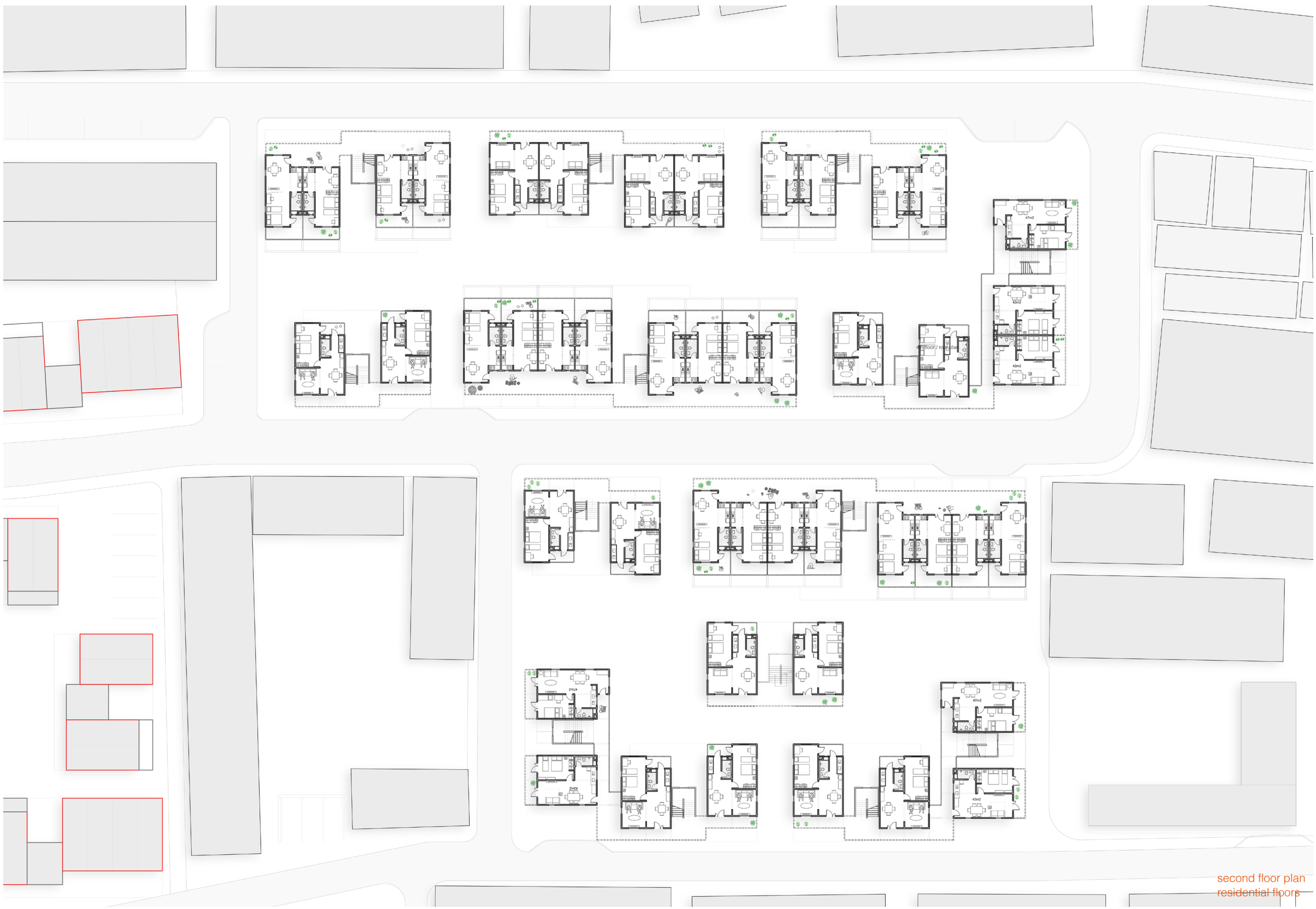
urban section



ground floor plan
market street



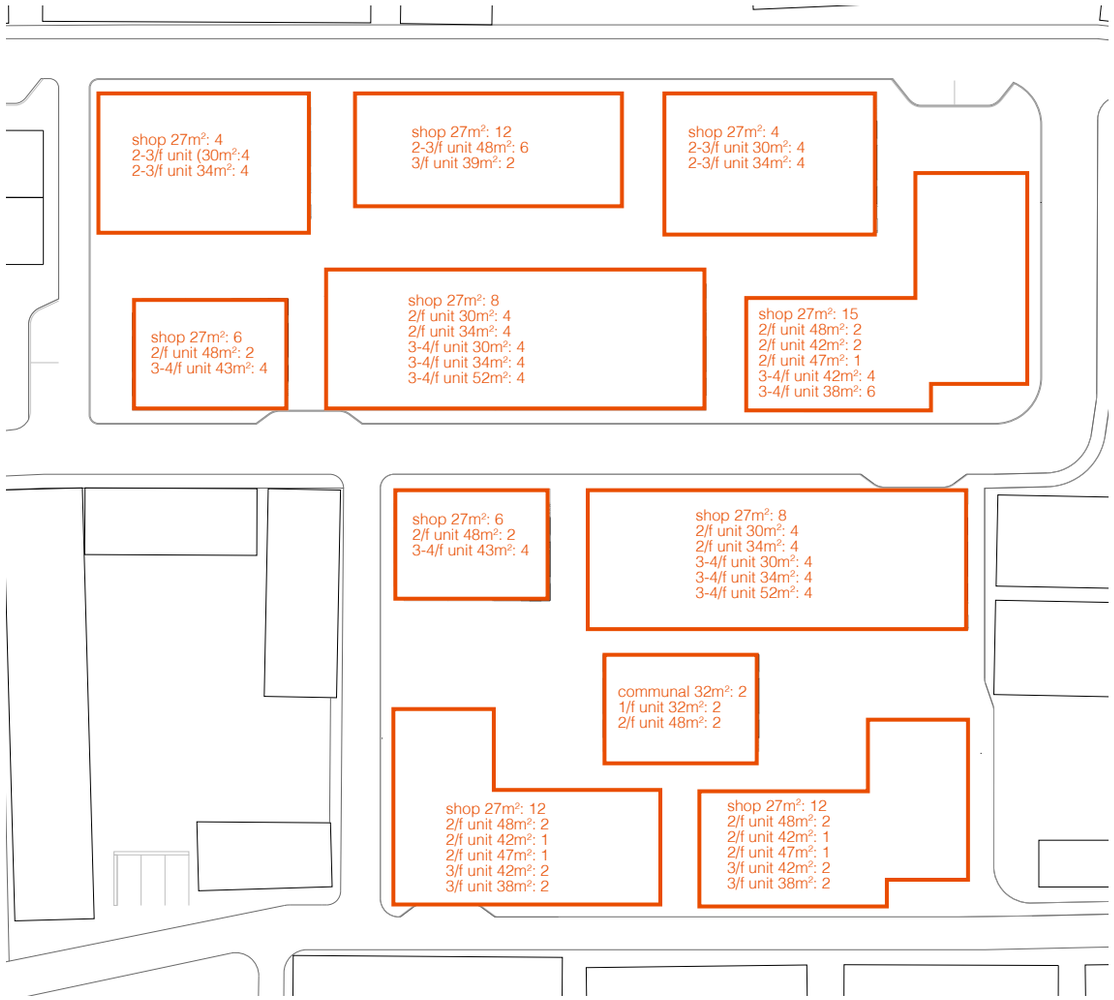
first floor plan
communal plinth



second floor plan
residential floors

DESIGN OUTCOME

number of unit types



In total these are the unit types created from the building typology variations and different floor heights. It has increased the density by bringing 12% more dwelling units compared to before which will be more to sold to non-residents, and dwelling space per person have increased from 4.5m² to 11m². Not only this, but the design offers designated personal expandable spaces and communal spaces to work together.

DESIGN OUTCOME

density calculation

PLOT 1	EXISTING	NEW
Area	0.27 ha	0.27 ha
Number of Dwellings	85 units	114 units
Total Dwelling Area	1530m²	3812m²
Expandable space		826m²
Communal area		664 m²
Gross Floor Area	1853 m²	8920 m²
FSI	0.69	3.3

PLOT 2	EXISTING	NEW
Area	0.29 ha	0.29 ha
Number of Dwellings	91 units	86 units
Total Dwelling Area	1638 m²	3812m²
Expandable space		592m²
Communal area		388 m²
Gross Floor Area	1984 m²	6639m2²
FSI	0.68	2.3

+24 dwellings units (+12%)

Increased dwelling space per person (from 4.5m² to 8.4m²~11m²)

Creation of designated personal expandable spaces for living & work purposes

Creation of communal space to work together





1:100 cluster model

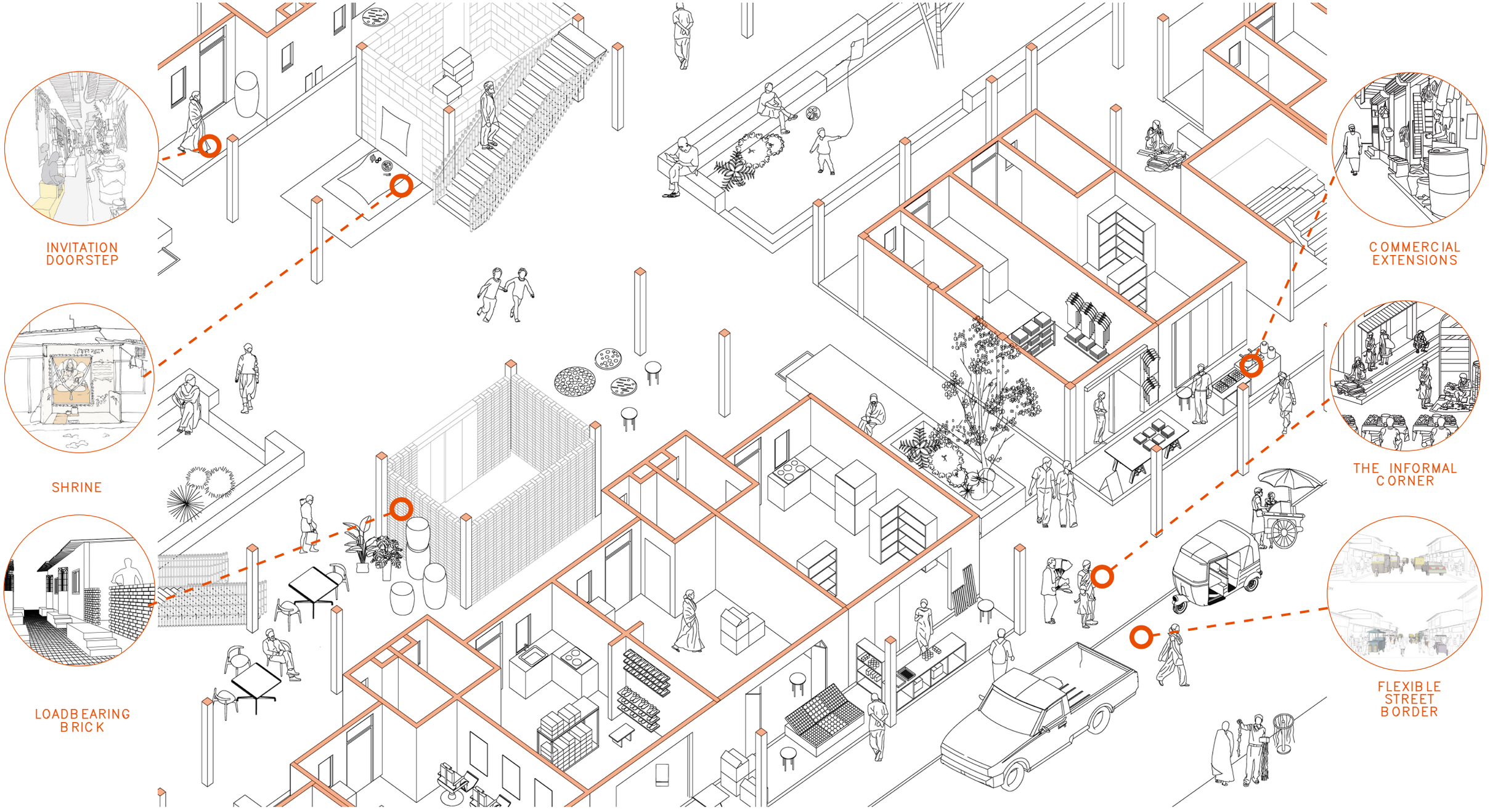




1:100 cluster model

DESIGN OUTCOME

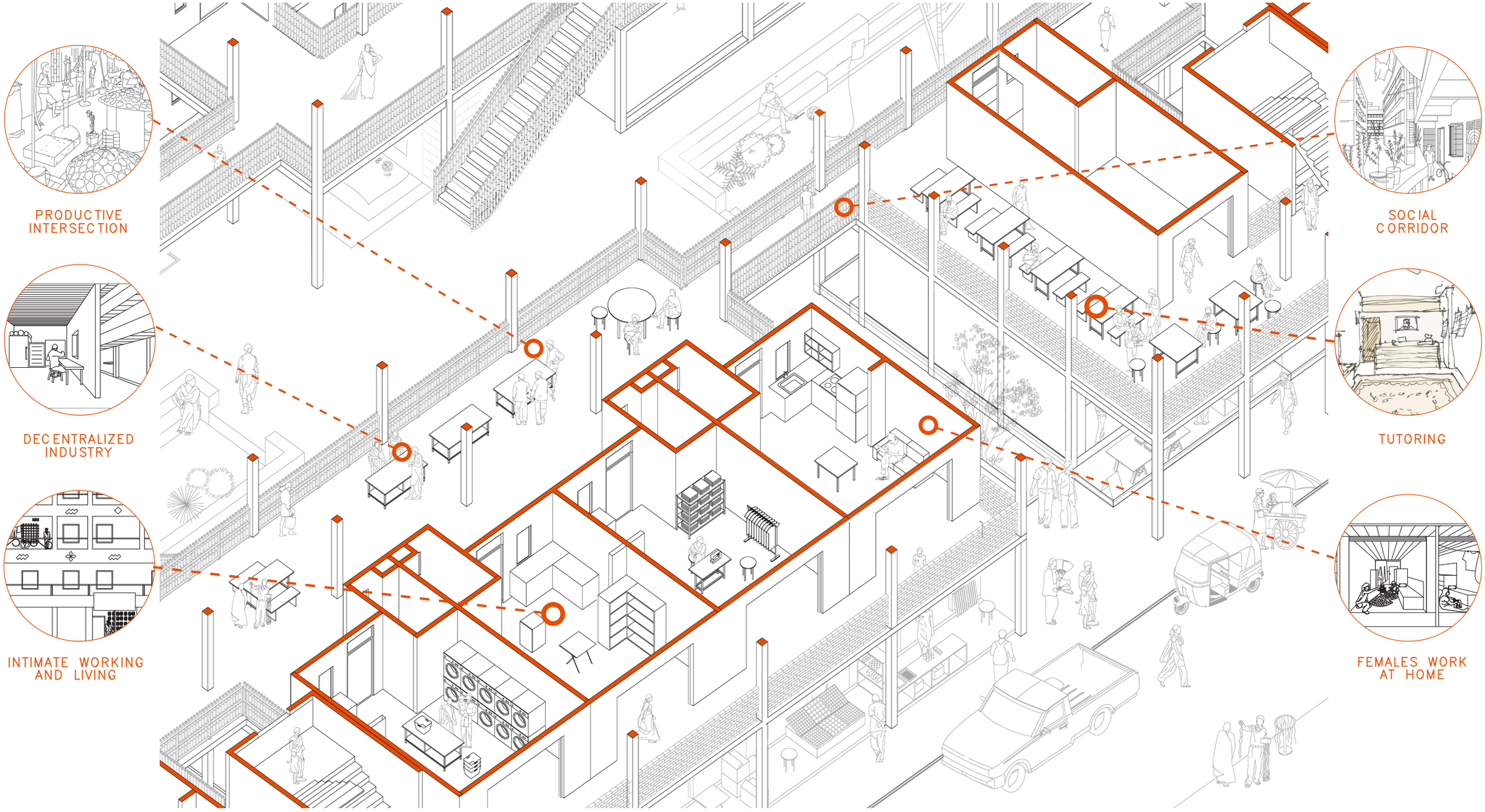
patterns of inhabitation



market street activity

DESIGN OUTCOME

patterns of inhabitation



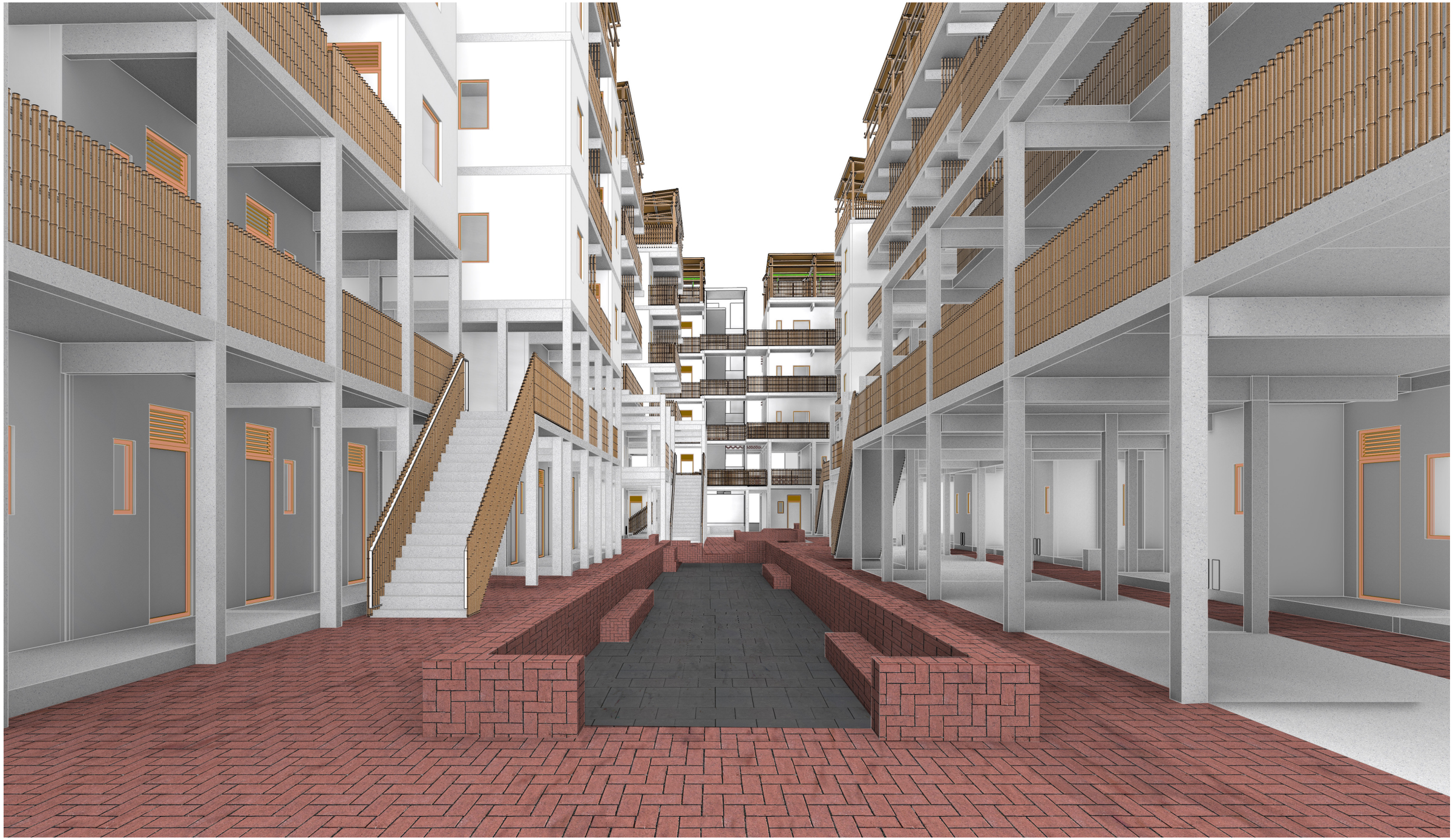
communal plinth activity



INNER STREET
5 years after



MAIN STREET
5 years after



INNER STREET
after construction



INNER STREET
5 years after



COMMUNAL PLINTH
after construction



COMMUNAL PLINTH
5 years later



INSIDE DWELLING
after construction



INSIDE DWELLING
5 years later



RESIDENTIAL FLOORS
after construction



RESIDENTIAL FLOORS
5 years later




BALAMURUGAN
GENERAL STORES
ENGLISH MEDIUM
NURSERY TO STD. X
SCHOOL OFFICE
9890266435

5

BUILDING TECHNOLOGY



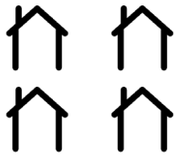


Construction site in Nalasopara East

CONSTRUCTION IN INDIA

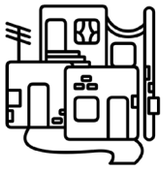
conventional construction

EFFICIENT CONSTRUCTION



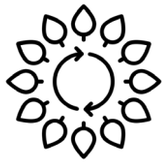
Urban Housing Shortage in India: 18.78 million units

AFFORDABLE DESIGN



96% of housing shortage pertains to EWS and LIG

SUSTAINABLE MATERIAL



Conventional construction materials are energy intensive

Current low-cost housing in India is an established protocol of one stage after another: 1. in-situ RCC frame with infill of concrete blockwork; 2. plastering; 3. services and 4. finishing. The current construction industry is fragmented into several firms, which are mostly non-registered, blue-collar workers with lack of professional and specialized services to construction firms: developers, contractors, labor subcontractors and workers (recruited from villages by labor subcontractors).

Housing as an industry is still hand-crafted and heavily dependent on unskilled labor and on-site construction. It is a time-consuming process due to labor inefficiency and there is also a large amount of material waste that is not being efficiently utilized. One of the main reasons for this is the lack of standards for building materials and poor enforcement of standards that exist. The result is often a quality that is subjective to site conditions, labor force and climatic conditions. These factors create a situation where competition in housing construction is not based on construction costs, but is instead based on securing access to land and managing material costs.

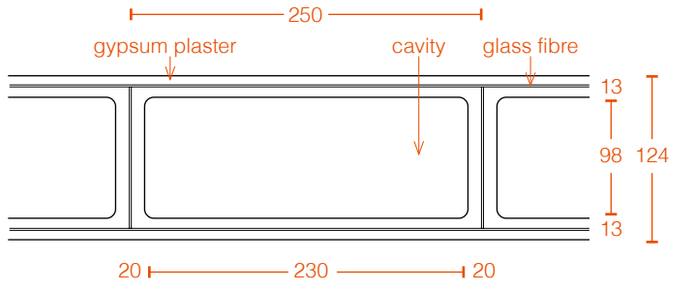
Key Challenges in Mass Housing Sector Today
Urban housing shortage in India of 18.78 million units demands for a speedy delivery of housing units. 96% of this housing shortage pertains to the EWS and LIG which emphasizes the specific level of affordability for these group of people. Furthermore, conventional construction materials such as cement, burnt clay bricks and steel are energy-intensive, thus a more sustainable material is preferred. Sand (used in concrete) is also considered a scarce commodity in India today due to its rapid depletion from construction, hence low-cost replacement for sand is needed. (Paul 2016, 19-21)



GFRG CONSTRUCTION

GLASS FIBRE REINFORCED GYPSUM





GYPSUM PLASTER



- an abundant material waste by product of the fertilizer industry
- eco-friendly resource
- low-cost material

FIBRE GLASS



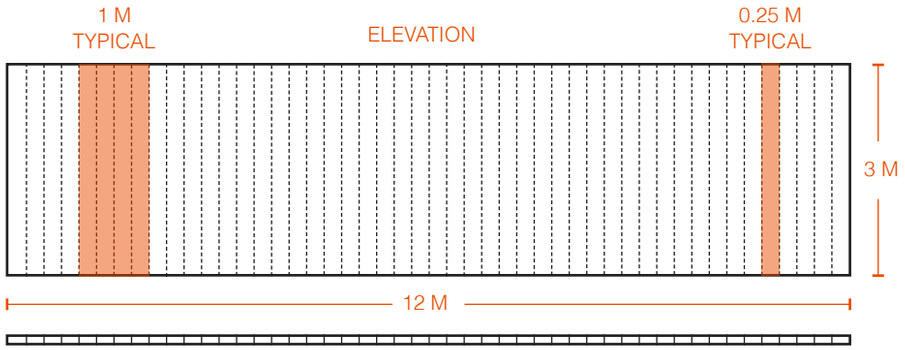
- agelessless
- fire-resistant
- increased flexural strength
- increased tensile strength

Glass Fibre Reinforced Gypsum (GFRG) panels hold promise as a rapid, affordable, and sustainable mass housing solution. GFRG panels were introduced in Australia in 1990 and are now manufactured in India, making reuse waste gypsum from the ferilizer industry. The panels are made of calcined gypsum, reinforced with glass fibres.

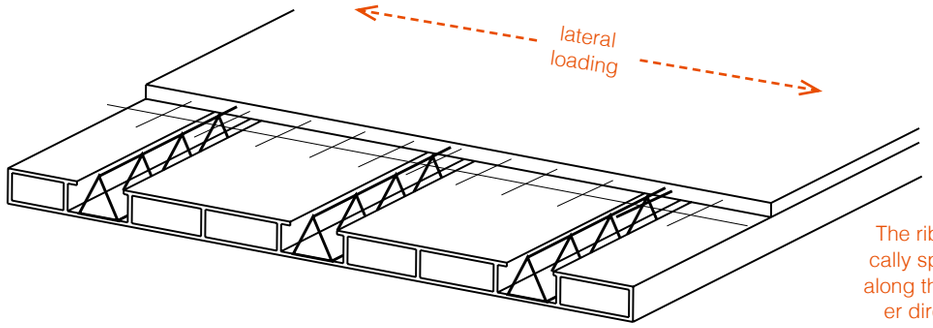
The panel, manufactured to a thickness of 124mm under carefully controlled conditions to a length of 12m and height of 3m, contains cavities that may be unfilled, particially filled, or fully filled with reinforced concrete as per structural requirement. Experimental studies and research in Australia, China and India have shown that GFRG panels, suitably filled with plain reinforced concrete possesses substantial strength to act not only as load bearing elements but also as SHEAR WALL, capable of resisting lateral loads due to earthquake and wind. It is possible to design such buildings up to 10 storeys in low seismic zone. However the the structure needs to be properly designed by a competent structural designer.
GFRG panel can also be used advantageously as in-fills (non-load bearing) in combination with RCC framed columns and beams (conventional framed construction of multi-storey building) without any restriction on number of storeys. It is an integrated composite building system using factory-made prefab loadbearing cage panels and monolithic cast-in situ RC infilled for wall, floor and roof slab. Manufacture of GFRG panels with increased thickness (150-200mm) can also facilitate design and construction of taller buildings. (*Compendium of Prospective Emerging Technologies for Mass Housing 2015*, 26-29)

GFRG CONSTRUCTION

floor application

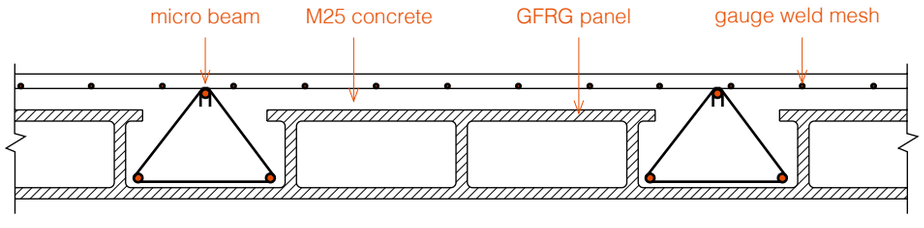


Standard prefabricated panel dimensions



The ribs typically spanning along the shorter direction

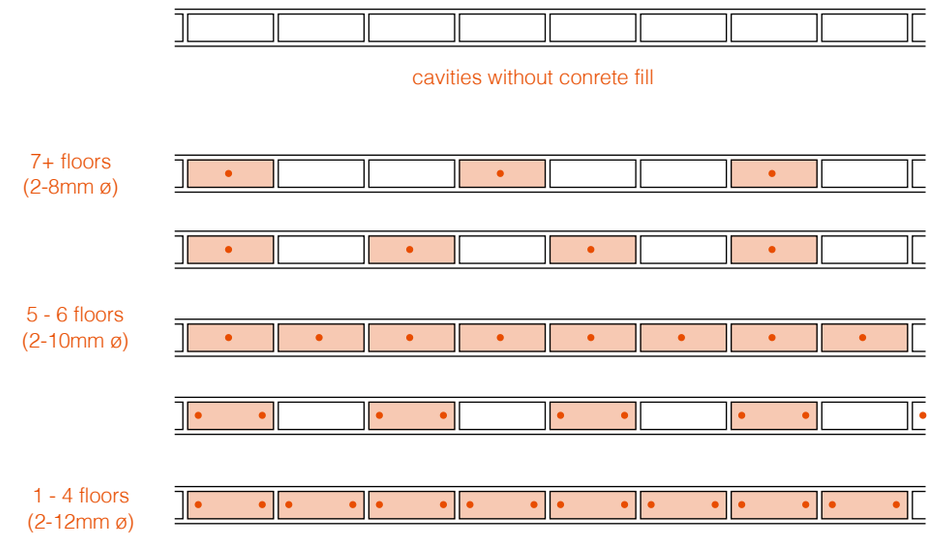
slab behavior



reinforced gfrg floor panel section

GFRG CONSTRUCTION

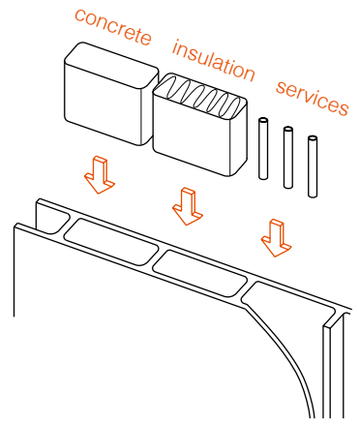
wall application



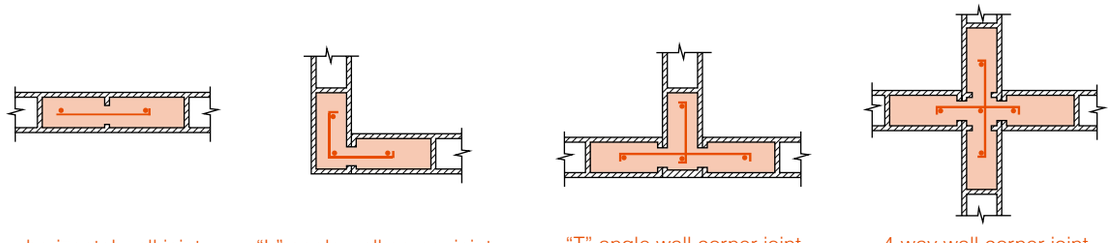
RCC infill to increase load carrying capacity

concrete infill

steel reinforcement



typical wall corner joints



horizontal wall joint | “L” angle wall corner joint | “T” angle wall corner joint | 4-way wall corner joint

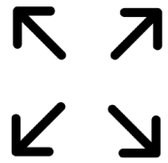
Source: (Paul 2016, 20-4), (*Glass Fibre Reinforced Gypsum (GFRG)*)

GFRG CONSTRUCTION

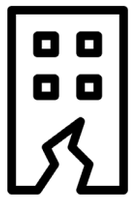
advantages - efficiency | versatility | green technology



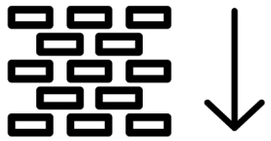
High speed of construction involving less labor. Use of panels are comprehensive



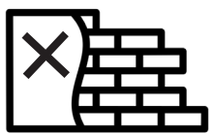
Thinness -> increased carpet area for the same built-up area (saving 8-10% per built up area for the same carpet area)



Lesser building weight contributing to reduction in earthquake forces



Save fertile agricultural land and energy intensive burnt clay bricks



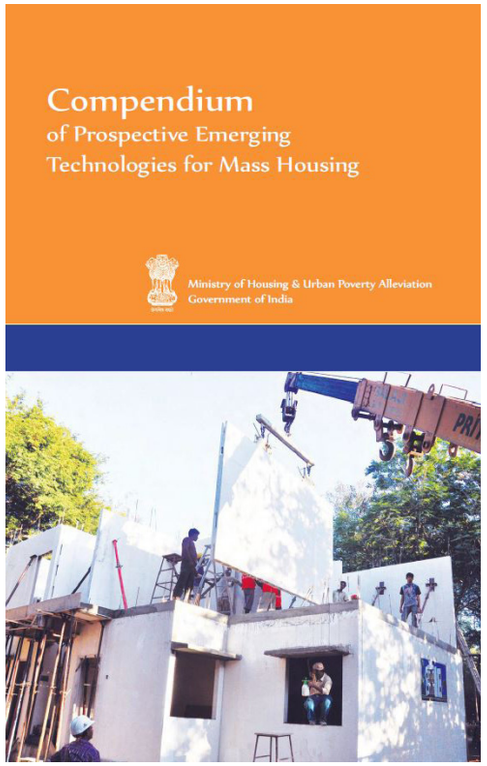
No plastering requirement for walls and ceiling and less use of cement



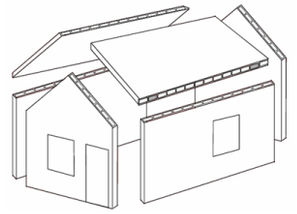
Cost effectiveness, less embodied energy and less carbon footprint in use of industrial waste material (GYPSUM) recycled use of industrial waste, resistance to water and fire (FIBRE GLASS)

GFRG CONSTRUCTION

emerging mass housing material in india



Source: (*Compendium of Prospective Emerging Technologies for Mass Housing* 2015, 23-7)



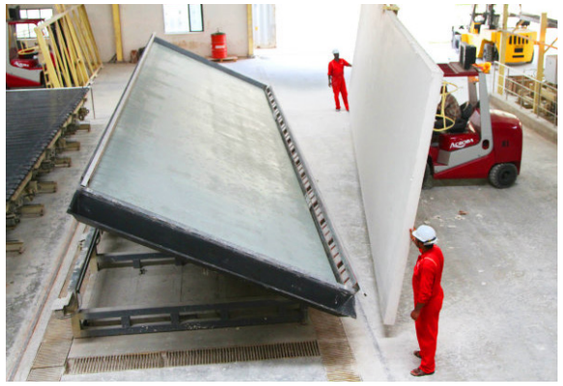
ELEMENTS	DETAILING
upper floors	multistorey GFRG buildings can be up to 10 storeys
floor slab system	embedded microbeams & RC screed (with integrated connection between slab & wall)
staircase system	steps with concrete C-block brick RC micro beams with RC screed under beams for mid/floor landing using panel for waist slab
walling system	embedded RC horizontal tie beam RC lintel cum sunshade embeeded RC columns integrated with RC plinth beam
foundation	foundation footing below GL foundation basement above GL RC plinth beak in 0.00 level with starter bars as parts of basement

The government of India has listed GFRG in the Compendum of Prospective Emerging Technologies for Mass Housing by the Ministry of Housing & Urban Poverty Alleviation. The classification of the material have been set to three classes:
1) water-resistant grade for external walls in wet areas
2) general grade for structural/non-structural application in dry areas
3) partition grade for non-structural internal partition walls in dry areas.
The chart above shows the basis arrangement of GFRG panel building system.

IIT Madras have been studying the feasibility of using these panels for mass housing in India for over a decade. To demonstrate the application of this technology, a two-storey GFRG building of 184 square meter area was built at IIT Madras campus. Using the prefabricated light-weight GFRG panels for the entire building system facilitated substantial reduction in the building self-weight, construction duration and workforce requirement. Based on these studies at IIT Madras, GFRG has been approved as a building material suitable for construction of buildings in India up to 10 storeys by Building Materials Technology Promotion Council (BMTPC). Detail guidelines in the use of GFRG panels in Buildings have been prepared by the IIT Madras for design guidelines. (*Compendium of Prospective Emerging Technologies for Mass Housing* 2015, 23-7)



1



2



3



4

1. Glass fibre reinforced gypsum panels are manufactured in semi-automatic plant using slurry of calcined gypsum plaster mixed with certain chemicals including water repellent emulsion and glass fibre rovings, cut, spread and imbedded uniformly into the slurry with the help of screen roller. Panels are also manufactured from reused of waste gypsum from the fertilizer industry.

2. Panels are dried at 275 C before shifting to storage area or cutting table. The wall panels can be cut as per dimensions & requirements of the building planned.

3. After stacked and organized in stillages, the panels are transported to the site by a truck.

4. Pre-cut GFRG panels are lifted by cranes onto the prepared concrete floor or foundation. Using GFRG lifting jaws, the pre-cut GFRG panels are decanted, one by one from the stillages and placed into their final position, propped and screwed together. (*Compendium of Prospective Emerging Technologies for Mass Housing* 2015)



5



6



7



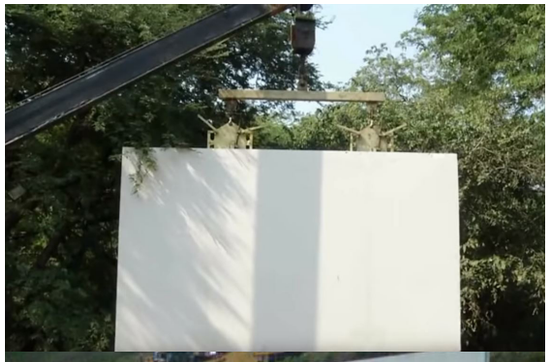
8

5. excavation and manufacturing of the foundation

6. Foundation is comprised of fly ash block masonry* resting on 900mm resting on wide strip base 1m depth be ground. Then a network of reinforced conrete plinth beams with starter bars are casted. The entire gap is filled with soil and then plastered with cement. This process takes 11 days to complete.

7. A coat of water repellant coating Zycosil/equivalent to saturation level over RCC plinth beam to provide water proofing treatment to joint between wall panel & plinth beam.

8. Up to plinth level, the construction is done as for conventional building. GFRG panels does not require any special foundation. (Paul 2016, 26-7), (Cherian 2017, 99)



9



10

9. On the first day of the superstructure construction, the wall panels are erected with the help of a crane. A special locking system is used to grip the ribs of the panel on top enabling easy lifting without any damage to the panel. The panels are hoisted vertically and positioned in place over the starter bars jutting out from the plinth beam. Then, appropriate reinforcement are inserted as for the design ito the cavities.

10. Then, appropriate reinforcement are inserted as for the design ito the cavities. The vertical steel bars are tied to the starter bars and the verticality of the panel is ensured by using the plumb bob (plummet). (IIT Madras 2014)

GFRG CONSTRUCTION

process - III. wall erection



11



12



13



14

11. In the two story building, every third cavity is required to be filled with concrete and reinforced with a 10mm bar. Other cavities can be filled with any inert material such as low-grade concrete or quarry dust mixed with 5% cement and water.
Plumbing and electrical services are installed in the voids and if required, concrete is poured or insulation inserted into the selective cavities suitably reinforced with minimal steel.

12. Grooves are cut into the edges of the panel to facilitate integral bonding with adjoining panels. It is mandatory that all joints between connecting panels are filled with concrete and suitably reinforced with steel.

13. Once the panels are placed properly, the cutting of doors, windows, sanitary fitting etc. is done.

14. Shuttering (formwork) for sun shades is also put in place along with reinforcement bars. External renders or decorative facings can be added externally or internally to the panels as it is flushed and finished ready for primers. (IIT Madras 2014), (Paul 2016)



15 (outside)



15 (inside)



16



17

15. Temporary structure for the floor slabs are constructioned along the edges of the walls

16. Connections between cross walls with the foundations and floor/roof are achieved through reinforced concrete filling or R.C. beams. Concrete tie beams which connect the panels to the walls at all junctions are filled.

17. They are placed horizontally over the walls in different rooms. The ribs typically spanning along the shorter direction. (Attarwala 2016), (IIT Madras 2014)

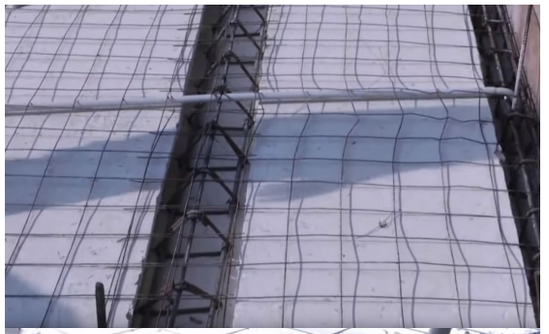
GFRG CONSTRUCTION

process - IV. floor slab connection





18





19

18. Every third cavity (in every 750 mm) in the horizontal GFRG panel is cut open from the top and a reinforcement cage inserted to serve as a concealed beam, with a T-beam in action.

19. Further, a steel welded mesh is placed on top of the entire floor slab and is subsequently embedded in a screed of concrete 50 mm thick. Conduits for electrical work are kept in place before concreting the slab. (Paul 2016, 30)



20



21



22



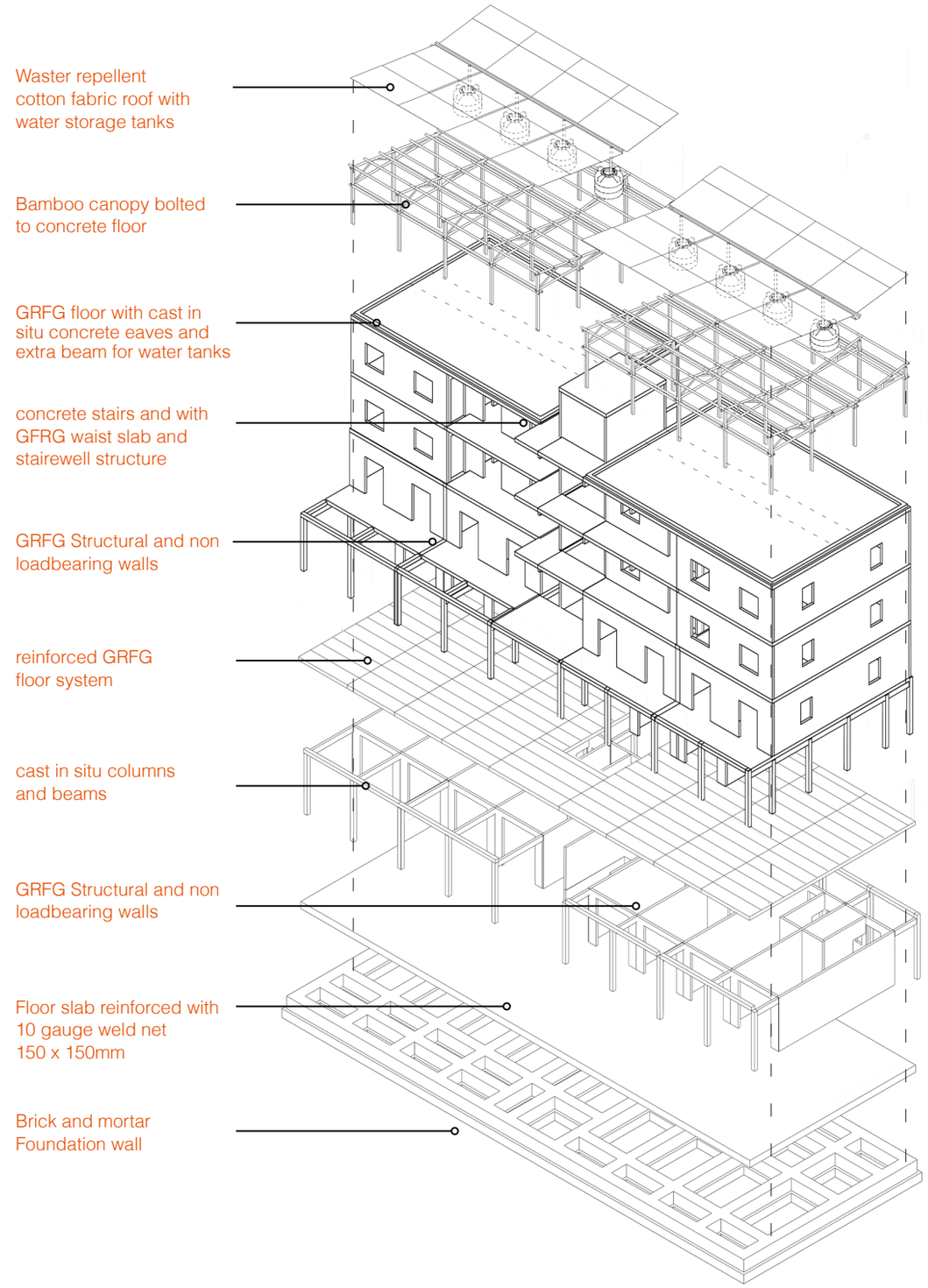
23

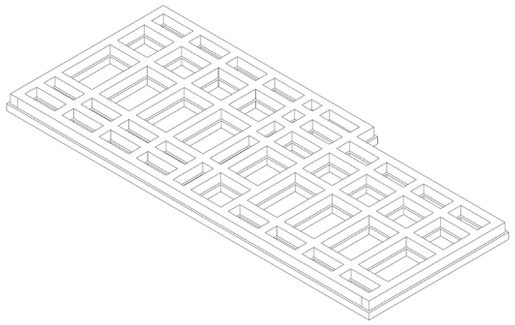
20. The staircase work is also taken up using GFRG panels as the waste and landing slabs with reinforcement bars in ALL THE CAVITIES.

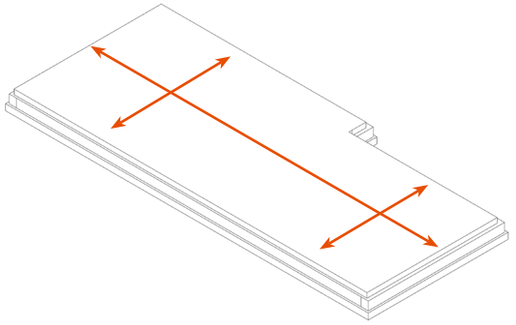
21. Then the GRFG panels on the roof slab are put place along with the reinforcement at various locations.
The reinforcement for the balcony portion, the staircase and the entire concreting of the roof will be done in just one day. Conduits and plumbings have all been put in place. We have every third cavity with an embedded beam and we have screed on top with welded gauges.

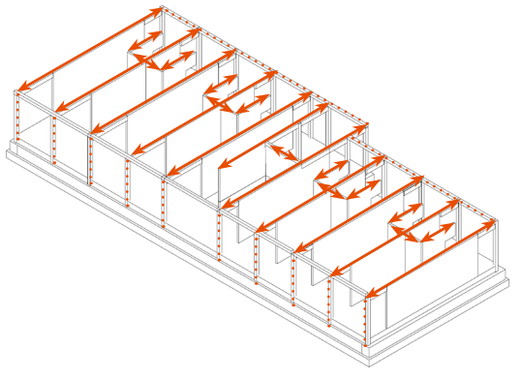
23. For the interest of draining the rain water on the roof, a slope has been laid down with 75mm of screed on the front side and 50mm (minimum screed thickness) on the rear side so that there is a natural slope in the roof.

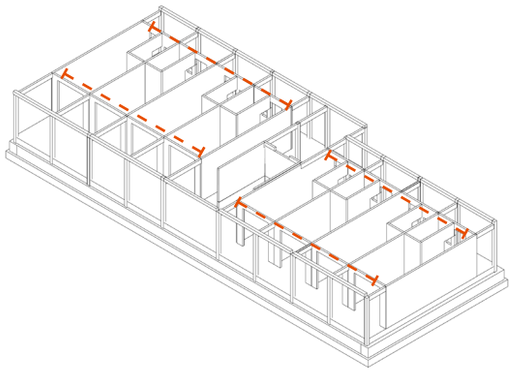
24. One team works on the concrete, one on the putting the reinforcement cages in place, putting the fittings for plumbing and conduits in place. So it will move from one end to the other. (Attarwala 2016), (Paul 2016, 31)

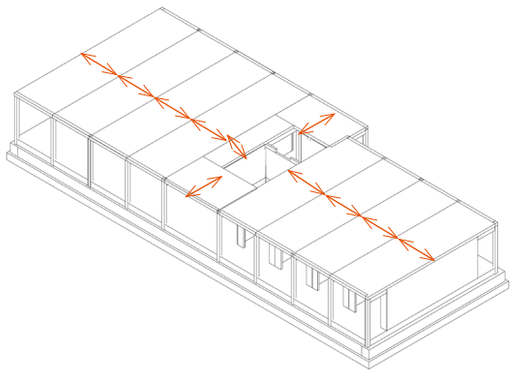


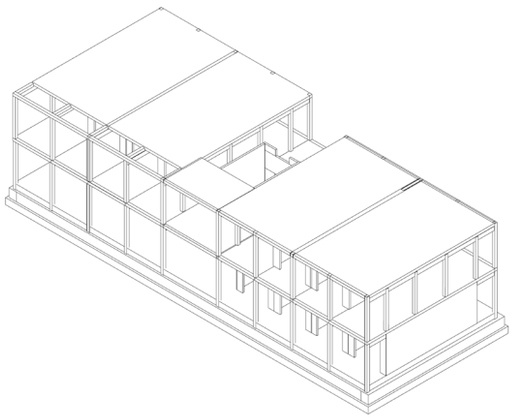


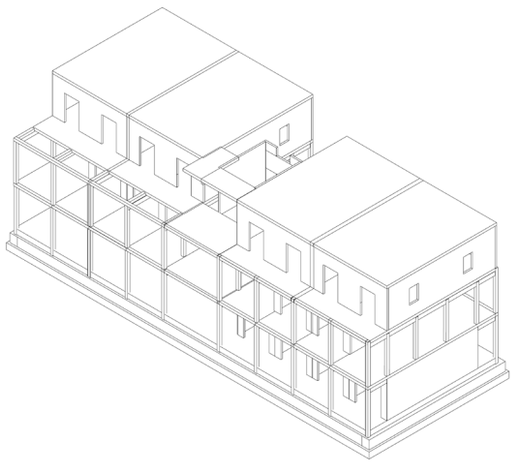


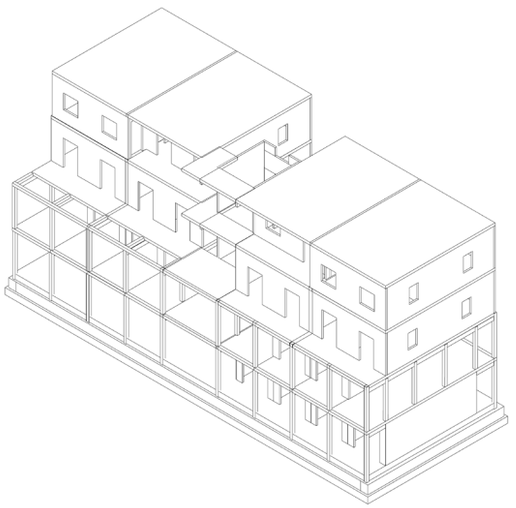


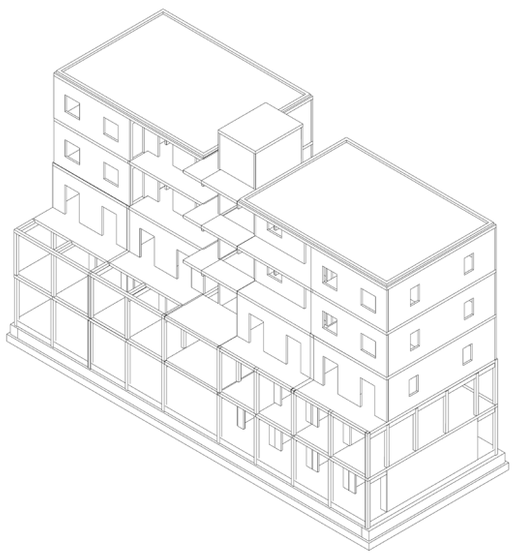


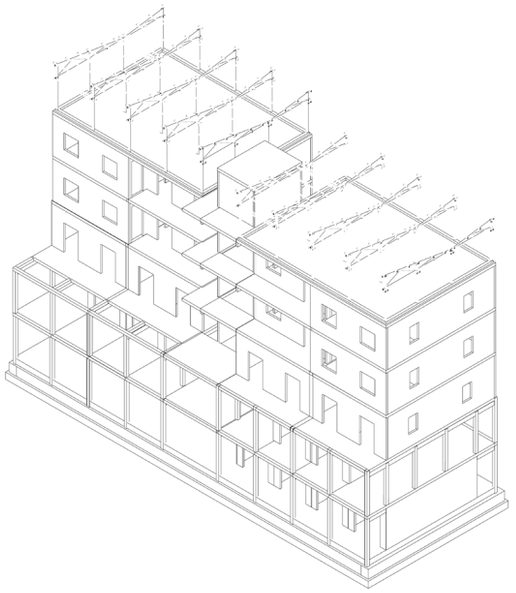


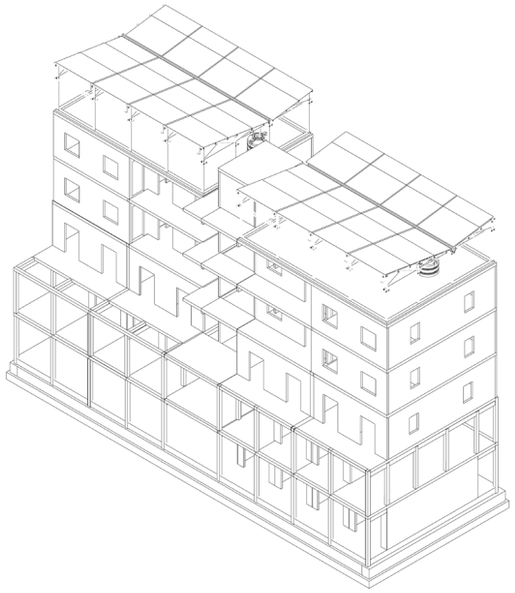


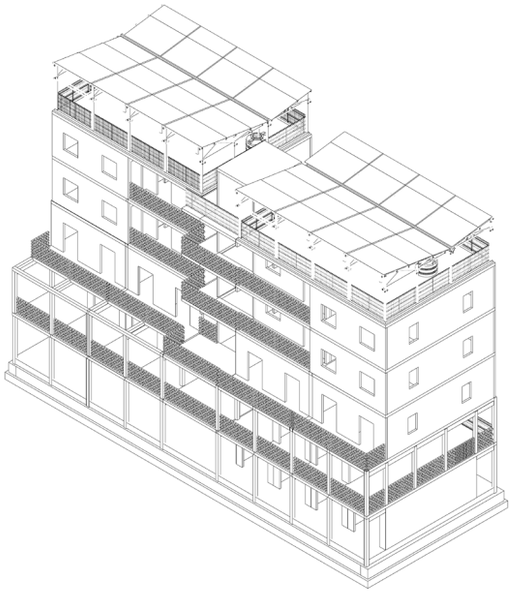




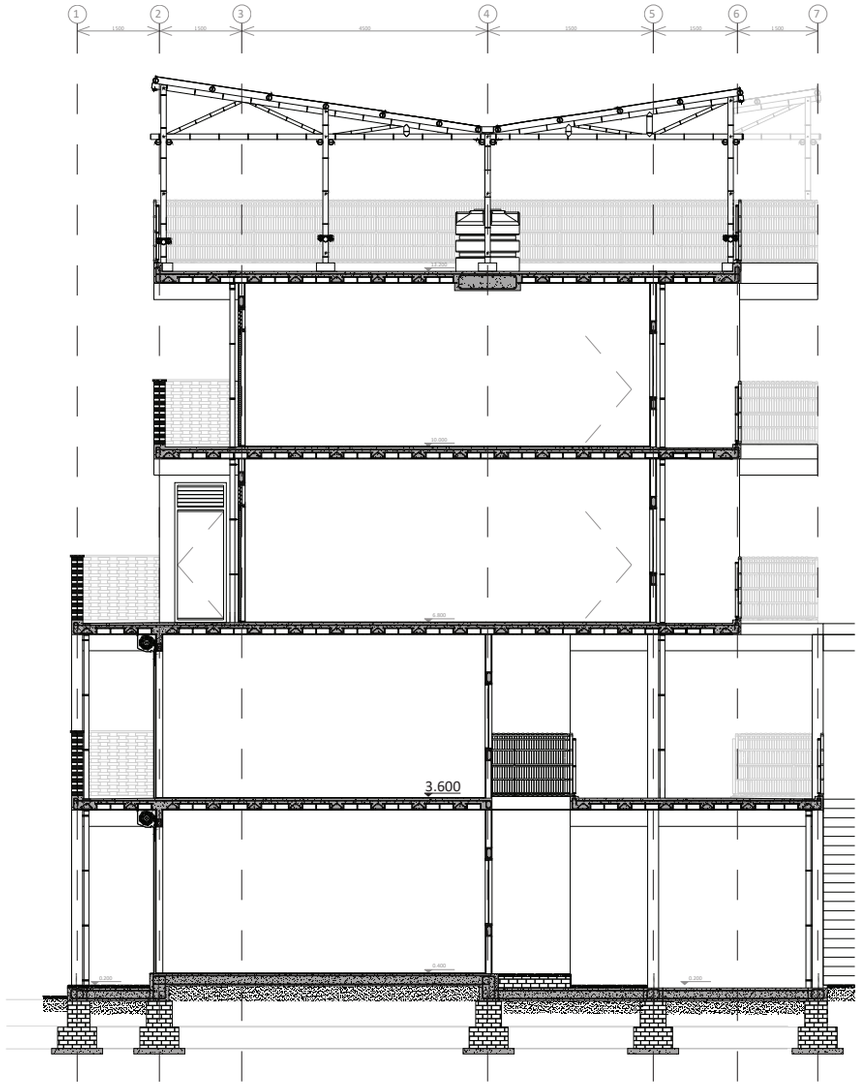


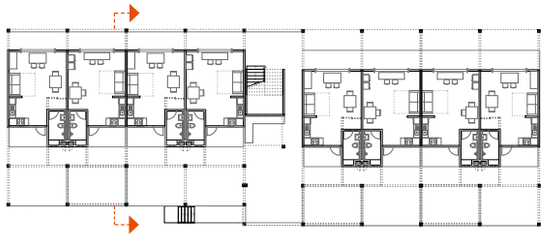






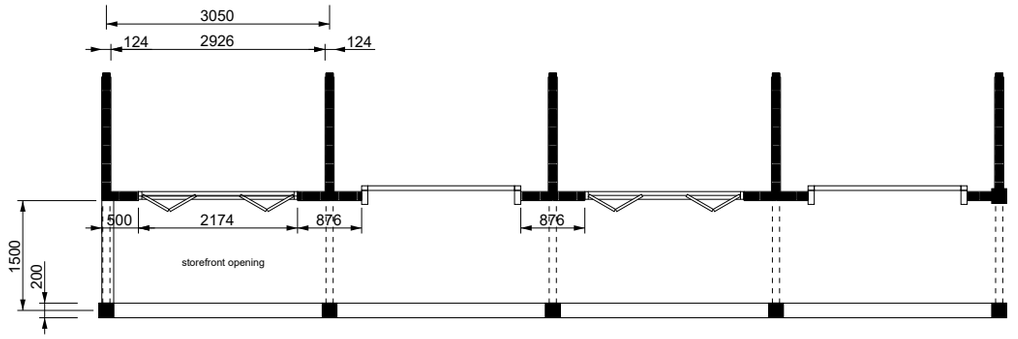
detail section





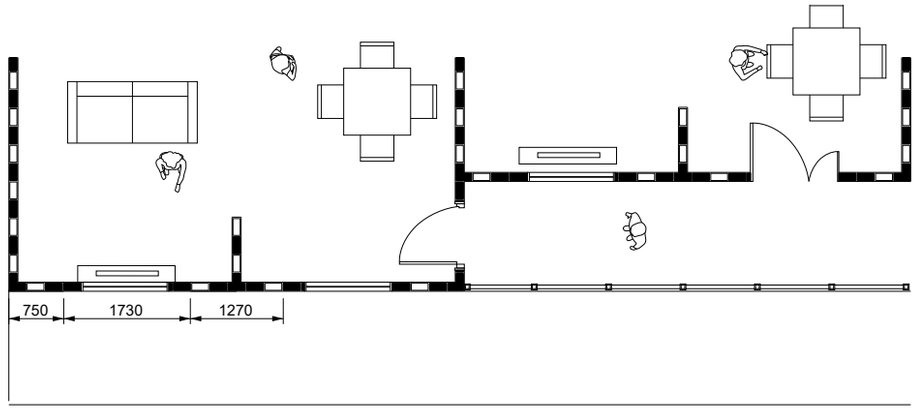
4.5M MODULE G/F PLAN

detail plan



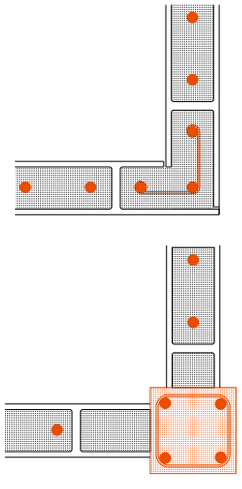
500-750mm filled
750*2=3000/2

3M MODULE G/F PLAN

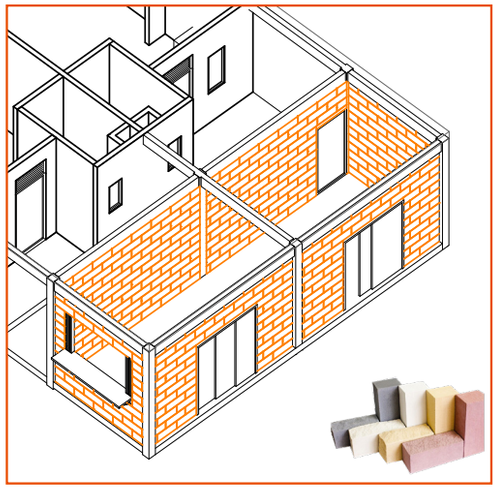


3M MODULE 2/F PLAN

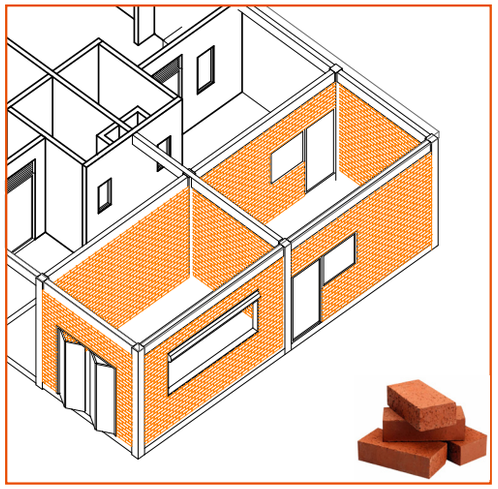
When applied to the design, the panels have different amount of fill of concrete depending on the floor level. While the shop units on the ground floor have all the available cavities filled, the upper residential units on the second floor will have an alternating fill of cavities and near to the window or door openings.



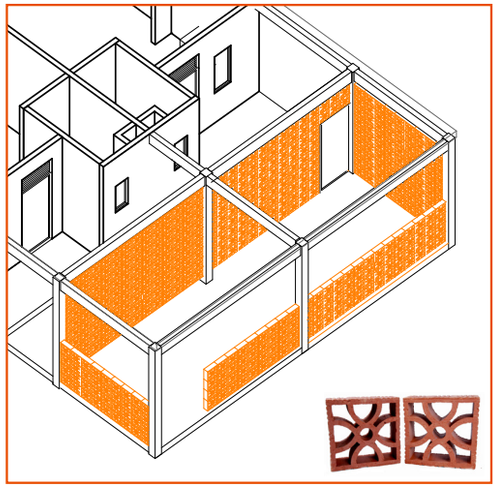
TYPICAL WALL
CORNER JOINTS



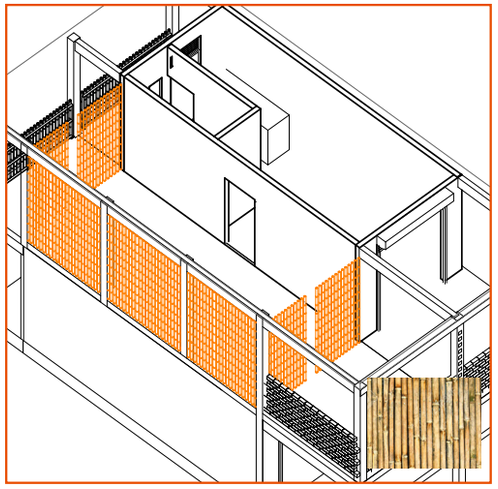
lime sand brick



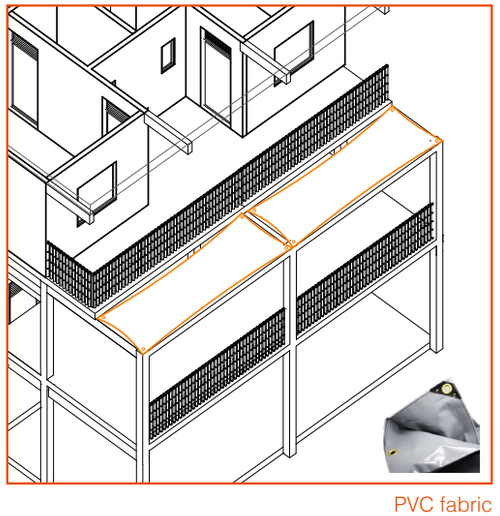
brick



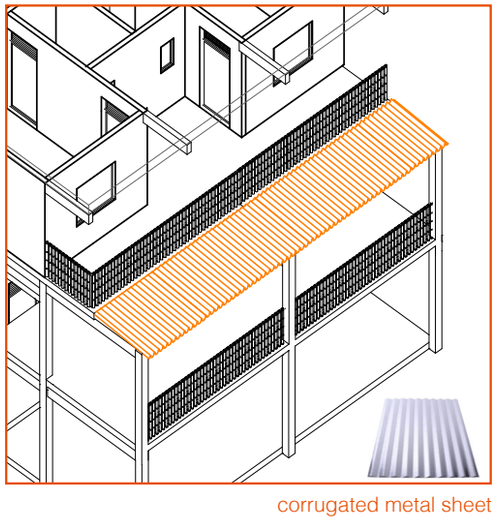
clay jali bricks



bamboo



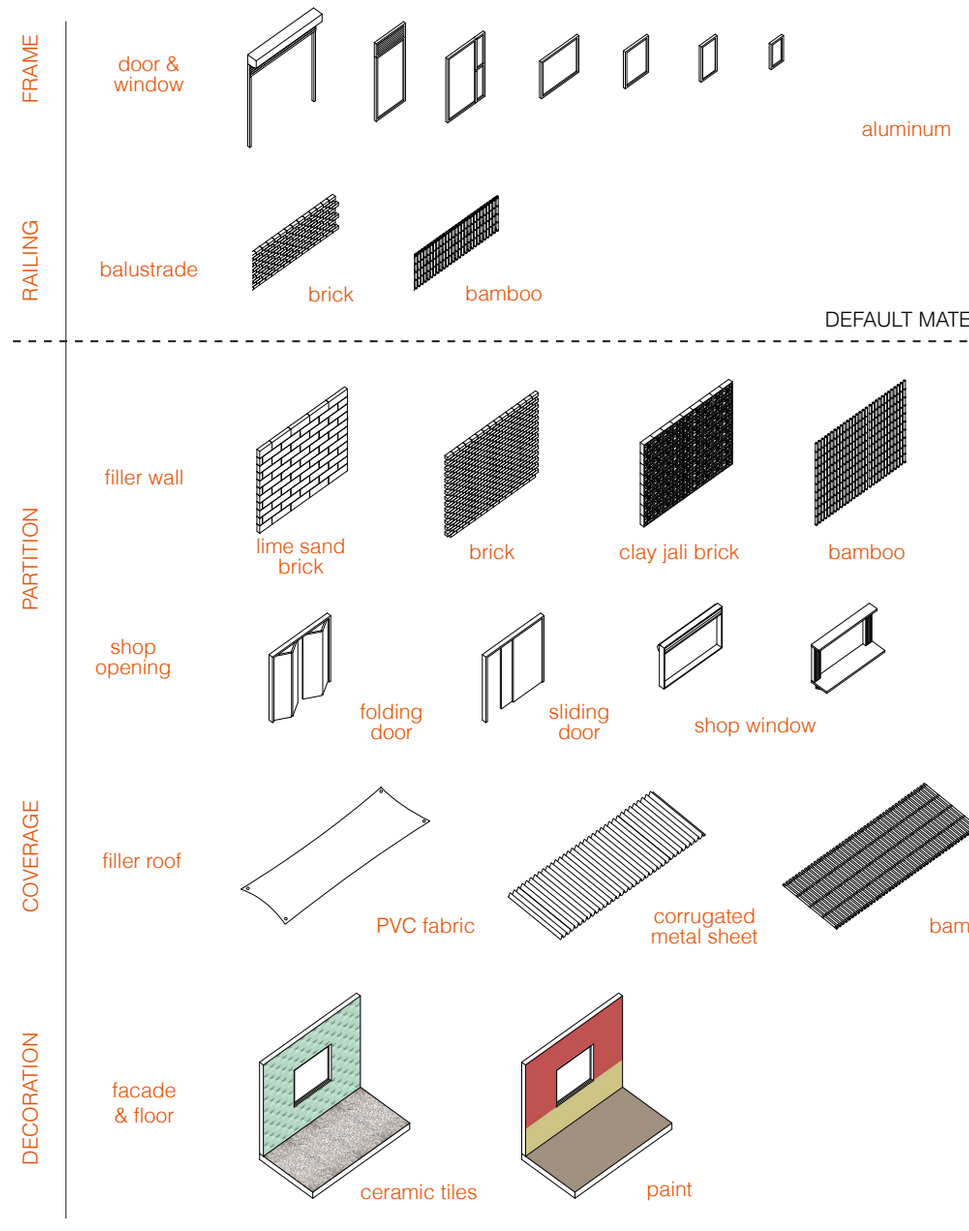
PVC fabric



corrugated metal sheet

MATERIALITY

appropriation possibilities



The design consists of standardized panels which fit the default set of door and window frames for the general building form for rapid and affordable construction. Nevertheless, the design also incorporates frameworks which allow various possiblities of appropriation. After the residents begin residing in the building, they will have an option to enclose, demarcate or decorate their designated units with the potential set of material catalogue above.

This way, the design achieves both efficiency in the construction process and encourages a participatory process in personalizing the potential approporiation spaces as given. Over time, the standarized building will be filled with changes that cater for individual income-generating, domestic or social needs.



Jawahar Kala Kendra, Jaipur

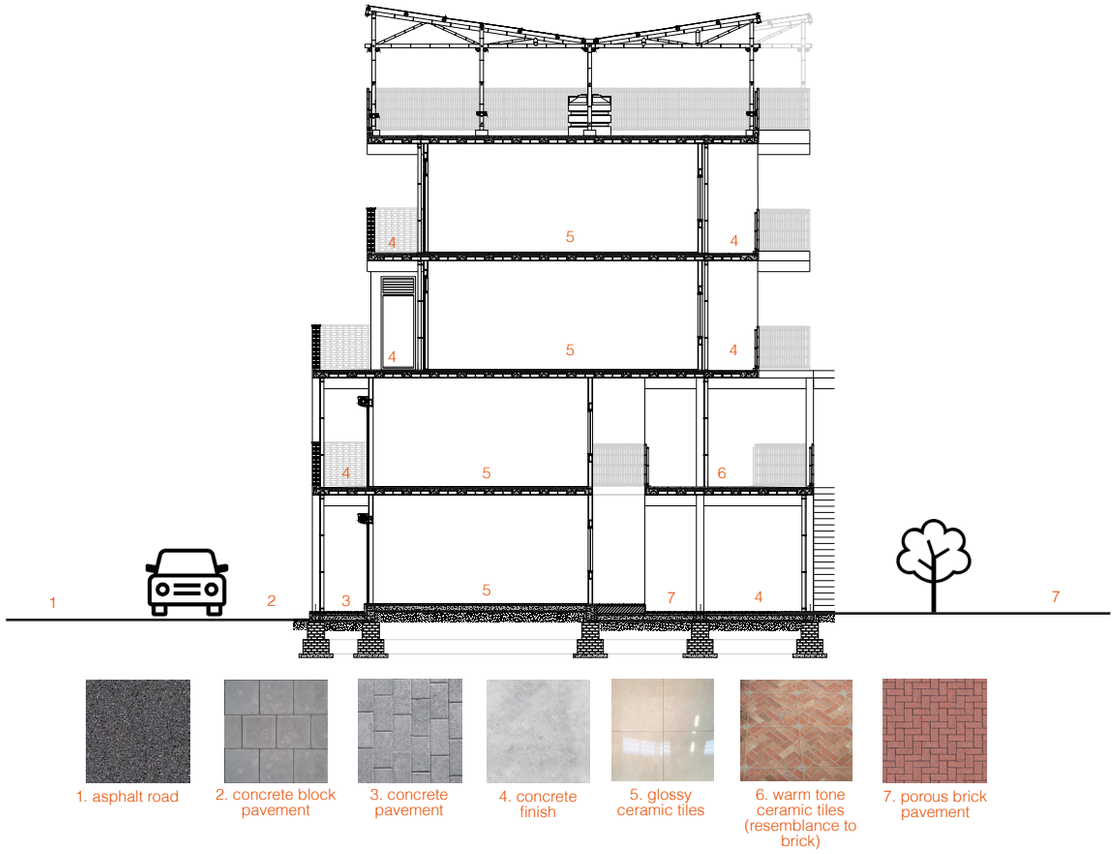


Tara Group Housing, New Delhi

Photo Source:(Bahga & Gaurav 2018)

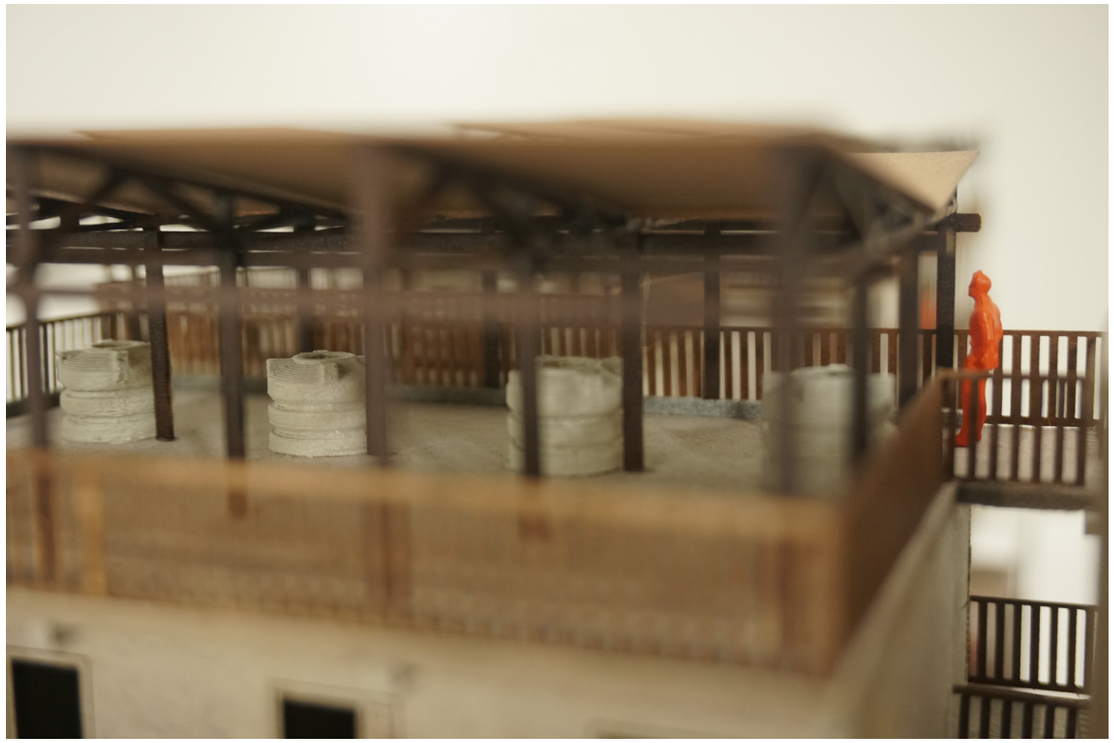
MATERIALITY

pavement & flooring



The pavement and flooring will vary based on the type of the use. Starting from a standard vehicular road made in asphalt, pedestrian road will be a concrete block pavement and then a smaller size of concrete pavement for the individual stoop. Stepping into the community ground, one will be greeted by the warmth of the brick pavement which is also used to form the furnitures around the sunken courtyard. Such ambiance is found in projects such as Charles Correa's Tara Group Housing and Jawahar Kala Kendra where the warm tone and steps create an intimate feeling inside the courtyard.

On the first level of my building which is still communal use, the similar red tone will be replicated by ceramic tiles in resemblance to brick. In upper levels, the corridors and balconies will have a basic concrete finish but residents will have the freedom to make changes by tiling.





MATERIALITY

roof material



Photo Source: (Heringer 2017) Handmade School in Bangladesh



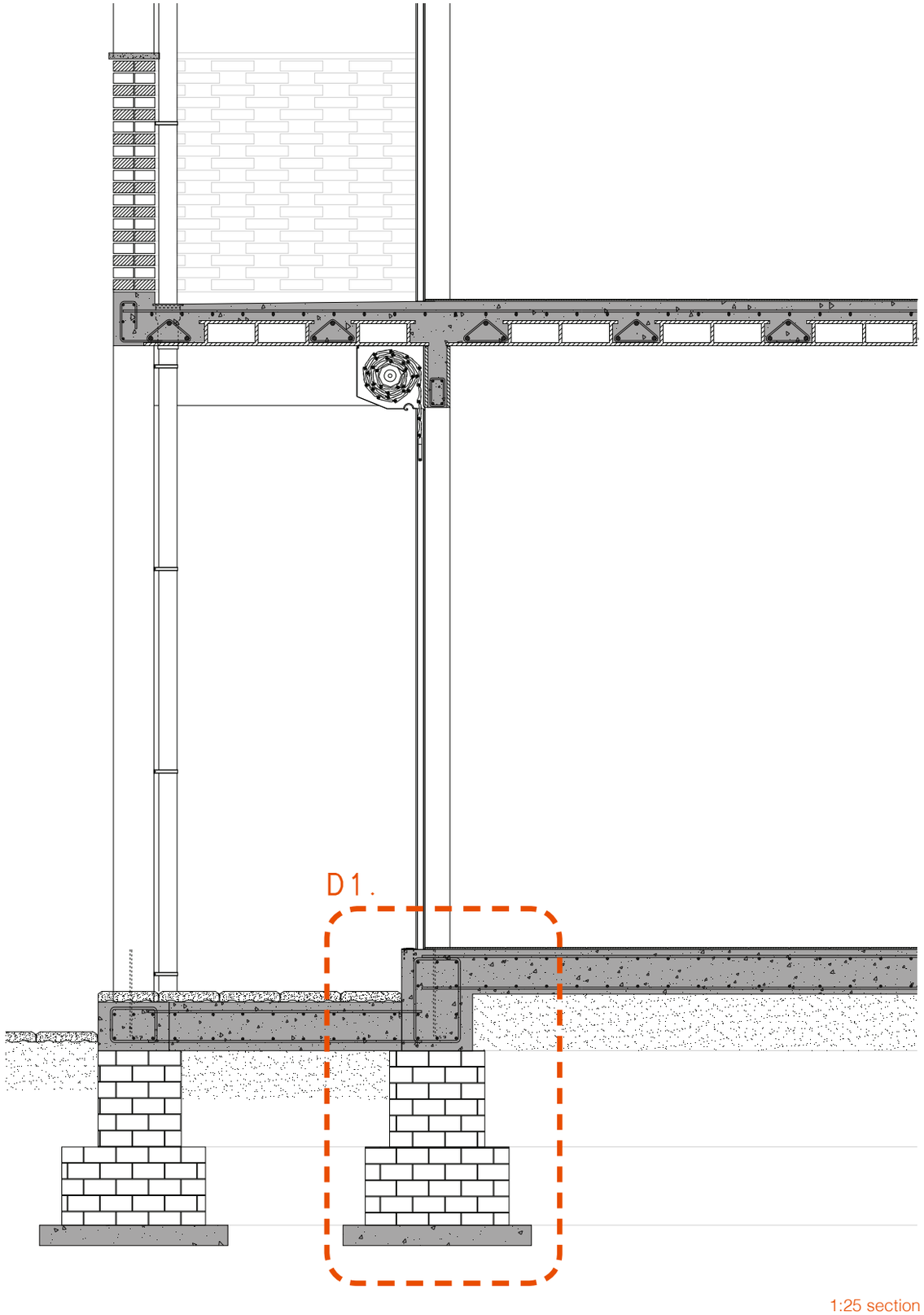
Photo Source: (Montiel 2019) Integrated Bamboo Bench



Photo Source: ("PVC Membrane") PVC Waterproof Fabric

As bamboo is a material that is affordable and easy to assemble, the roof of my design is made of a bamboo truss structure that is supported by the bamboo columns attached to the concrete pedestal on the floor. Around the outer columns, a horizontal bamboo pieces are laid to also create a seating. (Montiel 2019)

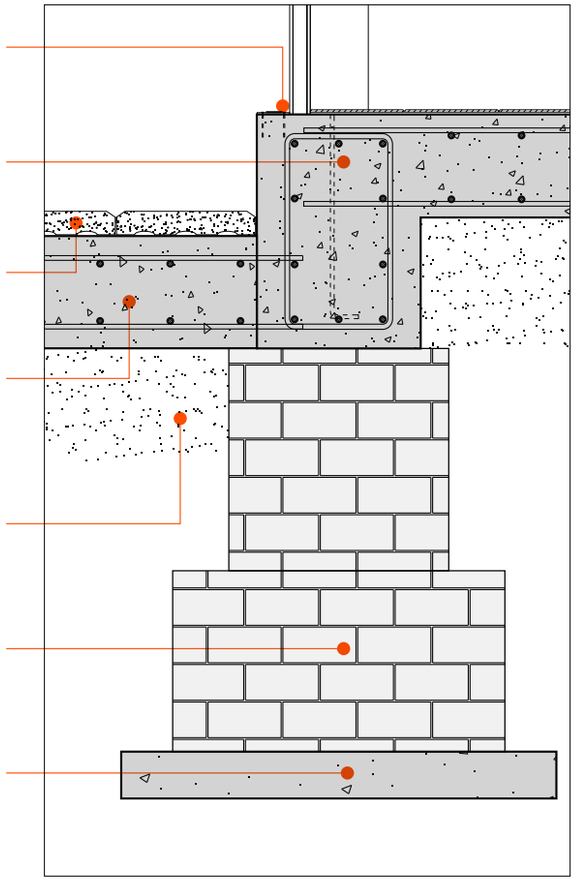
Instead of using the standard corrugated metal sheets bolted onto the roof structure, I have decided to use PVC, or polyvinyl chloride fabric as an equally functional material instead. PVC fabric is an outdoor waterproof textile commonly found in tents or backpacks. It is a cost effective alternative to traditional roofing systems and can be produced in various colors to coordinate with individual needs of the building project. The fabric is UV stable, so the temperature on the semi-open roof floor can stay comfortable for multipurpose uses even in the hot weather. The durability of PVC fabric is explained by a protective acrylic top coating that allows a design life of approximately 15 to 20 years. As many of the PVC fabric is produced with a ring around the corners, the roof will be designed with L-brackets secured to anchor bolts to easily hang the fabric one layer on top of the other following the flow of the water. In case of damage or aging, the fabric is more easily replaceable without the need to remove the bolts compared to the corrugated metal sheets. ("PVC Membrane")



1:25 section
communal plinth

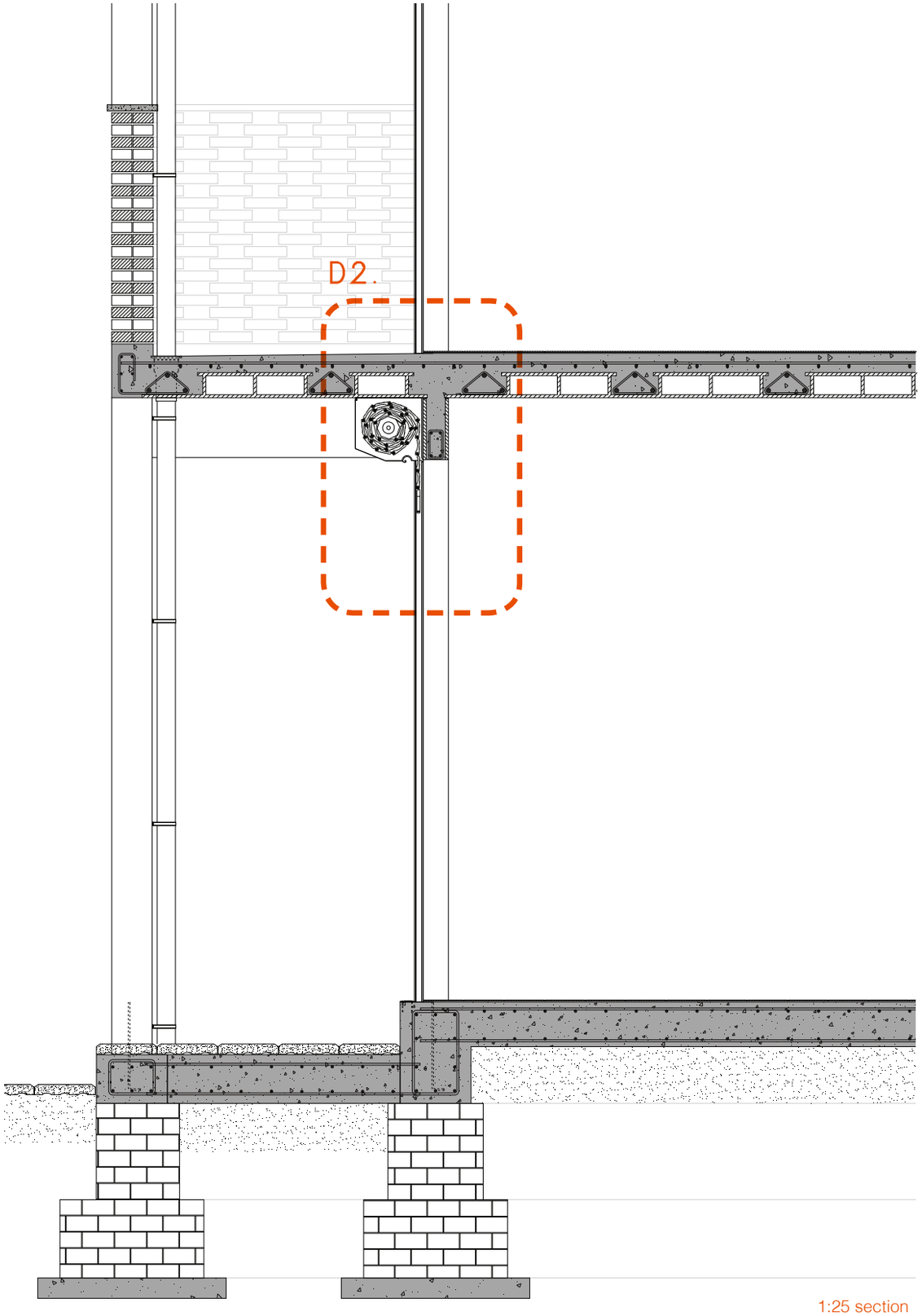
DETAILS

foundation



D1.

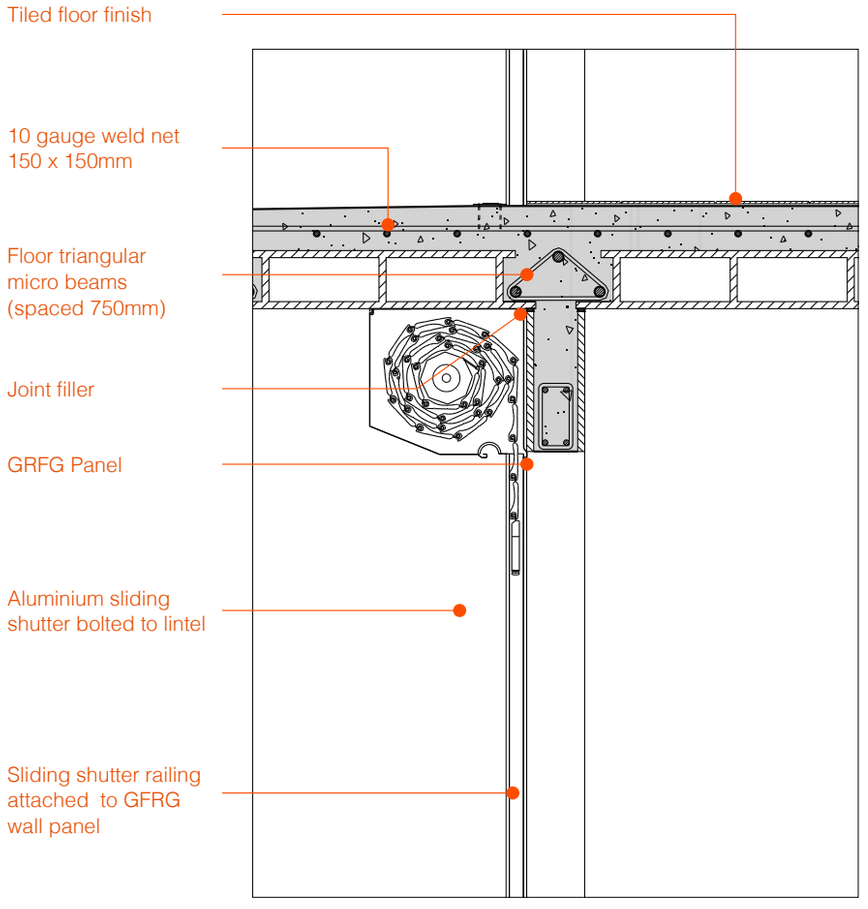
Source: (*GFRG Building, Structural Design Manual* 2012), (*Glass Fibre Reinforced Gypsum (GFRG)*)



1:25 section
communal plinth

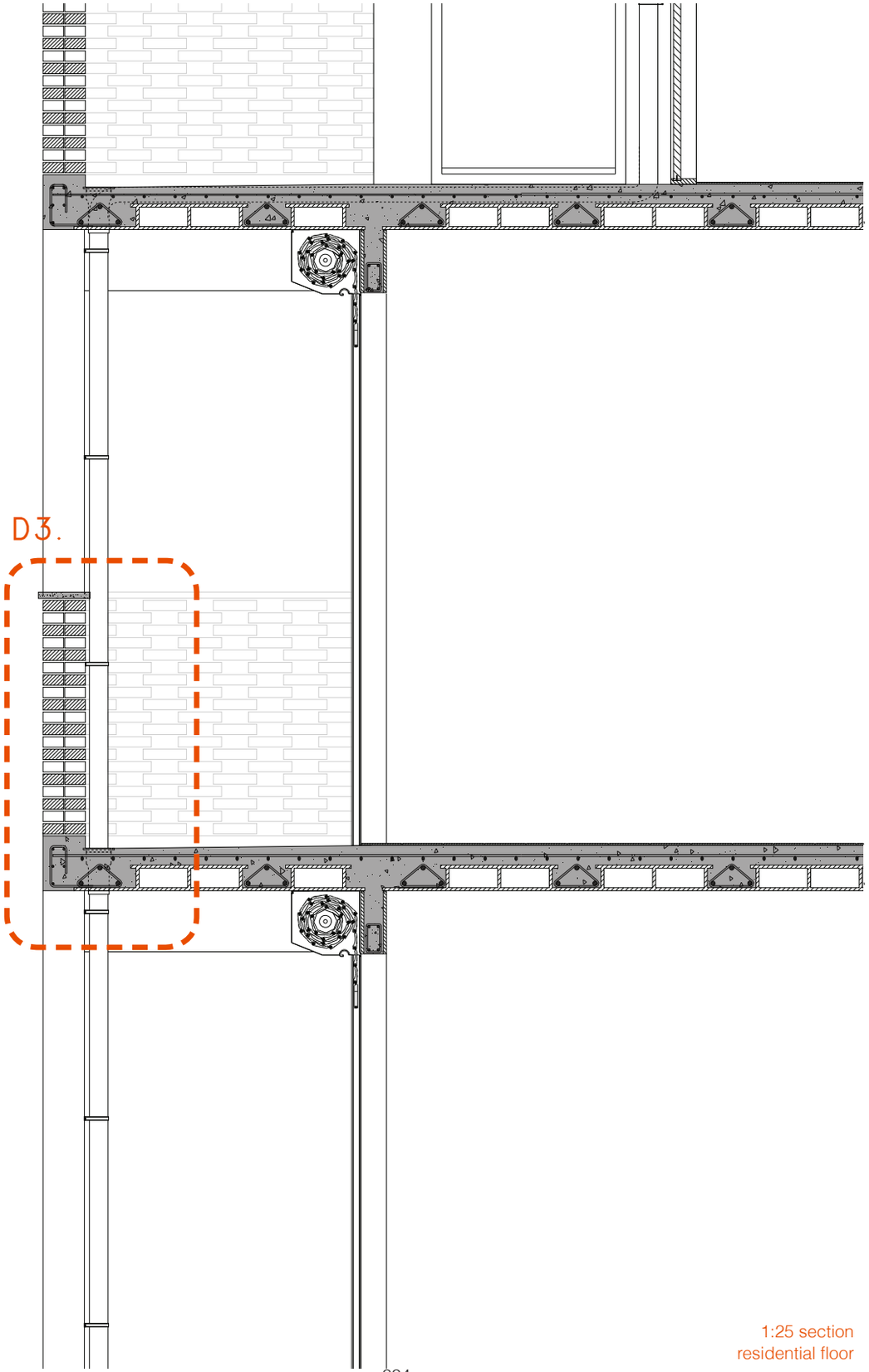
DETAILS

wall to floor connection (non-loadbearing)



D2.

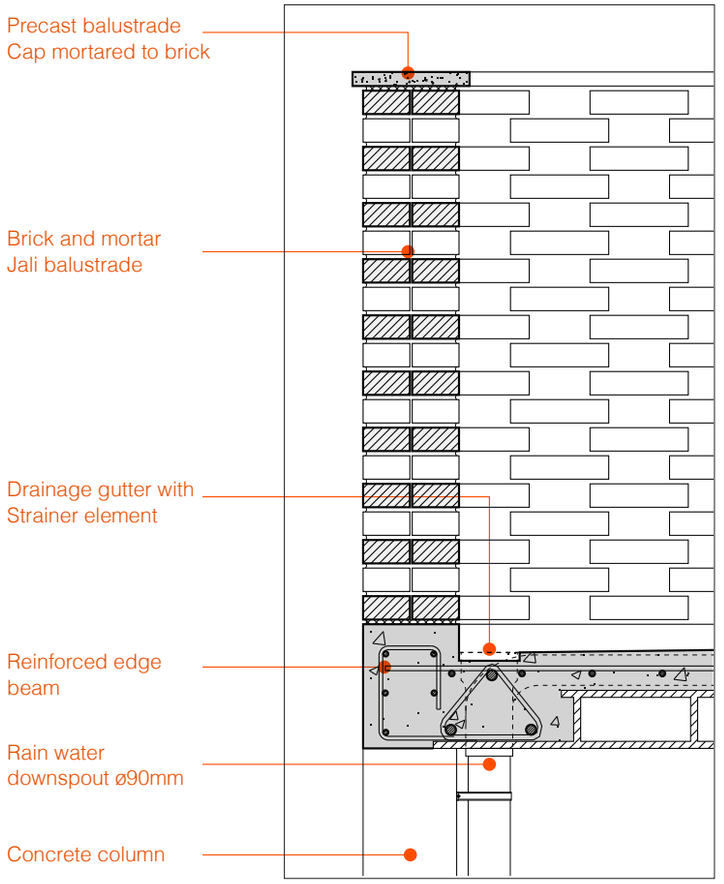
Source: (*GFRG Building, Structural Design Manual* 2012), (*Glass Fibre Reinforced Gypsum (GFRG)*)



1:25 section
residential floor

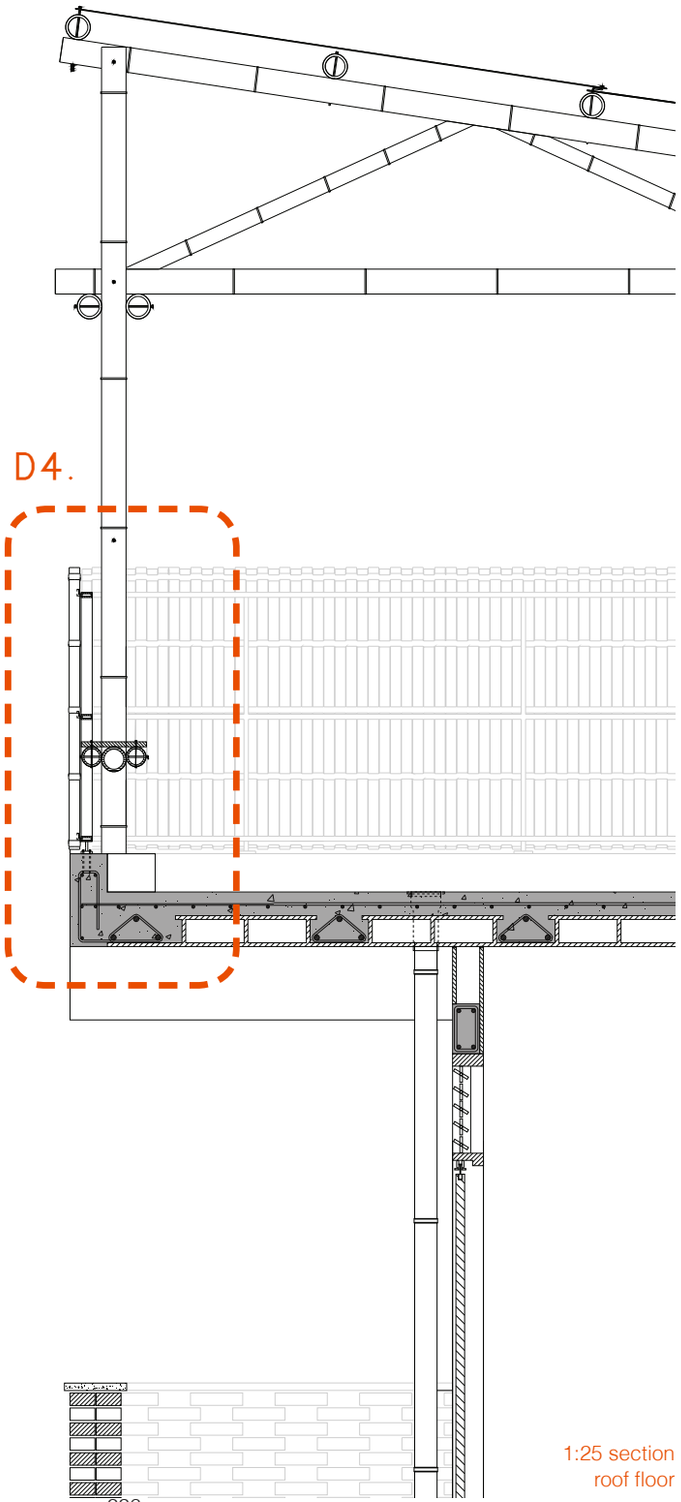
DETAILS

balustrade



D3.

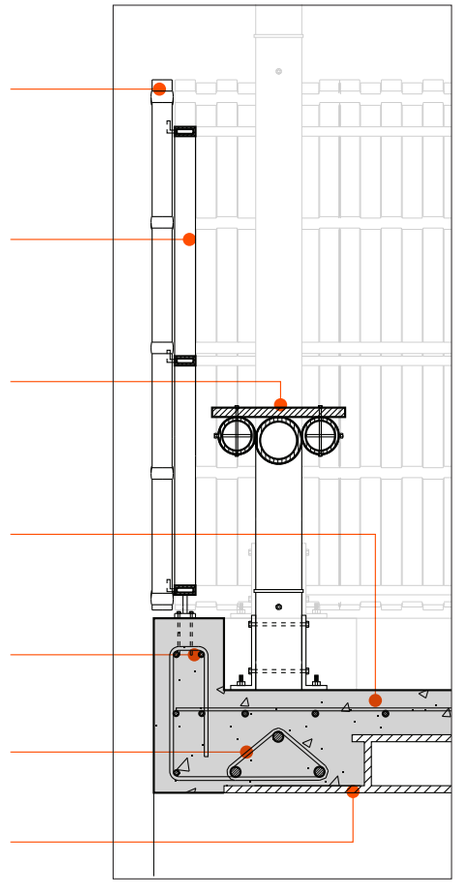
Source: (*Glass Fibre Reinforced Gypsum (GFRG)*)



1:25 section
roof floor

DETAILS

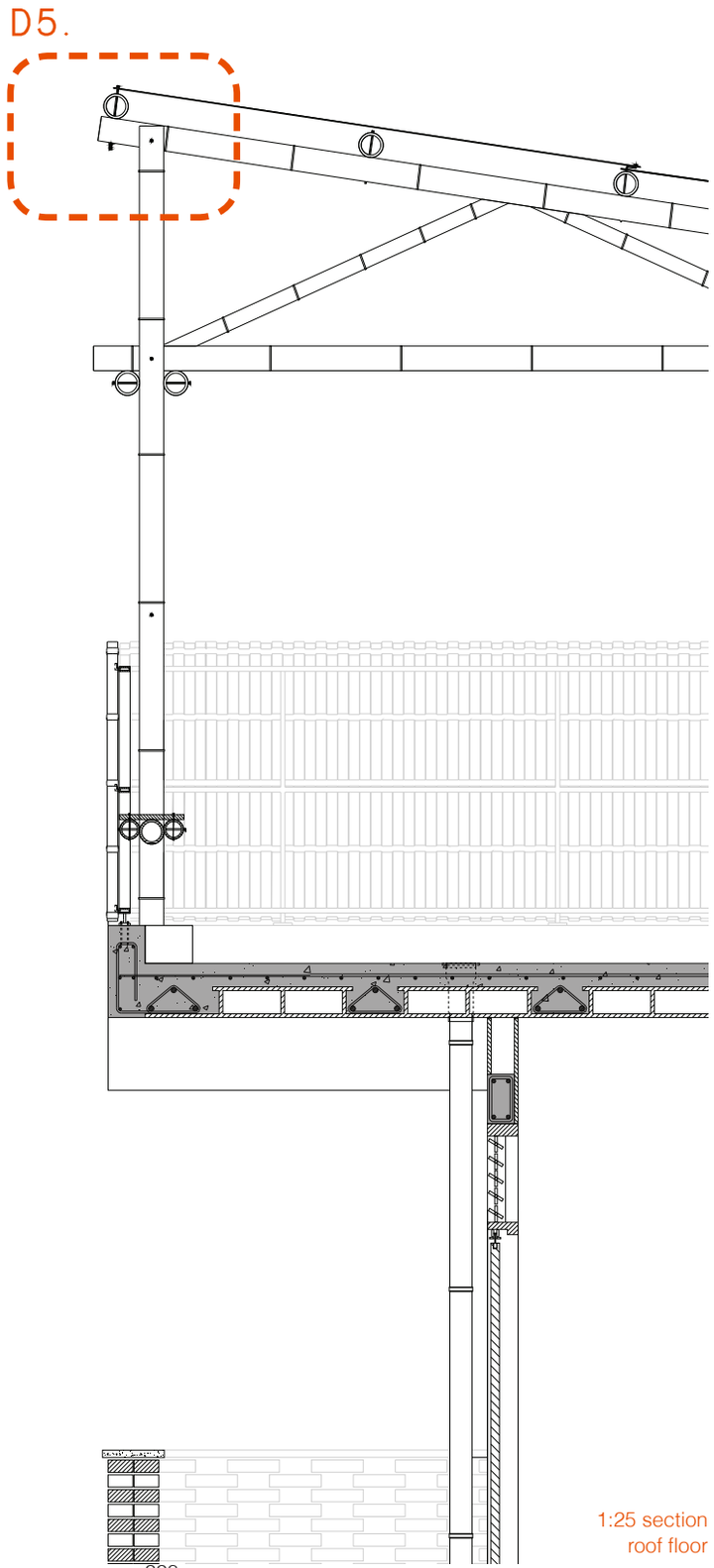
balustrade



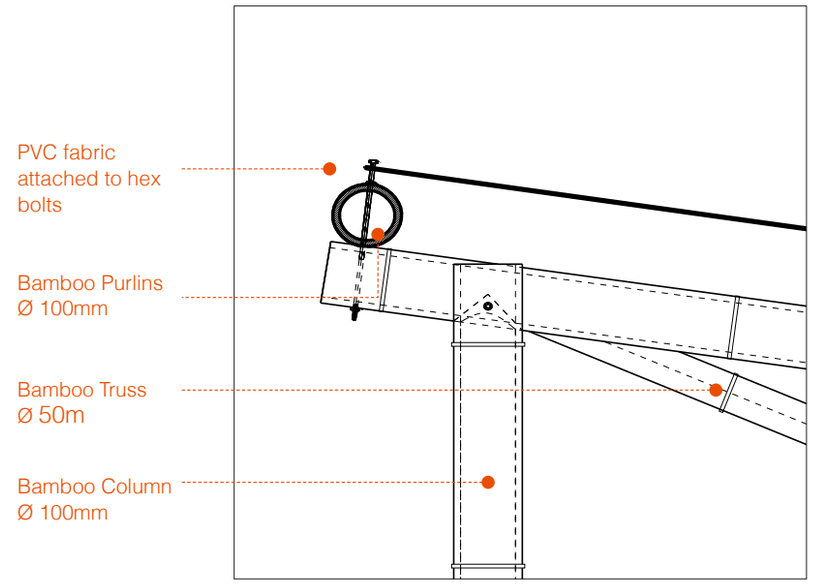
D4.

Source: (*Glass Fibre Reinforced Gypsum (GFRG)*)

D5.

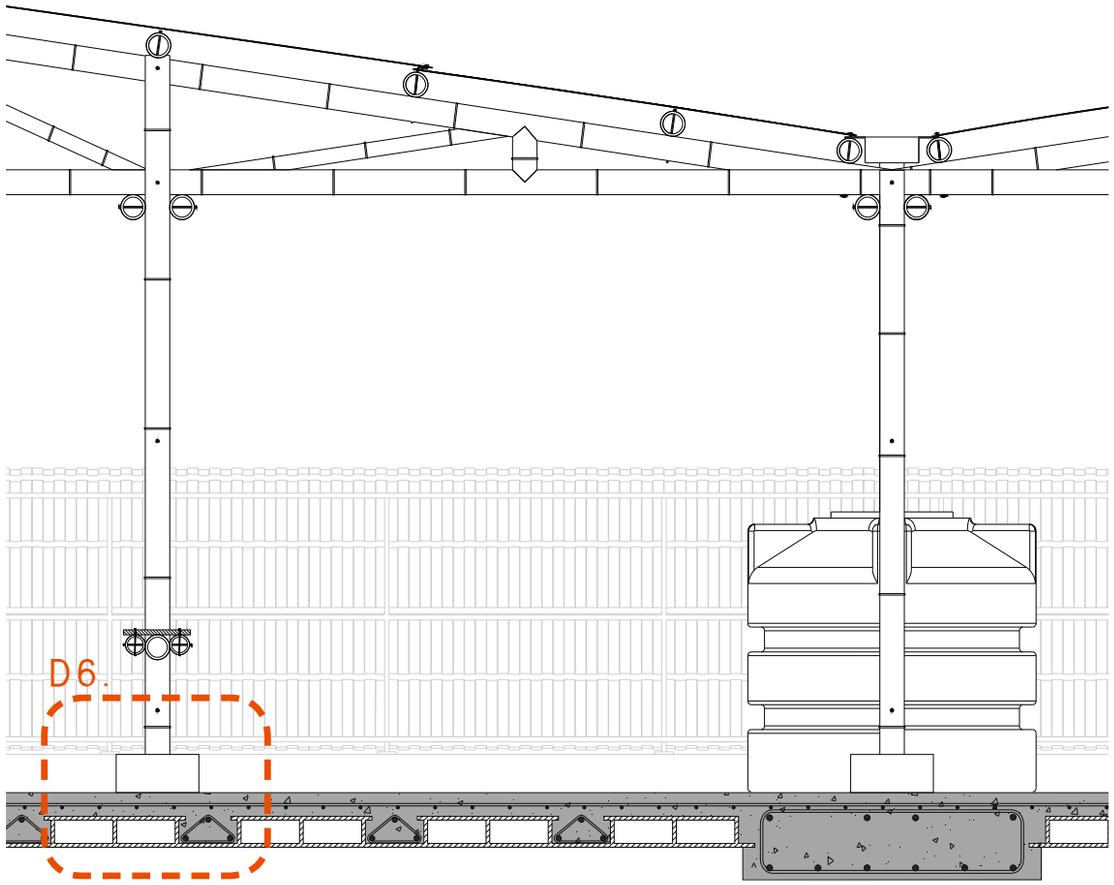


1:25 section
roof floor



D5.

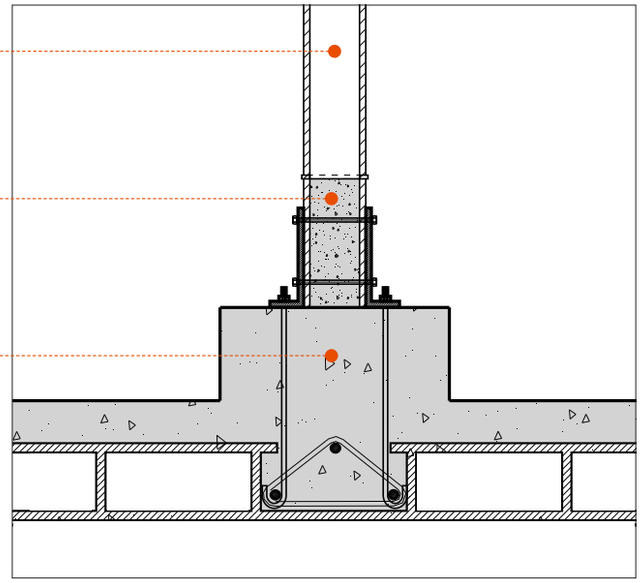
Source: (Dinh 2018)



1:25 section
roof floor

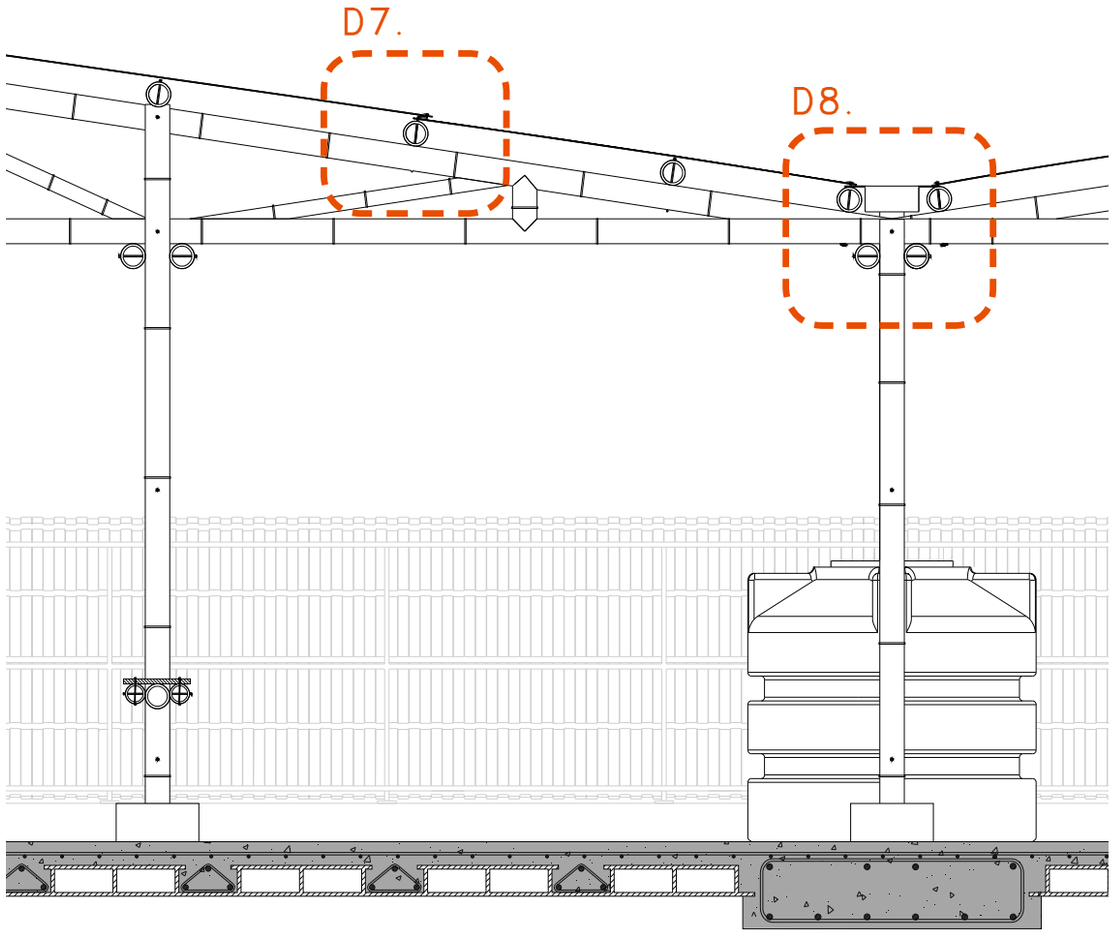
DETAILS

roof



D6.

Source: (*Glass Fibre Reinforced Gypsum (GFRG)*),
(Dinh 2018)



1:25 section
roof floor

DETAILS

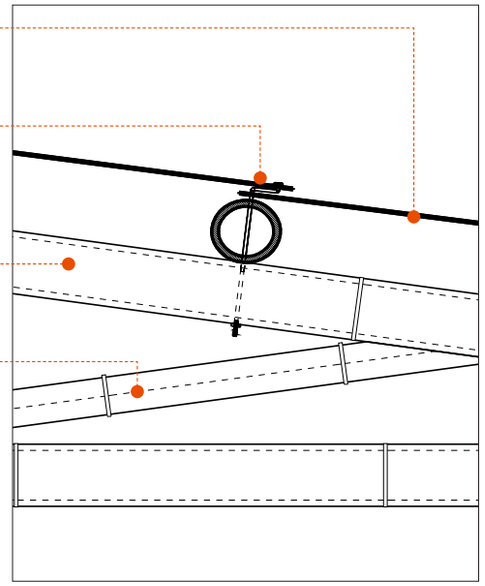
roof

PVC fabric sheets attached to hex bolts

L- Brackets 160 x 60 x 10 secured to anchor bolts

Bamboo Purlins Ø 100mm

Bamboo Beams Ø 100mm



D7.

Source: (Dinh 2018)

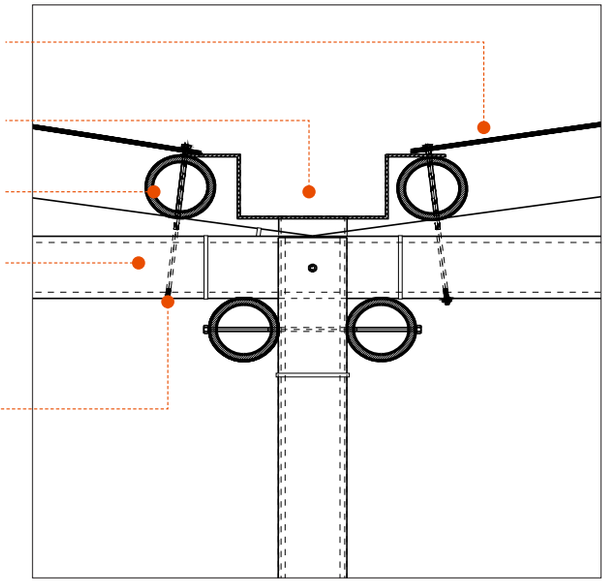
PVC fabric sheets attached to hex bolts

Aluminium Gutter

Bamboo Purlins Ø 100mm

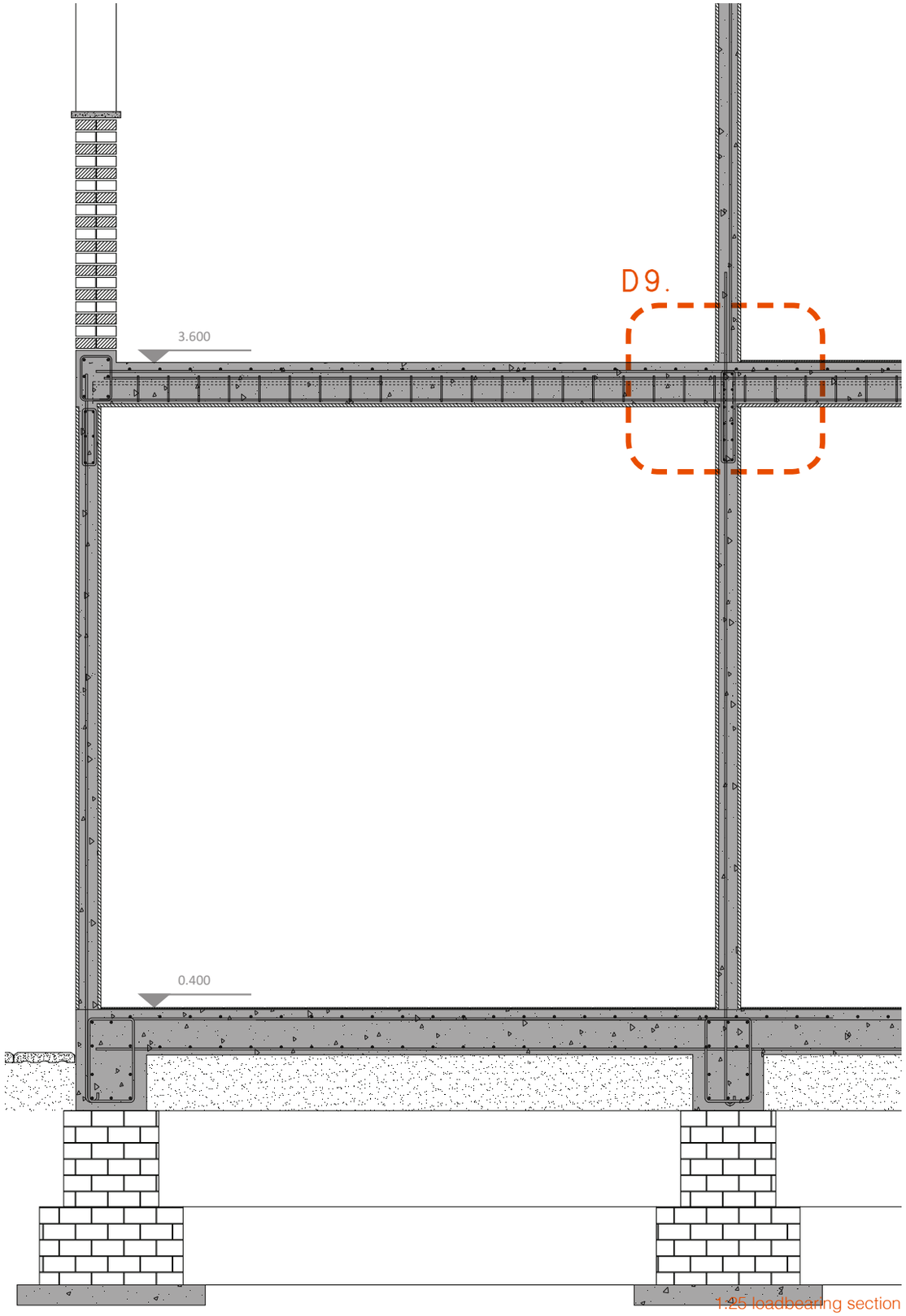
Bamboo Beams Ø 100mm

Stainless steel Hex bolts



D8.

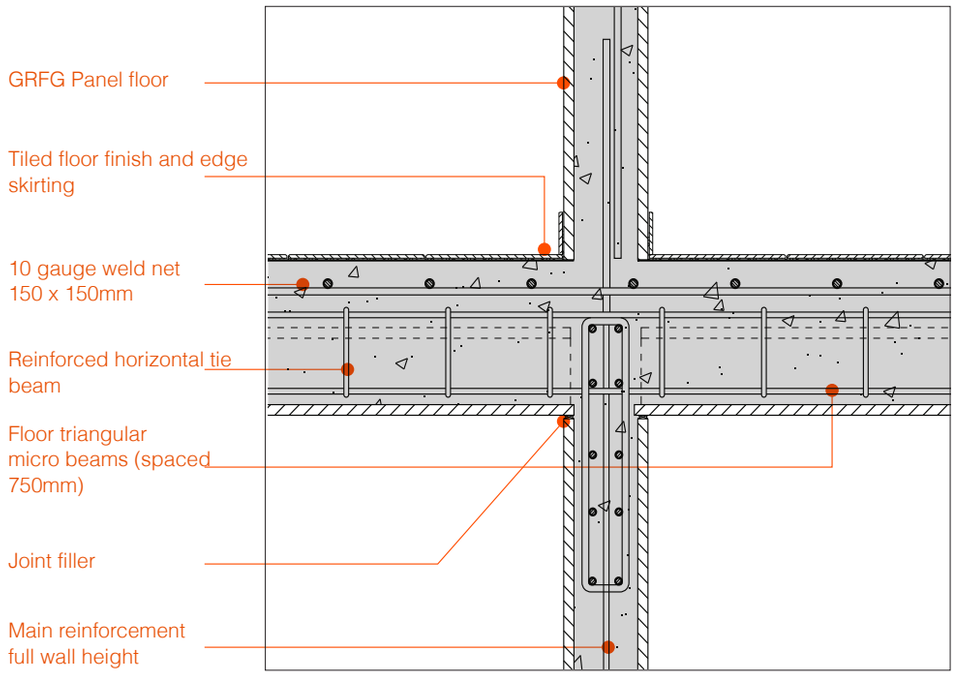
Source: (Dinh 2018)



1.25 loadbearing section
communal plinth

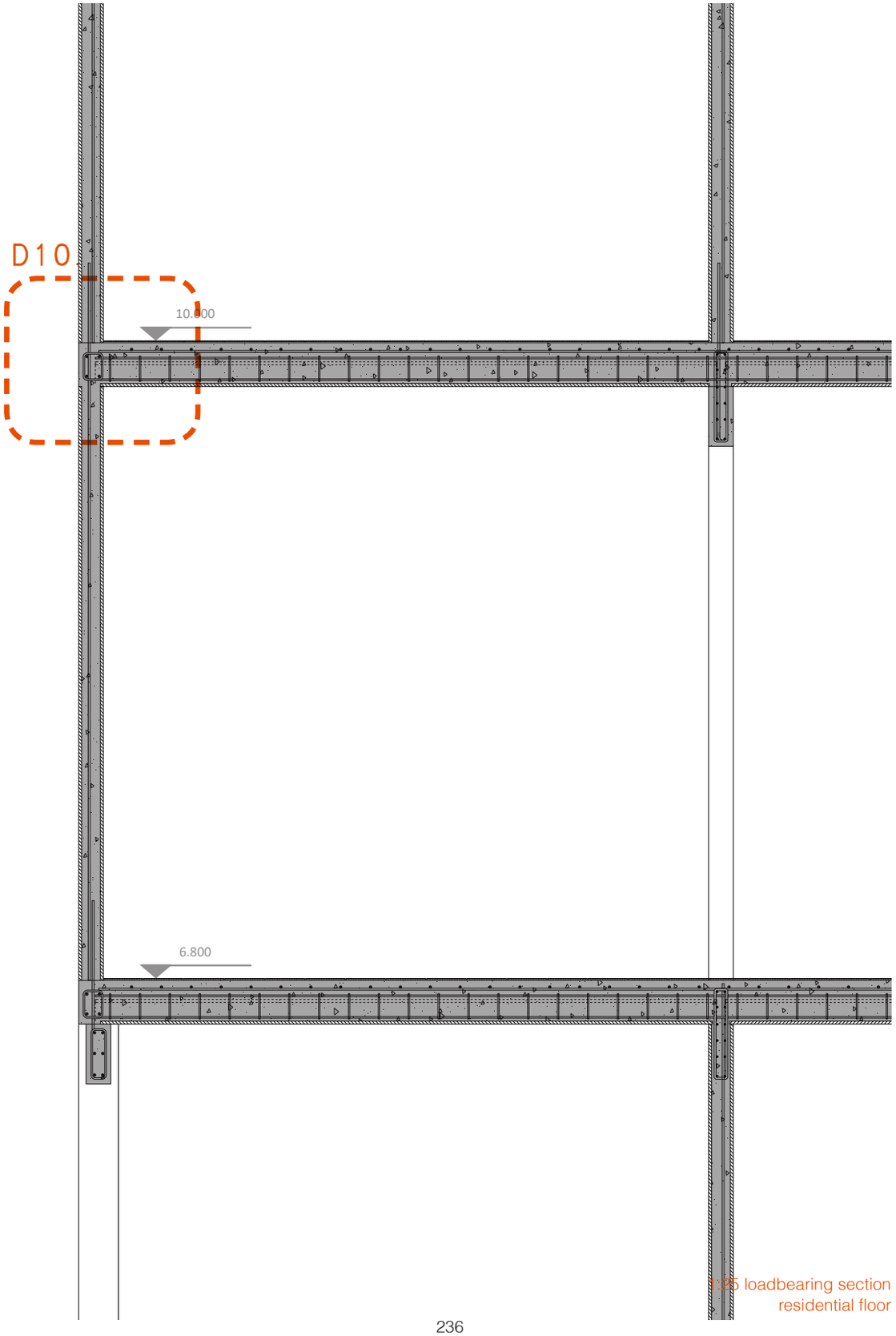
DETAILS

floor to wall connection (loadbearing)



D9.

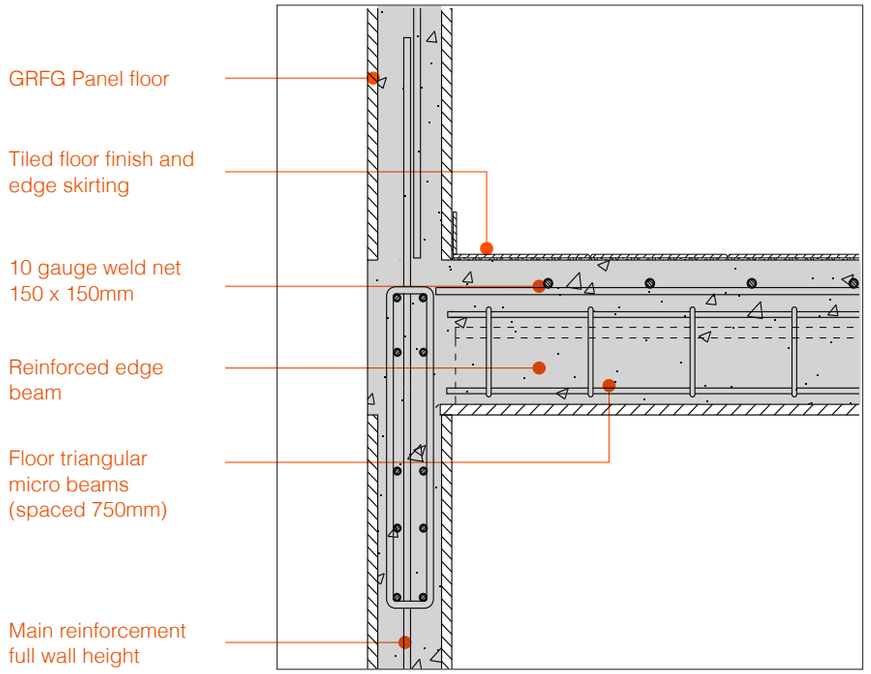
Source: (*GFRG Building, Structural Design Manual* 2012)



1:25 loadbearing section
residential floor

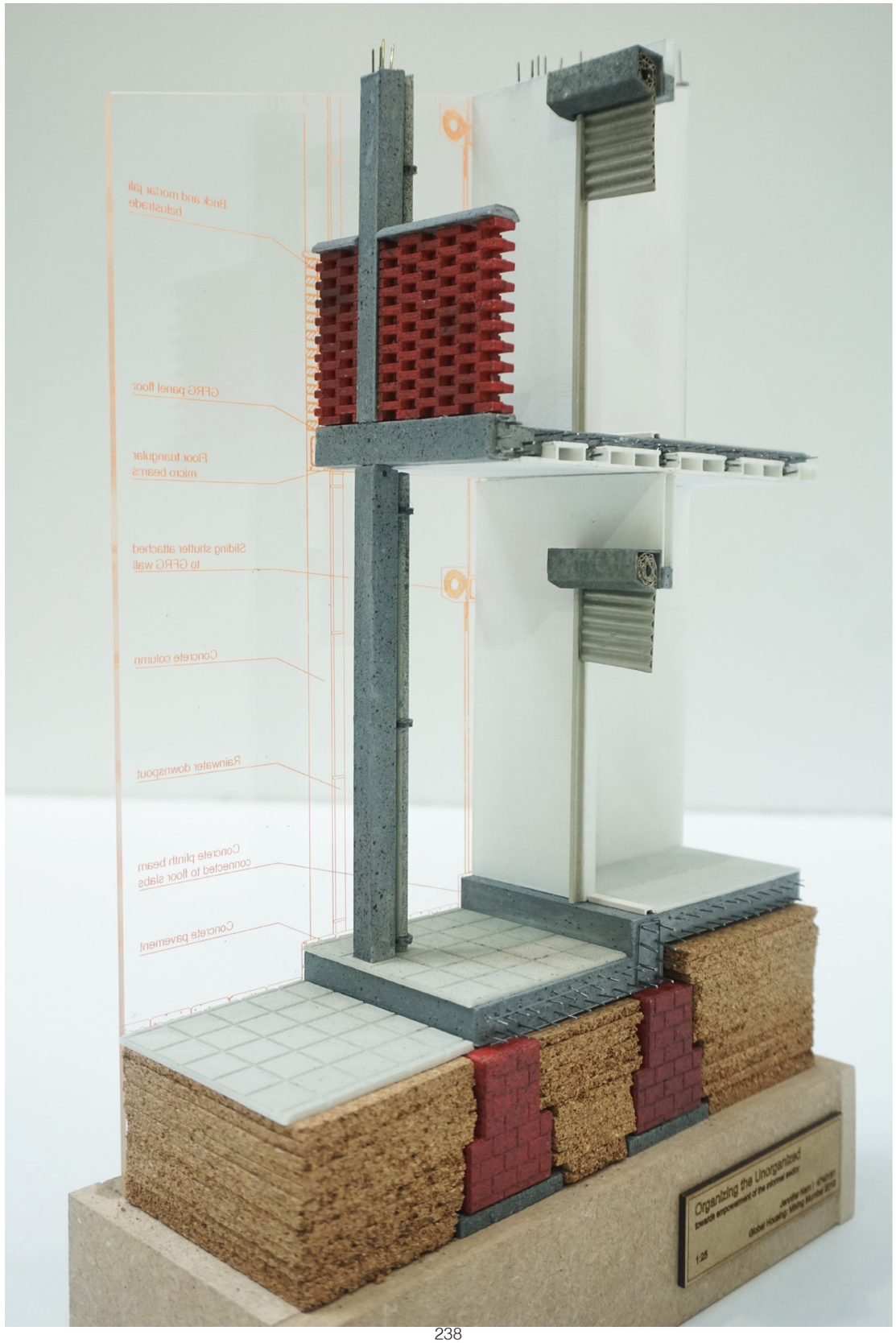
DETAILS

floor to wall connection (loadbearing)

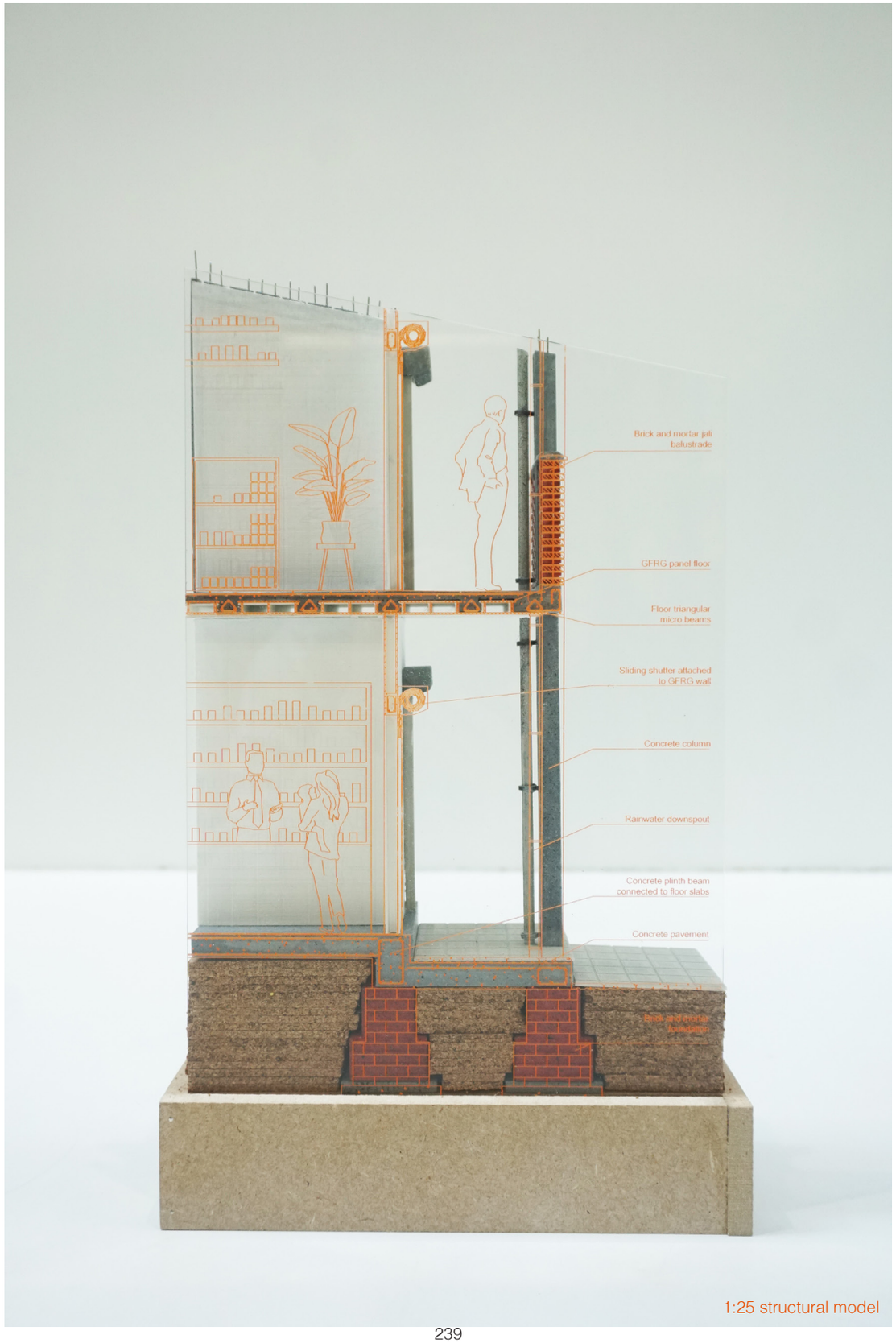


D10.

Source: (*GFRG Building, Structural Design Manual* 2012)



238



1:25 structural model

239

COMPARISONS

mechanical properties

	EMPTY PANEL	WITH CONCRETE INFILL	BRICK WALL
weight	40 kg (-90.0%) weight of 1m² GRFG panel	250 kg (-37.5%) weight of 1m² GRFG panel with concrete infill	400 kg weight of 1m² brick wall (9" thick) with 2 sides of cement plastering
ecological footprint	35.59 kWh Embodied energy of 1m² GRFG wall		194.38 kWh Embodied energy of 1m² Brick wall
compressive strength	73.2 kg / cm²	180.70 kg / cm²	35 ~105 kg / cm²
flexural strength	21.25 kg / cm²	20.80 kg / cm²	
tensile strength	35 kN / m	28.8 kN / m	
unit shear strength	50.9 kN / m		
modulus of elasticity	7500 N / mm²		
fire resistance (700-10,000 C)	4 hours		
earthquate resistance	up to Ritcher scale* 8		
sound transmission class (STC)	40 dB		
water absorption	< 5%		

Data Source: (Cherian 2017, 97-8), ("Glass Fibre Reinforced Gypsum Panel System" 2012, 3-20)

Light weighted GFRG Wall Panel has high compressive strength, shearing strength, flexural strength and ductility compared to BRICK MASONRY wall. It has very high level of resistance to fire, heat, water, termites, rot and corrosion which are far more than brick masonry wall. Concrete infill with vertical reinforcement rods enhances its vertical and lateral load capabilities. GFRG wall buildings are resistant to earthquakes, cyclones and fire. CO2 reduction is about 2.9 tons per panel. (slideshare-process)

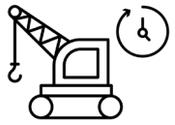
The high loadbearing capacity of this composite material can be credited to the glass rovings. These filaments are 3100-3800 Mpa, a strength which is much higher than even that of steel used for concrete reinforcement which is maxiumum 500 Mpa. Elastic Modulus of glass roving is 76-78 Gpa. (slideshare-comparisons)

However there are some limitations to its applications: It cannot be used for wall with circular or higher curvature, and clear span shall be limited to 5m for residential buildings, for non-residential buildings, the span shall be limited to as specified in Designs Manual. (*GFRG Building, Structural Design Manual* 2012)

*a numerical scale for expressing the magnitude of an earthquake on the basis of seismograph oscillations. The more destructive earthquakes typically have magnitudes between about 5.5 and 8.9.

COMPARISONS

overview of cost and impact



CONSTRUCTION SPEED

21 days

GFRG Wall Building (1500 ft²)

120 days

Conventional Building (1500 ft²)



CONSTRUCTION COST

Rs. 13.25 Lakhs

GFRG Wall Building (1500 ft²)

Rs. 18.27 Lakhs

Conventional Building (1500 ft²)



EMBODIED ENERGY

35.59 kWh

Embodied energy of 1m² GRFG wall

194.38 kWh

Embodied energy of 1m² Brick wall

Data Source: (Attarwala 2016)

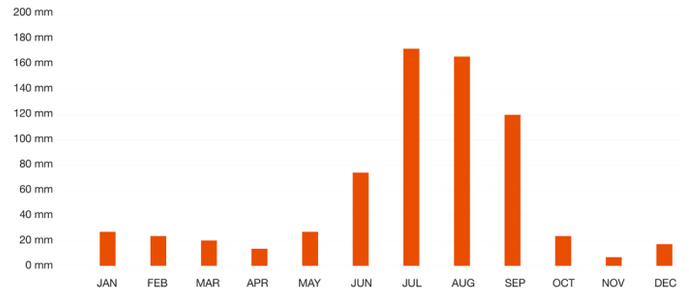


Photo Source: (Chandrashekhar 2019)

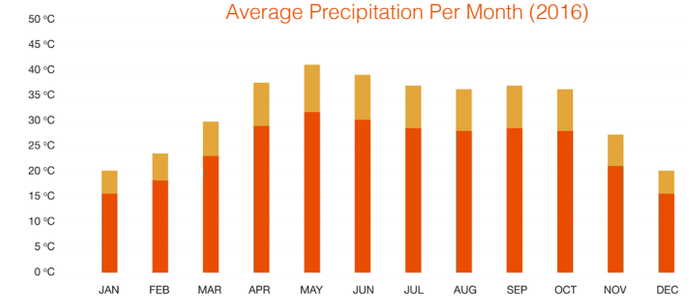
Monsoon season in Mumbai

C LIMATE

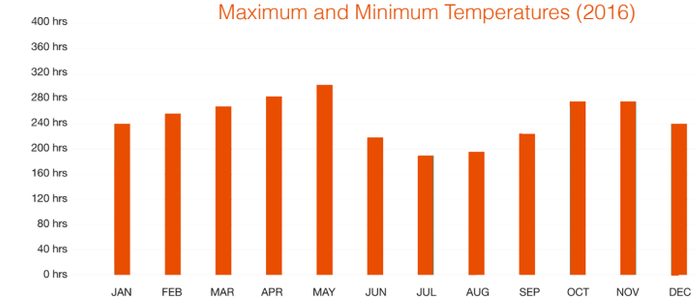
seasons of mumbai



Average Precipitation Per Month (2016)



Maximum and Minimum Temperatures (2016)

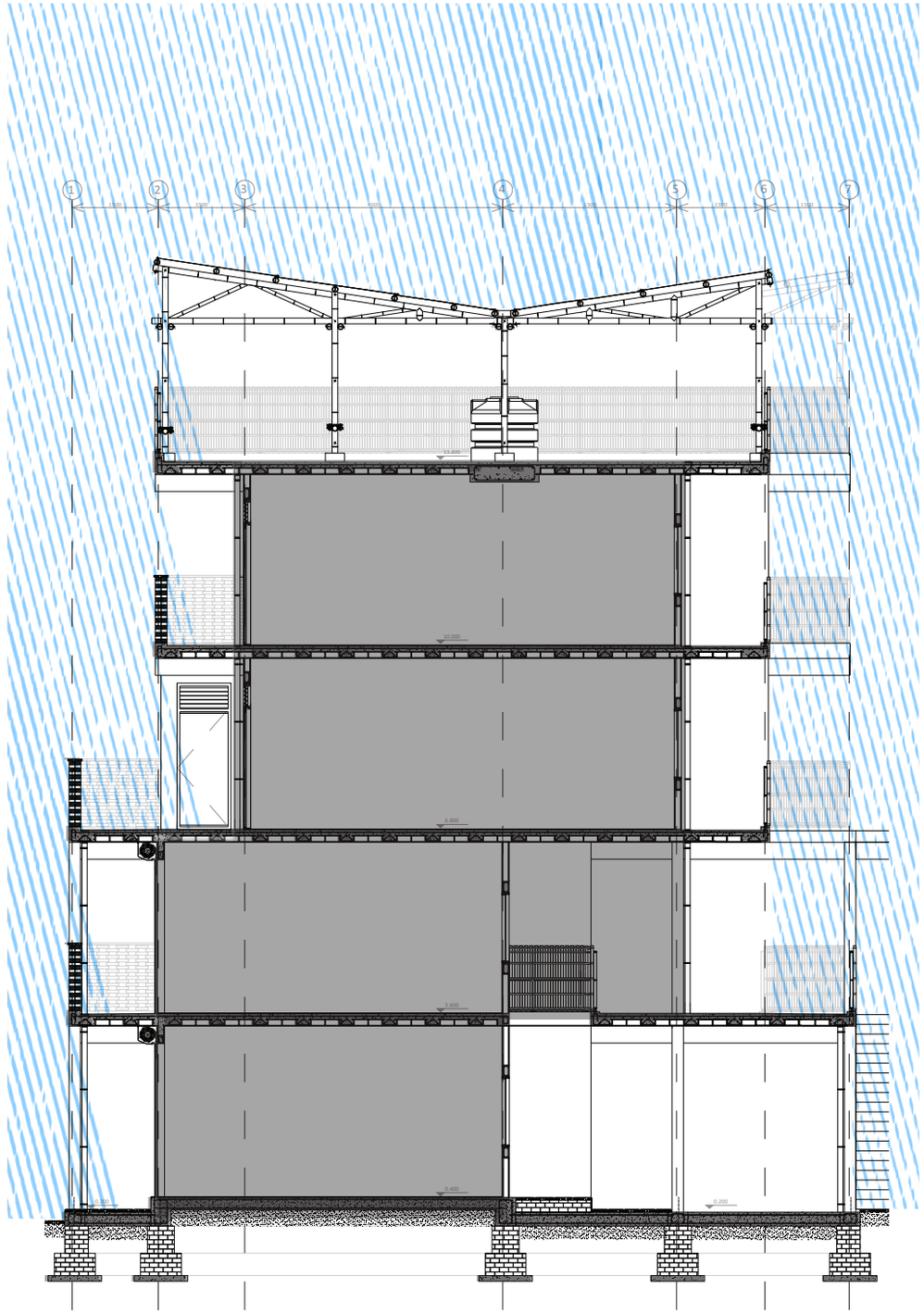


Hours of Sunlight per Month (2016)

Diagram Source: (Class Research 2019, 211)

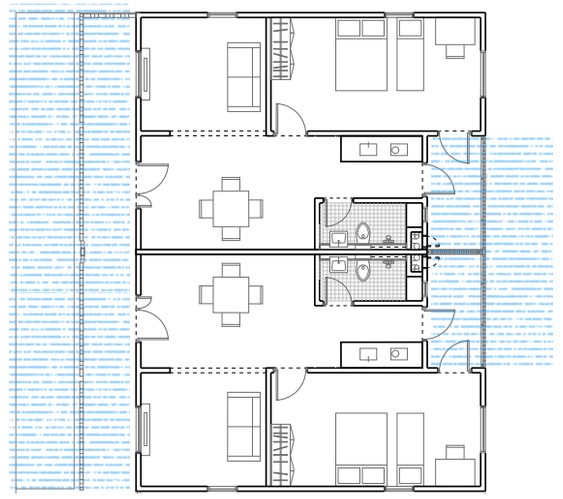
India covers an extensive area which covers different climate between north and south. Located in the western coast of India by the channels of the Arabian sea, Mumbai's climate is characterized by moderably hot weather and high level of humidity. There are two major seasons, a wet monsoon season from June to September, and dry and warm days from December to January. Located in the coastal and tropical location, Mumbai's temperature stays mostly constant throughout the year. The amount of sunlight in India is the highest in May, reaching up to 41 degrees celsius, while the minimum can reach 16 degrees celsius in January. (Class Research 2019, 211)

Precipitation in Mumbai is a huge problem in the months of July and August. On average, Mumbai receives 180.7mm per month, and 2169mm of rainfall per year. This situation is worsened by global warming as Indian sea level is rising about 1.3mm per year and precipitation increasing with about 6 to 8% by 2030. (Chandrashekhar 2019) Numerous parts of Mumbai are considered as low elevation zones that are prone to flooding. This results in Mumbai as a highly vulnerable place to climate hazards and underpreviledged people in slums are mostly located in the low lying areas in the city. In the summer months however, Mumbai is facing a water shortage due to lack of rainwater and potable water sources. Efficient collection of rainwater and balanced distribution of rainwater throughout the year are important climate goals to be integrated in the design.



C LIMATE

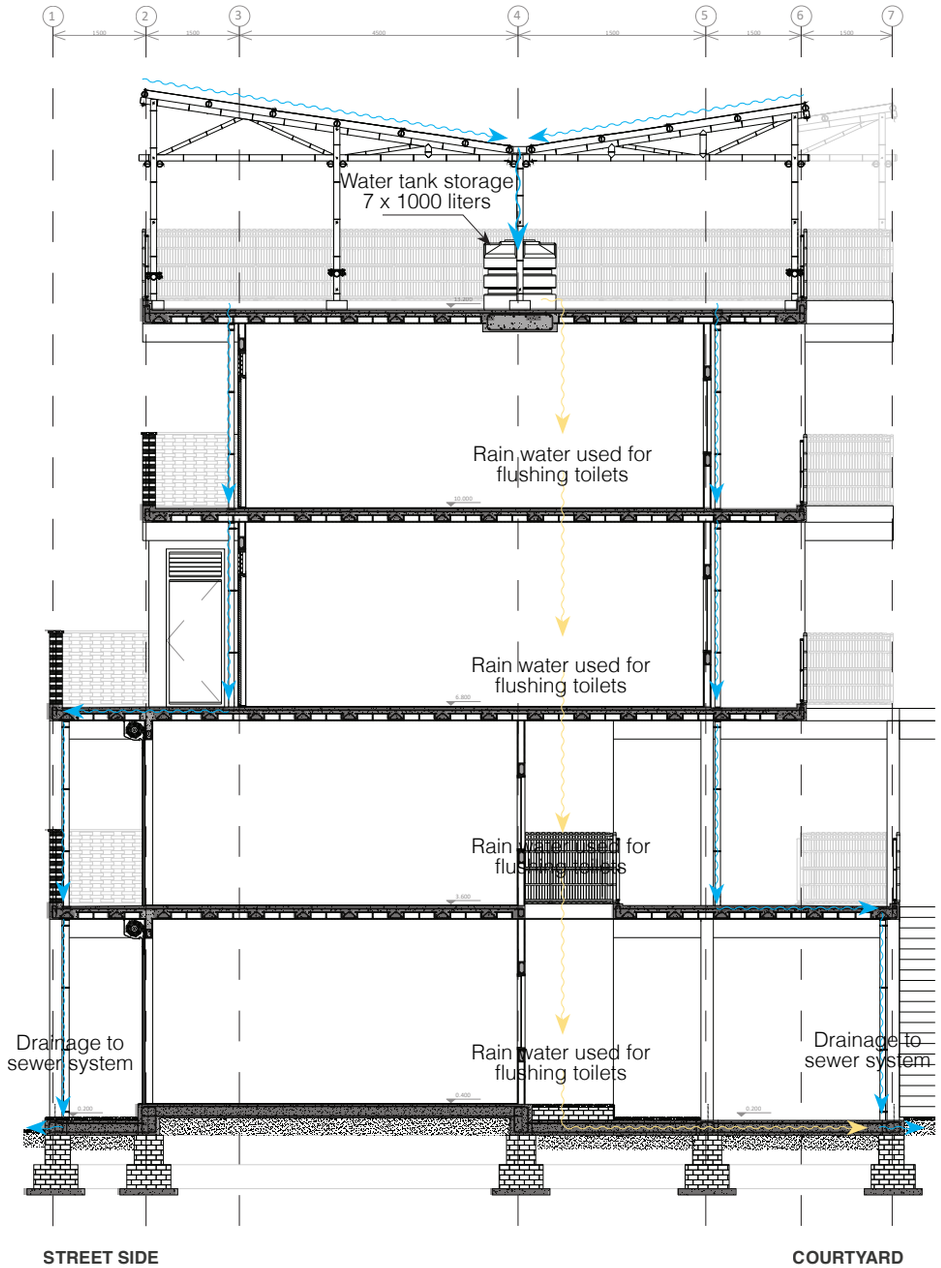
rainwater management

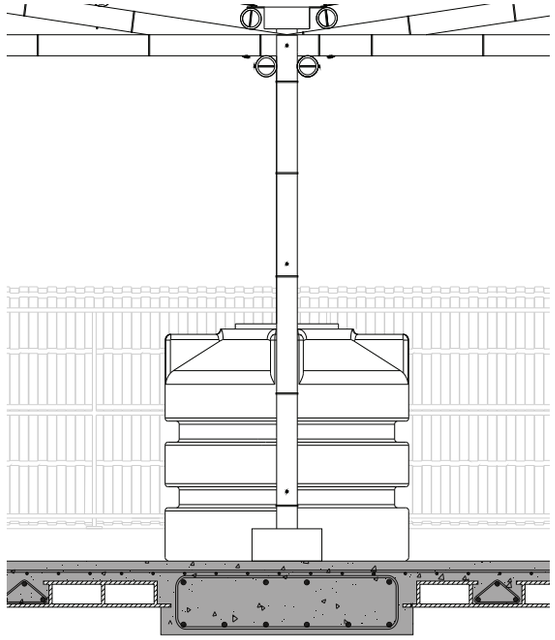


precipitation

UPPER FLOOR UNITS

Having the corridors on the front facade and private balconies on the back facade is that even when it rains, the setback of the dwelling space will become wet as the extended floor level above functions as a canopy. This way, residents are free to keep their doors and windows open in the rainy season without much water reaching the inside. The corridors and balconies have drainage on the outer edges which leads to rainwater to the sewer system. The shop units on ground floor have a higher foundation of 400mm above ground level so that it provides an extra protection from the potential flooding.





3M Module Roof Plan

The inverted roof structure allows the collection of rain-water into the central pipe that is connected to the water tanks on the roof floor. The rainwater stored in the tanks will be used for supplementary greywater for flushing toilets. The water tanks are located on the top so that the water always falls downward into the units and eliminates the need for the mechanical pump to move the water upward.

Although the greywater will be constantly used the tanks whenever it is available, the heavy weight of the water tanks important aspect to tackle. Hence the tanks are evenly spread apart on the roof floor, each of them near to the structural lines of the loadbearing walls and bath-rooms. For an additional reinforcement, extra thickness of concrete right below the tanks will be created all the way across the building, as shown in the detail section above.

C LIMATE

rainwater management



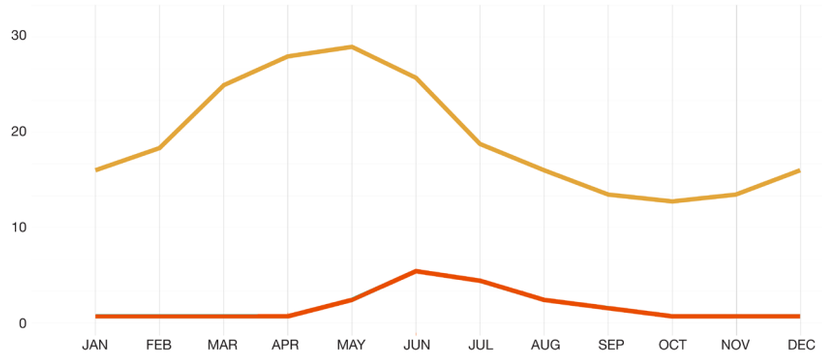




When the water tanks on roof floor are completely filled during the monsoon season, the remaining rainwater will lead down to the ground floor tanks in between the buildings. This water, accessible by simply turning a knob, will be mainly used for watering the plants and cleaning. The ground floor tanks are integrated with a planter and serves as an entrance to the community, while its appropriate height also allows it to be an useful urban furniture, a bench.

The sunken courtyards can transform into a small pond during the monsoon season and creates a different atmosphere inside the community as well.

Maximum and Minimum Wind Speed per Month (2019)



Wind Direction Distribution in Percentage (2019)

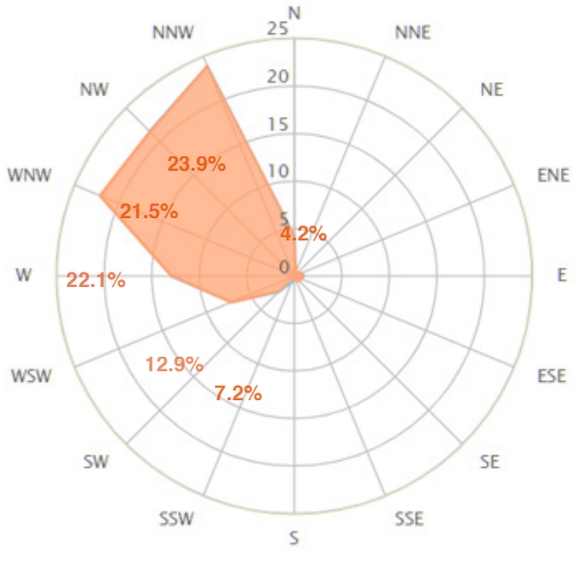


Diagram Source: (Class Research 2019, 210)

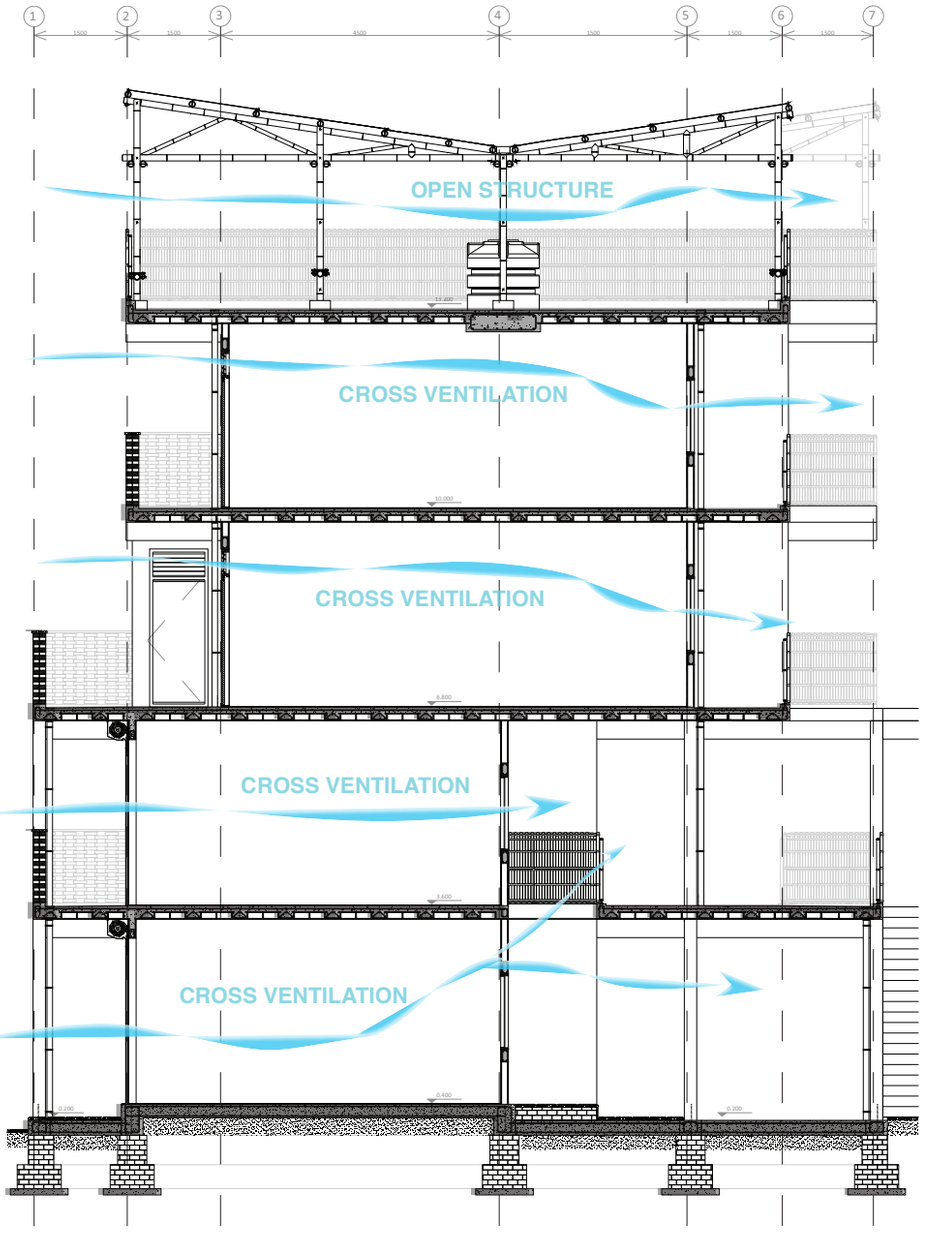
C LIMATE

wind applied in site context



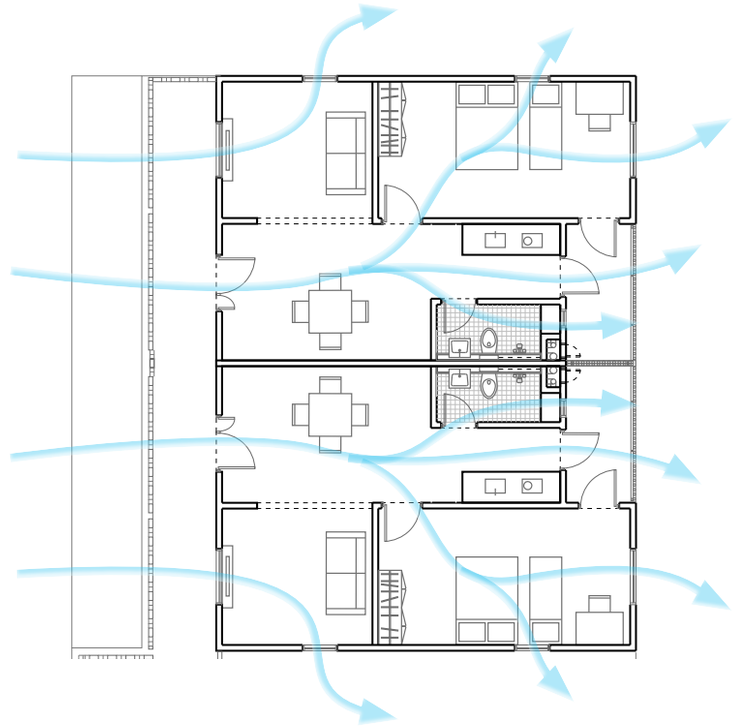
The wet season in Mumbai is also when the wind is the stronger, as the diagrams indicates high wind speed in the months of March to July. In a tropical climate of Mumbai, wind will play an essential role in cooling inside the unit as well as improving its cross ventilation.

As shown in the wind rose above, the prevailing wind direction of Mumbai comes from the northwest. This works well in the urban layout of the design as the wind can fluidly pass through in between the buildings as well as the stairwells.



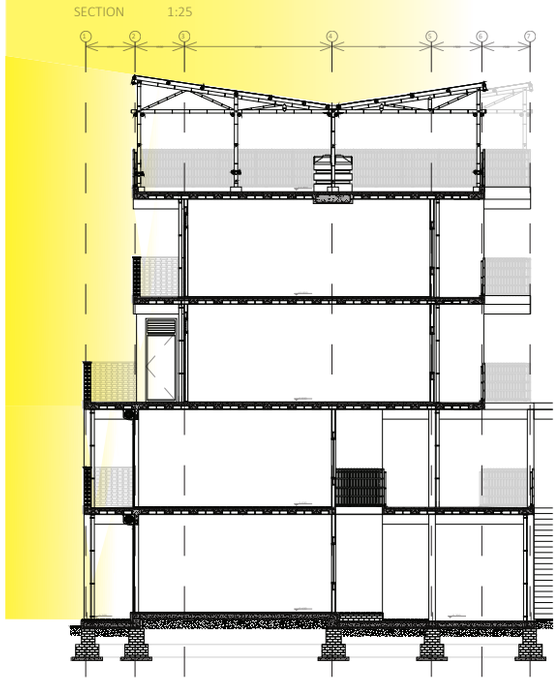
C LIMATE

cross ventilation

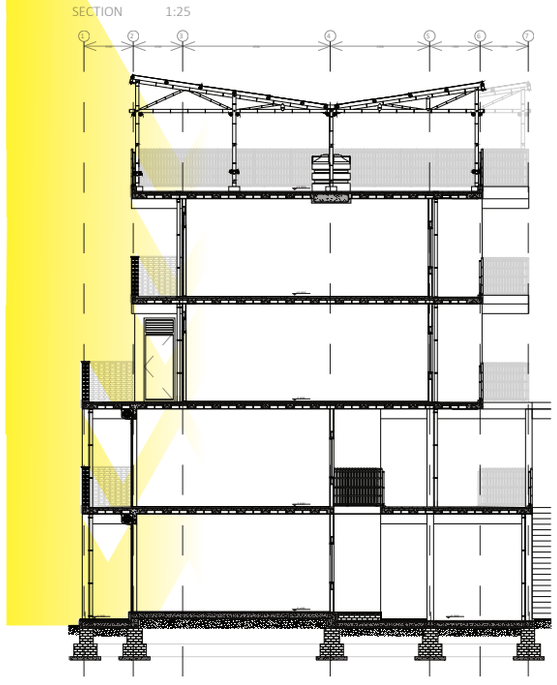


In addition to the urban arrangement of the buildings, cross ventilation is achieved inside the dwellings, as all units have at least one window opening, from one end to the other. The doors near the kitchen have louvers which can always let out exhaust air even when the door is closed. The communal roof floor is an open structure where there is a constant flow of air, making it an ideal place to hang laundry and dry assorted goods.

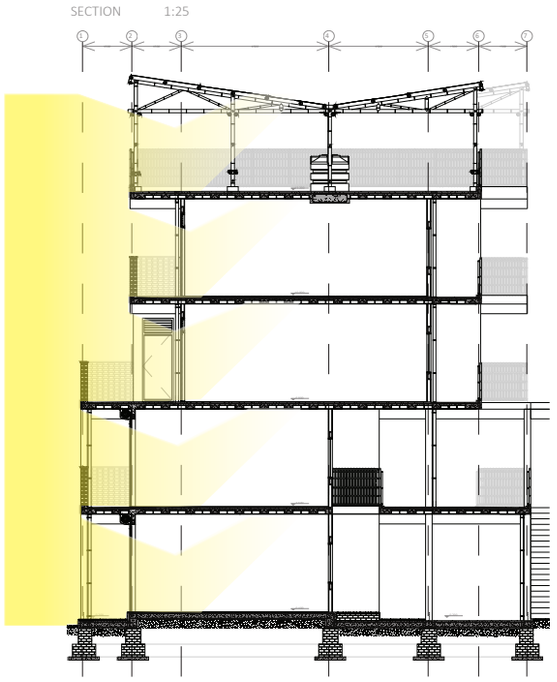
high sun
orientation



mid sun
orientation



low sun
orientation



In order to keep the dwelling units cool in an year-long humid climate, direct sunlight should be avoided. The extended corridors on the front facade functions as a canopy, a buffer to keep the direct heat away from the dwelling when the sun is the highest and strongest.

The balconies on the back facade, provide enough shading during the mid sun orientation. Then in the low sun, the surrounding buildings will block most of the sun, or only the weakened light will be coming into the unit.



6

REFLECTION & CONCLUSION



FUTURE OUTLOOK

fundamental design principles



The aforementioned design outcome using the GFRG panel is not to be considered the ultimate design solution, but as a pilot project that pursues innovative housing design in the lens of the low-income baithi chawl residents and the informal workers in a specific region. Although the design is an outcome of a tangible research which I have carried out throughout the year, I understand that it cannot satisfy every resident's needs and desires as there is simply a vast diversity in people in Nalasopara, Mumbai and India at large. Under the framework of controlled participation and Community Land Trust, the design of the building typologies are open for improvement as the construction carries out in different baithi chawl sites over time. There are certain fundamental elements which needs to stay consistent to keep the main goals of the project: street aligned building. The hiearchy of street which coincides with hiearchy of commercial activity is a fact that will be found in all site conditions and the design must cater for this all throughout the transformations. Second feature in relation to the first element is the distinction between inner community and the outer commercial activities. In order to create a more intimate living environment that residents want to stay in, the design must consider the front and back facade of the building and the programs inside accordingly. Last element is the scalability typologies while maintaining its design character. The project is an affordable housing which must focus on its efficient form and adaptability to different sites, so complications in the details and arrangement should be mitigated in order to realize the building.

REFLECTION

master graduation thesis



This year's global housing studio, Mixing Mumbai, affordable housing for inclusive development, aimed to create an alternative means of affordable housing which tackles the issue of unplanned development of the private developers that displaces the poor in a dense urban context.
I found it helpful the way that the given brief of the studio was specific to start with, and it dealt with a global issue which shows a sense of urgency. To understand the complex issue in an unfamiliar place of Mumbai necessitated an in-depth research on the historical transformations as well as its current situation, which I have learned a lot through textual research. However, looking back, I believe I have had the most impact when visiting Mumbai during the field trip. The prevalence of the urban poor and their living conditions was a very striking experience for me. I was also amazed by the crowded streets full of people, vendors and shops that occupy every corner of the busy road. The unhealthy and precarious conditions of where the low-income people live was also simply unimaginable by physically visiting the spaces.
Within an extensive problem in a complex context, I have decided after the research and site visit phase to narrow down the topic to look through the lens of the informer workers, as predominant population of the urban poor is dependent on informal work. My personal observation was that low income people often incorporate living and working, and it was a natural decision to consider income generation as a key feature in the dwelling in Nalasopara.
Overall the process of defining my graduation topic from the studio topic was rather smooth, as the problems were evident and extensive. However, I was afraid that many of the students have overlapping themes, and consequently similar designs, so I have tried to distinguish to what I want to achieve throughout the design phases.

REFLECTION

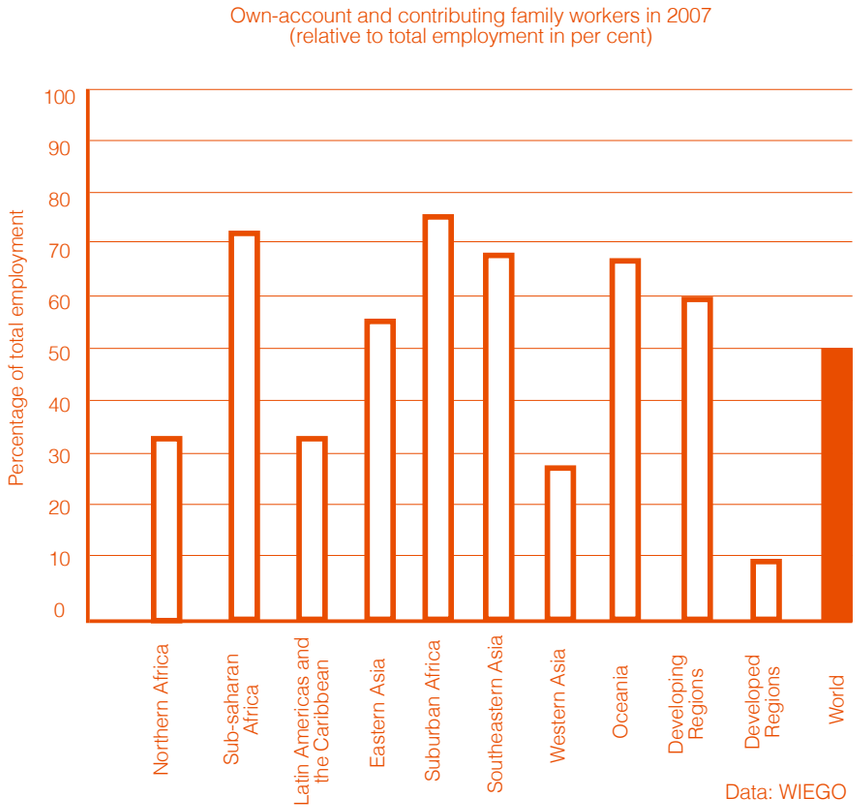
social, professional, scientific relevance



Urbanization and globalization have resulted in more than half of the world's population living in the cites. In India, population will exceed 1.6 billion people by 2050, half of whom will be residing in urban centers. Mumbai, a commercial capital of India, especially experienced an exponential growth of population from rural-urban migrations of people in search of numerous aspirations from the city over the last decade. Unfortunately, its employment growth in the formal sector is unable to keep up with the overflowing workforce which was constantly filled by the informal sector. The informalization continues to expand as the restrictive labor regulations and increasing competition promotes subcontract hiring. Consequently, of the 68% of the total non-agricultural workforce in Mumbai is employed in the informal sector, and livelihoods of over 400 million workers and their families in the entire India is depend on it.
Without doubt, the informal sector is the backbone of the India's economy. Despite the myths that informal sector is temporary and marginally productive, informal economy is permanent and expanding in line with the formal economy – it produces with and trades with and provide services to the formal economy, producing up to two-thirds of its GDP. Despite its significant contribution, the dominant narratives continue to label the informal sector as illegal, and it is reflected in the city planning. The informal sector also excluded from the formal sector housing, resulting in 60% (18 million) of the city's population living in slums and informal settlements across the city. This leads to intensifying spatial divisions and inequalities of social classes. The current disadvantages of the informal workers go against the right to work, which Universal Declaration of Human Rights states that everyone have the free choice of employment, favorable conditions of work and protection against unemployment.

REFLECTION

social, professional, scientific relevance



The informal workers does not only pertains to India but they are also prevalent around the world, and they face harsh realities in their everyday life. As number 11 of United Nation's Sustainable Development Goal expresses, sustainable cities and communities can be achieved by ensuring access to adequate, secure and affordable housing and basic services.31 Increasing the capacity for integrated participatory planning and management can also enhance sustainable human settlement and inclusive urbanization at large.32 Through collaborative effort and engagement of the informal workers in the design and planning process, a more flexible dwelling types can be created and basic rights such as access to public space and public services can be provided. Ultimately, the empowerment of the informal sector will be able to not only benefit the workers themselves but also enable the economy itself to flourish. Source: ("About the Sustainable Development Goals")



Sustainability Development Goals

REFLECTION

ethical issues



Understanding the harsh realities of the urban poor in Mumbai was an eye-opening experience all the way from the contextual to design research. I have come to realize that the definition of the informal economy is far more extensive than it sounds, as it is deeply integrated into the economic cycle that we cannot sustain without, especially in India. The urgency of the housing shortage for these people also became clear to me as the displacement of the urban poor in Mumbai is evident in a place like Nalasopara where the density of the illegal private redevelopment is inhumane. Choosing the informal sector as the specific interest in affordable housing was not a difficult one as I grasped on to its scope of prominence. However, realizing the diverse makeup of the workers and different lifestyles, I faced challenges defining what are some spatial features I can implement into the design in a systematic manner.

When elaborating the design, one of the biggest challenges was understanding the sense of scale of space for the urban poor. For the majority of the low income groups in Mumbai, every inch of space is a precious living and working space. Our definition of a small room can easily become a dwelling for a family of five in Mumbai. Efficient use of space, and providing the flexibility to appropriate and expand was a key finding from the observations.

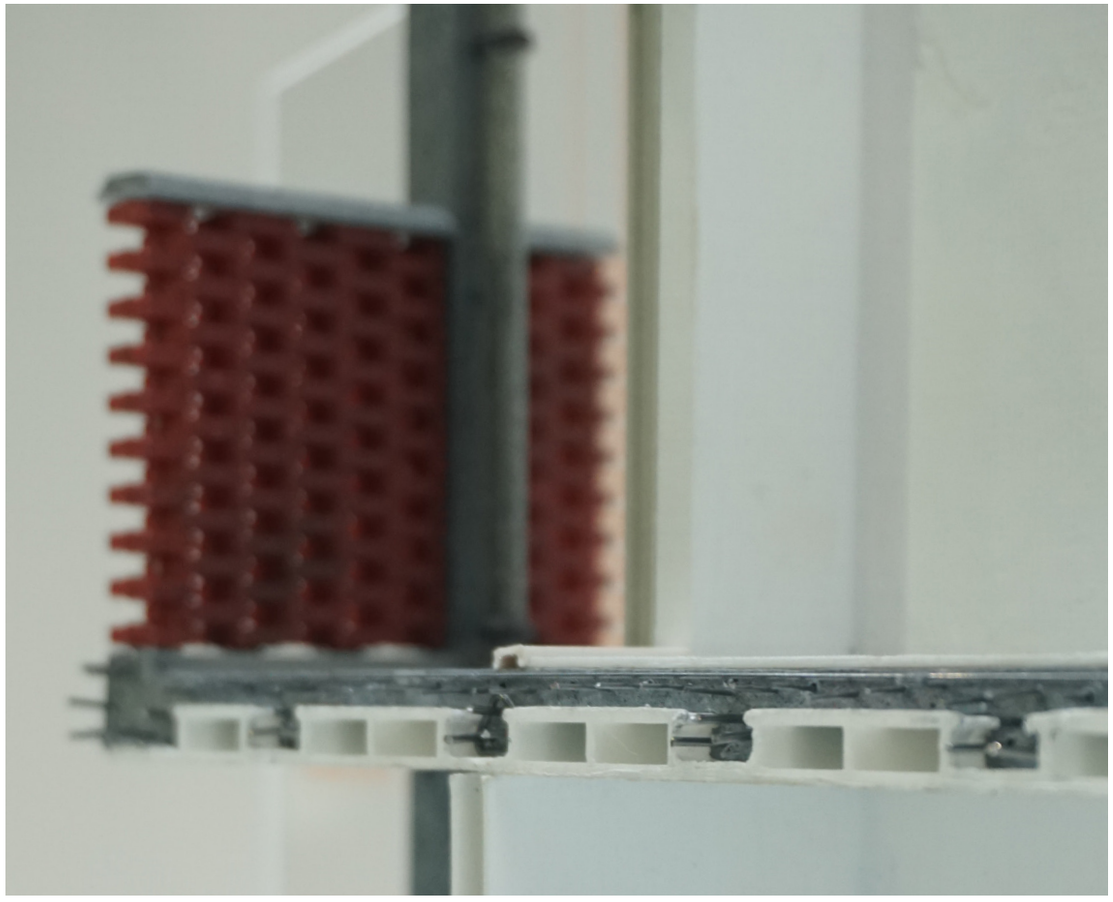
The site which I have chosen in Nalasopara is remaining clusters of ground storey Baithi chawls surrounded by a dense redeveloped five-storey buildings. It was challenging for me to find the right scale of a unit module in this context which can be a better condition in both inside and outside the dwelling.

Second design challenge I have encountered was to implement an unconventional building material which is not yet extensively practiced in India. From the early phase, I have chosen to use glass fibre reinforced gypsum (GFRG) panels as both of my loadbearing and non-loadbearing structure due to its affordable, efficient and



REFLECTION

potential applications of the results



sustainable qualities. It was indeed an interesting journey to learn a construction system which I am not familiar of. Although it was difficult in the beginning to find enough design references of the GFRG panels due to the lack of research materials, yet it also provided freedom for me to explore different means to express the design architecturally with specific design intentions. The general feedback on this decision of the material has been positive, but one of the aspects which I tried to keep in mind all throughout the design process was to not allow the modular system to impose a rigid and sterile atmosphere that do not reflect on the fluid practices of the inhabitants. I tried to overcome this by incorporating different materials that bring warmth and allowing spaces meant for future appropriation, which I believe turned out to be successful. Considering its practical construction and design value, I believe my design outcome has great potential in its actual application in practice in Mumbai. The design features a simple modular system which can not only meet the needs of the cost of affordable housing and provides a speedy solution to the housing shortage. Also more importantly, the design also caters for the specific needs of the masses of informal workers by integrating the street in income as well as generating spaces for a collaborative community. As a designer, I imagine the impact of the sense of collectivity will be able to trigger the sense of empowerment as they will work together in designated areas with sufficient space, light and ventilation, as well as acquire the rights to make adjustments to the provided frameworks in addition to the dwellings for their individual needs. The issue of the wealth disparity and profit-oriented low income housing in Mumbai is too vast to be solved with a single solution, yet I believe this design consideration will bring a step forward in raising awareness of the influence of the informal workers and a new outlook on what affordable housing can become with an emerging material.

"About the Sustainable Development Goals - United Nations Sustainable Development." United Nations. United Nations. Accessed January 18, 2019. https://www.un.org/sustainabledevelopment/sustainable-development-goals/.

"Aranya Community Housing, Indore, India." MIT Incremental Housing, n.d. http://web.mit.edu/incrementalhousing/articlesPhotographs/pdfs/aranya-3-Details1146.pdf.

Attarwala, M. Glass Fibre Reinforced Gypsum (GFRG) Panel. December 2016, https://www.slideshare.net/ssa43/glass-fiber-reinforced-gypsum-gfrg-panel. Powerpoint Presentation.

Bahga, Sanyam, and Gaurav Raheja. "An Account of Critical Regionalism in Diverse Building Types in Postcolonial Indian Architecture." Frontiers of Architectural Research 7, no. 4 (October 2018): 473–96. https://doi.org/10.1016/j.foar.2018.09.001.

Basu, Ranjeeta and Marie D. Thomas. 2009. ''Exploring women's daily lives and participation in the informal labour market in Mumbai, India'' Gender & Development Vol. 17 , Iss. 2.

"Bouwgroepen (CPO)." Ik bouw in Den Haag. Accessed January 16, 2019. https://www.ikbouwindenhaag.nl/bouwgroepen/bouwgroepen-cpo.htm.

Chalana, Manish. "Slumdogs vs. Millionaires." Journal of Architectural Education 63, no. 2 (2010): 25-37.

Chandrashekhar, Vaishnavi. "As the Monsoon and Climate Shift, India Faces Worsening Floods." Yale Environment 360. Yale School of Forestry & Environmental Studies, September 17, 2019. https://e360.yale.edu/features/as-the-monsoon-and-climate-shift-india-faces-worsening-floods.

Chen, Martha Alter. "Rethinking the Informal Economy: Linkages with the Formal Economy and the Formal Regulatory Environment." Linking the Formal and Informal Economy, January 2006, 75–92. https://doi.org/10.1093/0199204764.003.0005.

Chen, Martha Alter. "The Informal Economy." NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy 26, no. 2 (2016): 155–72. https://doi.org/10.1177/1048291116652613.

Cherian, Philip, Shinto Paul, S. R. Gouri Krishna, Devdas Menon, and A Meher Prasad. "Mass Housing Using GFRG Panels: A Sustainable, Rapid and Affordable Solution." Journal of The Institution of Engineers (India): Series A 98, no. 1-2 (June 14, 2017): 95–100. https://doi.org/10.1007/s40030-017-0200-8.

Class Research. "Hard & Soft Data and Urban Form & Housing" Mumbai: A Periodical Investigation, Global Housing Studio, 2019.

Class Research. "Mixing Mumbai" Affordable Housing for Inclusive Development, Global Housing Studio, 2018.

"Community Land Trust Model Best Suited to Reinvent Dharavi." The Hindu. The Hindu, September 16, 2017. https://www.thehindu.com/news/cities/mumbai/community-land-trust-model-best-suited-to-reinvent-dharavi/article19700938.ece.

"Compendium of Prospective Emerging Technologies for Mass Housing." Government of India, n.d.

Contractor, Qudsiya, Neha Madhiwalla, and Meena Gopal. Uprooted Homes, Uprooted Lives: A Study of the Impact of Involuntary Resettlement of a Slum Community in Mumbai. Mumbai: Centre for Enquiry into Health and Allied Themes, 2006.

Das, P.K., Gurbir Singh, Ritu Dewan, and Kabir Agarwal. Chasing the Affordable Dream: A Plan to House Mumbai's Millions. Mumbai: Bombaykala Books, 2018.

Dinh, Trung. "Bamboo Architecture Precedent Research, 2018." November 12, 2018. https://issuu.com/trungdinhbao1994/docs/bamboo_architecture_precedent_bookl.

Dömer, Klaus, Hans Drexler, and Joachim Schultz-Granberg. Affordable Living Housing for Everyone. Berlin: Jovis Berlin, 2014.

Elsaeed, Mohamed S.M. "COST MODEL FOR USING GLASS FIBRE REINFORCED GYPSUM SYSTEM (GFRG)." International Journal of Development and Economic Sustainability 4, no. 3 (June 2016): 33–47. http://www.eajournals.org/wp-content/uploads/Cost-Model-for-Using-Glass-Fibre-Reinforced-Gypsum-System-GFRG.pdf.

"Glass Fibre Reinforced Gypsum Panel System." Performance Appraisal Certification, no. 1 (May 31, 2012): 1–45.

Glass Fibre Reinforced Gypsum (GFRG) Wall Panel Construction Manual, n.d., 1–108. http://www.frbl.co.in/cm.pdf.

Government of India. Ministry of Housing & Urban Poverty Alleviation. *Compendium of Prospective Emerging Technologies for Mass Housing*. Building Materials & Technology Promotion Council.

Government of India. Ministry of Housing & Urban Poverty Alleviation. *GFRG Building, Structural Design Manual*. IIT Madras: Structural Engineering Division Department of Civil Engineering, 2012.

"Gifu Kitagata Apartment Building." AFASIAARCHZINE.COM, December 23, 2011. https://afasiaarchzine.com/2011/12/sanaa-18/.

Gross, Tandiwe and Kharate, Amar, Organizing the Invisible - Strategies of Informal Garment Workers in Mumbai. Berlin: Global Labour University, 2017.

Heringer, Anna. "Handmade School in Bangladesh." Archello. Anna Heringer Architecture, 2007. https://archello.com/project/handmade-school-in-bangladesh.

IIT Madras. "Rapid Affordable Mass Housing Using GFRG Wall Panels. Prof. Devadas Menon & Pr, IIT Madreas" Youtube. Video File. January 5, 2014. https://www.youtube.com/watch?v=_hTp2VGVPyA&t=53s.

"India Population 2019." India Population 2019 (Demographics, Maps, Graphs). Accessed October 30, 2019. http://worldpopulationreview.com/countries/india-population/.

"Informal Sector: Customer Profiles in Mumbai." Micro Housing Finance Corporation Limited. Accessed June 15, 2019. http://www.mhfcindia.com/Mumbai Informal Sector Stories.pdf.

Kumar, Gudipati R. "An Analysis on the Role of India's Informal Economy." The Hans India. July 14, 2017. https://www.thehansindia.com/posts/index/Young-Hans/2017-07-14/An-analysis-on-the-role-of-Indias-informal-economy/312388. (Accessed December 14, 2018).

Livios. Accessed October 30, 2019. https://www.livios.be/nl/bouwinformatie/techniek/sanitair-en-water/regenwater/rekenvoorbeeld-regenwaterrecuperatie/.w

Matias, Rahul. "Tool-House Case Study: The Urbz Office." Urbz. May 21, 2012. Accessed January 05, 2019. http://www.urbz.net/articles/tool-house-case-study-urbz-office.

Mehrotra, Rahul. "Negotiating the Static and Kinetic Cities." In Other Cities, Other Worlds: Urban Imaginaries in a Globalizing Age, 205–18. Durham and London: Duke University Press, 2008.

Montiel, Rozana. "Gallery of From the Territory to the Inhabitant / Rozana Montiel: Estudio De Arquitectura - 4." ArchDaily. Estudio de Arquitectura, July 11, 2019. https://www.archdaily.com/921604/from-the-territory-to-the-inhabitant-rozana-montiel-estudio-de-arquitectura.

Mori, Alejandro Aravena, and Iacobelli Andrés. Elemental: Manual De Vivienda Incremental y diseño Participativo = Incremental Housing and Participatory Design Manual. Ostfildern, Germany: Hatje Cantz, 2016.

Padora, Sameep, Maitri Dore, and Mythili Shetty. In the Name of Housing: a Study of 11 Projects in Mumbai. Mumbai: Urban Design Research Institute, 2016.

Patel, Shirish B. "Dharavi: Makeover or Takeover?" Economic & Political Weekly XLV, no. 20 (June 12, 2010): 47–54. https://www.jstor.org/stable/40738495.

Paul, Shinto. "Use of Glass Fibre Reinforced Gypsum Panels with Reinforced Concrete Infills for Construction of Walls and Slabs." Indian Concrete Journal, December 2016.

"PVC Membrane | Tensile Membrane Structure Materials." PFEIFER Fabritec, n.d. https://fabritecstructures.com/tensile-membrane-structure-resources/tension-fabric-structure-materials/pvc-membrane/.

Raveendran,, Govindan, et al. "Home-Based Workers in India: Statistics and Trends." WIEGO Statistical Brief, vol. 10, Dec. 2013, pp. 1–9., https://www.wiego.org/publications/home-based-workers-india-statistics-and-trends.

Roy, Ananya, and Nezar AlSayyad. Urban Informality: Transnational Perspectives from the Middle East, Latin America, and South Asia. Lanham, MD: Lexington Books, 2004.

Rybczynski, Witold., How the other half builds. Montreal: McGill University, 1984.

Sarwal, Karan., Tarisma The spirit of Tara. Noida: Creative Concept. 2011.

Sengupta, Urmi. "NEW FRONTIERS AND CHALLENGES FOR AFFORDABLE HOUSING PROVISION IN INDIA," n.d.

Tapia, Daniel. "Superlofts Blok Y / Marc Koehler Architects." ArchDaily. ArchDaily, July 19, 2018. https://www.archdaily.com/898293/superlofts-blok-y-marc-koehler-architects.

Turner, John F. C., and Colin Ward. Housing by People: towards Autonomy in Building Environments. New York: Marion Boyars, 2017.

Unni, Jeemol, and Suma Scaria. "Government Structure and Labour Market Outcomes in Garment Embellishment Chains." Indian Journal of Labour Economics, vol. 52, no. 4, Jan. 2009, pp. 631–650., https://www.researchgate.net/publication/254412642.

