SHONATOLA LOW-COST HOUSING

architecture for the people

RENS VAN POPPEL

INCREMENTAL ARCHITECTURE,
URBANISM, AND FLOOD-RESILIENCE
AS AN ANSWER TO RAPID
URBANISATION

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GRADUATION REPORT
Shonatola Low-Cost Housing: Architecture for the People
01-07-2025
TU Delft
MSc Architecture, Urbanism and Building Sciences
architecture track

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AR3AD105, AR4AD105
MSc 3/MSc 4 Dwelling Graduation Studio
Global Housing: Architecture of Transition in the Bangladesh Delta

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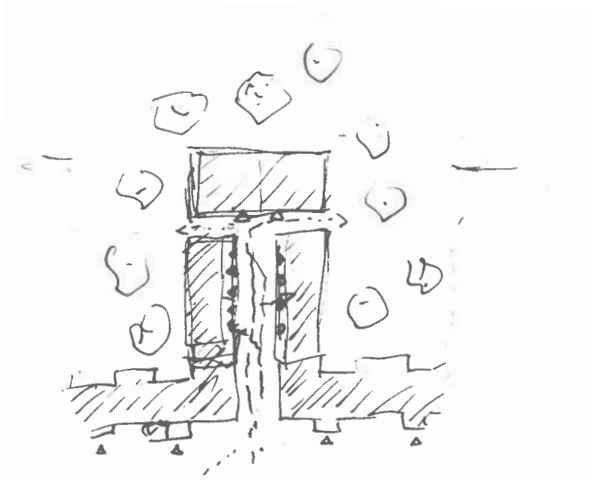

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Preface

INTRODUCTION AND ACKNOWLEDGEMENTS

This graduation booklet is the final product of the TU Delft graduation studio Global Housing: Architecture of Transition in the Bangladesh Delta. It is the documentation of my thesis project, consisting of a research and design proposal developed over the course of a year.

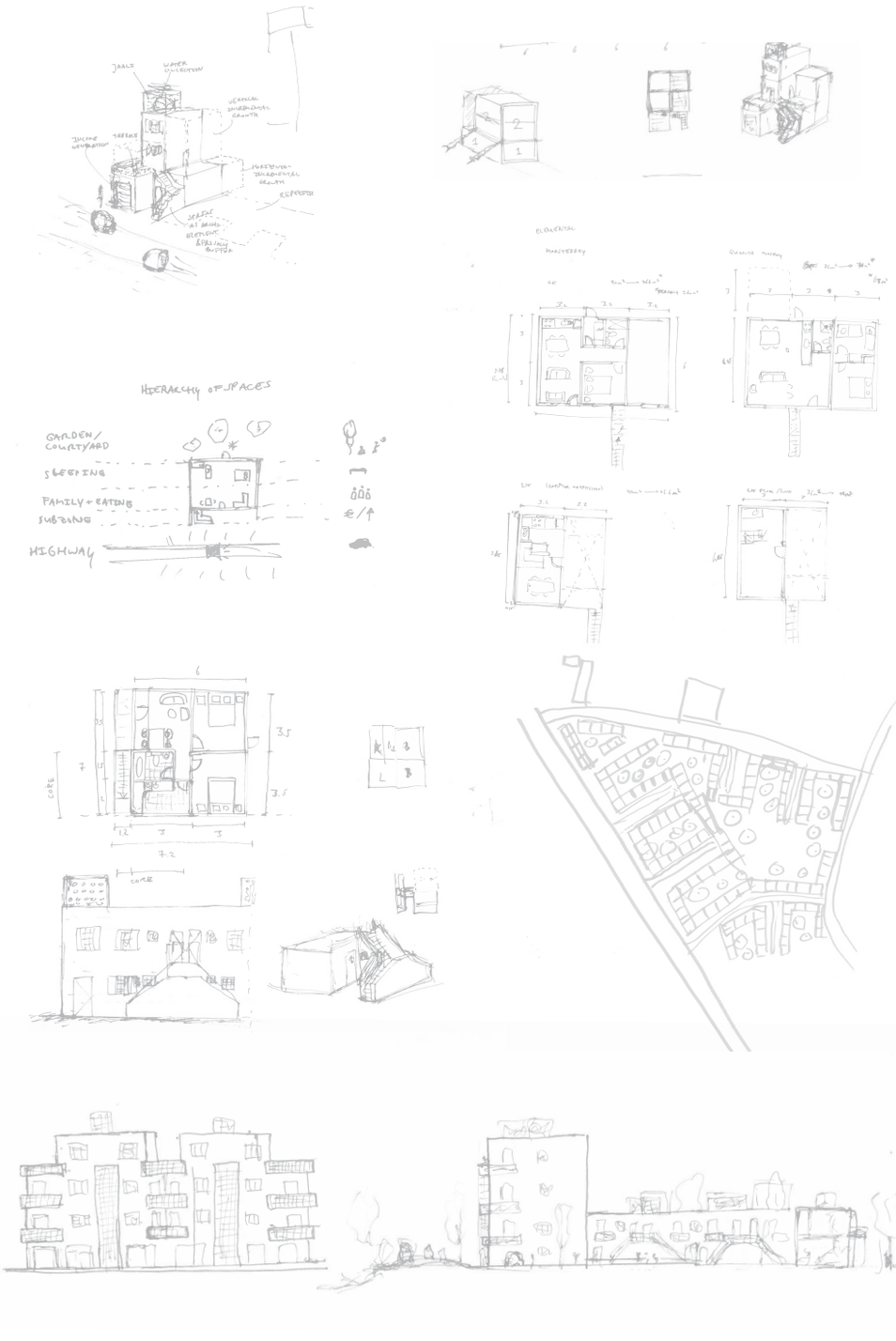
I had the privilege of being part of the research group on solutions for rapid urbanisation, affordable housing, and climate resilience in Bangladesh. In December 2024 we visited Bangladesh to conduct our field research, supported by our tutors and the local SUST university.

Visiting Bangladesh and developing this project was a significant experience. To work on urgent global matters was a confronting, but deeply meaningful experience. The incredible kindness and resilience of the people in Bangladesh, despite the harsh realities of slum-living, left a lasting impression on me.

Discovering the philosophies of B.V. Doshi and Charles Correa reshaped my understanding of the city and how we can make a valuable contribution to it as architects, urbanists, developers, researchers, and residents. Again, this is something I will take with me in my professional career.

I would like to thank my friends and family for their support during this project. A special thanks goes to my tutors, Rohan Varma, Marina Tabassum, Rocio Conesa Sánchez, Frederique van Andel and Nelson Mota. Through their expertise, I was able to further develop my skills in the built environment in unique global contexts.

I hope you find this research as insightful and engaging to read as it was for me to create.



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Part I

RESEARCH

I. THE PROBLEM

Shonatola Low-Cost Housing
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Problem statement

THE PROBLEM

The UN predicts that 70 per cent of the world will be urbanised by 2050. By then, three billion people will live in informal settlements. Research is needed on how to cope with these trends to make cities and human settlements inclusive, safe, resilient and sustainable (United Nations Statistics Division, 2023). With a population of roughly 173 million people and an area of 148.460 km², Bangladesh is one of the densest countries in the world (Bangladesh Bureau of Statistics, 2024). Yet, it is also one of the countries most stricken by climate change. Largely consisting of a flat river delta in a tropical monsoon climate, Bangladesh is extremely vulnerable to flooding. Major weather events torment the country and lead to the destruction of homes and the displacement of millions, further causing migration to urban areas. Due to this climate-induced urbanisation, Bangladesh's major cities are overflowing, leading to informal settlements all across the country.

Next to the capital Dhaka, second-tier cities will especially see a massive influx in immigration. The division of Sylhet is in the northeast of Bangladesh and has a population of about 11 million people, of which the regional capital city of the same name houses 700.000. 27 per cent live in one of the 754 city slums (Pal & Hussain, 2016), known for their inadequate housing and the lack of infrastructure, drinking water and basic amenities. Furthermore, the Sylhet division is extremely prone to flooding, with 80 per cent of Sylhet submerged under water in 2022 (Bangladesh Red Crescent Society, 2022).

Bangladesh's unique context, distinguished by climate-induced rapid urbanisation and overflowing cities, calls for immediate research. At first glance, the situation may seem somewhat unique for the Bengali climate. Yet, with the consequences of climate change intensifying, the same problem will likely occur in countless places across the globe over the coming decades.

The issues with informal settlements and rapid urbanisation show that mass housing schemes that fit flood-susceptible areas are needed. Incremental housing strategies seem most probable in coping with the lack of adequate housing, but little to no research has been done on how a context-specific, large-scale incremental strategy can be adapted to implement flood-resilience measures, while still coping with the financial and minimal constraints of the strategy.

Informal settlement in Sylhet, high-rise in background (own work)

Theoretical framework

THE PROBLEM

Out of the existing incremental housing strategies, a combination of theories into an adapted, incremental housing scheme seems the best fit for the context of Sylhet. As for the sites-and-services plans proposed by Caminos and Goethert (1978), I largely agree with the criticisms of Doshi and Correa. Moreover, the Aranya and Belapur projects seem a better fit for the Bengali context. Yet, with the huge influx of migrants and the current size of informal settlements in Bangladesh, an even more scaled-up approach may be needed that relies more on auto-construction and slum upgrading, while still employing several examples of the evolutionary houses like PREVI-Lima. This will provide a typology mix, which is also pivotal in creating pleasant urban spaces.

Another argument for an adapted version in the Sylhet context is that the success of each incremental project differs hugely depending on context: a global framework does not exist and is improbable (Bredenoord et al., 2014; Caldeira, 2016).

Furthermore, accepting auto-construction as the most accessible and affordable form of housing for the urban poor is pivotal (Bhan, 2019; Bredenoord et al., 2014). Enough cases in the global South demonstrate the success of such implementations (Neuwirth, 2005). Even though this may lead to what Ananya Roy (2004) calls "the ideology of space" and the "aestheticisation of poverty", I feel this strategy is still best. I do agree though, that the problem of poverty and informal settlements goes much further than architecture, being based more on socioeconomic aspects. Yet, I feel good governance and design may still contribute to a solution, as long as they are given enough time. By combining incremental strategies such as the core-house, sites-and-services and (in-situ) slum upgrading, a larger strategy that fits with the Bengali context and its lack of adequate housing can be created.

A combination of the research of Correa and Elemental provide proper starting points for incremental design guidelines. Combined with knowledge from case studies and management principles, these could lead to a model for Sylhet, Bangladesh.

The literature on flooding discusses rural and urban responses to flooding, yet many of the examples are not focussed on the material and construction scale in the urban context. The material and construction principles are researched in rural cases, and although several of these principles can also be applied in a denser, urban context, instances such as space, material availability, and incremental measures are not discussed as much. Research on flood resilience measures in urban contexts, is often on a larger scale for citywide approaches, largely leaving out the architectural design within the urban fabric on the scale of the dwelling and the neighbourhood.

Floods submerged many houses on the Char Bara Dhul, a riverside village, leaving many residents marooned (Asif Mahmud & WFP, n.d.)

Research question

THE PROBLEM

My research aims to answer the question:

How can incremental housing strategies be made site-specific and suited to the flood-susceptible context of Sylhet to create affordable, context-based housing solutions?

This leads to the following subquestions:

What main lessons can be learned from incremental housing projects from the past?

To set up a framework for a successful incremental design strategy, it is crucial to look at projects from the past. Since it takes years before one can truly evaluate the success of an incremental housing strategy, preferably cases of 30+ years of age are analysed. In order to review various innovative strategies, the selection of case studies spans further than the Indian subcontinent, with the majority coming from elsewhere in the Global South. These case studies will be analysed through several main criteria to set up a database. From here, a framework can be set up for an affordable incremental housing strategy.

The main criteria are:

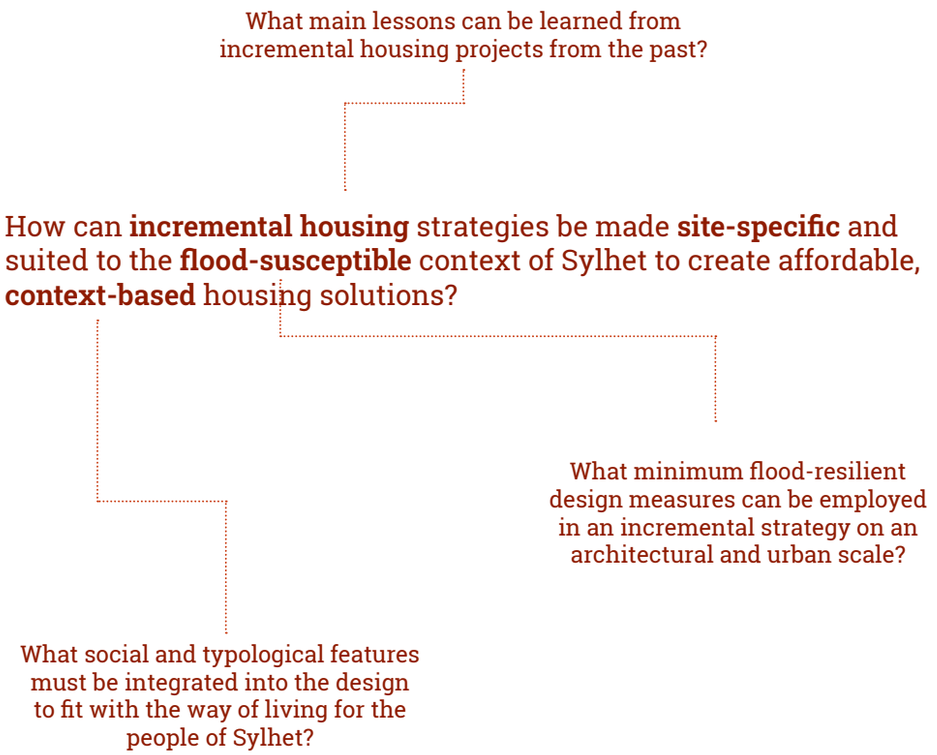
i. *stakeholders;*
ii. *participation and mode of incrementality;*
iii. *architectural design of the unit;*
iv. *urban design;*
v. *typology;*
vi. *material & construction techniques;*
vii. *finance, funding and affordability;*
viii. *governance;*
ix. *FSI, GSI, dw/ha, incremental ratio*

What minimum flood-resilient design measures can be employed in an incremental strategy on an architectural and urban scale?

I further define the framework by researching specific flood-resilience design measures for the Bengali flood-susceptible context. This is done through analysing material and construction measures from manuals on flood-resilient design and vernacular architecture. The flood-resilience aspect focuses on both pluvial and river floodings.

What social and typological features must be integrated into the design to fit with the way of living for the people of Sylhet?

One must understand the way of living to design a successful housing strategy. This encompasses the typology of the single dwelling unit, the urban fabric and ways of living on the neighbourhood scale, as well as the cultural and social aspects.



Methodology

THE PROBLEM

To answer this thesis' main question ***'How can incremental housing strategies be made site-specific and suited to the flood-susceptible context of Sylhet to create affordable, context-based housing solutions?'*** various methods are employed.

What main lessons can be learned from incremental housing projects from the past?

This question will be answered through a case study analysis of several projects, a literature study and interviews with specialists on incremental housing strategies. The case studies will be put together in a database. The case studies currently considered, are:

i. *Aranya Low-Cost Housing, Indore, India, 1989, Balkrishna Doshi*
ii. *Quinta Monroy, Iquique, Chile, 2003, Alejandro Aravena*
iii. *Charkop Sites-and-Services, Mumbai, India, 1980, Vidyadhar Phatak, Alain Bartoud*
i. *Belapur, Navi Mumbai, 1983, Charles Correa*
ii. *PREVI Lima, Peru, 1969, Peter Land*
iii. *Urbanización Caja de Agua, Lima, Peru, 1961, Junta Nacional de la Vivienda*
iv. *Mohammadpur Geneva Camp, Dhaka, Bangladesh, 1971-present, UNHCR*
v. *Jhenaidah Community Upgrading, Jhenaidah, Bangladesh, 2014, Khondaker Hasibul Kabir, Suhailey Farzana, Co.Creation.Architects*
vi. *SPARC, India, Sheela Patel, 1984-present*
vii. *Baan Mankong, CODI, Thailand, 2003-present*

Probably, not all of these case studies will be thoroughly addressed. Specifically, case studies such as Belapur, Aranya and Quinta Monroy are almost overanalysed in current academics. Yet, when simply put in statistics, these are still valuable analyses, considering they are among the most impactful and well-documented case studies in their architectural categories.

Geneva Camp, Jhenaidah, SPARC and Baan Mankong seem somewhat outliers since these are not necessarily designed or built on a large scale. Yet, these projects provide further insights into incrementality through a different, more participatory lens, possibly providing key takeaways for the framework.

The expected output of the case studies will be in the form of a qualitative and quantitive analysis of the projects on aforementioned criteria. Interviews will provide further background and additional insight, leading to diagrams to help steer the incremental housing framework in the right direction.

What minimum flood-resilient design measures can be employed in an incremental strategy on an architectural and urban scale?

This question will be answered through a literature study, studies of existing buildings in Sylhet and judging them on their material and construction qualities, as well as interviews with experts on flood-resilient design. The expected output is a toolbox that adds to the framework on materialisation and construction guidelines.

What social and typological features must be integrated into the design to fit with the way of living for the people of Sylhet?

Interviews and site analysis will help answer this question, with the aim of creating a design that will benefit and fit into the people's lives. By talking with locals, analysing the functional layout of homes and through photographs, this ethnographic approach gives the final set of tools to answer the main question in the form of the design proposal.

Relevance and definitions

THE PROBLEM

RELEVANCE

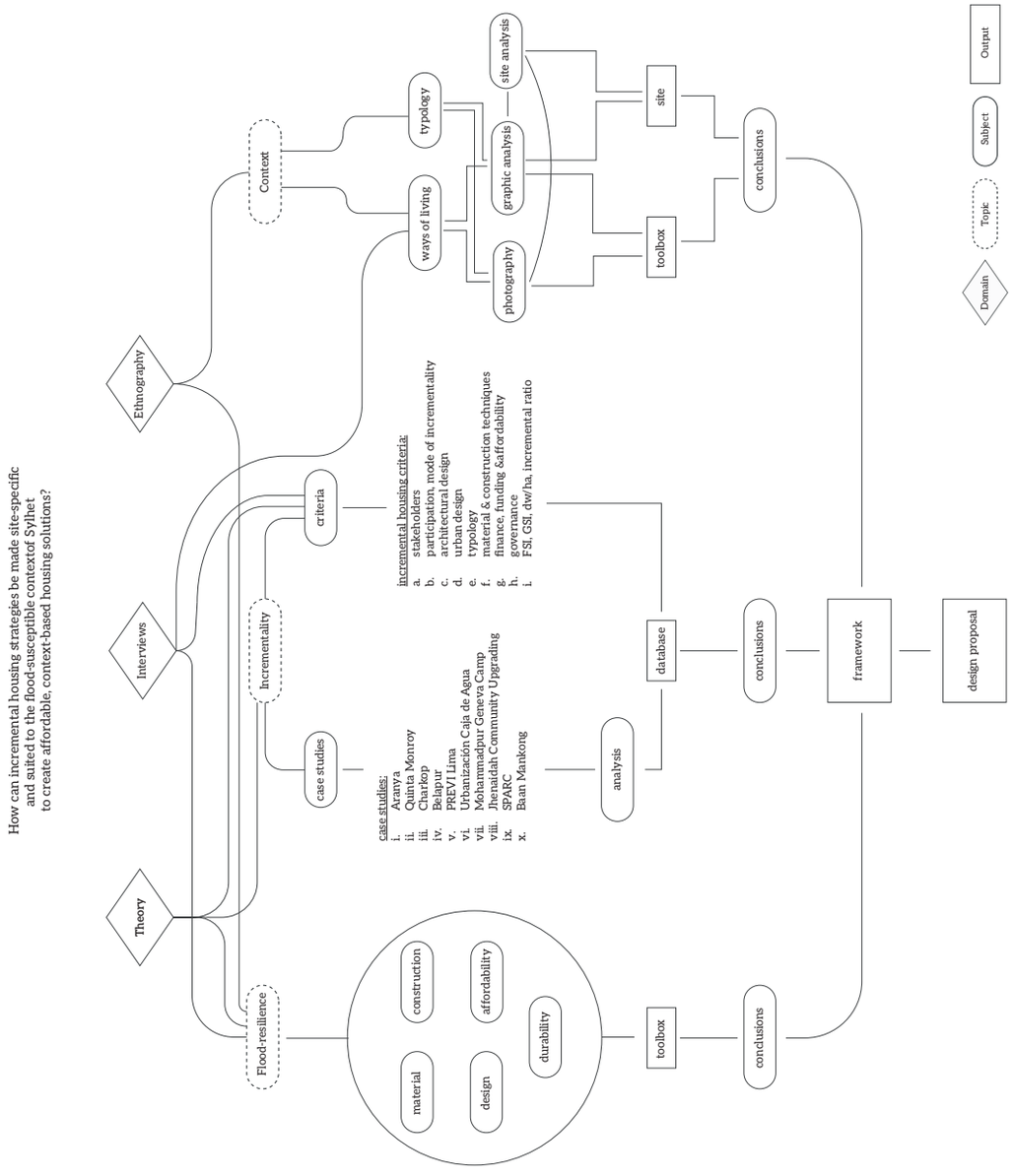
This research is relevant since modern-day scalable incremental housing solutions could help tackle rapid urbanisation and slum forming. Paired with flood-resilience measures, this research provides solutions for Bangladesh and Sylhet. As climate change keeps worsening, this research is also relevant and valuable for other contexts around the world.

DEFINITIONS

Global South
I combine the definitions of Sheppard, Leitner, and Maringati (2012) on Southern residents: "those, everywhere, whose livelihoods have been made precarious by geohistorical processes of colonialism and globalizing capitalism." and that of Oxford Languages dictionary (2024): "the nations of the world which are regarded as having a relatively low level of economic and industrial development, and are typically located to the south of more industrialized nations."

Incremental housing
For this research, Nelson Mota's (2021) definition of incremental housing is used. Mota defines incremental housing as "A conceptual approach to the design of houses that can gradually accommodate vertical and/or horizontal changes and expansions, evolving from the initial configuration in a series of increments over time."

Informal settlement
A piece of land which squatters have claimed and built upon, creating a slum or shantytown. The dwellings lack access to improved water; access to improved sanitation; sufficient living areas; durability of housing; or security of land tenure (United Nations Human Settlements Programme, 2003).



Initial research plan setup

II. LITERATURE REVIEW

Shonatola Low-Cost Housing
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Incrementality

LITERATURE REVIEW

INCREMENTALITY

The past decade, incremental design has been one of the main strategies employed for housing the poor. Since the 1970s, incremental housing has become a key concept for slum mitigation and resettlement programmes. However, even though it is often employed in that field, incremental design is not necessarily a practice only related to the upgrading of informal settlements and affordable housing.

DEFINING INCREMENTALITY

In this research, incremental housing is defined as: "A conceptual approach to the design of houses that can gradually accommodate vertical and/or horizontal changes and expansions, evolving from the initial configuration in a series of increments over time" (Mota, 2021), fitting with the ideology of "housing as a verb" (Turner, 1972). It is this gradual growth over time that makes the incremental design strategy so fit for affordable housing programmes, since this allows for broader financing over a longer period for a yet-to-be-finished product by the dwellers themselves (Bredenoord et al., 2014; Nohn & Goethert, 2017; Wakely & Riley, 2011).

INCREMENTAL HOUSING STRATEGIES THROUGH TIME

Looking at the history of incrementality, incremental design can be divided into a variety of historical categories: the growing house, aided self-help, sites-and-services, evolutionary houses, and expandable houses.

GROWING HOUSE

One of the first cases of incremental design can be found in the works of Leberecht Migge. In 1932, in the middle of a financial crisis, Migge published his book Die wachsende Siedlung nach biol¬ogischen Gesetzen (The growing settlement according to biological laws), in which he argues for a 25 m² core that could grow organically through feasible additions to the house (Haney, 2010; Hochhäusl, 2014). His later collaboration with planner Martin Wagner in an exhibition saw them as leading architects and planners of the Neues Bauen, aiming to alleviate the housing crisis of the 1930s (Wagner, 2016).

AIDED SELF-HELP

Aided self-help approaches were first developed in 1904, with Sweden's national "Own Homes" Loan Fund as a primary example (Harris, 1999). The incremental strategy gained popularity due to the great housing needs during and after the Interbellum. With the help of architects and urbanists like Charles Abrams (1964) and John Turner (1968), aided self-help housing was widely used for global aid by the United Nations and World Bank from 1960 to 1980. Distinct characteristics of aided self-help housing strategies are the minimum resources and financial feasibility of the project, but there must be clear ideas on how one could build and add to their house (Mota, 2021).

SITES-AND-SERVICES AND CORE HOUSING

The incremental sites-and-services strategy derives from the self-help approach.

Here, the emphasis is on the: "interwoven relationship between top-down design of the infrastructure (services) and bottom-up incremental improvement of the houses built on the plots (sites)" (Mota, 2021), combining governmental policies with the empowerment and emancipation of low-income groups.

The dwellings are often core-houses: minimal, serviced, habitable cores (Napier, 2002). Core housing could be viewed as an incremental strategy on its own, but this thesis and other studies would argue it is rather a sub-strategy or umbrella term for the incremental architectural approach since it describes what is initially delivered instead of how the house develops over time and how this process is managed and viewed (therefore, it could also be part of aided self-help, or be used to describe expandable housing).

The key characteristics of any sites-and-services plan are (i) resilient infrastructure, (ii) security of tenure, and (iii) implemented self-help housing. The main difference with the aided self-help approach is that the self-help approach focuses mainly on the scale of the dwelling and communal resources, while the sites-and-services approach designs total new urban districts with a government-developed infrastructural network.

Millions of homes were built in developing countries following the sites-and-services plan, further popularised by Caminos and Goethert (1978), who argued for the approach by stating it is the choice of either providing complete dwellings to the few or to provide basic utilities and services to the many.

THE CORREA AND DOSHI APPROACH

Indian architects Doshi and Correa disliked the sites-and-services approach because of its rigidity. Therefore, they adapted a model in which dwellings were clustered differently, providing a better connection between the urban plan and the houses. The most famous examples of this philosophy are the Aranya Housing project (Doshi) and the Belapur project (Correa).

THE NEW LANDSCAPE

Correa's housing strategies have developed from a deep understanding and theories of the mechanisms of cities. In his book, The New Landscape (Correa, 1989), Correa analyses cities and informal settlements to set up a framework for adequate housing solutions. For instance, Correa argues that economic reasons are the main driver of rural-urban migration. Therefore, adequate infrastructure for transport between job opportunities and housing is crucial for well-functioning neighbourhoods. Additionally, Correa argues for disaggregated, non-centralised, and diverse low-rise housing solutions at a human scale.

Correa summarises these principles in his bills of rights for housing with the principles: incrementality, equity, malleability, open-to-sky spaces, disaggregation, pluralism, participation, and income generation. (Correa, 1989; Varma, 2018).

BILL OF RIGHTS FOR HOUSING

INCREMENTALITY
EQUITY
MALLEABILITY
OPEN-TO-SKY SPACES
DISAGGREGATION
PLURALISM
PARTICIPATION
INCOME GENERATION

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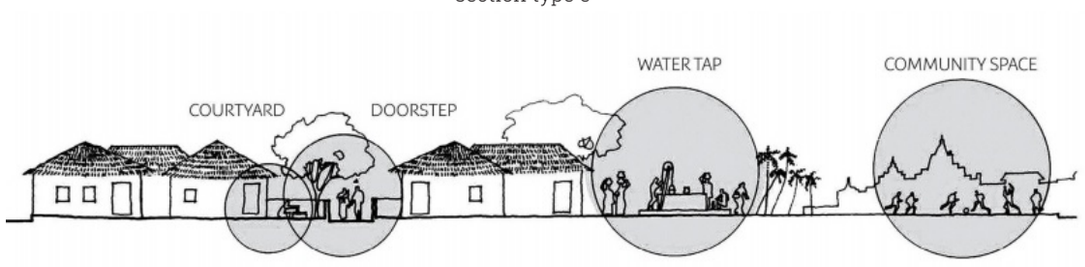


'Hierarchy of spaces' section by Charles Correa, denoting hierarchy of transitional space in the public realm (Correa, 1989)

Additionally, Correa provides examples of cities and neighbourhoods, showcasing their mechanisms and using these as a basis for his urban planning. One of these is the hierarchy of spaces, prevalent in many Indian villages and towns. The smallest and most intimate is the private courtyard. The second space, the doorstep, provides intimacy: children play on the street and neighbours meet one another. Thirdly, neighbourhood meeting spaces, such as the water well, become community-significant sites. The fourth and principal area is used by the entire town or village.

Most notably, the emphasis of Correa his manifesto is not on the architectural design, but on the urban space: good urban design facilitates community and liveable cities. Architecture can change over time. People know how to build a house; the expertise of a designer is mostly needed to shape these urban spaces for thriving cities (Correa, 1989; Varma, 2018).

EVOLUTIONARY HOUSE

Another approach to incrementality is the evolutionary house. This approach focuses on a dwelling type that could grow through time. After World War II, many architects of CIAM researched the field, with the 1969 PREVI-Lima project in Peru as the most famous example. Under the supervision of Peter Land, renowned architects from all over the world designed evolutionary houses, clustered in an urban plan. Revisiting the project many years after, the project can be deemed successful, with incremental additions beyond the wildest imagination of the architects (García-Huidobro et al., 2008; Nohn & Goethert, 2017).

EXPANDABLE HOUSES

The expandable house is similar to the evolutionary house, but focuses more on the pragmatic materialistic aspect of building the house, fitting more with vernacular practices (Mota, 2021). The 1965 Skjetten Town project by Nils-Ole Lund is an expandable housing project following a humanistic approach. A housing manual was provided to the housing system, based on a grid, that demonstrated how individuals could incrementally grow their dwellings.

ELEMENTAL AND CURRENT STRATEGIES

Although incremental strategies seem to have taken a break after 1980, they are up for a revival (Nohn & Goethert, 2017; Wakely & Riley 2011; Wakely 2018). Projects like that of Quinta Monroy and Villa Verde in Chile as proof (Aravena & Iacobelli, 2016).

Elemental found its origins as a collaboration between experts in affordable housing. Elemental analysed common Chilean housing models and case studies on affordable housing. Commonly, large-scale affordable housing schemes provide many dwellings with small housing units. However, these are often cramped, with rooms too small and awkwardly placed so they cannot be extended into 'normal' dimensions for regular families. Moreover, plot configuration dictates incremental growth. For instance, narrow

row-house plots for rowhouses often lead to rooms without daylight and ventilation.

Drawing from these case studies, Elemental proposed a different model. Instead of building completed, small dwellings, one could build half a good house with the same capital. This house could incrementally be added to over time to reach the aspired growth. This end stage of incremental growth is often found around 70 to 80 m² (Aravena & Iacobelli, 2016)
.
Additionally, Elemental argues housing should be seen as an investment and not as a mere social expense. As acquiring housing requires significant family capital, the urban poor benefit greatly if this capital can gain value over time. When housing serves as an investment, value appreciation renders housing not only a shelter against the environment, but a tool to overcome poverty (Aravena & Iacobelli, 2016). This is in line with Correa's (1989) notions on housing and that of management models on affordable housing in the Global South (Bredenoord et al., 2014). Furthermore, low-rise housing is preferred, as this prevents common areas that cannot be maintained may cause value loss.

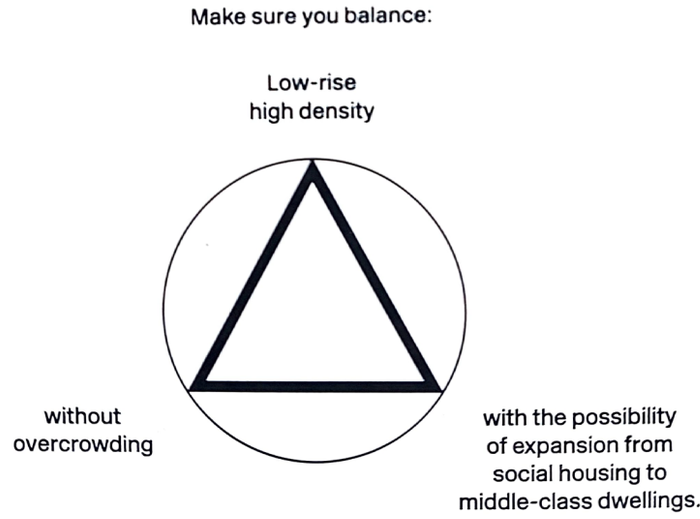
The incremental philosophy of Elemental, which they call 'the ABC of incremental housing', states that an architect should focus on (i) what is more difficult, (ii) what cannot be done by individual residents, and (iii) on what will guarantee the common good in the future. The ABC of housing therefore consists of the following design conditions:

i. A good location; with projects dense enough to pay for expensive, well-located sites.
ii. Harmonious growth in time: The design must facilitate further expansion by strategically building the structural partition walls, firewalls, installations (bathroom and kitchen), stairs, and roof. Individual additions are also framed, leading to customisation instead of neighbourhood deterioration.
iii. Urban layout: design collective space for up to 25 families to enhance social harmony.
iv. Provide structure for the final growth scenario, instead of solely the primary phase.
v. Middle-class DNA: in its final state, the dwelling should have an area of at least 72 m², with four large bedrooms (3x3m). The bathrooms must be spacious enough for a bathtub and washing machine and must be next to the bedrooms. A parking spot should also be provided.

In conclusion, incremental housing must balance low-rise high density, without overcrowding, whilst keeping the possibility of expansion from social housing to middle-class dwelling (Aravena et al., 2018).

GENERAL ADVANTAGES AND DISADVANTAGES OF INCREMENTAL HOUSING STRATEGIES

If we are to match the pace of today's rapid urbanisation, incremental housing is the most promising solution due to the speed

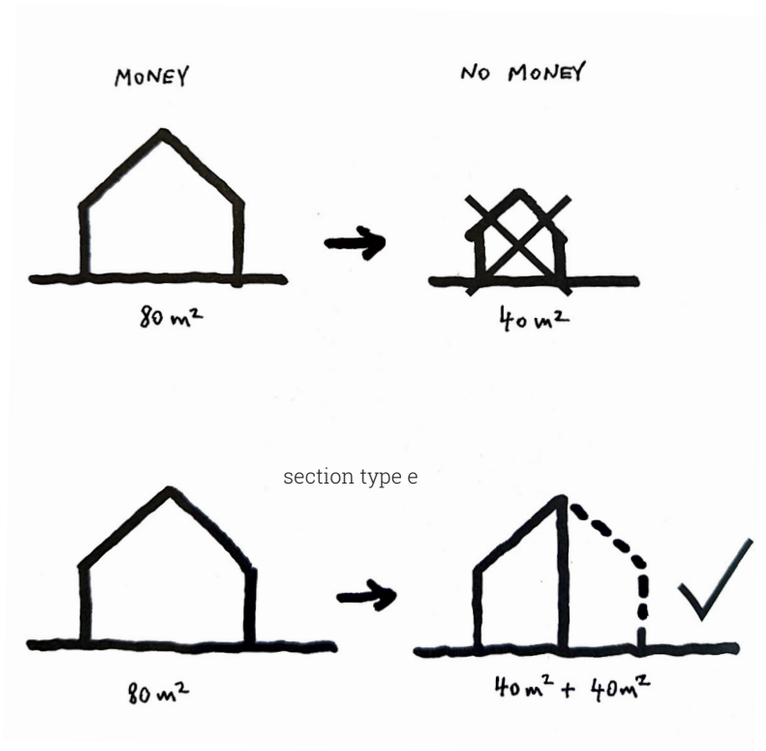


ABC of incremental housing

A: focus on what is more difficult,
B: what cannot be done individually
C: what willl guarantee the common good in the future

1. project location that allows density
2. harmonious growth in time
3. urban layout: design collective space
4. provide structure for final growth scenario
5. growth scenario of middle class DNA

Elemental's ABC of housing and incremental design principles
(Aravena Mori & Iacobelli, 2016)



Half-a-house concept (Aravena Mori & Iacobelli, 2016)

of the schemes, while still having a long-term focus (Nohn & Goethert, 2017). It is also among the most affordable for low-income families, making it especially suitable for (mass) housing projects in the global South. Furthermore, its bottom-up incremental freedom enables citizen participation and strengthens communities and individuals (Bredenoord et al., 2014; Wainer et al., 2016; Wakely & Riley, 2011).

The downsides to incremental approaches are mainly on their dependence on good governance. A sites-and-services plan without proper policy and governance is deemed to fail, regardless the quality of the design (Bredenoord et al., 2014). Additionally, since most incremental housing strategies take up lots of horizontal land and contribute to urban sprawl, seeing as they are often implemented on the urban periphery (Bredenoord et al., 2014; Caldeira, 2016).

THE CASE FOR INCREMENTAL HOUSING

To conclude the literature review on incrementality, Wakely & Riley's (2011) case for incremental housing discusses the extent of sites-and-services schemes in the past and present, as well as the in-situ slum upgrading projects that took over after sites-and-services turned out of fashion. It also poses guidelines on a managerial level for future incremental projects. Wakely and Riley pose sites-and-services projects sometimes failed because they were built on cheap land, were far from the city, and lacked good transport, infrastructure, and links to work opportunities and urban social services. In several cases, the base dwellings and plots were still too expensive for the urban poor, while government institutions were also too impatient for these long-term housing schemes to mature before being evaluated.

Still, with the current knowledge, incremental housing schemes such as sites-and-services and slum upgrading make a strong case. With security of land tenure, households are more engaged and feel more responsibility for the quality of their dwelling and neighbourhood, investing in their dwellings by saving up and sharing the development costs with the government. Participation is key for the incremental development. Here, local communities of informal settlements also play an important role in its success.

In conclusion, Wakely & Riley point out seven points in which incremental housing strategies can find support from the public sector (i) land and location, (ii) finance, (iii) infrastructure and services, (iv) beneficiary selection, (v) site planning and building controls and supports, (vi) community organisation and asset management, and (vii) citywide strategic planning. These can be used to upgrade existing informal settlements, but also for new low-income housing programmes such as the sites-and-services approach (Wakely & Riley, 2011).

Flood-resilience

LITERATURE REVIEW

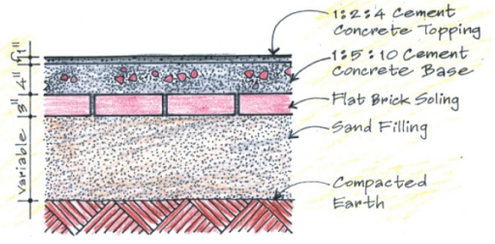
DESIGNING FOR FLOOD RESILIENCE

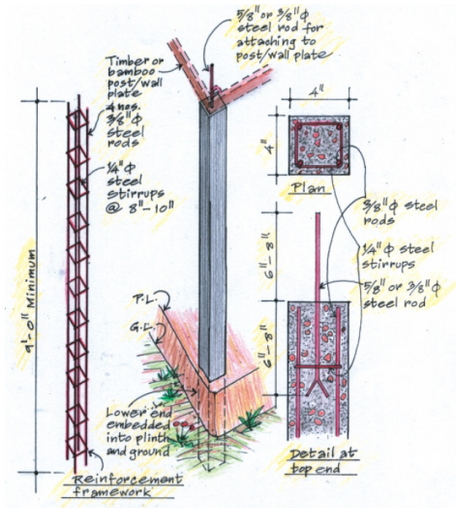
Floodings occur both in urban and rural areas of Bangladesh. The floods are often due to (i) river outbreaks, caused by heavy rainfall, (ii) urban flooding due to poor drainage, and (iii) coastal flooding as a consequence of the sea-level rise (K. I. Ahmed, 2005, 2014; Shaw et al., 2013). Coastal flooding is largely left out in this research, given that Sylhet is not located near the coast, but does cope with the fluvial (river) and pluvial (rainfall) flood types. Implementing flood resilience measures can reduce damage costs a hundredfold (Global Impact Investing Network, 2024).

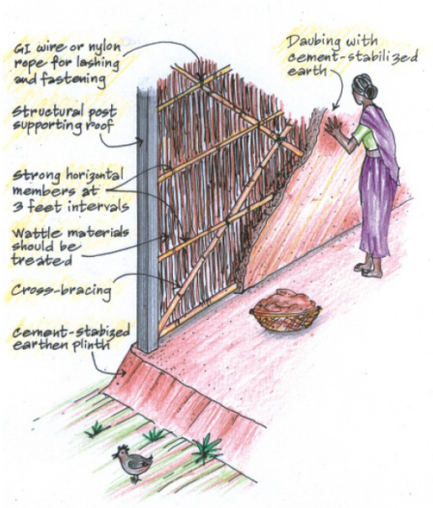
SMALL SCALE MEASURES

Several flood-resilience design measures can be undertaken on the scale of the building. The manual by K. I. Ahmed (2005) covers various construction techniques in detail, providing a thorough design manual on flood-resilient building. Summarising, these measures can be structured under the building components plinth, posts, walls, and roofing. Furthermore, the manual discusses material qualities, construction techniques, and design guidelines. The main materials used in rural Bangladesh, are bamboo, timber, brick, reinforced concrete (RC), thatch, earth and mud.

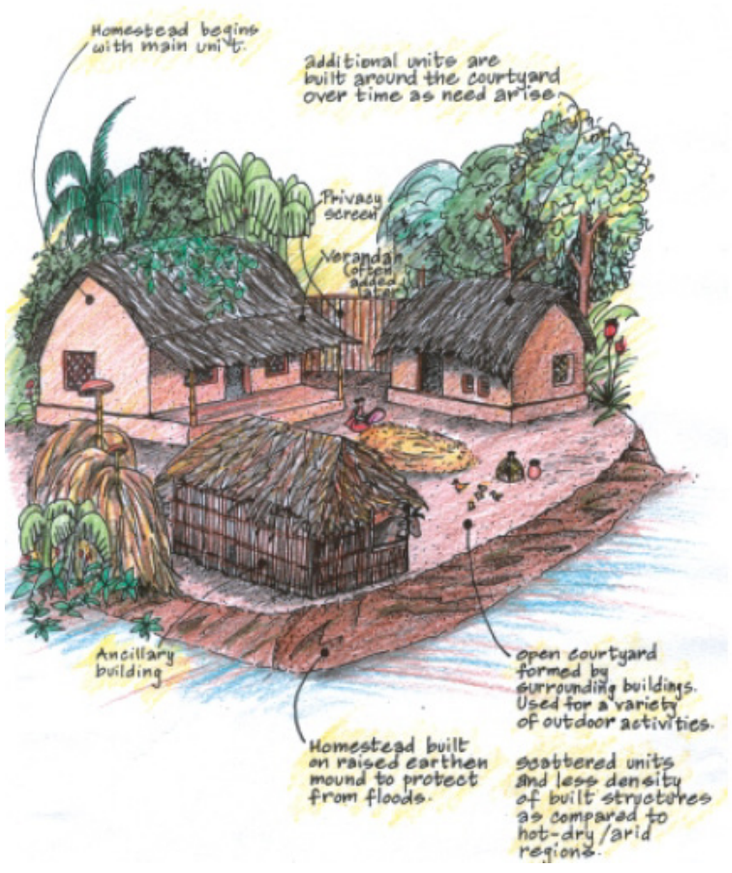
Raising the plinth above ground level is a basic design feature of huge importance for a flood-prone context. Although earthen foundations are common, brick or concrete foundations are most resilient. Another option is to raise the building entirely by building on posts. These posts are often bamboo posts in a concrete stump. In rural areas, bamboo mats, earth, CI sheets and brick are used as walls. Out of these, brick is the only material with longer success against flooding with a high water level. Many roofs are made from thatch and CI sheets, which could fail during long, intense rainfall. RC roofs are safer, yet the structure of the walls needs to be able to hold up the roof. Additionally, the RC roof becomes a point of refuge during high-level floods (K. I. Ahmed, 2005; Mallick et al., 2024; Mokhlesur Rahman & Islam, 2013). In addition, the United Nations Environment Programme (2021) poses several guidelines on various design principles for the house. These guidelines will make of good use for a flood-resilient housing design.







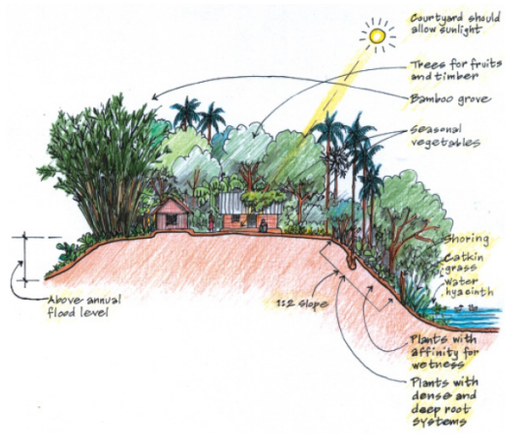
Various construction techniques for flood-resilient design on the scale of the dwelling (Ahmed, K. I., 2005)



Various construction techniques for flood-resilient design on the scale of the cluster (Ahmed, K. I., 2005)

LARGE SCALE MEASURES

In urban design, proper drainage is a key aspect of flood mitigation, which is frequently the main problem for floods in informal settlements (K.I. Ahmed, 2014), along with informal settlements occurring in the most flood-prone areas, deemed unsafe for development (French et al., 2020). Streets that slope towards drainage, adequate alarm systems, and sometimes shelters can be of great importance (Brown et al., 2012). Building embankments, digging waterways for water relief, or planting specific vegetation, are solutions that help prevent fluvial flooding (French et al., 2020). Next to these, transformative approaches, such as floating houses, prove more beneficial over time, since the previous approaches only work up to a certain limit (Apreda, 2016). In rural areas, some of these practices are already carried out to battle the effects of climate change (Anik & Khan, 2012). Finally, community awareness has led to social resilience to floods, meaning communities were able to better resist and overcome floods and destruction (Amoako, 2017; Brown et al., 2012).



III. CASE STUDIES

Shonatola Low-Cost Housing
architecture for the people

Framework

CASE STUDIES

In order to analyse various incremental housing strategies, various case studies have been picked out on basis of their incremental nature, management strategies, architectural or urbanist relevance to the project. These are all thoroughly analysed to help provide a framework for graduation project design.

Additionally, the projects with clear architectural and urban design are researched on a qualitative and quantitative basis to allow further comparative analysis. For this analysis, a framework has been set up in the form of a matrix. The main assessment criteria are:

i. *basic project information;*
ii. *mode of incrementality;*
iii. *urban design;*
iv. *typology;*
v. *architectural design, density metrics;*
vi. *materials & construction;*
vii. *finance & affordability;*
viii. *governance;*
ix. *participation & community engagement;*
x. *timeframe & phasing;*
xi. *outcomes & impacts.*

This assessment matrix may also be used by academics to add to the qualitative and quantitative case study analysis.

Project		
Architect		
Year		
County		
City		
Site area		ha
Units planned		dw
FSI		
GSI		
dw/ha		dw/ha
incremental ratio		
Initital unit size		m²
Developed unit size		m²
Plot size		m²
Plot dimensions		

Main Criterion	Sub-Criterion	Description / Indicators
Stakeholders	Initiators, Implementers, End-Users	Who initiated, who built, who lives there?
Mode of incrementality	Incremental strategy	Aided self-help, sites-and-services, core house, slum upgrading, etc.
Urban Design	Integration with city fabric	Infill, edge, new town
	Neighbourhood/block/cluster configuration	Street layout, shared spaces, safety, access
Typology	Dwelling	Detached, row house, duplex, etc.
	Types	Amount of dwelling typologies
Architectural Design	Base unit design	Size, flexibility, climate fit, social logic, expansion areas
	Structural pre-provisions	Which elements were pre-built?
	Plot layout	Footage, description
	Base m²	Footage, description
	Developed m²	Footage, description
Density Metrics	FSI (Floor Space Index)	Total floor area / plot area
	GSI (Ground Space Index)	Ground coverage / plot area
	Dwellings per hectare (dw/ha)	Urban density measurement
	Incremental Ratio	Final built area / initial built area
Materials & Construction	Base materials	Local or imported? Vernacular vs industrial?
	Technical DIY-friendliness	Are residents able to build safely? Provisions for future expansions, such as reinforced foundations, etc.

Case study evaluation matrix (own work)

Main Criterion	Sub-Criterion	Description / Indicators
Finance & Affordability	Subsidy & funding model	State, NGO, cross-subsidy, public vs. Private, etc.
	User contribution	Loan, sweat equity, savings group
	Initial cost per unit	In local currency or USD
Governance	Governance structure	Top-down, bottom-up, partnership, community-managed
	Land tenure	Freehold, leasehold, cooperative, informal
	Maintenance framework	Community-managed, municipal, other
Participation & Community Engagement	Type of participation	Co-design, co-production, self-construction, feedback loop
	Timing of participation	Pre-design, during, post-occupancy
	Technical assistance	Was the community given training, workshops, or technical guidance?
Timeframe & Phasing	Urban phasing	Were all base dwellings developed simultaneously? Were additional typologies added for cross-subsidisation?
	Execution of incremental additions	Was phasing planned or emergent? Did the extensions happen within the incremental frame or did they surpass it?
Outcomes & impacts	Scalability & replicability	Were similar schemes developed elsewhere?
	Barriers & enablers	What helped or hindered replication?
	Livelihood & income generation impacts	Does the project provide income generation opportunities, amenities, etc.
	Overall success	Evaluation on the success or failure of the strategy years after completion
	Main lessons learned	What are the key takeaways for the project?

Case study evaluation matrix (own work)

B.V. Doshi, Aranya Low-Cost Housing

CASE STUDIES

Designed by B.V. Doshi, the Aranya Low-Cost Housing project is a landmark for incremental housing programs. Commissioned by the Indore Development Authority (IDA), the project aimed to address the city's many informal settlements. Many of the low-cost housing projects at the time were still beyond the financial reach of the lowest income groups (Curtis, 1988). Through research on the existing informal settlements (Centre for Minimal Cost Housing, McGill University, 1984) further insight and a better understanding of the needs and constraints of the lower income groups was developed. Doshi's Aranya provided a solution that reached these low income groups by designing a settlement in which the people themselves would finish their homes.

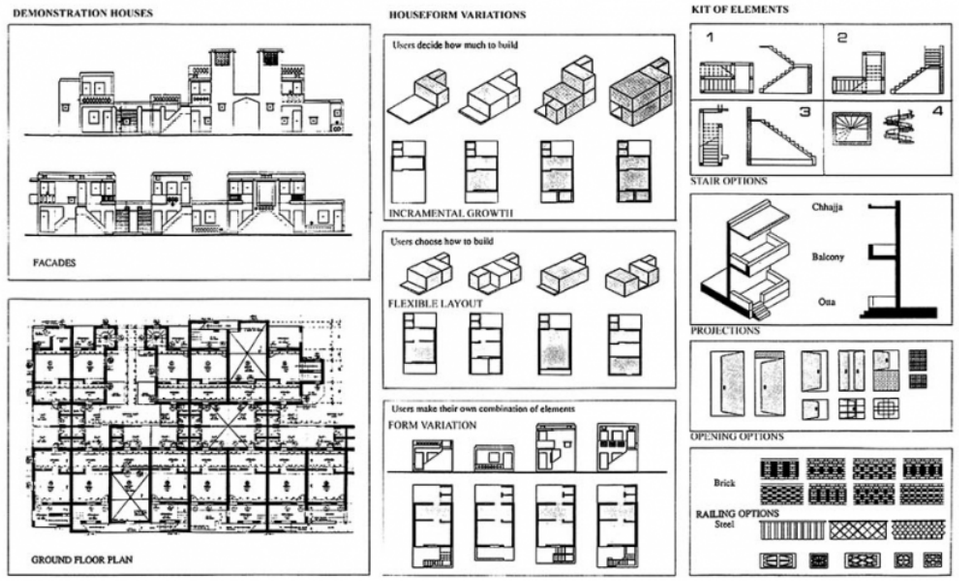
The sites & services programme was designed to house 65.000 people from the economically weaker section (EWS) and lower income groups (LIG). The ideological points of the project aim at the creation of an integrated hum habitat, focussing on lifestyle, culture and affordability and community living. These concept points are categorised in: vitality, imageability, equity, efficiency, flexibility, feasibility (Sharma & Metha, 2007).

The plan holds a clear spatial hierarchy, which is based on the mechanisms of the typical rural, Indian village. The township is divided into various neighbourhoods and communities, which are respectively split up in clusters before leading to the street and the dwelling unit.

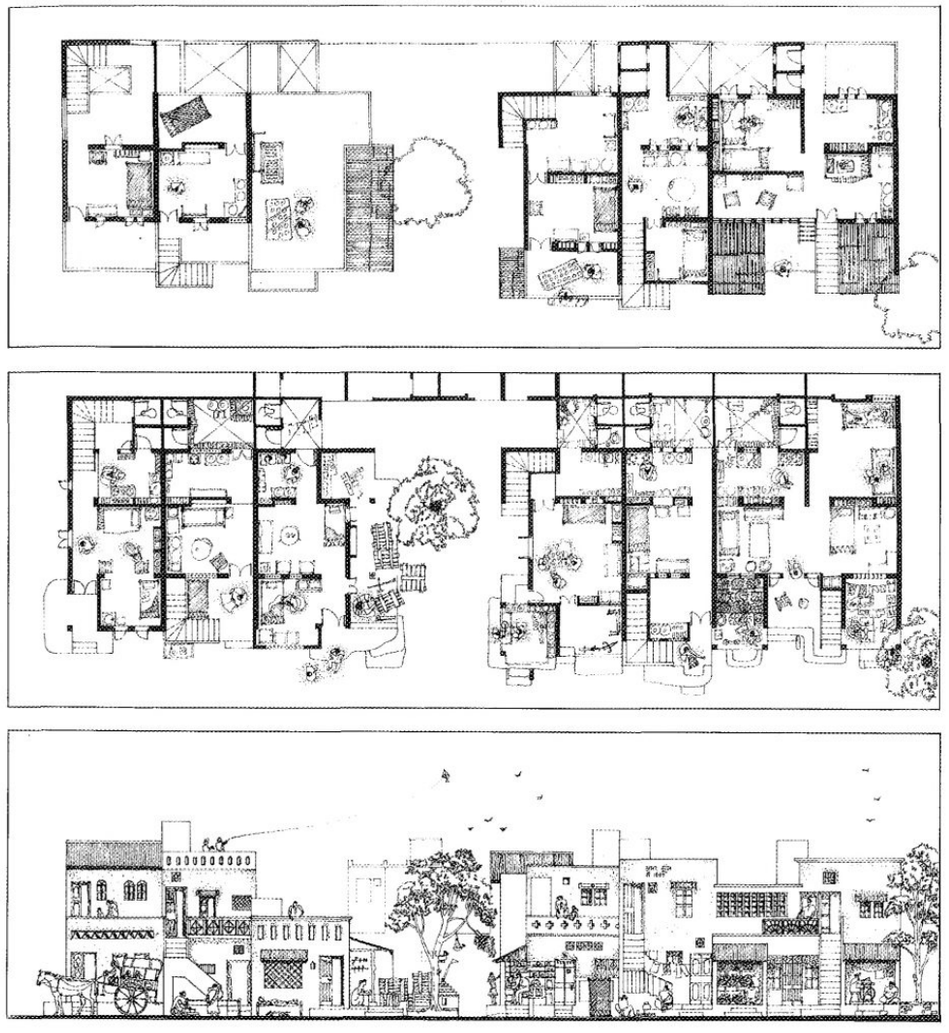
The plan consists out of six neighbourhoods, wherein a network of roads ands spines lead from a town centre with amenities and communal spaces. The six main roads through the neighbourhood serve as continuous spines of open spaces. These are subdivided into clusters of smaller courtyards, next to which the houses are placed. At every scale, the courtyard serves as the communal meeting space. Furthermore, the roads prioritize for slow traffic, whereas cars take opposite routes, away from the project's centre.

The project has a vast infrastructural network, providing all serviced plots and core units with water, septic tanks, and electricity. The infrastructural layout is executed as to minimise the amount of piping and other cost-cutting design measures. The plots are tailored to different income groups, especially the urban poor, while integrating basic infrastructure and public space within a cohesive urban layout (Curtis, 1988; Sharma & Metha, 2007).

The plots vary per income group from a 35m² serviced plot and a sanitary core at the back courtyard (EWG) to serviced plots with a core house (LIG), to fully developed plots for middle and high-income groups. The diverse income groups fostered special and community organisation, but also allowed for cross-subsidisation to aid the EWG (35% subsidised by HIG) (Curtis, 1988; Sharma & Metha, 2007).
The row-house dwellings could develop from the back into two story houses, as shown by the demonstration houses. By housing the



The design of Aranya through clusters, incrementality and a kit of parts
(Aranya Low-Cost Housing, 1993)



Courtyard and cluster design (Aranya Low-Cost Housing, 1993)

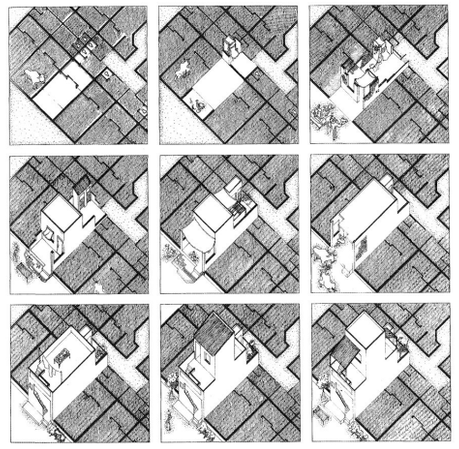
services at the back of the 3,6m wide and 9m long plot, development occurred from back to front, freeing up the street façade for income generating home-businesses. Similarly, the top floor could be rented out for additional income generation.

Eighty demonstration houses were built to showcase possible incremental extensions. Through a kit of parts, Doshi showcased various technically adequate solutions for windows, stairs, jali's and other architectural components which also define the street image.

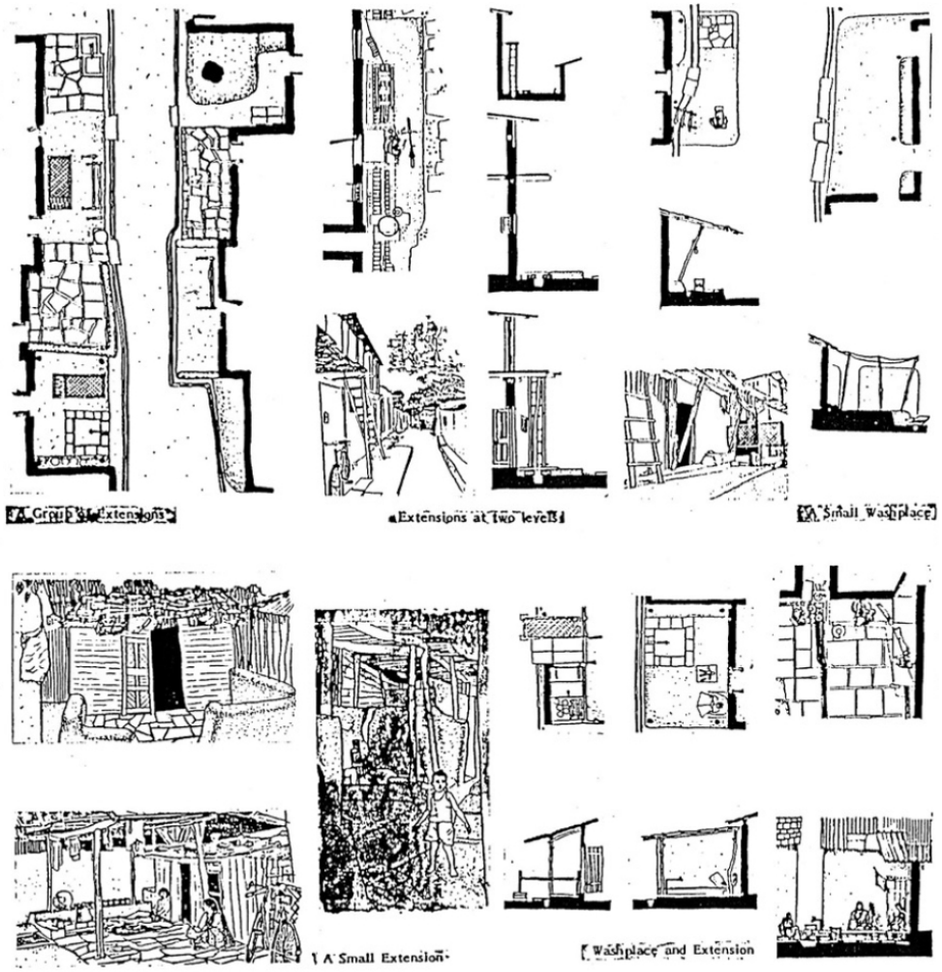
The project is widely acclaimed and earned Doshi both the Aga Khan and Pritzker prize. Currently, the settlement still houses a thriving community. However, most of the dwellings do not take the form of the demonstration houses, but have their own architecture. Even so, this aspect highlights the projects' strengths, as the neighbourhood is still a sought-after place to live. However, the four-storied buildings and loss of several courtyards does highlight the unprecedented growth of the township, stretching the boundaries of the original plan.

Critics of Aranya highlight the failure of the project to keep the eighty demonstration houses within the affordable housing price tag. Shortly after completion, the market took over and prices improved fourfold. In many instances, the dwellers preferred the capital and sold their home and returned to the informal settlements (Roy, 2004). Furthermore, development of the serviced plots took longer than anticipated (Steele, 1998), which meant the housing shortage and sprawl of informal settlements caught up with the project's assignment of slum rehabilitation, again emphasising architecture itself cannot solve poverty (Mollard, 2022).

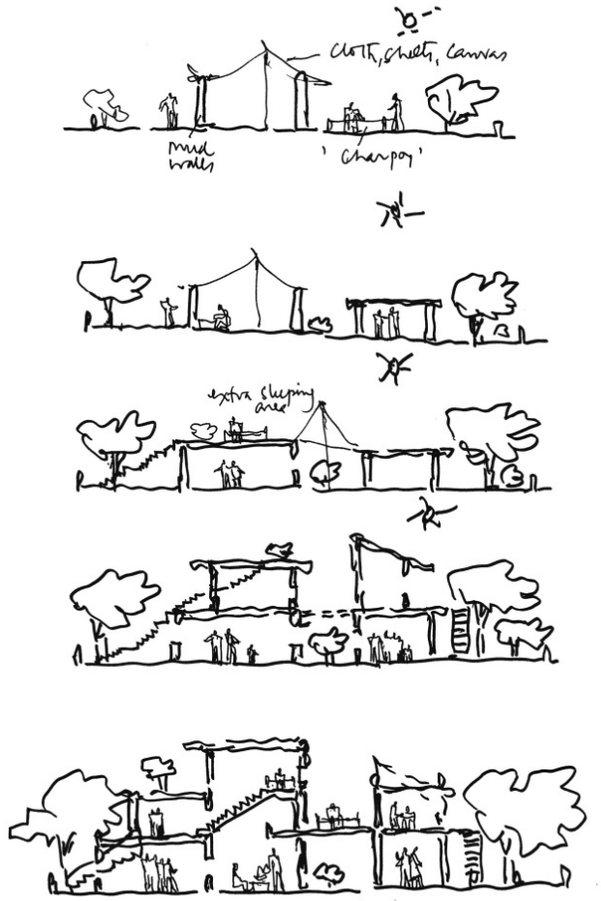
Nevertheless Aranya is the crucial proof of the opportunities of incremental housing, providing a framework future projects could be based off. Aranya's achievements highly outweigh its flaws. High occupancy and satisfaction rates indicate a resilient community and thriving neighbourhood, further arguing the project's widely recognised success.



Incremental growth of the dwelling (Aranya Low-Cost Housing, 1993)



Reference studies on informal settlements (Aranya Low-Cost Housing, 1993)



Doshi's sketches on incremental growth
(Aranya Low-Cost Housing, 1993)

Aranya today is extremely diverse in character
(Google Street View, 2025)

Project	**Aranya housing**	
Architect	**Balkrishna Doshi**	
Year	**1989**	
County	**India**	
City	**Indore**	
Site area	**86**	ha
Units planned	**6500**	dw
FSI	**0.1-1.8**	estimate
GSI	**0.1-0.7**	estimate
dw/ha	**75-150**	estimate
incremental ratio	**2.0-5.0**	
Initital unit size	0 - 5 - 20	m²
Developed unit size	100+	m²
Plot size	35 - 45 - 80	m²
Plot dimensions	3,6m x 9m - 5m x 9m	

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
Stakeholders	Initiators, Implementers, End-Users	Indore Development Authority (IDA), Vastu-Shilpa Foundation (B.V. Doshi), HUDCO, World Bank for co-funding dwellers
Mode of incrementality	Incremental strategy	Sites-and-services, core-house (occassionally)
Urban Design	Integration with city fabric	Edge/new ton, Indore outskirts
	Neighbourhood/block/cluster configuration	Hierarchy through network of clusters and courtyards along spine configurations as communal spaces. Central spine of commercial and community facilities. Residential network from central spine. Well-laid out infrastructural network.
Typology	Dwelling	Row houses, core-houses designed for 2 stories
	Types	Variable plot sizes for EWS and LIG groups: Typology 1: serviced plot and sanitary core (>35m²) for EWG Typology 2: serviced plot and core-unit (>45 m²) for LIG Additional: middle and higher income apartments for cross-subsidisation.
Architectural Design	Base unit design	Serviced plots and core-houses, min. 35m². Sanitary core at private courtyard. Growth from back to the front. Provisions for vertical and horizontal incremental growth. Orientation minimized sun exposure in hot, dry Indore climate. Cross-ventilation.
	Structural pre-provisions	Foundation, toilet, water tap, infrastructure connections, septic tank (per 20 houses), load-bearing walls (in case of core-unit).
	Plot layout	35m² to 80 m². Designated buildable area, small private backcourtyard, frontage onto public or semi-public lane.
	Base m²	EWG: >35m² LIG: >45m²
	Developed m²	EWG: >35m² LIG: >45m²
Density Metrics	FSI (Floor Space Index)	Inital: 0.1 (estimate) Current: 1.0 to 1.8 (estimate)
	GSI (Ground Space Index)	Initial : 0.1 Current: 0.7 (estimate)
	Dwellings per hectare (dw/ha)	150 (estimate)
	Incremental Ratio	2.0-5.0 (estimate), great differences from a single-storied home to current four-storied structures.
Materials & Construction	Base materials	Load-bearing brick masonry, concrete slabs and structural elements, local timber, bamboo, and terracotta tiles
	Technical DIY-friendliness	Medium: within grid, local construction techniques and materials through local masons and residents, stub-outs for future plumbing and electricity.
Finance & Affordability	Subsidy & funding model	Public sector initiative with a cross-subsidy model. Profitable scheme for further EWS development. IDA provided land and initial infrastructure funding. Co-funded by HUDCO and the World Bank.
	User contribution	Downpayments and loans based on income per family for base dwellings, sweat equity and savings for incremental additions
	Initial cost per unit	No hard data
Governance	Governance structure	Top-down framework of planning and initial implementation, bottom-up user-driven incremental development and community management.
	Land tenure	Freehold ownership
	Maintenance framework	Municipal for primary infrastructure. Community-managed for shared open spaces at the cluster level, individual maintenance of dwellings.
Participation & Community Engagement	Type of participation	Self-construction
	Timing of participation	Post-occupancy
	Technical assistance	Training centres on industrial, constructional and technical skills. Material banks to feed building activity. Demonstration houses.
Timeframe & Phasing	Urban phasing	Phasing of commercial and high-income dwellings. Subsidisation for low-income dwellings.
	Execution of incremental additions	Emergent and market-driven within incremental framework. Current four-story developments look not like the demonstration houses and push the boundaries of the plot, but do not compromise the communal spaces.
Outcomes & impacts	Scalability & replicability	No direct copies, but precedent and inspiration for many sites-and-services and incremental housing projects throughout the world
	Barriers & enablers	Enablers: visionary design, extensive research, government support, cross-subsidy, cultural fit, security of tenure Barriers: unforeseen value increase and future affordability, management of incremental growth
	Livelihood & income generation impacts	Income generation for ground floor units. Amenities present in masterplan (school, health centers, and commercial areas)
	Overall success	Succesful landmark project, high occupancy and satisfaction, vibrant community life in courtyards and public spaces, economically accessible, however prices quadrupeled after completion. Doshi received the Aga Khan Award for Architecture in 1995 for Aranya. Some issues with infrastructure maintenance, variations in construction quality, and potential for overcrowding in some areas as density increases beyond initial projections.
	Main lessons learned	Flexibility; infrastructure; facilitating masterplanhousing instead of dictating; cross-subsidisation; income mix; cultural appropability

Case study evaluation matrix (own work)

Case study evaluation matrix (own work)

Charles Correa, Belapur

CASE STUDIES

In the 1960s, Mumbai was experiencing an unprecedented growth in population and its informal settlements. Due to its topographical constraints, the city grew further inland and away from the city centre, at the end of the narrow peninsula. Correa and others proposed the construction of Navi Mumbai, a new city across the water, connected with its counterpart via railway. Commissioned by the City and Industrial Development Corporation (CIDCO), Correa developed the low-cost housing project (Correa, 1989; Varma, 2018).

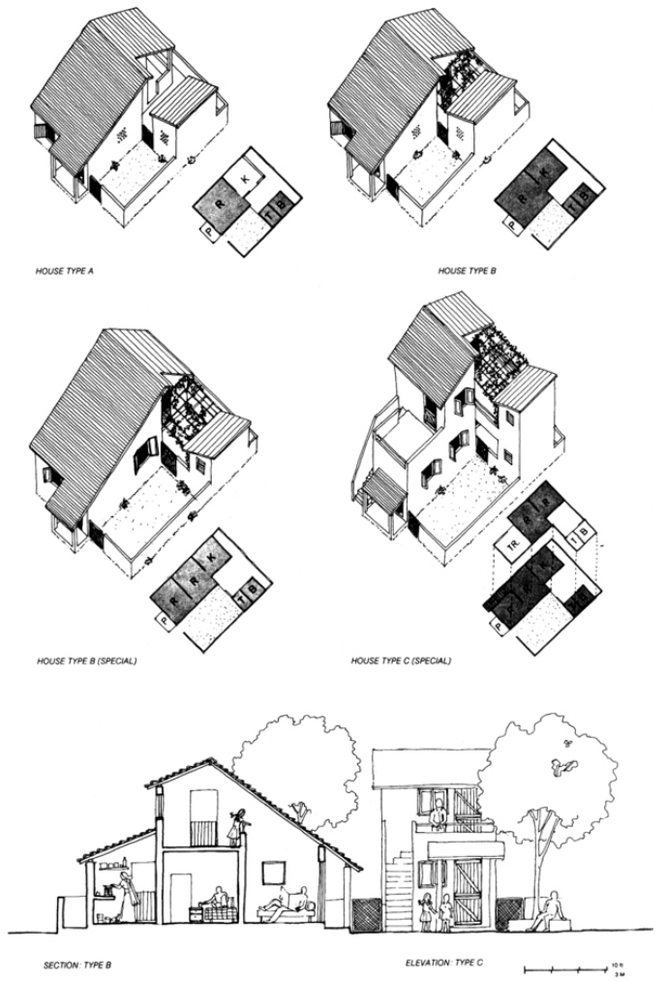
Correa's understanding of informal settlements and the mechanisms of the city is apparent in its design. Correa argued migrants move to cities for jobs, not for housing. Therefore, the three interlocking factors for affordable housing are: job location, transport pattern and housing site (Varma, 2018). Further following his bill of rights for housing, consisting of: incrementality, equity malleability, open-to-sky spaces, disaggregation, pluralism, participation and income generation, Correa developed the 'artist village'. The project fostered social and economic diversity through housing for low to middle-income groups (Correa, 1989).

The adapted sites-and-services project explored an alternative to the conventional mass housing programmes through low-rise high-density planning in non-linear forms. The urban design is based on a clear spatial hierarchy of fractals of courtyards and dwellings, following the different scales of community. The base module contains seven dwelling units, grouped around an 8m x 8m courtyard. Three modules combined lead to the next 12m x 12m courtyard. Another three of these are interlocked to form a final 20m x 20m courtyard, leaving room for amenities and communal spaces in the centre.

The plots vary between 45 and 75 m², depending on the typology. The typologies range from freestanding serviced plots with core units to developed, freestanding duplex housing, all with two private courtyards to facilitate future incremental growth. The initial plan was "merely indicative" and simple enough for local masons and carpenters to construct (Varma, 2018). Incremental growth takes place in just one direction, with blind facades facing the neighbours to prevent social conflicts (Correa, 1989).

The project faced some difficulties, as only a fraction of the total units planned were constructed. This was partly due to problems with public transport and the location of the satellite village relative to Mumbai and Navi Mumbai, which was still under development. Critics also argue that the village-like character Correa aims to achieve does not fit the assignment of contemporary high-density urban planning (Lukose, 2015; Roy, 2004). Today, most of the original Belapur houses have been replaced by more contemporary, RCC urban developments, taking up the full plot and reaching up to four stories. The few original dwellings that are left are in a bad state (Lukose, 2015). Additionally, there was no clear division of maintenance for the

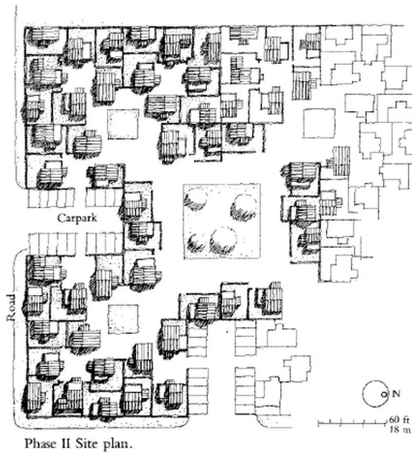
The Belapur housing cluster (Correa, 1989).



Trpology and house design (Correa, 1989)

courtyards, leading to deterioration as it was neither public nor private (Ravishankar et al., 2014).

Despite these flaws, the characteristic urban design and courtyard layout remain strong. Correa himself stated that this is the core of the project, not the architectural design of the unit (Varma, 2018). If anything, time has proven that good urban design facilitates the framework for liveable neighbourhoods, where the dwellings adapt over time. Therefore, the project is nonetheless regarded as successful, where its accomplishments and flaws serve as a lesson for future incremental housing strategies.



Belapur cluster (Correa, 1989)

Belapur today (Google Street View, 2025)

Project	**Belapur**	
Architect	**Charles Correa**	
Year	**1983**	
County	**India**	
City	**Navi Mumbai**	
Site area	**5,4**	ha
Units planned	**540**	dw
FSI	**0.4-1.1**	estimate
GSI	**0.3-0.6**	estimate
dw/ha	**100**	dw/ha
incremental ratio	**2.0-5.0**	
Initital unit size	22	m²
Developed unit size	45-120	m²
Plot size	66	m²
Plot dimensions	45-75	m²

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
Stakeholders	Initiators, Implementers, End-Users	City and Industrial Development Corporation (CIDCO) of Maharashtra, Charles Correa Associates dwellers
Mode of incrementality	Incremental strategy	Sites-and-services, core-houses/expendable houses
Urban Design	Integration with city fabric	New Town/Edge
	Neighbourhood/block/cluster configuration	Hierarchy of courtyard clusters, amenities and meeting spots at larger courtyards, intimate at smallest scale. Car-free.
Typology	Dwelling	Detached courtyard housing
	Types	Typology A: core house and sanitary unit Typology B: 2-room house and sanitary unit Typology C: 3-room house and sanitary unit Typology D: two-story house Typology E: duplex
Architectural Design	Base unit design	Plot with core and sinitation. Open spaces for incremental growth at open-to-sky courtyards. Expansions only happen in one direction
	Structural pre-provisions	Foundations, plinth, kitchen, bathroom, infrastructure connections
	Plot layout	45m² to 75m². Designated buildable area and private courtyard.
	Base m²	Typology A: 22 m² Typology B: 32 m² Typology C: 45 m² Typology D: 55 m² Typology E: 70 m²
	Developed m²	45 to 120m²
Density Metrics	FSI (Floor Space Index)	Initial: 0.4 Developed: 1.1 (estimate)
	GSI (Ground Space Index)	Initial: 0.3 Developed: 0.6
	Dwellings per hectare (dw/ha)	100 dw/ha
	Incremental Ratio	2.0-5.0
Materials & Construction	Base materials	Local materials, masonry, concrete, timber shingles
	Technical DIY-friendliness	Middle: foundations, infrastructure connections, designated expansion areas.

Case study evaluation matrix (own work)

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
Finance & Affordability	Subsidy & funding model	Public sector CIDCO. Cross-subsidy
	User contribution	Loan, sweat equity, savings
	Initial cost per unit	No hard data
Governance	Governance structure	Top-down
	Land tenure	Freehold
	Maintenance framework	Municipal (infrastructure), no framework for courtyards
Participation & Community Engagement	Type of participation	None
	Timing of participation	Post-occupancy
	Technical assistance	None
Timeframe & Phasing	Urban phasing	Gradual phasing of clusters
	Execution of incremental additions	Incremental additions started in the courtyards, but later additions meant total new dwellings constructed
Outcomes & impacts	Scalability & replicability	Planned, but not carried out (HUDCO)
	Barriers & enablers	Enablers: cultural understanding, institutional backing, flexible design, security of tenure, income mix Barriers: maintenance, location, management of incremental growth
	Livelihood & income generation impacts	Income generation for artists as home studios. Planned amenities, although not built
	Overall success	Successful incremental & affordable housing project. achieved social mix, vibrant community life. The houses did not suit the urban context and have been replaced by regular multistory RC structures. The urban plan is still intact.
	Main lessons learned	Courtyard planning; infrastructure; facilitating masterplanhousing instead of dictating; income mix; cultural appropability

Case study evaluation matrix (own work)

Elemental, Quinta Monroy

CASE STUDIES

Quinta Monroy was Elemental's first project. Commissioned in 2003 by the Chilean Ministry of Housing, the slum upgrading project was challenged with the rehousing of 100 families squatting in a settlement near the centre of Iquique. Drawing from their extensive research on affordable housing, this was the first physical implementation of their 'parallel building' (Aravena & Iacobelli, 2016).

Through their half-a-good-house principle, the firm used the Chilean housing subsidy of 7500 USD per family to pay for central land, infrastructure and half of a house, later to be expanded by the families themselves.

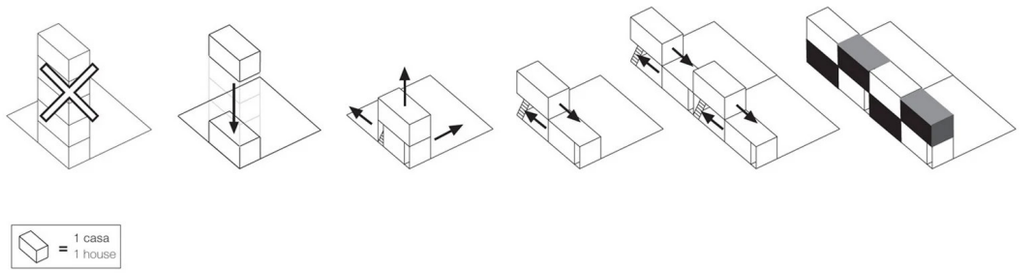
Elemental used a series of participative workshops on typology, building design, the urban layout, and difficult decision-making on cost-cutting measures of the base dwelling. As an example, votes were organised on using the funds for either money or land. In talks about typology, the squatters even went as far as threatening to go into a hunger-strike if multifamily housing was proposed (Aravena & Iacobelli, 2016).

The design followed their ABC of incremental housing. The base dwellings provided a foundation, load-bearing, fire-resistant division walls, a bathroom, kitchen, living room and a bedroom. The parallel building groups five dwellings, two ground-bound houses with a courtyard, and three apartments with direct street access through an external staircase. These clusters were grouped around four central courtyards, providing community spaces on the original land (Aravena & Iacobelli, 2016).

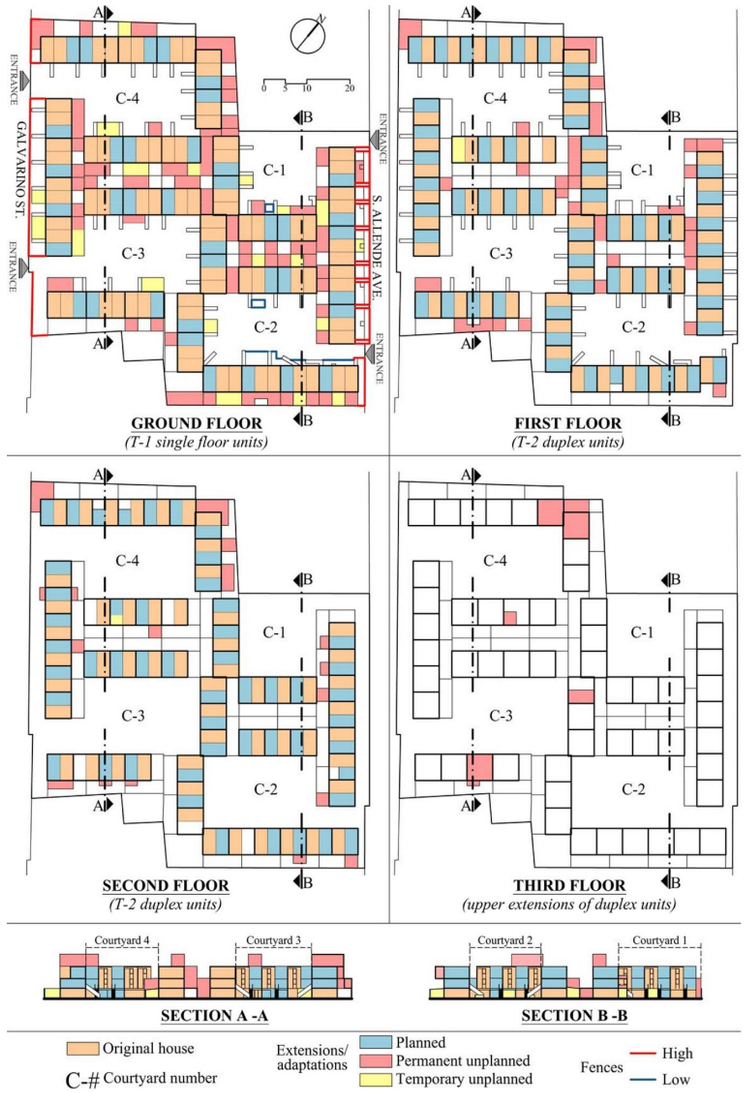
Both dwelling types could be expanded by claiming strategic 'voids' in the structure. The house could grow from 36m² into a 72m² home, whilst the apartment grew from 25m² to 72m. Elemental provided technical assistance and workshops on the home expansion. The base dwellings dictated the urban design, while it was complimented by the modifications, which add individuality to the design.

Although widely regarded as successful, earning multiple prizes and having lead to several iterations of Elemental's incremental housing strategy worldwide, Quinta Monroy has outgrown its 72 m² confinements. Recent studies show that courtyards and communal spaces have gradually been claimed, while extra floors have also been added in some cases (O'Brien & Carrasco, 2020; Carrasco & O'Brien, 2021).

Critics remind us that if not properly maintained within its framework, Quinta Monroy could gradually slide back into its original slum-like qualities. Certain informal additions have reintroduced degradation of living conditions and compromise safety. This further stimulates the urban inequalities, once again showcasing how architecture itself cannot solve poverty if, even years later, a proper regulatory framework is not enforced (O'Brien & Carrasco, 2020; Carrasco & O'Brien, 2021).



Quinta Monroy and the origins of the 'parallel building'
(Aravena & Iacobelli, 2016)



Type of housing extensions per story and typology (Carrasco & O'Brien, 2021)

However, the project is still one of the best examples of incremental housing in the 21st century, where other models such as Villa Verde, Monterrey, and Lo Barnechea provide housing for low-income groups that would otherwise not have the luxury of affordable housing.

User modifications of the living room (Aravena & Iacobelli, 2016)

Project	**Quinta Monroy**	
Architect	**ELEMENTAL**	
Year	**2003**	
County	**Chile**	
City	**Iquique**	
Site area	**0,5722**	ha
Units planned	**100**	dw
FSI	**0,6-1,3**	
GSI	**0,3-0,6**	
dw/ha	**175**	dw/ha
Incremental ratio	**2.0-3.0**	
Initital unit size	25-36	m²
Developed unit size	72	m²
Plot size	100	m²
Plot dimensions	11m x 9m	

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
Stakeholders	Initiators, Implementers, End-Users	MINVU, Elemental, Chile Barrio, original dwellers
Mode of incrementality	Incremental strategy	Aided self-help
Urban Design	Integration with city fabric	Urban infill on valuable 5,000 m² site in the city center of Iquique.
	Neighbourhood/block/cluster configuration	13 three-story blocks arranged around four communal courtyards. Earthquake-resilient. Prevent communal stairwells due to conflicts and collective fees.
Typology	Dwelling	Parallel building: three-story duplexes
	Types	Typology 1: ground floor house with a backyard. Typology 2: "half a house" duplex
Architectural Design	Base unit design	"half a good house", voids and yard for incremental resident-led infill.
	Structural pre-provisions	Foundations, load-bearing structure, several exterior walls, several partition walls, kitchen, bathroom, staircase
	Plot layout	House with front and back garden, external stairs as access for the duplex apartment, incremental expansion in orous voids of the structure and possibily in the garden. Approx. 90 m² plot
	Base m²	House: 36 m² Apartment: 25m²
	Developed m²	House: 72 m² Apartment: 72 m²
Density Metrics	FSI (Floor Space Index)	0,6-1,3
	GSI (Ground Space Index)	0,3-0,6
	Dwellings per hectare (dw/ha)	174,8
	Incremental Ratio	House: 2.0 Apartment: 2.3
Materials & Construction	Base materials	Reinforced concrete, concrete blocks, re-use of CI-sheets, timber
	Technical DIY-friendliness	High DIY friendliness, just the "easy half". Provided structural walls, foundations (within voids) for incremental expansion

Case study evaluation matrix (own work)

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
Finance & Affordability	Subsidy & funding model	State-subsidized: Chilean government's social housing program, subsidy of USD $7,500/family. This subsidy had to cover land, infrastructure, and building costs. The high land cost (70% of the budget) left very little for construction.
	User contribution	Subsidy provided base dwellings. Savings and labour for incremental additions.
	Initial cost per unit	USD $7,500
Governance	Governance structure	Initiated top-down by government, design and implementation through bottom-up. Developed under "Dynamic Social Housing Without Debt program."
	Land tenure	Joint property ownership
	Maintenance framework	Individual unit maintenance, collective/municipal responsibility courtyards
Participation & Community Engagement	Type of participation	Co-production, self-construction.
	Timing of participation	Pre-design, during and post-occupancy
	Technical assistance	Technical assistance trough Elemental. Workshops on architectural and urban design, program of the minimum amenities, etc.
Timeframe & Phasing	Urban phasing	Simultaneous, no cross-subsidisation
	Execution of incremental additions	Planned within the 'voids'. Later, unregulated expansions encroached beyond limits of the project (extra floors, claiming communal spaces).
Outcomes & impacts	Scalability & replicability	Over 2500 similar units developed worldwide. Open-source architecture. Projects: Monterrey, Lo Barnochea, Villa Verde, Renca
	Barriers & enablers	Enablers: strategic location, "half a house" concept, value appreciation, security of tenure Barriers: quality of self-build, unintended encroachment, low profit for construction companies, lack of commitment by governments and municipalities for incremental social housing programs
	Livelihood & income generation impacts	No amenities planned, but extensions allowed rental (sub-letting) or home-based businesses.
	Overall success	Successful and influential model for affordable incremental housing. Families kept the land, secure tenure, value appreciation through self-build. Various awards. However, "contested incrementalism" shows unplanned expansions can sometimes compromise public spaces and aesthetic quality.
	Main lessons learned	Half-a-house; provide what is difficult; location matters; housing as an investment; empower self-build; balancing freedom and control; community engagement

Case study evaluation matrix (own work)

MHADA, Charkop sites and services

CASE STUDIES

The Charkop sites and services programme was set up as part of the World Bank-supported Bombay Urban Development Project (BUDP) of 1979. The project was implemented by the Bombay Metropolitan Region Development Authority (BMRDA) and the Maharashtra Housing and Area Development Authority (MHADA). Charkop fell under the Land Infrastructure Servicing Program (LISP), which was responsible for sites and services projects on the urban fringes, where 50% of plots were focused on EWG's and 10% on LIG's. The remainder was used for apartment buildings aimed at higher income groups, utilising cross-subsidisation (Testi, 2003; World Bank, 1985).

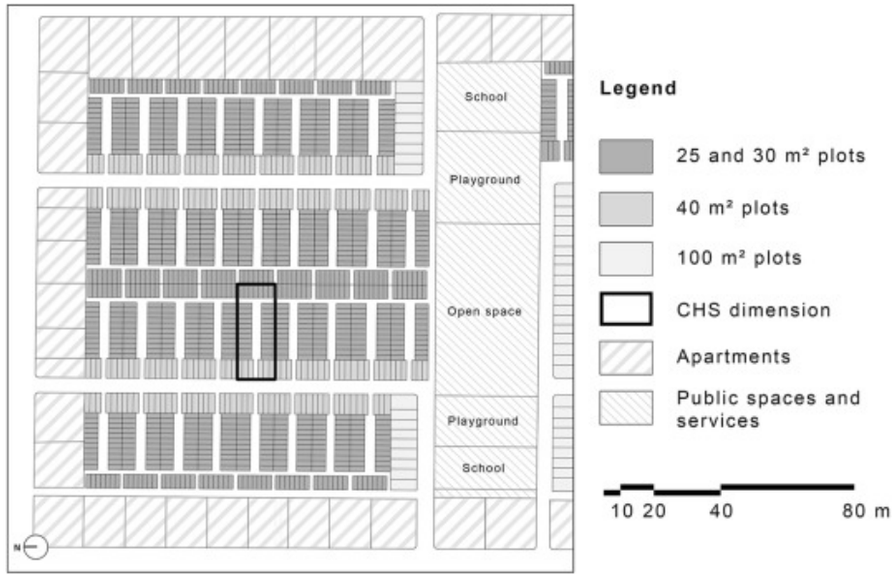
Through a survey of income groups, a lottery was held for property distribution. The selected households held leasehold agreements, which were renewable every 60 years. To let the plots remain in the hands of EWG and LIG families, MHADA handed out "no objection certificates" after the 20-year loan was repaid, allowing the owners to sell or rent out their property if desired. Additionally, MHADA set up Co-operative Housing Societies (CHSs), composed of 35 households, responsible for negotiating rules, maintaining shared spaces, and liaising with authorities (Testi, 2023; World Bank, 1985).

The urban layout followed large block-like structures, with apartment blocks on the periphery. The superblock houses amenities and open spaces, along which 100 m² plots are situated. The CHS clusters are planned along main roads with the 40m² plots. Each cluster can be entered through the main road, leading to a courtyard of six 40m² plots and twenty-nine 25 m² plots (Testi, 2023).

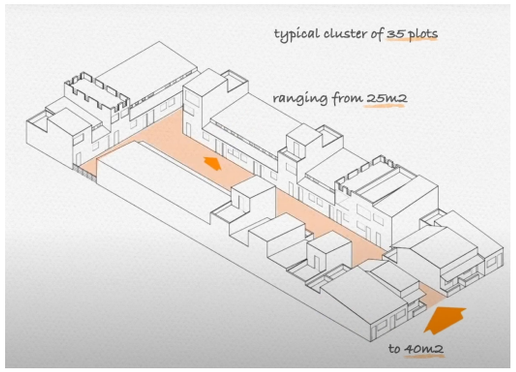
Some of the serviced small plots consisted of a core unit, whose simple structure contained a veranda, a living room, a mezzanine, a cooking space, and a toilet. Due to their small size, the 3m wide dwellings were incrementally upgraded into two story structures (Padora, 2010; Testi, 2023). Through the CHSs and the Urban Land (Ceiling and Regulation) Act, incremental expansions of the dwelling, which was still publicly owned by MHADA, were allowed as long as they fulfilled the building regulations and FSI (Testi, 2023).

Charkop is one of the most successful sites and services projects. It excelled both in its management and design. Nearly fourty years after its design, Charkop is still a vibrant neighbourhood. Its urban hierarchy and courtyards still house strong communities, which have upgraded to the Indian middle class. Current structures display a high variety in facades and floorplan, yet they still abide by the building requirements set by MHADA, as even now, most structures have two floors, with the occasional exception of a third (Gulyani, 2016; Padora, 2010).

Charkop courtyards today (Gulyani, 2016)



Charkop sector masterplan (Testi, 2003)



The Charkop cluster (Blend Ed, 2022)

The urban adaptability was enabled due to the security of tenure, spatial hierarchy, small plot sizes, flexible planning rules, and a permissive regulatory environment (Testi, 2023; World Bank, 1997). However, urban adaptation also has its downside, since increasing land values attract wealthier income groups, possibly forcing low-income groups out. These mechanisms were already at play through black market purchases of plots right after construction (Apperloo, 2011), but are inevitable in any incremental housing scheme that fosters value appreciation as a tool to overcome poverty.

Charkop main street today (Varma, 2022)

Project	**Charkop**	
Architect	**MHADA**	
Year	**1986**	
County	**India**	
City	**Mumbai**	
Site area	**90**	ha
Units planned	**9093**	dw
FSI	**0.8-1.5**	
GSI	**0.6**	
dw/ha	**101**	dw/ha
incremental ratio	**2.0-2.5**	
Initital unit size	25, 40	m²
Developed unit size	80	m²
Plot size	25-40*	m²
Plot dimensions	3m x 8-13m	m²

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
Stakeholders	Initiators, Implementers, End-Users	MHADA, BMRDA, BUDP, World Bank, CHS
Mode of incrementality	Incremental strategy	Sites-and-services
Urban Design	Integration with city fabric	New town
	Neighbourhood/block/cluster configuration	Courtyards clusters along main roads in super blocks
Typology	Dwelling	Row houses
	Types	Typology 1: core-house plot Typology 2: small dwelling larger dwellings and high income apartments outside cluster
Architectural Design	Base unit design	25 to 40 m² base plot with core and sanitation, vertical and horizontal growth
	Structural pre-provisions	Serviced plot, room, toilet, cooking area
	Plot layout	3m wide plot with verandah and back garden
	Base m²	Typology 1: 25 m² Typology 2: 40 m²
	Developed m²	Typology 1: 50 m² Typology 2: 80 m²
Density Metrics	FSI (Floor Space Index)	Initial: 0.9 Developed: 1.5
	GSI (Ground Space Index)	0.6
	Dwellings per hectare (dw/ha)	100 (estimate)
	Incremental Ratio	2.2
Materials & Construction	Base materials	Masonry, CI sheet, concrete
	Technical DIY-friendliness	Medium, carried out by contractors but guided through regulations and CHSs
Finance & Affordability	Subsidy & funding model	State funded, public, cross-subsidy
	User contribution	
	Initial cost per unit	Loan
Governance	Governance structure	Top-down, bottom-up CHS
	Land tenure	Leasehold, eventual freehold
	Maintenance framework	Municipality: infrastructure, shared spaces, CHS individual lots and courtyards
Participation & Community Engageme	Type of participation	Feedback loop

Case study evaluation matrix (own work)

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
	Timing of participation	During
	Technical assistance	Technical assistance through building requirements
Timeframe & Phasing	Urban phasing	Phases per sector
	Execution of incremental additions	Horizontal and vertical growth within framework
Outcomes & impacts	Scalability & replicability	Yes, part of nationwide S&S project
	Barriers & enablers	Enablers: Government funding, good management, spatial hierarchy, urban adaptability, security of tenure, value appreciation Barriers: Value appreciation and market workings
	Livelihood & income generation impacts	Amenities planned within project
	Overall success	Successful sites & services project. Urban adaptability shows strength
	Main lessons learned	Urban adaptability, security of tenure, spatial hierarchy, small plot sizes, flexible planning rules, permissive regulatory environment, management systems

Case study evaluation matrix (own work)

Peter Land, PREVI

CASE STUDIES

El Proyecto Experimental de Vivienda (PREVI) de Lima was one of the most groundbreaking experimental social housing projects in history. Commissioned by the Peruvian Government and backed by the UN and the United Nations Development Programme (UNDP), Peter Land advised the nation its housing bank (Banco de la Vivienda) of Peru.

PREVI consisted of four pilot projects (PP) on incremental, growing houses (PP1), urban upgrading and restoration (PP2), self-help housing and sites and services (PP3), and earthquake resilient buildings (PP4) (García-Huidobro et al., 2008). This case study focuses on several dwellings of the PP1 experiment.

PREVI was structured around several experimental principles:

i. *A high-density, low-rise urban layout.*
ii. *A growing house concept with an integral courtyard.*
iii. *Housing clusters within the urban plan.*
iv. *A pedestrian-oriented design at human scale.*
v. *Earthquake-resilient construction technologies*
vi. *An integrated neighbourhood landscape plan.*

Additionally, the project was based on home ownership, funded through national subsidies and loans, to ensure extensions would be made by future dwellers. The urban plan was set up for various dwelling types, and included a neighbourhood, amenities, and collective spaces (García-Huidobro et al., 2008).

Land led 26 internationally renowned and local architects tasked with the affordable, incremental housing assignment. Each growing house contained basic infrastructure, bathrooms, bedrooms, a living room and courtyards. Additionally, the design must facilitate vertical and horizontal expansions.

James Sterling proposed square plots, the cluster consisting of four squares, turned into a larger square. Each dwelling surrounds a central courtyard, providing light to adjacent rooms. In one example, the 81m² unit has grown to 240 m². The central courtyard is still a present open space that provides circulation to the upper floors (García-Huidobro et al., 2008).

Aldo van Eyck aimed to limit incremental additions through interlinked heptagonal plot shapes, hoping to maintain cross-ventilation and daylight access through the front and back courtyards of the rectangular house. The kitchen was planned as the central element of the dwelling. In one example, the 89 m² base dwelling has expanded up to 232 m². Despite the unusual geometry, residents still claimed the courtyard spaces for dwelling expansions.

Kikutake, Kurokawa and Maki designed a two-story row-house dwelling, running from front to back, with access from the street and a back lane. Extensions were planned on the first-floor terraces, but families claimed the courtyards and front space, claiming part of

Arial view of PREVI. Dwellings after completion and dwellings now (Land, 1976).

Case study homes (García-Huidobro et al., 2008)

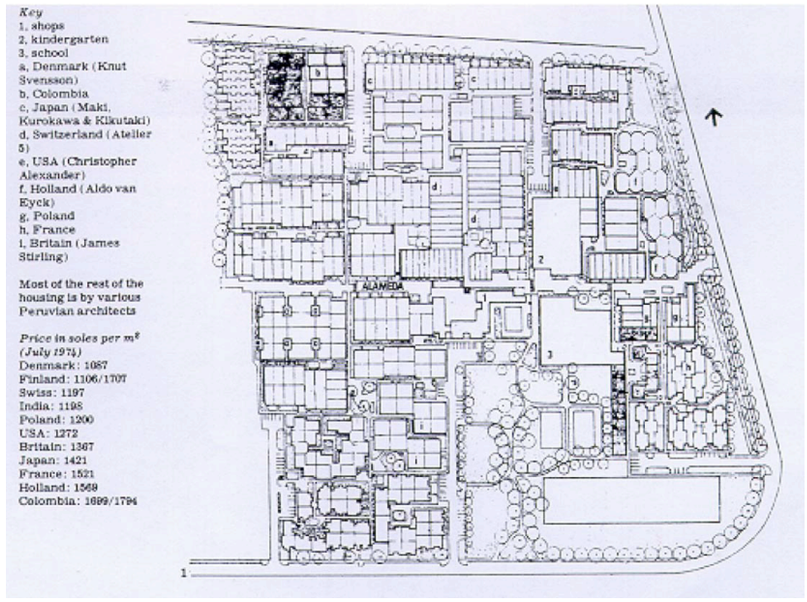
the street for a home business. In some cases, the 97m² base dwelling was expanded into a four-story 344m² dwelling.

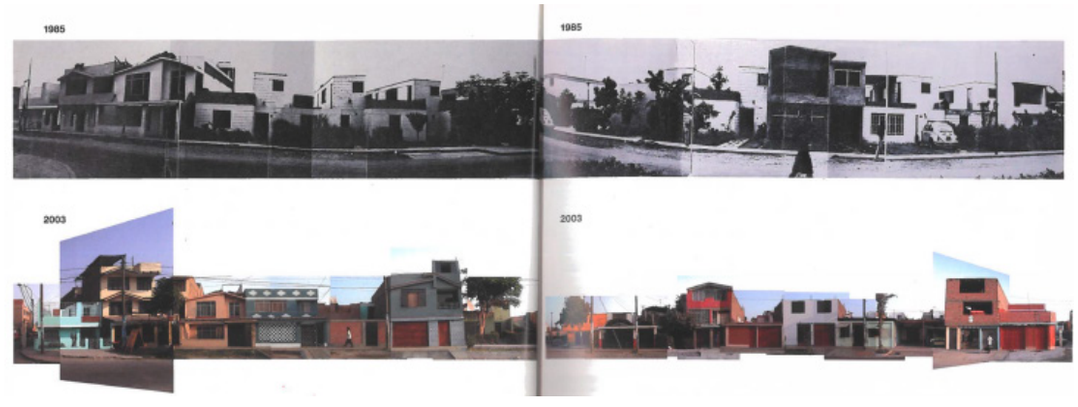
Toiva Korhonen designed a row house with multiple courtyards. Although not intended, naturally first claimed the courtyards and later expanded the 64m² dwelling vertically into a 210m² home. Again, the flat roofs facilitated easy vertical expansions, yet occasionally, stairs have been placed awkwardly by residents themselves (García-Huidobro et al., 2008; Matteo, 2017).

Initially, the most successful PP1 dwellings were scheduled for mass replication. However, due to the long timeframe of incremental housing strategies, funding, and a lack of political will and shifting government priorities, this was never implemented. The government instead opted for sites and services approaches from PP3 (García-Huidobro et al., 2008).

Currently, PREVI its urban plan is still clearly present, where its neighbourhood and cluster setup provide liveable spaces in a colourful community. The original designs of the houses have become unrecognisable due to user modifications, which, similar to the surviving urban plan, can be seen as a highlight of its success (Matteo, 2017).

Present-day PREVI (Matteo, 2017)





Case study homes (García-Huidobro et al., 2008)

Present-day PREVI (Matteo, 2017)

Project	**PREVI**	
Architect	**Peter Land, multiple**	
Year	**1973**	
County	**Peru**	
City	**Lima**	
Site area	**12,3**	ha
Units planned	**467**	dw
FSI	**0.5-1.4**	estimate
GSI	**0.3-0.7**	estimate
dw/ha	**85**	dw/ha
incremental ratio	**2.5-4.0**	
Initital unit size	80	m²
Developed unit size	200-400	m²
Plot size	90-100	m²
Plot dimensions	varies	

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
Stakeholders	Initiators, Implementers, End-Users	Government, UN, UNDP, Peter Land, architects, Banco de la Vivienda del Perú, dwellers
Mode of incrementality	Incremental strategy	Growing house
Urban Design	Integration with city fabric	New town
	Neighbourhood/block/cluster configuration	Neighbourhood with centre, dwelling clusters, communal courtyards, pedestrian oriented
Typology	Dwelling	row house
	Types	26 total Sterling: square plot with central courtyard Van Eyck: hexagonal plot with rectangular, central dwelling Kurokawa: linear plot with courtyards Korhonen: linear plot with courtyards
Architectural Design	Base unit design	Growing house with courtyard, allowing vertical and horizontal expansion
	Structural pre-provisions	Foundation, plinth, bathroom, bedrooms, living room, basic infrastructure
	Plot layout	Sterling: 100m² Van Eyck: 89m² Kurokawa: 97m² Korhonen: 100m²
	Base m²	Sterling: 81m² Van Eyck: 89m² Kurokawa: 97m² Korhonen: 64m²
	Developed m²	Sterling: 240m² Van Eyck: 232m² Kurokawa: 344m² Korhonen: 210m²
Density Metrics	FSI (Floor Space Index)	Initial: 0.3 - 0.5 (estimate) Developed: 1.0 - 1.4 (estimate)
	GSI (Ground Space Index)	Initial: 0.2 - 0.4 (estimate) Developed: 0.5 - 0.7 (estimate)
	Dwellings per hectare (dw/ha)	38 dw/ha

Case study evaluation matrix (own work)

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
	Incremental Ratio	Sterling: 3.0 Van Eyck: 2.6 Kurokawa: 3.5 Korhonen: 3.3
Materials & Construction	Base materials	Masonry, reinforced concrete
	Technical DIY-friendliness	Medium, most expansions required contractors and were planned on new floores, rather than voids
Finance & Affordability	Subsidy & funding model	Public, state-funded and international UNDP funding
	User contribution	Subsidised and loan-payments
	Initial cost per unit	No data
Governance	Governance structure	Top-down
	Land tenure	Freehold
	Maintenance framework	Municipal
Participation & Community Engagement	Type of participation	None
	Timing of participation	post-occupancy
	Technical assistance	No
Timeframe & Phasing	Urban phasing	Similtaneous development
	Execution of incremental additions	Extensions within frame (new stories) and outside of frame (courtyards, street claiming)
Outcomes & impacts	Scalability & replicability	No, planned, but not implemented
	Barriers & enablers	Enablers: International recognition & funding, diversitysecurity of tenure Barriers: Experimental nature\Institutional inertia, political will, funding
	Livelihood & income generation impacts	Income generation at streets, amenities planned
	Overall success	Highly succesful in its experimental nature, thriving neighbourhood today

Case study evaluation matrix (own work)

Caja de Agua

CASE STUDIES

Initiated by the Junta Nacional de la Vivienda in 1961, Urbanización Caja de Agua was a sites and services approach for slum resettlement. It was part of the Urbanización Popular de Interés Social (UPIS, Low-Income Social Housing Subdivision) program. UPIS offered affordable, low-income housing at minimal standards of urban development. Caja de Agua sought to rehouse residents from the dense Cantagallo informal settlement in the centre of Lima (Ministerio de Vivienda, 1970).

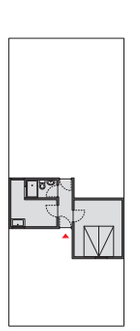
The urban plan provided 8m x 20m plots in a mirrored rowhouse configuration. The core house was placed in the centre of the plot, leaving ample space at the front and backyard for incremental growth. Clusters of 18- to 24 plots were arranged to define spaces for greenery and public space. Additionally, the project provided amenities such as schools, parks, markets, and community centres, although not all were completed (Gyger, 2016).

Residents were offered two types of one-storey core houses: Núcleo 1 (31.5 m²), which included a bathroom, kitchen, and bedroom, and Núcleo 2 (43.75 m²) with an additional room. For expansions, residents were provided with floor plans of what the expanded house could look like.

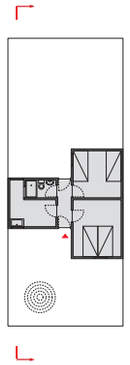
However, no technical guidance was offered for these extensions. This led to residents ignoring the proposal, improvising extensions independently (Gyger, 2016). Extensions enclosed the courtyards and multiple floors were built. Additionally, properties were subdivided for rental income generation, increasing densification and informalising the urban fabric. The municipality reported concerns of the project replicating the slum-like conditions of Cantagallo through overcrowding, throwing of the cohesive neighbourhood and leading to an individualised development pattern (Ministerio de Vivienda, 1970). Nevertheless, this individual character is currently seen as a core feature of sites and services and other incremental housing schemes worldwide, rather than being a flaw.

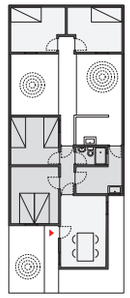
Currently, diverse stages of development can be found in Caja de Agua. Most dwellings have expanded vertically, often with external stairs for multi-family dwellings. Some barely expanded single-story cores can also be found. Contrasting with the other case studies, very few dwellings seem to have any other sort of income generation at ground level. Presumably, this may be attributed to project location and the monotony in income groups, base typologies, and urban planning. As a result, despite architectural diversity in the expanded dwellings, the streetscape lacks the vibrancy typically associated with mixed-use incremental settlements. However, the generous plot dimensions successfully enabled incremental growth, forming a residential neighbourhood of multi-family buildings and smaller rowhouses.

Present-day Caja de Agua (Gyger, 2016)

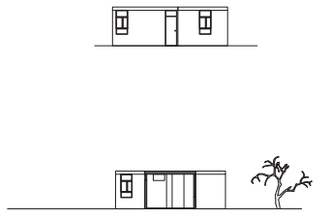


Núcleo 1 en 2
Núcleo 1 and 2

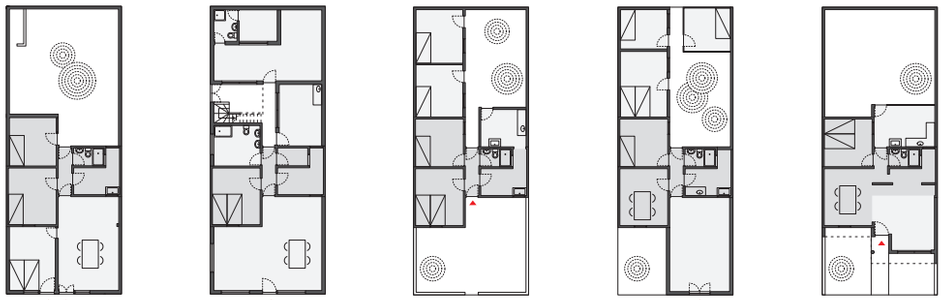




Aanbevolen uitbreidingen
Recommended extensions



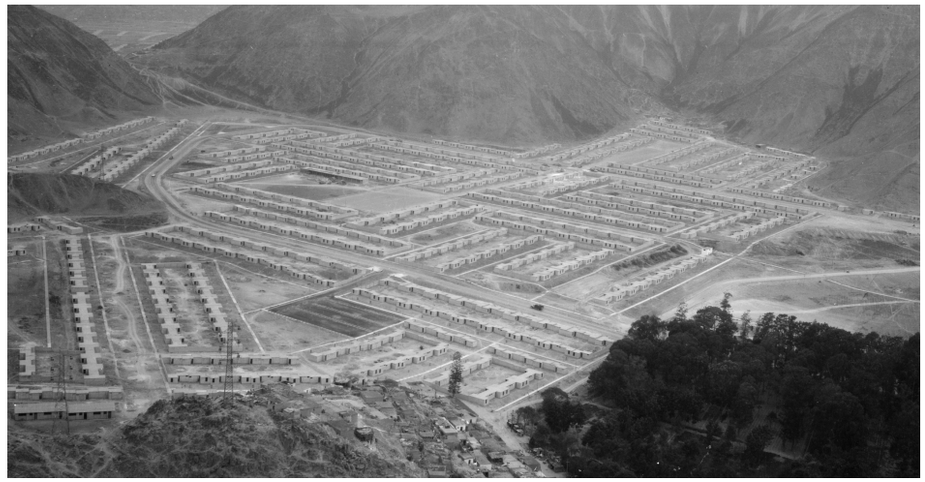
Doorsnede Núcleo 2
Section Núcleo 2



Woninguitbreidingen zoals aangetroffen tijdens de evaluatie door het *Ministerio de Vivienda*, 1970
Dwelling extensions as found during the evaluation by the *Ministerio de Vivienda*, 1970

0 2 10m

Floorplans of the units (Gyger, 2016)



Urban plan right after construction (Gyger, 2016)

Present-day Caja de Agua (Gyger, 2016)

Project	**Caja de Agua**
Architect	**JNV**
Year	**1966**
County	**Peru**
City	**Lima**
Site area	**37,5** ha
Units planned	**2372** dw
FSI	**0,1-0.9** estimate
GSI	**0,1-0,5** estimate
dw/ha	**63,3** dw/ha
incremental ratio	**2.0-7.0** estimate
Initital unit size	32 - 46 m²
Developed unit size	160 - 480 m²
Plot size	160 m²
Plot dimensions	8m x 20m

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
Stakeholders	Initiators, Implementers, End-Users	Junta Nacional de la Vivienda, state architects and planners, dwellers, Cantagallo dwellers
Mode of incrementality	Incremental strategy	Sites and services, core-house
Urban Design	Integration with city fabric	Edge
	Neighbourhood/block/cluster configuration	Linear clusters, community spaces and amenities inbetween
Typology	Dwelling	Row house
	Types	Nucleo 1: core-house with wet core and one room Nucleo 2: core-house with wet core and two rooms
Architectural Design	Base unit design	Nucleo 1: core-house with wet core and one room Nucleo 2: core-house with wet core and two rooms
	Structural pre-provisions	Foundations, plinth, bathroom, kitchen, bedroom, basic infratsructure
	Plot layout	160m² plot with front and backyard for expansion
	Base m²	Nucleo 1: 32 m² Nucleo 2: 44 m²
	Developed m²	160 - 480 m²
Density Metrics	FSI (Floor Space Index)	Initial: 0.1 Developed: 0.9
	GSI (Ground Space Index)	Initial: 0.1 Developed: 0.5
	Dwellings per hectare (dw/ha)	63 dw/ha
	Incremental Ratio	2 to 7 (estimate)
Materials & Construction	Base materials	concrete, masonry, concrete blocks
	Technical DIY-friendliness	Medium, structural frame for development and provided reccomendation floorplans
Finance & Affordability	Subsidy & funding model	State-funded
	User contribution	Loans
	Initial cost per unit	No data
Governance	Governance structure	Top-down
	Land tenure	Freehold
	Maintenance framework	Municipal
Participation & Community Engagement	Type of participation	None
	Timing of participation	Post-occupancy
	Technical assistance	No assistance, but recommendation plan for completed house
Timeframe & Phasing	Urban phasing	Phasing
	Execution of incremental additions	Gradual. Vertical and horizontal extensions beyond frame, claiming coyrtyards and high individual expression
Outcomes & impacts	Scalability & replicability	Similar S&S models in Peru, but other cores
	Barriers & enablers	Enablers: strong government commitment, adaptable design, security of tenure, state funding Barriers: technical assistance, location, income generation and urban planning
	Livelihood & income generation impacts	Amenities in centres
	Overall success	Successful on scale of the dwelling: multistory and diverse development. Challenged in urban design and community building
	Main lessons learned	S&S, technical assistance, core-housing, plot dimensions

Case study evaluation matrix (own work)

Case study evaluation matrix (own work)

Co.Creation.Architects, Jhenaidah housing

CASE STUDIES

The Mohishakundu Shordarpara housing upgrade in Jhenaidah may not as clearly be an incremental housing strategy in comparison to previous case studies. However, its bottom-up participatory and self-construction approach of base dwellings within the Bangladesh context justifies its analysis and comparison with the selected affordable housing strategies. Co.Creation.Architects, formed by local designers Khondaker Hasibul Kabir and Suhailey Farzana, completed the project in 2017, sparking other community upgrading projects elsewhere in the city.

Before the project began, the community, composed mainly of day labourers, van drivers, rickshaw pullers, and agricultural workers, suffered from poor drainage, overcrowding, and fragile housing conditions. Most dwellings were constructed from mud, bamboo, and corrugated iron. Despite these conditions, the community had strong internal cohesion, but leadership was predominantly male. The upgrading project radically shifted this structure by positioning women at the forefront of savings, design, and construction decisions (Kabir & Farzana, 2021).

A participatory process was initiated through community mapping, savings groups, and design workshops. Supported by Co.Creation. Architects and the Jhenaidah Citywide Community Network, the women-led process resulted in two core house designs. House Type 1 is a 33.5 m² single-storey brick structure with two rooms and a verandah, while the 36 m² House Type 2 divides the rooms over two floors, but has a smaller footprint.

Two demonstration homes were built first, followed by 18 more with housing loans, and later five additional houses supported through ACHR's Decent Poor Program. The houses were constructed using locally available fired brick and filler slabs for the floors. Through workshops, Co.Creation.Architects aimed to promote cost-saving materials like treated bamboo. However, the community opted for brick to avoid the stigma of "poor people's materials.", providing further insight in aspiration picture of affordable housing in the context of Bangladesh. All construction was done on-site, on land already owned by residents, and with materials procured collectively to reduce costs. Most houses were self-built, aided by local masons and a volunteer engineer from the Jhenaidah Polytechnic Institute.

A system was set up to provide loans for the funding of the buildings, while participation with the government further enhanced the speed of the project (Kabir & Farzana, 2021). Both dwellings cost 1200 USD (100.000 BDT) to build, with loans to be repaid in eight years through weekly instalments of 3,50 USD (300 taka). The expenses were purely material costs, since the land was already owned by the families (Kabir & Farzana, 2021).

The core-houses provided the residents with the possibility to incrementally expand their homes. Since windows and doors had to be bought by the dwellers themselves, some

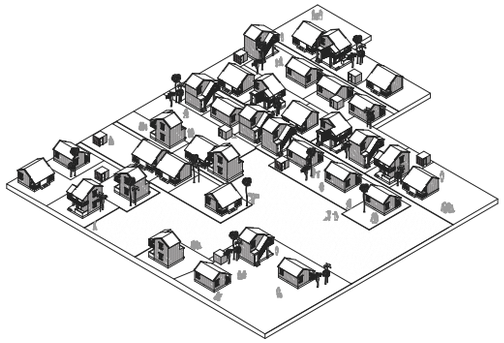
Community mapping in progress (Kabir & Farzana, 2021)

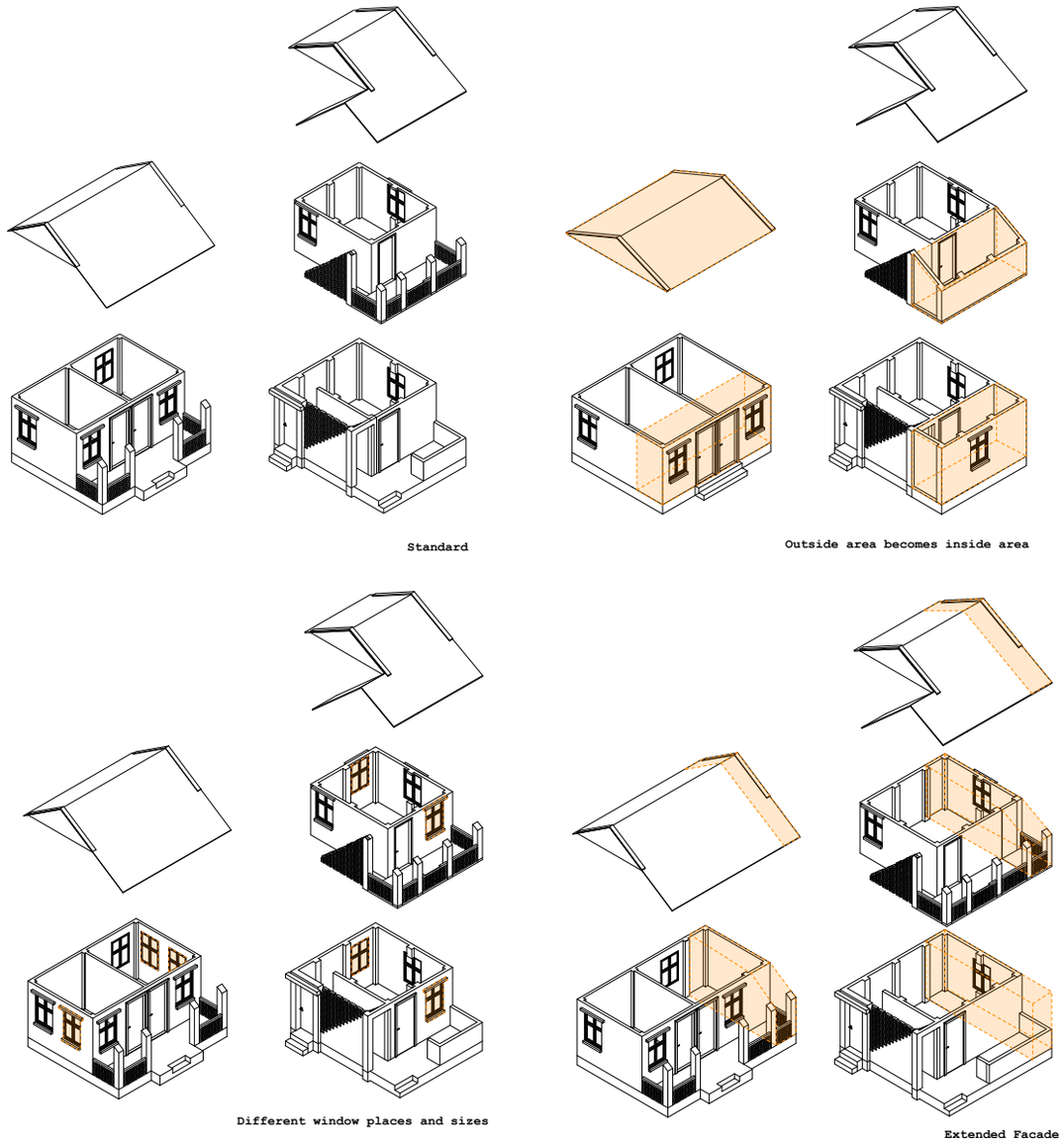
The developed demonstration house and the community (Kabir & Farzana, 2021)

adjusted the opening sizes to fit with whatever they could find on the market. Later on, additional rooms were added to the dwellings, existing rooms were expanded, facades were painted or individual expression was added in another form.

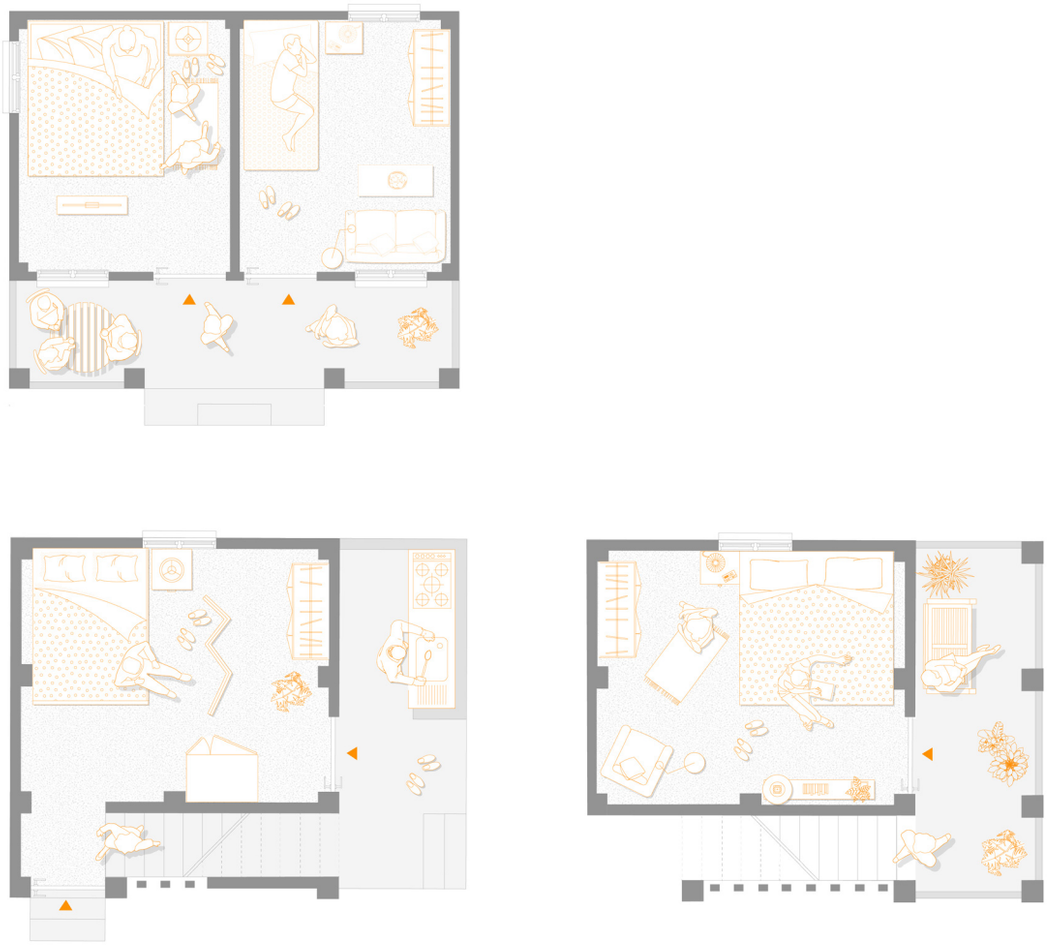
In an interview with the designers for this research, Farzana mentioned Co.Creation. Architects have set up similar projects in Jhenaidah, with the women showing other communities how the strategy could be replicated. However, (as was first also the case with the original project, although resolved) new projects were pestered with problems of repayment of the loans. In new projects, the communities were given too many options for their dwellings, leading to a deadlock in decision making and the speed of the progress. This meant that many of the men opted not to repay the loans and use the money for other expenses, instead that of upgrading their dwellings through the participatory scheme. This unforeseen setback meant the local government discontinued several of its participatory housing projects.

Co.Creation.Architects does still work on other participatory city-upgrading projects in Jhenaidah. In the interview with Farzana, she underlined the necessity of these grassroots approaches for community-upgrading. Understanding the way of living is key. Only through such participatory processes can affordable, incremental housing be established in a way that fosters a sense of ownership and connection among residents.





Exploded isometric of the two main dwelling types
(own work, in collaboration with C. Soediono and Y. Doorn)



Floor plans of the two dwelling types
(own work, in collaboration with C. Soediono and Y. Doorn)

Mohammadpur Geneva Camp

CASE STUDIES

After the 1971 War of Liberation, Pakistanis who lost their homes and found themselves stateless sought refuge at the Mohammadpur Geneva Camp in Dhaka. After the 1947 partition of India into West and East Pakistan (Bangladesh), many people from the Indian Bihar region migrated to East Pakistan. During the 1971 liberation war, a portion of these Urdu-speaking people sided with West Pakistan, since the Urdu-speaking Bihari identified more with West Pakistan than with East, also speaking a different language and sharing different culture than the Bengali society (M. U. Rashid, 2020).

After the war, many of the Bihari lost their homes and they were not welcome in either Pakistan or Bangladesh, becoming refugees. From that moment on the Bihari would live in refugee camps throughout Bangladesh, Geneva camp being one of the at least 116 settlements.

The Mohammadpur Geneva Camp is located in the Mohammadpur neighbourhood of Dhaka and is built on the land of the Liaquat Housing Society. More than 30 thousand people live in the 9 blocks of the camp.

In 1971 plots of 8′ x 8′ (2,5m x 2,5m) were assigned for two refugees, first living in tents. After that, the refugees started building more permanent structures out of bamboo. Later, this turned to multistoried Reinforced Cement Concrete (RCC) and brick structures on the same plot area of 64 sqft (6m2).

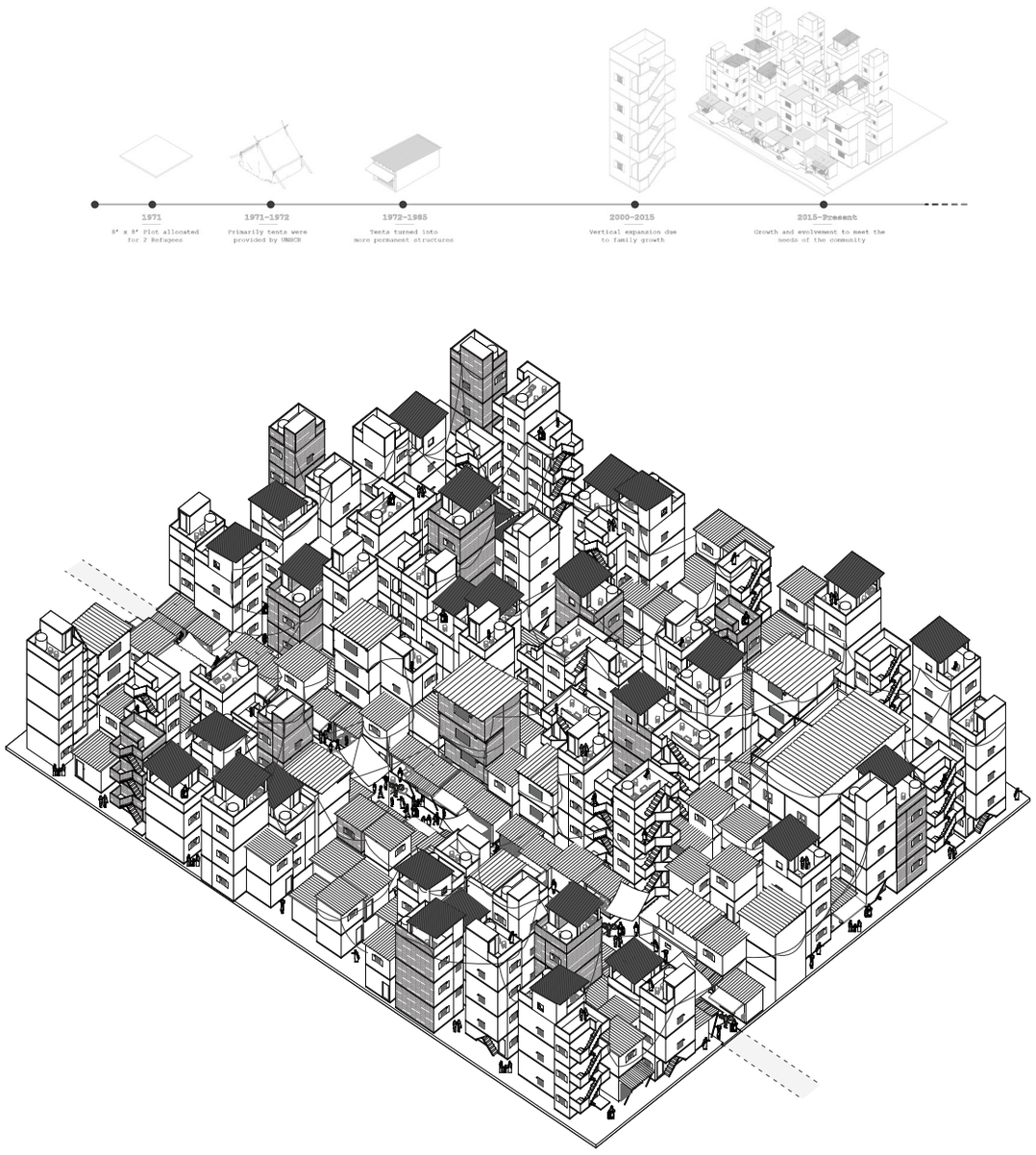
Today, the small original plots are still recognisable due to the irregular vertical nature of most of the dwellings. After all horizontal space was built up, the vertical search for space created a high-density environment with a labyrinth of small alleys inbetween the structures. Public amenities, such as MISSING

The majority of the built-up area is residential, while on ground level many of the roadside dwellings function as a shop during daytime and as a bedroom at night. The main roads are known for their vibrant marketplaces and commercial functions. Elsewhere, a mosque, clinic, and school are built, as well as 261 toilets for the 30,000 inhabitants and just three drinking water points and 35 tube-wells (M. U. Rashid, 2020).

Through the narrow network of alleys people enter their home by taking the staircase to their floor. These RCC stairs area often built on the side of the building and also lead up to the roof. The stairs are often extremey steep and narrow, making it impossible to pass eachother on the stairs.

The larger roads are often commercial, vibrant marketplaces. The tallest structures (up to five/six floors) can be found along these streets. Further back through the network of alleys, the buildings tend to have less stories, sometimes even consisting of solely the ground floor.

Mohammadpur Geneva Camp (bdnews24.com, 2024)



Axonometric of the heart of the camp
(own work, in collaboration with C. Soediono and Y. Doorn)

The main street is extremely crowded, with many vendors selling their goods and people walking through. Smaller shops are oriented towards the street and are built in front of the residential blocks that take up the rest of the space. Public toilets and drinking water points are found on

Throughout the camp, the self-built dwellings can be categorised through various ways, with plot size often being expanded slightly with the stairs above ground floor. The homes have no amenities like a kitchen or toilet and host families of five to eight people. The single room is a living room, bedroom and place for cooking all at once, with raised beds for extra storage space.

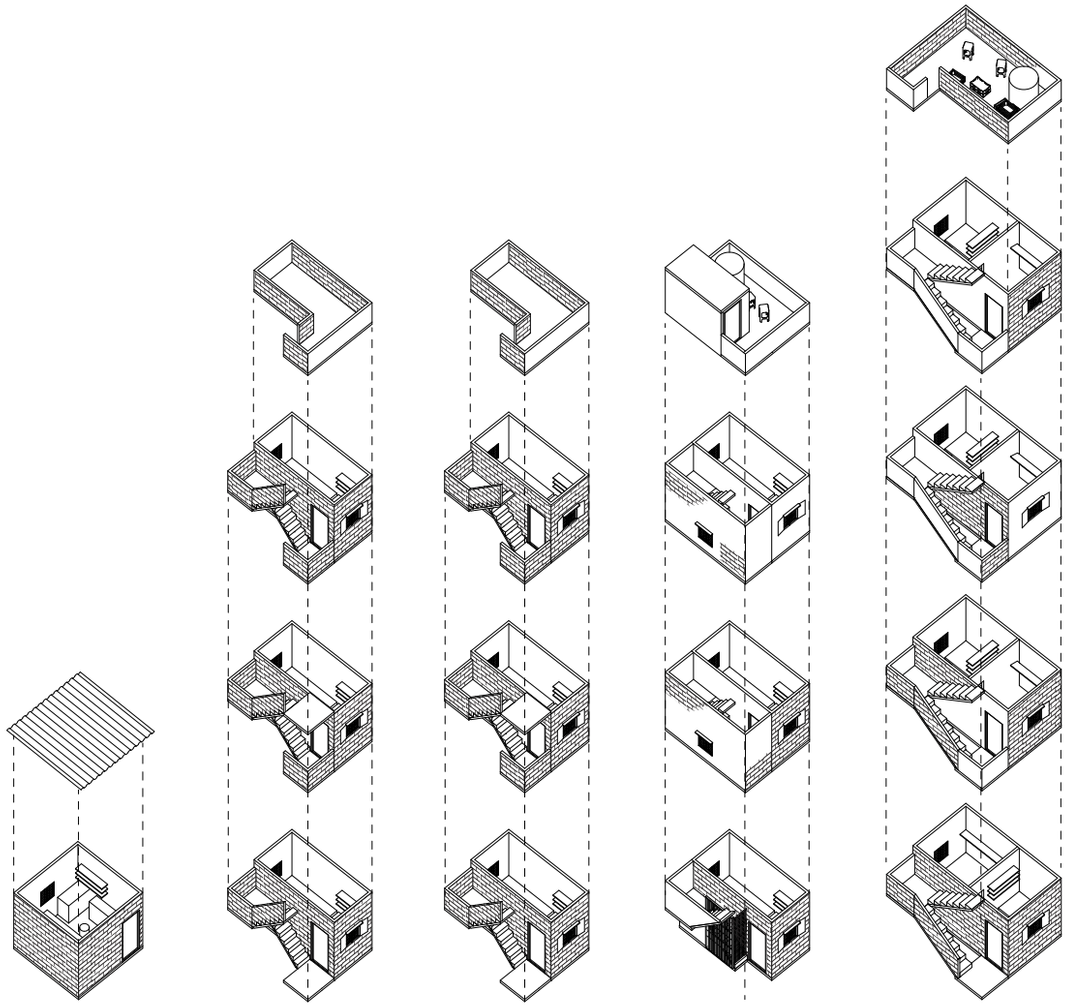
Some variations of the 8′ x 8′, 8′ x 10′ and 10′ x 12′ dwellings are shown below. The dwellings are built up with a Reinforced Concrete Structures with 3″ thin clay burnt brick walls, which are occasionally whitewashed. The roofs often are often made from concrete to enable future vertical expansion, or are made up of corrugated sheets.

The staircases take different forms per building. Open staircases alternate with gated stairs and fully enclosed, darker staircases.
Multiple families live in the buildings, with one floor housing a single family. The roofs are used by the families as additional space to dry clothes. Additionally, rain water is collected in large barrels, while allotments can also be spotted on several of the rooftops.

Some of the stories are painted in bright colours for individual expression of the dwellers. The window panels also tend to differ from colour. This, as well as the incremental growth of the houses is a recurring theme in Bengali (self-help) architecture.

The marketplaces are the hearth of the camp. The majority of the camp inhabitants work in handicraft, frequently using their living room at ground level as a shop to provide income generation. It is no surprise that the majority of inhabitants therefore work inside the camp, instead of outside its borders.

Aerial view of Geneva Camp
(bdnews24.com, 2024)



Exploded isometric of developed dwellings
(own work, in collaboration with C. Soediono and Y. Doorn)

Floorplans of the various dwellings
(own work, in collaboration with C. Soediono and Y. Doorn)

SPARC

CASE STUDIES

The Society for the Promotion of Area Resource Centres (SPARC), founded by Sheela Patel, is a Mumbai-based NGO that has, since 1984, worked in close alliance with the National Slum Dwellers Federation (NSDF) and Mahila Milan, a federation of women's savings groups. Together, they form the Indian Alliance (IA). The collaboration is internationally recognised for its pioneering, community-led approach to housing for the urban poor. Rather than treating informal settlements as problems to be eradicated, IA considers them legitimate starting points for development, placing slum dwellers at the heart of the process (Patel et al., 2015).

Its bottom-up, participatory approach to the incremental upgrading of housing provides further insights into the managerial strategy for this thesis. IA emphasises community-led surveys, savings schemes, collective decision-making, and step-by-step construction.

SPARC's model of incremental housing goes far beyond physical construction. It is a political and social management process that distributes knowledge, finance, and solidarity through grassroots networks. Many of the early members were pavement dwellers facing imminent eviction. They resisted by documenting their communities and learned how to plan, design, and build adequate dwellings.

Central to this approach is the idea that the poor can and must be the main actors in resolving their housing challenges, as the majority of existing low-cost housing models are still beyond the reach of the poorest of the poor. The Alliance facilitates learning through iterative cycles of discussion, field trips, trial projects, and community exhibitions. For instance, when faced with resettlement, pavement-dwelling women from Byculla were trained in measuring, budgeting, assessing building materials, and site planning. They created cardboard models, surveyed vacant land, and debated trade-offs such as private versus shared toilets (Patel et al., 2015).

SPARC advocates for truly participatory processes, instead of 'sprinkling' the label of participation on processes by merely letting residents paint their homes. On design, SPARC found community participation leading to adequate and acceptable housing for the poor, often in the form of co-designed core housing (Patel et al., 2015). These houses are often funded through collective saving groups, which also serve as collateral when approaching banks for loans (Patel & Bartlett, 2016). Conclusively, the participatory process also bears its fruit, as the community develops a thorough understanding of the path to proper housing, which they can further apply within their own and across other communities.

The Adarsh Nagar project is one of the in-practice examples. Under the supervision of Mahila Milan, the community designed and built core houses and received loans, repaid through collective group savings. This collaborative management model is perhaps most vividly illustrated in the Adarsh Nagar project in Dindoshi. The project faced challenges, such as escalating material costs, gendered leadership tensions, and delays in public infrastructure provision. Yet the result was a community-governed, incrementally upgraded settlement that remains inhabited and improved upon decades later (Patel & Bartlett, 2016).

A downside to the bottom-up model for the poorest of the poor is its scalability and speed of construction. Over a course of 30 years, 36,000 dwellings were built with support from the IA (Patel & Bartlett, 2016). Within roughly the same timeframe, India's slum population grew by nearly 70 million people.

Nevertheless, the potential of SPARC and the Indian Alliance demonstrates how incremental housing can become a vehicle for both material improvement and political empowerment. The managerial strategy occupies a position between beneficiary and expert, enabling facilitation from within the communities. This is best concluded in the Alliance's quote: "We beat the path by walking." (Patel et al., 2015).

The Adarsh Nagar community project in 1992 and in 2015
(Patel & Bartlett, 2016)

Baan Mankong

CASE STUDIES

Launched in 2003 by Thailand's Community Organisations Development Institute (CODI), the Baan Mankong programme represents a nationwide, community-led slum upgrading initiative. Baan Mankong provides a platform for upscaling the bottom-up, participatory slum-upgrading and rehabilitation approach. The programme decentralises housing finance and planning to the local level, where organised communities negotiate for land, design their housing, and manage infrastructure upgrades (CODI, n.d.).

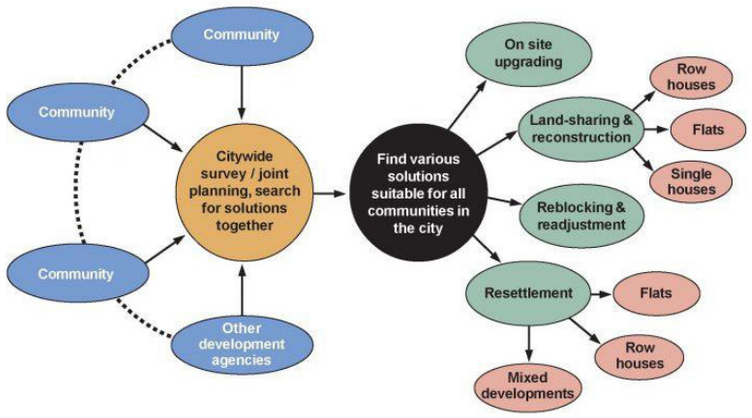
The programme lets communities take full charge, as they are responsible for the surveys, strategy, budgeting, design, and construction. CODI takes on the role of facilitator, providing direct funding, infrastructure, technical assistance, and (if needed) negotiator, while also optionally serving as a bridge between the communities and municipal authorities.

Central to the model is collective tenure through long-term leases or cooperative ownership. Its financial model is based on collective loans managed by the communities. How this security of tenure is achieved depends on the context of each community, as CODI can help negotiate with public and private land owners of the squatted site. If no solution can be found through leaseholds, collective land use, or other means to dwell within the existing settlement, CODI aids the community, searching for land for rehabilitation (CODI, n.d.).

The design of the new housing is also chosen through community decision-making. In situ upgrading, rehabilitation, core housing, multi-storey row housing, and other forms of dwelling are choices to be made by the people, depending on the negotiations.

This model has proven effective at scale: within its first decade, Baan Mankong upgraded over 90.000 households in more than 1,500 settlements across Thailand. Yet, like SPARC and the IA, the programme its strength lies not just in numbers but in developing local capacities and local partnerships to resolve local housing problems. The process also reconfigures relationships with the state, with municipalities often co-investing in infrastructure while communities lead the process (CODI, n.d.).

Yet, challenges remain. Although security of tenure is prevalent, long-term tenure can be uncertain. Additionally, precisely the model its strengths, such as the collective loans and collective ownership, a survey has shown residents are still "wary of the resulting debt burden" (Archer, 2011). Nevertheless, the process and physical housing product are rated highly. However, even CODI acknowledges that the physical form of housing is the easy part (CODI, n.d.). The real challenges for the communities lie in the issues of land, politics, negotiation and people.



The Baan Mankong process
(CODI, n.d.)

Conclusion

CASE STUDIES

Comparing the outcomes of the case studies, a framework for participatory, incremental housing can be established.

SPATIAL DATA

Looking at the compartive data of the case studies, a few things are noticable. Most of the incremental housing programmes reach a floor space index (FSI) of 1.0 to 1.5. Depending on the character of the base module, the GSI is either extremely low for core-housing, or relatively high in developed or growing house scenarios.

The incremental growth and size of the starter unit is related to each other in the way that a small core house leads to a large incremental ratio. Not surprisingly, the incremental ratios of Caja de Agua and other sites-and-services programmes are highest, reaching a ratio of 10.0 in extreme scenarios.

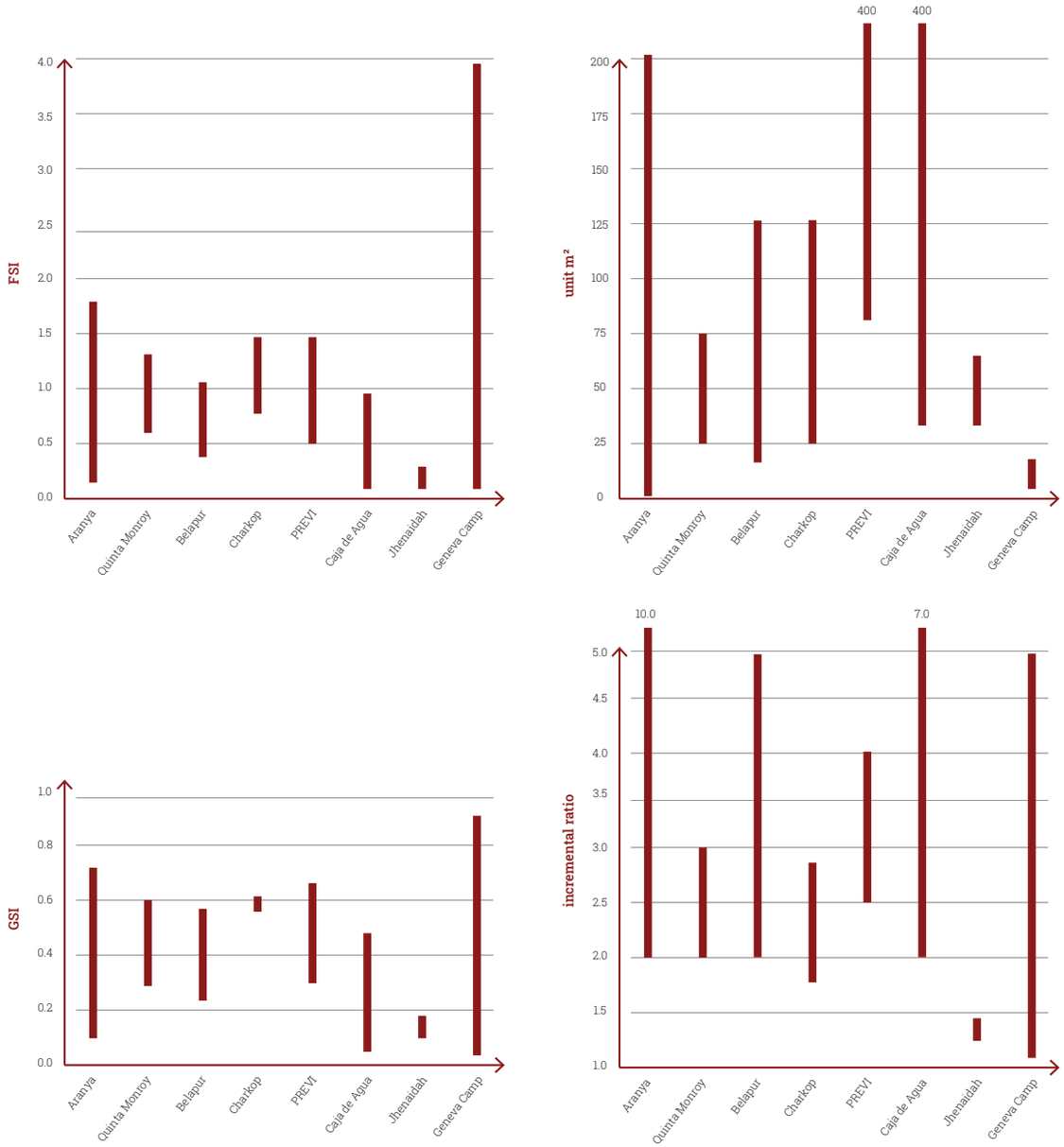
Geneva Camp and Jhenaidah are outliers in the graph, but are still put in as a comparitive guideline on the other forms of invremental development. SPARC and the Baan Mankong are not in the graphs, since these are form of organisation on many different project, which analysed on their managerial strategies, which do not have specific data on footage, FSI, or GSI.

MAIN LESSONS LEARNED

It is evident that good urban design facilitates architectural growth and liveable cities. Furthermore, location is a key enabler of a proper strategy. Since migrants move to the city for jobs, proximity to income generation is a must. Within the plan itself, income-generating activities must also be present. Hierarchical planning of urban spaces that facilitate amenities, communal spaces, and well-laid-out plot configurations is pivotal for the creation of a vibrant neighbourhood.

On the architectural scale, the case studies show that plot dimensions greatly affect how future incremental growth takes place. Small plots promote vertical growth, while buildings on vast plots tend to stay closer to ground level. Proper infrastructure and foundations are needed to facilitate the incremental growth, where the law of least effort can accurately predict the growth pattern.

The most recurring themes that enable the strategy's success on a managerial scale are the security of tenure, participation, guidance of the project by the architects, NGOS or others, state funding, and cross-subsidisation. Residents must take responsibility and get involved in the entire process. This way, people feel connected and responsible for the design and maintenance, while they also learn how to develop adequate housing. These lessons can then be passed on to other communities in their search for proper housing.



Comparative analysis of the case studies on spatial data for the initial and developed scenarios

IV. CONTEXT & FIELD RESEARCH

Shonatola Low-Cost Housing
architecture for the people

Field trip programme

CONTEXT & FIELD RESEARCH

From December 4th 2024 to December 14th 2024, the Global Housing group visited Bangladesh. For our research, we visited the regions of Dhaka and Sylhet. Under the supervision of Marina Tabassum, Nelson Mota and Rohan Varma, we visited various informal settlements and architectural sites in Dhaka.

In Dhaka, we developed a deeper understanding of the ways of living through conversations with slum dwellers. Some of the informal settlements visited were the Korail slum and Mohammadpur Geneva Camp.

Near Dhaka, we also visited the housing production of the typical Bangla Baton houses. These dwellings are preconstructed on one central site. After purchase, the dwelling is disassembled and reconstructed on the plot of the buyer.

In Sylhet we worked in partnership with Shahjalal University of Science and Technology (SUST). Through lectures and guided field visits to the local slums, villages, communities, and building sites, we gained a broader understanding of Bangladeshi building methods and way of living. Additional visits to tea plantations, the haors (wetlands), and national parks provided further insight in the context we were working in.

What follows is a brief documentation of my photographs taken on the field trip. All photographs are taken with permission only.

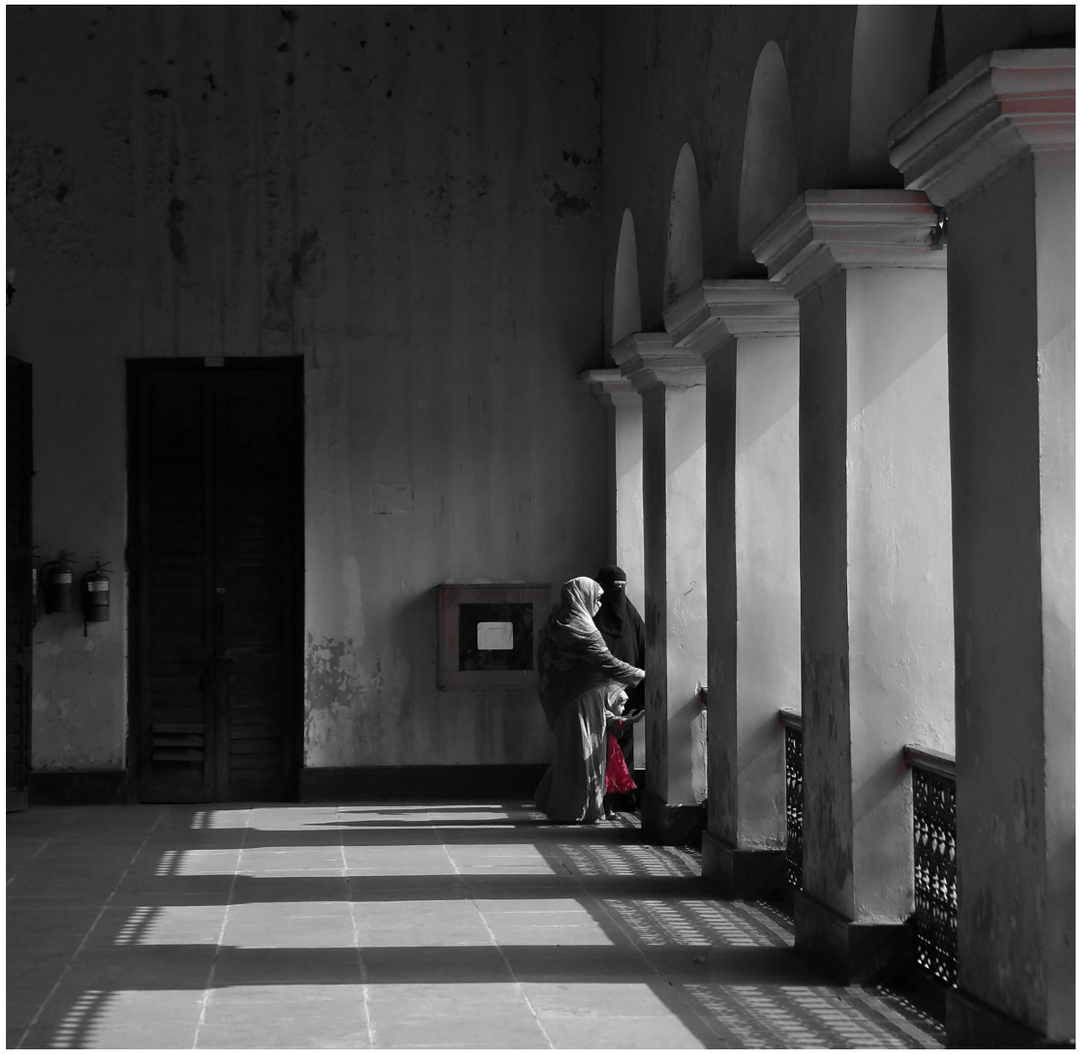
Site visit at Geneva Camp

Group photos at the Bangla Baton construction site and SUST

Selected photographs

CONTEXT & FIELD RESEARCH

Windows at Mohammadpur Geneva Camp



Museum visitors, Dhaka

Children and women near Bait Ur Rouf mosque, Dhaka

Children near Bait Ur Rouf mosque, Dhaka

Battle for light at Mohammadpur Geneva Camp, Dhaka

Shop in old Dhaka

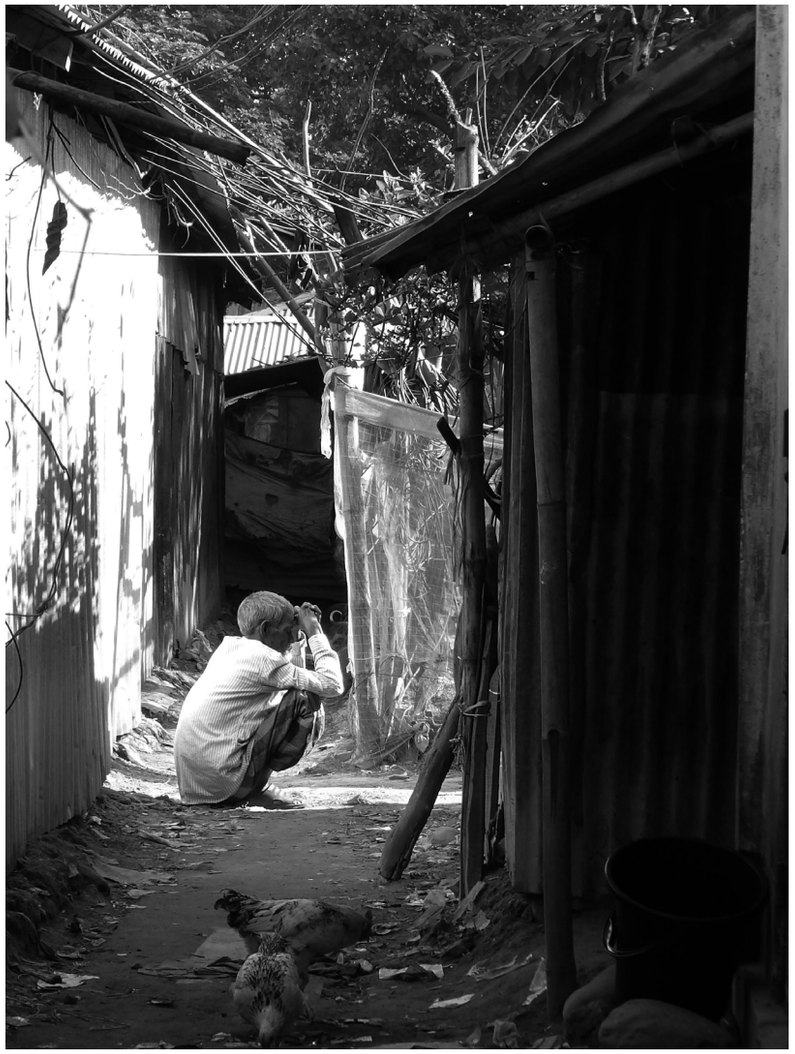
Farmer in the haors

Shop in old Dhaka

Sweepers colony as seen from Keane brige, Sylhet

Man on a boat in the Laladihi pond, Sylhet

Curious children, Sylhet



Man, Sylhet

Parliament, Dhaka

Cow near a house, Shonatola

Woman at Shonatola village

Smoke and smog, Dhaka

Climate

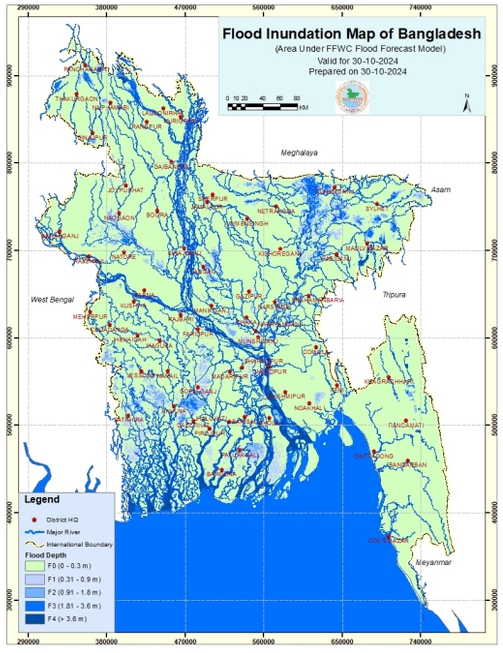
CONTEXT & FIELD RESEARCH

Temperatures in Bangladesh can vary from 12.3 ˚C to 28.1 ˚C in winter and from 22.8 ˚C to 33.4 ˚C in summer. Comparing Sylhet to Dhaka, Sylhet has a slightly cooler climate.

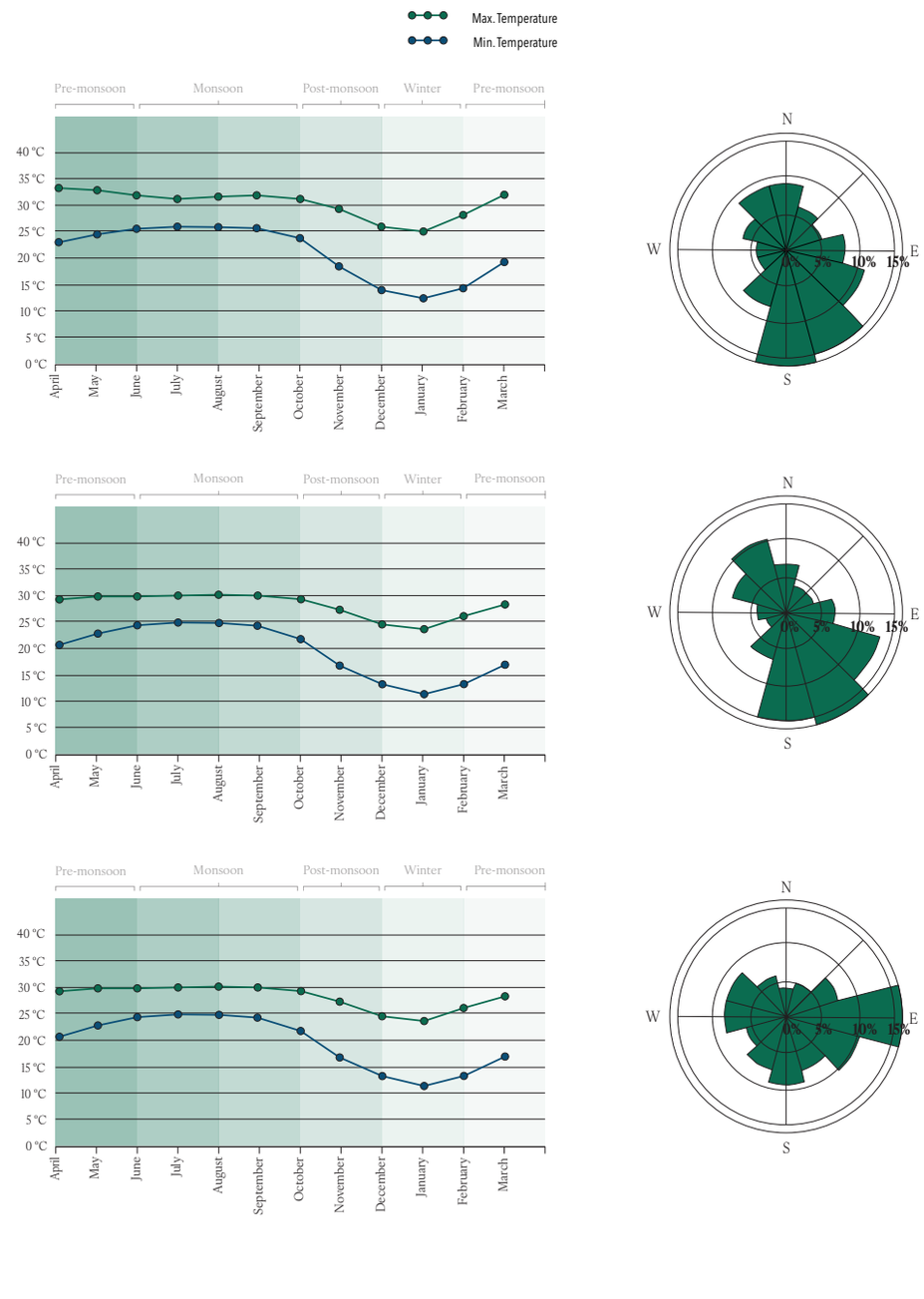
Compared to Dhaka and most of Bangladesh, Sylhet has an irregular wind direction. The dominant wind direction for most of Bangladesh and Dhaka is South/Southwest, while Sylhet mainly has strong winds from the East.

During the monsoon season (March to September), winds come in from the South/ Southwest across the Indian Ocean. Outside of the monsoons, this wind speed decreases.

In terms of rainfall, Sylhet is one of the wettest areas of Bangladesh. Not surprisingly, it is therefore also one of the regions most prone to floods.



Flood Inundation Map of Bangladesh
(Flood Forecasting & Warning Centre, 2024)



Climate data of Bangladesh (Climate Data, 2024; Global Wind Atlas, n.d.)
As documented in Global Housing, Architecture of Transition in the Bangladesh Delta (TU Delft Global Housing, 2023)

Sylhet & Shonatola

CONTEXT & FIELD RESEARCH

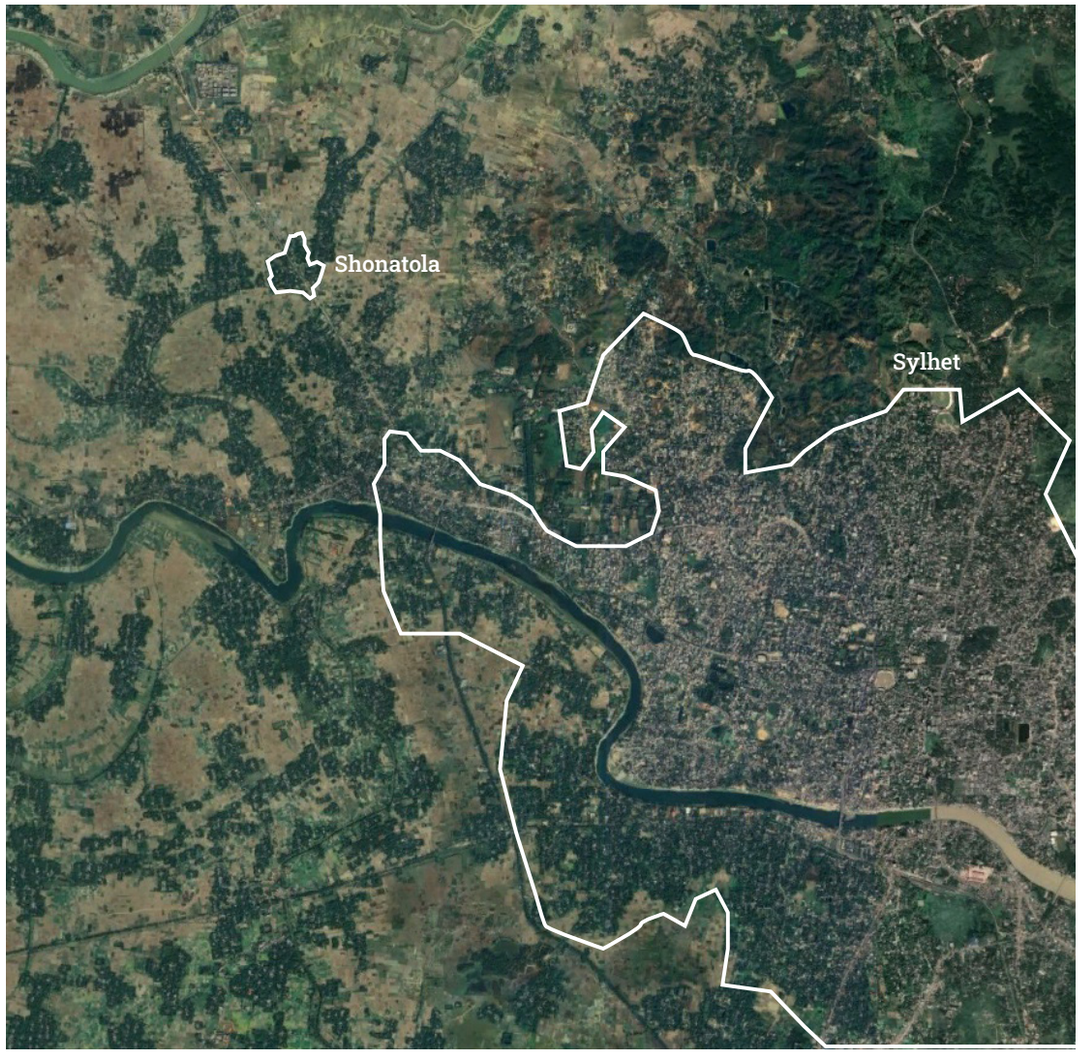
As mentioned at the start of this research, Sylhet is one of Bangladesh's largest cities. Located in the Northeast of Bangladesh, it finds itself in a hilly terrain. The Sylhet division is known for its lush nature and tea gardens, but also for its economic significance.

Similar to other second-tier cities around the country, Sylhet is expanding rapidly. This growth has expanded the city's footprint beyond its historic core, exerting increasing pressure on the surrounding rural landscape. Sylhet is slowly annexing neighbouring villages that find themselves in a transitional peri-urban space. These transitional spaces, which were predominantly self-sustaining and agriculture-focused by nature, are currently forced to face land speculation, rising living costs, and changing social structures. This story is further visualised through satellite images over the years.

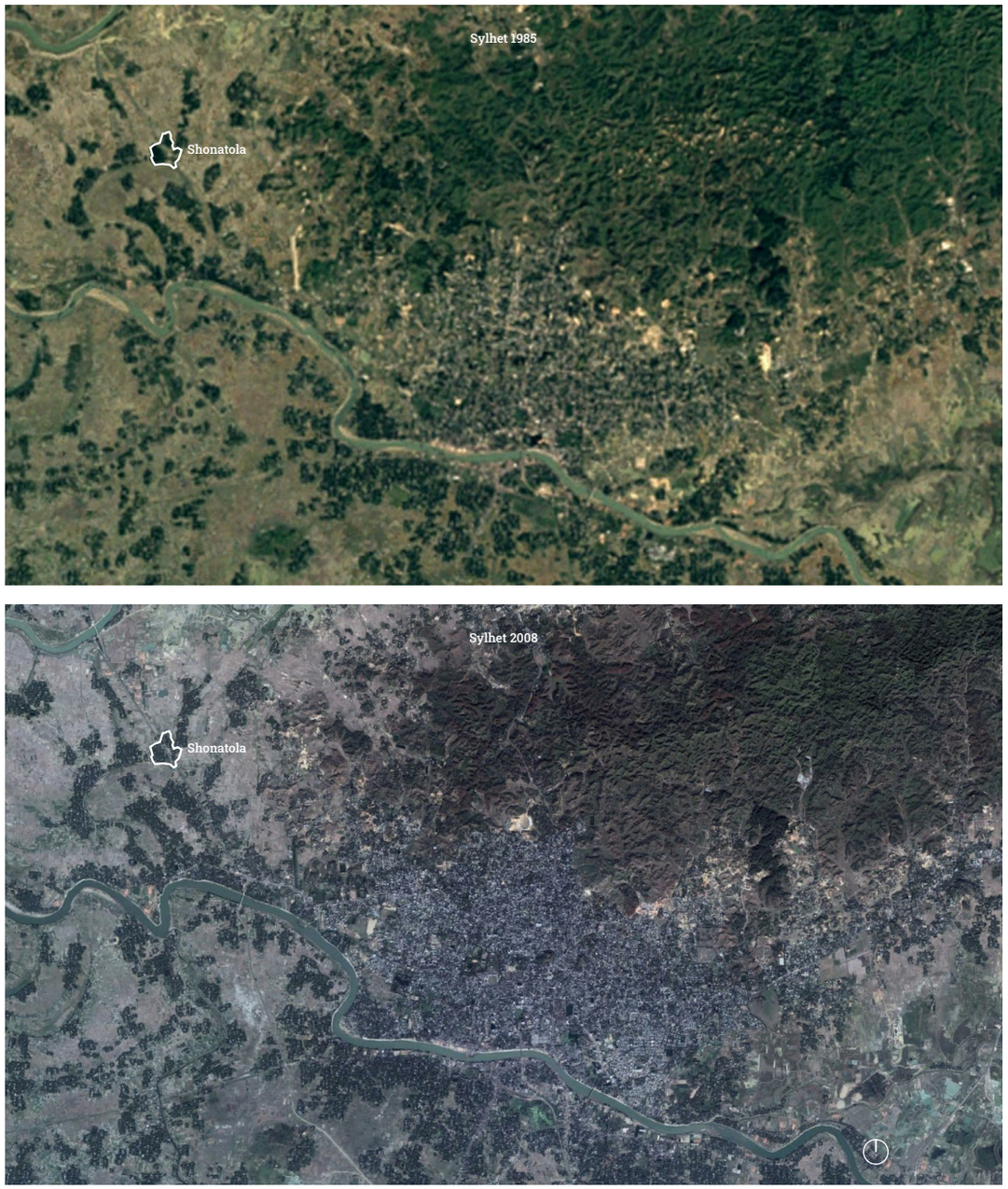
One of these villages is Shonatola. The village finds itself along the Badaghat road and houses around 1800 people, all living in courtyards in smaller communities. Still, most people engage in agriculture or work as vendors and handymen at the bazar.

South and North of Shonatola are the Shari Goyain and Surma river. The rivers flood several times per year, exposing the entire village to climate disaster. Paired with heavy rainfall, these floods can take up to five days before settling down. Most of the infrastructure and non-concrete houses need to be rebuilt, as the majority of dwellings are made from bamboo and CI sheets.

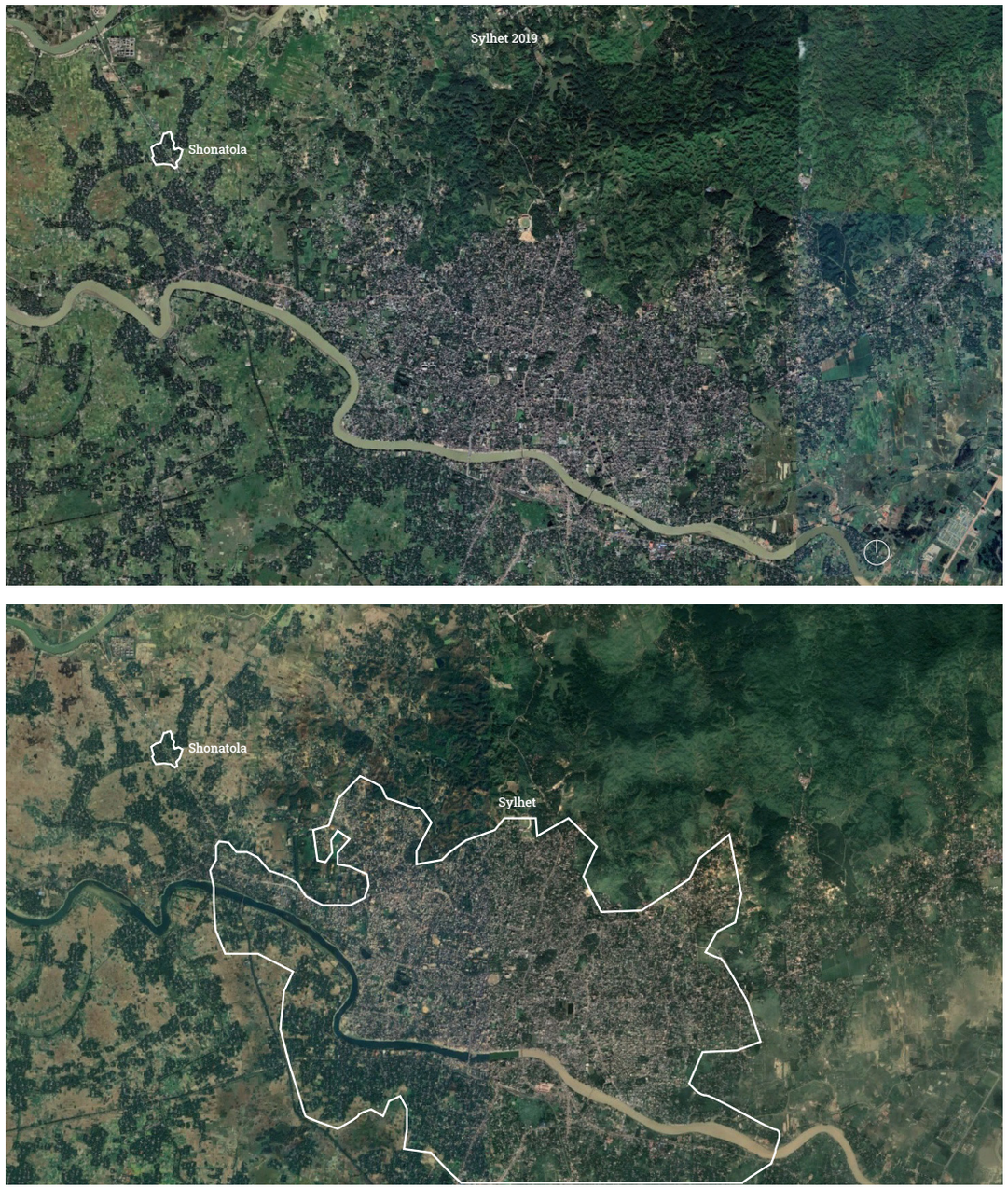
Dhaka and Sylhet



Sylhet and Shonatola (Gooogle Earth, 2025)



Sylhet and Shonatola over time (Goooogle Earth, 2025)



Sylhet and Shonatola over time (Goooogle Earth, 2025)

Shonatola

Amenities

Community significant clusters

CONTEXT & FIELD RESEARCH

Shonatola is most characterised by its amenities along the Badaghat road. These amenities are clustered inbetween the agricultural land and dwellings. I deem these the community-significant clusters, since they are the heart of the village. The main clusters are the school and mosque cluster and the bazar.

SCHOOL-MOSQUE CLUSTER

The school and mosque cluster is centrally located. Directly accessed from the road, the school serves not only as centre of education, but also as a place of refuge during floods. The reasoning behind this, is that the school is one of the few multi-storey RCC buildings.

Behind the school, along a dirt-path, one finds the mosque. The mosque is one of the central meeting places of the villages. Additionally, the post office is found next to the religious centre.

BAZAR CLUSTER

The bazar is the heart of the village. The relatively busy market is the centre of commerce. Apart from shops, spots for woodwork and other building activities are located in its vicinty. A large community centre, which can be rented out for weddings and other events is located at the South of the cluster. Across the road, the graveyard forms a fork in the centre of the village.

School and mosque cluster

Bazar cluster

Bazar cluster

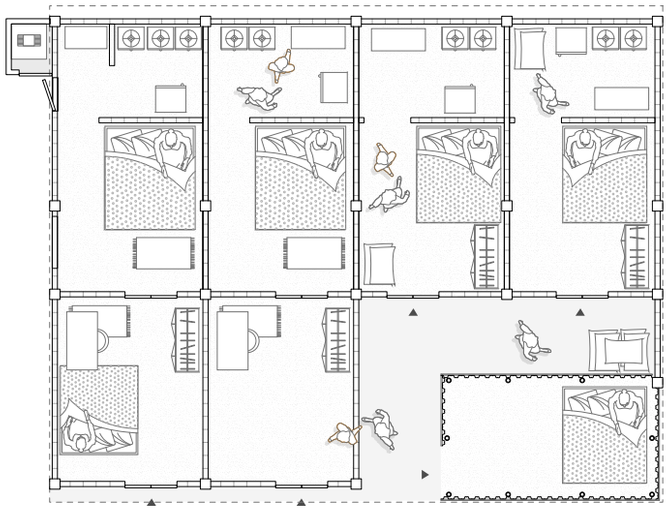
Incremental housing

CONTEXT & FIELD RESEARCH

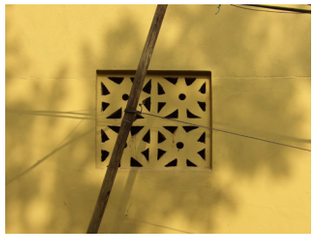
The dwellings are clustered in courtyards. Often families live here under one or multiple roofs. Most families are poor and live in inadequate housing.

The materials are upgraded incrementally. Through long processes of saving up money and upgrading materials or expanding the dwelling, residents aim to upgrade their housing into RC structures with brick infills.

The dwellings currently found are often linear in plan. One enters a small room, often for storage or home labour. The bedroom is often behind the entry room, with a kitchen at the back. If present at all, the toilet is found at the side of these constructions.

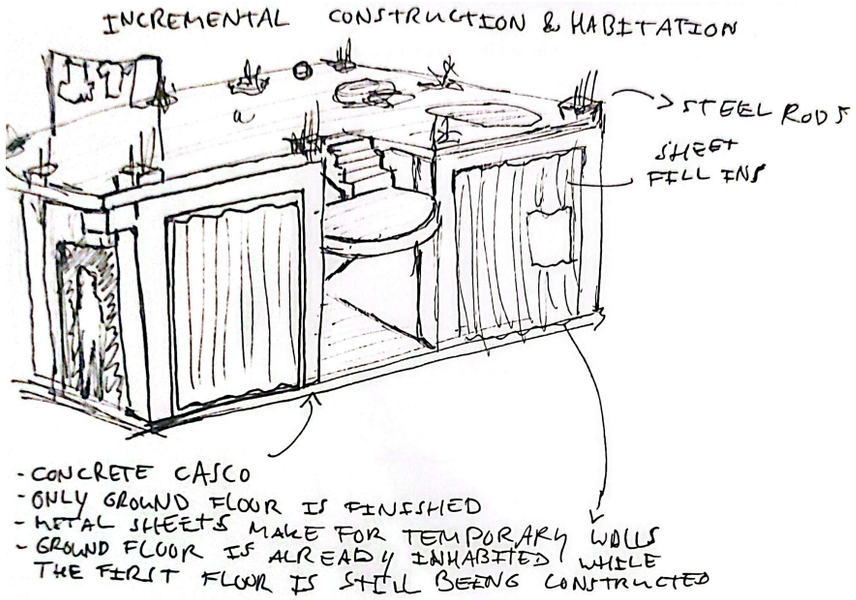


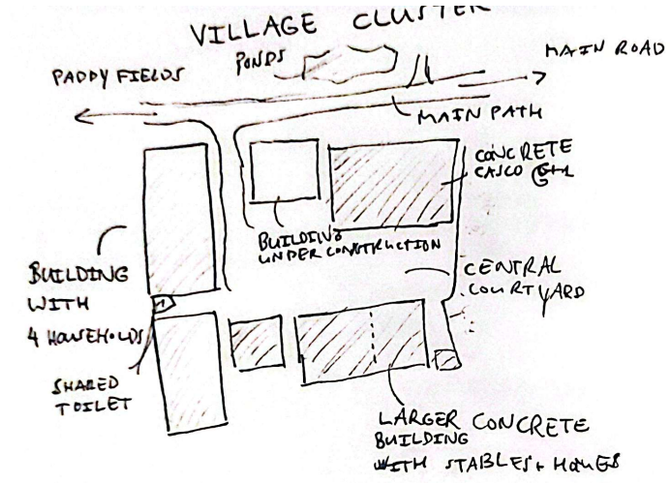
Floorplan of homes along a courtyard



Details of dwellings

Dwellings of the village





CLUSTER OF BIG FAMILY, OFTEN 5-9 PEOPLE PER HOUSEHOLD.
≈35 PEOPLE/CLUSTER

MOST BUILDINGS USE CORRUGATED SHEETS
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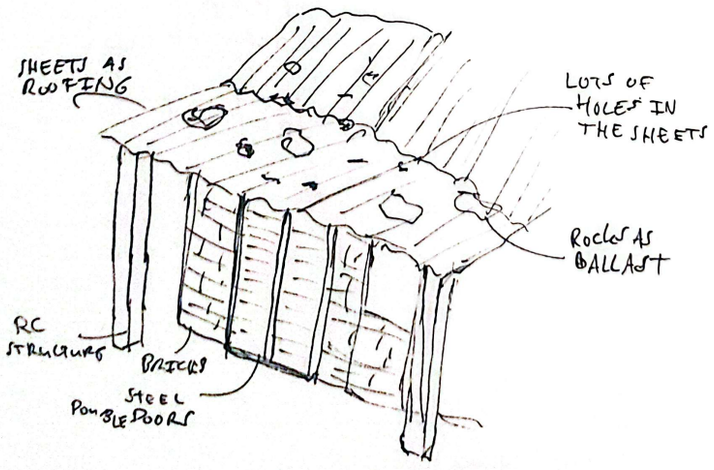
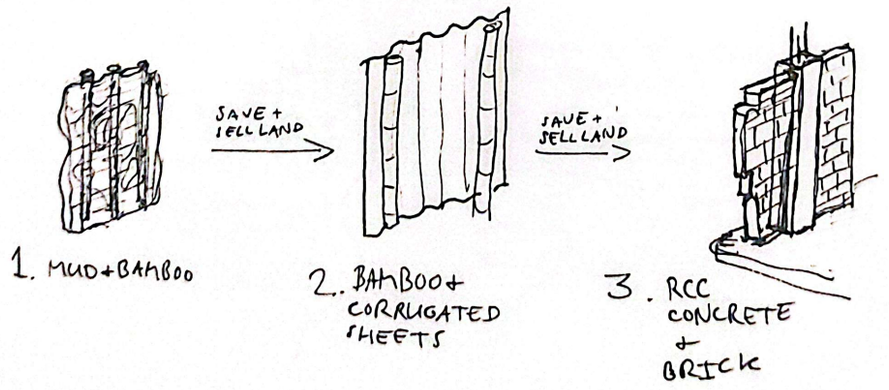


BUILDING IN PHASES - INCREMENTAL UPGRADING

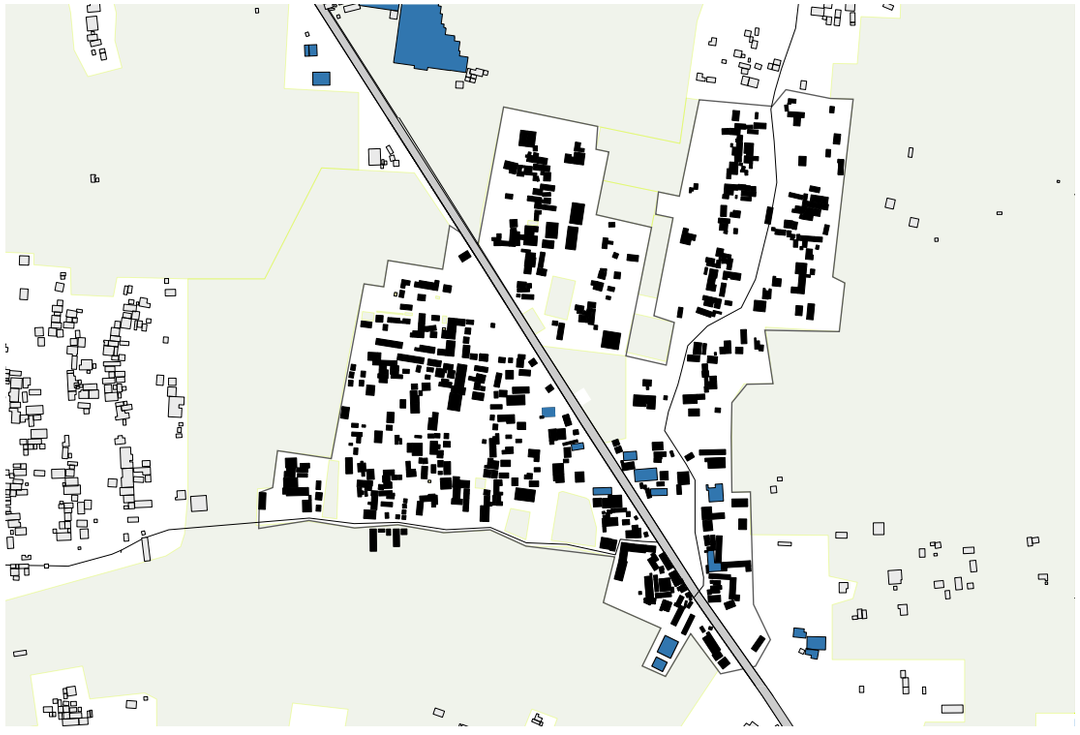


Sylhet expanding

CONTEXT & FIELD RESEARCH

Sylhet's expansion has become clearly visible through a number of factors. For one, the municipality took land from the village to widen the Badaghat road into a four-lane highway. Alongside, the municipality started constructing drainage works to keep the road from flooding.

Moreover, plot-based developments are taking over the village. As the land along the road increased in value, developers started constructing mid-rise dwellings. These plot-based developements cause for an incherent and contrasting image. Fears among the villagers have come up that Sylhet and Shonatola may be onthe path to become like Dhaka.



Plot-based developments

The evolution of Badaghat road (Left: Google Street View, 2022)

Dainage works

Plot-based developments

Plot-based developments

Plot-based developments

Conclusions

CONTEXT & FIELD RESEARCH

Concluding from the analysis, it is evident that the village needs guidance for a proper rural-urban transition that allows for liveability and affordable housing.

The site analysis can be summarised best through 6 steps:

i. Shonatola finds itself along a newly constructed highway, increasing traffic movement from and to Sylhet. The low-lying terrain and paddy fields get flooded through pluvial and floods by the nearby rivers.

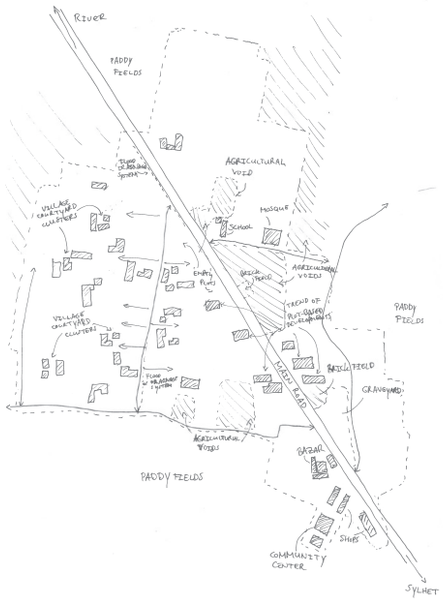
ii. The amenities (school, mosque and bazar), the significant community clusters, are the centre of the village.

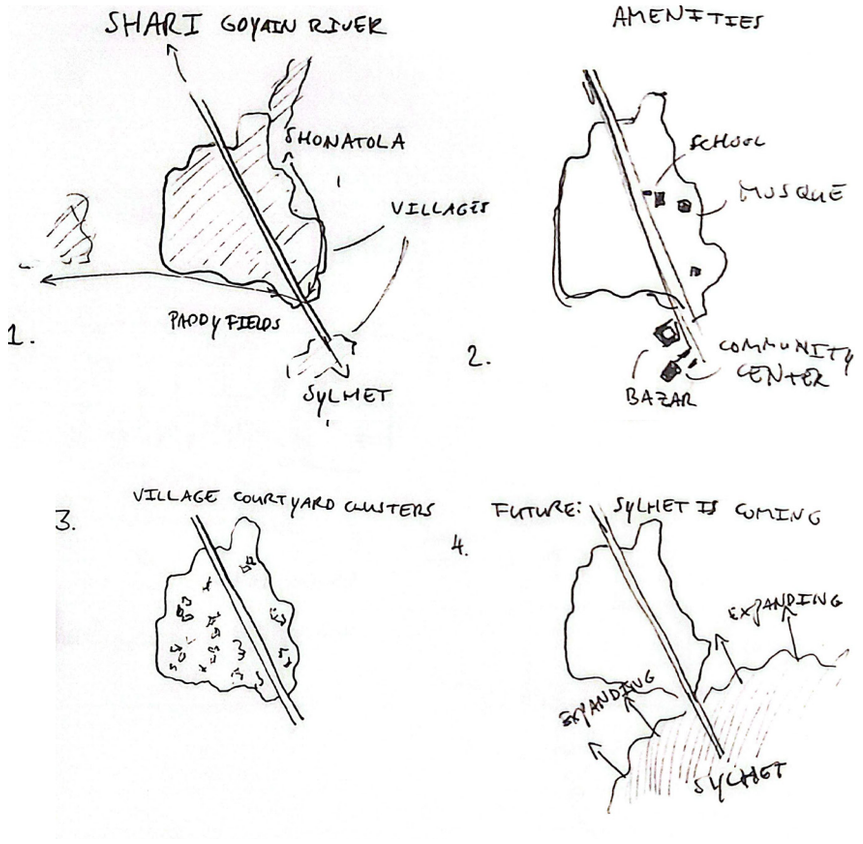
iii. Dwelling currently takes place further from the road in courtyard clusters.

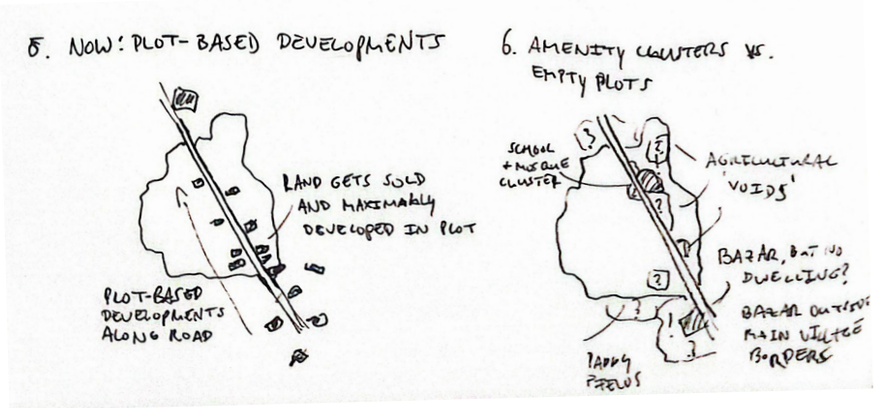
iv. Sylhet's expansion calls for direct action for a well-managed rural-urban transition.

v. Plot-based developments along the main road have negative consequences on the village.

vi. The urban fabric still holds many 'agricultural voids'. Surprisingly, these voids are directly adjacent to the community-significant clusters.







Main conclusions diagrams

Part II

DESIGN

V. DESIGN CONCEPT

Shonatola Low-Cost Housing
architecture for the people

Concept

DESIGN CONCEPT

The research has defined a clear base for the design concept for Shonatola's rural-urban transition. The concept is centred along two main principles: incrementality and community strengthening and upgrading.

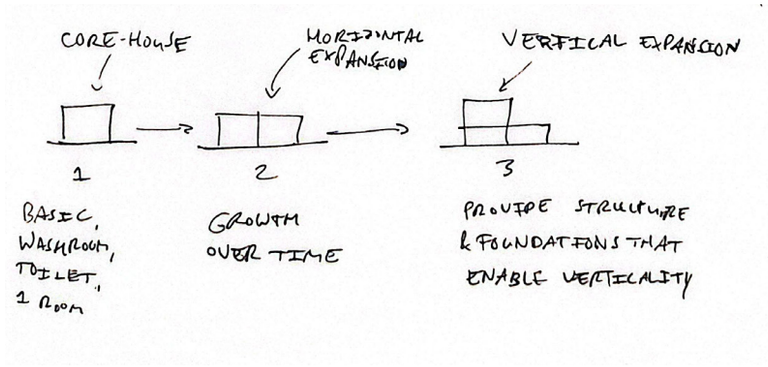
Incrementality

The research strongly recommends incremental housing as a strategy for affordable housing. This is the project's main pillar. Moreover, the incremental housing strategy follows a number of subcriteria.

i. Through adapted sites-and-services and the philosophy of Correa, Doshi, and Aravena, the incremental housing approach must be made site-specific. Instead of a tabula rasa or empty slate as starting point, the strategy must be interwoven with its context.
ii. For this context-based approach, development predominantly occurs on the unbuilt plots along community-significant clusters.
iii. Economic design choices ought to be made in planning, materialisation and building techniques.
iv. The strategy requires a setup that leads to an easiliy replicable model for future application in other areas.

community strengthening & upgrading

i. Build with the community. Participation is pivotal, as through interviews with the residents the model is developed to fit their needs and aspiration picture.
ii. Collective spaces must be fostered and enhanced through amenities and courtyards on various scales, from community-significant cluster to semi-private backyards.
iii. Match bottom-up & top-down through self-organisation and expertise urban planning and design.
iv. Embrace auto-construction as a tool and encourage individuality.
v. Displacement must be minimised. Instead of viewing existing structures as unfit and through a negative lens, although not always structurally adequate, many can be kept. The strategy must not destroy proper dwellings that families have long saved up for, only to move the families away and have them pay for the new 'designed' dwelling. By mostly building on 'empty' plots, destruction, and therefore displacement, is kept at a minimum.

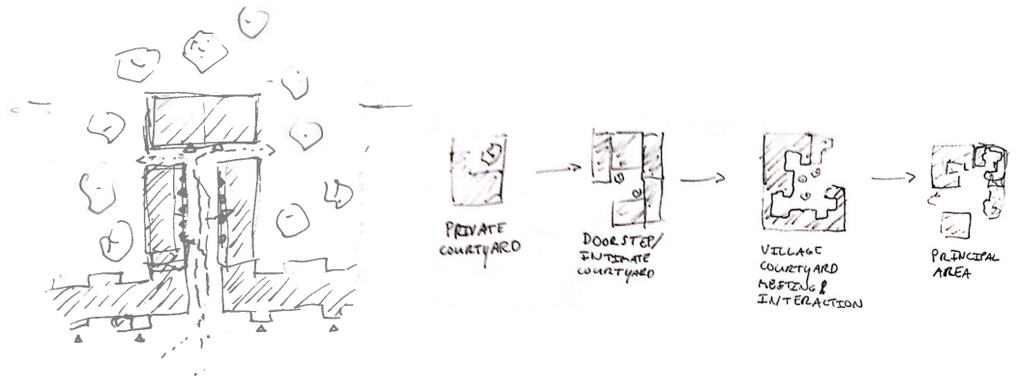


Incrementality

i. site-specific
ii. community-significant clusters
iii. cost-effective
iv. replicability

community strengthening & upgrading

i. participation
ii. collective spaces
iii. bottom-up & top-down
iv. individuality
v. minimise displacement



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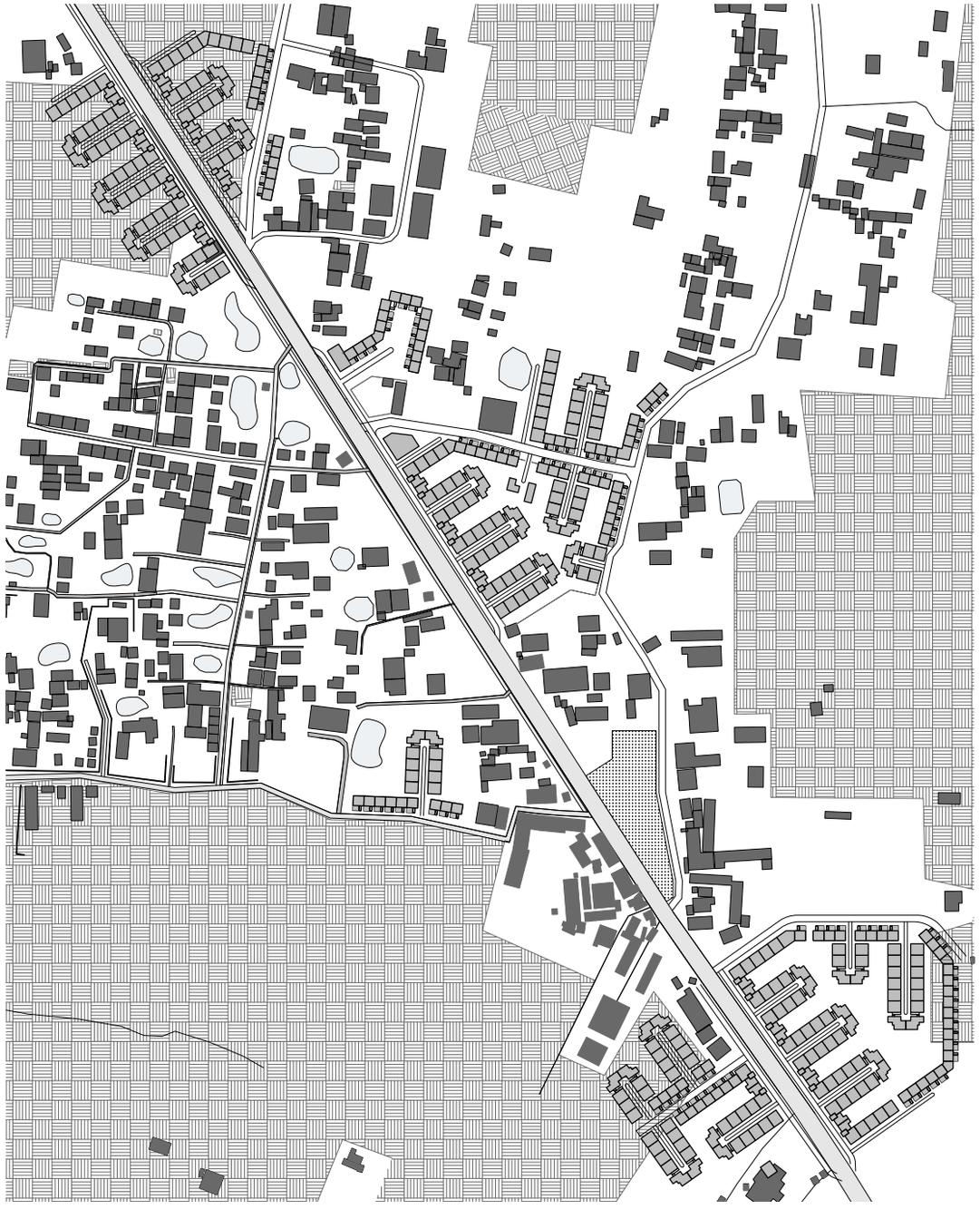
Masterplan

DESIGN CONCEPT

The masterplan focuses on developing clusters along Badaghat Road. These clusters are situated on currently unbuilt, centrally located plots, allowing for site-specific interventions that respond directly to local needs. As community-significant spaces, these areas have been identified as the most logical and impactful locations for residential expansion.

Cluster size varies based on the scale and availability of land. Larger clusters are positioned around key social anchors, such as the school-mosque and the bazaar, which play a central role in the village's identity. Meanwhile, smaller, more modest interventions are inserted between existing built-up areas, highlighting the context-sensitive nature of the design approach.

The urban design supports both present social patterns and future growth. By organizing homes around shared courtyards, the layout promotes social cohesion while improving accessibility and safety. Infrastructure is integrated incrementally, supporting phased development and active community participation. The layout prioritizes collectivity, natural ventilation, and effective drainage within a low-rise, high-density framework. Unbuilt plots are preserved to allow for future adaptation and expansion as needs evolve.



Typologies

DESIGN CONCEPT

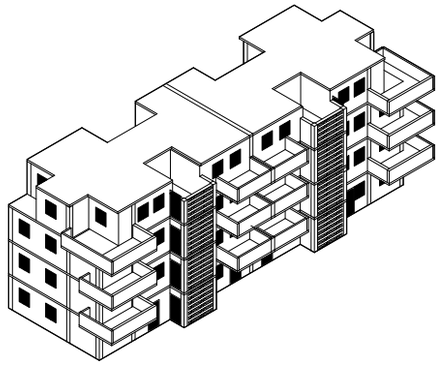
Dictated by the location of the dwelling in relation to the context, four main typologies shape the urban design. From core units to full dwellings, the designs support personalization while maintaining structural integrity and shared architectural language.

Located along the highway, typology A is aimed at middle and high-income target groups. The main criteria for its location along the Badaghat road is the need for income creation, as the highway facilitates more opportunities for economic activity. Seeing as the plots along the main road are the most expensive, the multifamily building has the highest FSI and consists of various large apartments.

Within the courtyards, typology B provides housing solutions for the poorest of the poor. The core-houses are sheltered from the highway through its courtyard configuration, providing intimacy and stimulating incremental growth.

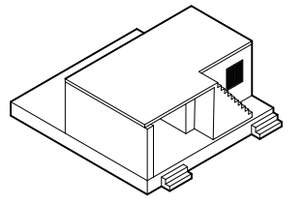
Typology C can be viewed as a further developed version of typology B. The expendable houses find themselves at the head of the courtyard and are aimed at low-income groups. Similarly, this typology still allows incremental growth.

Typology D is located along the secondary roads. It is aimed at more stable low-income groups. It allows for incremental growth by extensions in the designed voids.



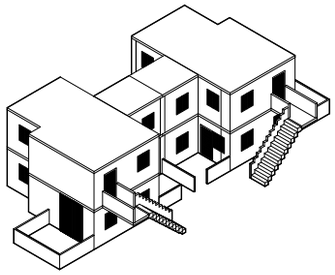
TYPOLOGY A

along highway
commercial plinth
multi-story
middle-high-income



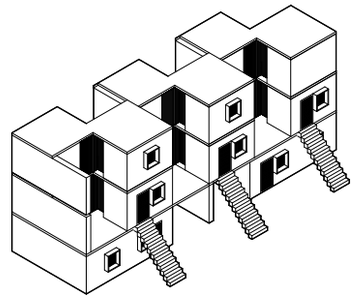
TYPOLOGY B

in courtyards
core-house
incremental character
'poorest of the poor'



TYPOLOGY C

end of courtyard
expendable house
incremental character
low -income

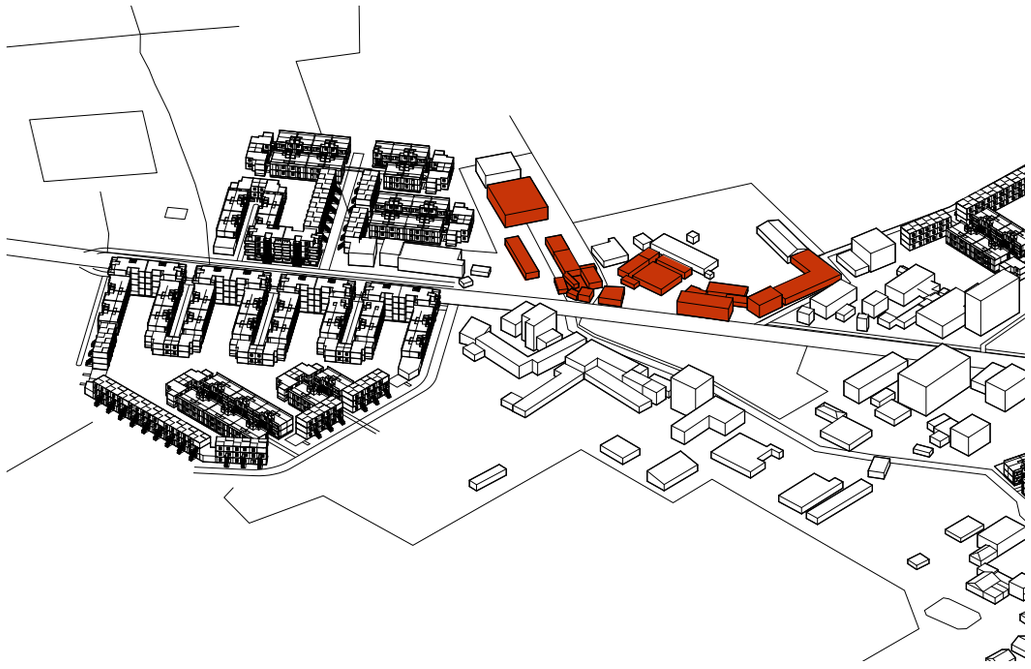


TYPOLOGY D

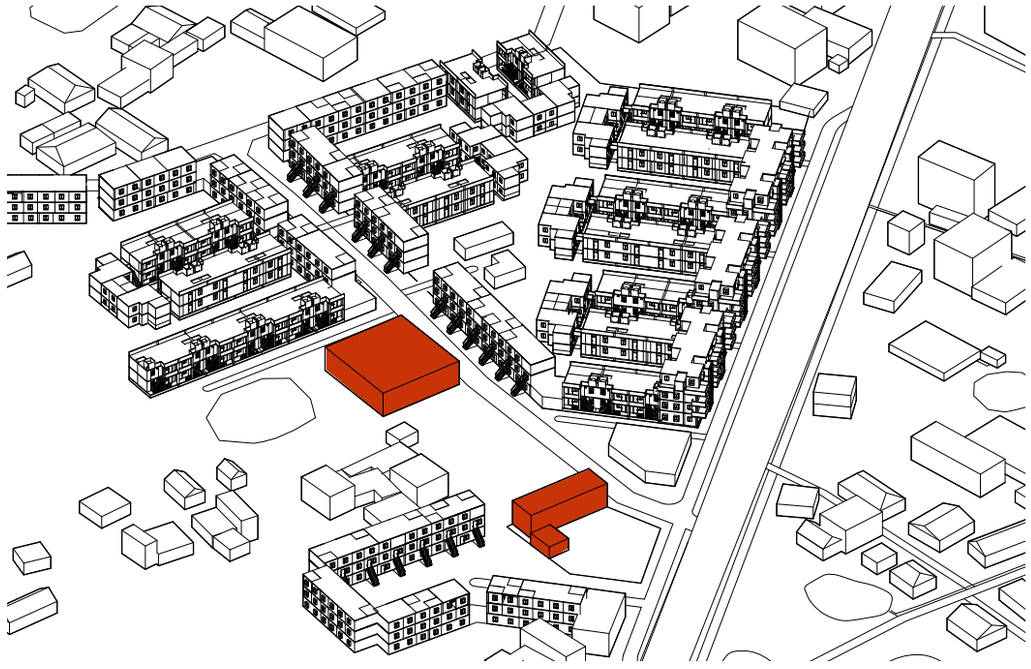
along secondary roads
expendable house
incremental character
low-income

Main typologies

Masterplan of the school-mosque cluster, highlighting amenities present



Bazar cluster, original amenities highlighted



School-mosque cluster, original amenities highlighted

Incremental growth

DESIGN CONCEPT

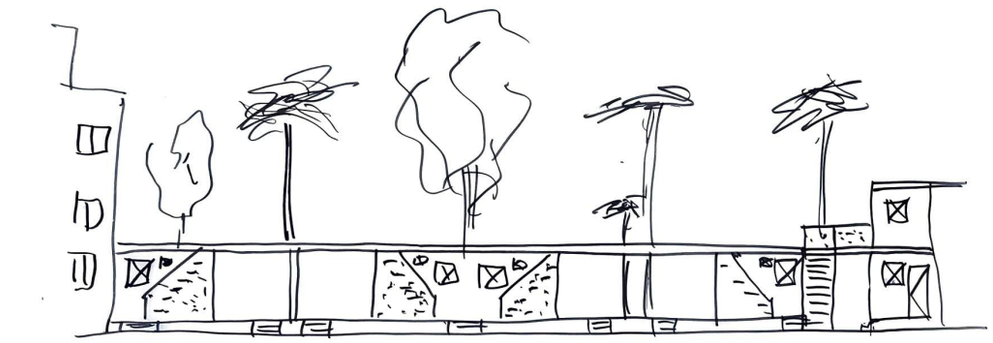
The incremental nature of the design, including its clustered courtyards, is rooted in the earlier research conducted on incremental housing. A clear understanding of how families expand their homes over time forms the foundation of this proposal.

The base scenario delivers the essential components that are most difficult for residents to construct independently. For all typologies, this includes infrastructure, a flood-resilient raised plinth, foundational structure, a kitchen, a bathroom, and a roof. These elements meet the minimum standards of adequacy and must be built with durable, long-lasting materials to avoid future structural compromise.

The design embraces the 'law of least effort' to support incremental expansion. Early extensions typically occur in the most easily claimable areas. Therefore, the base scenario anticipates and accommodates this logic. Pre-laid foundations, structural voids, and spatial margins are intentionally integrated to guide, facilitate, and simplify future growth, rather than obstruct it.

Each dwelling is designed to support a fully developed scenario of approximately 80 m². In doing so, the design embeds the potential for upward mobility and middle-class DNA aspirations into the physical fabric from the outset.

Crucially, the success of any incremental strategy depends on security of tenure. Without legal or social guarantees that residents can remain, no matter how good the design, incremental additions will not take place, as this is not worth the personal investment combined with any risk of eviction.



Incremental growth of the courtyards between start scenario and 20 years upon completion

Impression of the courtyard cluster

VI. TYPOLOGY B

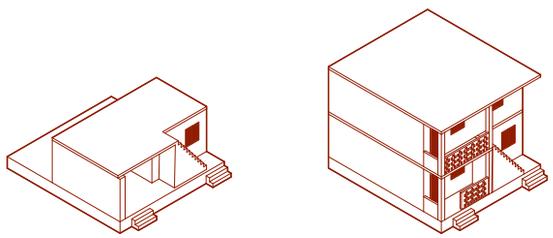
Shonatola Low-Cost Housing
architecture for the people

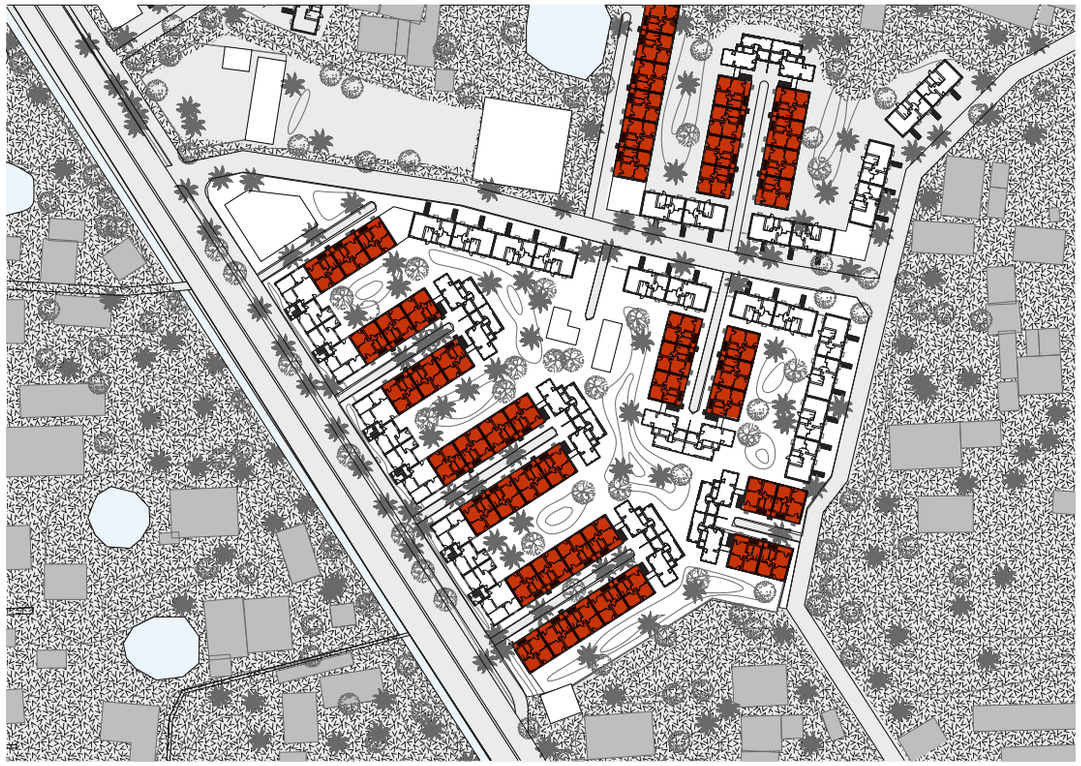
Design principles

TYPOLOGY B

The design of the project's main unit is inspired by the core-houses of various sites-and-services schemes from the case studies. Most notably, the influences of Doshi's Aranya are clearly visible.

The core-houses for the poorest of the poor are situated in the courtyards. In these semi-private spaces, eight core-houses are clustered and mirrored to minimise costs, while maintaining an intimate and context-suited design. The courtyard design is inspired by Charkop sites-and-services urban layout.





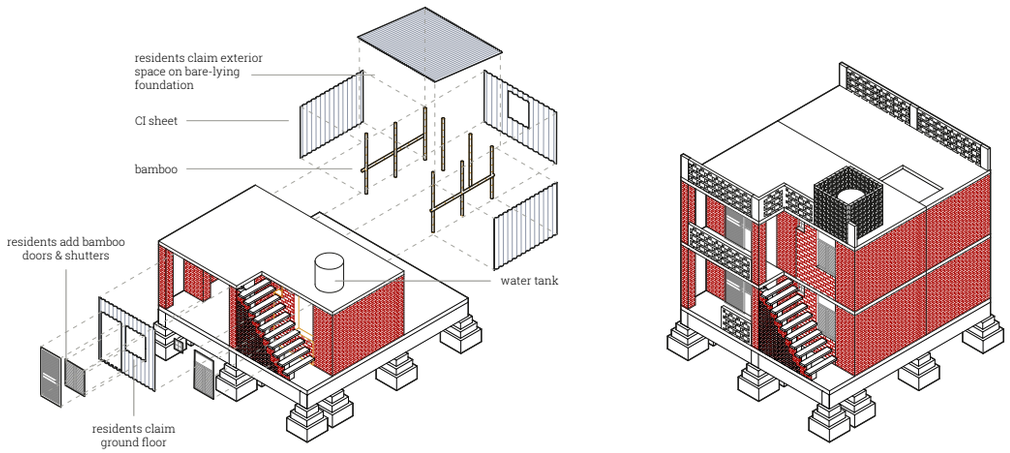
Core-houses at the school-mosque cluster

Construction

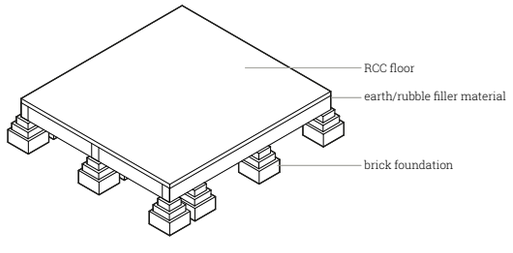
TYPOLOGY B

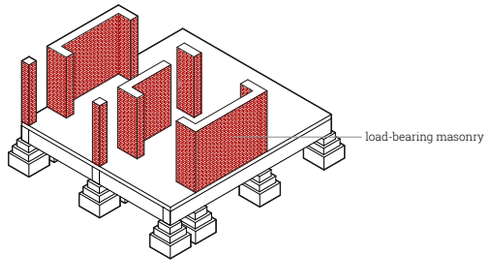
The construction approach prioritizes affordability, speed, and upgradability. The foundation of the core house is made from fired brick. On top, a concrete slab provides the base platform for construction. The robust materialisation and raised plinth provide resilience against future floods and keep water out of the house. On top of the foundation, load-bearing masonry is provided, as well as a staircase.

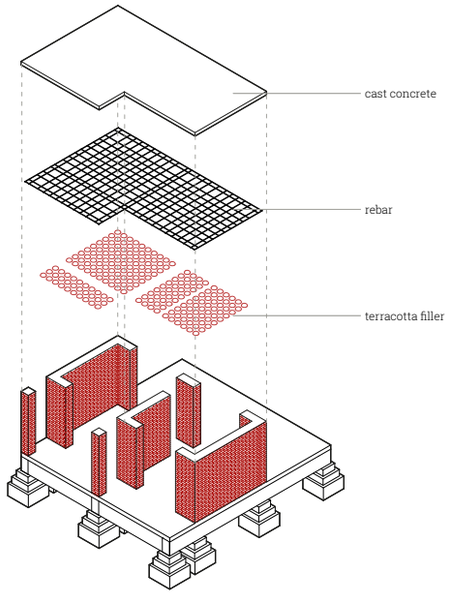
Upon completion, residents can claim the core unit with CI sheet and bamboo from their current dwellings. As residents gain resources, the unit can be extended both horizontally and vertically. The materials are gradually upgraded from CI sheets and bamboo to masonry or other desired materials. Auto-construction is encouraged, with clear detailing to guide safe, staged development.

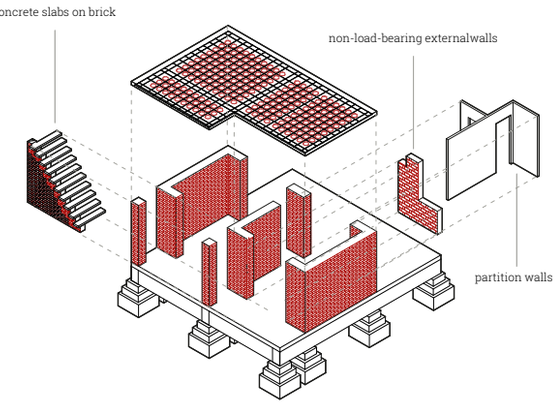


The starter core-house and its possible developed outcome

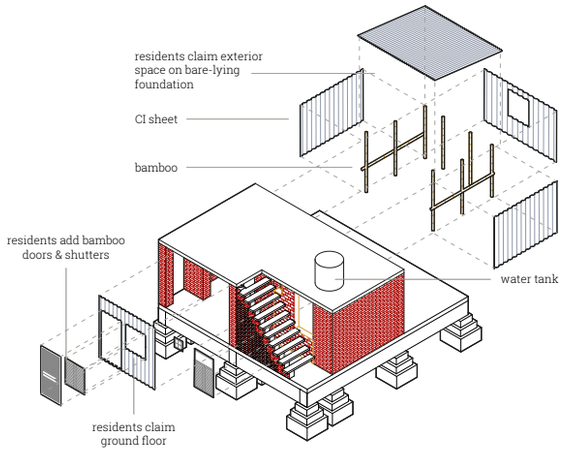


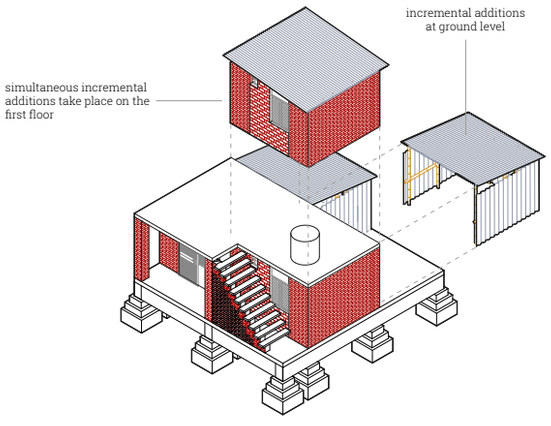


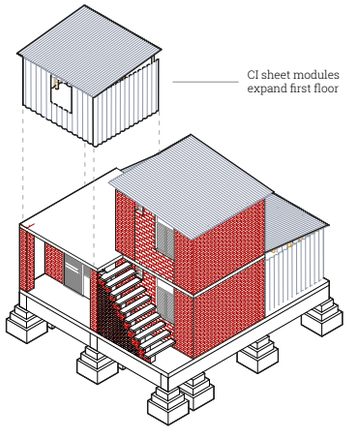


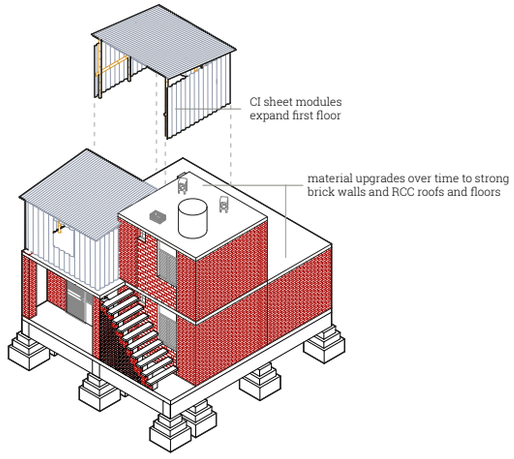


Construction of the core-house

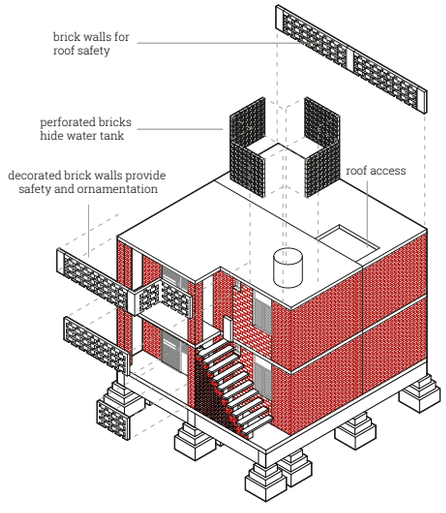


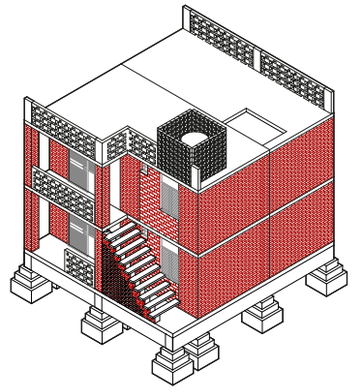






Construction of a developed scenario





Construction of a developed scenario

Base scenario

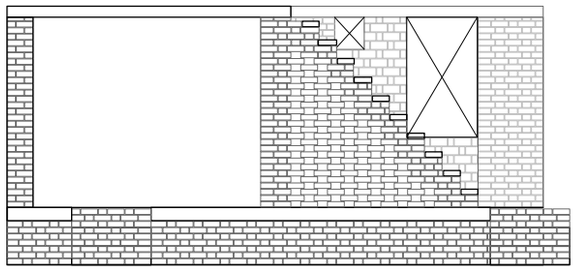
TYPOLOGY B

In the initial phase, residents receive access to a serviced plot with the core housing unit. The 12 m² core house on a 7m x 8m plot. The foundations and raised plinth are laid out beyond the core to facilitate and guide future extensions.

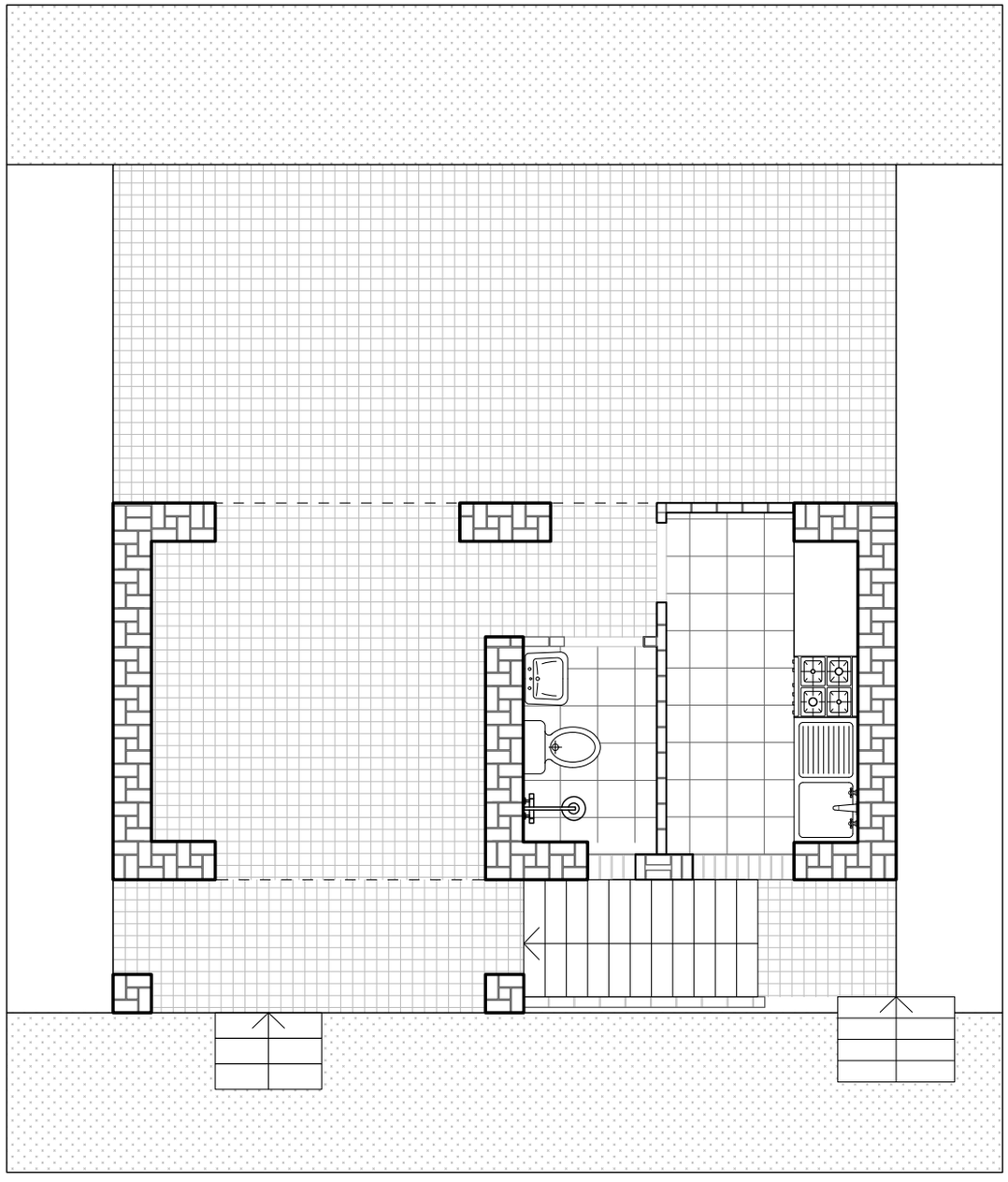
The 3,5m x 3,5m core provides a bathroom and kitchen. The floor slab runs over to the load-bearing masonry across the entire width of the plot, thereby creating a void that can be easily claimed later on.

Connected to the core, a staircase leads to the first floor. Underneath the stairs room is left vacant for storage. The verandah created by the positioning of the stairs and core is based on the many transitional spaces found at the existing dwellings of Shonatola.

Window and door openings are left void. It is up to the residents to provide these. This is one of the many cost-effective design choices to render the unit most affordable for the poorest of the poor.



Elevation of the base scenario



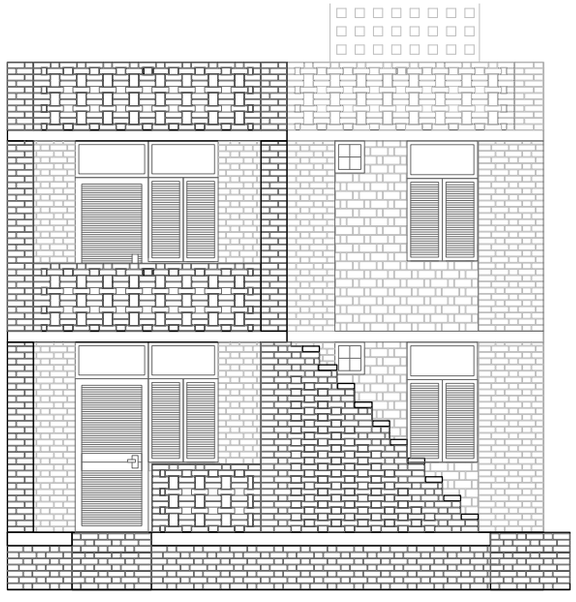
Ground floor of the base scenario

Developed scenario

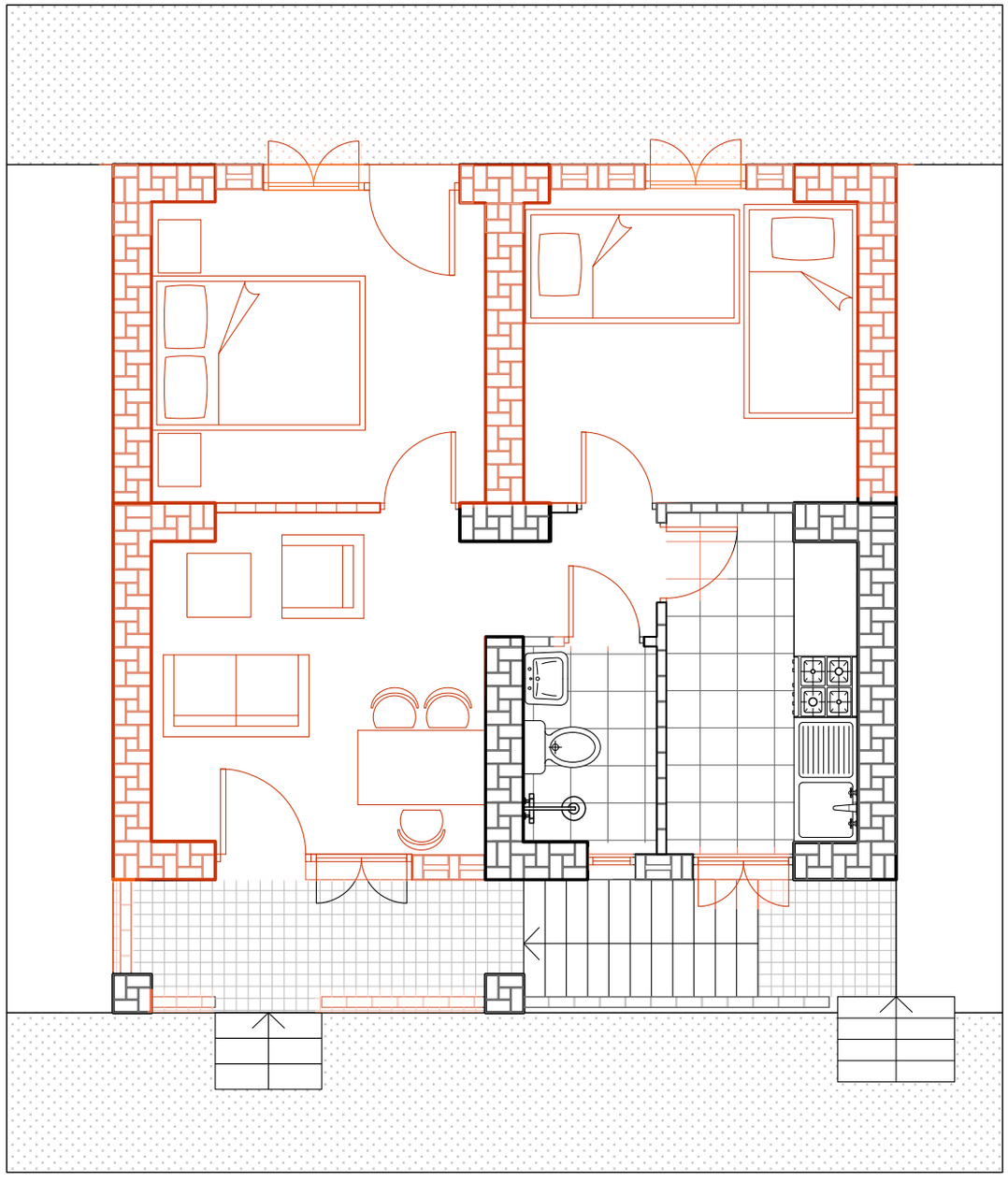
TYPOLOGY B

A future developed scenario may lead to three additional rooms at ground level. The exact development of the core house could vary and will likely not be the same for any of the dwellings.

In this scenario, the plot is shared by two families, with the top floor rented out for income generation. Hereby, two 49 m² homes share the plot. In this proposed floorplan, residents have placed windows and extended the masonry as planned. The garden courtyard can be accessed from the back bedroom, while the kitchen allows for eyes on the street, enhancing safety and direct visual connection for parents to their children playing outside. Expressive brick walls and parapets have been added, as well as an open masonry shelter to hide the water tank on the roof.



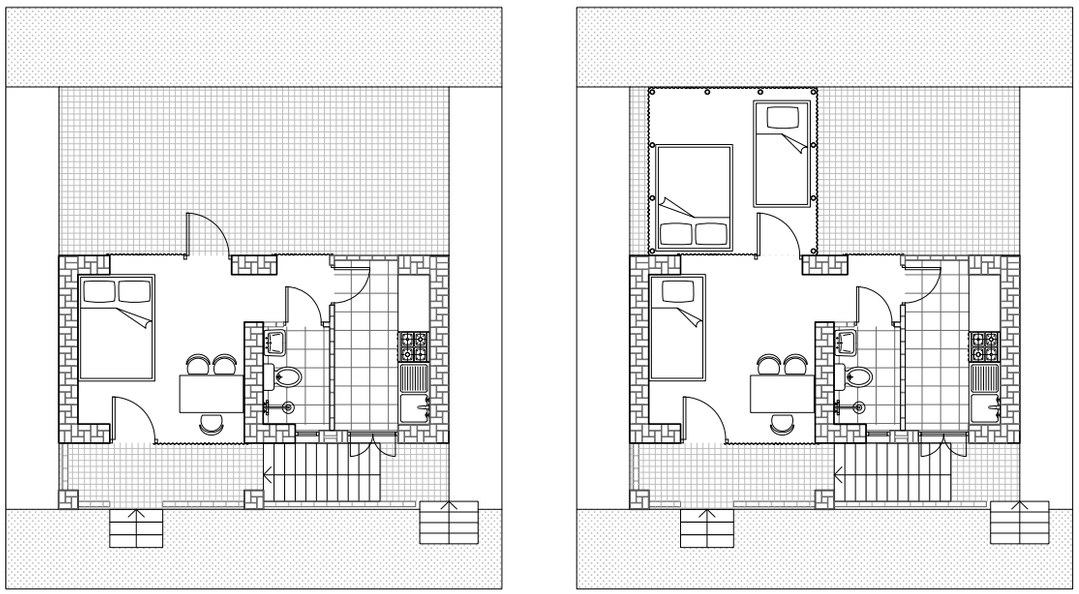
Elevation of a developed scenario



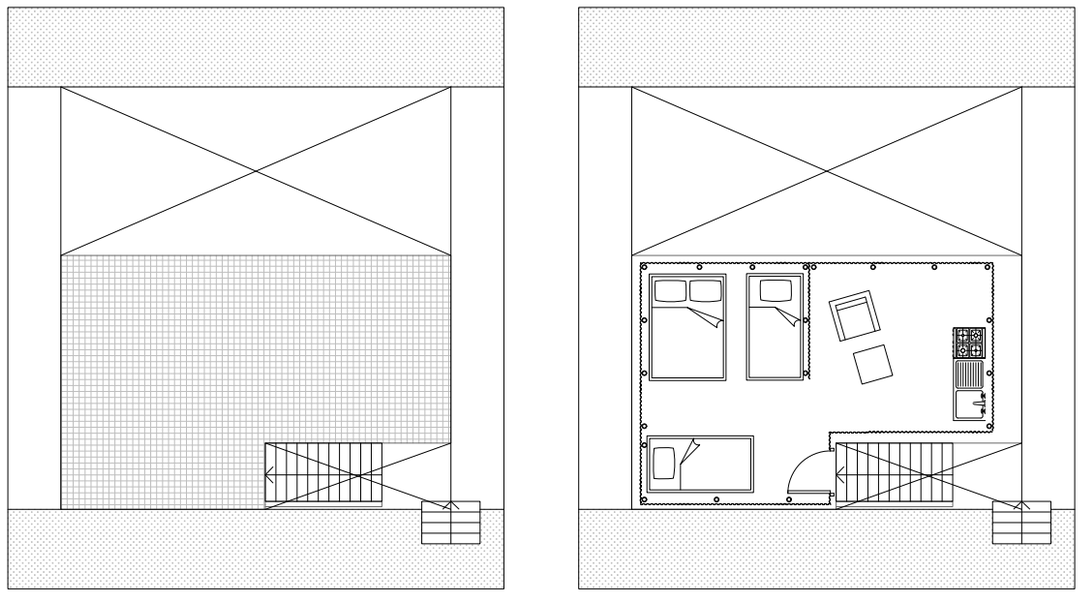
Ground floor of a developed scenario

Timeline

TYPOLOGY B



Timeline of possible extensions on the ground floor



Timeline of possible extensions on the first floor

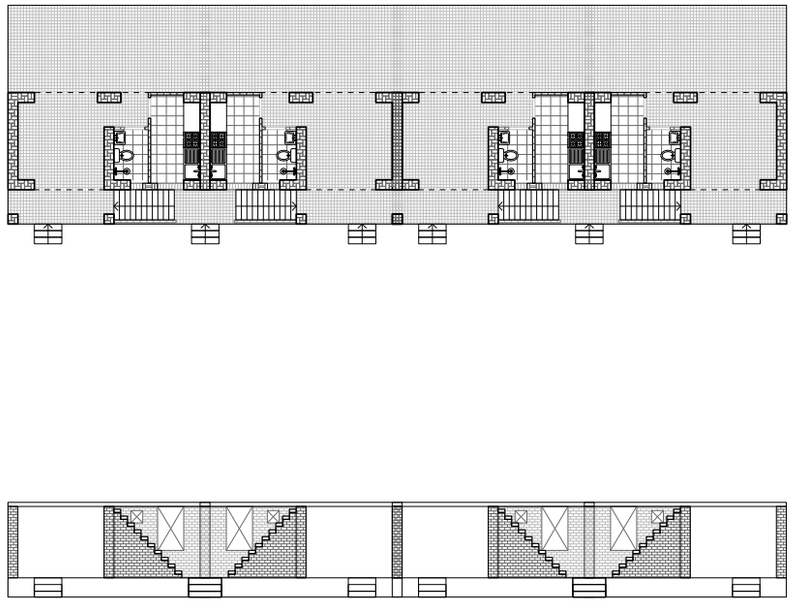
Clustering

TYPOLOGY B

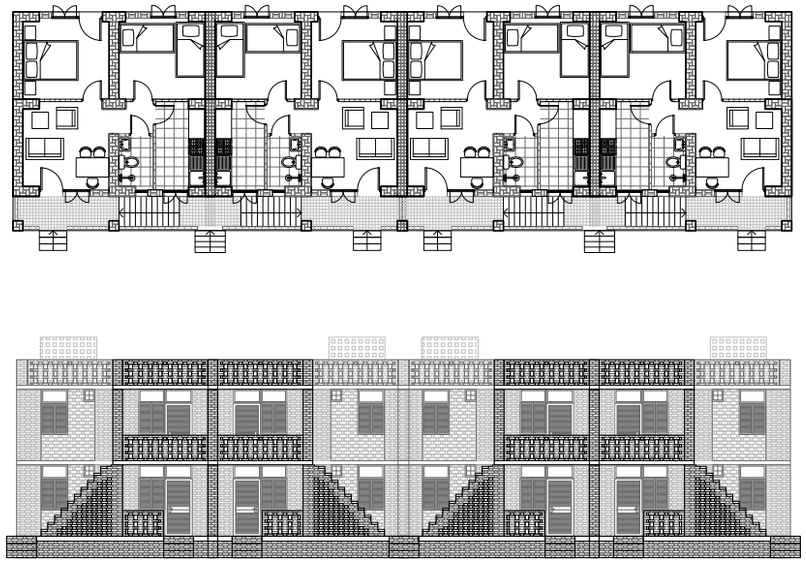
The units are mirrored per cluster to minimise plumbing costs. The infrastructure, connected cores and continuous floor slab further demonstrate how the most affordable house is not built as a single house, but rather as the parallel building.

The elevations and floorplans show the base scenario and what a developed scenario would look like if designed by an architect.

However, incremental housing takes all sorts of unexpected shapes, aesthetic or not. This is one of the consequences and the beauty of utilising auto-construction, enhancing individuality.



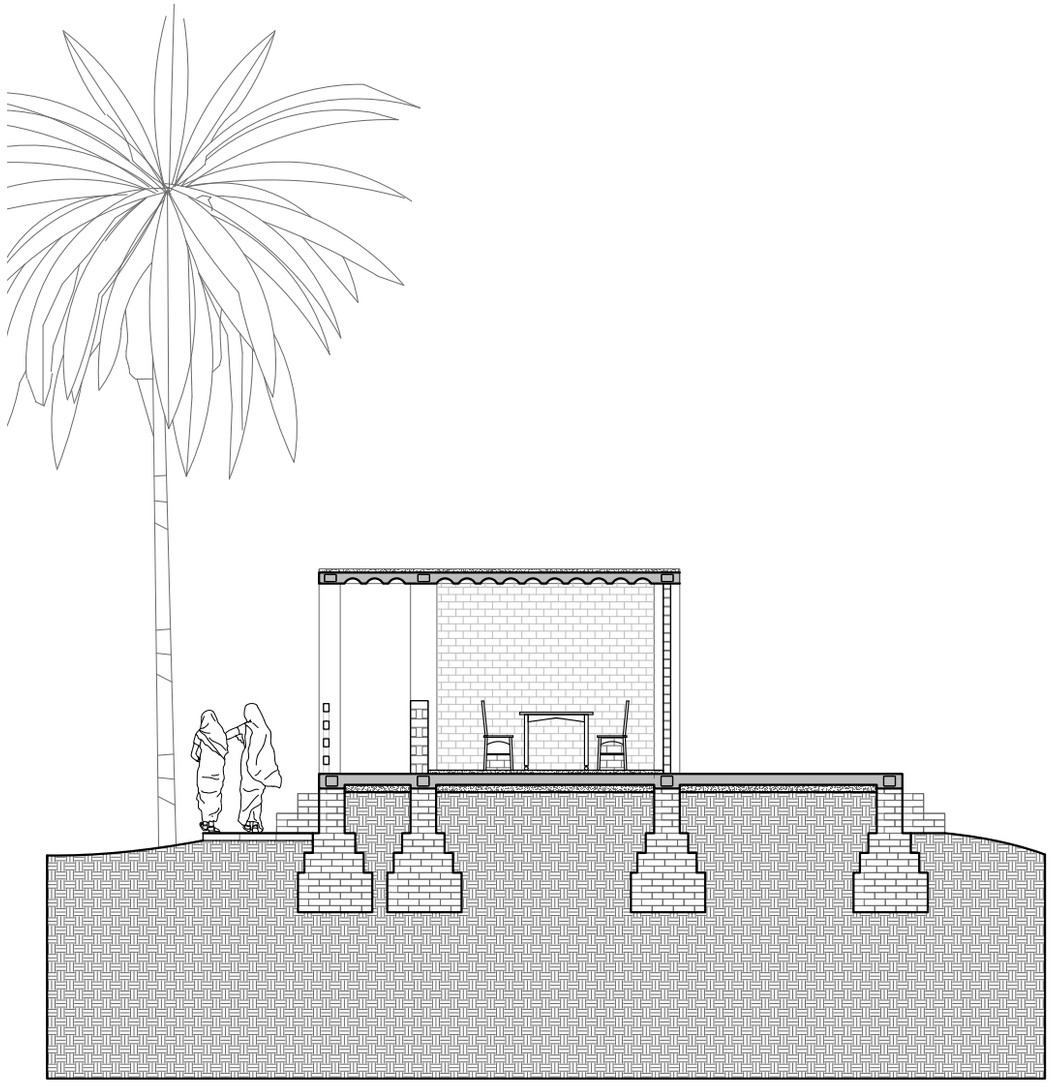
Clustering at the base scenario



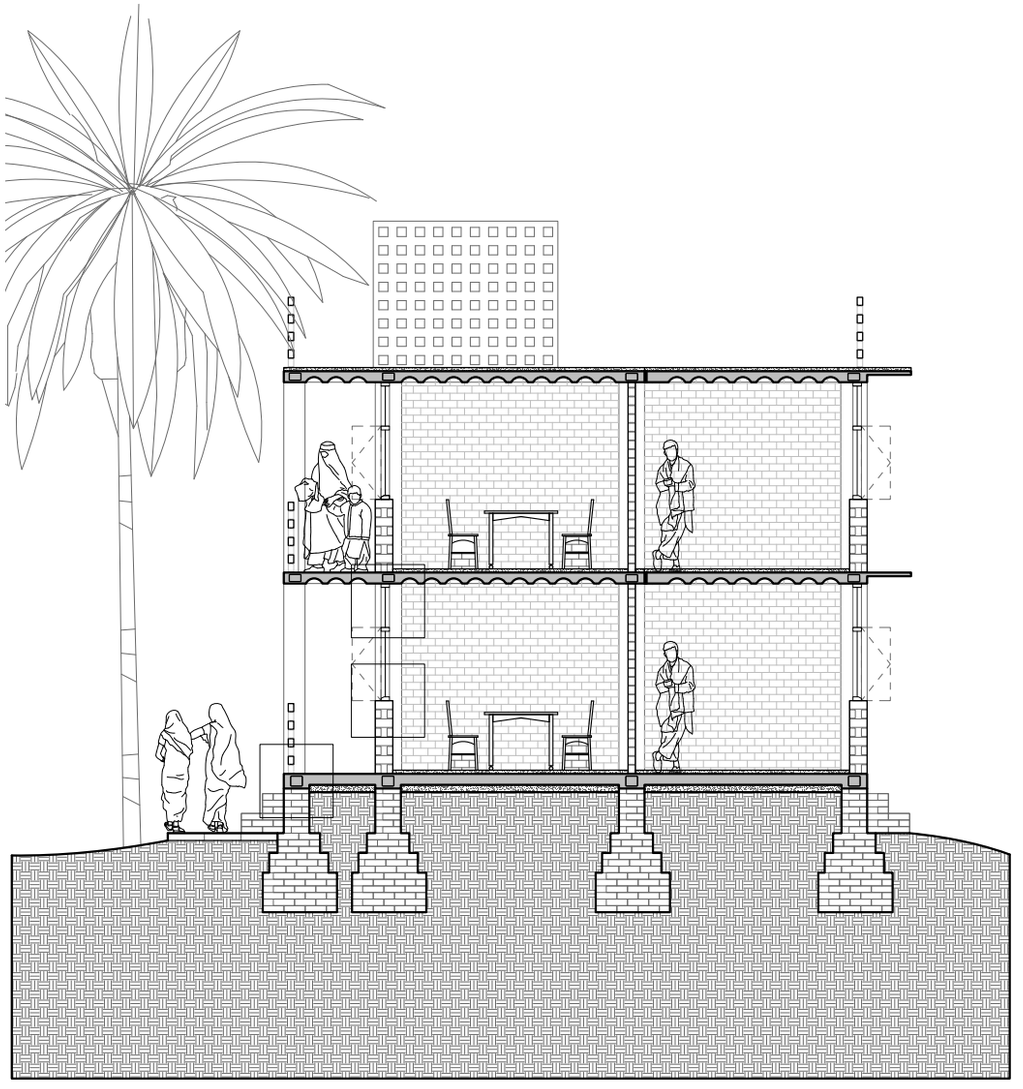
A designed architecture versus an incrementally adapted architecture

Section

TYPOLOGY B



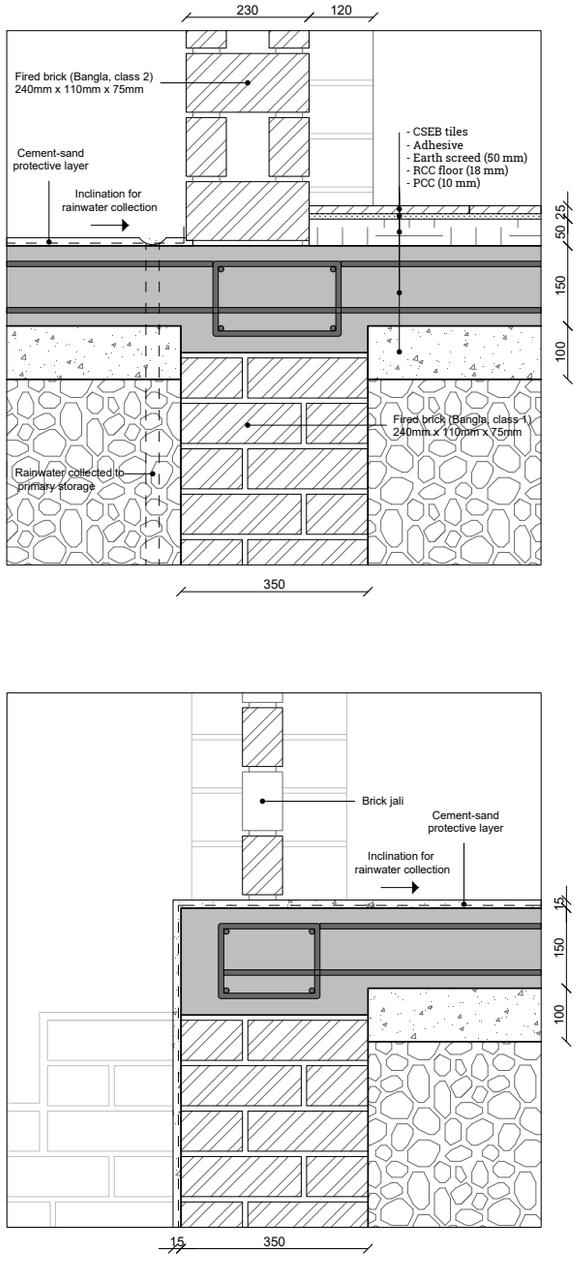
Section of the base scenario



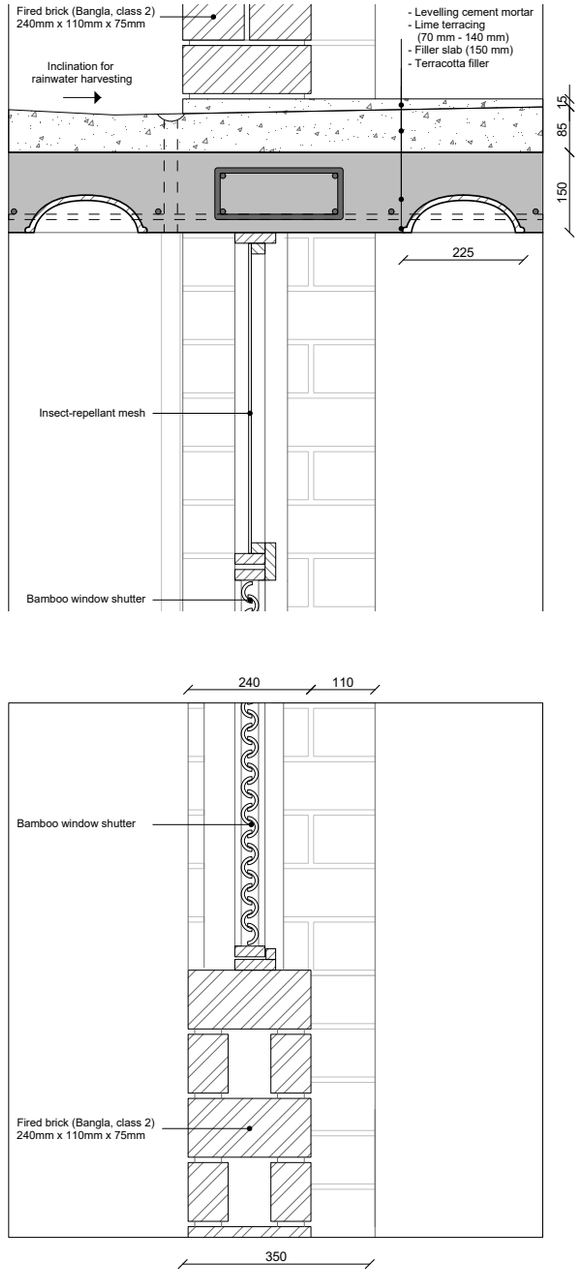
Section of a developed scenario

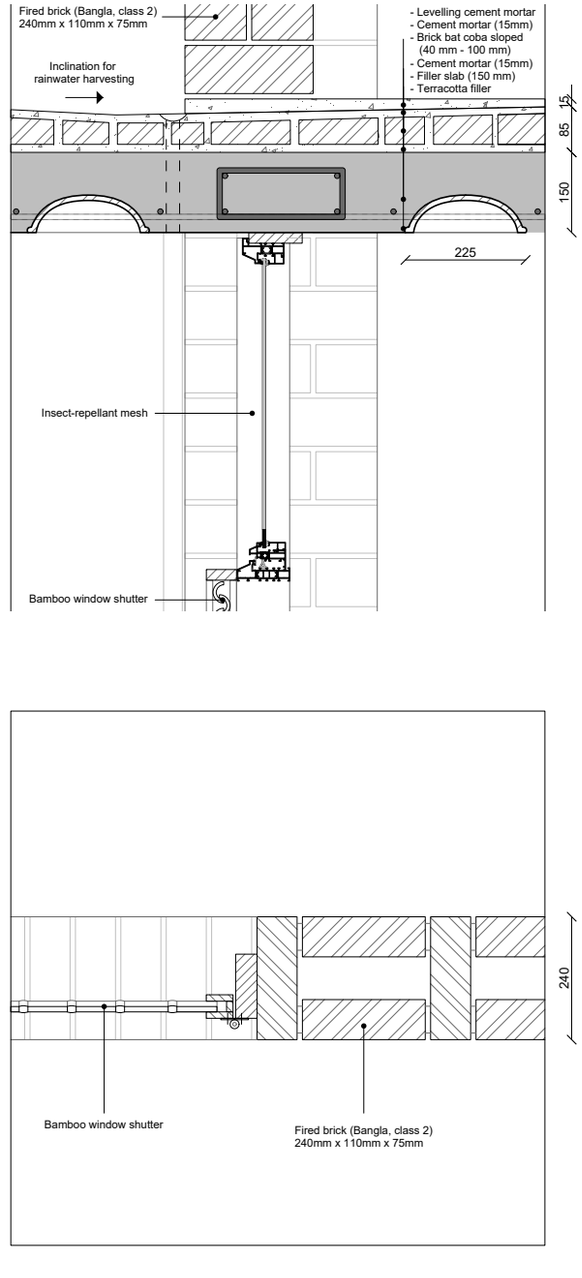
Details

TYPOLOGY B



Technical building details of the developed dwelling





Technical building details of the developed dwelling

VII. TYPOLOGY D

Shonatola Low-Cost Housing
architecture for the people

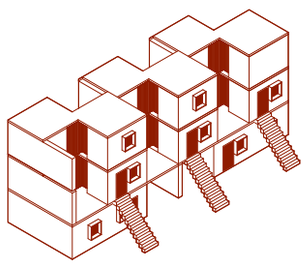
Design principles

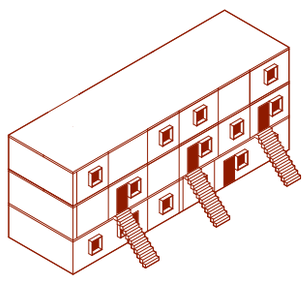
TYPOLOGY D

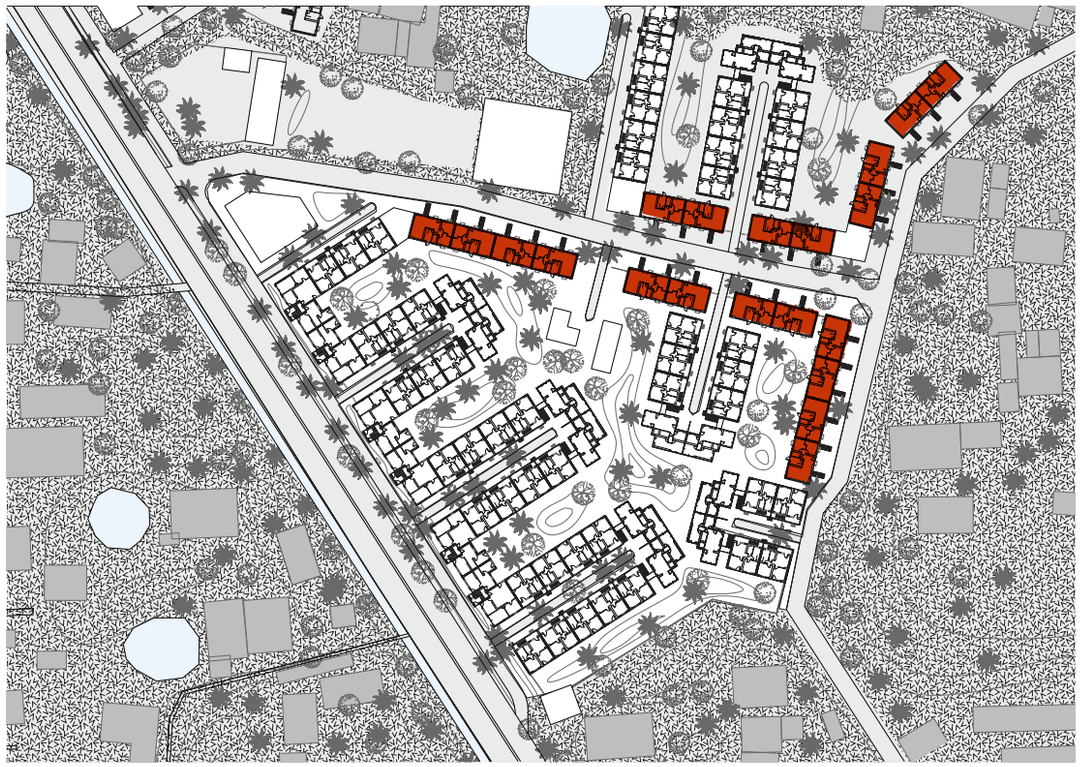
Typology D is situated along the secondary roads and is intended for more stable low-income households. The design draws strong inspiration from Elemental's open-source housing models, particularly Quinta Monroy and Monterrey. Building on the proven effectiveness of these precedents and Alejandro Aravena's call for adaptable, replicable systems, the core principles of Quinta Monroy are reinterpreted here with contextual and playful variations in form and layout.

The design allows for incremental aditions by claiming the voids present on the ground and upper floor. Simultaneously, extensions may also occur in the front yard. Given its accessible location along the secondary roads, the ground floor provides opportunities for income generation if desired by the residents.

The external stairs that serve as access for the top floors shape the street image. By direct street-access, shared access is avoided to minimise the possibility of conflicts between neighbours.







Parallel-building houses at the school-mosque cluster

Floorplans

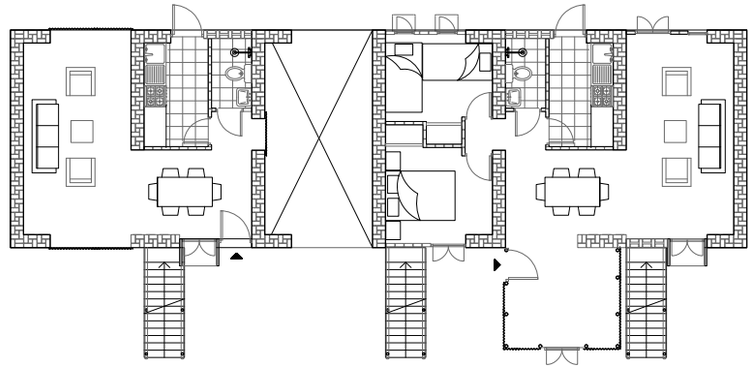
TYPOLOGY D

The block accommodates five dwellings in a fixed configuration. The building is composed of two ground-bound houses and three apartments, which are accessed through the external staircase.

The dwellings at ground level contain a spacious living room and a wet core that includes a kitchen and a bathroom. Load-bearing walls provide structural integrity, while voids between the walls are intentionally left unbuilt. These spaces are to be claimed by the residents for future expansions. The floorplan (right) shows a possible configuration for additional bedrooms.

Further incremental additions can occur in the front yard, which could provide further income generation opportunities through home businesses. In doing so, the houses can be upgraded from the 40 m² base dwelling into a 72 m² developed home.

The apartments contain roughly the same basic functions for the base unit. A small living room, kitchen, bathroom, and a bedroom are provided. For incremental growth, the design shapes voids between the structural walls. These current terraces will be claimed for future expansions, providing residents with the choice to either develop a two-bedroom apartment with a large living room, or to use some of the living room area for a third bedroom. In doing so, the dwellings are upgraded from a 40 m² base scenario to an 80 m² developed scenario, more than doubling its original size.



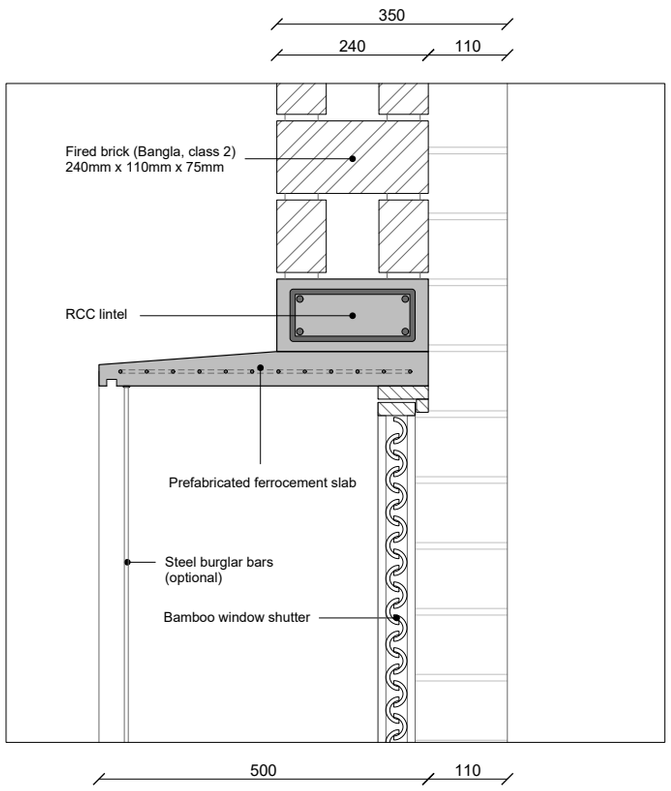
Floorplans of base scenario (left) and developed configurations (right)

Elevations

TYPOLOGY D

The facades provide a clear urban face that is consistent at its base. Hereby, it aims to shape the urban environment in a controlled manner. However, the incremental additions add individuality inbetween the architectural monotone of the base design.

Additionally, the design utilises prefabricated, concrete cchajjas. These protective window sills, since the 'horizontal' rain can cause serious damage to the frame, are a classic feature of South Asian architecture.

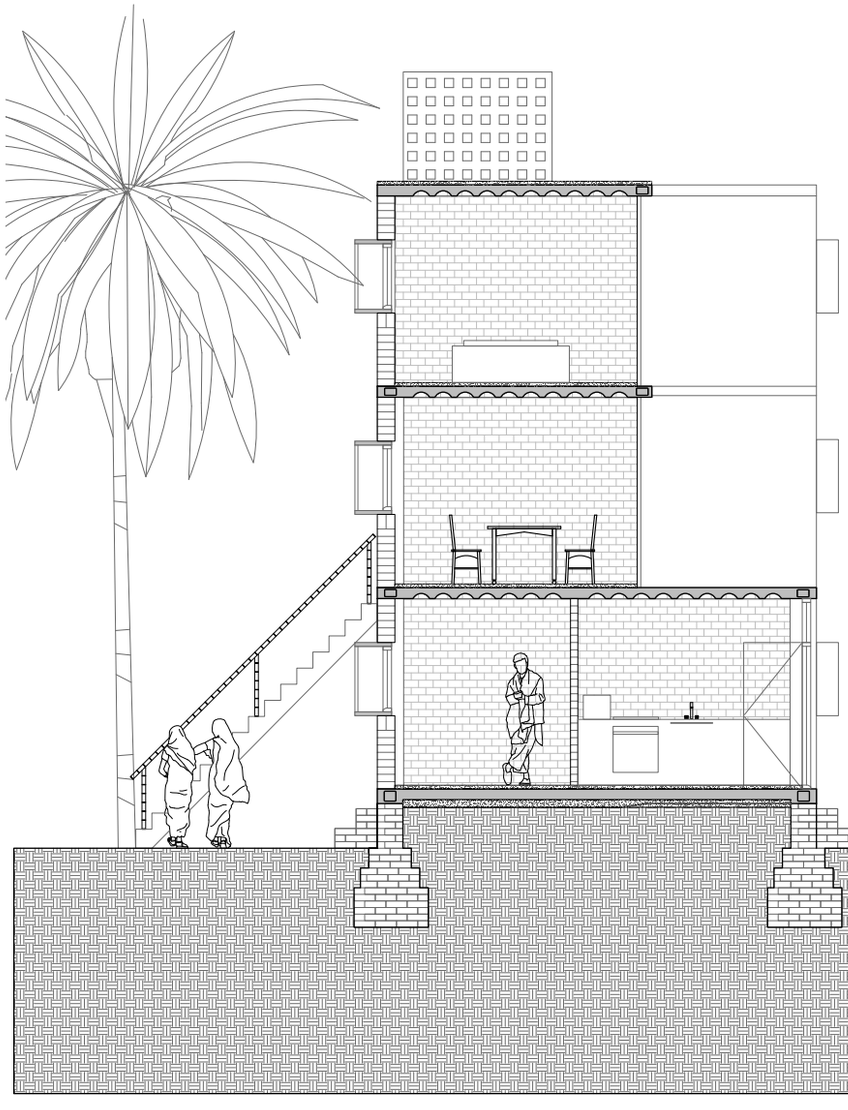


Vertical window detail of the prefabricated, ferrocement cchajja

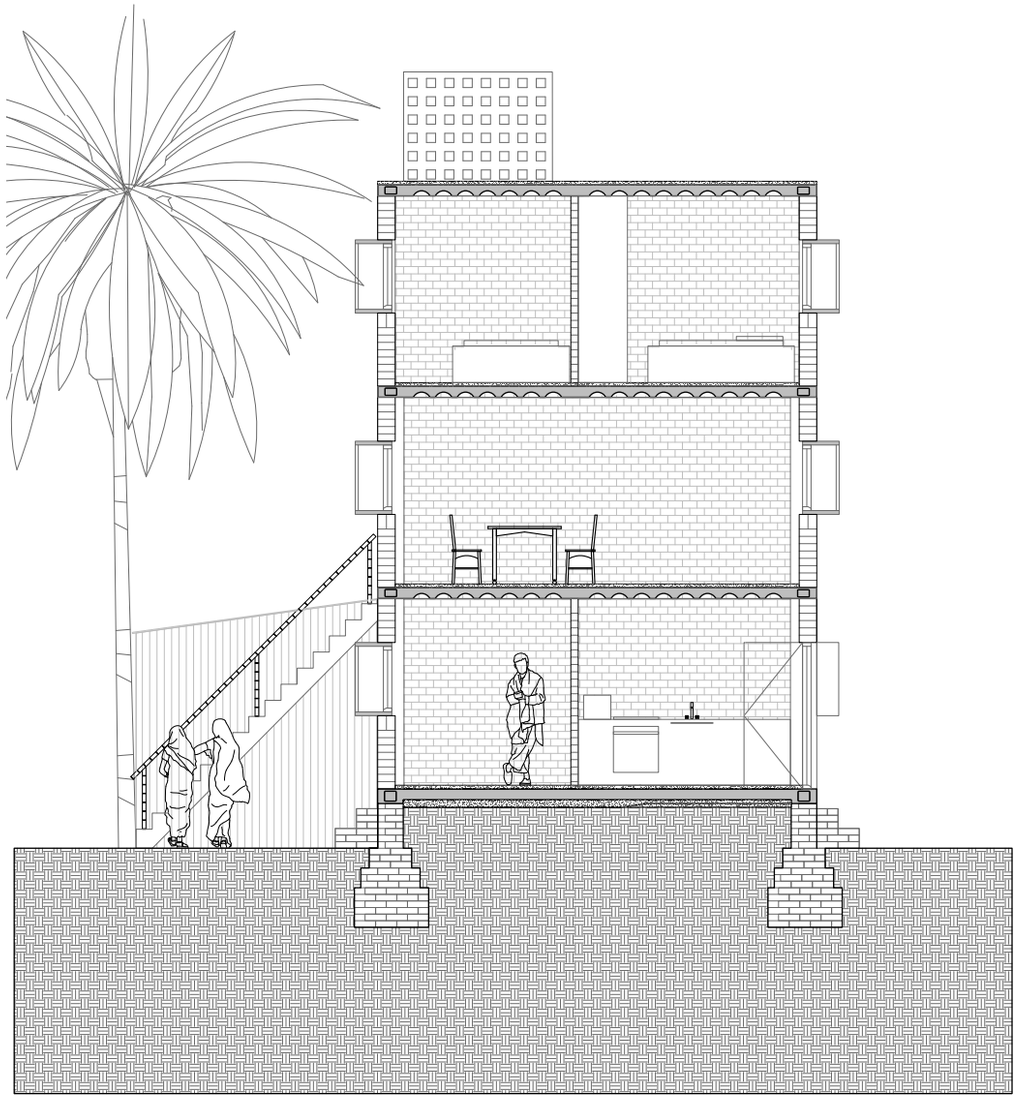
Elevations base (top) and developed scenario (bottom)

Section

TYPOLOGY D



Section base



Section developed

VIII. TYPOLOGY C

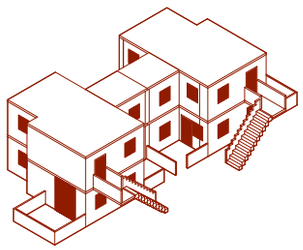
Shonatola Low-Cost Housing
architecture for the people

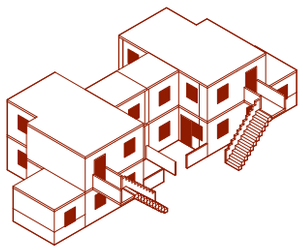
Design principles

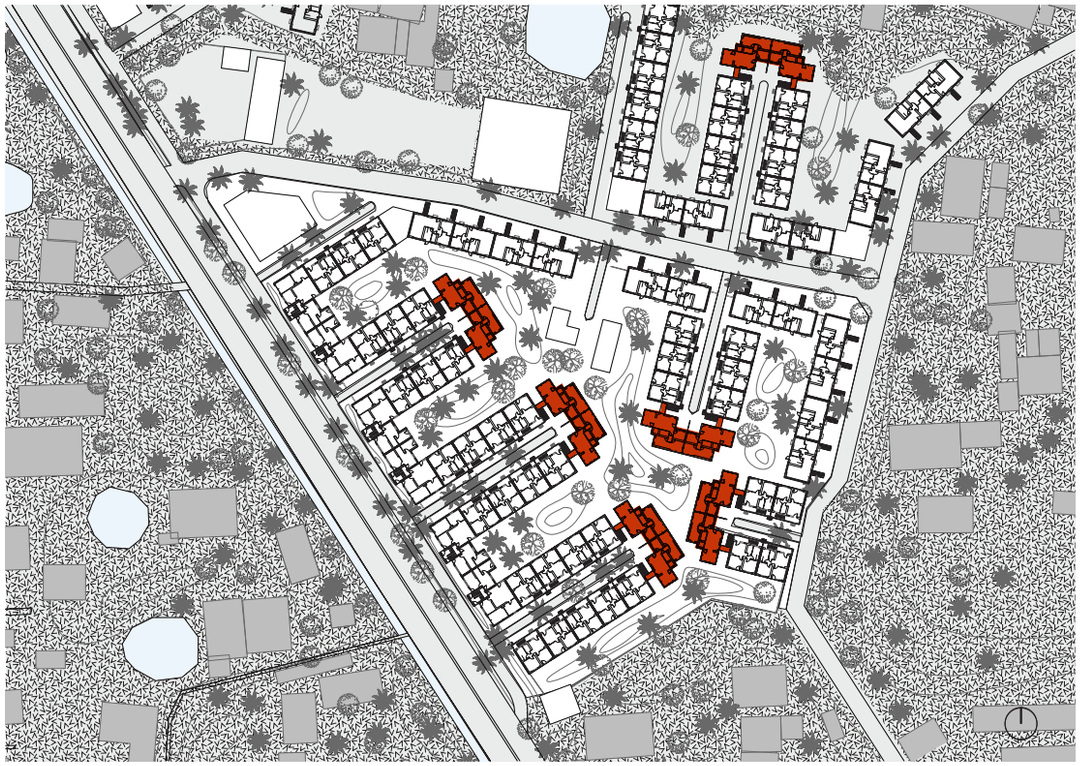
TYPOLOGY C

The design for typology C is inspired by the typology B base scenario and several of the incremental housing case studies. Other works of Raj Rewal and Doshi, such as his ECIL housing provided further inspiration for its final shape.

The typology C dwellings close off the courtyard at the rear, taking up a central position in the cluster as visual anchors that provide safety and cohesion for the semi-private courtyards. Moreover, the building serves as a gate to the community garden behind. These gates are formed by the walkway that leads from the stairs to the first-floor access, thereby forming a 'barrier' between the semi-private courtyard and the communal gardens.



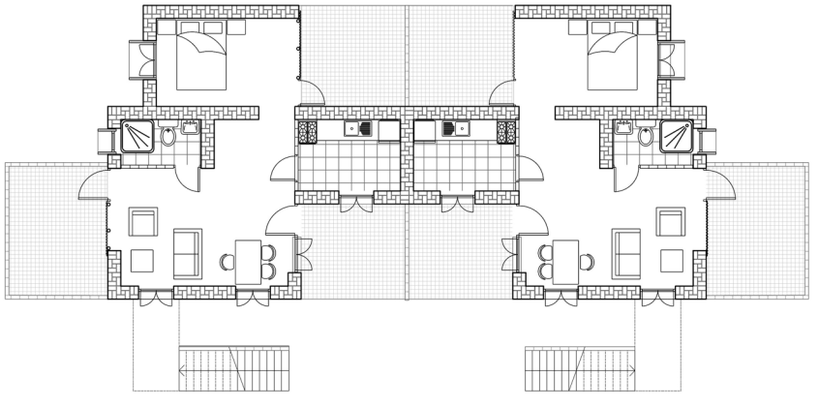


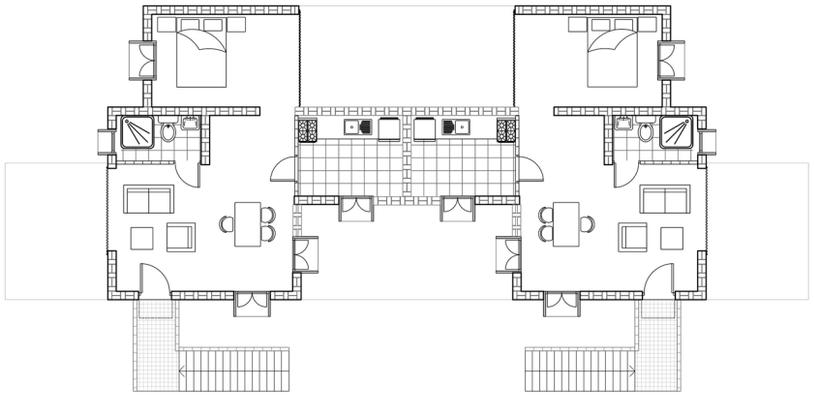


Expandable houses at the school-mosque cluster

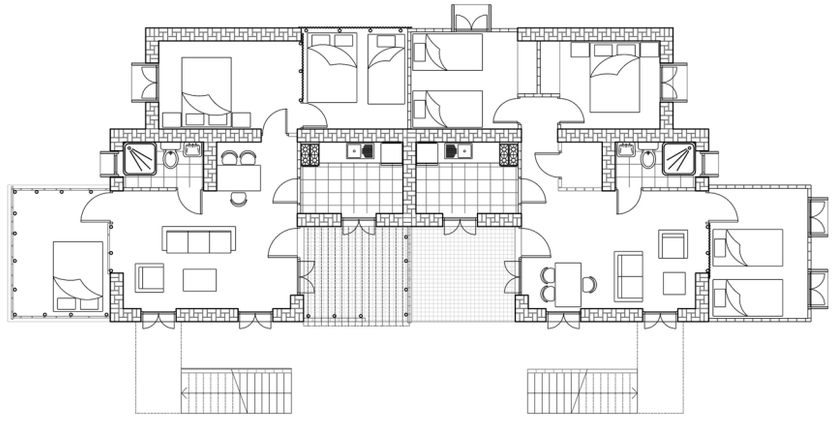
Floorplans

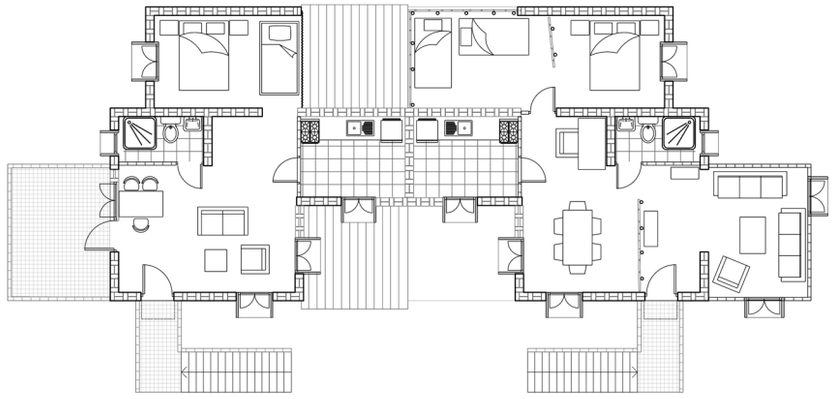
TYPOLOGY C





Floorplans base scenario





Floorplans developed scenario

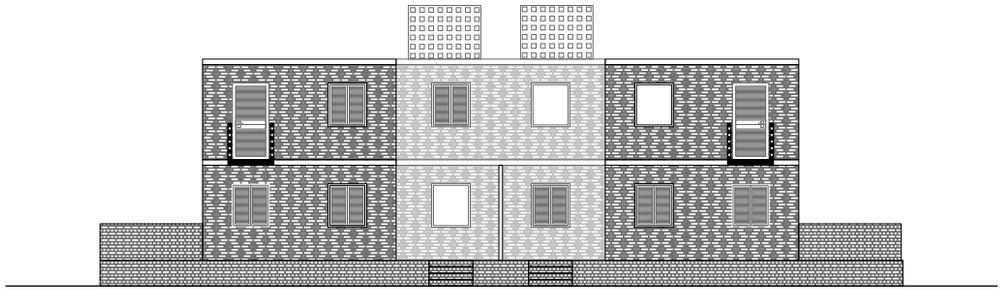
Elevation

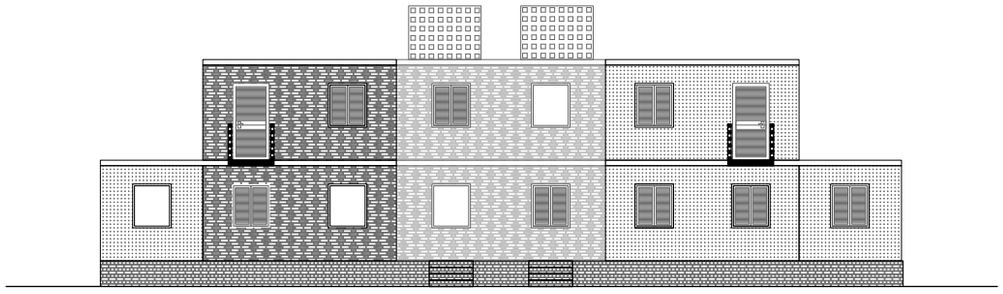
TYPOLOGY C

The typology C building serves as an expandable house for low-income groups. The foundations are laid out beyond the core house, to provide terraces that allow for future growth.

The four dwellings that compose the building all commence in a 47 m² base scenario. This base scenario entails a kitchen, bathroom, living room, bedroom, and storage space. As is also the case for the other dwelling typologies, the bathrooms and kitchens are clustered to save on plumbing costs. Additionally, they are planned along the facade for natural ventilation, as required in Bangladesh building law.

By extending the building on the terraces, residents are able to expand their homes to a developed size of 73 m². Similar to the incremental design of typology B and D, this 26 m² of additional area can be gradually claimed by the user, respecting both the 'law of least effort' and personal resource availability.





Elevations base (top) and developed scenario (bottom)

IX. TYPOLOGY A

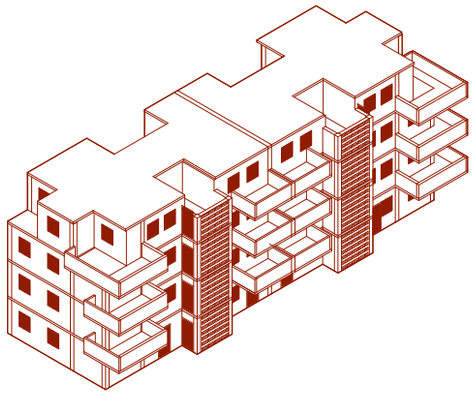
Shonatola Low-Cost Housing
architecture for the people

Design principles

TYPOLOGY A

Typology A is strategically located along the Badaghat Road, where it serves as the most formal and economically oriented housing typology within the masterplan. The apartment building provides income generating activities through its shops in the plinth, as the residents can capitalise on its prime location with its clear visibility and access to infrastrure.

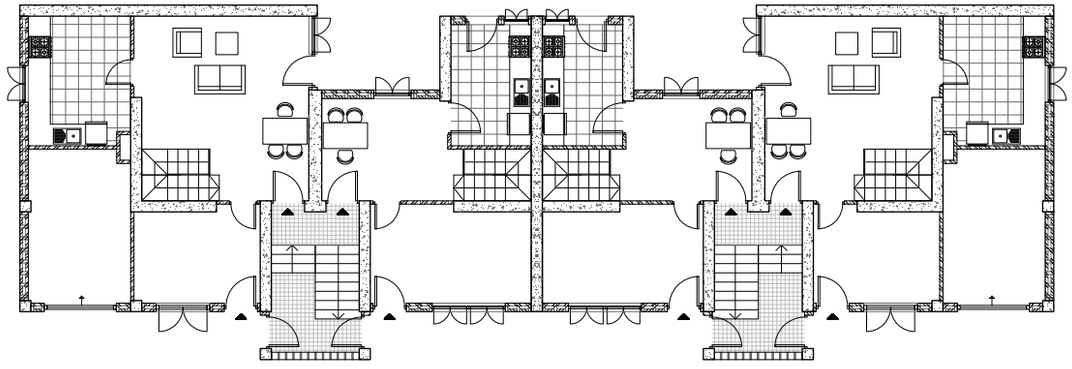
The building's eight apartments are aimed at middle- and high-income households. By targeting wealthier income groups, the more expensive land is paid for. Parts of the profits of the development are used to cross-subsidise the low-income dwellings of the courtyard typologies. Moreover, the social mix of the masterplan is also enhanced through this economic diversity..

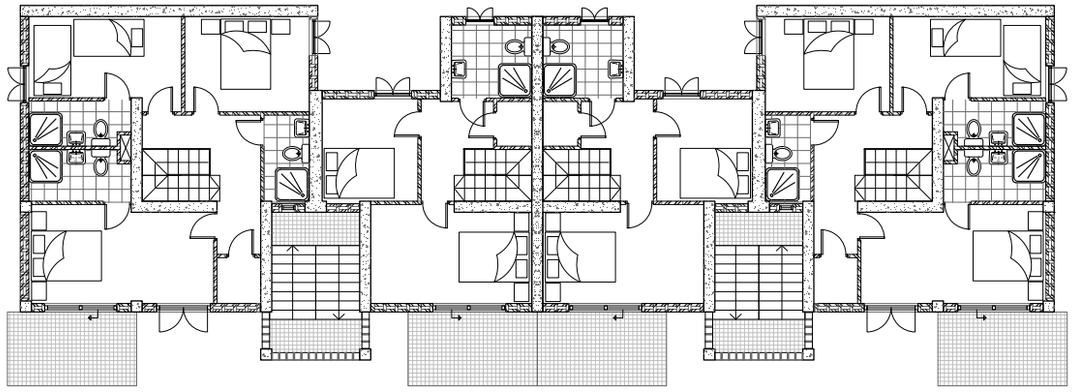


Apartment blocks at the school-mosque cluster

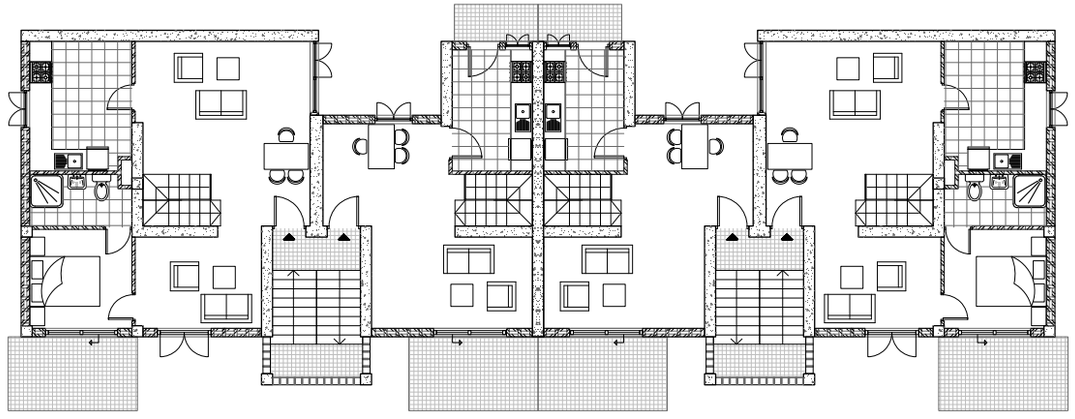
Floorplans

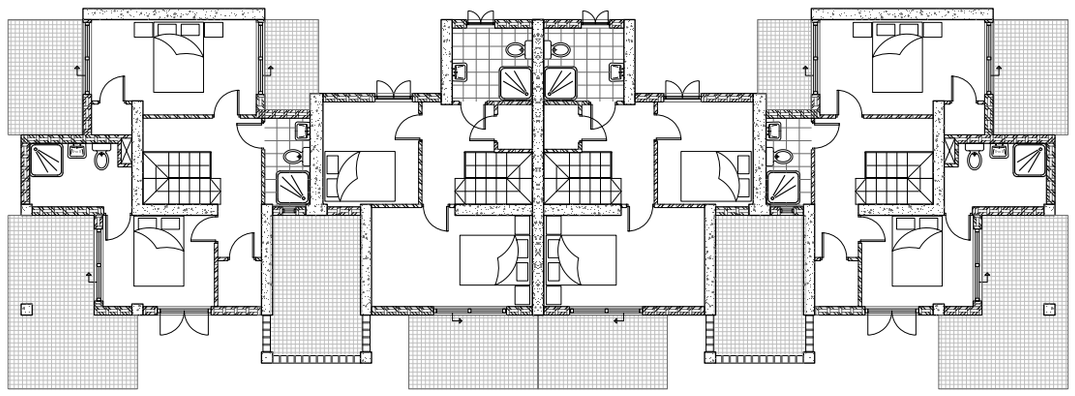
TYPOLOGY A





Ground floor (top) and first floor (bottom)





Second floor (top) and third floor (bottom)

Elevation

TYPOLOGY A

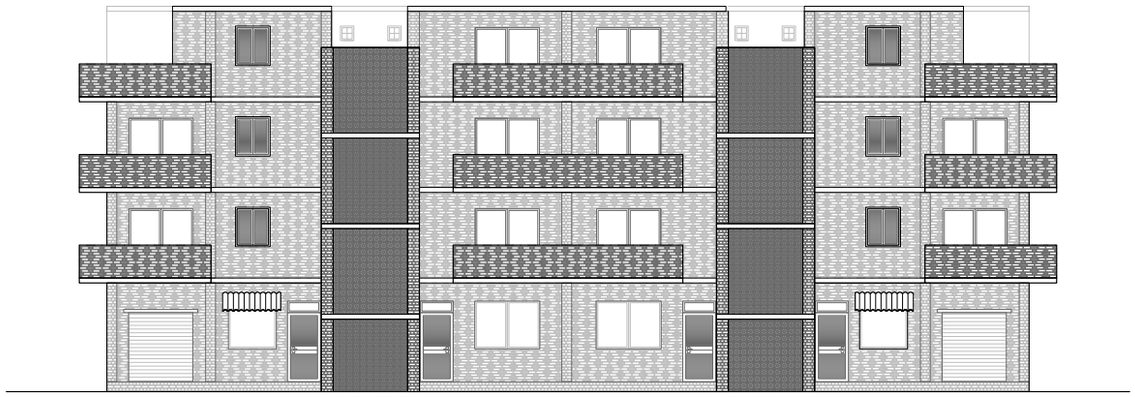
Unlike the courtyard-based, low-rise housing types (B, C, and D), Typology A adopts an apartment building format. The units include generous apartments, while retail spaces on the ground floor establish a commercial plinth that activates the street edge and reinforces the urban character of the highway.

The retail spaces at ground level can also be used as rooms for the apartments at the same level. The retail spaces at the corner of the building could even be used as a garage.

The ground floor apartments consist of two 122 m² (including 24 m² retail space) apartments and two 75 m² (including 12 m² retail space) apartments. These apartments have a living room, large kitchen, bathrooms, and multiple bedrooms, as well as balconies facing the street or the garden courtyard.

The apartments on the upper floors are accessed through the shared stairwell. The stairwell is shielded from the road by a brick jali, providing both a sense of security and enough daylight. From here, the two 106 m² and the two 122 m² apartments can be reached.

Although incrementality is not as much a key part of this building as it is the main identity of the other typologies, that does not mean no incremental additions take place. Many buildings in India and Bangladesh, such as Charles Correa his LIC or Tara housing demonstrate that even 'finished' dwellings have spaces to be claimed. Balconies and terraces often are made part of the dwelling, or are simply sheltered from the surroundings through jalis, steel bars, or other forms of material.



Elevation of the apartment building

Impression of typology A

X. WATER MANAGEMENT

Shonatola Low-Cost Housing
architecture for the people

Water management

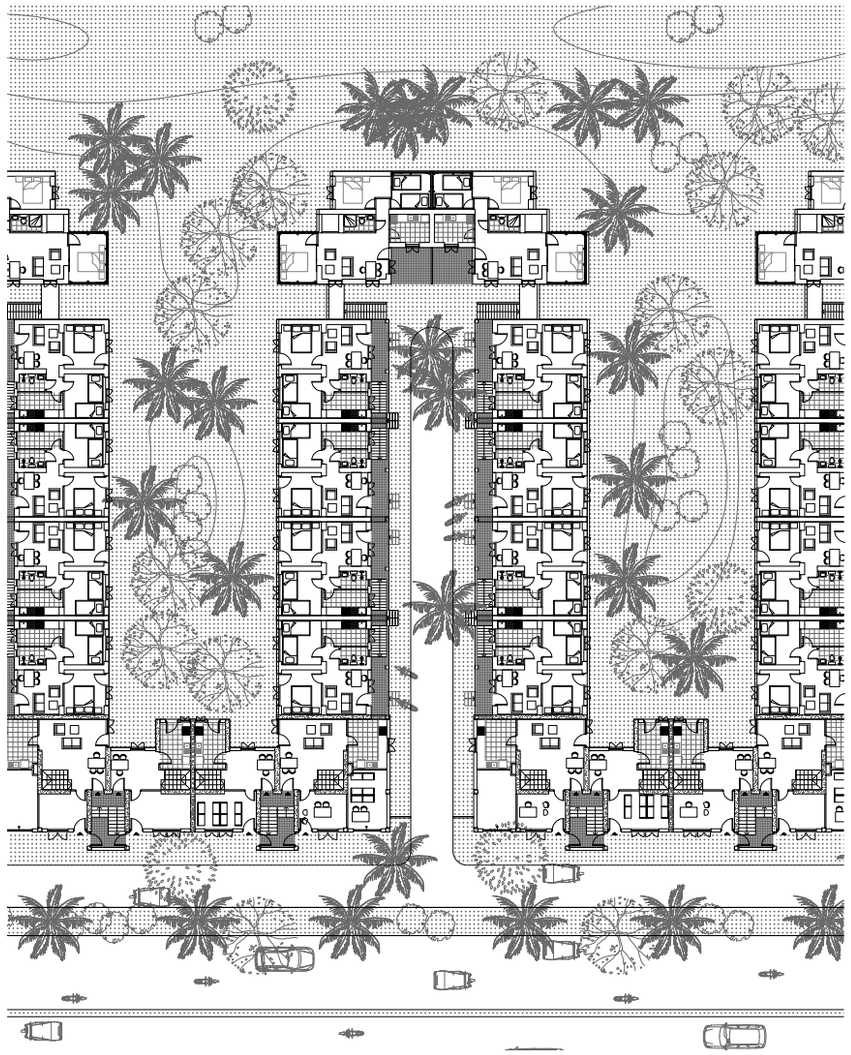
WATER MANAGEMENT

The flood resilience of the project is addressed on multiple scales. At the dwelling level, the design incorporates raised plinths, robust materials that resist prolonged water exposure, such as concrete foundations and fired brick, and RC slab roofs for vertical refuge in the event of extreme flood scenarios,

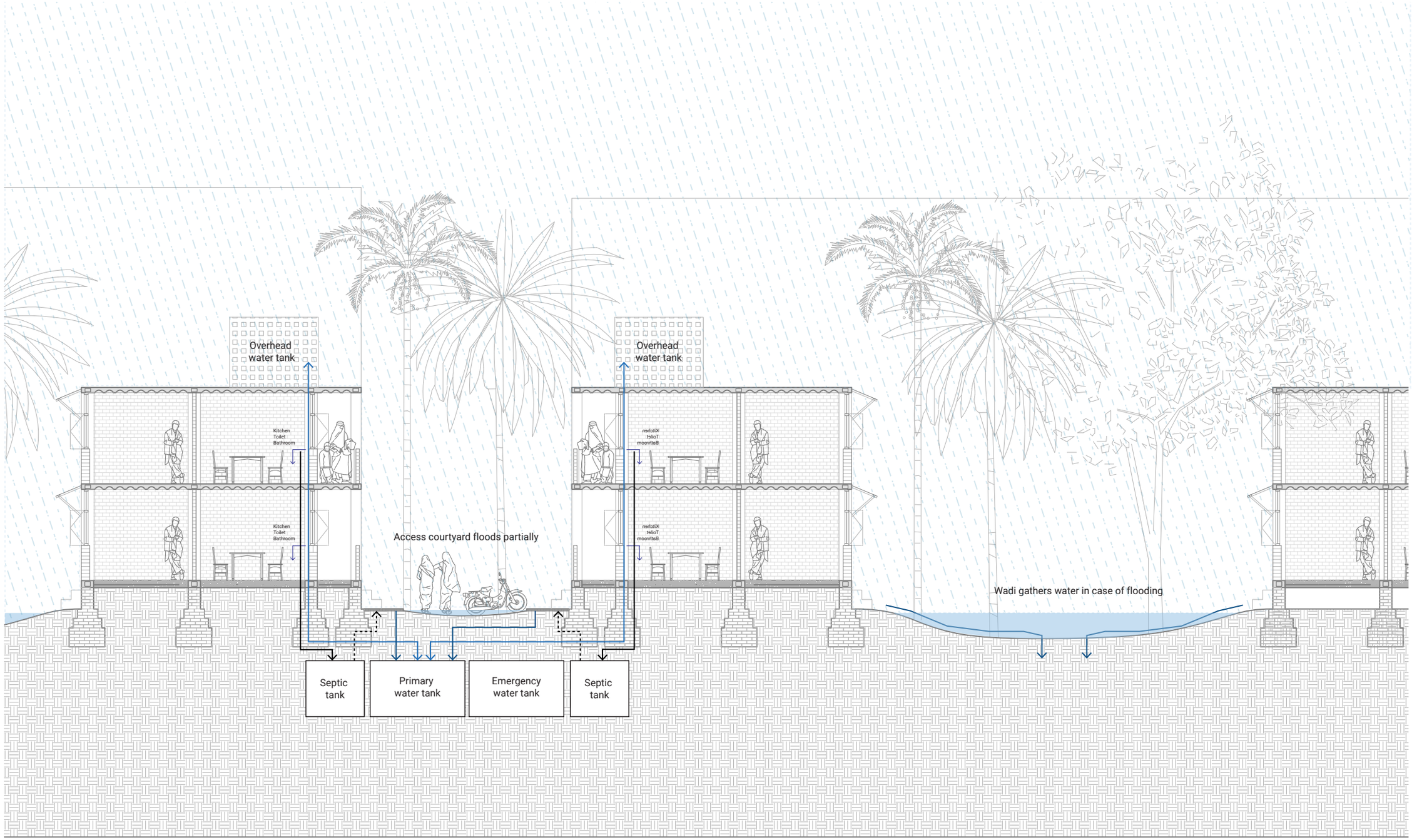
At the urban scale, the water management plan redirects the water away from the dwellings to lower-lying public spaces, such as the community gardens and the paddy fields. The newly built storm drainages and elevated road, as well as the raised plinths for the housing structures, all work together to keep the dwellings dry. Streets are designed with stormwater gradients and drainage, while green spaces, such as swales and wadis, double as temporary water catchment zones.

As the climate sections show, excess water is lead from the street to the courtyards. Here, wadis and vegetation serve for water retention, rendering the communal and public space, that is a garden and urban farming resource in the dry season, as a multifunctional flood-resilience resource.

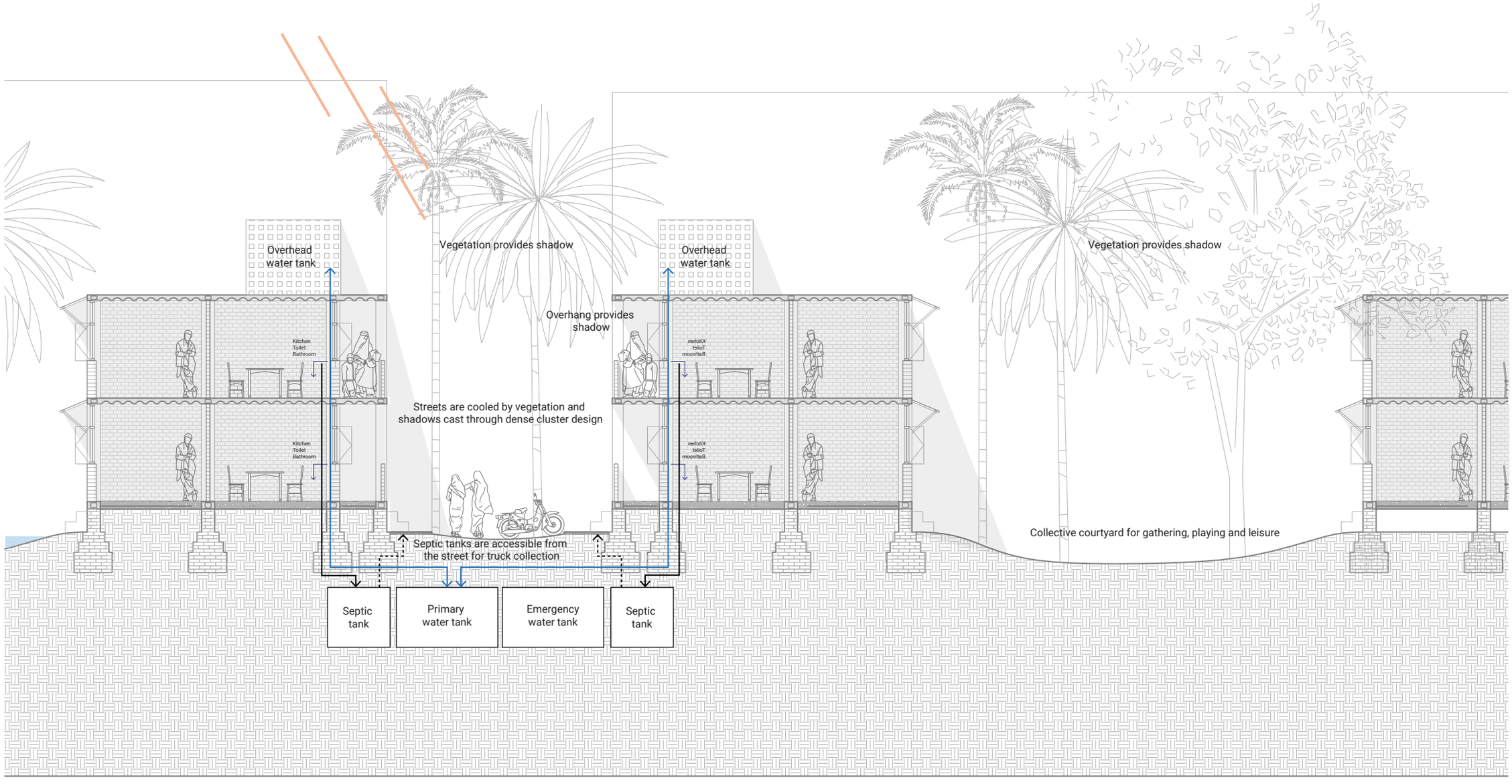
Rainwater is harvested in underground tanks. This water can be pumped up to the overhead water tanks, which are hidden behind brick jalis. If not enough rain water has been harvested in dry season, the emergency water tank serves as a back-up. In terms of other infrastructure, septic tanks are put underneath each cluster. This way, the courtyards serve as cost-efficient infrastructure clusters.



Cluster courtyard plan



Climate section: monsoon



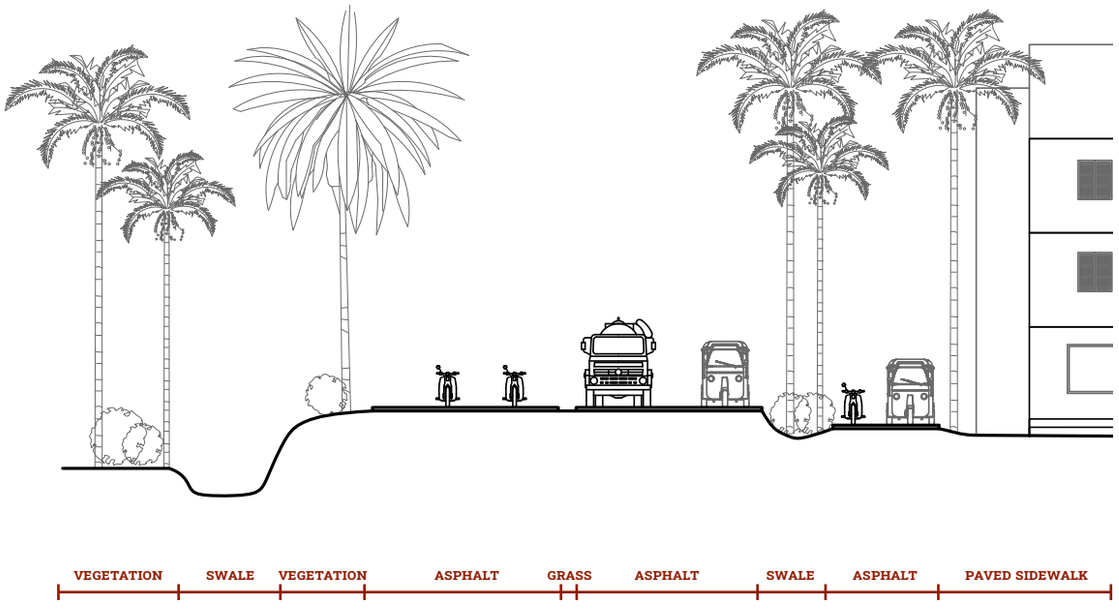
Climate section: dry season

Street profiles

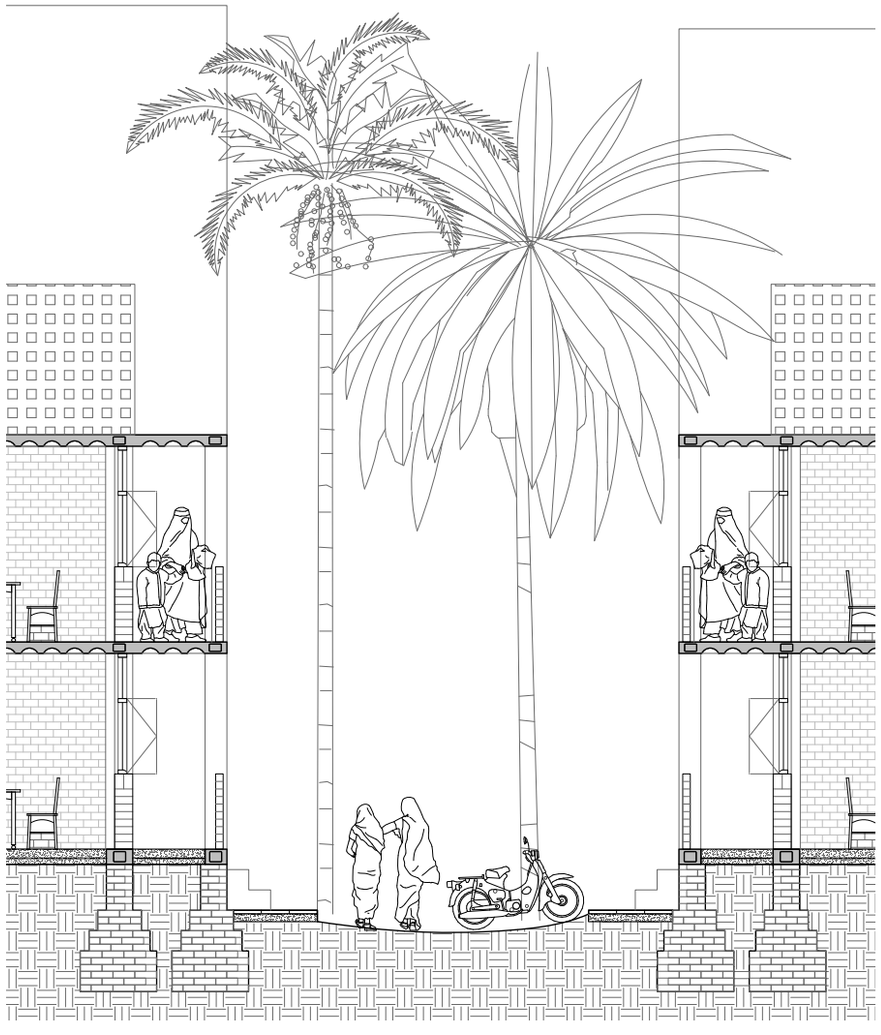
WATER MANAGEMENT

The street sections show how the water is directed at a slope, away from the dwellings. Badaghat road is seperated from the clusters by a service road. In between and along the sides, additional swales are placed for water catchment. Vegetation is implemented for further flood-resilience.

In the courtyards. the streets are paved and elevated in front of the dwellings. Combined with the robust, raised plinths, this ensures the dwellings do not flood and people can still access their home with dry feet. Only in extreme scenarios will the street just below plinth level.



Street section of Badaghat road

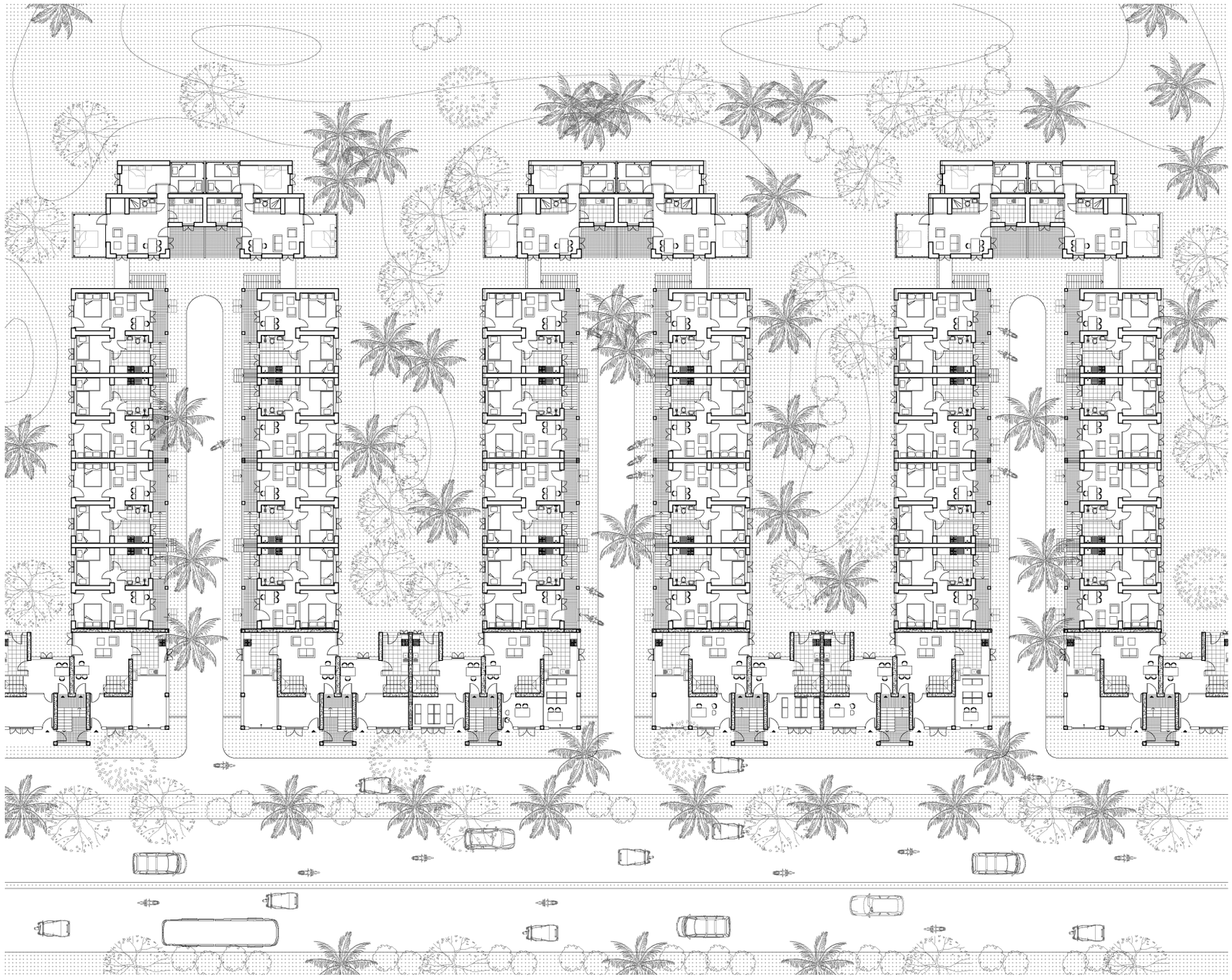


Street section of the courtyard

Cluster plan

WATER MANAGEMENT

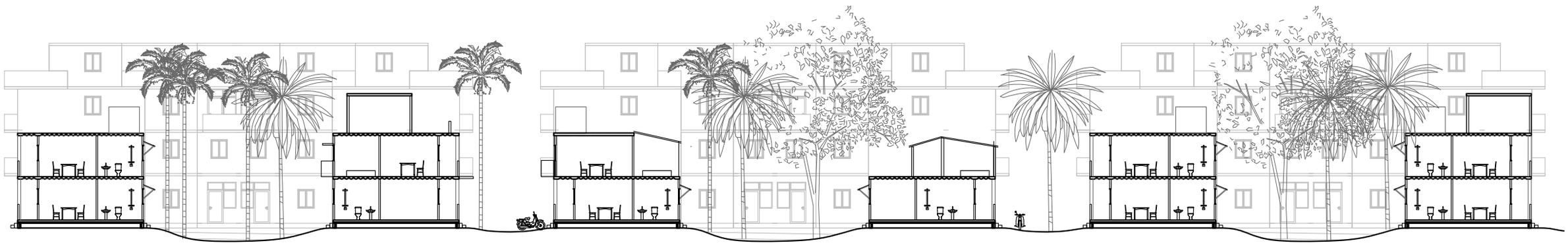
The cluster plan displays the relation between the various plan elements. The cluster is sheltered from the busy Badaghat road through vegetation and swales. A service road provides access to the income generation of typology A. The courtyards are more semi-private, fenced off by a gate. On the other end, the walkway of typology C leads to the communal gardens.



Cluster plan

Cluster sections

WATER MANAGEMENT



Sections of the courtyards and gardens

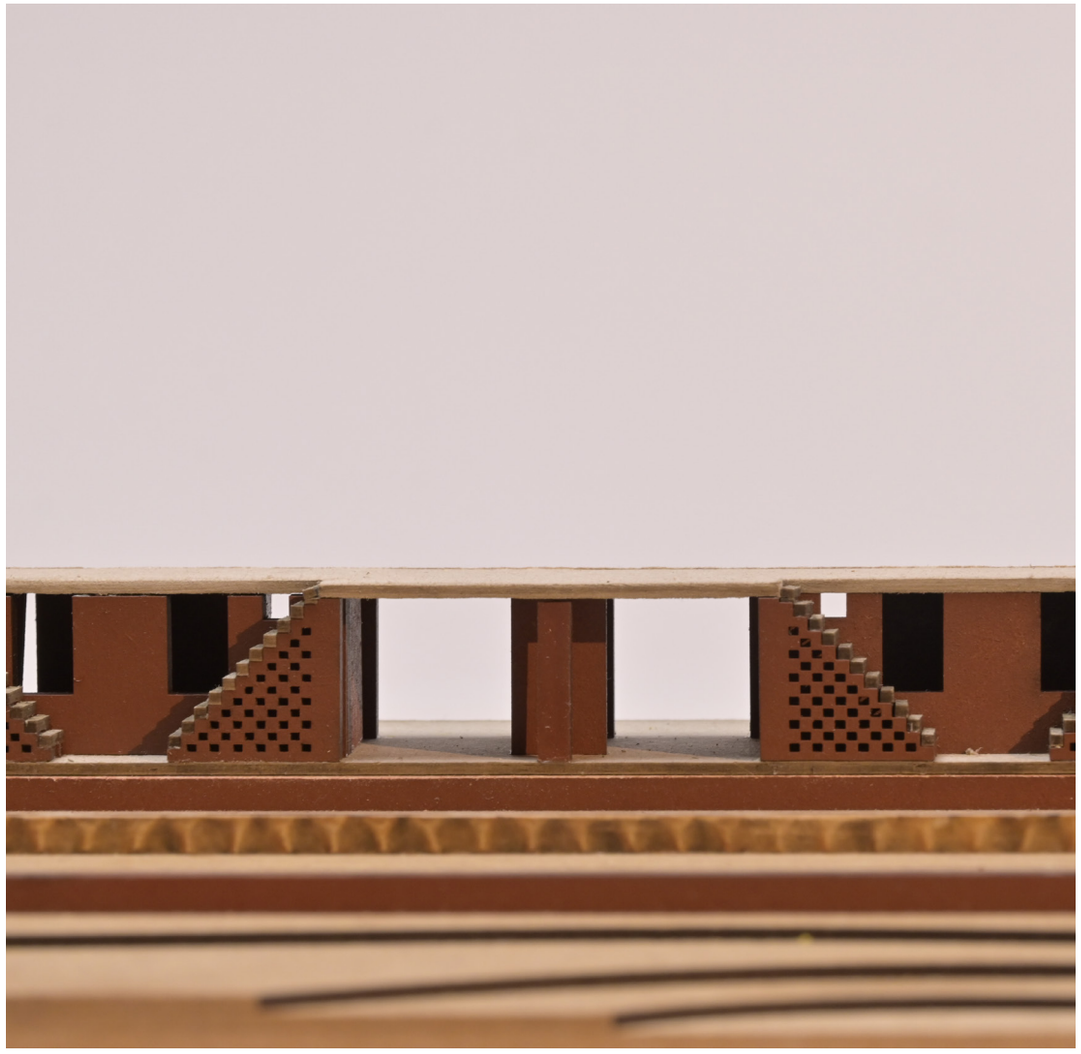
XI. ARCHITECTURAL MODEL

Shonatola Low-Cost Housing
architecture for the people

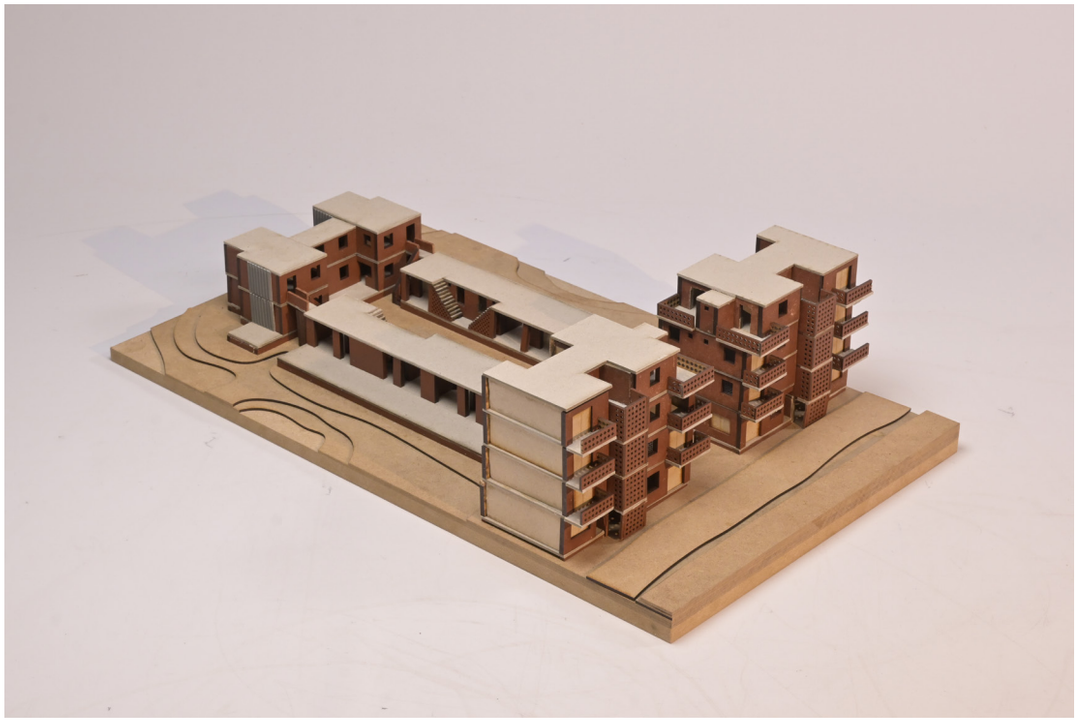
Architectural model

ARCHITECTURAL MODEL

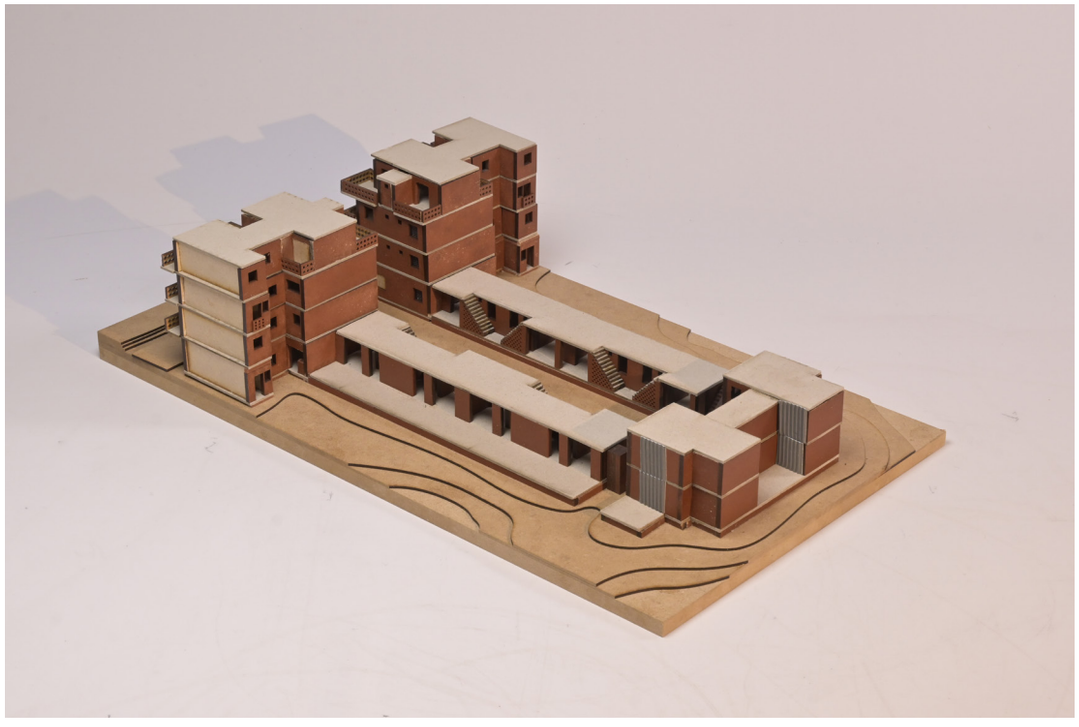
Model of the base scenario's core-units



Model of the base scenario's core-units



Model of the cluster base scenario



Model of the cluster base scenario

Model of the cluster developed scenario

Model of the cluster developed scenario

Developed dwellings have been personalised and added on in various ways

The base design has been heavily modicated, but is still visible

Connection between developed typology B and C units

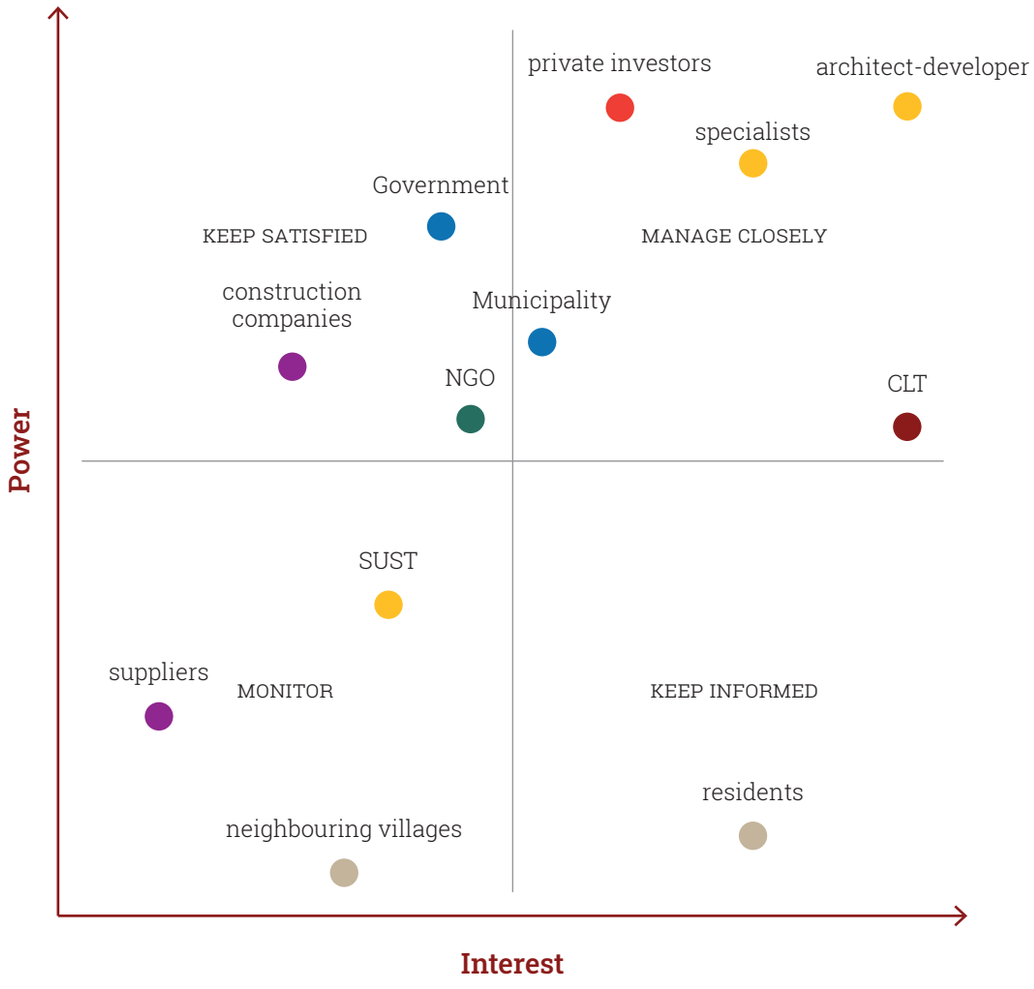
The cluster's forefront as seen from the other side of Badaghat road

XII. MANAGERIAL STRATEGY

Shonatola Low-Cost Housing
architecture for the people

Stakeholder analysis

MANAGERIAL STRATEGY



Stakeholder analysis diagram

GOVERNMENT
The Bangladeshi government is responsible for broad policies on housing, urbanism, and flood-resilience. Especially the housing and urban development departments, as well as other public development programmes, can provide funding and legal support.

MUNICIPALITY
The Sylhet municipality is responsible for the direct management and governance on behalf of the public institutions. The municipality supports and handles local planning, zoning, building permits, local infrastructure provision, such as the drainages and other flood-resilience works.

ARCHITECT/URBAN PLANNER
For this research, my role has been that of architect/urban planner, as well as developer and general manager. The design of the dwellings, urban plan, public spaces, and other are the main tasks from the architect and urban designer role.

DEVELOPER
The developer is in charge of managing the overall building project and process. The main tasks of the developer are that of land acquisition, cost management, stakeholder management and guiding the overall process.

SPECIALISTS
A flood-resilient, large-scale, affordable housing project requires multiple experts. These specialist provide specific knowledge on technical and managerial matters to help the project succeed. The main specialists required are water/flood-resilience experts, structural engineers, climate experts, community managers, construction managers, technical implementers, cost experts, and more.

NON-GOVERNMENTAL ORGANISATIONS
As shown in the Baan Mankong and SPARC case studies, NGOs play a pivotal role in the management, communication and community self-organisation of the project.

PRIVATE INVESTORS
Apart from public funding, private investors could aid the project's realisation. As proposed by Wakely and Riley (2011), incremental housing projects can greatly benefit from support from the public sector.

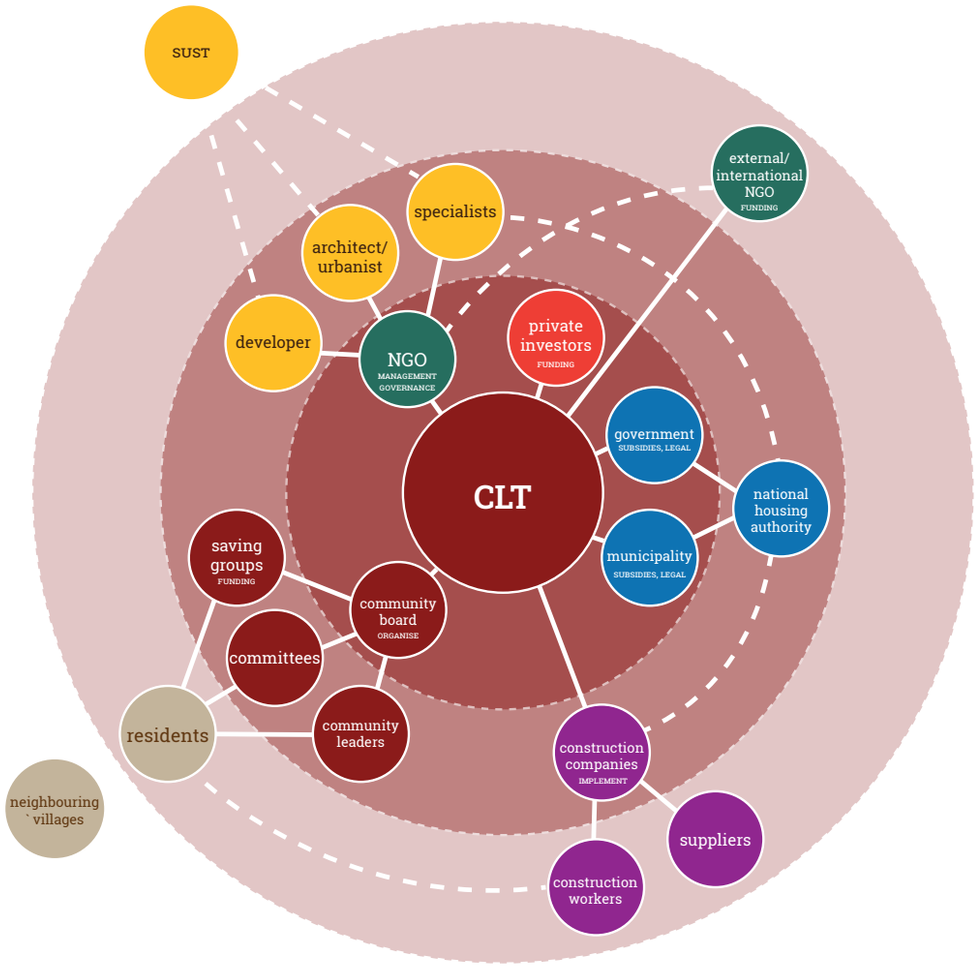
COMMUNITY LAND TRUST
The CLT is self-organised by the community. Its main task is holding land within the CLT at affordable prices, preventing price speculation and urban fragmentation as with plot-based developments. Through leaseholds, individuals can develop and dwell on their plots.

RESIDENTS
The residents are highly interested in their livelihoods. However, as individuals they do not hold great influence outside of the CLT.

CONSTRUCTION COMPANIES
The construction companies are responsible for the project execution. However, as a paid private actor, their interest is not as great.

Organisation and stakeholder relationships

MANAGERIAL STRATEGY



Organisation and stakeholder relations diagram

In order to get the project to a successful implementation, the relationships between the network of stakeholders must have a clear organisation. As suggested in the research, the managerial strategy matches top-down facilitation with bottom-up implementation and agency.

As participation and community organisation is pivotal, the community land trust (CLT) is at the heart of the organisation. Similar to the schemes of SPARC, Baan Mankong, and the Co-opertative Housing Societies (CHS) of Charkop sites-and-services, the community is responsible for decision making, savings, coordination, land ownership and long-term affordability. The NGO, this project's SPARC/Baan Mankong, is set up by the architect, urban designer, developer, and other specialists. The NGO serves as a facilitator, proving management and technical expertise to guide the CLT. For the NGO and CLT, the relationship with the local Shahjalal University of Science and Technology (SUST) can be utilised for further expertise from an academic background.

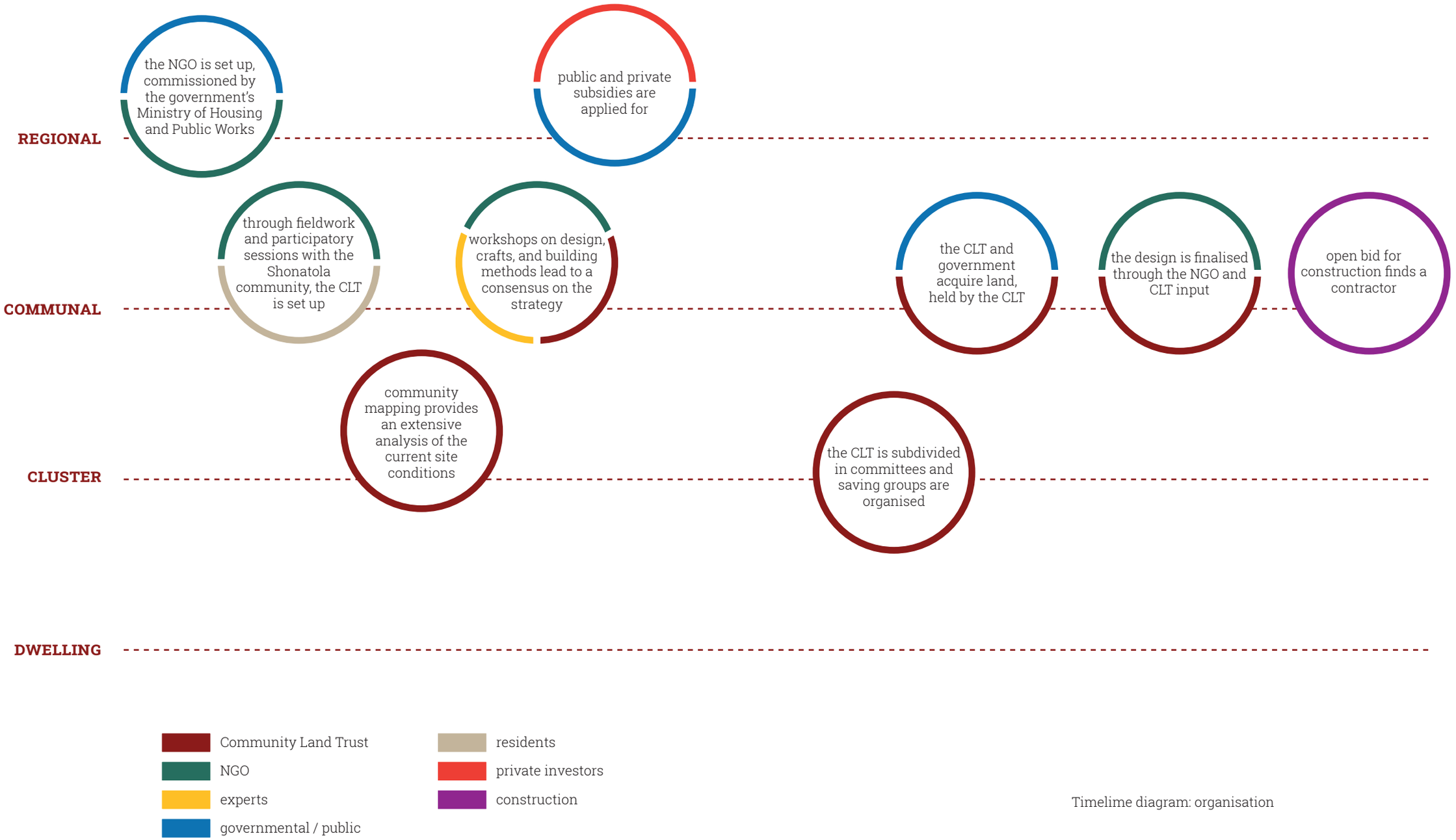
The CLT is lead by the CLT board, composed of community leaders, committee heads, and head of the savings groups, act as the primary decision-making unit. These subgroups are made up out of tightly involved residents, enabling the bottom-up grassroots approach to shape planning and implementation processes. The committees actively participate in workshops, provide feedback on design proposals, and help steer the self-building trajectory, as provided by training from the NGO, the Bangladesh government housing programmes or municipal instances, or external NGOs such as UN Habitat.

Local government bodies engage with the project by providing legal assistance through permits and subsidies. Their relationship with the CLT is both administrative and enabling, providing state support for infrastructure and housing subsidies. Additional funding is done through private investors, microfinance institutions through collective saving groups, and possibly external NGOs.

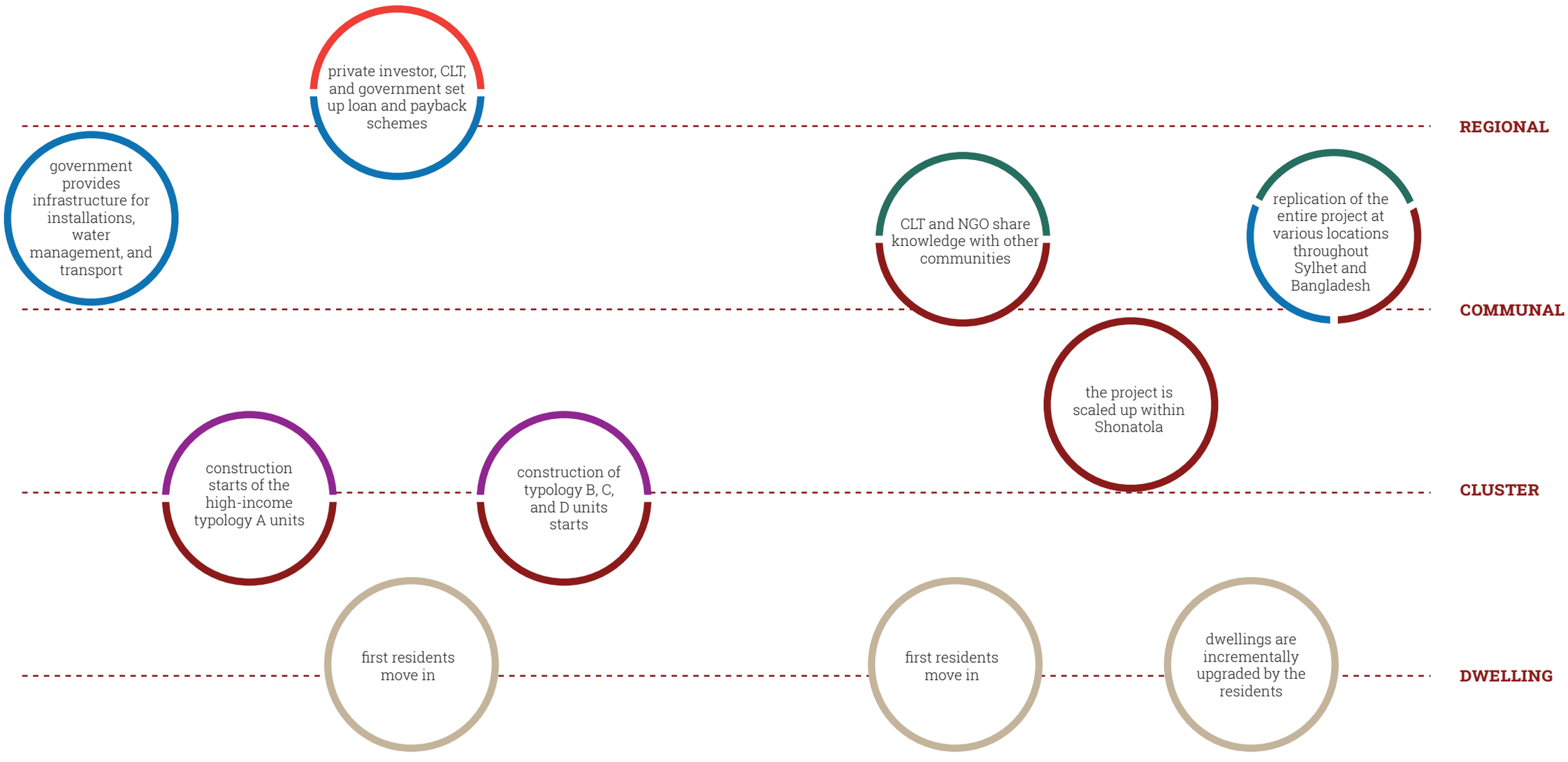
Finally, the construction firm, contracted through a bidding process, preferably of local masons and construction workers, collaborates closely with both the CLT and resident committees. Through workshops provided by the NGO, the residents actively engage in the construction process on activities that do not require extreme expertise. Upon completion of the base units, the residents are responsible for the incremental development of their homes.

Roadmap

MANAGERIAL STRATEGY



Timelime diagram: organisation



Timelime diagram: construction

Incremental constraints

MANAGERIAL STRATEGY

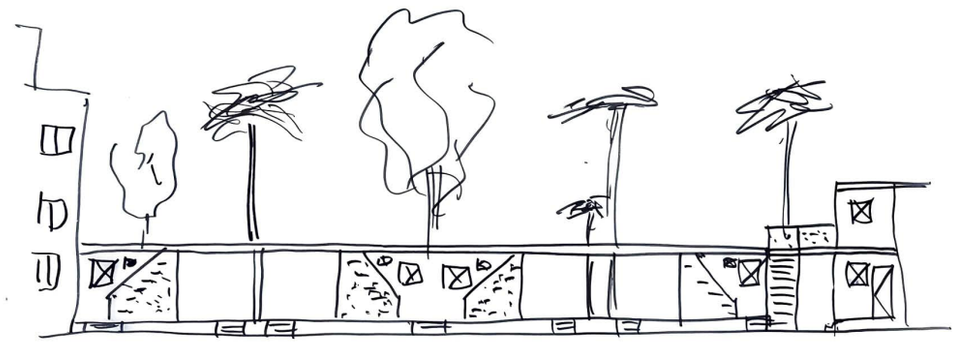
As shown in the research on case studies, incremental growth goes where it can. The law of least effort means that even rigid design shapes that create inconvenience for growth, will not stop incremental additions if that is the easiest way to expand. Some design decisions, such as enough room for the first phase of 'easy' growth and raised plinths do work.

The best solution however, is to closely monitor incremental additions long after completion of the initial scheme. As Charkop sites-and-services has shown, organising the community in collective courtyard committees (the CHSs) ensures that individual incremental growth does not take place at cost of the urban design and other residents.

In the Shonatola low-cost housing approach, the CLT and its subcommittees are responsible for monitoring this growth. The incremental growth constraints, or rather its set of rules, are as follows:

i. Incremental growth may only happen within the allocated plot. Claiming of public space is not allowed.
ii. For the incremental typologies B, C, and D, the maximum amount of floors is G+2 (three floors). The foundations of the building and its structural base components are designed for this scenario and need to withstand natural disasters. Adding additional floors forms structural risks in the extreme scenarios.
iii. On a managerial level, it is not allowed for residents to directly sell their plot or house for profit. As with the Baan Mankong and Charkop schemes, market speculation is countered through leaseholds that turn freehold after 15 years of occupation.

    Doshi's Aranya has shown that if no governance measures are taken on this level, the value appreciation makes prices quadruple. Often the intended EWG and LIG residents decide to sell their dwellings for profit and move back to the informal settlements or inadequate housing they owned beforehand. Therefore, the and stays in control of the CLT to ensure the housing solutions are for the intended target groups of Shonatola, rather than commercial developers or investors and higher-income residents. This does not mean value appreciation does not take place. On the contrary, this ensures the right people can still profit from the value increase of their homes while living in it.



Incremental growth constraints

Cost analysis

MANAGERIAL STRATEGY

The design encompasses many cost-cutting techniques. Most notably, the infrastructure is clustered in the courtyards. By mirroring and clustering the core-units, the kitchens and bathrooms at dwelling level, minimum plumbing costs are required.

The Bangla class 1 and class 2 bricks are local materials that fits the aspiration picture of the residents. It is also relatively cheap as a building material and therefore easily accessible. The dwellings is not plastered or painted, saving additional cost.

The floor slabs are made of filler slabs. This cost-effective construction technique utilises concrete slabs with waste ceramic in between the steel reinforcement bars, saving on concrete costs by around 30% (Chougule, 2016; Tafsirojjaman, 2019).

Additionally, the residents and CLT provide sweat labour by working on the construction themselves on unskilled labour parts together with the construction experts. Through the workshops and other specialist meetings, the community can also aid with more skilled labour. This sweat labour and employment of local construction workers additionally helps drive the costs down.

Finally, the incremental nature of the project aids the accessibility for financing. Instead of a mortgage and a resulting large debt up front, residents incrementally pay for their homes. This means that even apart from the cost-effective total design, the incremental financing renders the design extremely affordable, providing housing solutions for the urban poor that were previously not possible.

For the cost analysis, estimates have been taken from various sources. However, these differ greatly. The main sources are Jhenaidah (Kabir & Farzana, 2021) as it roughly utilises the same material and construction techniques, expert estimates, our own conducted material research (TU Delft Global Housing, 2025), and other cost estimates on concrete and filler slabs (Chougule, 2016; Tafsirojjaman, 2019).

Jhenaidah cost around 100.000 BDT per house, but has no load-bearing masonry, no installations, and no flood-resilience measures. This explains the similar prices for our unit that has a smaller core, but does provide a large foundation base, extended floor slab and extended foundation.

For the typology B unit, in session with expert Marina Tabassum, we concluded that the overal cost of the unit lies at around 2500 BDT/sq. ft. (€59,88/m²). This is 30% cheaper compared to traditional building cost in Bangladesh at 3500 BDT/sq. ft. (€83,83/m²).

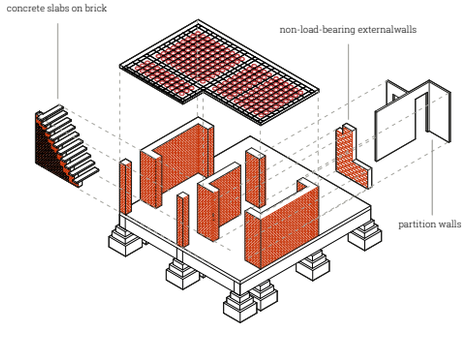
Do note that these costs are not definitive and may vary upon expert cost analysis by cost specialists in the Sylhet market.

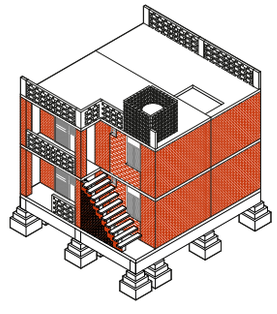
COST-EFFICIENT MEASURES

i. incremental financing
ii. clustered infrastructure
iii. local material & construction
iv. filler-slab roofs
v. sweat labour

traditional building costs	3500 BDT/sq. ft. (€83,83/m²)
Shonatola low-cost housing	**2500 BDT/sq. ft. (€59,88/m²)**

close to **30%** cost decrease
in addition to **incremental financing**





XIII. CONCLUSIONS

Shonatola Low-Cost Housing
architecture for the people

Spatial building data

CONCLUSIONS

Each developed typology has variying dwelling sizes and a varying amount of dwellings within its block. In total, 10 different dwellings are designed for the project. The incremental ratio differs per group.

As mentioned previously, typology A does not hold the same incremental character as the other units. Nevertheless, incremental expansions likely will take place on the balconies of the apartments. However, since this is not necessarily 'designed' growth in the same facilitating manner as the other building types, this increase in floor area is not taken into account for the spatial building data.

Typology B displays the biggest increase in incremental growth. The core-houses have a total incremental growth ratio of 7.8 (combining both the first and second floor) or 3,9 (ground floor only). For this typology, the floor areas are calculated at an average of 2 fully developed floors.

Typology C shows a slight increase in dwelling size, as all dwellings have a proposed incremental growth ratio of 1,6.

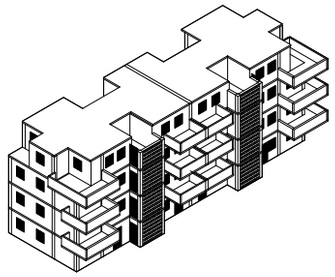
Typology D shows an incremental growth ratio of 2.0 for both the apartments and the ground-bound houses.

$$incremental\ \ growth\ \ ratio\ \ =\ \ \frac{developed\ \ floor\ \ area}{initial\ \ floor\ \ area}$$

$$floor\ \ space\ \ index\ \ =\ \ \frac{total\ \ floor\ \ area}{total\ \ plot\ \ area}$$

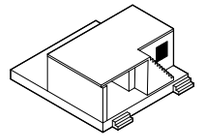
$$ground\ \ space\ \ index\ \ =\ \ \frac{total\ \ built\ \ up\ \ area}{total\ \ plot\ \ area}$$

Main spatial data indicators



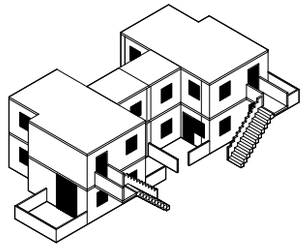
TYPOLOGY A

A1 (2x)		122 m² (incl. 24 m² retail)
A2 (2x)		75 m² (incl. 12 m² retail)
A3 (2x)		106 m²
A4 (2x)		122 m²
total floor area		856 m²



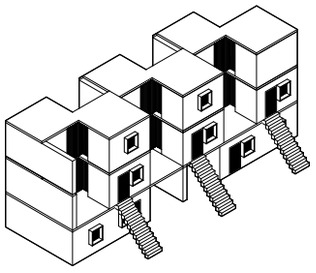
TYPOLOGY B

B1 (1x)	base	12 m²
	developed	47 m
	incr. growth	*35 m²*
B2 (1x)	base	0 m²
	developed	47 m²
	incr. growth	*47 m²*
total floor area		94 m²



TYPOLOGY C

C1 (2x)	(base)	47 m²
	(developed)	73 m²
	incr. growth	*26 m²*
C2 (2x)	base	47 m²
	developed	73 m²
	incr. growth	*26 m²*
total floor area		292 m²



TYPOLOGY D

D1 (2x)	base	40 m²
	developed	72 m²
	incr. growth	*32 m²*
D2 (3x)	base	40 m²
	developed	80 m²
	incr. growth	*40 m²*
total floor area		432 m²

Total amount of dwellings and total floor area of each typological block

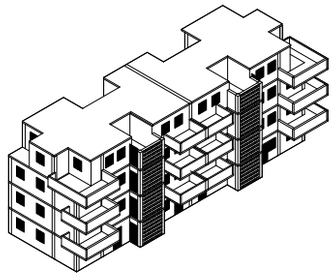
Density metrics

CONCLUSIONS

The school-mosque cluster is analysed as the most representative example of the project. The FSI of 1.12 is evidence of a significant increase in density compared to the previous situation. The 142 dw/ha further exemplifies this statement. In comparison, the GSI of 0.42 is relatively low, which is accounted for by the courtyards and public space.

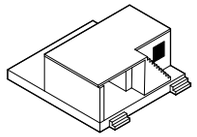
total plot area	10.306 m²
total built area	4.313 m²
total floor area	11.562 m²
total dwellings	146 dw
GSI	**0.42**
FSI	**1.12**
dw/ha	**142**

The borders of the school-mosque cluster taken for the spatial data



TYPOLOGY A

amount in cluster	3x
total dwellings	24 dw
combined floor area	2568 m²

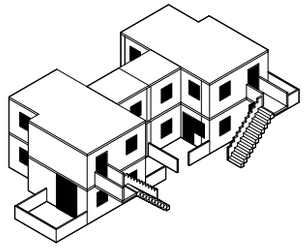


TYPOLOGY B

amount in cluster	36x
total dwellings	72 dw
combined floor area	3384 m²

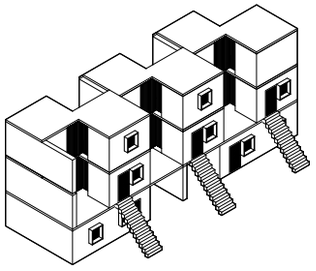
AMENITIES

361 m²



TYPOLOGY C

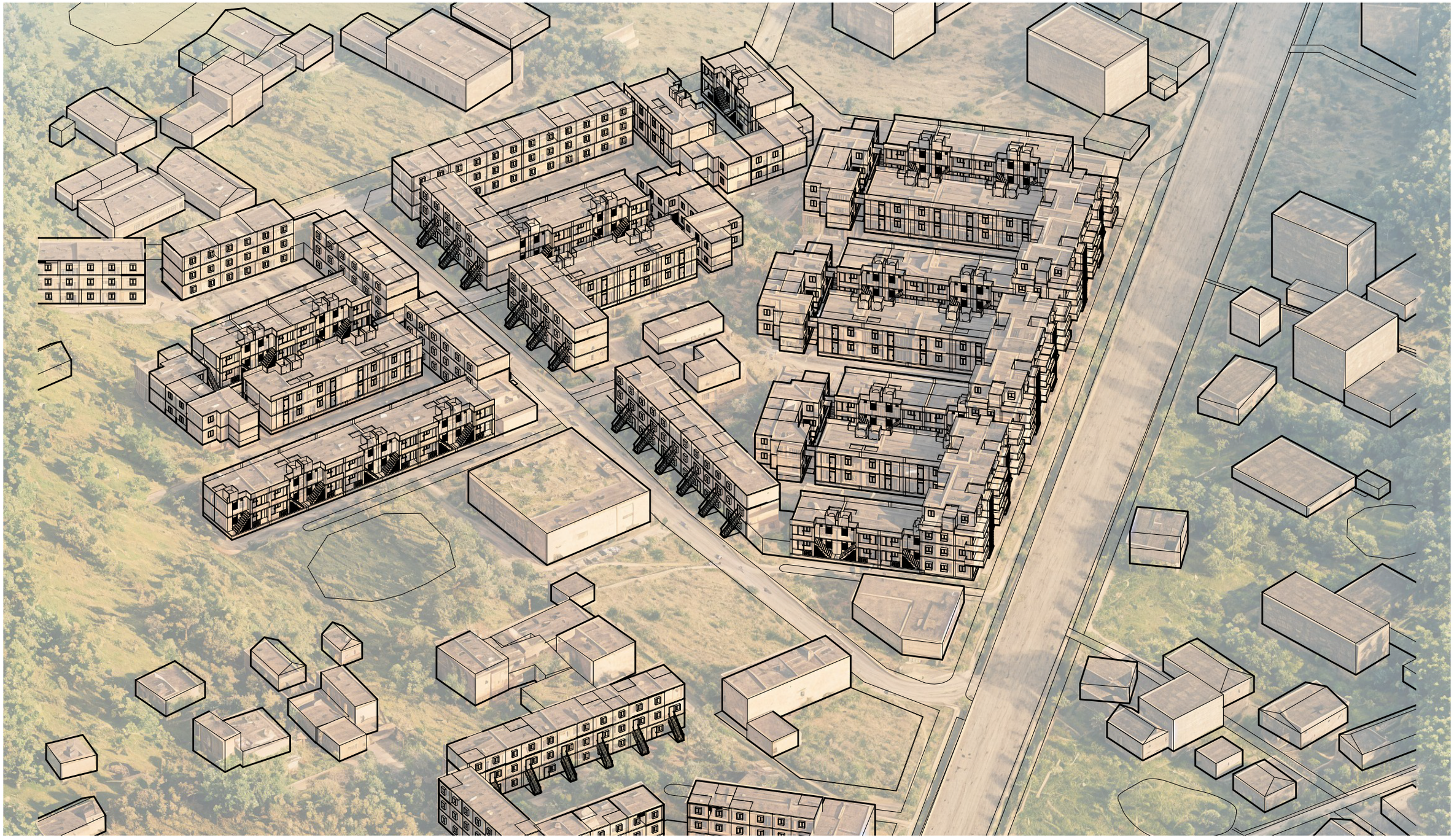
amount in cluster	5x
total dwellings	20 dw
combined floor area	1460 m²



TYPOLOGY D

amount in cluster	6x
total dwellings	30 dw
combined floor area	2592 m²

Total amount of dwellings and floor area in the school-mosque cluster



Impression of the school-mosque cluster

Conclusion

CONCLUSIONS

The strategy embodies the answer to the research questions posed at the start of this thesis. Through the combined knowledge gained from the research, the design poses a scalable and affordable housing strategy for Bangladesh that truly reaches the poor. To conclude this thesis, the main questions set out at the start of the project are answered both through the research and through the resulting design proposal.

WHAT MAIN LESSONS CAN BE LEARNED FROM INCREMENTAL HOUSING PROJECTS FROM THE PAST?

Case studies on design, management, and participation of various incremental housing strategies formed the foundation for the proposed approach. Groundbreaking incremental housing projects, such as Aranya, Belapur, PREVI, Quinta Monroy, as well as more recent participatory and managerial projects such as Jhenaidah, SPARC, and the Baan Mankong, reveal that success in incremental strategies lies in enabling gradual growth, security of tenure, and community-driven development within a well-structured urban framework.

For nearly all these projects, especially sites-and-services schemes, the urban design facilitated the physical growth and incremental process, still supporting the neighbourhood decades after completion. Many of these strategies succeeded where they prioritized urban layout and public space over rigid architectural design, recognising that good design empowers people to shape their own homes. The case studies are the proof that the theories of Charles Correa and the ABC of incremental housing by Elemental hold true.

As the research pointed out, the management strategy of any scheme, even well beyond the initial construction phase, is most crucial for the project's success. As the case studies and research have pointed out, without proper governance, even the best of designs fail. As Wakely and Riley (2011) have pointed out, incremental housing is one of the most probable strategies for affordable housing. The key pillars for such a strategy are partcipation, as people must feel responsible for the housing themselves, security of tenure, as personal investment is not worthwhile with the risk of eviction looming, income generation, and a central project location with proper infrastructure and transport.

These insights directly formed the Shonatola masterplan through its variety of typologies, flexibility in unit growth, and spatial hierarchies centred around communal courtyards that create vibrant and resilient neighbourhoods.

Furthermore, the design addresses all five A's of adequate housing: availability, affordability, acceptability, accessibility, and adequacy (Ayala, 2025). With a strong emphasis on affordability, the incremental housing strategy provides adequate housing solutions for Bangladesh.

WHAT MINIMUM FLOOD-RESILIENT DESIGN MEASURES CAN BE EMPLOYED IN AN INCREMENTAL STRATEGY ON AN ARCHITECTURAL AND URBAN SCALE?

The flood resilience of the project is addressed on multiple scales. At the dwelling level, the design incorporates raised plinths, robust materials that resist prolonged water exposure, such as concrete foundations and fired brick, and RC slab roofs for vertical refuge in the event of extreme flood scenarios,

At the urban scale, the water management plan redirects the water away from the dwellings to lower-lying public spaces, such as the community gardens and the paddy fields. The newly built storm drainages and elevated road, as well as the raised plinths for the housing structures, all work together to keep the dwellings dry. Streets are designed with stormwater gradients and drainage, while green spaces, such as swales and wadis, double as temporary water catchment zones.

WHAT SOCIAL AND TYPOLOGICAL FEATURES MUST BE INTEGRATED INTO THE DESIGN TO FIT WITH THE WAY OF LIVING FOR THE PEOPLE OF SYLHET?

Due to its participatory and research-based nature, the strategy fits with the local needs of the Bangladeshi people, therefore providing acceptable and adequate housing solutions. The typology of the courtyards, as well as features within the Bengali dwelling are mimicked to support the way of living. Nevertheless, some of the traditional village-like attributes have been changed, since Shonatola faces urbanisation through the expansion of Sylhet.

Local building techniques and methods are thoughtfully integrated in the plan, which further help the residents with feeling responsible and connected to their homes. The strategy seeks to strengthen the existing community through its design and management approach.

HOW CAN INCREMENTAL HOUSING STRATEGIES BE MADE SITE-SPECIFIC AND SUITED TO THE FLOOD-SUSCEPTIBLE CONTEXT OF SYLHET TO CREATE AFFORDABLE, CONTEXT-BASED HOUSING SOLUTIONS?

The design strategy serves as a direct answer to the thesis' main question. The design shows that incrementalism is not a compromise but a strategy for empowerment. Shonatola Low-Cost Housing delivers a comprehensive, context-specific, and scalable response to the urgent challenges of flooding, informality, housing inadequacy, and rapid urbanisation in Sylhet.

The incremental housing strategy is conceived as a context-specific sites-and-services programme, integrating the strategy with flood-resilience measures. The strategy forms a framework for long-term adaptability, affordability, and community ownership, in a way that empowers the communities to replicate the strategy elsewhere for sites at the peri-urban transition across Bangladesh.

XIV.REFLECTION

Shonatola Low-Cost Housing
architecture for the people

Reflection

REFLECTION

This research started on the premise of urgent challenges faced in many places in the world, taking Bangladesh as its subject. These include rapid urbanisation, the formation of informal settlements, the lack of affordable housing, floods, and other consequences of climate change. These economic and environmental vulnerabilities motivate me to set out solutions for Bangladesh's lower-income classes. Rather than imposing entirely new housing models, I was inspired by the potential of incremental housing strategies that empower residents to build and adapt their homes over time. These incremental housing schemes are proven to work by the literature and also have their roots in this part of the world.

By combining proven strategies from past incremental housing projects with tailored flood-resilient adaptations, this project seeks to create context-specific, affordable housing solutions that can truly make a difference in Sylhet, Bangladesh. This approach aligns with my personal belief in architecture as a tool for social impact, bridging design innovation with the lived realities of vulnerable populations.
The approach

I approached the research by looking into the mechanics of incremental housing projects. Through case studies, literature and interviews, I developed a deep understanding of incremental housing strategies on architectural design (construction method, unit dimensions, typology, materialisation), urban design (plot dimensions, urban layout, typology), and management (finance, strategy, stakeholders). I researched flood-resilience through literature and studying local and vernacular building techniques. This also ties in with the contextual research, where the site visit and interviews on-site helped understand the way of living and building in Bangladesh.

My project combined these aspects to develop a design that brings all these criteria together. The approach worked, since I am confident my project, when carried out, will provide the change and solutions needed for its context. The research led to a better understanding of architecture and housing can help people escape poverty, as well as standing up against the climate-induced issues of the area.

The feedback of my mentors Marina Tabassum, Rohan Varma, Rocio Conesa Sánchez and Frederique van Andel helped to further develop my project. Through their local expertise on building in Bangladesh, incremental housing, the way of life, building techniques and research on incremental housing, I am confident my project has a high chance of succeeding in Bangladesh.

The feedback sessions also helped point out weaknesses of the project I did not see at first glance, helping me solve the design. This meant that through this year of extensive research and design, I have learned more on the aspects of good architectural and urban design, as well as cost-effectiveness and bringing up an understanding for the housing market in different global settings.

What is the relation between your graduation project topic, your master track (A, U, BT, LA, MBE), and your master programme (MSc AUBS)?

My graduation project aligns with the Architecture track of the MSc Architecture, Urbanism & Building Sciences by addressing the design of affordable, adaptable, and flood-resilient housing. As in my project, the architecture master's programme of the TU Delft aims to provide solutions to architectural interventions that respond to global spatial, social, and environmental challenges.

Additionally, by focusing on housing as a dynamic process rather than a static product, qualitative urban design, managerial strategies, landscaping and building technology, the project reflects all parts of the MSc AUBS. Furthermore, it resonates with the Global Housing studio's themes of inclusivity, context-specificity, and resilience.

How did your research influence your design/ recommendations and how did the design/ recommendations influence your research?

My research laid the foundation for the project by systematically analysing incremental housing projects from the past and assessing flood-resilient design measures applicable to Bangladesh. This informed critical decisions on architectural design (unit size, typology), structural systems (such as raised plinths, material choice) and urban layout (courtyard typologies, cluster, sequences of spaces). Paired with the literature and design guidelines of Charles Correa and Alejandro Aravena, my project had clear guidelines for its design and management.

Conversely, the iterative process of design brought forward practical challenges that further refined my research focus. For example, choices on material availability, strengths and the desired typology meant I had to further research these aspects. The research and design constantly fed into each other, leading to a coherent and context-sensitive proposal.

How do you assess the value of your way of working (your approach, your used methods, used methodology)?

My approach combined research by design, case study analysis, literature studies, and on-site research, which proved valuable in tackling the project's complexity. Research by design allowed for testing hypotheses in spatial and structural terms, while case studies and literature provided concrete lessons on governance, participation, and typology. The site visit helped ground the project in Sylhet's unique environmental and social conditions.

The methodology was effective because it balanced academic rigour with design pragmatism. For instance, I often found the simplest solutions are best, but one

has to analyse many options to get to these seemingly 'simple' solutions. This way of working enabled me to remain flexible, adapt to new insights, and maintain coherence between the theoretical framework and design interventions.

How do you assess the academic and societal value, scope and implication of your graduation project, including ethical aspects?

Academically, the project contributes to the discourse on how incremental housing strategies can be updated for site-specific design and contemporary climate resilience, particularly in the Global South. It bridges a gap between architectural theory (incrementality, housing as a verb) and the pressing reality of flood-prone urbanisation in Bangladesh.

Societally, the project aims to empower low-income communities by providing a scalable and adaptable housing model that acknowledges their agency while ensuring safety and dignity. It also addresses issues of equity by making deliberate design choices that enhance affordability and accessibility. Ethically, in incremental housing, there could be a debate about what is the minimum that one provides. Additionally, even the cheapest forms of housing could still be inaccessible to the poorest of the poor, depending on the local policies and funding methods.

How do you assess the value of the transferability of your project results?

While the design is grounded in the context of Sylhet, the core principles of affordable housing, incrementality, and flood-resilience are highly transferable to other flood-prone and resource-constrained contexts in the Global South, some even globally. The methodology of combining context-specific research with adaptable design strategies can serve as a model for architects and urban planners facing similar challenges elsewhere. However, successful transferability would require contextual research to respect local materials, governance structures, and socio-economic dynamics.

OWN ADDITIONAL REFLECTIVE QUESTIONS

Reflecting, what would be the main hazards for an incremental housing project like this one to come to life?

As the literature has pointed out, incremental housing strategies succeed or fail depending on the management. Historically, good incremental housing projects have also failed by being evaluated and deemed a failure after not having let it grow for a sufficient amount of time. Changes in subsidy through changes in local or national politics have seen incremental housing projects been cut off. Also, not having participative sessions with the future residents, failure to keep security of land tenure, or an exploding capitalist market where prices quadruple are factors every design should try and tackle as much as they can. Unfortunately, factors such as politics are out of our hands as architects, urbanists and managers.

As incremental housing is not as popular as a solution today, compared to second half of the last century, how does my project provide a viable solution that could revive the interest in incremental housing?

By researching incremental housing strategies that were successful in the past and taking these elements into a new framework, incremental housing can be made site-specific to fit more sites than traditional incremental sites and services programmes. Instead of an empty slate of land or a tabula rasa, my project proves that incremental housing strategies can provide mass affordable housing in smaller, site-specific contexts.

AFTERWORD

Looking back, I am satisfied with the outcome of my project so far. The project solves the main issues it addresses and provides a promising framework for similar contexts in the Global South.

Personally, I found the project challenging. The project is demanding, since I had to place myself in a different context than the one I am used to (even though I have done other projects in the Global South before). The harsh circumstances of life in Bangladesh, as seen on the site visit, were also impactful, but moreover functioned as a motivation to make a valuable contribution to the existing research, to help improve the lives of those affected by climate change and living in poverty.

These lessons are valuable, also outside of Bangladesh, and provide me with an understanding of complex projects that will be useful for the rest of my career and personal life in and outside of the built environment.

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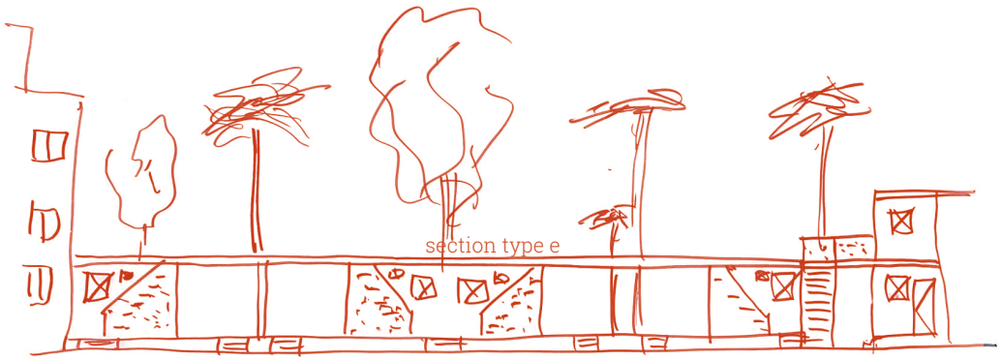

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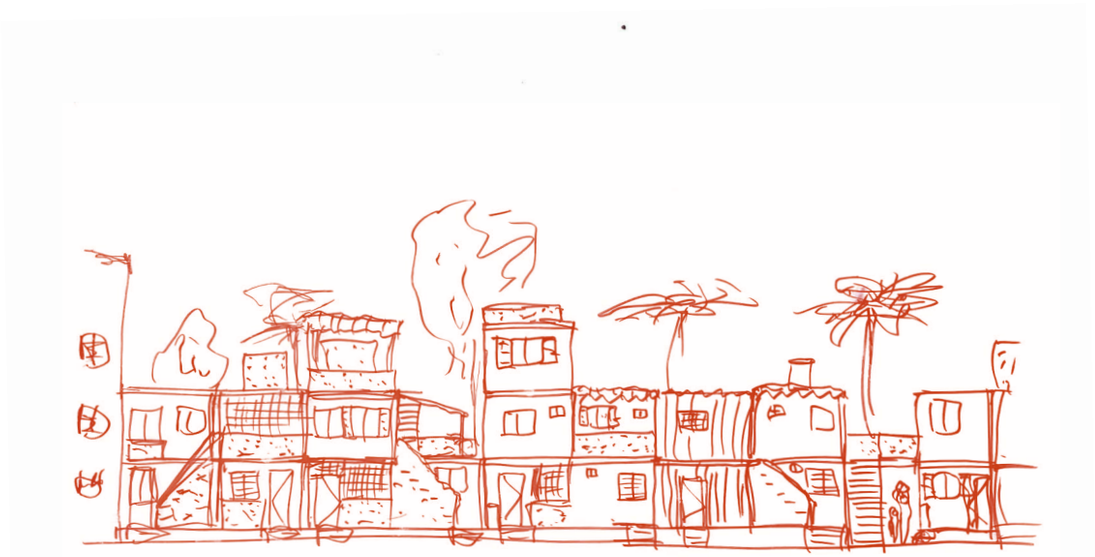

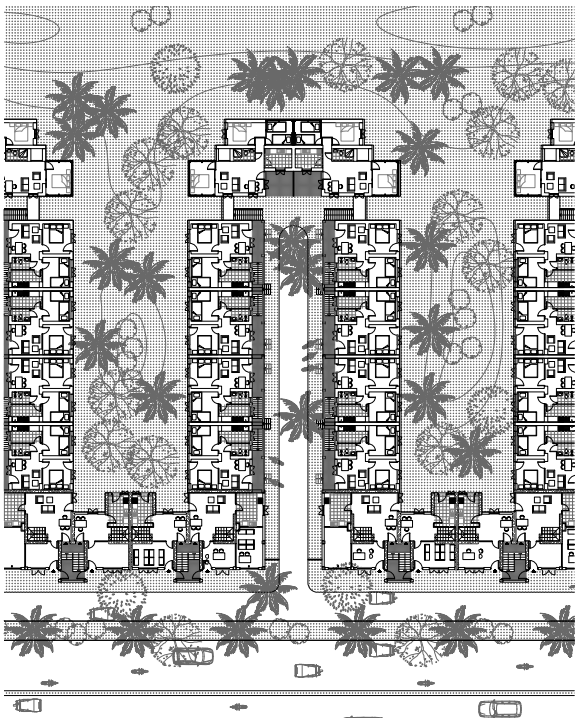

SHONATOLA LOW-COST HOUSING

architecture for the people

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