A Global Campaign

ROOF OVER OUR HEADS

Roof Over Our Heads

Roof Over Our Heads

SPARC

GLOBAL
RESILIENCE
PARTNERSHIP

Name of the Publication: "Roof Over Our Heads"
Subtitle: Building resilient homes for people living in informality within cities across the global south.

ISBN: 978-93-5967-758-3
ISBN for E Book: 978-93-5996-446-1

Lead Author:
Sheela Patel

Contributing Authors:
Smruti Jukur
Siddhi Mehta
Nihar Johari
Aryan Iyer
Indu Agarwal

Curation of Text & Review Editors:
Indu Agarwal
Aditya Sawant
Vinod Rao

Layout Design
Radhika Ganorkar-Chaware
Siddhi Mehta
Indu Agarwal

Design, Graphics and Illustrations:
Siddhi Mehta
Aryan Iyer
Khoosh Prajapati
Bhakti Shaparia

Publisher
Society for the Promotion of Area Resource Centres (SPARC)

Printer
Allwyn Jumbo Xerox, Mumbai

https://campaignforrooh.org

ROOF OVER OUR HEADS

Building resilient homes for people living in informality within cities across the global south.

Dedicated to the memory of

Jockin Arputham (1946-2018)

For his deep dedication to the challenges of homelessness and informality in cities and whose charisma, leadership and mentorship influenced all who came in touch with him.

CONTENTS

Jockin Arputham
(1946-2018)

Jockin Arputham explored an association with SPARC in 1986 when he and his federation, the National Slum Dwellers Federation (NSDF) joined SPARC and Mahila Milan to form what we now refer to as the Indian Alliance. An amazing, inspiring, and tough mentor, he crafted a strategy to facilitate aggregation of demand for change by those facing demolitions and evictions through data-based evidence that the poor themselves collected, collated, and represented. He demanded that professionals assist, support, and maintain a partnership with organized communities. In return his 'male only' organization made commitments to not only embrace SPARC and Mahila Milan (women pavement dwellers in Mumbai at that time) but to become an organization where all federations would have women's collectives and NSDF will have 50% women leadership so that they could have dual representation.

Apart from crafting this partnership in India, he influenced the founders of ACHR established in 1988 to ensure that every city and country it worked in has a federation of the urban poor, and a strong network of women's savings groups. Later, after visiting South Africa in 1992 and expanded engagement with African country activities, he helped create Slum Dwellers International (SDI), which was registered in 1996, and remained its Founding President throughout his life.

Among the several awards and honours he received were the Ramon Magsaysay Award for Peace and International Understanding in 2000, Padma Shri, Government of India 2010, Skoll Award for Social Entrepreneurship in 2013, and in 2014 he was nominated for the Nobel Peace Prize along with SDI[i]. Jockin was honoured with several awards during his lifetime, but he always considered that they belonged to the informal communities he represented.

We miss you Jockin and will always try to stay on the path you have shown us.

Saleemul Huq
(1952-2023)

"We will deeply miss you at COP 28 in Dubai. However, your spirit and invaluable teachings will guide and provide relentless focus on the crucial issues that climate activists, researchers, and governments should look at to safeguard the most vulnerable, in the present, past and the future."

Prof. Saleemul Huq has left a huge legacy of demands and expectations from all of us: students, friends, and those whom he advised. He played numerous roles as a mentor, guide, advocate, and tireless campaigner in the climate change space and generously shared his advice, facilitated, and patiently encouraged those seeking his guidance, constantly emphasising the importance of being accountable to those most affected by the adverse impacts of climate change.

Countless networks and institutions have greatly benefitted from his guidance, advice, and unwavering encouragement to explore possibilities while always keeping the concerns of people and their needs at the core.[ii] May his spirit continue to remind them of their collective responsibility and accountability to create transformative change that truly supports the most vulnerable.

your words of wisdom and commitment will forever continue to inspire us.

Acknowledgments

SPARC and the ROOH Secretariat would like to thank all the Founding Partners of the campaign – SDI, GRP, IIED, RtR, RtZ, Arup, HOLCIM, GCoM, TECHO, and Build Change, our funders USAID through GRP, who provided support in designing the framework of this Campaign, for building a program, and in documenting the labs in India, financial support from HOLCIM for conducting the workshop in Philippines and to GRP and ATE Chandra Foundation for the production of this book, Roof Over Our Heads: Building resilient homes for people living in informality within cities across the global south.

The documentation and analysis of this campaign and the nine labs was led by the ROOH Secretariat with the central involvement of Nihar Johari, Siddhi Mehta, Smruti Jukur, and Vinod Rao; with support from Aryan Iyer, Khoosh Prajapati, Bhakti Shaparia and Nandana Nair; with SPARC administrative staff, Sharmila Gimonkar and Maria Lobo from SPARC Programs team. Special thanks to Rahul Mehrotra and Smit Vyas (Studio 4000) for their invaluable inputs to the ROOH team in conceptualising the documentation of the process and data analysis of the labs.

We would like to thank our community leader Gunashekhar from the NSDF, Mahila Milan women's collectives from cities across India and our collaboration partners Hasiru Dala, their team and onsite facilitators from Bengaluru, and CURE with their team from New Delhi who helped us with on-site documentation and data collection.

Thanks to Radhika Ganorkar-Chaware for designing the layout of the book with inputs from Indu Agarwal and Siddhi Mehta. Additionally, we would like to thank Indu Agarwal & Aditya Sawant and for curating and assisting in writing the text for the book.

Special thanks to David Satterthwaite, David Howlett and Lauren Elizabeth Anderson for their constructive comments on the final draft of the book.

We would like to express our deepest appreciation to the current and past UN Climate Change High Level Champions, HE Razan al Mubarak, Dr Mahmoud Mohelidin, Nigel Topping, Gonzalo Muñoz, for their deep commitment and enthusiastic support for the campaign, and for members of their team who gave invaluable support - namely David Howlett, Bex Porter, Will Wild, Camila Fernández, and Carla Germani.

Numerous individuals have given their time freely. They include Robert Kay and Nigel Tonks (ARUP), Amira Ayoub, Gabriela Arrastúa for helping us conduct the roundtables in the USA, Europe, Middle East, and North Africa (MENA), and Latin America and the Caribbean (LAC) Regions. Nathanial Matthews and Anastasia Brainich (GRP), whose focused assistance has helped create the infrastructure back up for ROOH and thank Mathew Chandy (CORE), Benjamin Jance, Asma Jhina (GCoM), Magali Anderson (HOLCIM), Cristina Gamboa (World GBC), Prof. Saleemul Huq (ICCCAD), Geeta Mehta (Columbia University, USA), and Aditya Bahadur (IIED) for their unwavering support.

Thank you all for being a part of this incredible Year 1 of the Campaign.

With gratitude,
Sheela Patel,
Director | Society for the Promotion of Area Resource Centres

BUILD CHANGE iied International Institute for Environment and Development GLOBAL COVENANT of MAYORS for CLIMATE & ENERGY TECHO ಹಸಿರು ದಳ Hasiru Dala CENTRE FOR URBAN AND REGIONAL EXCELLENCE

“

I have had the privilege of meeting women community leaders from informal settlements in Nairobi, Kenya. They shared their actions under ROOH to build the resilience of themselves and their families against the impacts of climate change. As climate change worsens, community-led initiatives like ROOH are vital examples of leadership and impact, based on partnerships and on-the-ground success. ROOH is a flagship initiative in the Champions’ Race to Resilience, and I look forward to its growing outreach and impact.

- H. E. Razan Al Mubarak
U.N Climate Change High Level Champion
COP28

Summary

This book documents the first year of the campaign for "Roof Over Our Heads" (ROOH) since its launch at COP27[iii] at Sharm el-Sheikh, Egypt creating a pivotal moment in our journey towards addressing the global climate challenge to ensure climate resilient housing solutions for people living in informal settlements in the cities of the global south. ROOH seeks to create long-term transformation through community empowerment, incremental upgradation, retrofitting, and peer learning. It strives to achieve long-term benefits through collaborating with multiple stakeholders, procuring resources, and engaging policymakers, eventually contributing to improved housing, and living conditions for marginalized people worldwide.

Women leaders from SDI[iv] are at the centre and focus of ROOH. They are the campaigns' "accountability compass" and have played a significant role in the inception of this campaign and they remain the guardians of this strategy. This book has been written as much for them and for the communities who work with us as it is for all who have supported and worked with the ROOH campaign and to hopefully inspire more people and organisations to join the campaign and work with us to realise its goals. This book discusses the campaign, the range of partnerships with diverse groups of concerned individuals, organizations and collaborators who have shown a deep commitment to engaging with the issue of exploring inclusive, sustainable, and resilient housing solutions for informal settlements and have generously supported the ROOH campaign. Their contributions, monetary or in-kind, and advisory assistance have played a vital role in helping the ROOH Secretariat to develop a robust articulation of concepts and framework for ROOH, documentation of the campaign and the process for the learning labs in India.[v]

As a proof of concept for ROOH, seventeen settlements in nine cities and towns in India form the learning labs[vi] that have been initiated in India. The learning labs will act as incubators for the exploration of solutions to address the challenges that people in informal settlements experience with climate change. These issues are examined in the context of the microclimatic zones, considering both available choices and limitations and the Labs explore solutions through a collaboration between urban poor communities (especially women) and professionals. These narratives owe their existence to the kindness of the residents of informal settlements in all the labs that have been documented. They welcomed the teams of professionals into their homes,

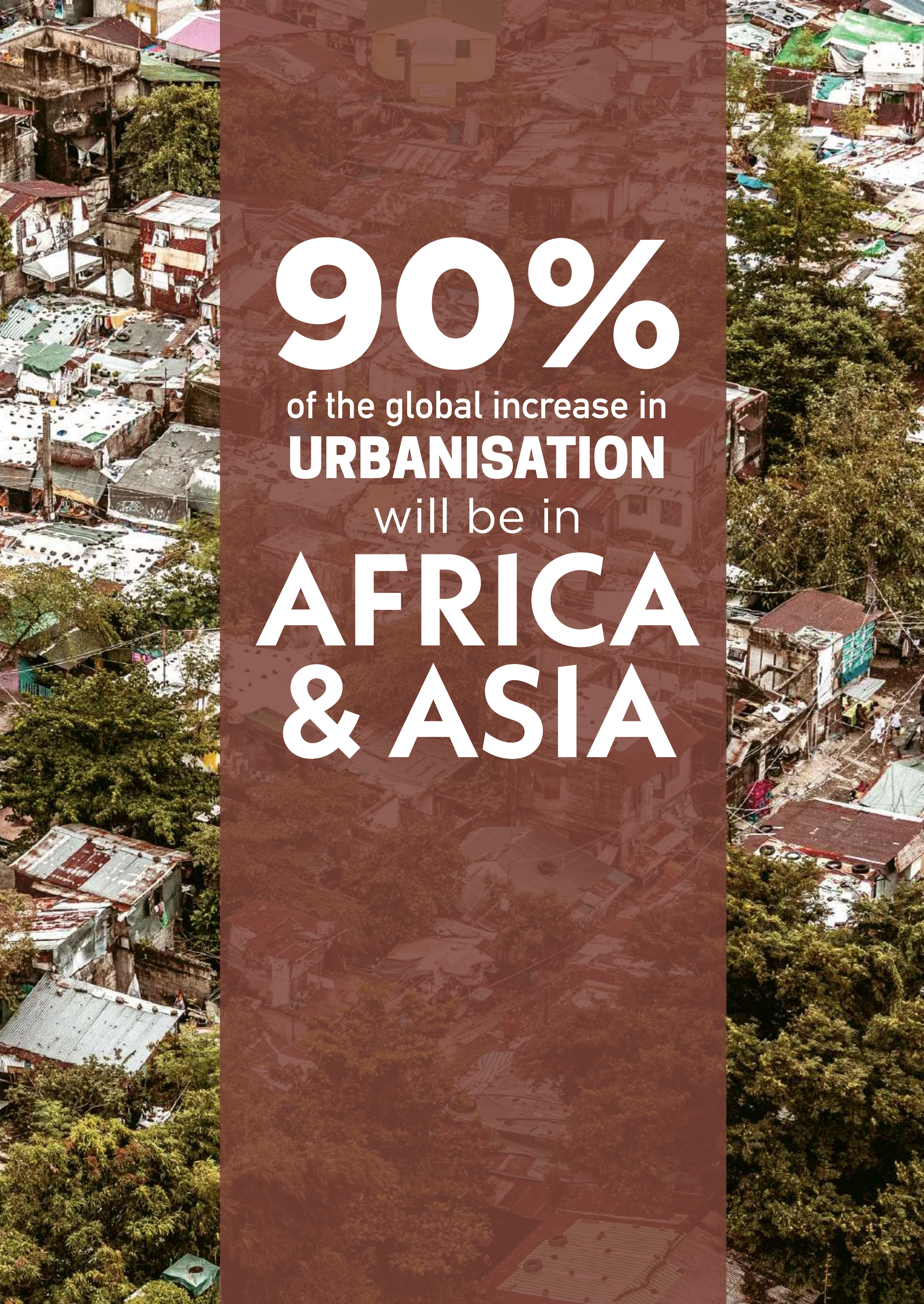
generously gave of their time and provided free access to their homes and settlements. The residents worked with the ROOH teams to develop questions based on which assessments were made to capture and document their histories of migration, their linkages to the homes they live in and the struggles they continue to face as they cope with extreme weather. While exploring these households involved in the labs, the ROOH team also visited private trusts and societies, developers, and officials to explore the backdrop of how these communities' located resources of materials, finance, and contractors to build and repair their homes.

The value of this documentation will also help build the foundations of engagement with ROOH partners who will take up another 90 labs using the "spine" of the documentation and data collected to produce powerful aggregation of how vulnerability exists in informal settlements while allowing them the creative freedom to explore locally specific and unique aspects of how choices for habitat design and construction occur.

This publication helps us take stock of the work done so far and to document the learnings of the campaign initiated in the first year. After the introductory Chapter 1, Chapter 2 explains in further detail all aspects related to the Campaign and Chapter 3 the structure of the campaign. Chapters 4 and 5 illustrate the action on the ground through the nine labs conducted across cities in India located in varying climactic zones. Chapter 6 provides analysis and learnings from the labs conducted so far. Chapter 7 concludes with explaining the next steps to take the campaign forward. As more cities from Africa, Latin America and Asia join the campaign the report next year will include a wider range of labs and experiences.

As we reflect on the past year and look ahead to the future, we are excited to announce the scaling up of the ROOH campaign. The labs conducted and documented in India in Phase 1 have not only enriched our understanding of the housing challenges but have also provided valuable insights into sustainable solutions. This marks the beginning of the implementation phase in our mission to provide sustainable solutions for the issues of informal housing. Improving the living conditions of informal settlements while simultaneously mitigating and adapting to climate change is not only a moral imperative but a crucial step towards a just and sustainable future where together, we can make a difference.

Quezon City, Metro Manila, Philippines
Photo Credit: Christoph Von Toggenburg
Source For Statistic UN Publication[vii]


90%
of the global increase in
URBANISATION
will be in
AFRICA
& ASIA


NEROLAC
BEAUTY

What Women Want

The concept of the campaign for ROOH came from one of the five asks of another campaign, called "What Women Want" where women leaders from SDI country federations prioritised issues to develop long term sustainable solutions to address the challenges that impacted their daily lives. The traditional methods of information sharing among women members of informal saving groups of SDI were interrupted by lockdowns and travel restrictions during the Covid-19 pandemic. Despite the limitations imposed by the pandemic, these groups managed to connect virtually, sparking discussions on what the women truly needed to ensure family safety, health, and long-term survival and prosperity. They identified five priority areas that they called 'What Women Want'[viii] which focus on the importance of recognizing and addressing the specific needs of women in informal settlements not just during the pandemic but also to deal with the increasingly intense climate events of floods, hurricane force winds and extreme heat.

1. Roof over Our Heads
2. Greens in our meals
3. Women! "Take care of your own Health".
4. Wheels & Wages (Transport challenges faced by women)
5. Warriors not victims: Coping with disasters

These are demands for five campaigns and while all five issues were discussed, they were developmental issues which now needed to be combined with the challenges of climate change linked knowledge assessment features and solutions that made them viable in the future. ROOH is the first demand to explore how women can improve the resilience of their homes to extreme weather. To further add simplicity yet complexity to this process, women's reflections indicated that everyone else decided what is needed and "told" women what should be done.

The challenge remains as to how women define, explore, facilitate partnerships, and influence communities and cities to believe that change sought by women in informality is not only good for them but good for the city and the planet.

ROOH kick starts this journey; a quest to change how issues get raised by women in informal communities and while they drive the explorations, the ROOH campaign seeks to facilitate and strengthen existing approaches within governments to produce affordable, available, and accessible building materials with designs and construction techniques. It also seeks the acknowledgement within governments for the need for alternatives in governance and financing that are affordable and accessible for informal inhabitants. Together we aspire to produce a bottom-up, demand driven solution building process who's local, national, and global circulation of knowledge and ideas will expand everyone's choices of making their homes resilient to extreme weather.

“At COP27, I was pleased to unveil the Roof Over Our Heads Campaign with Sheela. This campaign has a human rights approach close to my heart. Hundreds of millions of people live in poor quality housing. These individuals don't just face the effects of the climate crisis; they lack even the most fundamental rights: access to clean water and sanitation, waste disposal, and a healthy environment, and the kind of services that protect wellbeing and safety.

I am therefore heartened to see that this pioneering collaboration between suppliers, cities, architects, financiers, academia, and of course the communities themselves, has got off to such a positive start in its first year. I am sure this is going to make a difference to many millions of people living in informality.

Mary Robinson,
Chair of the Elders

1

Introduction To ROOH

Approximately 1 billion people currently live in informal settlements, which are typically home to 30–50% of urban residents in the cities of the Global South. This number is projected to double by 2050, with most of this increase expected to be in Asia and Africa, specifically in South Asia and East Africa.[ix]

The current structures of urban development planning still follow colonial planning norms, many dating back to the late 19th or early 20th century. These norms were designed for formal cities and either ignore or punish those living in informal settlements. New internal (in country) displacements due to storms, floods, wildfires, droughts, and extreme temperatures (as well as riots and local conflicts) have been estimated at 21.9 million annually across the past decade (31.8 million in 2022).[x] Both these present migrants and future anticipated climate refugees who will come to cities will require housing, basic services, and resilience to face the climate change impacts that will worsen many existing shocks and stresses while creating new challenges in the form of more extreme weather events like torrential rains and resultant floods, heat waves and cyclonic winds. Without serious management of land and housing and infrastructure in cities, dense informal settlements today will get denser and more dangerous. Covid-19 highlighted the inequities where people living in overcrowded and poor housing were hit the hardest. As this deficit grows, the need is expected to outstrip the public resources needed to address these problems and the situation demands a re-examination and revision of resource allocations. Prevention is better than disaster relief. While quantification of economic losses due to weather destroying city assets is done, most disaster plans have not worked for the informal slum dwellers in general. While state and global reforms seek to make equitable investments for habitat and produce campaigns to draw attention to these urgent deficits, not much has created the volume of change needed. ROOH and its learning labs seek to create a global campaign striving for an urgent priority setting in an already urbanized planet while working with very vulnerable communities to help produce better, more robust habitats with their own investments in their homes and to produce resilience at the same time. While the labs undertake to help households help themselves, the campaign will demand improved governance and accountability of the public and private sector. *Thus, ROOH has two important elements: advocacy for transformative change and action on the ground.*

Advocacy for Transformative Change

ROOH is a campaign that envisions delivering resilient, low carbon, energy efficient and affordable homes that households undertake themselves, recognizing that households and neighbourhoods that design, construct, and finance their own homes should be provided with better options by the markets for carbon neutral materials while state and global financing provides serious investments to improve tenure security, amenities, and services. ROOH's vision has created a campaign supported by the UN High Level Champions' Race to Resilience (RtR) and Race to Zero (RtZ) Campaigns[xi]. It advocates to deliver locally driven, globally assisted resilience breakthroughs to help achieve the RtR goal of assisting 4 billion people who are the most vulnerable and enable them to build homes that are resilient to the disastrous impacts of climate change. The aim of delivering ROOH will need an "unusual" coalition of partners, from slum dwellers and their networks, to financiers, designers, architects, suppliers such as the cement and concrete industry or paint manufacturers, roofing materials, and other such accessible materials. Meanwhile educational institutions must begin to include their needs for better designs and construction systems in the architecture, engineering and social science education curriculum. City mayors, whose electoral constituencies are these households whose needs must be taken care of in the new world need to look at development and climate change together and must produce investments and solutions. And financing mechanisms that are inclusive and develop financial instruments that can lend to these households. All these must become stakeholders in the resilient housing solutions we seek, to make a difference to the lives of the more than one billion people living in informal settlements in poor quality housing.

> "
> I remember many years ago explaining how the climate issue overlaps with what they are interested in - human rights, working with slum dwellers and showing that there is a synergy. And I think this is what we are now seeing, that that synergy can be brought out. Take it forward and that's a win, win for all of us.
>
> -Dr Saleemul Huq
> Director, ICCCAD
> Launch of ROOH at COP27

ROOH is a bottom-up campaign created by women leaders of informal settlements and keeping slum dwellers, especially women in the driving seat is the signature of this campaign and action. SDI and similar sister social movements with long-term, on-going engagements with women's collectives will drive this in as many cities of their affiliates and partners as possible. Each lab comprising of women and young professionals will assess their present habitat and discuss what stays and what needs to change – and this will then be explored and tested and based on tests and assessments of what works, shared with all others who will similarly drive their own processes that value and focus on the women and their communities in informality. Each social movement associated with ROOH will be facilitated to obtain funding and manage their labs with the commitment that what works will be scaled up through their networks.

ROOH aspires to develop this process so that more and more networks, organizations, and communities can explore and appropriate this process and produce locally sustainable outcomes that fulfil as many resilience goals as possible. ROOH envisages that these collaborations will spawn off several action circles that will coalesce to promote the systemic changes in ROOH's priority areas.

Goals and Strategy

Goals

The ROOH campaign envisions uplifting vulnerable communities in informal settlements by enhancing their living conditions, strengthen climate resilience, and advocating for secure housing. It seeks to address the challenges of planning, administration, and policy implementation and empower people living in informal settlements to be heard and be part of the solution and mobilize public and private finance at scale and get this to people that need it so that houses are built, and existing homes retrofitted. Our mission is to cultivate community-led labs, primarily led by women's collectives, fostering innovative housing solutions, and promoting cross-city collaboration.

Strategy

Creating communication and engagements that bring in interested stakeholders through round table meetings, in-person, virtual or hybrid where the challenges that ROOH faces are presented (as much as possible by women leaders themselves) and seek what contributions different constituencies can make. These round tables are held at global, regional, and national level bringing all the champions of the ROOH campaign to meet different constituencies that we seek to engage.

Summaries of all round tables (web based and physical events) as videos and written reports are now available on the ROOH website and You tube[xii]. A yearly timetable of events is emerging with COPs at the end of each calendar year, and we hope to present ROOH to various audiences and engage more organisations to explore partnerships with the ROOH Campaign at regional and city level climate events.

Action on the ground - ROOH Labs Goals and Strategy

Goals

The Labs are at the heart of the delivery of the ROOH campaign that explore solutions through a collaboration between community women and professionals, to deal with the challenges of creating a safe, liveable habitat that is resilient to extreme weather conditions including those related

North America

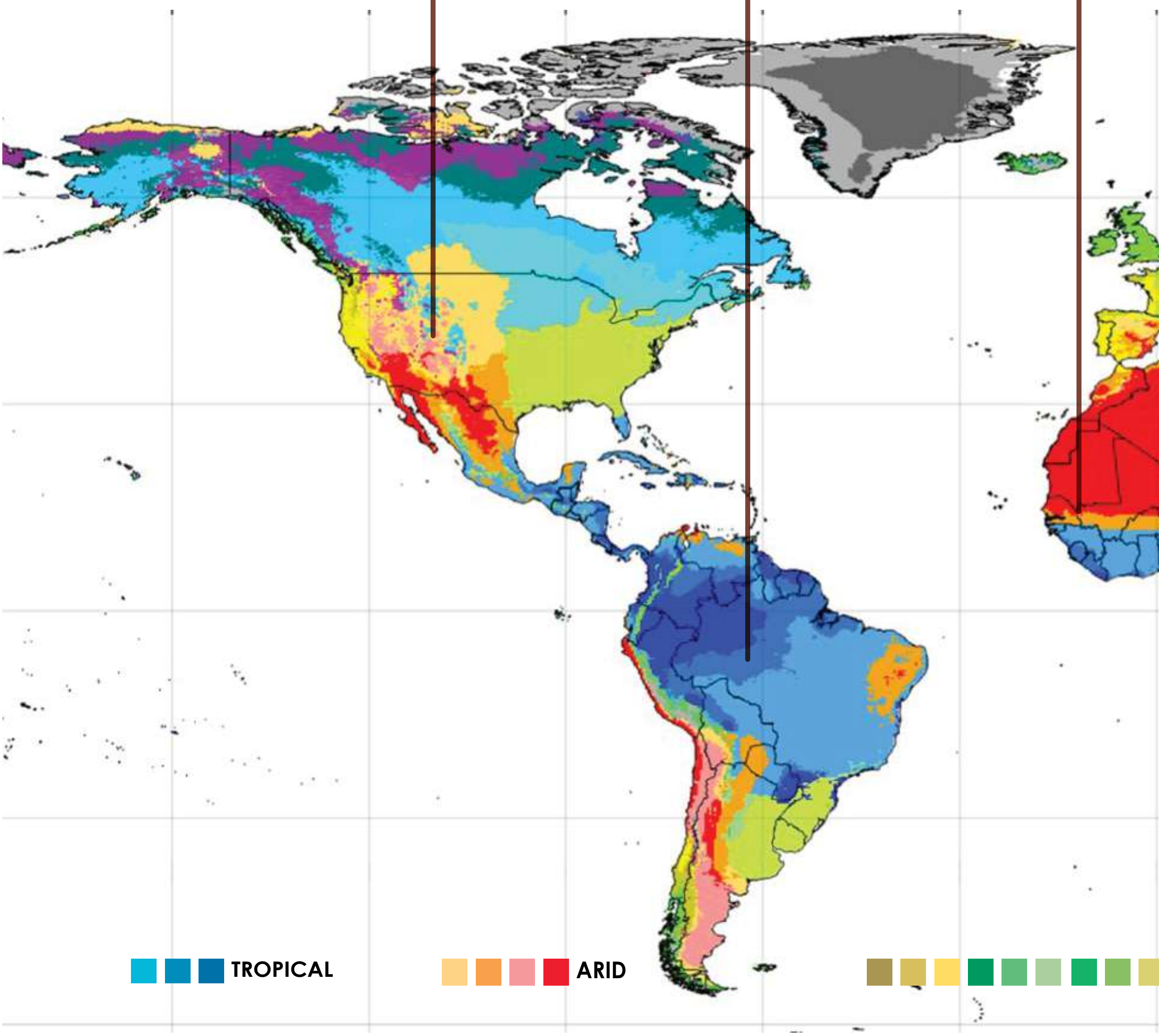
The percentage of people living in slums in North America is relatively low compared to other continents. In 2020, it was estimated to be around 7%.

South America

Approximately 20% of the urban population in South America lived in slums in 2020.

Africa

The percentage of people living in slums in Africa varies by country and region. But it was estimated that around 60% of the urban population lived in slums in 2020.



Beck, H. E. et al. Present and future Köppen-Geiger climate classification

Europe

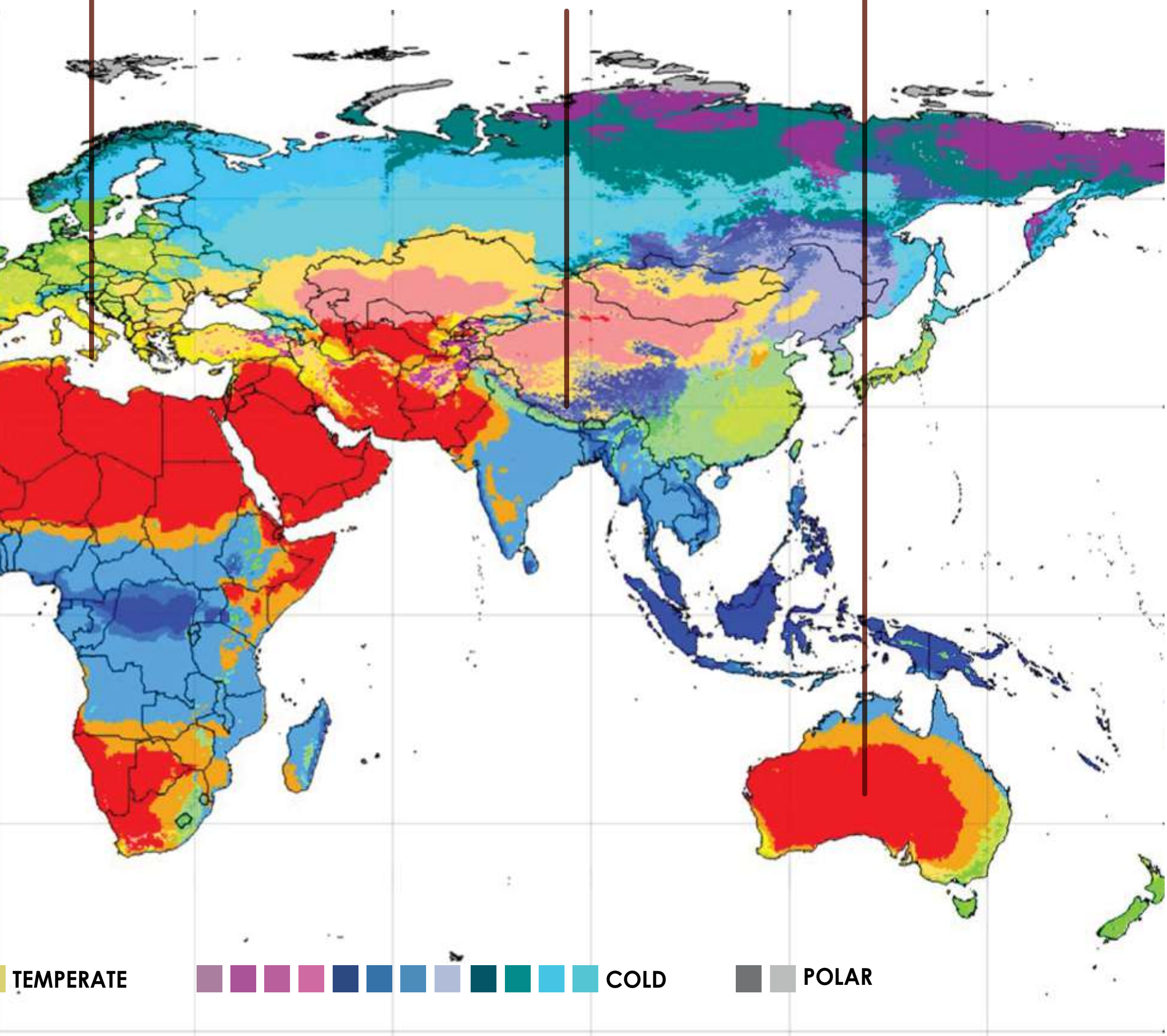
Europe also has a relatively low percentage of people living in the slums. In 2020, the estimate was around 7% of urban population.

Asia

Asia had a significant number of people living in slums, with the percentage varying widely by country. in 2020, it was estimated that around 33% of the urban population in Asia lived in slums.

Oceania

Oceania also has a relatively low percentage of people living in the slums. In 2020, the estimate was around 5% of urban population.



maps at 1-km resolution. Sci. Data. 5:180214 doi: 10.1038/sdata.2018.214 (2018) to climate change. Labs are intensely local and seek to explore outcomes that are local but accessible to other labs in different geographies allowing them to examine solutions and test what works for them.

Professionals and women's collectives from specifically selected neighbourhoods together answer some common questions to assess the existing habitat for its resilience levels as a basis for the challenge of producing design, and sourcing affordable construction materials at the local level for all who live without tenure. Data and issues that are raised then get shared with design professionals, material providers and contractors, financing agencies who lend them money as well as with city governance structures. Through such presentations communities can articulate what works for their settlements and make representation to the city of what it needs to do to further make their resilience investments more robust.

Strategy

The ROOH campaign envisages that 100 labs will be conducted in different settlements that have the support and backing of organisations or social movements that can contribute professional assistance for the neighbourhood's diagnostics and solution building. In India an advance proof of concept with 9 labs has been initiated to develop the foundation of the inquiry and assessment. All labs will work with local communities in their local contexts while accommodating and expanding the inquiry and solutions to address specific local realities.

Peer-to-peer learning and training between networks and social movements of the urban poor will be a priority for the labs so that poor neighbourhoods and women's collectives OWN the legacy and the knowledge, ideas and processes created by the ROOH campaign.

Two elements of ROOH and what they can contribute to the climate and development discourse.

The two components of the Campaign, advocacy, and action on the ground in the form of Labs enable equal and democratic engagement with all and give everyone the right to research and explore ways to produce resilience against extreme weather conditions as well as address older development deficits by developing a global, regional, national and local structure that facilitates engagement with each other.

In the past and even today, development interventions are top-down with finance and solutions predefined; bottom-up approaches can produce good solutions but don't reach the scale needed as there is no support or justification for their strategy and are unfortunately categorized as either/or binaries. The ROOH campaign with its advocacy and labs, is also a testing of this binary crisis and seeks to create a circular engagement between those who produce knowledge, those who make decisions and those who make impact assessments that lead to policy, financing, and outcome changes. This is to acknowledge that there is a role and contribution for all committed to this idea; however, the structure needs to be democratic, with risk taking and learning for both success and failure.

Facing the Challenge and Bridging Links

The challenges that poor people face have been further exacerbated by the extreme weather conditions due to climate change while the development deficit is already in a crisis. All the silos of development and

What Is Roof Over Our Heads, Its Elements And What Does It Want To Achieve?

Roof Over Our Heads is a global campaign for people living in informal settlements and poor-quality housing which is intensely local but linked and connected to the national and global challenge of extreme weather. Its primary focus is on people living in developing countries in the global south. However, the Campaign recognises that everyone, everywhere needs a good roof over their head and a decent house that is resilient and energy efficient. Though this includes people living in developed countries in low quality housing, there is a space to develop a 'retrofitting for resilience' campaign in the global north.

The last four decades of intense evidence building for greater financial, technical, and planning support for habitat and infrastructure for informal communities has not produced a serious dent in the rising informality of habitat and the devastation created through climate linked episodes. ROOH as a campaign seeks to facilitate and strengthen existing approaches within countries to produce affordable, available and accessible building materials with designs and construction techniques conducive to resilience. It also seeks acknowledgement within government for the need to create alternatives in governance that accept the present and future climate migrants whose vulnerability must be addressed and planned for.

ROOH starts with the central involvement of communities, especially women, from informal settlements. This adaptation response also acknowledges that informal inhabitations will have to accommodate another 1.5 billion climate refugees. New ideas, new alliances and new innovations are urgently needed, and ROOH represents one such intervention.

"

Communities recognize that they don't know how to do spatial planning, how to do any of the form of planning aspects of neighborhoods, but they want their voice to be heard about how their neighborhood is to be replanned and they understand that some people will have to have their houses torn down to make the streets wider to have a fire truck roll through or an ambulance. They understand that, but they want to be part of the negotiation to negotiate how their neighborhoods change. And then, to be respected for their know how, and to be treated as equal partners.

- Laila Iskander
Former Minister,
Urban Development, Egypt

debates, discussions and programmes on social justice bundle up together in the lives of the very poor in messy and intensely complex ways where single investment inputs and outcomes can't make an impact or be measured. The ROOH Campaign focuses on this immediate need of the people and explores new ways of producing knowledge to make habitats healthy and resilient. The knowledge that is produced locally needs to be disseminated to a wider audience; this is done by creating 'Bridging Links' between the campaign advocacy and action on the ground that makes each deeply committed to the other and helps inform each other's processes. The idea of 'Bridging Links' is based on Locally Led Adaptation (LLA) principles that seek to link what is deeply driven by local realities to global discourse while considering the deep impact and influence that the global has on the local. It seeks to examine the overarching challenges of linking local to global development challenges like the Sustainable Development Goals (SDG's) and to climate challenges anchored by the UNFCCC.

The creation of Bridging Links facilitates live, ongoing communication, supports investments, advocacy, learning and solution creation and benefits from both ends of the spectrums of advocacy and action. It accommodates the diversity of stakeholders needed to explore real change-making yet honours every stakeholder's contribution with generosity and humility. It reveres the amazing capacity of poor women and their collectives living informally in the city who bear the burden of neglect and invisibility under the State and builds their capacity to explore resilience challenges that address both developmental and climate change deficits that they face. The logic is simple yet powerful. "Build your own capacities for what you can do, then negotiate with duty bearers for what their contribution is and what must be provided".

Our journey so far and next steps

Organizations engaged in the partnership are at different levels of formalizing their commitments and engagements. This is to facilitate each to understand this unusual relationship with informal constituencies. The process of developing a global, regional, national, and local structure that facilitates engagement with each other and the investments that can be made in the labs to produce evidence rather than relying on conjectures from either end has begun. The campaign itself is a testing ground for new and non-hierarchical processes where all will learn new ways to dialogue and negotiate as well as manage risks and celebrate breakthroughs.

“

We are talking about informal communities and women in those communities as empowered agents of change, not passive recipients. I know they can’t do it on their own and need a radical collaboration as we say, but I think it starts with recognizing the agency of involving those in the frontline who are the most motivated to find solutions and need that support.

Nigel Topping
Climate Champion COP26
(ROOH Roundtable, 24th August 2002)

2

The Campaign

Climate change with additional elements of extreme heat, torrential rains, and cyclonic winds that informal neighbourhoods had not anticipated has led to additional vulnerability in the absence of affordable solutions. Despite a growing understanding that homes now need to have more resilient solutions and urgently need new designs, materials and financing mechanisms, and improved research and evidence for changing practices, these have not yet become accessible to those most vulnerable, leading to challenges of affordability on the one hand and availability of material on the other.

These challenges are now being acknowledged; construction materials in cities are seen to be large emitters of CO_2 and those producing construction materials are being pressured to reduce the carbon footprint of their materials. The informal sector represents 40 to 70 percent of the housing stock where materials and construction techniques are based on the knowledge and skills of artisanal informal contractors who are themselves restrained by limited resources, knowledge of designs, and access to materials.

A major challenge for ROOH has been to position this invisible constituency as a market for building materials, finance, and design by creating better opportunities with new knowledge and new systemic intervention by governments so that the challenges of informality can be faced squarely. In a world seeking to develop a just

Timeline for ROOH – Goal 2030 :

2022: Launch of the Concept at COP27, getting partners and developing the strategies engaging many constituencies.

2023: Develop the concepts to drive ROOH, develop the lab process and initiate the activities in India through the labs. Explore and facilitate social movements and networks to engage with and begin country linked research and activities to support the campaign in driving the activities to produce resilient houses on the ground and globally. Produce the first publication presenting the work in 2023 at COP28.

2024: Continue round tables and engagement with social movements and assist partnerships for labs and campaigns. Begin stage two and three in India while engaging with all social movements and networks seeking to set up labs through stage one of setting up and undertaking a data base for labs.

Continue round tables with deeper dialogues between lab representatives and social movements and other assisting and supporting partnerships working on the campaign.

Bring in youth from informal settlements as well as universities to develop partnerships to participate in ROOH.

Fundraise for the 5-year ROOH programme.

Through activities and challenges faced each year we will modify and build on what we learn and need to do the next year. At the end of 2027 by which time all the labs will have explored solutions and shared successes and failures which the campaign will take up, the focus will be on stage four and five of scaling up what works, seeking resolutions of blockages and measurements of impact as well as wider dissemination of the campaign advocacy and action on the ground.

transition for all, the role of governance and the issue of huge volumes of city residents being excluded due to lack of tenure must be addressed. As the Sharm El Sheikh agenda now draws attention to adaptation and loss and damage informal neighbourhoods, both present and future, need assistance to develop solutions to increase resilience urgently.

ROOH seeks to provide a platform to overcome the barriers between formal and informal aspects of design, finance, and construction, leading to the provision of resilient homes for all in cities, be it addressing habitat and amenities, construction undertaken by communities (informal and formal) or private sector involvement in the development of informal settlements. For example, organized communities supported by SDI and the Asian Coalition for Housing Rights (ACHR)[xiii] are active in over 600 cities across the globe, have over 800,000 members that regularly save money, and have a financial asset base of some US$70 million. While acknowledging that these numbers are impressive when examined in percentages, they represent a very small number. Yet, past investments have assisted only those with tenure to build or improve houses and amenities, due to the barrier created by the issue of tenure those working in social movements are increasingly aware that the route of 'tenure first' collapses when climate change impacts the worst off first.

Governments have not invested in infrastructure and housing improvement for those living informally despite the MDGs and SDG targets, and as this deficit grows, the need outstrips the public resources needed to address the problem. All social movements that first sought to obtain tenure and seek access to amenities did so with evidence building and aggregating who needed tenure and developed designs and solutions and sought access to government subsidies to assist in building seemingly respectable volumes of housing. However, it is both shocking and disappointing that while these achievements are a result of great investments and activism, and the numbers impressive, they represent a small proportion of those who got improved habitat in comparison to the overall number of households that need these improvements. An ACHR study[xiv] indicates that in Asia 92 % of the houses were constructed by the poor themselves, thus indicating a need to help these communities to improve the resilience of their homes to extreme climate events. It would also be a valuable exercise to quantify the volume of investments they make themselves, so they are not viewed as beneficiaries but partners in development and if nothing else they are provided with basic amenities while they make their homes resilient.

While ROOH urges state institutions to address security of tenure and basic amenities, it seeks to support resilient housing driven by poor households themselves. As a priority, ROOH seeks to keep women and their neighbourhoods at the centre of a process where NGOs, universities, providers of building materials and finance work with them and their cities to transform their homes to be resilient as soon and urgently as possible. Networks of the poor that exist at city and national levels have the organisational capacity and resources to learn, test and innovate solutions to achieve this change that also needs to draw attention to three or more generations of those who live informally in cities. To be developed means not just to survive but to thrive in resilient homes.

ROOH aims to help deliver systemic changes in the four areas of finance, design, construction, and governance simultaneously. While it is important to mobilise public and private finance at scale so that houses can be built and existing homes retrofitted, there is also a need to work with the communities, especially women in informal settlements, to co-produce and catalyse innovation and design houses that are decent, resilient, and "low carbon" to build and live in. For the construction element the aim is to work with the industry and suppliers, to meet the needs of the people with innovative and resilient materials that are affordable and accessible. Sometimes one third or half the residents of a city live informally with no secure tenure, amenities and services and ROOH seeks to address the challenge of planning, governance, and policy implementation to empower people living in informal settlements to be heard and to be part of the solution.

How is Roof Over our Heads going to deliver solutions?

After the Campaign and the first 100 labs are initiated, ROOH wishes to create conditions where top-down strategies, investment finance and knowledge meet bottom-up strategies and finance solutions halfway in a spirit of partnership showcasing that both have value and contributions to make towards what they cannot do or accomplish on their own. So, developing Labs that are intensely local yet able to share what they can achieve themselves and inspire their peers to explore and aggregate their insights and solutions nationally, regionally, and globally help sharpen the articulation of what they need and what they can do. The campaign will link stakeholders from social movements where the labs are located to material manufacturers, engineers, architects, mayors, educational institutions, and many others already engaged, all of whom begin to value this proposition and to explore their roles in this engagement.

In the event of climate disasters impacting neighbourhoods there are ongoing attempts to link up with early warning systems to realistically assist the slum residents, especially women who are among the first responders to prepare for impending climate events and create a constructive pathway for immediate assistance and long-term resilient habitat. Finally, with the COP28 focusing on losses and damages, how can this process assist communities and their networks to develop legitimacy and for informal communities to get compensation for the losses and damages they incur due to climate change, and to help develop data to estimate how resilient homes can avoid huge losses showing that investment in advance preparation would be better than post disaster compensation.

The exchange of ideas and knowledge is critical and must ensure that impactful solutions and valuable ideas and strategies are developed in one place.

ROOH is a bottom-up led campaign created by women leaders of informal settlements associated and affiliated with SDI and keeping slum dwellers, especially, women in the driving seat is the signature of this campaign and action. SDI will drive this in as many cities of its affiliates and partners as possible and will share and learn with all others who will similarly drive their own processes but with a focus on the local women and their communities. Similar other networks working with informality in cities are now part of the campaign and will also participate in creating and supporting their labs.

ROOH Principles for Engagement and its commitment to Locally Led Adaptation principles

ROOH is committed to the Principles for Locally Led Adaptation[xv] (LLA), where eight principles have been developed to help ensure that local communities are empowered to lead sustainable and effective adaptation to climate change at the local level. Both SPARC and SDI are signatories to the LLA principles.

The following four principles guide all engagements within the ROOH Campaign. These principles drive the behaviour of those actively engaged in the Campaign and its implementation and advise any partner engagement.

Flexible

The campaign has flexibility at its heart, underpinned by the expectation of mutual respect that all engaged organisations have for one another, acknowledging that each is working from different perspectives and lived experiences while building bridges for producing solutions and negotiating to find common ground. The ROOH network has business unusual, and it is understood that some offers of support will not fit a 'typical' engagement, yet it does not diminish the value of these contributions and a flexible approach will be applied. What is special is that it is crucial to create a circle of support for communities taking the biggest risk to explore something new, to acknowledge that such long standing problems have no quick fixes, as well as to accept that both successes and failures will produce crucial outcomes. Thus the "Engagement Framework" will be reviewed annually as will ROOH's partnership agreements.

Transparent

Any resources, knowledge, solutions, innovations, governance models etc., developed through the campaign will be shared openly and distributed as widely as possible, to enable sharing of both successes and failures to unlock real community learning and ultimately scale community action exponentially. Successes and failures, risks and their resolutions will be carefully assessed and shared and learnings from them will be a part of each of our reports. In return we expect all partners to participate in and respect these values.

Collaboration

A sense of shared ownership is the driving spirit of the campaign and broad collaboration is encouraged and sought out. The campaign and these principles for engagement will evolve and develop in collaboration with a broad range of stakeholders and collaborators. All engaged partners bring the spread and outreach of their networks to support ROOH. Collaborations created within the ROOH process may also operate within its presence which is also fine.

Deeply Local in action but global in its vision

ROOH seeks to ensure engagement of the communities, especially women at all levels as the processes develop and engagements build up. ROOH acknowledges that any work undertaken under the campaign cannot be deemed a success unless it addresses the needs of and provides opportunities for people at a deeply local level. ROOH celebrates all forms or versions of the strategy emerging from its work as a compliment to the initial idea and concept of the campaign.

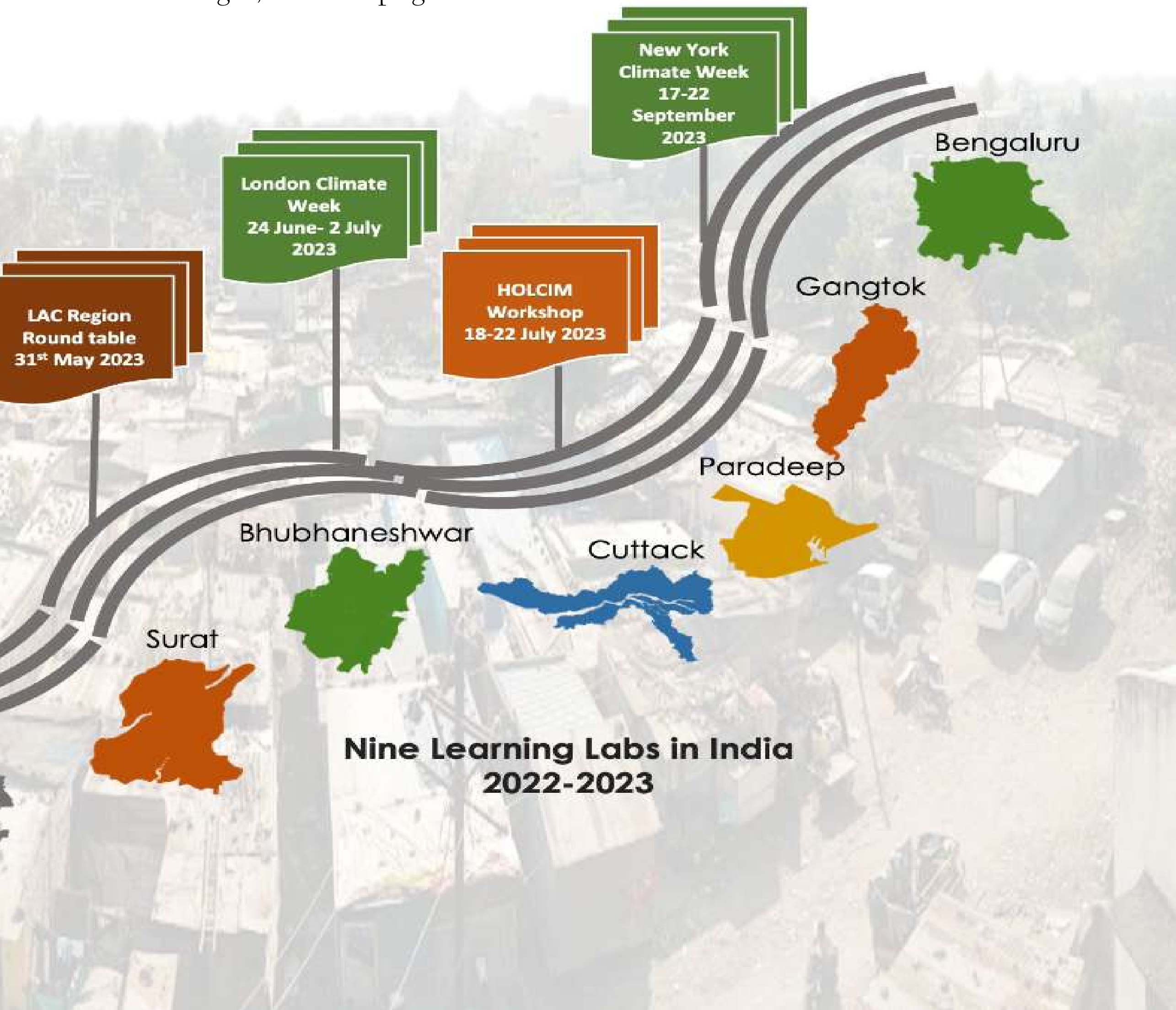
Engaging Partners through Round Table conversations

Covid 19 lockdowns and the collective inability to travel led to a web culture for communication that has worked very well for ROOH. Through web based as well as physical or hybrid meetings, the Roundtable conversations were an amazing instrument for the ROOH Campaign. These discussions brought together diverse views from different geographies in the north and south and represented a wide spectrum of constituencies that were essential for spreading the ideas of ROOH and for finding potential partners for the labs as well as the campaign. These round tables have allowed ROOH discussions and debates to discuss habitat challenges internationally, nationally, and locally and provided an opportunity for ROOH partners to interact and gain insights into their potential contributions to the campaign. The discussions helped share, define, refine, and develop the conceptual frameworks, locate stakeholders at all levels in different constituencies, and

explore the formation of a community of practice that links the very local to global and all those in between. They also produced opportunities to promote the concept of locally sustainable results and resilience objectives through a community-oriented and polycentric strategy.

The discussions in the round table and subsequent follow up have focused on evaluating the interests, knowledge, and abilities of each representative invitee to explore how they could contribute. Many critical features and dimensions of the campaign and labs have emerged from such advice and recommendations. Through this dialogue, the campaign continues to identify many more associations and organisations to explore collaborations and extending their support. Many have begun to contribute their time, expertise, knowledge, networks, and finance to advance the campaign's objectives.

Ultimately, the long-term objective of the partnerships is to make a lasting and sustainable contribution to climate change linked issues of the habitat crisis globally. The international outreach of the campaign is evident by the wide range of organizations and speakers from various regions, some new and many who were long term associates of SPARC and SDI.




IMPLEMENTATION COMMITTEE
ENABLING PARTNERS
STEERING COMMITTEE
COMMUNITY PARTNERS
DESIGN & TECHNICAL PARTNERS
DELIVERY PARTNERS
Roof over our heads
KNOWLEDGE PARTNERS
SUPPORTING MEMBERS
COMMUNITY PARTNERS
PROGRAM IMPLEMENTATION

The Structure

There has been some concern by committed organisations for ROOH to develop a governance structure from the beginning. However, those developing this know that they seek a new and different arrangement that will emerge as the campaign evolves and as the needs on the ground become clear. The nature of the transactions is emerging as more organisations join the process and roles and responsibilities move and shift as they explore what they can contribute.

The process seeks to be locally driven with deep communication, knowledge and sustainable processes that are local, national, and global and put actors and stakeholders on an equal playing field. ROOH has ambitious aspirations to develop this process so that as many networks, organisations, and communities as possible can appropriate this process and produce locally sustainable outcomes that fulfil as many resilience goals as possible. Instead of a top down centrally defined strategy, the polycentric approach seeks networks that share and learn together through coalition building and cooperation between different actors. ROOH envisages that these collaborations will spawn off several action circles that will coalesce to promote the systemic changes in ROOH's priority areas.

The ROOH secretariat is hosted in India by SPARC, an affiliate of SDI. Global Resilience Partnership (GRP)[xvi] has played the role of facilitating the funding to develop the

3

process in the year one i.e., 2022-2023, and Race to Resilience[xvii] has adopted ROOH as a flagship initiative with long term support from the UN High Level Champions[xviii] and their team.

The secretariat now has process to build a strategy where all documentation and audio visuals materials are converted into reports and short videos that are accessible for further dissemination within the existing partnerships, as well as useful for those interested to learn more about this program.[xix] In the coming year the strategy of round tables will be used to continue briefing all in general and partners in particular about the emerging activities, insights, and actions of ROOH. It will bring stakeholders at local, national, and global levels for discussions on finance, materials, design, construction, and sharing this with educational institutions, and mayors and ministers for developing a dialogue on what the communities have stepped up to do and what the duty bearers local to global need to do to compliment these investments and efforts.

ROOH Partner Engagement

The process of engagement constantly evolves and so far, the structure we have is that as action on the ground, the labs form the centre of the process, share the initial assessments of the phase one with the artisanal contractors who construct their homes, material providers, designers, and experts in architecture planning and in structural safety, and people who provide the finance. These circles widen to national, regional, and global levels, so that organizations that have a global presence work at each level while others can work locally, nationally or at a continental level.

Most of the labs will be embedding ongoing activism that involves some social movements. Those working directly with the communities of the poor are especially critical for the labs which need networks and sustained engagements that bring members as almost an essential contribution. The past experiences of community networks have been that a strategy crafted around how women and communities create knowledge and insight about their lives, and aggregating and disaggregating it for their needs produces possible solutions and advocacy content which when explored, experimented with, and assessed produces solutions which others can copy, adopt, or adapt to their situation, or use the connect to produce something that is locally needed. This new way of producing scale which works for the poor contrasts with a standardized global solution developed by experts. Here the solution is co-produced.

Although the ROOH campaign will continue till 2030, the labs will be conducted between 2023 to 2026 with different stages set up each year. They will be accompanied by careful assessments and impacts, financial viability, and safety

> “
> Extreme heat affects women, the homeless, the elderly, children, outside workers, so it is not only a life threatening fact it is also an equity issue that we must address and unfortunately, that equity issue is particularly visible in informal settlements. Why? Because homes in informal settlements are built with unsustainable materials that basically exacerbate the effect of extreme clmate. So that’s a problem.
>
> Mauricio Rodas
> Mayor of Quito, Ecuador, 2014-2019

checks as well as acknowledging what does not work and needs to go back to the exploration stage. It is a humbling reality check that problems unsolved in three to four generations of living in informality cannot have a magical transformation and will have many internal and external challenges whose documentation and analysis and representation is as critical as celebrating the breakthroughs we hope to achieve.

The governance architecture is thus still being formulated, mainly to allow both the secretariat and the emerging partnerships to explore how they can contribute and to view explorations as an opportunity to build a common foundation, relationships, and trust, and to produce commitments and obligations that each partnership is comfortable to make.

Many engagements are increasingly moving in that direction as the work being undertaken together is getting systematized with more and more clear commitments on both sides.

Ultimately, there will be steering committees at the global and campaign level and at the local and the lab level with some partners on committees at both levels, but as this book is being written, these have yet to be firmed up. Some responsibilities are outlined below:

Advocacy

- Updates and messaging are now in place, so webinars, workshops and communication get routinised.
- Attending events to showcase ROOH on the net or physically.
- Sharing of all insights, engagements, representation, and explorations to build the ROOH processes locally and globally.
- Participation of ROOH as a program and campaign in global and regional events linked to climate.

Action on the Ground

- Building Labs and developing a documentation of the work done and building the next stage while seeking to develop training for trainers at country and regional level labs.

Exploring engagement and partnerships

- Convening with and exploring bilaterally, the agreements of partners through framework development.

Developing financing strategies

- For work which the secretariat is undertaking.
- For other specific tasks of the campaign and labs, which will help detail the activities for the future.

In the coming year, all those engaged can move to clearer and more defined roles and functions at local to global levels and the aspiration is that at each level all stakeholders will be represented. To date the campaign has clear agreements with roles played by:

The Climate Champions Team

The team is a critical interface between the ROOH campaign and RtR and RtZ that will provide strategic advice to the campaign from governance to implementation. The Climate Champions Team, via. RtR provides an opportunity for the campaign to be profiled at key climate events and milestones. The team also offer their networks and convening power to the steering committee. Like all other groupings their representation can be in as many levels as they can participate in.

Networks of the urban poor and their allies for the foundational network of labs

SDI, International Alliance of Waste Pickers[xx], Huairou Commission (HC)[xxi], TECHO[xxii], ACHR amongst others are crucial partners whose recommendations will define the locations of the labs, the support for research the labs will need, and the scalability potential they can produce. Building on the skill sets and long-term learning agenda of these networks that create the social movements remains the solid foundation for the ROOH process.

Global Resilience Partnership (GRP)

Their critical support from assisting in the creation of the secretariat to advice on all engagements and drawing from its huge network to locate and advise people, giving time and hand holding has been very important for ROOH to take off.

Mayors and duty bearers are critical stakeholders in our discussions; however, we start with assisting in what women and their communities can do and highlight the challenges they face. ROOH asks duty bearers to view resilient homes as a critical element of preparedness for vulnerable communities and urgently review past negligence to address the needs for amenities and services, as those losses and damages will be borne before any others and the costs of that burden cannot be borne by the city or the communities.

Partners take their brief from the lab profile created to work with the delivery partners to develop deeply local, implementable solutions. Various committees for partners will be created with engagements described below:

Implementation Partners Committee will be created in the coming year at different levels as labs and campaigns develop local, national, and regional level actions and activities. The implementation committee's responsibilities will be focused on a more management type role, focused on the delivery of the labs and driving consistency where appropriate across how labs are delivered. This includes peer learning and exploring potential for scaling of the strategy. E.g., local NGO branches, local academics, residents' groups etc.

- Implementing partners are critical as labs and their functioning is crucial and at the heart of this process. These partners are on the ground and in direct contact with the lab communities in which the labs are implemented.
- They contribute with local knowledge produced through active and direct engagement in the on-ground lab activities. This includes deep listening to the community experience and needs, and to develop a lab profile for that settlement type.
- They help with identification and selection of community lab locations.
- Setting parameters for the labs, e.g., is there a minimum scale to be met, what to do with labs with multiple challenges.
- Realistic programming and timelines for implementation within each lab location.
- Invitation to suitable partners for each lab implementation and organisation of teams of partners for individual labs.
- Management and tracking of lab implementation.
- The role could also include training local trainers for each community to disseminate learning.

Technical Assistance Partners of the campaign provide technical advice for design, materials, construction, and finance to the campaign. This has the potential for assisting in scale and focus, and financing specific studies across the labs or with a specific set of lab locations, introduction of ROOH to philanthropic bilateral and multilateral funders, private sector donations, grants and so on. They offer their expertise and technical advice to respond to the lab profile with solutions for implementation and they can work remotely. These solutions could be engineering design leading to construction drawings, or innovations of a new material available.

- Examining ways for embedding lab and campaign material into educational curriculums, facilitating young students to work with youth in communities where labs are being developed.
- Build commitment and responsibility of the consulting education and other institutions to respond to the local challenge and seek to develop resources that could be applicable to other lab locations.

A lead design & technical partner will be identified for each lab to convene other specialists as needed, and ultimately provide the required information to the delivery partner. e.g., engineers, architects, land tenure experts, construction consultants.

The financial expertise to develop lending to these communities is critical. Creating local and national currency-based lending wherever possible with a clear understanding that the burden of interest rate payment regarding currency borrowings do not fall on these households. And that based on the data, the labs should produce the lending instruments evolving from those insights (e.g., the microcredit movement built its design after studying how informal businesses operated).

Knowledge partners will provide different skills to others, for example:

- Skills in GIS (Geographic Information System) mapping to create open-source databases.
- Skills in policy advocacy to bring together the impacts of the campaign implementation and create compelling petitions to relevant policymakers.
- They work closely with all lab partners and the steering committee. e.g., academia, built environment consultants, NGO's, advocacy campaigns.
- Develop Learning monitoring and assessment frameworks at both local and global level.
- Link research and other institutions to ROOH.

"Most of the time, people living in slums are determined to change their reality, they just need organizations and governments to support them, and join them in their path to improvement, articulating efforts and promoting participative instances for everyone to get a chance to propose and use the knowledge and abilities each person has, we can address dynamics that are based on caring and solidarity, those dynamics can be the basis of a new form of conceiving and building the cities, where human rights are the guide.

Gonzalo Muñoz
Climate Champion, COP 25
Global Ambassador Race to Resilience, Race to Zero

4

Action on the Ground - LABS

After developing the ROOH campaign the next step was to develop a framework for both the campaign advocacy and the work on the ground through the labs that can speak to each other. The challenge was to explore discussions and debates that demonstrate commitment to create change which works at both ends. The aim was to create an assessment tool that builds knowledge of what works in their present homes and what does not through intense and detailed dialogue and discussions with women's collectives and their networks at the lab levels; then to explore new possibilities and solutions to survive extreme weather. This also acknowledges and amplifies the small circle of access for choices within which present design, material, and finance is accessible to the poor.

At the level of the labs the outcomes from the initial dialogue seek to develop assessments, measurements, and possibilities for change that when aggregated at city, national and global level can produce evidence for what needs to change. The five stages elaborated in this chapter provide a glimpse into how this process plays out. The campaign itself has two elements where advocacy and action create a large partnership (hopefully) with public and private institutions, companies and agencies who will both champion this cause and make seminal contribution to help expand the choices available locally to informal households.

With a deep commitment to an accountability between labs and the campaign there are emerging values that have produced useful ways to reflect on how to stay within the value frameworks where the expansion of possible and available alternatives becomes a journey towards a resilient house. Over various stages of the lab activities there would be a transition to improved quality that move households from surviving disasters to resilient homes in which they can thrive. This is not assured, and risks and failures will occur at various levels. However, the hope is that these are viewed as challenges that we must overcome rather than mark them as failures. No crisis of such long standing neglect can get solved magically. Therefore, the larger the network of support for communities and their affiliates directly, the greater the possibility of exploring ways of averting failure and/or deal with it to help deflect the sense of defeat it can produce.

The 100 labs of ROOH

The ROOH campaign will demonstrate locally developed solutions by creating 100 labs with women and young professionals participating in first assessments of the resilient quotient of the present homes and exploring design solutions, which will create their own trajectories of intensely local adaptation responses accompanied by action on the ground.

In the climate change context ROOH seeks to change many narratives. First, the poor are not beneficiaries but active problem solvers despite their very meagre resources. In a lot of rhetoric about all aspects of climate change from mitigation to adaptation and loss and damage, there is a cursory reference to "billions" being affected but no clear segmentation of the vulnerability and what action is needed. Giving households and neighbourhoods agency to make change will make them partners to their city and nation who also must make investments that match what households and neighbourhoods do.

Selection of Labs

All labs are selected based on a secondary analysis conducted by gathering data from various sources such as the Global Köppen Classification[xxiii], by locating the climatic zones of the country, and census data[xxiv] where available. This data helps to analyse the overarching information such as climatic zones of the country, prevalent building materials used for roofs, floors, and walls in different regions, as well as to identify trends, challenges, and opportunities related to building materials and climate factors. Considering the findings from the secondary analysis, the next step involves identifying the cities for the learning labs. Factors under consideration include climatic diversity, population density, vulnerability, housing conditions, and potential for interventions. It is important to ensure representation of different regions and climatic zones in the selected cities.

There is also a carefully developed rationale for the choice of location. First, the location ensures that the most vulnerable neighbourhoods and within that the most vulnerable households get chosen and that the women's collective's support them. It is also critical that the neighbourhoods are part of networks that already function and can stay involved in the process for two to three active stages and two years of studying impacts. This element is foundational to the identification of the labs as it demonstrates the real time change that gets explored. It helps identify and aggregate the reasons why such vulnerability exists and what externalities perpetuate this vulnerability while highlighting that poor and vulnerable households have agency; they chose to come to the city to survive and despite all odds manage to survive.

Conducting meetings with women's collectives, partners, and federations in each state/city is crucial since they help discuss the ROOH initiative, objectives of the learning labs, and the roles of the stakeholders. Capacity-building support provided to the local communities enhances their understanding and involvement in the program and campaign. Coordination with local authorities and community representatives is also essential for smooth implementation ideally but in some instances may not happen at the start of the process. Ongoing discussions and communication prior to the identification of labs and visits by members of the network which the communities are a part of, accompanied by ROOH professionals to conduct assessments of the selected settlements to ensure that they fulfil the criteria and examine the logistical arrangements that include venue selection, equipment setup, and resource allocation.

The initial process after a group discussion about the history of the settlement and its rough profile and introductions, is a walk through the settlements to understand the physical layout, infrastructure, and housing conditions, and to define the study area. Focus group discussions with community members residing in the selected settlements help gather insights about their experiences, challenges, and coping mechanisms related to heat, wind, rain, and housing materials. The feedback and perspectives shared by the community get documented with their permission and based on the findings from the group discussions and transect walks, individual households get selected for intervention.

The purpose and objectives of the learning labs is essential to the selected households, and their consent sought for intervention. Households with temporary and semi-permanent structures, using different building materials are a priority while assessing vulnerabilities and mitigation strategies. A comprehensive survey of the chosen dwelling units is done to collect data on existing roof materials, floor types, wall construction, and coping mechanisms. Socio-economic characteristics of the households and their specific housing needs and aspirations get documented. Simultaneously a supply-side survey is conducted to assess the availability, affordability, and quality of alternative building materials and the readiness of the supply side to adopt innovative solutions.

The data collected from surveys, focus group discussions, and secondary analysis is used to identify key needs, challenges, and opportunities and helps develop a comprehensive understanding of vulnerabilities and issues related to materials used in the construction of the roof, floor, and walls in the selected settlements, as well as identifying gaps in current practices and interventions.

While the material and construction methods begin to be experimented with and tested, the focus remains on alternative building materials that are climate-positive, cost-effective, and sustainable. Collective and participatory approaches facilitate community members and selected households in the co-creation of solutions. Collaboration and co-design processes are critically essential with the stakeholders, including community members, women's collectives, partners, federations, and experts to develop practical and context-specific solutions. The outcomes, recommendations, and guidelines for implementing the identified innovative solutions will be documented throughout the process. An illustrative and easily understood documentation of the data the 100 labs will gather has emerged from the 9 labs developed in India to test the efficacy of the process and allows inputs that are very local, specific, and unique challenges that the residents face, added to what can be universally aggregable.

What emerges from labs will be tested and developed, and ideas, techniques and problem-solving mechanisms can be shared with a peer to peer cross-learning between communities across different labs, cities, countries through actual house model exhibitions with full acknowledgement that they will be adapted, adopted, reformulated, and celebrated for what works locally. These strategies have been used in the last two decades to take innovations of housing and infrastructure across community networks in SDI, ACHR and all partner social movements[xxv].

The 5 "A" s of assessing the outcomes.

Affordability, Acceptability, Accessibility, Adaptability, and Availability – these are five As of ROOH which are the key factors influencing the quality of housing and residents' well-being in informal settlements. These factors, in that order, play a significant role in determining whether a housing material is suitable and conducive for individuals and communities

living in informal settlements. If any solution does not fulfil the five A's, it fails to have any significant impact in the living conditions of the urban poor. While this has initially been developed for the housing materials, we believe that design, finance, or governance provisions will all gradually be examined in these frameworks.

Affordable building materials can improve the lives of people in informal settlements by reducing their financial burden and is particularly important since most people in these settlements have limited financial resources. Low-cost building materials that have a longer life can help to keep the cost of construction and maintenance down, making it more acceptable to those who live in informal settlements. However, it is also important to consider the durability and longevity of these materials to ensure that residents do not have to repair or replace them constantly.

Acceptable materials in terms of cultural, social, and aesthetic considerations to the local communities that also meet the norms and requirements of local climatic conditions and are not only functional, but also provide comfort and protection. That makes the residents of informal settlements feel a sense of ownership for the choice they make.

Accessibile in terms of transportation, storage and handling is important to ensure that construction can be undertaken safely and efficiently. It is important that building materials and construction techniques are accessible to those who live in informal settlements so they can build and incrementally upgrade their dwellings without facing significant barriers.

Adaptable building materials that are flexible and can be altered or extended as needed can help the informal residents to adapt their homes to their changing needs and the increasing demands of climate related issues. Building materials need to be durable, lightweight, sustainable, and readily available in the local markets near the informal settlements.

Available and appropriate materials in the local markets would ensure that construction can be undertaken with regards to time efficiency, cost effectiveness, convenience. The availability of building materials is a critical factor, particularly in informal settlements where access to resources and supplies are limited or not possible.

Phases Of Implementation

The structure of the Labs envisaged five phases of exploratory study to develop a methodology that can be replicated in different cities across different climatic zones in the country and across the globe. For instance, the 9 labs have been initiated in Indian cities where NSDF and MM have a presence and will develop the pilot labs to create a stage-by-stage study, research, action, and application of knowledge to put the principles into effect. The past scrutiny of innovations explored by the federations and by SDI and other social movements show this as a robust process. The careful development of locally useful solutions that can be adapted to other neighbourhoods emerges from the testimonials that communities facing similar challenge's review and adopt. These boundaries are expanding increasingly through web-based discussions as well as peer exchanges which are physical where financing is possible.

Once the Labs complete stages 1 to 3 they will share the methodology with other city and national affiliates to conduct/explore using both the strategies and actual design materials and construction systems, constantly looping back to the networks to provide feedback on what works and what does not, and how a solution emerges. This then becomes accessible to the repertoire of workable solutions. The labs use networks as well as the campaign to "crowd source" solutions.

Base Data Gathering and Analysis is a combination of primary and secondary data analysis, where census data is used as a secondary data source along with data from other relevant sources. With the help of this initial phase of base data gathering, the team can develop a better understanding of the various microclimatic zones in the country as well as regions that are most vulnerable to natural disasters. The gathering of data by affiliates to produce proof for their communities as well as for the partners they collaborate with has a long history in SDI. For data to be a benchmark to determine vulnerability while measuring the current conditions against which the modifications and impacts will be computed, the NGOs and federations can construct the questions to be discussed and share the results with the lab members and their network as well as with local businesses, financing, and design linked discussions whose inputs are essential for the solutions. The secretariat with its advanced experience can help with this and link with both local and global academic institutions who are examining how their students can participate on the web.

The women leaders and communities need to be consulted first-hand, and their conversations, experiences, and understanding are the foundation of the process and need to be considered. This enables the team to determine which materials are presently used and whether the information from secondary sources corresponds to the opinions of the local populations in the various cities and microclimates that are chosen.

Getting to know the construction material providers and local contractors in the initial stage of the lab is critical to understand the manner of construction, and the stages and phases of construction they practice if building incrementally. Gathering insights from the local contractors helps understand the methods of construction adopted and the way in which the whole process is financed. This also provides insights into the kind of finance mechanisms people depend on and how these influence choices of material used. This also reflects the skills and experience of construction systems and of the incremental stages and phases of the housing. Another way of understanding the finance mechanisms used during the construction processes is through discussions with local informal financiers and loan providers. Knowledge of the residents' savings and investment patterns helps locate where house investments are in their priorities, and how they get planned.

Design and Solutions are part of the second phase and the focus will be on the use of data analysis to formulate all types of changes that communities and professionals need to begin to explore using the climate lens, linking usage of materials that are resilient with issues of safety and convenience. Creating solutions, with the choice of materials used while keeping in mind the challenges communities face, with the help of other partners in the industry like engineers, architects, planners, designers, and manufacturers. The estimation of financing this phase will also emerge, and exploration from the finance aspect will begin at this point with an understanding of what the community needs and the challenges they face, solutions that are available, affordable, and accessible need to be figured out.

The campaign and the labs seek to tackle issues that households and neighbourhoods can do themselves and what the governance and administrative levels need to undertake to match the resilience building the communities undertake, which makes it universal in as many of the informal settlements that are facing similar issues of survival and extreme climatic conditions that are getting worse in the current scenario. In the past development investments were denied to informal neighbourhoods because they were "illegally" encroaching the land. There are changes that need reflections at the governance system or government level, through policy changes and reforms. However, the climate challenges dealing with potential destruction are already occurring in various parts of the world, resulting in loss and damage much bigger than investments made to produce adaptive practices for resilience.

In the round tables the discussions with cities are critical, and one in which incremental improvement towards norms of safety are encouraged rather than focus on the inability of the poor to fulfil minimum standards which forms the basis of exclusions.

Demonstration through workshops that seek to investigate data at community and household levels is crucial for research both locally as well as globally. The aggregation of data helps provide a broader understanding of how cities and their informal inhabitants can work towards building their houses across the different climatic zones under consideration (warm and humid, hot, and dry, temperate, composite, and cold). Urgently focusing on what needs to be done differently in each location has to be linked to what emerges globally across labs. Examining and communicating similarities and differences; what is unique and what is different can expand choices locally and globally.

This campaign and the labs envisage bringing in a people-centric approach to reach the solutions leading from basic shelter needs through choosing better construction materials and tackling energy poverty. Looking at settlement or cluster levels through the climate lens involves creating the capacity for making these assessments within the women's collectives and their community. The household surveys of selected communities help residents and external professionals involved to understand the issues and concerns that produce existing construction and use of materials that is needed for examining how alternatives can be explored. Remote sensing data collection not only helps to gain a better understanding of the structures, it helps communities get a view of how their settlements looks from a different perspective. With this high-resolution satellite data, morphological patterns and heterogeneity of structures is better understood. Moving from macro to micro level the vulnerabilities a community faces need to be made evident and interventions they practice at local level and at individual household level are taken into consideration.

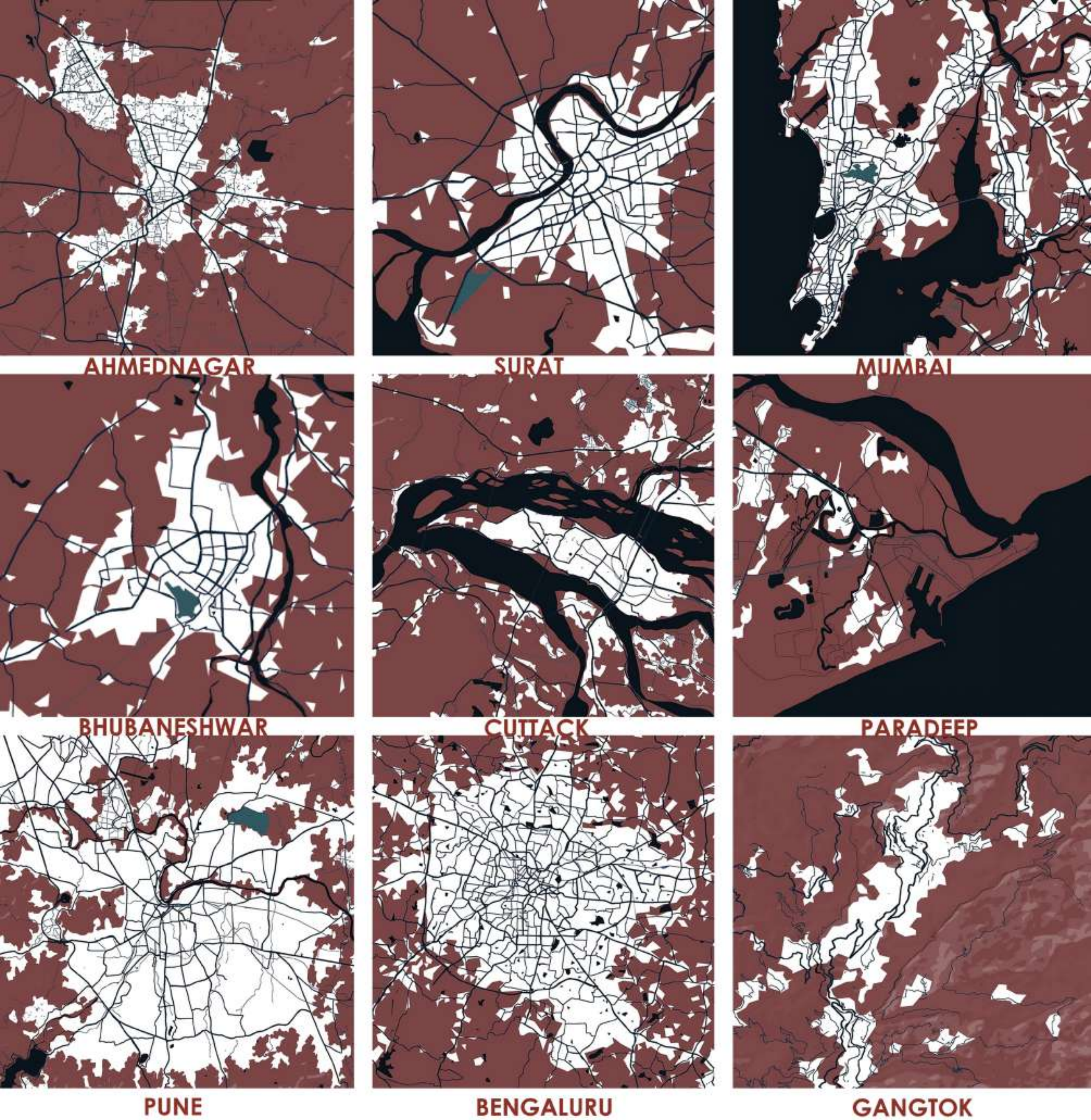
Scaling up across other regions/countries: To date the initial location choices for labs and how these choices made are clear and ready and can lead to sharing this process with other country partners after one year of developing the methodology and tracking the entire process in India. The strategy to start the labs in India and complete 9 of them served many purposes. First, the need to undertake as practical action what was sought as critical features of the labs themselves. Secondly, it helped both the federation networks and the young professionals to centrally integrate the joint knowledge production process that remains at the heart of the strategy of labs. Thirdly, there was a need to understand and articulate the pathways between the strategies of the labs and the campaigns and how the two intersected.

The plan now is that once the methodology and the pilot settlement study are done in India the same is shared through demonstrations undertaken as training and sharing with those who wish to conduct such labs in other countries. The Indian team will share their experience as well as get insights into what needs to change in design and selection to suit the realities of the countries where such sharing is done. Engagement with peer social movements where SDI and other peer networks like ACHR, TECHO, Huairou Commission and Global Network of Waste Pickers, Habitat for Humanity[xxvi] and Build Change[xxvii] and their networks can explore these processes. The clarity of how local reality requires changes in process as well as maintaining data points across all labs will enable global aggregation and build elements needed by their constituencies considering regional realities in different countries and regions. This is the urgent next step in the activities envisaged in 2024. Local, national, and global partners who can advise support and engage with labs will hopefully produce new partnerships and alliances to help the labs locally and share what is emerging regionally and globally. Partners and organizations across the globe in this campaign will help enrich and widen insights about the context of the different situations and related solutions for the same challenges of habitat in different regions with different climatic conditions.

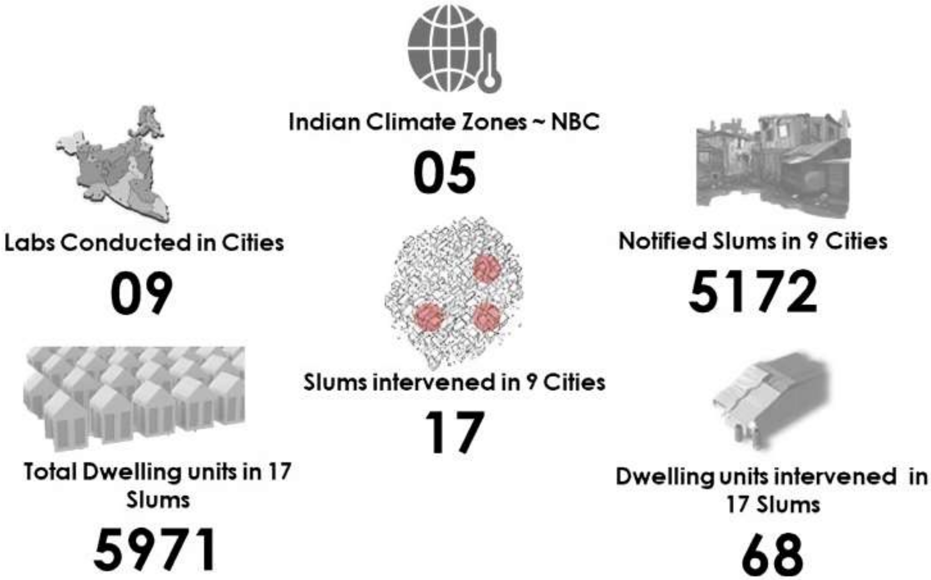
Impact assessment and its dissemination. Assessments at local and aggregated level are essential. Creating both participatory measurements of processes, impact and outcomes is embedded in the strategy of ROOH. It must work at both ends. Communities and women's collectives should be able to take informed decisions with wider choices and support and examine the impacts and assess the value of the levels of change. It needs to provide a wide spectrum of materials, design, and solutions of technical origins. Ideally both communities and their organisations and professionals associated with ROOH need to be the first ones involved in the monitoring and evaluation.

Initially, it would be ongoing tracking plus exploration of new possibilities that emerge from the data gathering done at every stage of the project and campaign. The strategy to update progress, with added information deepening insights of ways of communication and dealing with failures, risks, and unanticipated occurrences (also climate events that impact the labs) is the critical challenge for the secretariat and partners involved in the impact assessment process as we move labs from India to other regions. The final phase of this cycle of 100 labs will be a consolidated data of all phases being available in the public domain through both digital platforms as well as through the 100 labs becoming learning and exposure centres for their regions and cities. It leads to a critical action to be undertaken in 2024 to develop a data base that is digital and has peer communication linked to the knowledge platform.

Communication of the ROOH process will continue through round tables, podcasts videos and in-person meetings. Commitment to democratise space for podcasts, knowledge materials, videos, blogs, newsletters, paper publications that local communities and their networks can do is an exciting possibility that is critical. Examining how deeply we can translate written and audio materials to reach local groups is in progress as digital tools are making this possible, and the aim is to achieve a dedicated website and online archive. Women's collectives have shown us how a few smart phones in each neighbourhood produce assistance for the whole group to engage in the digital communication. They contribute to the reporting through video messages and view what others are saying and doing. We know that such processes can only remain alive and relevant when information dissemination remains particularly important and is done at every step in a decentralised way. Our collective commitment to learn share and build on what we know and seek what we don't know is at the heart of the ROOH process.



Hot-Dry Warm-humid Composite Temperate Cold



5

LIVING THE LABS

The campaign seeks to identify alternatives to the existing living conditions in the informal settlements considering the unique challenges posed by different microclimates and settlement contexts. Labs serve as a platform for co-creation where various perspectives converge to develop holistic solutions with communities and professionals working together to ensure that the housing choices produced are both adaptable and affordable (prices are in line with current affordability). The solutions/ alternatives promote community resilience by exploring options and testing those that can adapt to changing climatic conditions.

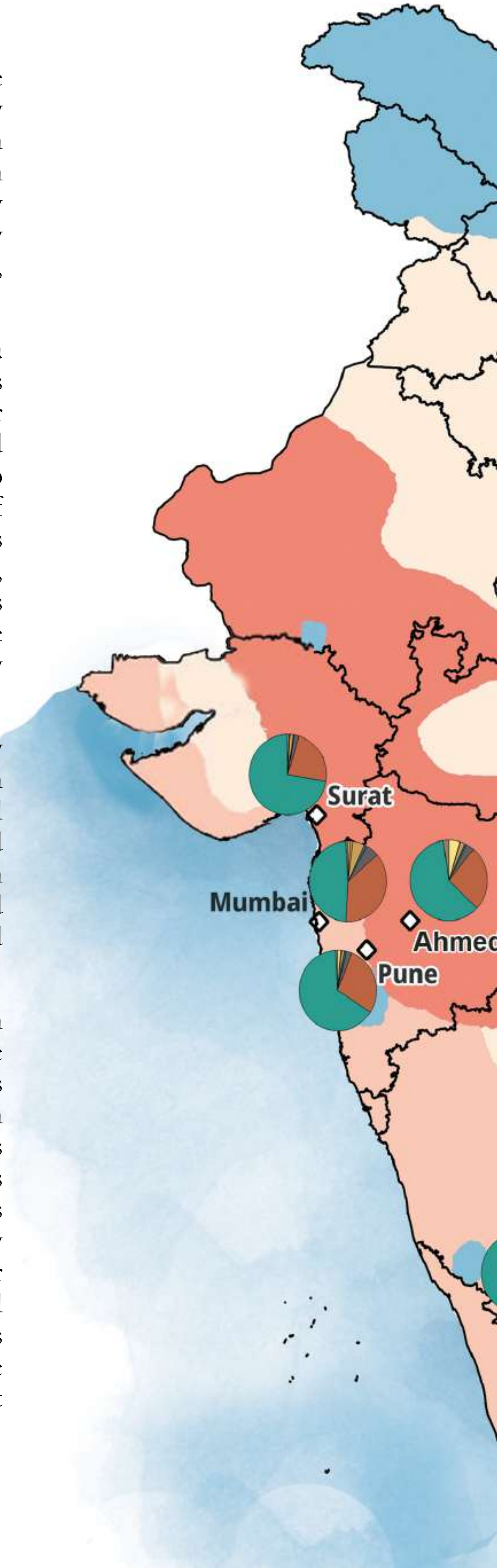
The ROOH Labs involves learning and working with communities through their "lived experience" in their vulnerable habitats. This calls for long-term commitments that will develop via numerous trial and error iterations, testing solutions until they are approved by communities for scale.

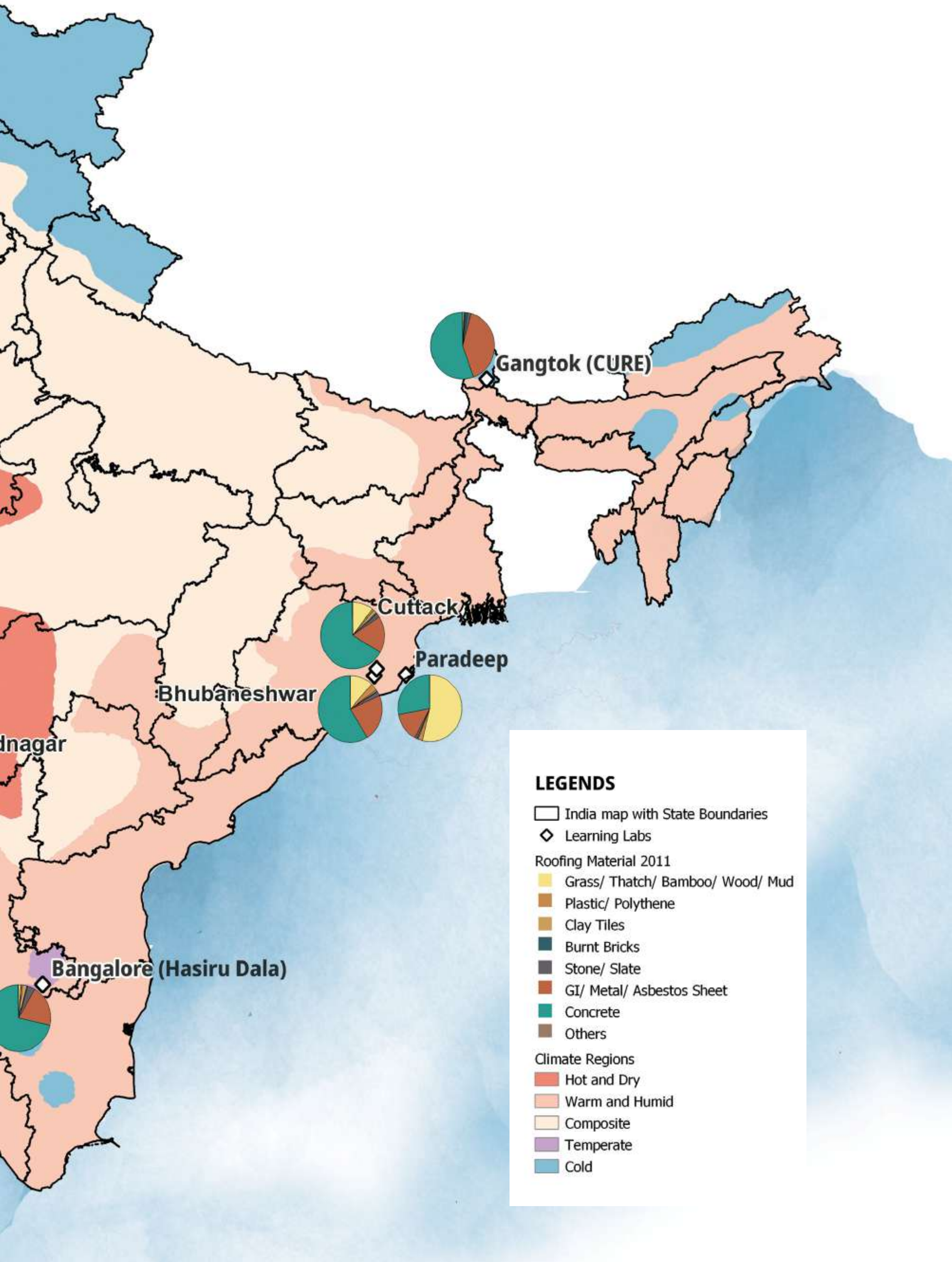
ROOH stage one documents various coping mechanisms people use when living in informal settlements, often with high densities on unhabitable lands along water bodies, railway tracks, swamps, marshes, sewerage networks, near industries etc., most in poor quality housing, devoid of basic services. Labs have been undertaken in 9 cities across 5 climate zones in India to understand and address challenges faced by people living in informal settlements, particularly focusing on finding sustainable, resilient, affordable, and accessible housing solutions.

Selecting cities within varying climate zones is a strategic approach to addressing vulnerabilities in informal settlements across diverse weather conditions. The selection of Indian cities and settlements in particular for the labs hinged on two factors: the proactive presence of the alliance of SPARC, NSDF and Mahila Milan within these cities and collaboration with associated partners, CURE, and Hasiru Dala , the waste pickers network. This ensured engagement with the residents of these informal settlements since Mahila Milan already has a presence there.

Another factor in city selection was a secondary study encompassing climatic zones based on the Köppen Climate classification, the National Building Code classification for India, and secondary data analysis of decadal census data in 64 cities. This comprehensive analysis considered construction material data for roofs, walls, and floors, spanning the past two decades.

Two crucial factors were carefully considered in conjunction while choosing the cities firstly, the strategic location in different climatic zones across the country to gain insights into the construction materials used by residents in informal settlements and secondly, the social aspect of the labs that was brought out with the presence of active members and contacts in the cities. This network not only aided in data collection[xxviii] but also allowed for potential collaborations and training artisanal contractors located within the communities. This approach ensures a holistic understanding of the housing needs and challenges across different microclimates in India.





Gangtok (CURE)
Cuttack
Paradeep
Bhubaneshwar
dnagar
Bangalore (Hasiru Dala)
LEGENDS
India map with State Boundaries
Learning Labs
Roofing Material 2011
Grass/ Thatch/ Bamboo/ Wood/ Mud
Plastic/ Polythene
Clay Tiles
Burnt Bricks
Stone/ Slate
GI/ Metal/ Asbestos Sheet
Concrete
Others
Climate Regions
Hot and Dry
Warm and Humid
Composite
Temperate
Cold

Siddharth Colony
Gokul Waadi
Laal Taaki

Hot-Dry

AHMEDNAGAR

3,50,859
Population

5,22,000
Projected Population

3.37%
Avg annual growth rate:

39.30 Sq. Km
Area Of Municipal Corporation

Latitude° N 19.0948 Longitude ° E 74.7480

Total Slum Population
37,257

Total Slum Population
11%

Slum Dwelling Units
7,782

Slum Pockets
22

649m
elevation
above Sea Level

Max
40°C

11°C
Min

Avg Rainfall
608.1 mm

Ahmednagar: Navigating the Microclimate Challenges of 3 Informal settlements

Ahmednagar, a city with hot, dry climate and irregular rainfall, faces the dual challenges of drought and susceptibility to flooding. The informal settlements of Siddharth Nagar, Gokul Waadi, and Laal Taaki were selected for intervention and documentation.

Observations from the lab highlighted corrugated tin sheets as the primary construction material for roofs and walls in the slums of Ahmednagar. Although brick and mortar are occasionally used in wall construction, the prevalence of corrugated tin significantly impacts the microclimate of settlements and the indoor thermal comfort of dwellings. During the summer, the heat generated by these sheets poses health risks, particularly for children who are susceptible to issues like boils. Residents combat the intense heat by using damp cloths on doors to reduce dust and protect themselves from winds. Additionally, the high temperatures lead to gas cylinders exploding inside the dwelling, causing property damage and personal injuries. To escape the summer heat indoors, it is common for people to resort to sleeping outdoors.

In the monsoon, leaking roofs become a significant concern due to defective joints and the use of rusted corrugated tin sheets. Residents employ tarpaulin or plastic/PVC sheets as a temporary solution, but these require annual replacement due to weathering. Some households reinforce leaky roofs with materials like cardboard to minimize water seepage. Many dwellings share walls on both sides, limiting natural light penetration. To address this, some houses incorporate translucent fibre plastic sheets as roofing material, simulating skylight windows and enhancing interior lighting. In order to optimize thermal comfort and ensure long-lasting durability, temporary and semi-permanent dwelling units incorporate a layered approach for their roof construction. This involves the use of materials such as cement sheets, tin sheets, tarpaulin and clay tiles, which are stacked atop one another.

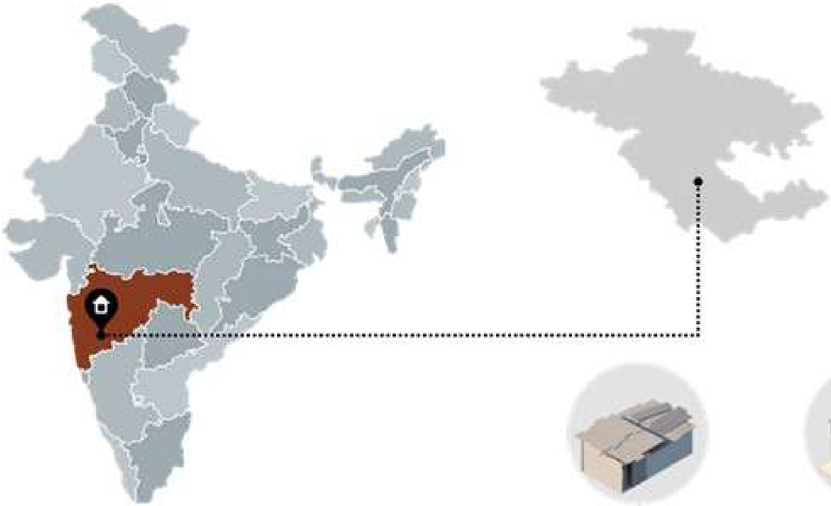
To overcome financial limitations, second-hand and salvaged materials such as doors, windows, and plywood are frequently used as construction materials in residential units.

Ahmednagar's Micro Market

In the micro market of the city, the choice of construction materials in informal settlements is influenced by the city's industrial character. Being an industrial city with production facilities, there is prevalence among informal residents for new materials. However, the resourcefulness of the community is evident in the use of second-hand materials sourced from discarded items at industrial estates.

The majority of vendors offer steel support sections and corrugated tin sheets, reflecting the majority of use of these materials in the slums. While corrugated tin sheets are widely used, a limited number of vendors also provide alternatives such as plywood, bamboo supports, and cement sheets. The choice of materials in these micro markets may not solely be driven by availability, but also by economic considerations. Residents often resort to using second-hand materials, layering them for structural integrity. Various makeshift solutions, such as utensils and plastic sheets to deal with roof leaks, steel mesh for added security, and green cloth for protection against heat, were prevalent. Some homes even featured tin sheet walls with small ventilation openings. The settlements in Ahmednagar underscore the challenges and trade-offs involved in constructing dwellings, considering the lifespan of materials, maintenance requirements, and cost-effectiveness. Resourceful coping mechanisms, including the reuse of materials and layering, are adopted by residents to mitigate environmental issues in their living conditions. Many locals opt to purchase construction materials from wholesale markets, recognizing the cost advantages over sourcing from local vendors. The availability of diverse materials indicates a certain adaptability within the community, while the economic factor is a significant driver in the decision-making process.

AHMEDNAGAR



Area of the Settlement

4.6 Ha (7.8 acres)

1.3 Ha (3.3 acres)

1.15 Ha (2.85 acres)

Total No. of Dwelling Units

250 DU (approx.)

100 DU (approx.)

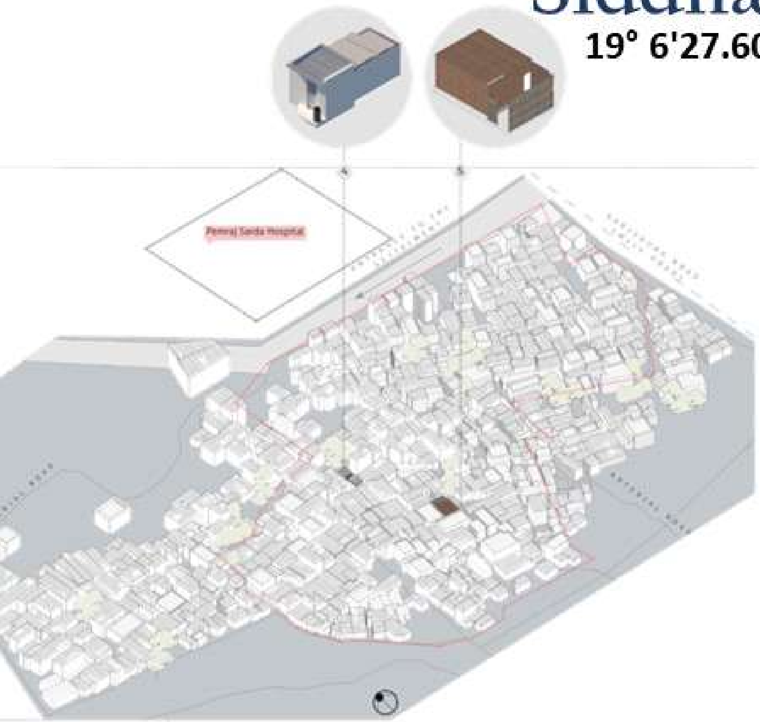
450 DU (approx.)

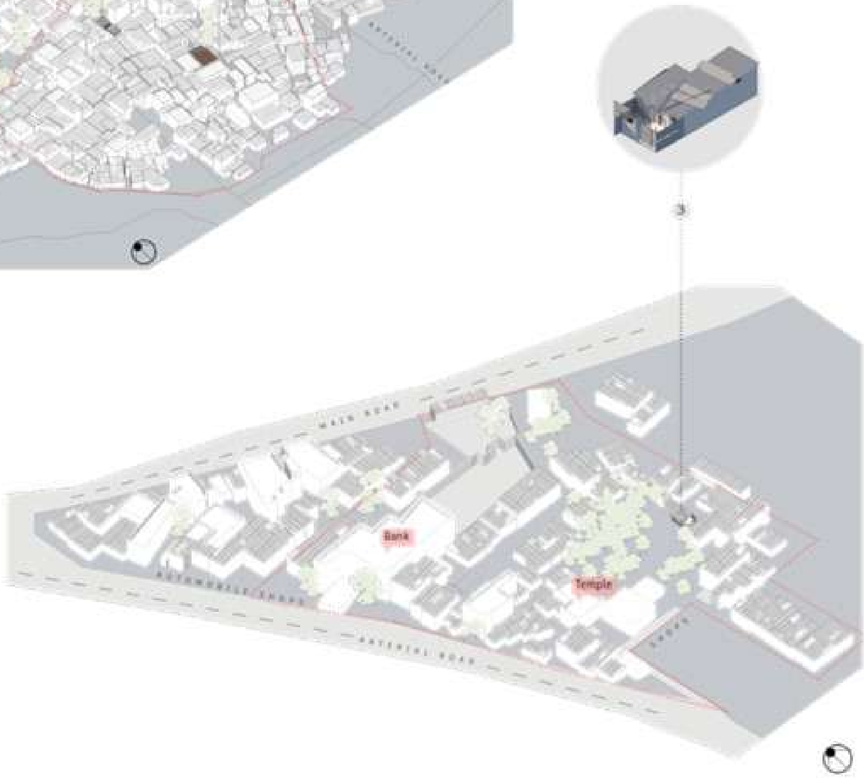
Gokul Waadi

19° 6'4.73"N 74°44'21.61"E

Siddharthnagar

19° 6'27.60"N 74°44'0.50"E





Laal Taaki

19° 6'20.27"N 74°44'13.01"E

A comprehensive profile of settlements in Ahmednagar

Three settlements were chosen in Ahmednagar, with Siddharthnagar situated near the Civil District Hospital. This settlement spans an area of 4.6 hectares (7.8 acres) and comprises 250 dwelling units and an average household size of 8-10 people. The land ownership is of a graveyard and is in close proximity to a drain. The slum has been notified and declared and has a history of 80 years. Within this settlement, the housing distribution is as follows: 15% temporary, 75% semi-permanent, and 10% permanent structures. Water in the settlement is sourced through bore wells. Notably, 98% of the houses are self-owned, while 2% are rentals. As discussed during focused group discussion, most of the dwelling units have toilets installed under the Swachh Bharat Mission (SBM). However, the sanitation facilities lack sewer connections, utilizing chambers that link to the nearby drain. Gokulwaadi is situated within the cantonment area and spans an area of 1.3 hectares (3.3 acres) with a total of 100 dwelling units. This notified slum has a century-long history, and the average type of housing can be categorized as 40% temporary, 50% semi-permanent, and 10% permanent structures. Notably, 80% of the houses are self-owned, while 20% are rentals. In terms of water supply, the settlement receives water every alternate day, and each house is equipped with a tap connection. Additionally, all dwelling units are equipped with toilets that are connected to a sewer system. The majority of Gokulwaadi's residents derive their livelihoods from selling various items such as steel utensils, cutlery, clothes, and more. Laal Taaki is a notified settlement covering an expanse of 1.15 hectares (2.85 acres) and comprising 450 dwelling units. The housing in this slum is categorized as follows: 30% temporary, 60% semi-permanent, and 10% permanent structures. Notably, 100% of the houses are self-owned. The settlement relies on bore water for its water supply. Additionally, most of the dwelling units are equipped with toilets that are connected to the sewer system.













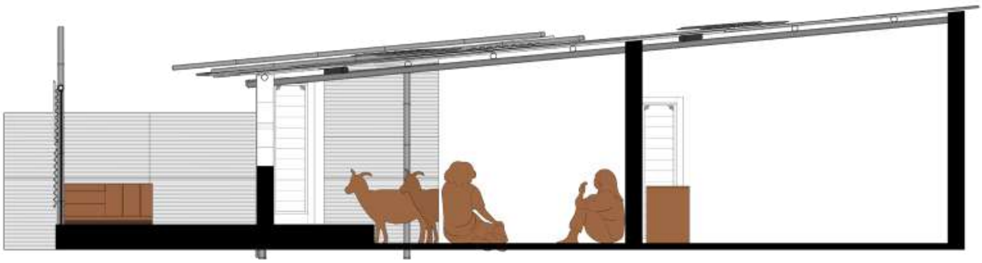

A1 Siddharthnagar

Name: Sunita
Age: 42
Housing Tenure: Semi Permanent (Semi-Pucca)
Structure Type: Detached
Area: 25 sq. mts
Family Size: 4
Family Occupation: Labour and house helper
House Investment - building, maintenance and upgrades: Rs. 44500

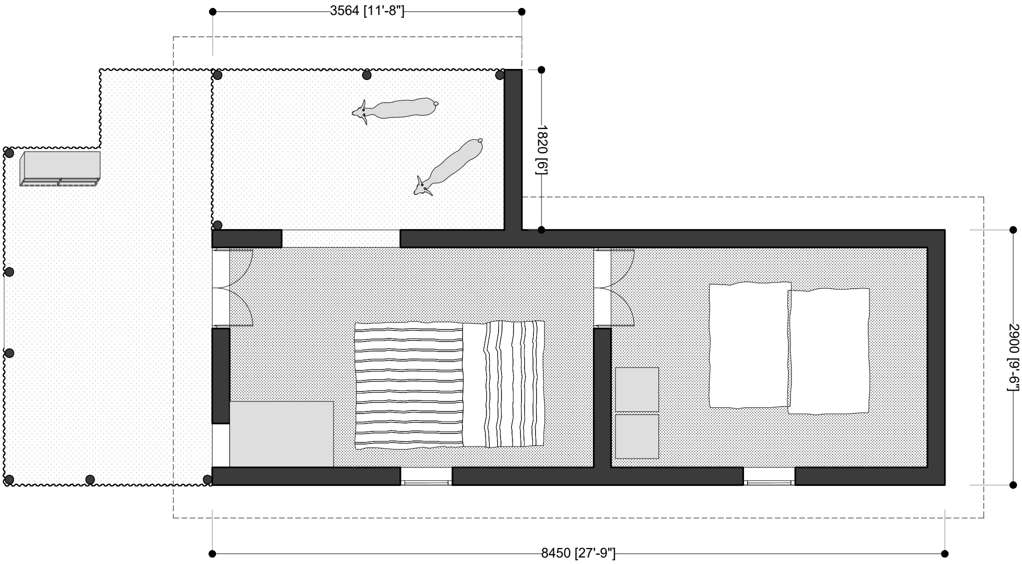
I reside in Siddharth Nagar, and my residence features a tin roof. While it offers affordability and easy installation, it tends to become uncomfortably hot during the summer. When it rains, the noise generated on the tin roof becomes quite disruptive, making it challenging for children to focus on their studies and impeding my ability to carry out household tasks. To address leakage issues during rainfall, we place a tarpaulin on top, but its durability is limited, necessitating frequent replacements. To reinforce the roof's structure, we utilize recycled steel sections sourced from the local market, providing support for the tin roof and serving as fixtures for our lighting.

Our dwelling is a simple structure with a mud base, brick walls held together by mud mortar, and corrugated tin sheets. Although the walls lack significant strength and pose a risk during severe storms, the mud composition contributes to a bearable indoor temperature during the summer. For the flooring, we opt for plaster with a mud base, as it is cost-effective and aids in maintaining a cooler environment within the house. In the front yard, we utilize bamboo and plywood boards, chosen for their cost-effectiveness and suitability for our housing needs.

Documentation

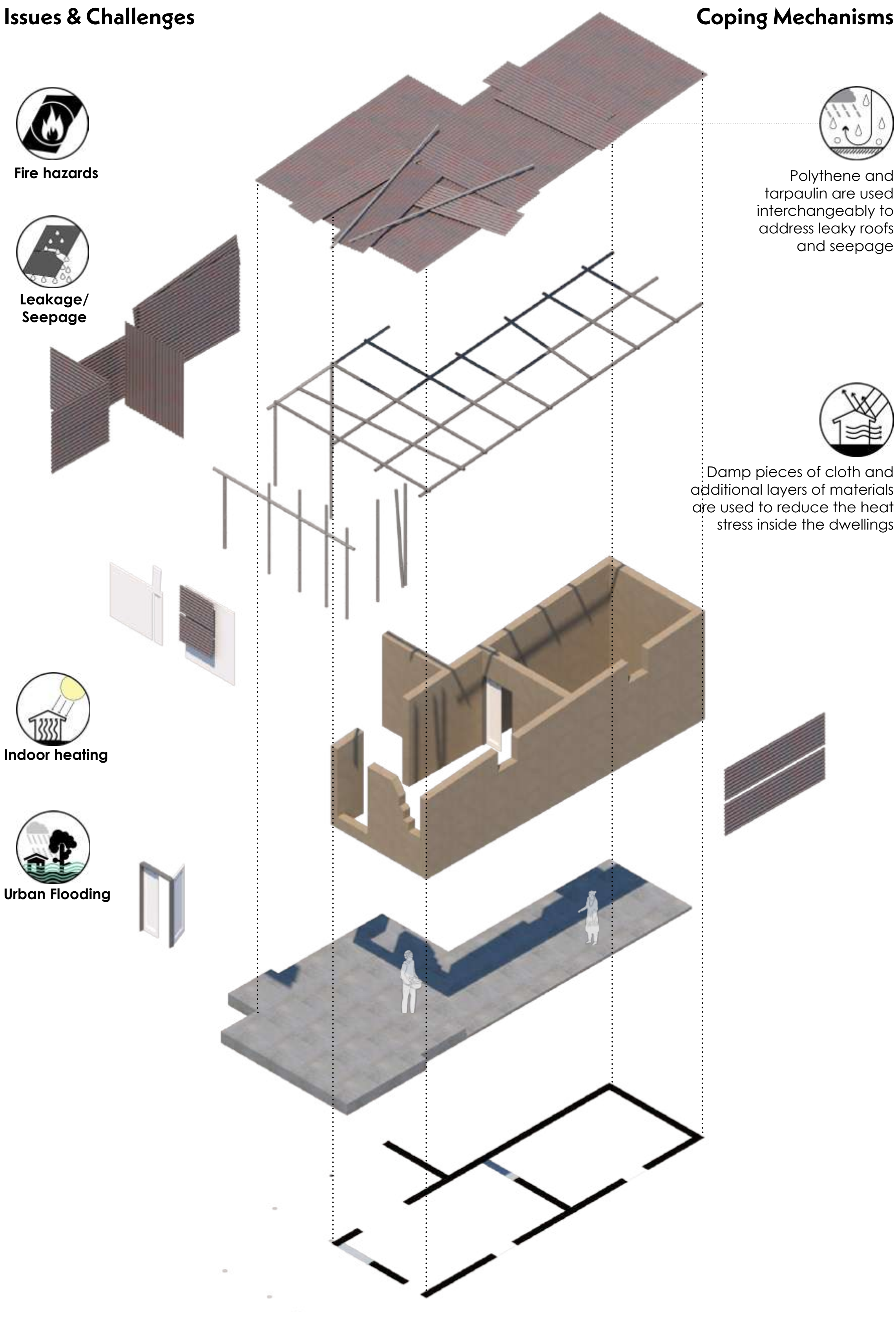


Section



Plan

1. Front Yard
2. Living/Sleeping Space
3. Cattle Shed
4. Sleeping Space



Issues & Challenges
Coping Mechanisms
Fire hazards
Leakage/ Seepage
Indoor heating
Urban Flooding
Polythene and tarpaulin are used interchangeably to address leaky roofs and seepage
Damp pieces of cloth and additional layers of materials are used to reduce the heat stress inside the dwellings

Attributes of materials

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Second-Hand	Rs. 300/ Sheet	Self-Built
	Tarpaulin	■■□□□	■■□□	■■□	Frequent	Second-Hand	-	Self-Built
WALL	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Second-Hand	Rs. 300/ Sheet	Self-Built
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 8/ Piece	Skilled Labour
STRUCTURE	Bamboo	■■□□□	■■■■	■□□	Frequent	New	-	Skilled Labour
	MS Section	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 90/Kg	Skilled Labour
FLOOR	PCC	■■□□□	■■■■	■■■	Infrequent	New	-	Skilled Labour

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

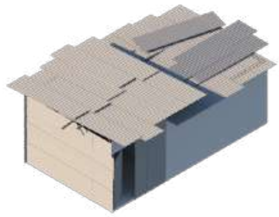
A2 Laal Taaki

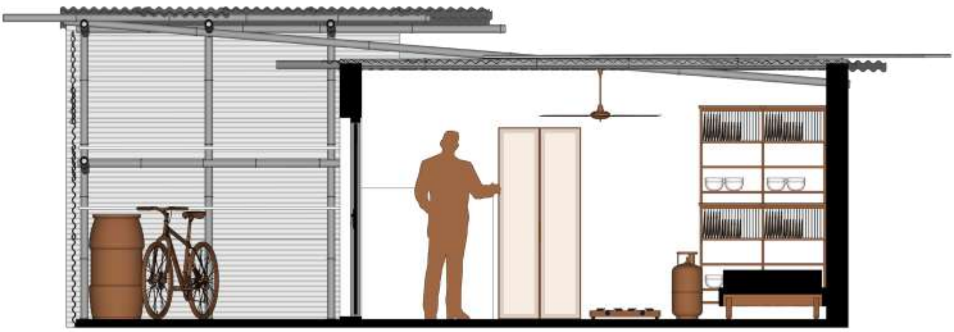
Name: Murlidhar
Age: 34
Housing Tenure: Semi Permanent (Semi-Pucca)
Structure Type: Semi Detached
Area: 26 sq. mts
Family Size: 3
Family Occupation: Painter and house helper
House Investment - building, maintenance and upgrades: Rs. 80800

I reside in Laal Taaki, where our dwelling is equipped with a roof composed of economical corrugated tin sheets. However, this choice, though affordable but poses challenges. In the summertime, the interior becomes uncomfortably hot, and during rainfall, the incessant noise of raindrops on the tin roof becomes unbearable. To prevent water ingress, we resort to placing a tarpaulin over it, that requires to be replaced every year.

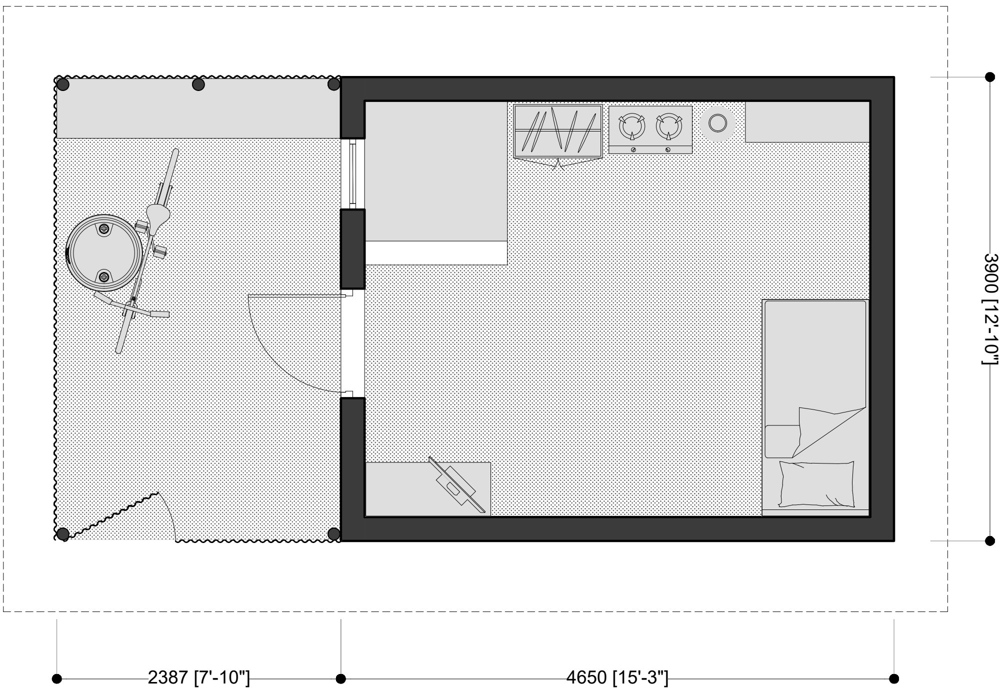
For the front part of our house, bamboo poles support the tin roof, complemented by a plywood board sheet. The overall structure of our house is modest, featuring brick walls and multiple layers of corrugated tin sheets. The brick walls serve as a thermal barrier, mitigating heat, but without a breeze, the interior can still become quite warm. The tin sheet walls, being relatively fragile, pose vulnerability, especially during intense storms. Our floor is a simple composition of plaster with a mud base. While cost-effective, this choice contributes to maintaining a cooler ambiance when the external temperature is scorching.

Documentation





Section

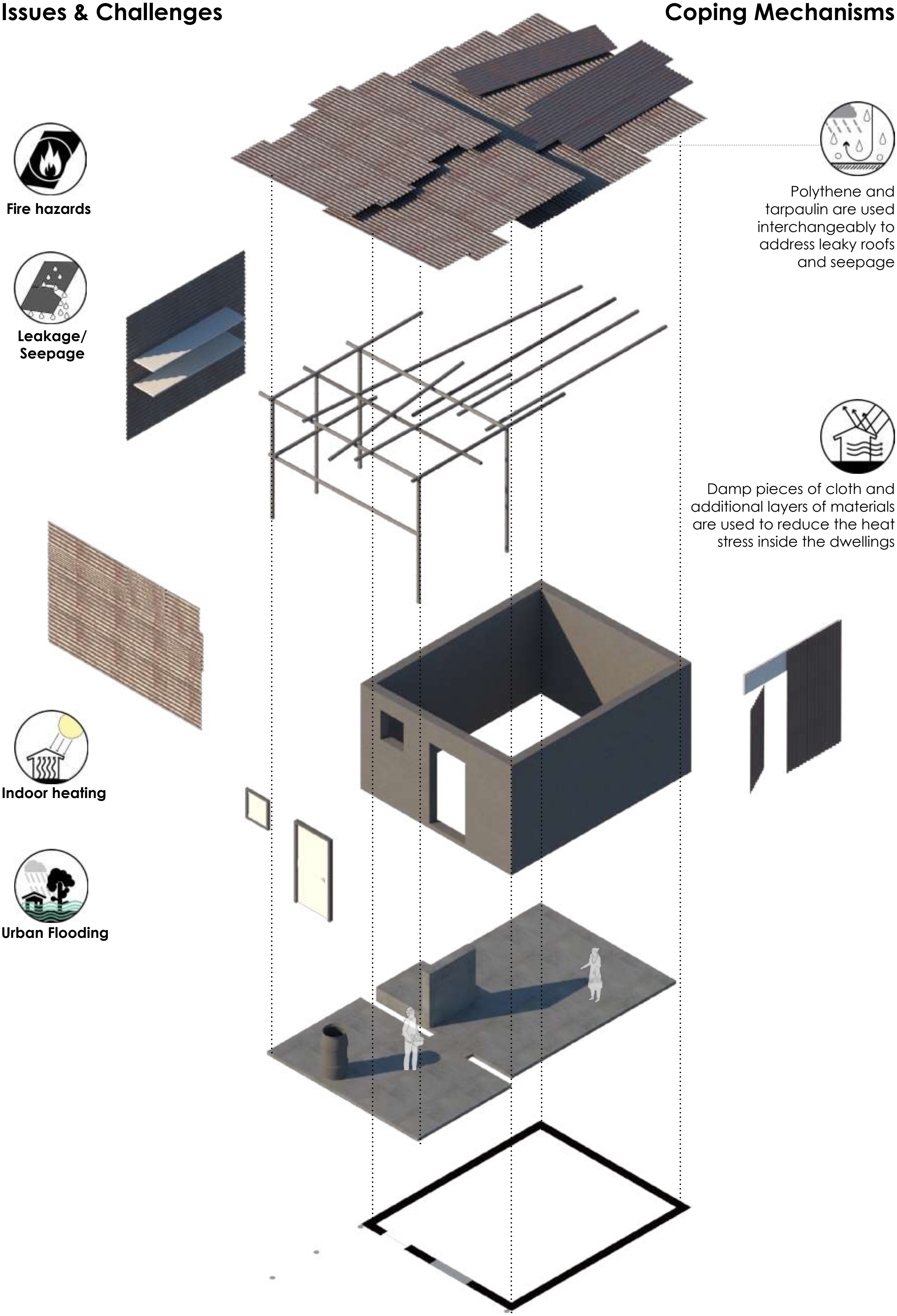


Plan

1.Foyer/Storage Space (DU Extension)
2.Living/Sleeping Space
3.Kitchen
4.Storage Space
5.Water Storage

Issues & Challenges

Coping Mechanisms



Attributes of materials

	Material	Thermal Conductivity	Shelf-life	Durability	Maintainence	Procurement	Cost	Execution
	S	S	S	U	U	U	S	U
ROOF	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Second-Hand	Rs. 300/ Sheet	Self-Built
	Flex Banner	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
WALL	Brick	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 8/ Piece	Skilled Labour
STRUCTURE	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Skilled Labour
	Bamboo	■■□□□	■■■■	■□□	Frequent	Second-Hand	-	Self-Built
FLOOR	PCC	■■□□□	■■■■	■■■	Infrequent	New	-	Skilled Labour

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

Rasulabad

Hot-Dry

SURAT

44,67,797
Population

63,31,000
Projected Population

2.95%
Avg annual growth rate:

462.149
Sq. Km
Area Of
Municipal Corporation

Latitude° N 21.1702 Longitude ° E 72.8311

Total Slum Population
4,81,658

Total Slum Population
11%

Slum Dwelling Units
129883

Slum Pockets
773

34.68 m
elevation
above Sea Level

Avg Rainfall
1243.4 mm

Max
44°C

10°C
Min

Surat: Navigating the Microclimate Challenges of Rasulabad

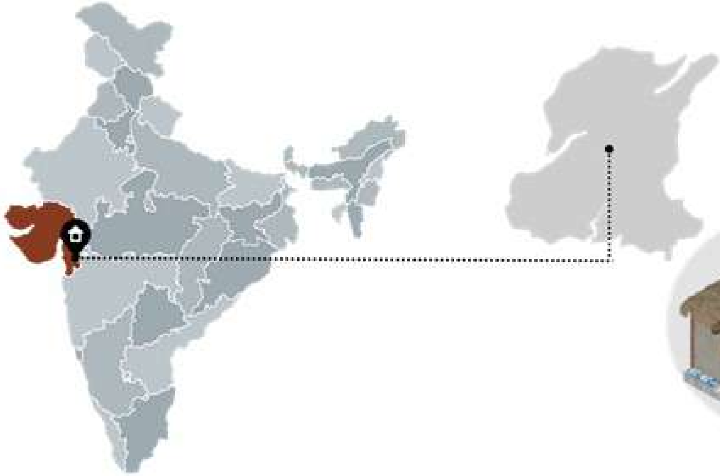
Surat, the second-most populous city in the Indian state of Gujarat, stands as one of India's fastest-growing urban centres, attracting a substantial influx of migrants from rural areas and other parts of the country. Surat Municipal Corporation data reveals the existence of 773 slums, providing shelter to over 2 million people. The city, demarcated into 54 wards and 7 zones, witnesses the highest concentration of slums in the south-east and south zones, primarily near industrial estates. Particularly vulnerable is the low-lying area along the Tapi River, prone to flooding during heavy rainfall. Enduring a hot and dry climate with scorching summers and mild winters, Surat grapples with various natural hazards, including floods, cyclones, heatwaves, earthquakes, and epidemics. Residents, lacking proper infrastructure like drainage systems, reside in houses situated in flood-prone low-lying areas, making them susceptible to displacement, property damage, livelihood loss, and heightened health risks from waterborne diseases.

Rasulabad, a community within Surat, confronts multiple challenges such as flooding, leakages, and security issues. Residents, facing hazards during the rainy season, resort to makeshift solutions like plastic sheets with limited effectiveness. Material choices prevalent are Aluminium-zinc coated (Al-Zn) corrugated sheets and cement corrugated sheets. Cement corrugated sheets and bricks are preferred for their longevity, though affordability remains a factor, leading some to resort to plastic sheets due to financial constraints. In response to these challenges, residents have formed self-help groups (SHGs) with the support of Mahila Milan, aiming to collectively save and upgrade their homes in the future. Varying income levels among households impact their ability to invest in housing improvements, and the affordability of materials becomes a crucial determinant in addressing their diverse needs.

Surat's Micro Market

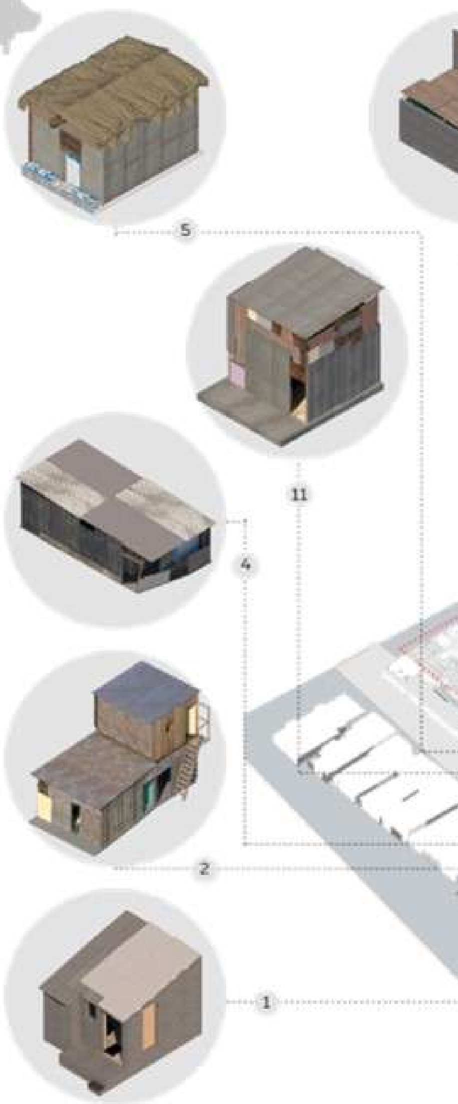
In Rasulabad, residents procure both new and second-hand construction materials from vendors and scrap dealers located in Navsari Bazaar, Udhana, Majura Gate, and Batar. The city's construction boom and possibly, the influence of local industries on microclimate has led to increased accessibility of materials such as cement sheets and fly ash bricks for those residing in informal settlements. These materials are often obtained from salvaged sites or sold as scrap at prices below the market rate, resulting in a diverse range of services and items, including wooden and metal door frames, window grills, and second-hand roofing sheets (GI, metal, and cement), second hand furniture. The preferences in household construction significantly influence the types of goods offered by vendors. For instance, fibre sheets were once popular until residents realized their structural limitations as roofing materials. Currently, cement sheets and metal sheets are the preferred roofing solutions. Wooden and concrete columns are also available in three different sizes to accommodate the varying needs of households. The close proximity of these shops to the settlement minimizes transportation costs, and any incurred costs are typically added to the materials' overall expenses. These establishments serve as reflections of construction trends, affordability considerations, and exhibit the diverse pool of materials that residents utilize to construct their homes.

SURAT



Rasulabad

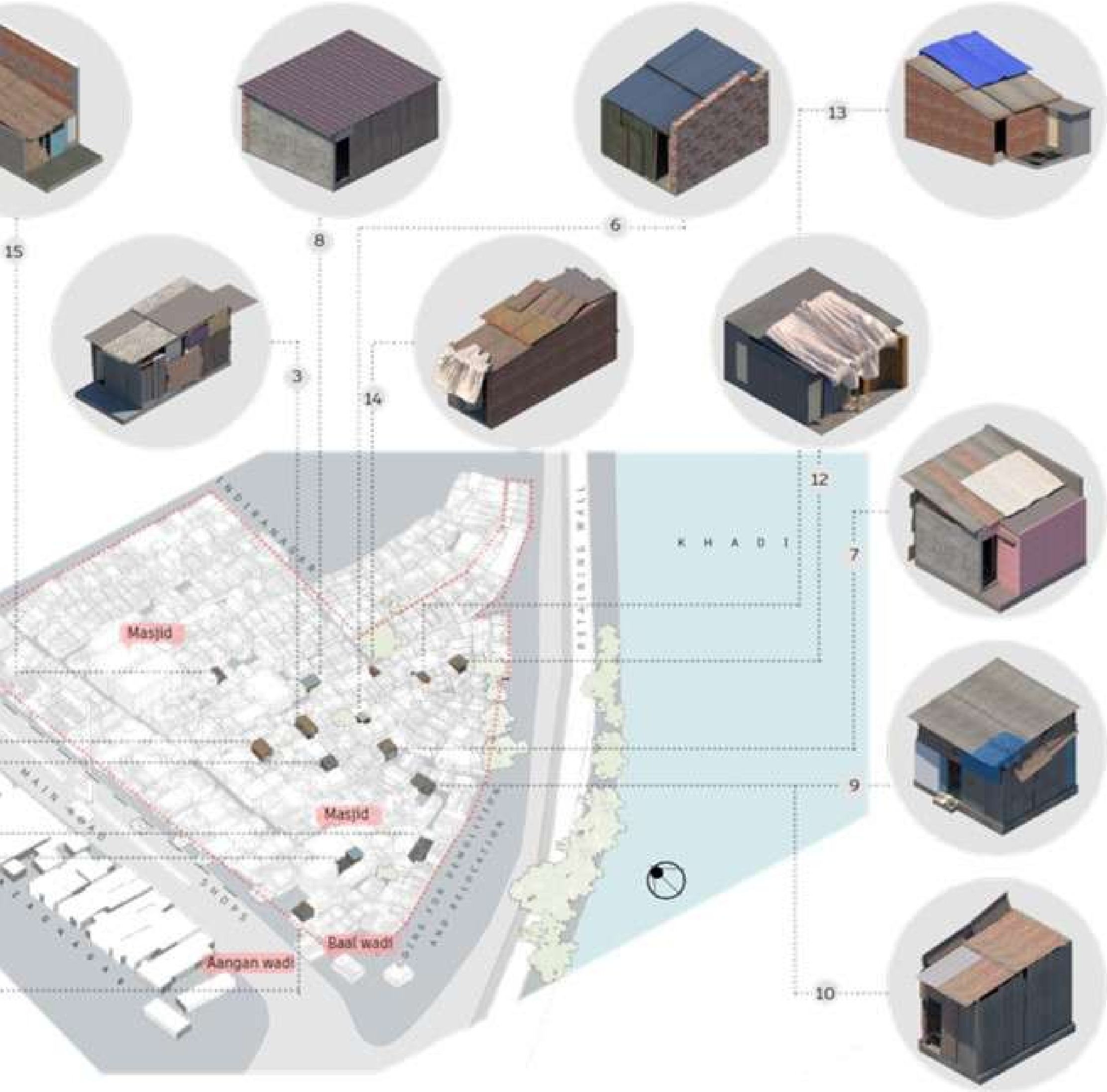
21° 9'4.44"N 72°48'45.52"E

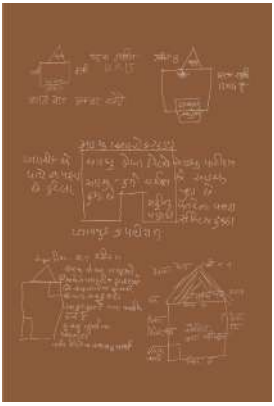


Area of the Settlement
3.1 Ha (7.58 acres)

Location of Settlement
Near Khadi (Creek)

Total No. of Dwelling Units
780 DU (approx.)


15
8
6
13
3
14
12
7
9
10
K H A D I
Masjid
Masjid
Baal wadi
Aangan wadi



A comprehensive profile of settlement in Surat

Rasulabad, situated in the southwestern part of Surat within the Bhatar ward, is a settlement that emerged approximately four decades ago due to relocation near Azad nagar necessitated for development projects near Majura gate and Althan by Surat Municipal Corporation (SMC). It is a notified slum with home to around 4,056 residents distributed across 780 households. Covering an area of 2.13 hectares, Rasulabad comprises 14 streets laid out in a linear pattern, where houses share walls on three sides, limiting natural light and ventilation. The settlement faces a significant challenge in the form of recurrent flooding, attributed to its low-lying position and unstable soil. This geological condition hinders the construction of resilient structures, resulting in property damage, infrastructure loss, and health risks.

The most severe flooding incidents occurred in 2004 and 2006, causing house collapses, mass relocations, and, in the latter case, complete evacuation due to water submersion leading to temporary refuge at the government school The aftermath included damaged houses, livelihood losses, and health issues stemming from sludge, slurry, and rodent infestations. The government responded with a relief fund of Rs 1600 per household after the 2006 floods. Dwellings in Rasulabad range from 10x12 to 12x15 in size, with incremental expansions over time. The socio-economic infrastructure includes 70-80 shops, 3 Govt. primary schools, and a government school teaching in Urdu and Marathi. While a health centre exists outside the area. Dwellings are predominantly self-owned, with varying proof of tenure.

Water supply is accessible to most of the houses, with municipality water available between the morning between 6 am-8 am. Private toilet connections are common, initially provided by the government but requiring reconstruction at residents' expense after two years.

Construction Dynamics in Rasulabad

In the settlement, contractors offer a diverse range of services, categorized into those contributing to the construction of permanent houses and those specifically involved in building temporary and semi-permanent houses.

The contractor that builds permanent houses outlined a comprehensive service model. They supply materials at a fixed cost, contingent on the house size, and establish fixed labour rates per sq. ft. Construction costs are further determined by estimated time frames; houses with metal roofs take 15 days, extending to 20-22 days for those incorporating girder channels. Meanwhile, RCC slab structures demand up to 40 days. Material usage trends, as per rough estimates, reveal prevalent use of cement sheets for roofing, with few opting for costlier metal sheets. Kota stones dominate floors due to their economic viability, while tiles, a pricier alternative, are sporadically utilized, often salvaged from other constructions. Construction rates fluctuate; labour and materials-inclusive projects incur higher costs, reaching up to Rs. 700 per sq. ft, whereas labour-only projects cost Rs. 225 per sq. ft. Houses utilizing RCC slab charges Rs. 1200 per sq. ft. Alternatively, some contractors offer lump sum contracts, factoring in estimated construction duration, required labour, and associated costs. Girder-roofed pucca houses take 1.5 months and cost Rs. 1-1.5 lacs, while RCC structures necessitate 2 months and entail expenses of Rs. 3 lacs.

Contractors specializing in temporary houses bill solely for labour, given the presumption that households procure materials independently. Due to the variability in dwelling sizes and construction uncertainty, fixed cost estimates are elusive. Construction times for kutcha houses are notably shorter, ranging from 3-4 days for single-floor structures to 8-10 days for two-floor ones. Furniture and additions are priced at Rs. 30-40 per sq. ft. Conversely, Temporary house contractors earn over time through increments that are undertaken regularly, every 2-3 years, mainly in houses which are built entirely of tin sheets.

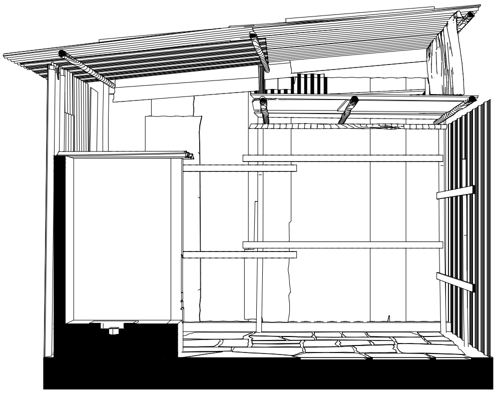
S1 Rasulabad

Name: Sultana
Age: 35
Housing Tenure: Temporary (Kutcha)
Structure Type: Semi Detached
Area: 19 sq. mts
Family Size: 7
Family Occupation: Domestic Worker, Skilled Labour
House Investment - building, maintenance and upgrades: Rs. 62392

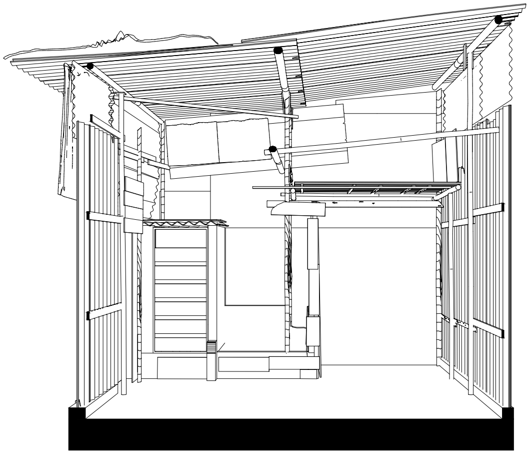
I live in Rasulabad alongside my family of seven, dwelling in a home constructed in 2012. Prior to this, we spent a decade in a rented room. Since its initial construction, our house has not undergone any significant modifications. Erected on vacant land with remnants of a shack, my husband, who works as a skilled labour, initially filled the depressed ground with mud, stones, and other salvaged materials. Subsequently, utilizing materials gathered over time, he installed columns and constructed walls and a roof using cement sheets.

However, our house faces challenges, as rainwater seeps in, leading to annual flooding. Health issues and injuries have significantly limited our family income, making it difficult to make substantial improvements to our dwelling. Consequently, during the monsoons, we employ plastic and tarpaulin sheets on roof to shield ourselves from the rain, but due to Khaadi (Creek) nearby flood is prevalent in the area and we are compelled to relocate to the nearby government school.

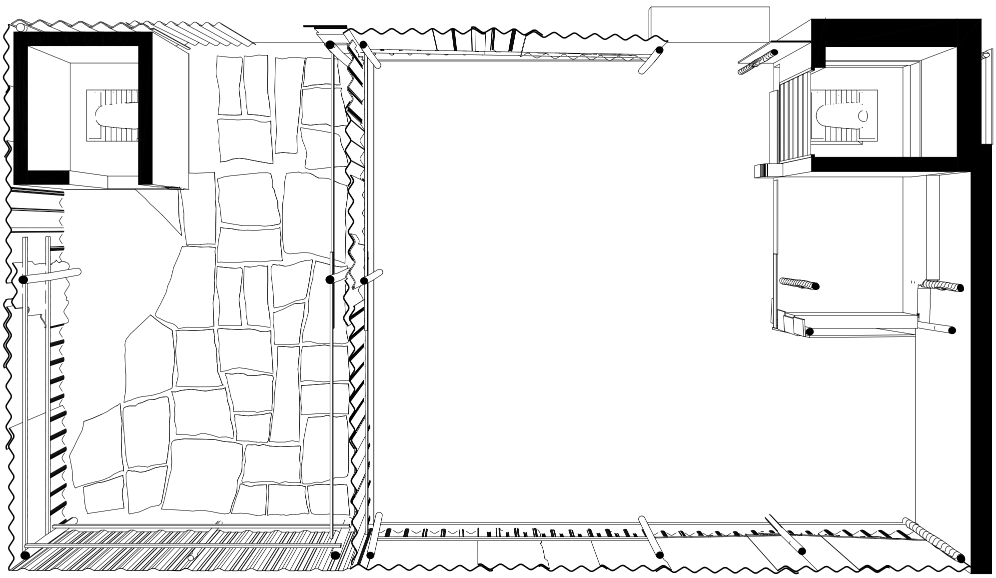
Documentation



Section



Section

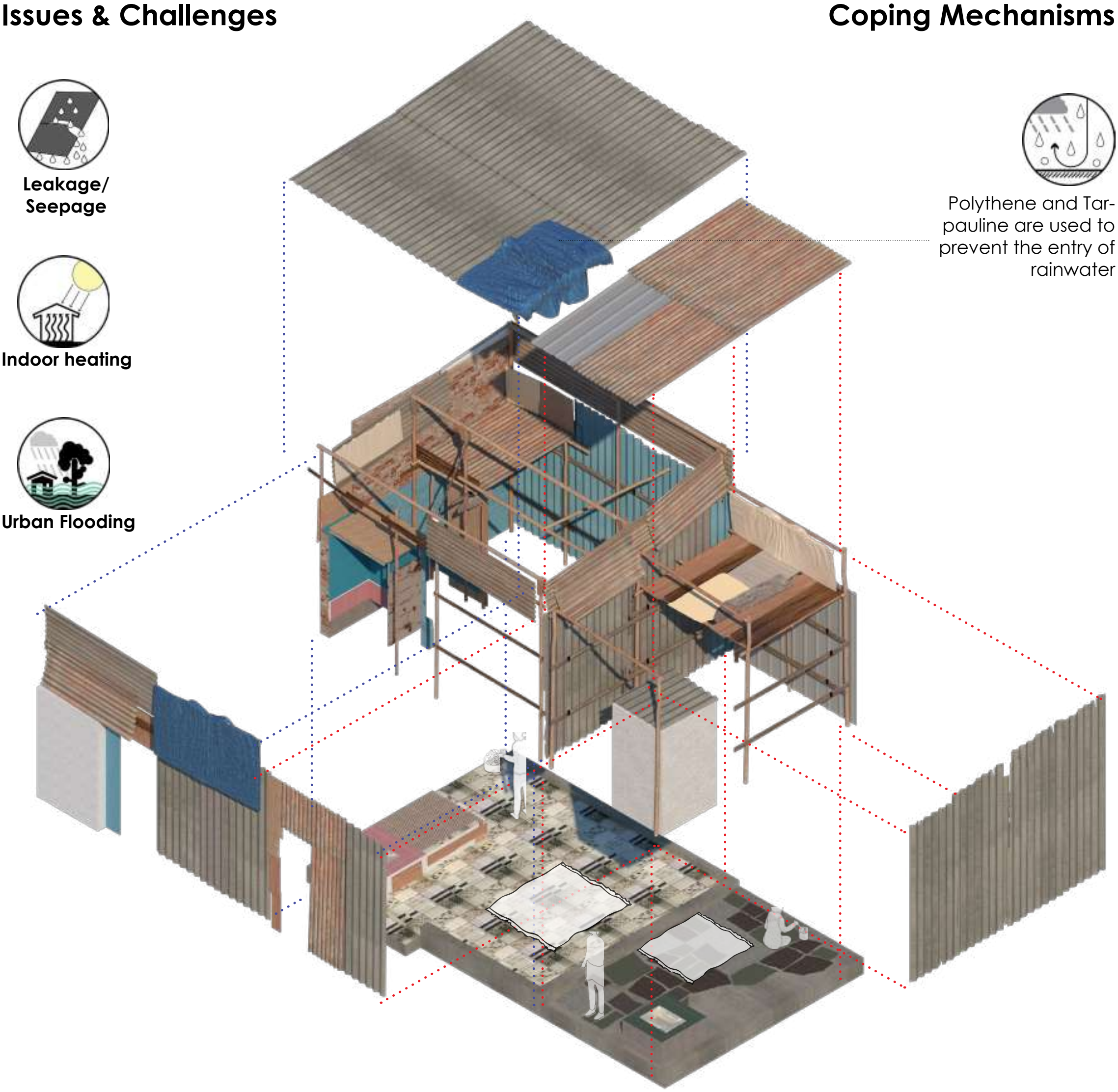


Plan

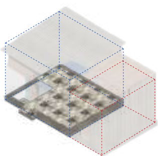
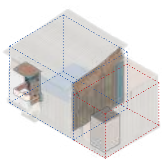
1. WC
2. Bath
3. Kitchen
4. Bedroom

Issues & Challenges

Coping Mechanisms



Timeline

Increments over time		
Year	2012	2014
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Migrated to Present Location	Damage to the Lateral walls
Response	House rebuilt with New Plinth	Walls rebuilt using cement sheets
Cost	Rs. 30,000	NA
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	Material (S)	Thermal Conductivity (S)	Shelf-life (S)	Durability (U)	Maintainence (U)	Procurement (U)	Cost (S)	Execution (U)
ROOF	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Second-Hand	Rs. 300/ Sheet	Self-Built
	Timber beam	■■■■■	■■■■	■■■	Infrequent	Salvaged	-	Self-Built
	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	Rs. 200/ Sheet	Self-Built
WALL	Brick	■■□□□	■■■■	■■■	-	New	Rs. 13/ Piece	Self-Built
	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Salvaged	-	Self-Built
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built
	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Salvaged	-	Self-Built
STRUCTURE	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Timber section	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Timber Column	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 13/ Piece	Self-Built
	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 400-460/Bag	Self-Built
FLOOR	Terazzo Tiles	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 80/Tile	Self-Built
	Kota Stone	■■□□□	■■■■	■■■	-	Salvaged	-	Self-Built

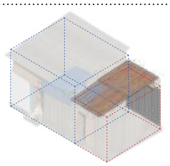
Thermal Conductivity:
- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

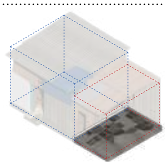
Shelf Life (Years):
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability
- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U





2012-2014	2018-2020	2023
Self-Owned	Self-Owned	Self-Owned
Self-Built	Self-Built	Self-Built
Damage suffered over time	Washing area+Weakened Flooring	
Rear wall and Roof rebuilt+ Toilet constructed inside the house	Tiles installed on the flooring, the toilet re-purposed into a common washing area	Present status of the dwelling
Rs. 40,000	Rs. 3800	
Self-Financed	Self-Financed	

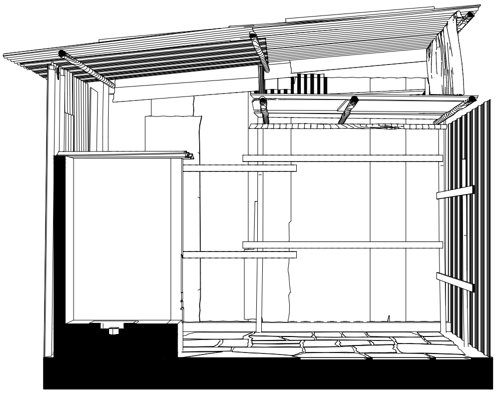
S2 Rasulabad

Name: Manisha
Age: 22
Housing Tenure: Temporary (Kutcha)
Structure Type: Attached
Area: 10 sq. mts
Family Size: 4
Family Income: Rs. 18000 per month
Family Occupation: Domestic Worker, Painter
House Investment - building, maintenance and upgrades: Rs. 88573

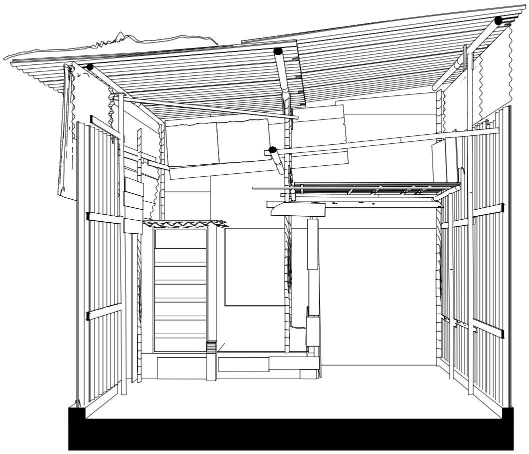
I have been residing in Rasulabad since 2002. The persistent issue of tenure insecurity looms over us as we lack any documentation to validate our occupancy of the house. Moreover, we have encountered numerous threats of eviction and experienced the demolition of our house without prior notice. Access to basic services is compromised; we rely on borrowing electricity from a neighbouring house and are forced to use the public toilet in Rasulabad since our dwelling is too small to accommodate one. Over time, our dwelling has undergone incremental upgrades. In 2002, it was constructed with wooden walls and metal sheets for the roof, which have been replaced every 4-5 years. In 2014, cement sheets were added to the roof, and in 2018, the floor was tiled using discarded tiles sourced nearby.

Several challenges persist, including concerns about rain. Recent health issues within the family have prevented us from making substantial investments to address this problem. As a makeshift solution, we use plastic sheets to prevent rainwater from entering the house. However, the damage to the underlying metal sheets still poses issues. To mitigate this, we have placed buckets under the damaged areas to collect the water that enters.

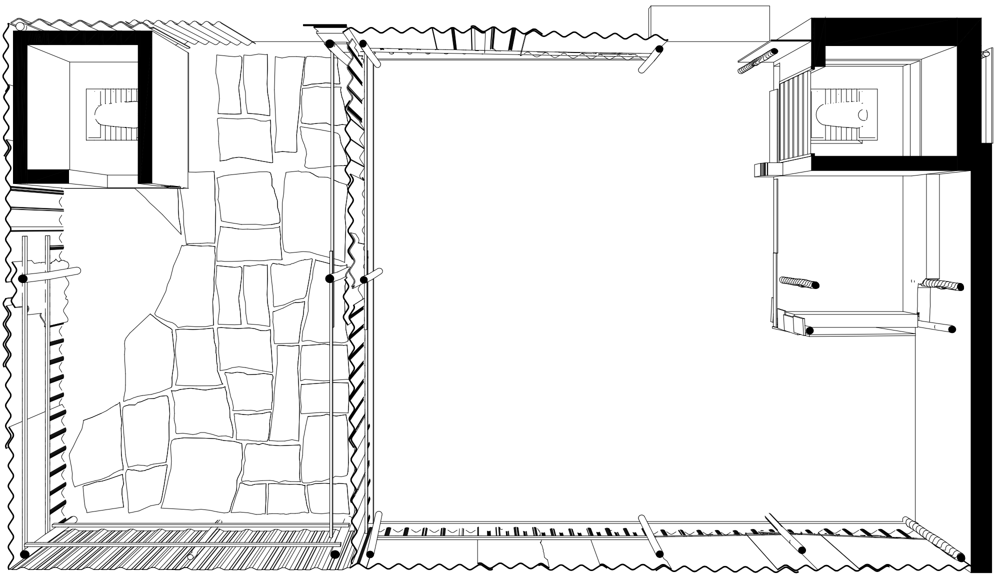
Documentation



Section



Section

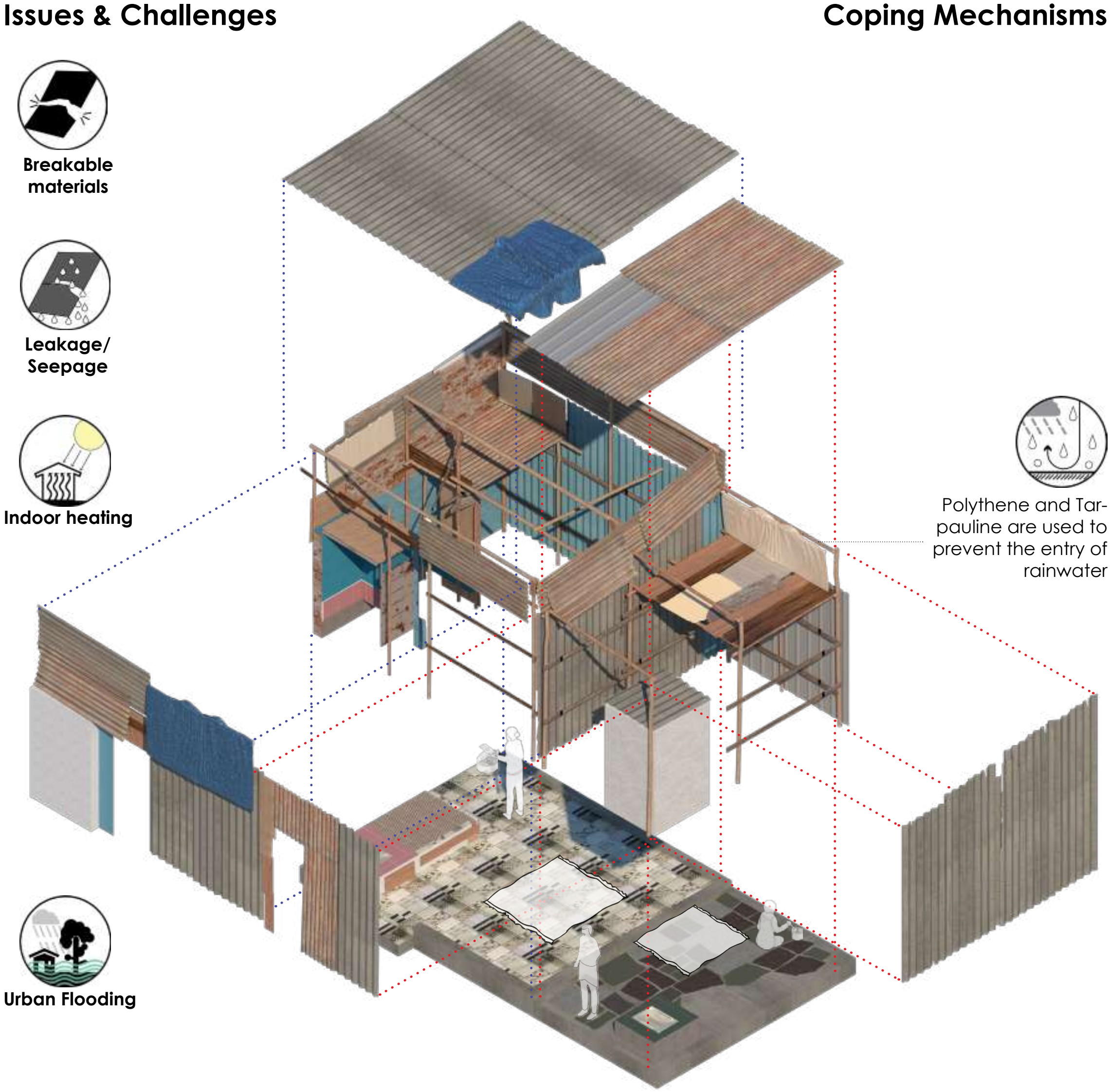


Plan

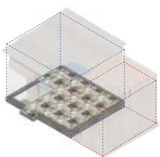
1. WC
2. Bath
3. Kitchen
4. Bedroom

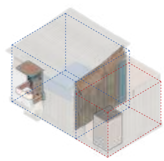
Issues & Challenges

Coping Mechanisms



Timeline





Increments over time		
Year	2012	2014
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Migrated to Present Location	Damage to the Lateral walls
Response	House rebuilt with New Plinth	Walls rebuilt using cement sheets
Cost	Rs. 30,000	NA
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

		S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Timber beam	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Salvaged	-	Self-Built
	Al-Zn Corrugated Sheets	■■■■■	■■■□	■□□	Frequent	Salvaged	-	Self-Built
	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built
WALL	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	Rs. 200/ Sheet	Self-Built
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built
	Al-Zn Corrugated Sheets	■■■■■	■■■□	■□□	Frequent	Second-Hand	Rs. 300/ Sheet	Self-Built
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 13/ Piece	Skilled Labour
STRUCTURE	Timber section	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Timber Column	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 460/ Bag	Skilled Labour
	Ceramic Tiles	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 80/Tile	Self-Built

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

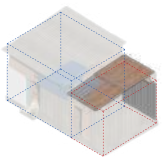
■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

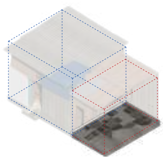
Durability

■□□ Low
■■□ Medium
■■■ High

Supply side perspective: S

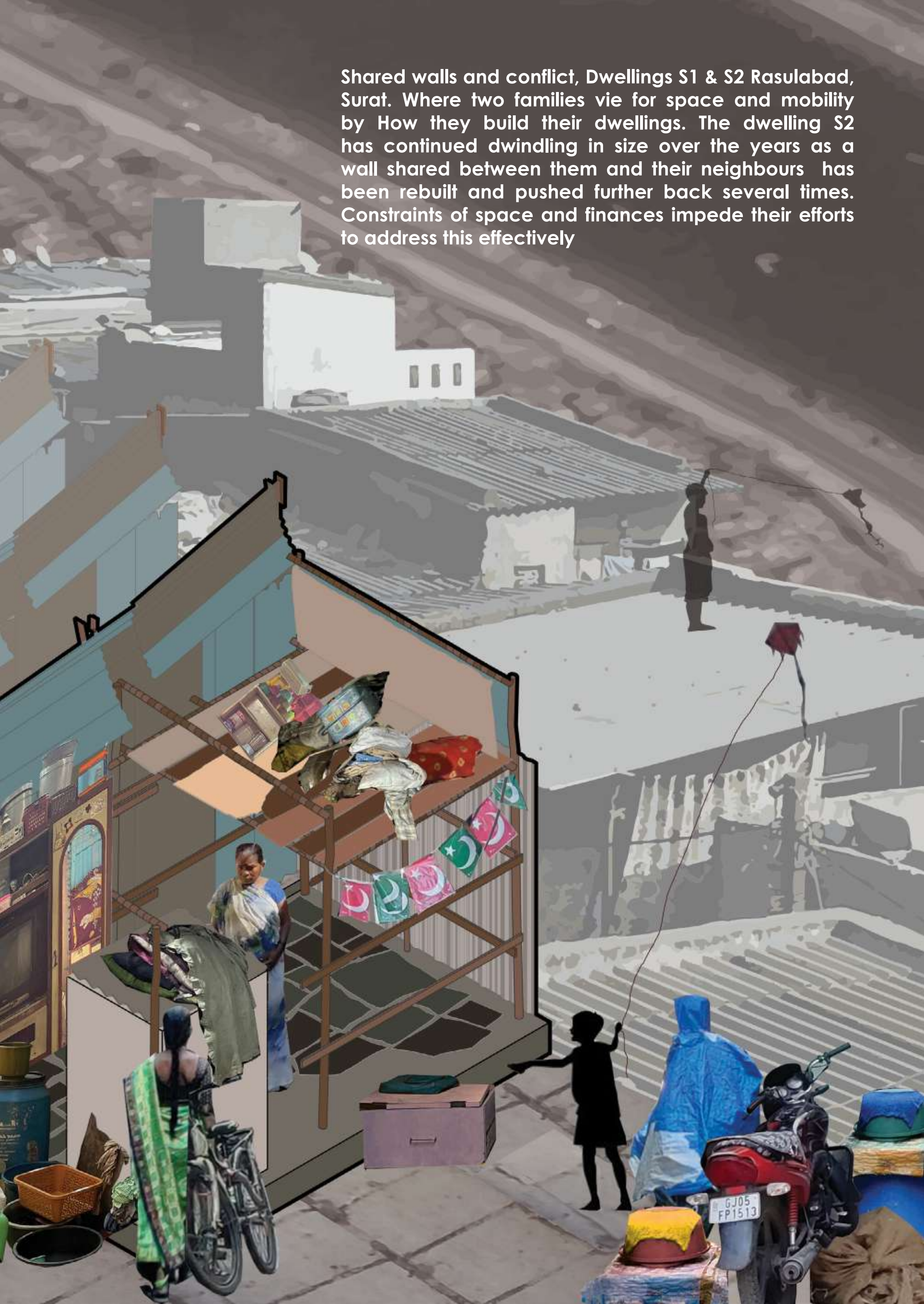
Users perspective: U





2012-2014	**2018-2020**	**2023**
Self-Owned	Self-Owned	Self-Owned
Self-Built	Self-Built	Self-Built
Damage suffered over time	Washing area+Weakened Flooring	
Rear wall and Roof rebuilt+ Toilet constructed inside the house	Tiles installed on the flooring, the toilet re-purposed into a common washing area	Present status of the dwelling
Rs. 40,000	Rs. 3800	
Self-Financed	Self-Financed	

Shared walls and conflict, Dwellings S1 & S2 Rasulabad, Surat. Where two families vie for space and mobility by How they build their dwellings. The dwelling S2 has continued dwindling in size over the years as a wall shared between them and their neighbours has been rebuilt and pushed further back several times. Constraints of space and finances impede their efforts to address this effectively



S3 Rasulabad

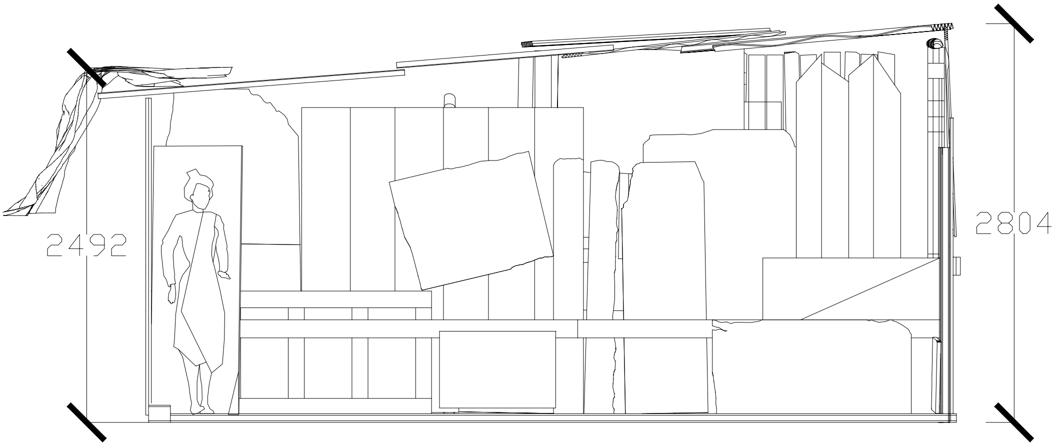
Name: Hirabai
Age: 50
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Attached
Area: 11 sq. mts
Family Size: 3
Family Income: Rs 7000
Family Occupation: Domestic Worker, unemployed (2)
House Investment - building, maintenance and upgrades: Rs. 50000

Our house is one of the oldest among those in Rasulabad. Constructed in 1982, it has experienced only minor modifications over the 40 years, only where we were able to afford the same. It's crucial to acknowledge that specific events during this period have greatly influenced our lives and shaped our housing needs. Particularly impactful was the passing of my son. Consequently, any alterations to the dwelling have been the result of actions taken by neighbouring households or minimal responses to urgent needs.

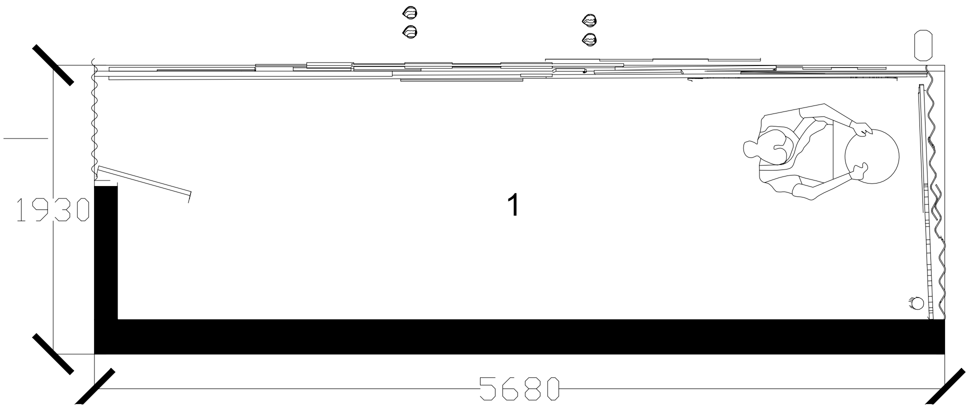
When initially built in 1982, our house had a mud floor, walls crafted from scrap wood, and a roof composed of salvaged cement sheets. The first modifications occurred in 2007, following our son's marriage, when a partition wall divided the house into two. After his unfortunate death later that same year, we installed tiles collected over several years on the floor. In 2012, we replaced the deteriorating door. More recently, our neighbours replaced the lateral walls, originally constructed with scrap materials, with sturdy walls in exchange for payment. This, however, reduced the size of our dwelling.

The cement sheets on the roof have never undergone a complete replacement; they are replaced as needed when they fall off during the rains or due to wind. The walls enclosing the back are frequently torn down by dogs and goats, requiring replacement as and when required. Our family deals with issues such as the roof dismantling during windy days and rainwater seeping into the house. Lack of significant income sources hinders any substantial investments in our dwelling. To cope, we utilize tarpaulin and plastic sheets during rains, although their effectiveness is limited.

Documentation



Section

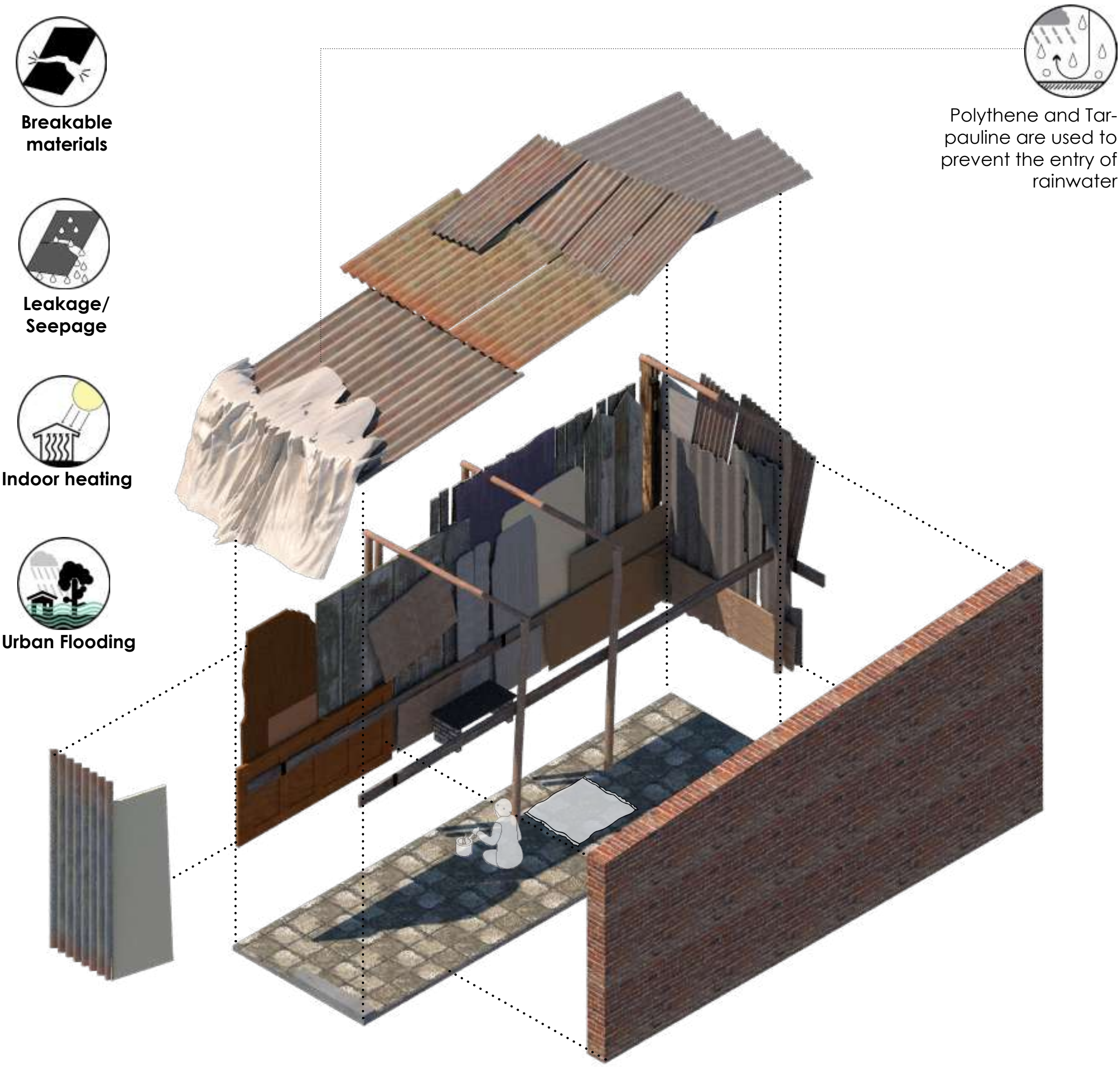


Plan

1. Multipurpose room

Issues & Challenges

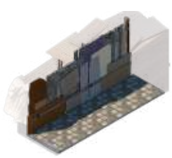
Coping Mechanisms



Polythene and Tarpauline are used to prevent the entry of rainwater

Timeline

Increments over time



Year	1982	2007
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Migrated to Rasulabad	Need for Privacy+Damage to plinth
Response	Dwelling constructed	Parition walls Built using scrapwood, Tiles installed on the floor
Cost	Rs. 500	NA
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Salvaged	-	Self-Built
	Timber beam	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Tarpauline	■■□□□	■■□□	■■□	Frequent	Salvaged	-	Self-Built
WALL	Brick	■■□□□	■■■■	■■■	-	-	-	-
	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Salvaged	-	Self-Built
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built
STRUCTURE	Timber section	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Timber Column	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
FLOOR	Terazzo Tiles	■■□□□	■■■■	■■■	-	Salvaged	-	Self-Built
	Kota Stone	■■□□□	■■■■	■■■	-	Salvaged	-	Self-Built

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

Durability

■□□ Low
■■□ Medium
■■■ High

Supply side perspective: S

Users perspective: U

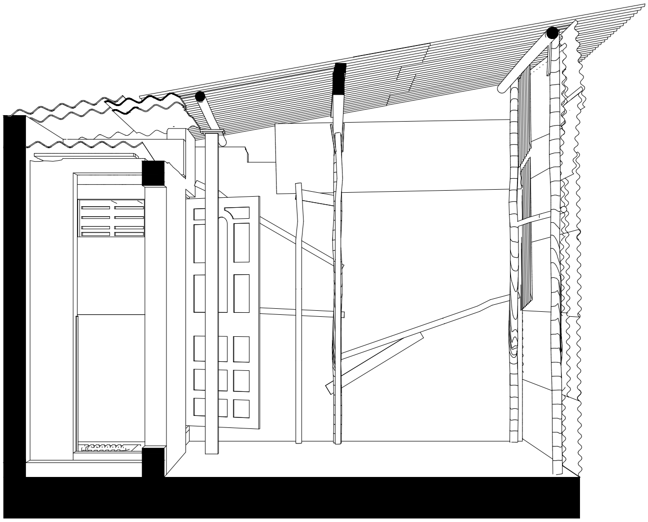
2012	**2019**	**2023**
Self-Owned	Self-Owned	Self-Owned
Self-Built	-	Self-Built
Damage to the doors and Plinth	-	
Doors replaced using second-Hand Plywood panels, Flooring tiles replaced	Brick and mortar wall built by the adjacent household, thereby narrowing the dwelling	Present status of the dwelling
NA	NA	
Self-Financed	-	

S4 Rasulabad

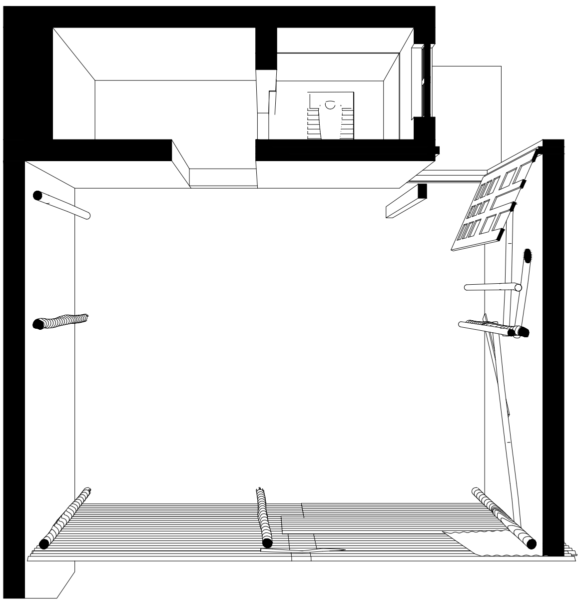
Name: Ravi
Age: 37
Housing Tenure: Temporary (Kutcha)
Structure Type: Attached
Area: 16 sq. mts
Family Size: 5
Family Income: Rs.22000
Family Occupation: Domestic Worker, Painter
House Investment - building, maintenance and upgrades: Rs.

I currently reside in Rasulabad with my family of five. We inhabit a house that was acquired in 2008. My occupation as a painter serves as one of the two sources of income in our family, the other being my wife, who works as a domestic worker. Over the years, our dwelling has undergone three stages of improvement. Initially, our house had walls and a roof made of corrugated tin sheets. However, in 2011, recognizing the impact of monsoons on the sheets, we raised the height of the roof and replaced the deteriorated sheets. Between 2015 and 2017, significant changes were made to address the challenges posed by the rains. The walls were reconstructed using cement sheets and wood, while the roof was rebuilt using a combination of metal sheets, plastic, and tarpaulin. In 2019, the focus shifted to the interior of the house, leading to the reconstruction of the bathroom. Our future aspirations include building sturdy walls and installing girder channels on the roof to enhance the overall structure. However, our family faces several challenges, primarily related to flooding and water seepage during the rainy season. This poses risks of insects and snakes entering our house through gaps in the walls. Security concerns have led us to avoid keeping any openings in the house. To cope with these challenges, we employ plastic sheets and tarpaulin on the roof. Additionally, we have installed a ladder inside the house to facilitate the fixing of plastic sheets and scrap material in the openings present in the roof.

Documentation



Section



Plan

1. Washroom
2. Kitchen
3. Bedroom

Issues & Challenges

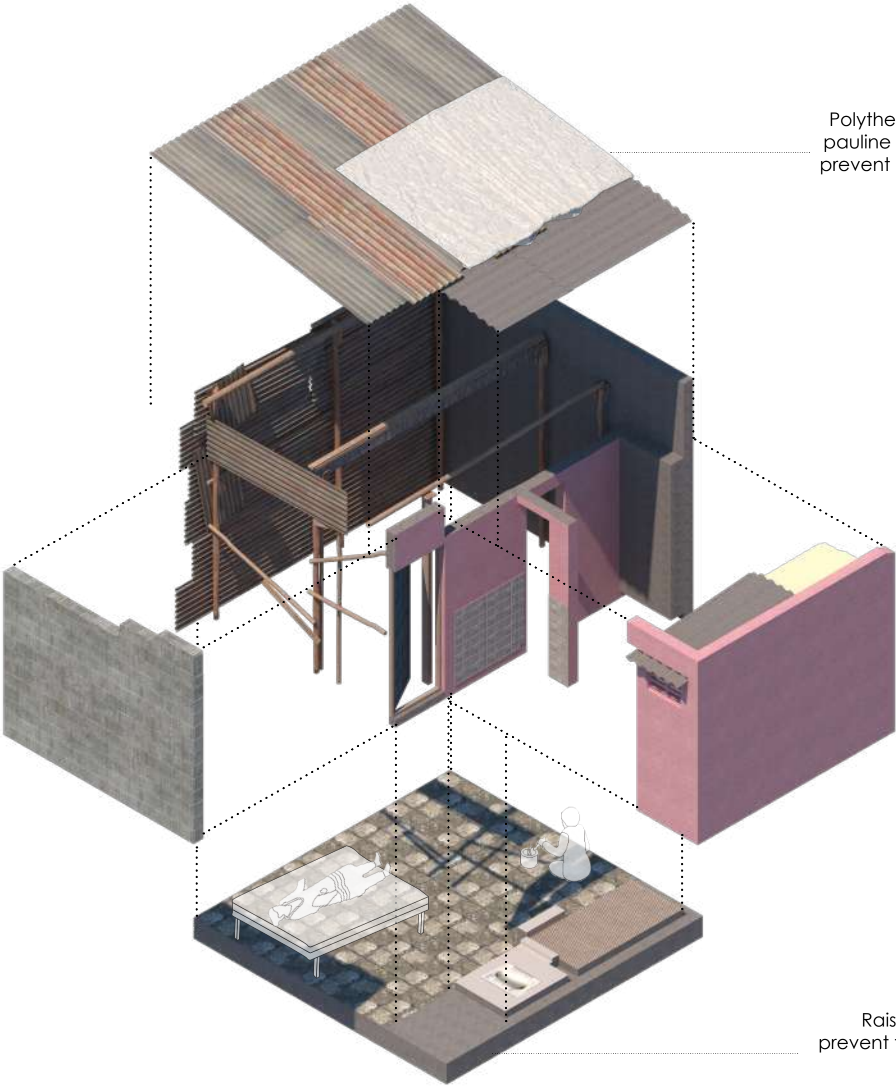
Leakage/ Seepage

Indoor heating

Urban Flooding

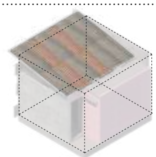
Coping Mechanisms

Polythene and Tarpauline are used to prevent the entry of rainwater



Raised Plinth to prevent the entry of rainwater

Timeline

Increments over time		
Year	**2008**	**2011**
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Family migrated to Rasulabad	Damage suffered by the roof
Response	Dwelling purchased	Roof reconstructed using cement sheets+Height of the dwelling increased
Cost	Rs. 13,500	Rs. 15,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Second-Hand	Rs. 300/ Sheet	Skilled Labour
	Timber beam	■■□□□	■■■□	■■□	Infrequent	Second-Hand	Rs.400/ Piece	Skilled Labour
	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	Rs. 200/ Sheet	Skilled Labour
	Plywood	■■□□□	■■□□	■□□	Frequent	Second-Hand	-	Skilled Labour
WALL	Brick	■■□□□	■■■■	■■■	-	New	Rs. 13/ Piece	Skilled Labour
	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Second-Hand	Rs. 300/ Sheet	Skilled Labour
	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	Rs. 200/ Sheet	Skilled Labour
	AAC blocks	■■□□□	■■■■	■■■	-	New	Rs. 43/ Piece	Skilled Labour
STRUCTURE	Brick	■■□□□	■■■■	■■■	-	New	Rs. 13/ Piece	Skilled Labour
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Second-Hand		Skilled Labour
	Timber section	■■□□□	■■■□	■■□	Infrequent	Second-Hand	Rs.400/ Piece	Skilled Labour
	Timber Column	■■□□□	■■■□	■■□	Infrequent	Second-Hand		Skilled Labour
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 460/ Bag	Skilled Labour
	Vitrified Tiles	■■□□□	■■■■	■■■	-	New	Rs. 80/Tile	Skilled Labour
	Terazzo Tiles	■■□□□	■■■■	■■■	-	New		Skilled Labour

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

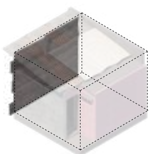
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

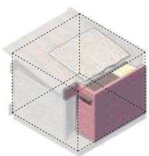
Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U





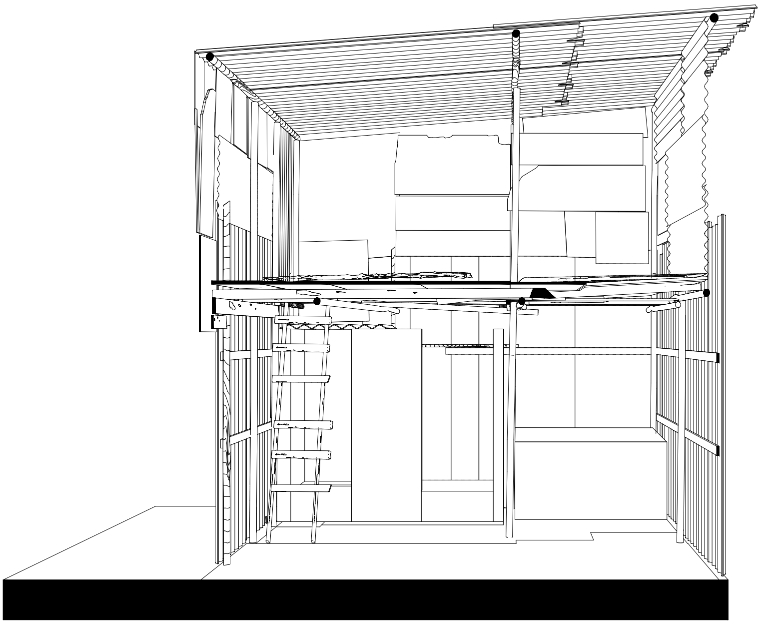
2015-2017	**2015-2017**	**2023**
Self-Owned	Self-Owned	Self-Owned
Self-Built	Self-Built	Self-Built
Damage suffered by the walls & Roof	Toilet Inside the dwelling	
Roofing and wall sheets re-placed+Plastic sheets layered as additional protection	Toilet built inside the dwelling using re-used and re-purposed materials	Present status of the dwelling
Rs. 6000	Rs. 6000	
Self-Financed	Borrowed Funds	

S5 Rasulabad

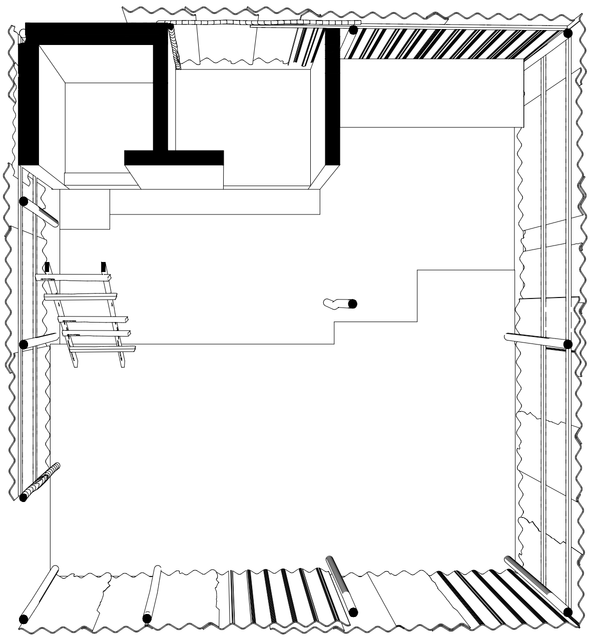
Name: Sattar
Age: 55
Housing Tenure: Temporary (Kutcha)
Structure Type: Semi Detached
Area: 63 sq. mts
Family Size: 6
Family Income: Rs.10000
Family Occupation: Mason, Domestic Worker
House Investment - building, maintenance and upgrades: Rs. 325842

I live in Rasulabad and work as a mason. My family and I have been living in our house for the past seven years. The house is relatively new, having undergone a significant expansion. Originally constructed in 2015, it had a kota stone floor that was already in place. Over time, we used collected cement sheets to construct the walls and roof. Between 2017 and 2018, we lowered the floor height to add another story to the house. The decision was driven by the growing size of our family and the need for additional storage space. In terms of challenges, rainfall is a concern, the design of the house, with its cement sheets and structure, leaves openings through which rainwater can enter. To address these issues, tarpaulin and plastic sheets have been installed on the roof and over the openings to prevent rainwater from entering our house.

Documentation



Section



Plan

1. WC
2. Bath
3. Kitchen
4. Bedroom

Issues & Challenges

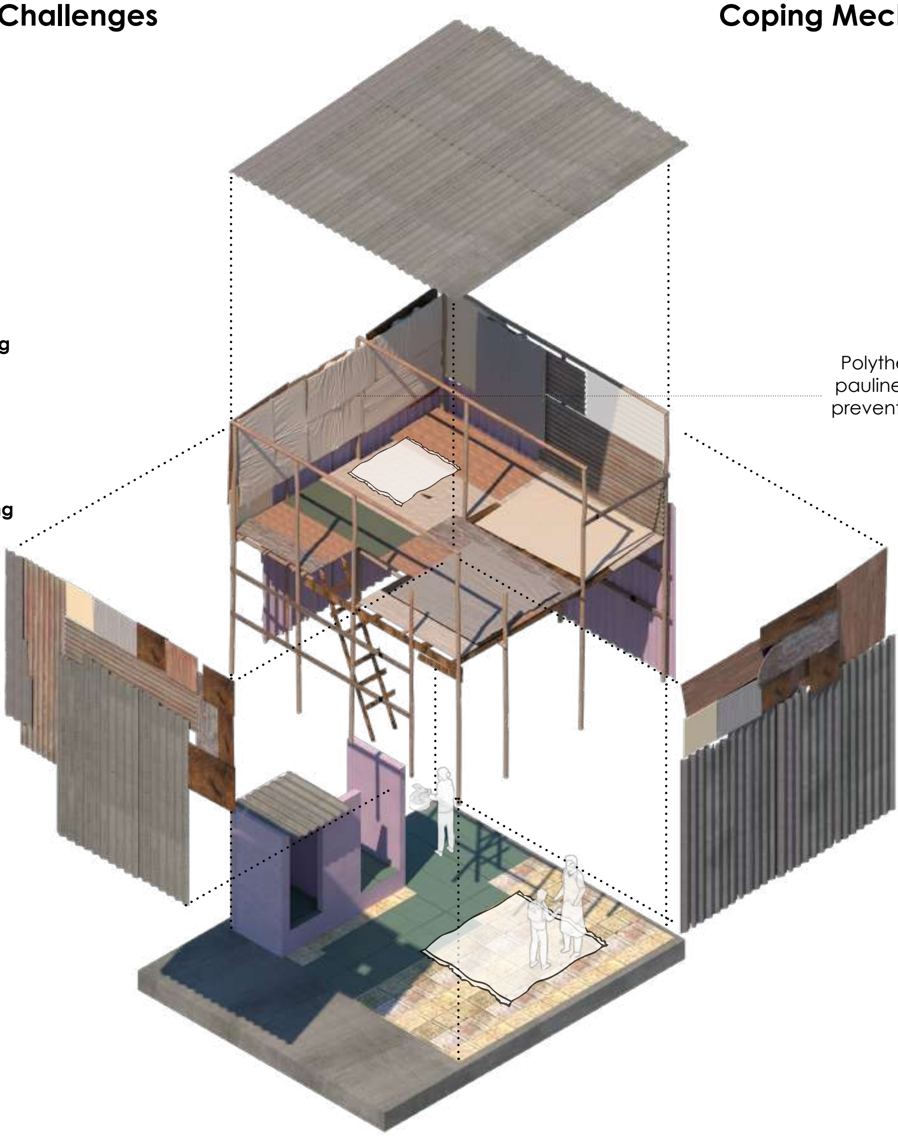
Leakage/ Seepage

Indoor heating

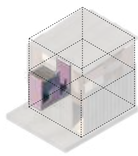
Urban Flooding

Coping Mechanisms

Polythene and Tarpauline are used to prevent the entry of rainwater



Timeline

Increments over time		
Year	**2015**	**2015**
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Family migrated to Rasulabad	Need for personal toilet
Response	Dwelling constructed	Toilet constructed inside the dwelling
Cost	Rs. 90,000	NA
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	Material	Thermal Conductivity (S)	Shelf-life (S)	Durability (U)	Maintainence (U)	Procurement (U)	Cost (S)	Execution (U)
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	Rs. 200/ Sheet	Self-Built
	Tarpauline	■■□□□	■■□□	■■□	Frequent	New	-	Self-Built
WALL	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	Rs. 200/ Sheet	Self-Built
	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built
	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Salvaged	-	Self-Built
	Laminated Ply	■■□□□	■■■□	■■□	Infrequent	Second-Hand	-	Self-Built
	Cardboard	■□□□□	■□□□	■□□	Frequent	Salvaged	-	Self-Built
STRUCTURE	FRP Roofing Sheet	■■□□□	■■■□	■■□	Infrequent	Second-Hand	Rs. 150/ Sheet	Self-Built
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 13/ Piece	Self-Built
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Timber section	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Timber Column	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 460/ Bag	Self-Built
	Terazzo Tiles	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 80/Tile	Self-Built
	Kota Stone	■■□□□	■■■■	■■■	-	Second Hand	Cost	Self-Built
	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

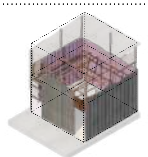
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

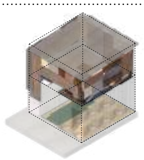
Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U





2015	2017	2023
Self-Owned	Self-Owned	Self-Owned
Self-Built	Self-Built	Self-Built
Damage suffered by the Walls	Need for Additional storage and living space	
Walls re-constructed using new cement sheets	Height of the dwelling in-creased,additional floor constructed	Present status of the dwelling
NA	Rs. 80,000	
Self-Financed	Self-Financed	

S6 Rasulabad

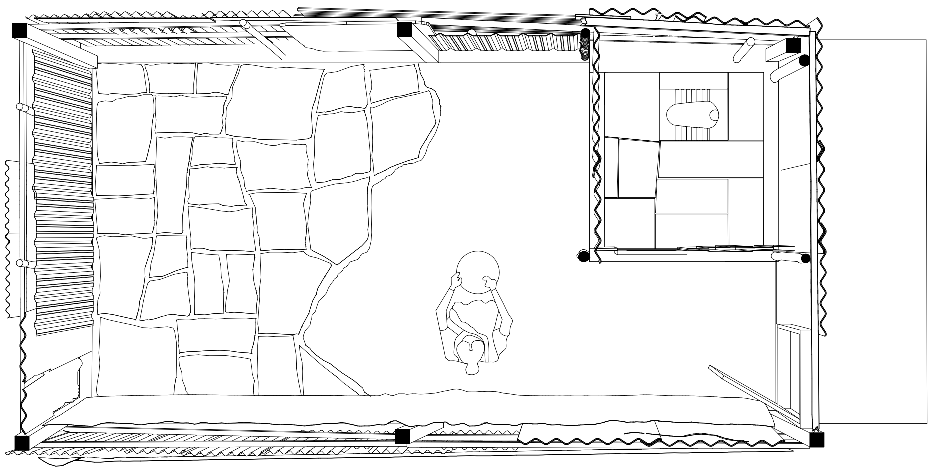
Name: Salaam
Age: 34
Housing Tenure: Temporary (Kutcha)
Structure Type: Attached
Area: 17 sq. mts
Family Size: 4
Family Income: Rs.12000
Family Occupation: Spices seller
House Investment - building, maintenance and upgrades: Rs. 24061

I live here in Rasulabad and have originally come from Dhulia, Maharashtra in 2010. At first, we rented a house, but later, we bought this one. We feel like we've settled down here, but there is an issue with our property tax and electricity bills; they come in our relative's name. Over the years, we've made some small changes to our house, mainly in response to the weather and sanitation needs. We raised the wall height and replaced the cement sheets initially. Our house is a bit of a mix when it comes to materials. The walls are made of plywood sheets, scrap wood, GI sheets, and cement sheets. The roof is mostly corrugated cement sheets, which we put up in 2014. Our flooring is a bit uneven; one part has Kota stone tiles we collected over time with some basic grouting, while the other part is made of compacted mud and cement. There are no windows because three of our walls are shared with neighbours, and the front doesn't have the right material for windows. Our house stands on concrete pillars with wooden logs as beams. Our house serves as both our home and where my husband stores the spices for our work.

During the monsoon season, the house gets flooded up to knee level, and we must put our furniture on bricks or cement blocks to keep it dry. In the summer, it gets hot, but we can't keep the front door open due to safety concerns. Since we can't have windows, it's even hotter inside. We also use fans, which probably make our electricity bills higher. Safety is a big concern for us, which is why we rebuilt the back wall with GI sheets. They're stronger than the salvaged materials we had before. We aspire to build brick and cement walls for added safety and stability.

Documentation

Section



Plan

1. Verandah
2. Temple
3. Kitchen
4. Bedroom

Issues & Challenges

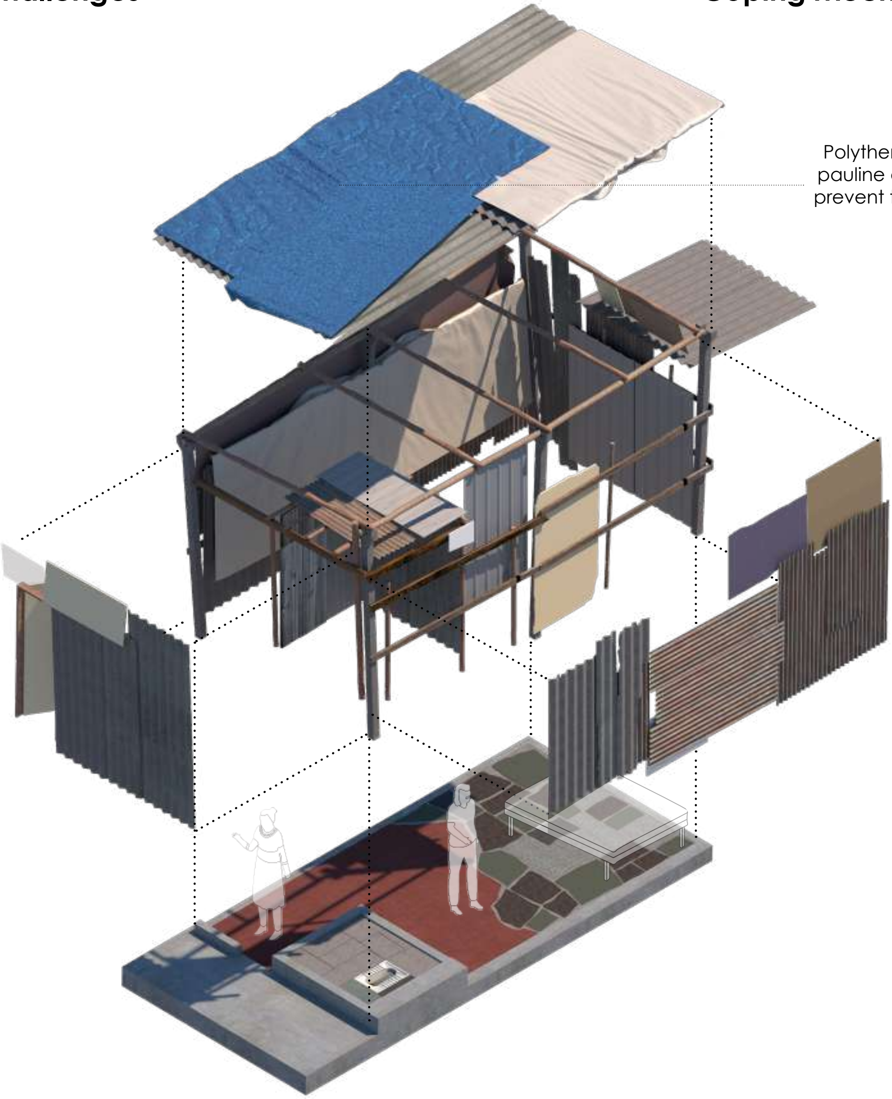
Leakage/ Seepage

Indoor heating

Urban Flooding

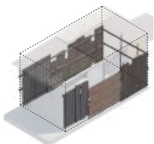
Coping Mechanisms

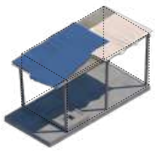
Polythene and Tarpauline are used to prevent the entry of rainwater



Timeline

Increments over time





Year	2010	2014
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Family migrated to Rasulabad	Damage suffered by the Roof
Response	Sheets comprising the dwelling walls and structure replaced	Roof and wall sheets replaced, Plinth re-contrsucted to cope with Floods
Cost	NA	Rs. 13,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	S Material	S Thermal Conductivity	S Shelf-life	U Durability	U Maintainence	U Procurement	S Cost	U Execution
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	New	Rs. 200/ Sheet	Skilled Labour
	Tarpaulin	■■□□□	■■□□	■■□	Frequent	Salvaged	-	Skilled Labour
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Skilled Labour
WALL	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	Rs. 200/ Sheet	Skilled Labour
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Second-Hand	Rs. 750/ Plank	Skilled Labour
	Plywood	■■□□□	■■□□	■□□	Frequent	Second-Hand	-	Skilled Labour
	Plastic Fibreboard	■■□□□	■■■□	■□□	Frequent	Second-Hand	Rs. 150/ Board	Skilled Labour
	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Salvaged	-	Skilled Labour
	Al-Zn Corrugated Sheets	■■■■■	■■■□	■□□	Frequent	Salvaged	-	Skilled Labour
	Cardboard	■□□□□	■□□□	■□□	Frequent	Salvaged	-	Skilled Labour
STRUCTURE	MS Section	■■□□□	■■■■	■■■	-	New	Rs. 760-1500/ section	Skilled Labour
	Timber	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Skilled Labour
	Bamboo	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Skilled Labour
	Cement Column	■■□□□	■■■■	■■■	-	Salvaged	-	Skilled Labour
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 460/ Bag	Skilled Labour
	Kota Stone	■■□□□	■■■■	■■■	-	Salvaged	-	Skilled Labour
	Marble	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 450/ Tile	Skilled Labour
	Red oxide	■■□□□	■■■■	■■□	Infrequent	Salvaged	-	Skilled Labour

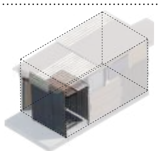
Thermal Conductivity:
- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

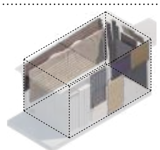
Shelf Life (Years):
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability
- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

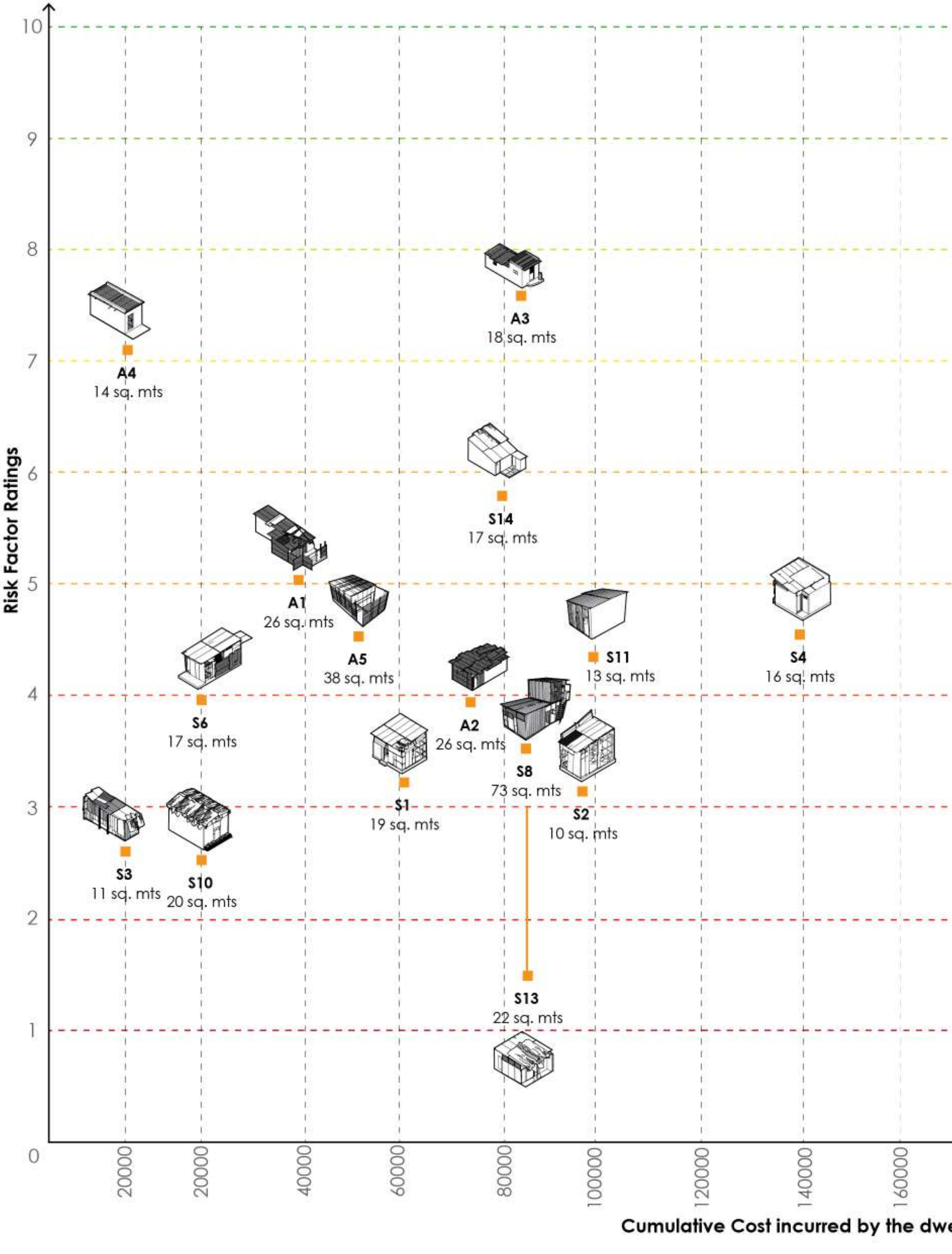




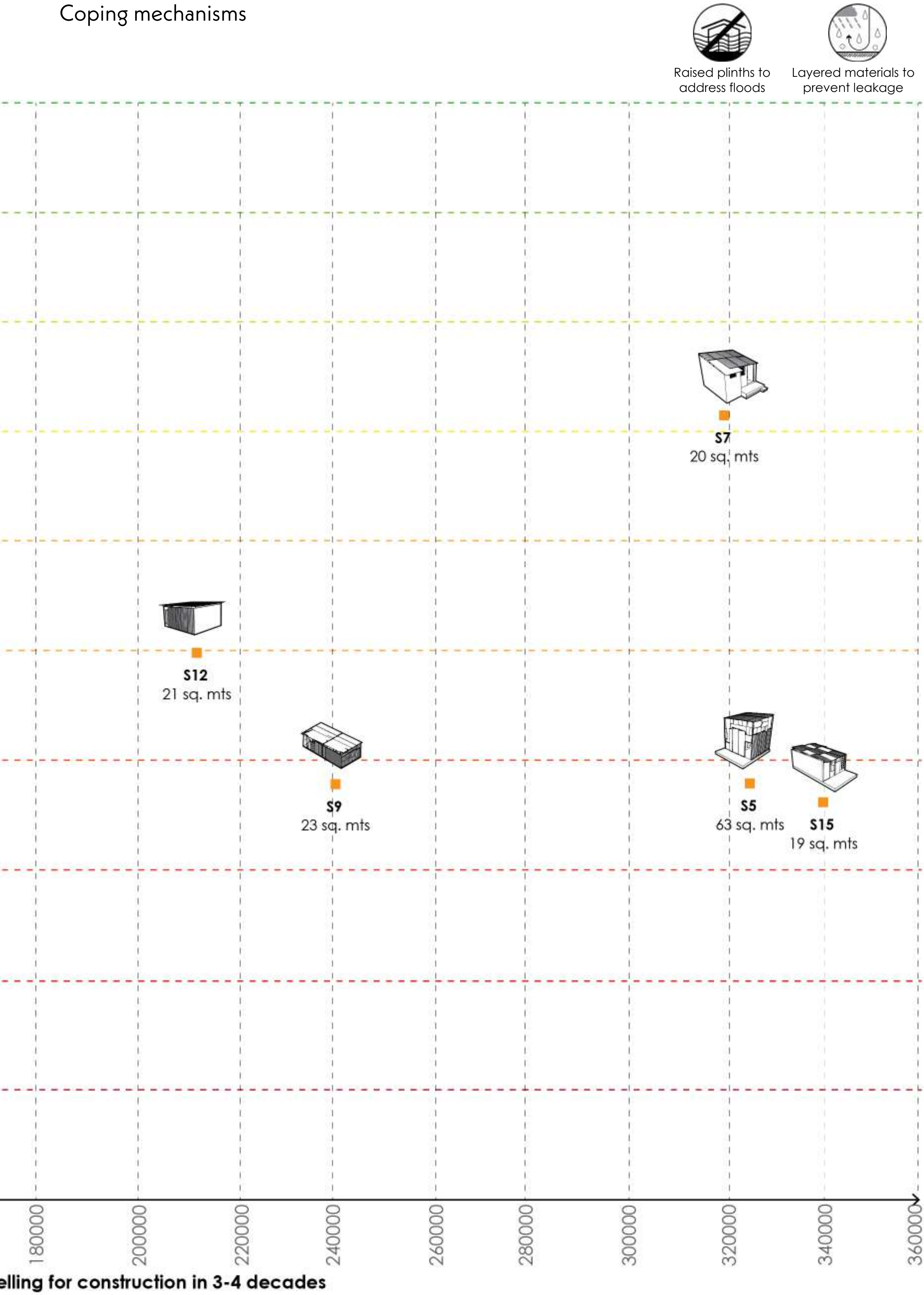
2016	2018	2023
Self-Owned	Self-Owned	Self-Owned
Self-Built	Self-Built	Self-Built
Damage to the Internal walls	Damage to the walls and Openings	
Washroom/Toilet rebuilt using new cement sheets	Cement sheets replaced on the walls+New doors installed	Present status of the dwell-ing
Rs. 2000	Rs. 90,000	
Self-Financed	Self-Financed	

Climate comfort and decadal costs incurred
Microclimate: Hot-dry

D.U area (Min): **10 sq. mts**
D.U area (Max): **72 sq. mts**



Coping mechanisms

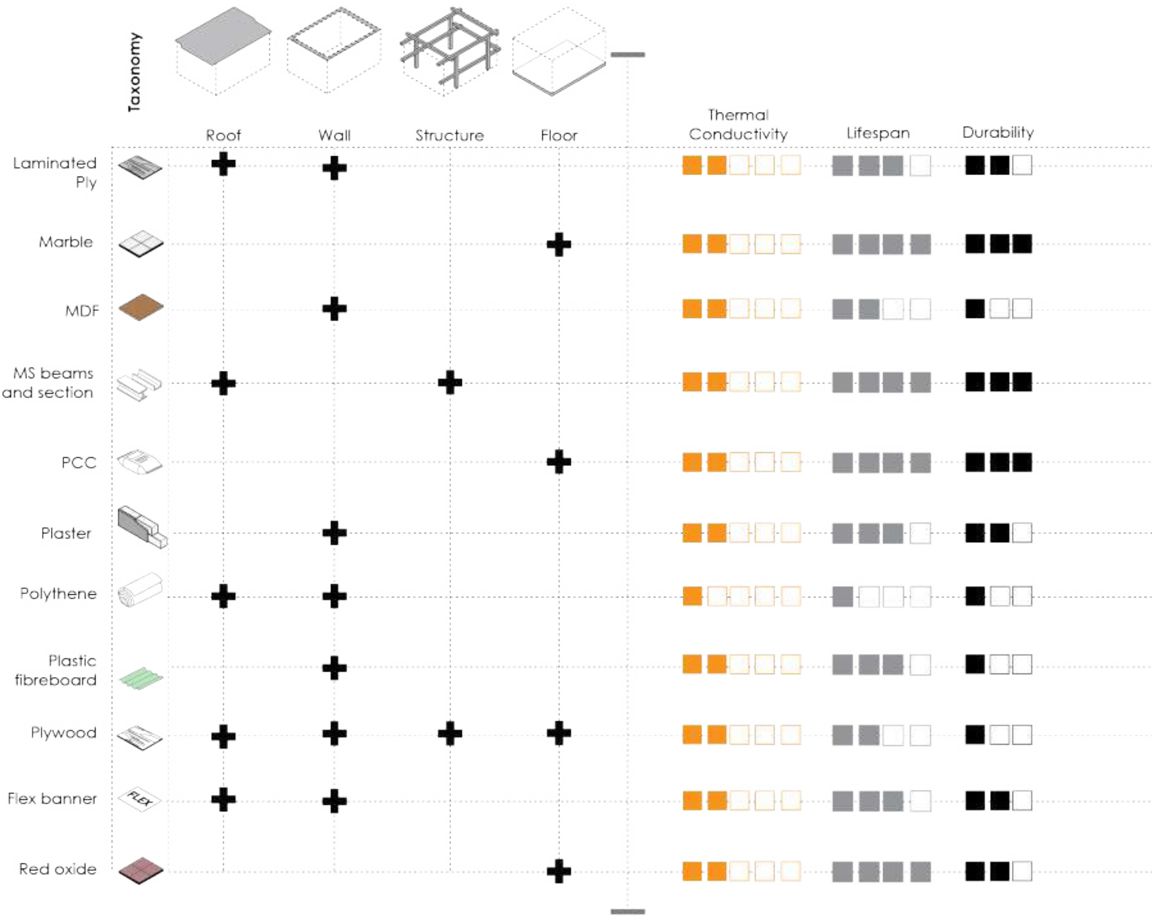


Dwelling materials in the Hot-dry Microclimate

Analysing compositions and impacts


intrinsic Factors
Extrinsic Factors
Weathering factors
Maintenance
Fire hazards
Electrocu-tion
Leekage Seepage
Pest Infestation +Rotting
Wear and Tear
Toxicity + chemical exposure
Rain
Wind
Heat
Material rating
-
Frequent
Frequent
-
Frequent
Infrequent
-
Frequent
-
Frequent
-
Infrequent
Infrequent
-
-
Infrequent
-
Infrequent
-
Infrequent
Frequent

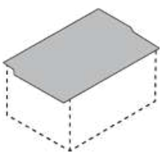
Dwelling materials in the Hot-dry Microclimate
Analysing compositions and impacts



At a glance

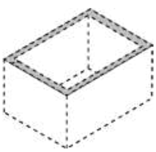
The table above lists all the materials that are being used to construct the 20 dwellings documented across Surat and Ahmednagar in the hot-dry microclimatic zone and are mapped according to the taxonomy in which their use is prevalent. The taxonomical classifications include the roof, wall, structure and floor/plinth of the dwelling. Materials are analysed through an inductive methodology comprising of their intrinsic characteristics and extrinsic hazards and rated for effectiveness as building materials based on empirical evidence and the perceptions of the users. The aggregate of these ratings, subject the mode of procurement and execution are used to rate the climatic/environmental vulnerability of dwellings.

Roof



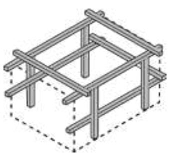
80%
Cement Corrugated sheets

Wall



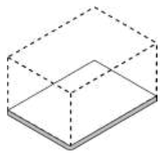
80%
Cement Corrugated sheets

Structure

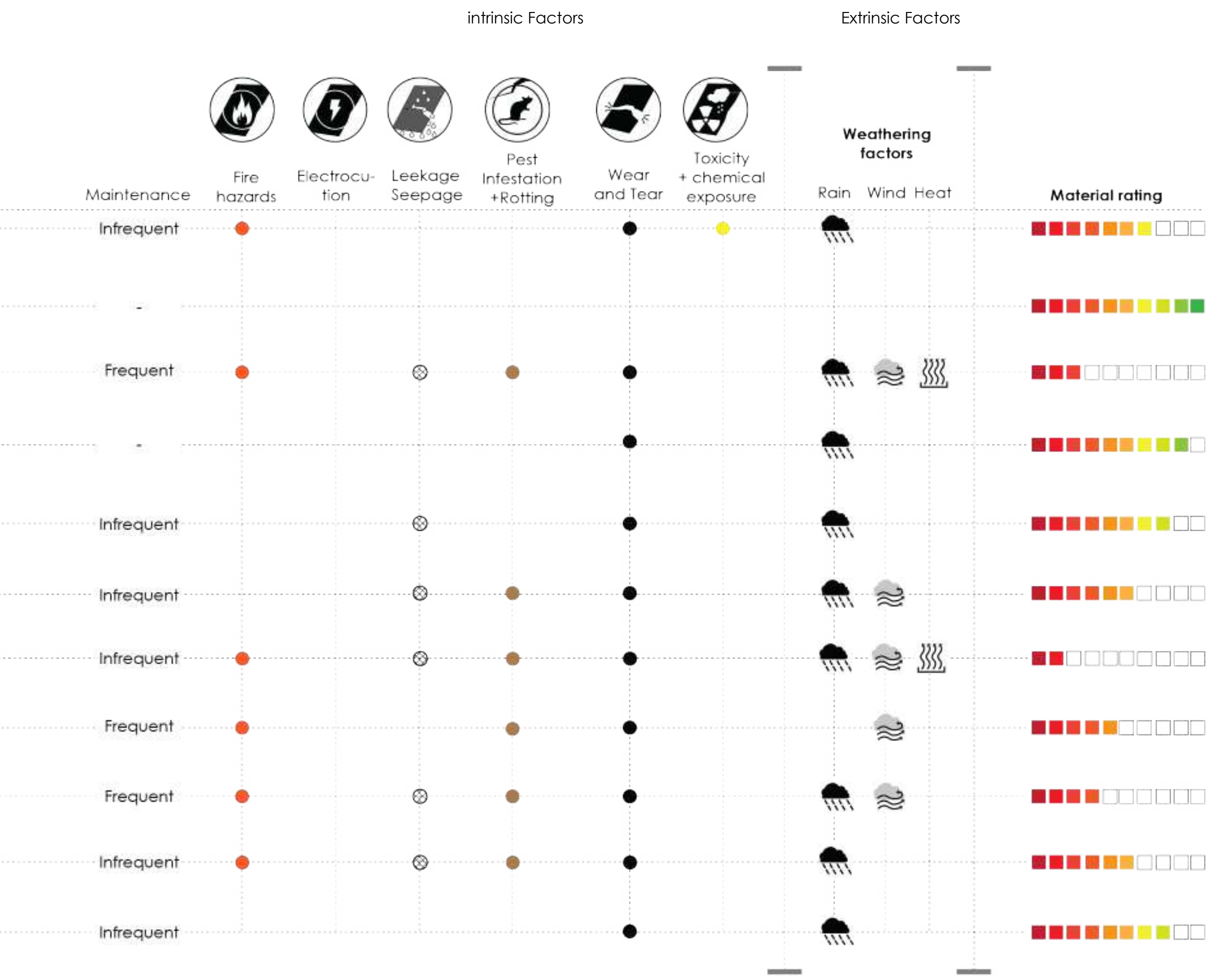


90%
Timber

Floor/Plinth



90%
Plain cement concrete

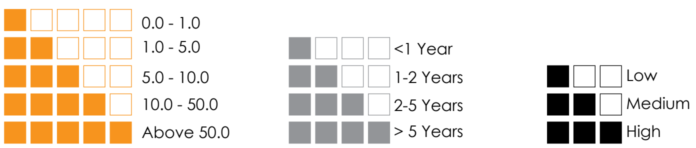


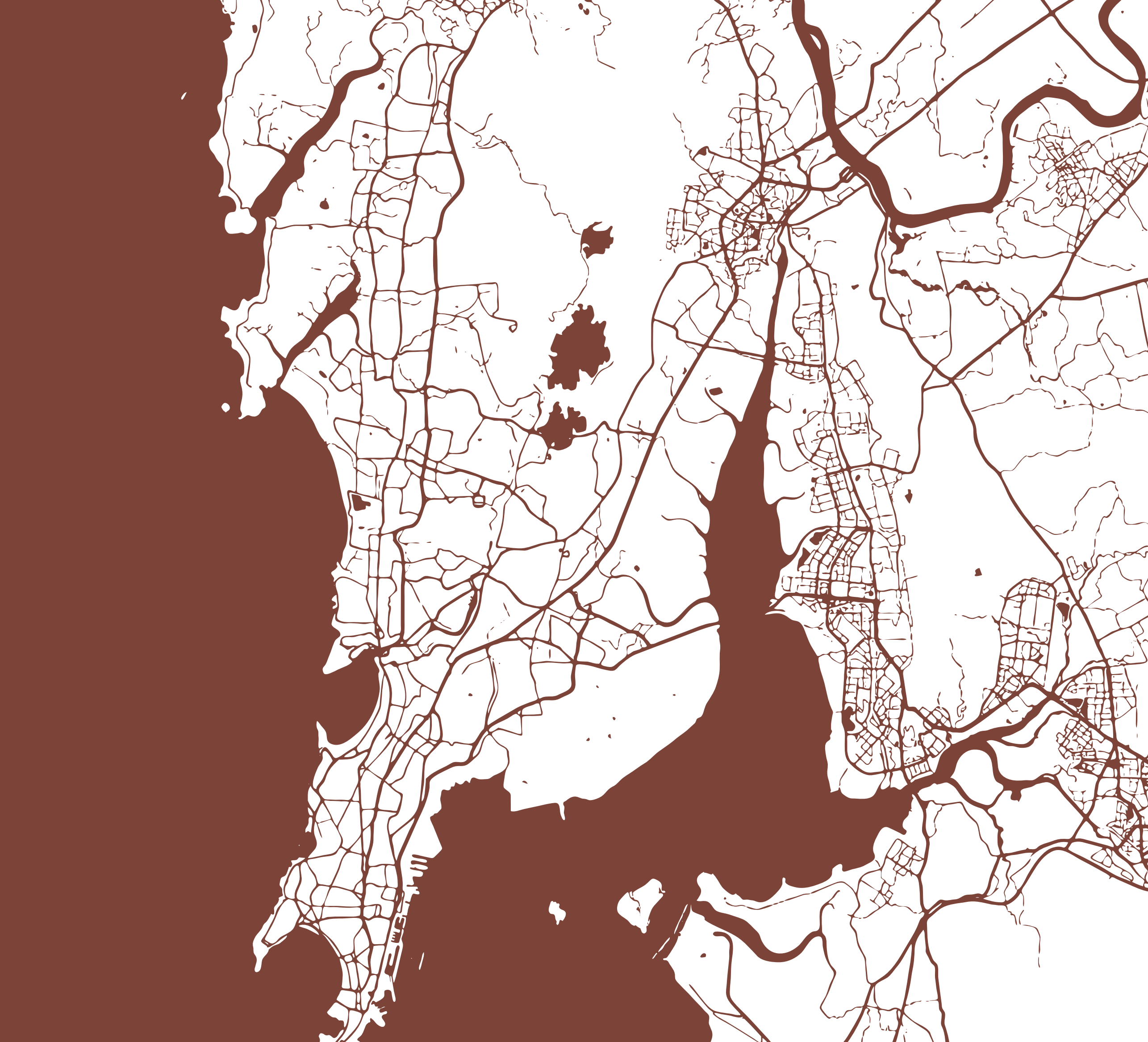
Contextual challenges: Hot-dry

Indoor heating

Urban Flooding

Legend





Warm-humid

Kaula Bandar

MUMBAI

1,24,79,608
Population

1,71,59,000
Projected Population

2.70%
Avg annual growth rate:

603.4 Sq. Km
Area Of Municipal Corporation

Latitude° N 19.0761 Longitude ° E 72.8775

Total Slum Population
52,06,473

Total Slum Population
42%

Slum Dwelling Units
11,35,514

Slum Pockets
2400

14m
elevation
above Sea Level

Max
32°C

18°C
Min

Avg Rainfall
2502.3 mm

Mumbai: Navigating the Microclimate Challenges of Kaula bandar

Mumbai, a bustling metropolis on the western coast of India, has faced numerous hazards over the years. Mumbai is prone to intense monsoon rains, leading to frequent flooding in low-lying areas. The city's inadequate drainage system and encroachment of natural water channels exacerbate this problem. Slums, often situated in vulnerable areas, bear the brunt of waterlogging, resulting in damaged homes, loss of possessions, and health issues. Mumbai city has 2400 slums. Situated along the coastal line, Mumbai is characterized by Warm Humid climate. Kaula Bandar, an informal settlement on the eastern waterfront of Mumbai, exacerbates challenges during monsoons, cyclones, and tsunamis. Originally established by Tamil immigrant populations six decades ago, this notified slum stands out due to its proximity to the wharf, contributing to its distinctive microclimate and the associated hardships. The prevalent construction materials in the settlement include plastics, cement boards, plywood panels, as well as brick and mortar.

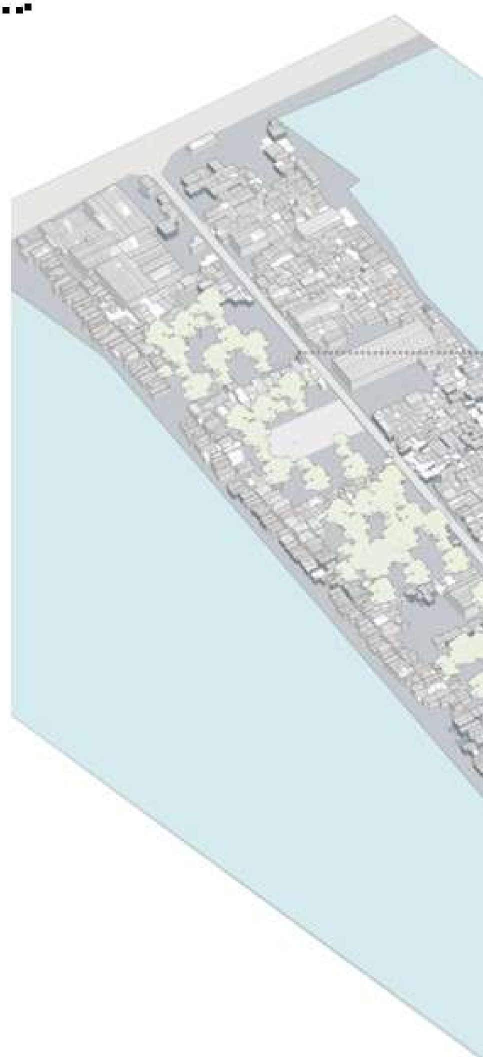
Mumbai's Micro Market

In Mumbai, like many other cities, the choice of building materials in different micro-markets can be influenced by a variety of factors, including economic conditions, local regulations, and the specific needs of the community. When it comes to slums in Mumbai, the choice of building materials is often influenced by the economic constraints of the residents. In many cases, people in slums may use low-cost and readily available materials for construction. These materials may include salvaged or recycled items, as well as more traditional materials like bamboo, corrugated metal, or plastic.

Materials are typically sourced from wholesale markets when residents embark on constructing a new house or undertaking a comprehensive upgrade. The preference for wholesale markets stems from the need for larger quantities of materials and the cost-effectiveness offered by such venues. Alternatively, residents procure materials from local vendors, both for new items and second-hand ones. Another method involves scavenging materials from nearby construction or demolition sites. In rare instances, employers may assist residents in construction by providing the necessary materials. The primary markets for material acquisition include Do Taaki and Lakda Bazaar, where used materials are obtained, and Cotton Greens, home to the wholesale market.

In addition to the actual purchase of supplies and building materials, residents often bear the costs associated with transportation, loading, and unloading. To economize, many people opt for hand-pulled carts, which prove to be a more affordable means of transport.

MUMBAI



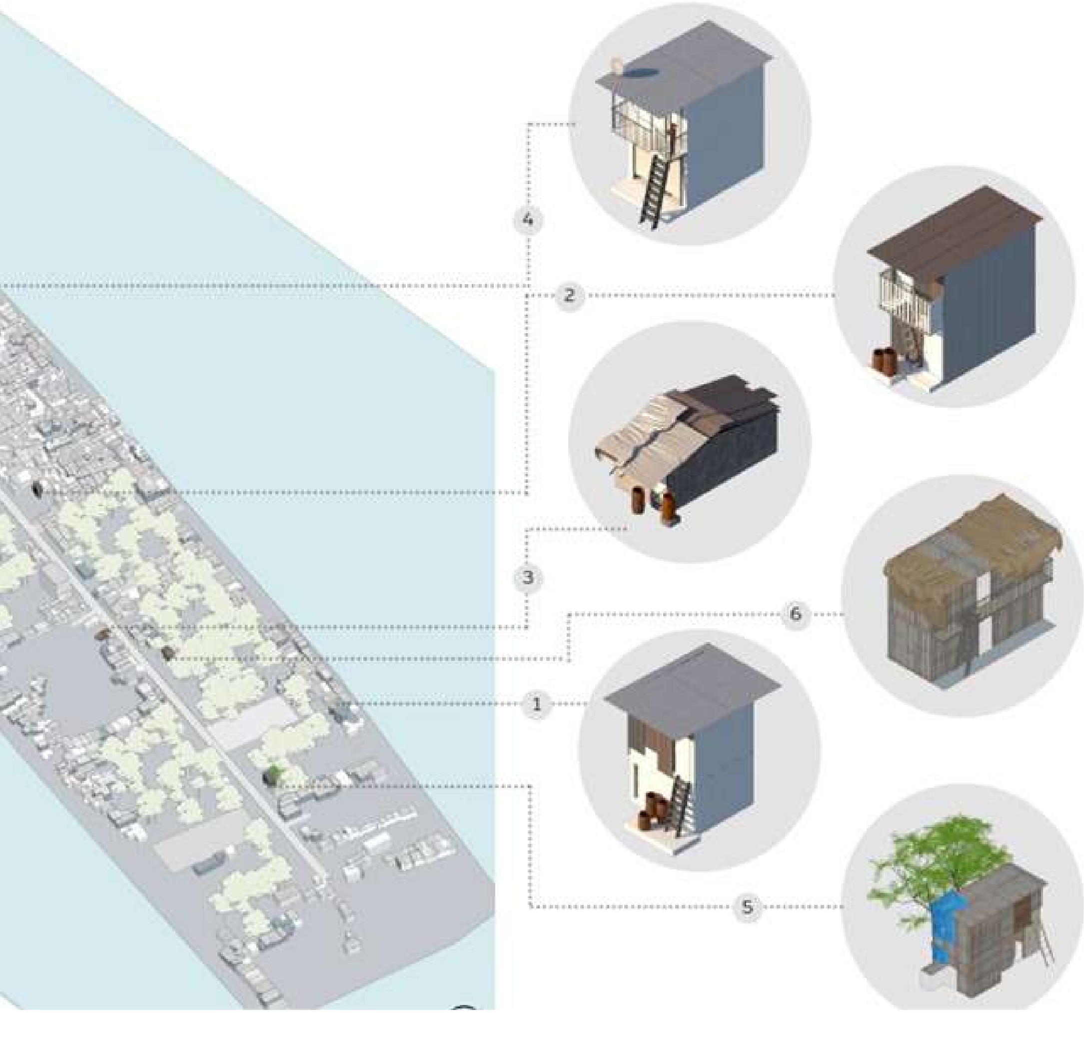
Kaula Bandar

18°58'40.79"N 72°51'8.99"E

Area of the Settlement
6.8 Ha (17 acres)

Location of Settlement
Near Estuary

Total No. of Dwelling Units
800 DU (approx.)


4
2
3
6
1
5






A Comprehensive profile of settlement in Mumbai

Kaula Bandar is located in Mumbai, situated on Bombay Port Trust land, where private companies have leased the area. The settlement spans 6.8 hectares (17 acres) and is positioned on an estuary. The housing composition consists of 30% temporary structures, 60% semi-permanent structures, and 10% permanent structures.

Residents face higher levels of heat stress inside their homes compared to the open air. The intrusion of high heat load is particularly notable in semi-pucca and kutcha houses, primarily through the roof, with variations based on roofing material and color. A majority of the surveyed houses across all locations consist of only one room, with windows smaller than 2x3 feet. Ventilation is generally poor, and cross ventilation is lacking in most homes. Informal livelihoods sustain the majority of surveyed households, with the average monthly family income for all respondents at the three sites being Rs 10,000. Formal ownership of houses is absent, as the land is leased to private companies by the Bombay Port Trust. The lack of savings poses affordability concerns for acquiring quality building materials. Many residents' resort to covering rooftops with additional layers of plastic, cardboard, or leaves to mitigate heat.

Residents often employ various coping mechanisms, such as sprinkling water on rooftops and courtyards, hanging wet curtains on windows, and painting rooftops white to reduce heat stress indoors. It was observed that, in extreme heat, dwellers prefer to step outside and seek shade under trees.

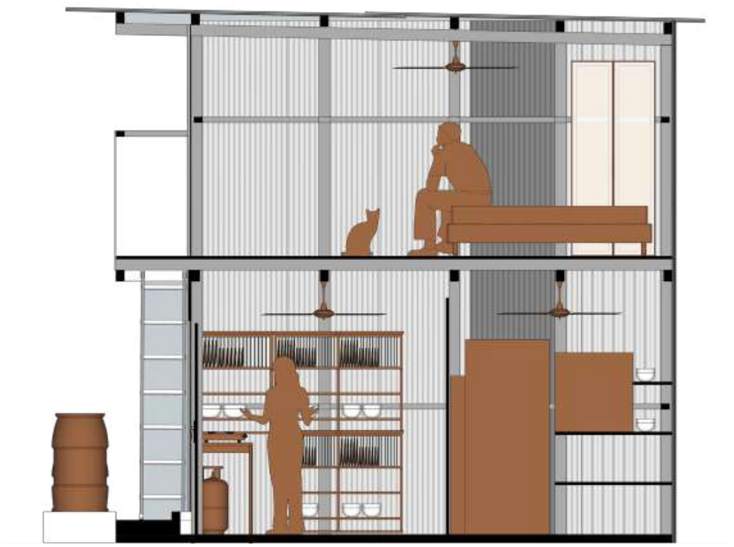
M1 Kaula Bandar

Name: Kodi Pavani
Age: 70
Housing Tenure: Temporary (Kutcha)
Structure Type: Attached
Area: 20 sq. mts
Family Size: 4

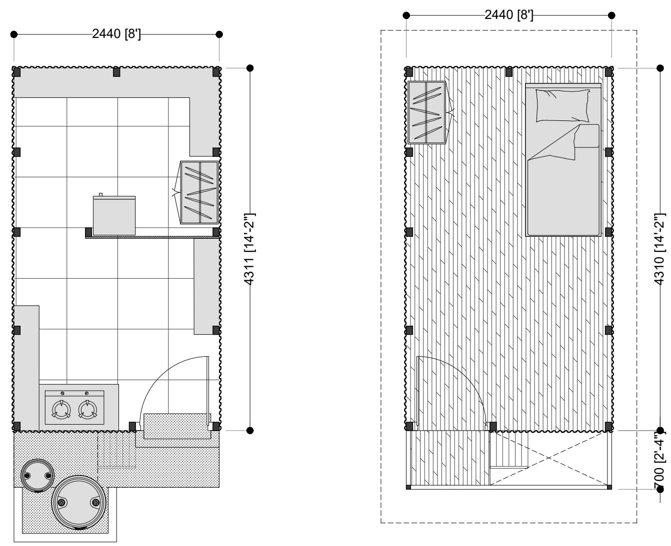
Family Occupation: service
House Investment - building, maintenance and upgrades: Rs. 60000

I have been a resident of Kaula bandar for the past 35 years. In the past, our house had red kaula (clay tiles), but currently, we opt for corrugated tin roofing sheets as the most convenient, and economical alternative. However, this choice leads to uncomfortable indoor temperatures, especially during the summer months. The corrugated tin roof has challenges during rainfall, as they can generate considerable noise indoors. To mitigate the risk of seepage through punctures caused by wear and tear, a temporary layer of tarpaulin is placed over the roof. Unfortunately, tarpaulin has limited durability and requires frequent replacement without regular maintenance. For structural support to the floor, wooden joists are used due to their easy installation, and typically lower cost. These joists also serve the dual purpose of supporting lighting fixtures. Our floor is made of plywood installed on top of the wooden joists to create usable floor space. The structure of our house comprises a concrete base, walls constructed with corrugated sheets and plywood boards supported by wooden studs, and a metal roof. However, the use of metal corrugated sheet walls poses a risk of collapse during heavy storms due to their low strength, and plywood boards are chosen for their affordability. The lower level of the house has vitrified tiles and a plywood board is employed to create a mezzanine floor on top of wooden joists.

Documentation



Section



Plan

1. Foyer
2.Living/Sleeping Space
3. Kitchen
4. Storage space
5. Water Storage
6. Balcony
7. Sleeping Space

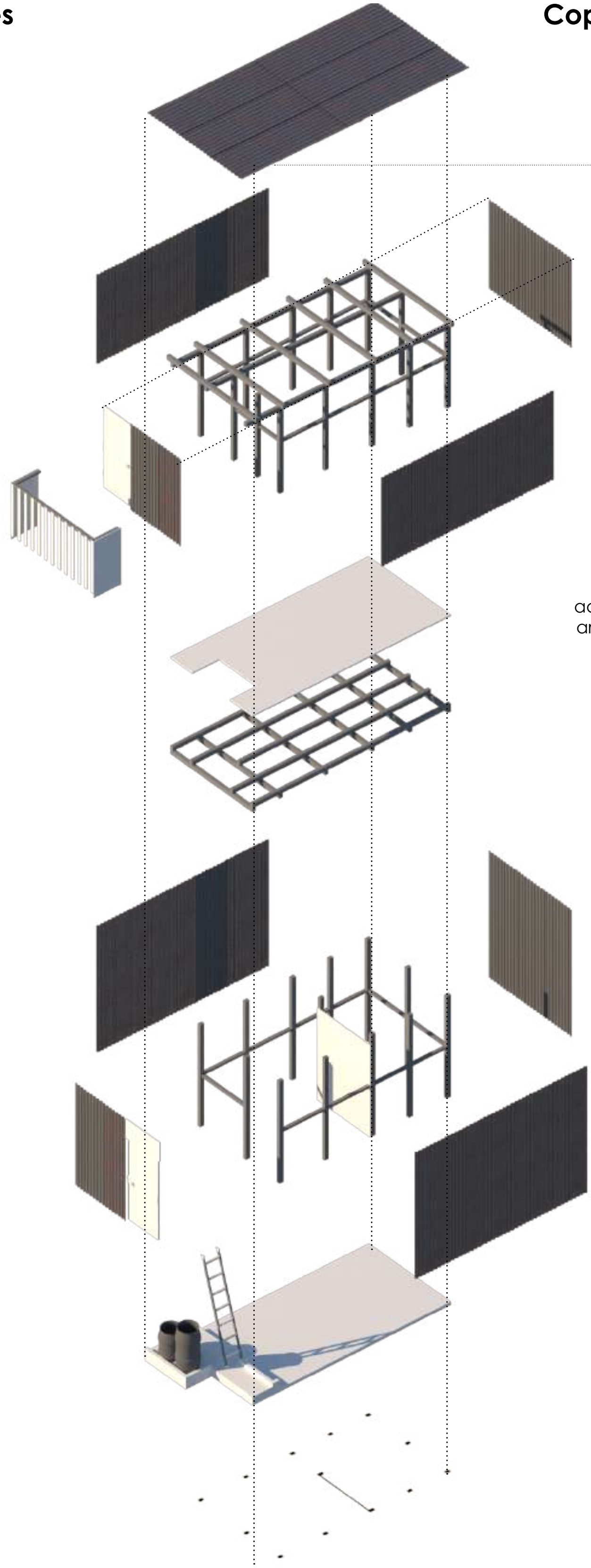
Issues & Challenges

Coping Mechanisms

Leakage/ Seepage

Indoor heating

Urban Flooding



Polythene and tarpaulin are used interchangeably to address leaky roofs and seepage

Damp pieces of cloth and additional layers of materials are used to reduce the heat stress inside the dwellings

Attributes of materials

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	New	Rs. 300/ Sheet	Skilled Labour
	Tarpauline	■■□□□	■■□□	■■□	Frequent	Second-Hand	-	Self-Built
WALL	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	New	Rs. 300/ Sheet	Skilled Labour
	Plywood	■■□□□	■■□□	■□□	Frequent	Second-Hand	Rs. 5-6/Kg	Self-Built
STRUCTURE	Timber Column	■■□□□	■■■□	■■□	Infrequent	Second-Hand	-	Self-Built
FLOOR	Vitrified Tiles	■■□□□	■■■■	■■■	-	Second-Hand	-	Skilled Labour
	Plywood	■■□□□	■■□□	■□□	Frequent	Second-Hand	-	Skilled Labour

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

Durability

■□□ Low
■■□ Medium
■■■ High

Supply side perspective: S

Users perspective: U

M2 Kaula Bandar

Name: Pushpa
Age: 65
Housing Tenure: Temporary (Kutcha)
Structure Type: Semi Detached
Area: 14 sq. mts
Family Size: 7
Family Occupation: Sweeper, Manual scavenger
House Investment - building, maintenance and upgrades: Rs. 10000

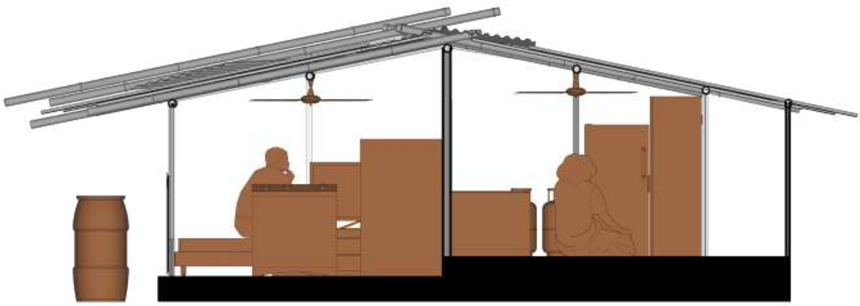
I've been a resident of Kaula bandar since 1982. Initially, I lived in the inner part but after my wedding, we moved to the road-front. However, both then and now, our house has been constructed primarily with Tadpatri (Tarpaulin sheets). Now we have corrugated tin roofing, as it is the easiest, quickest, and cheapest alternative, leads to uncomfortable indoor temperatures, especially in the summer. Additionally, the tin roofs are problematic during rain, causing significant noise indoors. To address this, we temporarily place a layer of tarpaulin over the roof to prevent seepage through punctures caused by wear and tear. However, tarpaulin has limited durability and requires regular replacement.

The structure of have plywood board walls supported by wooden studs, and a metal roof. Plywood poses a risk of collapsing during heavy storms. Bamboo poles are used as a cost-effective material to support the metal tin roof sheets. Previously, our house had no flooring, currently, half of it is covered with kota stone, ceramic tile, and plaster to minimize costs. During rain, we face flooding issues, and to cope up with that we use buckets to collect dripping water. Ship scrap materials are used on some walls due to easy availability in the port area.

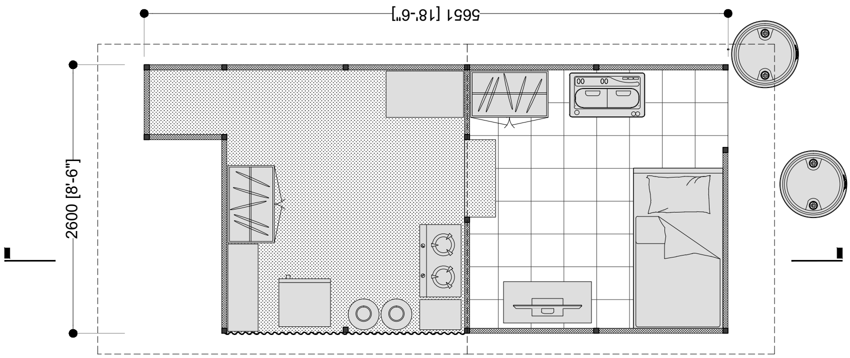
We encounter problems with tarpaulin flying away in windy conditions, and rust from tin sheets falling into food when damp due to high humidity. The interior becomes too hot, prompting us to perform household chores and sleep outside. During heavy storms, a tree has fallen on our house, and we've faced issues of electrocution. Due to these challenges, my daughter-in-law decided to leave the place.

To provide structural support to the corrugated tin roof sheets, mild steel hollow sections are used as structural members that serve the purpose of hanging lighting fixtures as well. The gateway of our dwelling is closed with half-used plywood boards and a curtain to save costs.

Documentation



Section



Plan

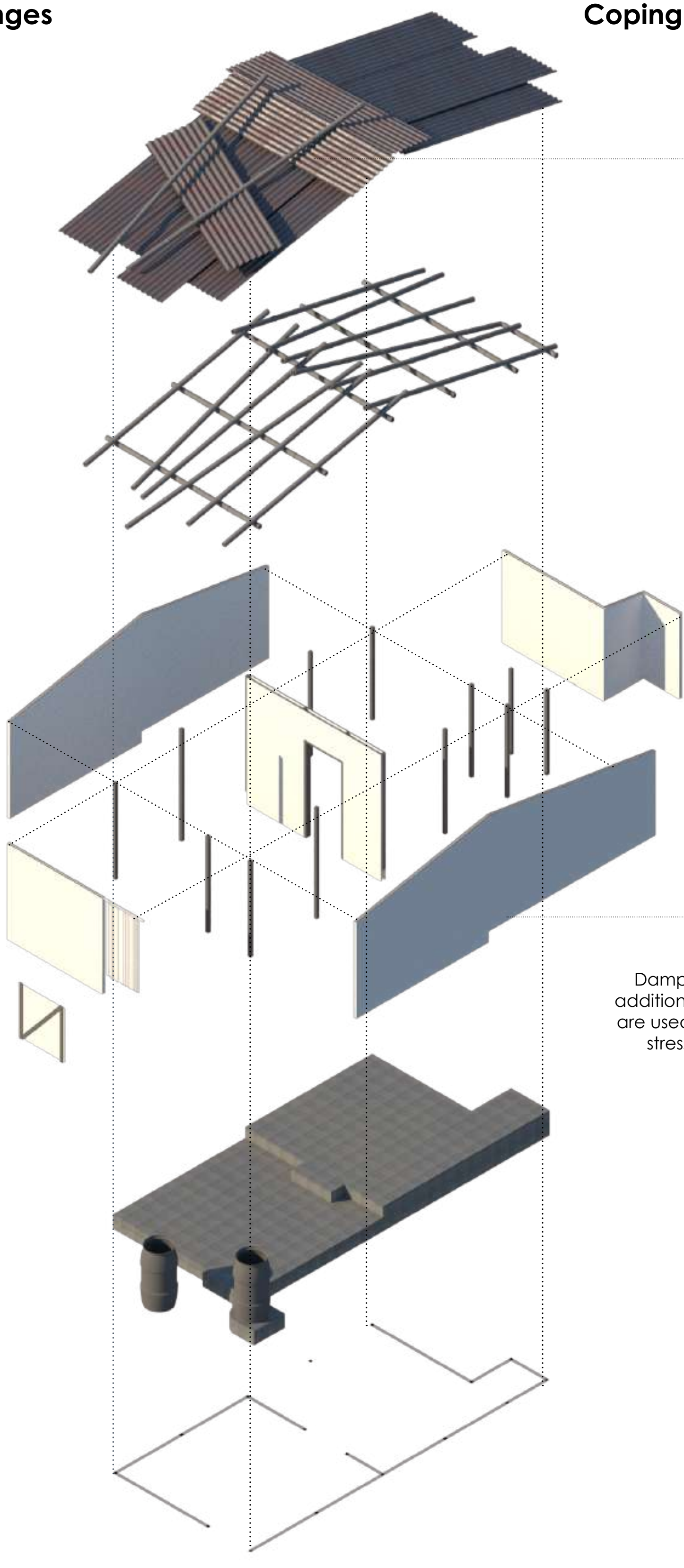
1. Foyer
2.Living/Sleeping Space
3. Kitchen
4. Storage space
5. Water Storage

Issues & Challenges

Leakage/ Seepage

Indoor heating

Urban Flooding



Coping Mechanisms

Polythene and tarpaulin are used interchangeably to address leaky roofs and seepage

Damp pieces of cloth and additional layers of materials are used to reduce the heat stress inside the dwellings

Attributes of materials

	Material	Thermal Conductivity	Shelf-life	Durability	Maintainence	Procurement	Cost	Execution
	S	S	S	U	U	U	S	U
ROOF	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Second-Hand	Rs. 300/ Sheet	Skilled Labour
	Tarpauline	■■□□□	■■□□	■■□	Frequent	Second-Hand	-	Self-Built
	Flex Banner	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
WALL	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built
	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Second-Hand	Rs. 300/ Sheet	Skilled Labour
STRUCTURE	Bamboo	■■□□□	■■■■	■□□	Frequent	New	Rs. 90/ Pole	Self-Built
	MS Section	■■□□□	■■■■	■■■	-	New	Rs. 90/Kg	Skilled Labour
FLOOR	Kota Stone	■■□□□	■■■■	■■■	-	Salvaged	-	Self-Built
	Vitrified Tiles	■■□□□	■■■■	■■■	-	Salvaged	-	Self-Built
	PCC	■■□□□	■■■■	■■■	Infrequent	New	-	Self-Built

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

Do Muhin
Jagganath Basti
Jalimunda

Warm-humid

BHUBANESHWAR

8,37,737
Population

12,21,000
Projected Population

3.19%
Avg annual growth rate:

186
Sq. Km
Area Of
Municipal Corporation

Latitude° N 20.2961 Longitude ° E 85.8245

Total Slum Population
3,01,611

Total Slum Population
36%

Slum Dwelling Units
80,665

Slum Pockets
436

45m
elevation
above Sea Level

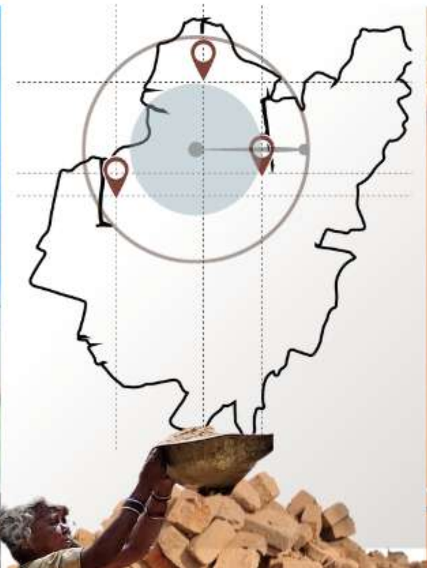
Max
32°C

22°C
Min

Avg Rainfall
1657.8 mm

Bhubaneshwar: Navigating the Microclimate Challenges of 3 Informal Settlements

Bhubaneswar is the capital city of the eastern Indian state of Odisha. It is the largest city in the state and serves as an important cultural, economic, and educational center. The city is located at the convergence of the Mahanadi River delta and the Bay of Bengal. The city has 436 slums. Bhubaneswar has faced several natural disasters, including cyclones, floods, and earthquakes. Three settlements were selected for intervention for the labs: Do Muhin, Jagannath Basti and Jalimunda. The settlement, Do Muhin, stretches along the road and water body, impacted by the sun's path. The north side, shaded, faces the water body, which joins the Kuakhai river. 90% of south-facing houses get intense sun, causing severe summer effects. Vernacular construction aids comfort, but ventilation issues lead to higher indoor temperatures. In Jagannath Basti, houses are strategically arranged for organized service distribution, maximizing street width for sunlight and ventilation. Back-to-back houses with street-facing windows predominate, while sun-oriented houses feature extended porches to reduce daytime exposure. Construction materials, including cement and corrugated sheets, contribute to elevated indoor temperatures, particularly in summers. Jalimunda, expanding north-south due to constrained private property, orients house east-west to mitigate sun exposure. Clusters of dwellings open to front open space, serving as kitchens and cattle sheds, reducing sun impact. With prevailing south-to-north winds, house orientation shields against strong winds, crucial in this cyclone-prone region with a history of devastating tragedies.



Bhubaneshwar's Micro Market

Individual preferences and choices regarding construction materials are highly subjective, often influenced by the available building materials and the financial capacity of the family. Equally crucial are the climatic factors that play a role in shaping these choices.

Over time, the evolution of dwellings in Do Muhin has shifted from rudimentary frame structures with polythene cladding or mud walls to more sophisticated constructions featuring plastered brick walls. The bricks are typically sourced from kilns in Mancheswar, while tin and cement sheets find their way from suppliers along Cuttack Road. Jagannath Basti witnesses the prevalent use of hollow cement bricks in construction, with cement sheets dominating the roofing landscape. Bharatpur emerges as a hub for material acquisition, housing numerous shops offering a comprehensive range of construction essentials. In this area, secondary steel rods are conveniently obtained from nearby scrap dealers. In Jalimunda, the sourcing of materials presents a challenge due to the predominantly aged houses, constructed several decades ago. These structures undergo regular maintenance, minimizing the need for drastic changes. However, in the case of newer constructions, which incorporate bricks, and cement sheets, materials are procured from nearby markets. Hollow bricks, a common choice, are priced at Rs 18/- per piece in this locality.

BHUBANESHWAR

Area of the Settlement

1.25 Ha (3.1 acres)

0.87 Ha (2.14 acres)

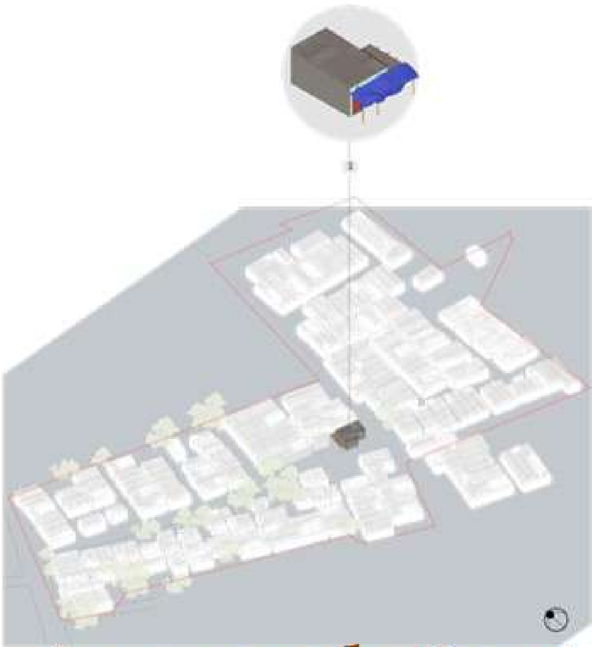
2.25 Ha (5.55 acres)

Total No. of Dwelling Units

154 DU (approx.)

410 DU (approx.)

350 DU (approx.)

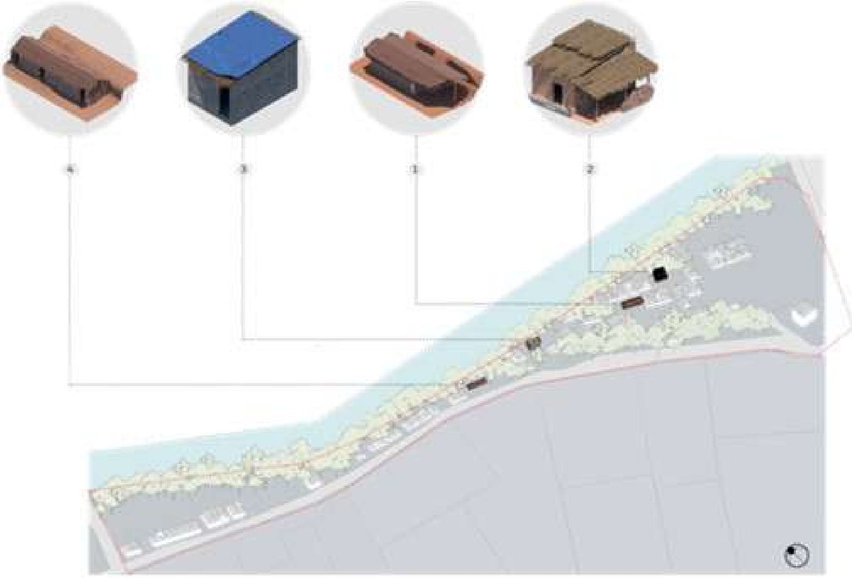


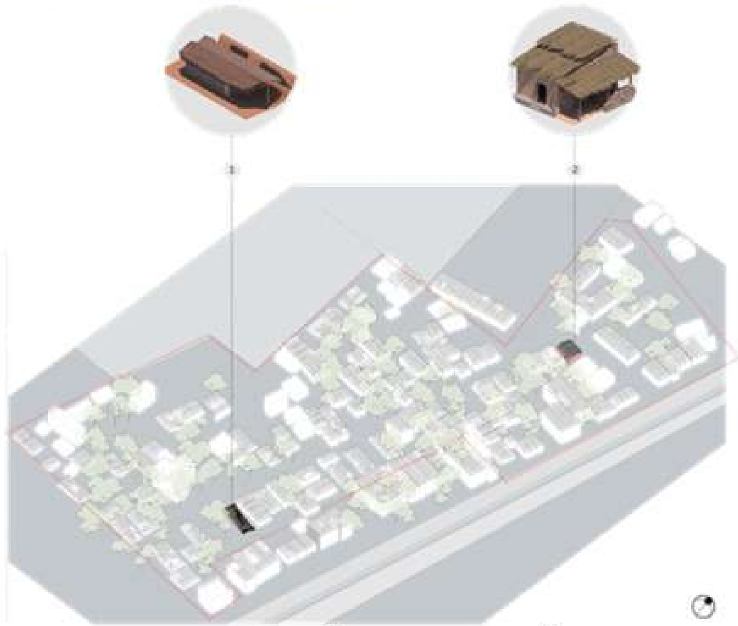
Jagganath Basti

20°17'31.32"N 85°45'55.95"E

Do Muhin

20°19'34.72"N 85°51'30.84"E





Jalimunda

20°21'36.27"N 85°49'39.51"E

A Comprehensive profile of settlements in Bhubaneshwar

Three settlements were selected for intervention for the labs in Bhubaneshwar. Do Muhin, a settlement near a river tributary, comprises 154 dwellings with divided land ownership under the general administration of Bhubaneshwar and the irrigation department. It falls under the JAGA mission, a state-wide slum upgradation program. Primarily inhabited by the Dara Singh tribal community, who migrated 30 years ago, recent migrations post-1999 cyclone include people from Orissa, Bengal, and Bihar. Morphological differences in dwellings reflect the timing of settlement, with recent ones displaying lower consolidation and higher precarity. Occupations include driving and labour for men, while women work in nearby industries. Most dwellings are semi-pucca, and ownership is largely self-owned. Limited access to toilets and water taps raises concerns, but JAGA enumeration provides a sense of security. Cyclones pose significant climatic challenges, impacting dwellings differently. Varied materials and construction methods, influenced by market flows, reflect changing relationships with the environment. Houses spend around Rs. 10,000 annually on maintenance. Labour costs, materials, and construction times vary, influencing dwelling expansion strategies. Roofing materials like tin and thatch are chosen strategically for cost and climatic considerations.

Constructed in 2018 to accommodate individuals displaced from central Bhubaneshwar settlements, Jagannath Basti, located within the Kalinga Stadium premises, houses 350 semi-Permanent households. The settlement aligns with the JAGA mission for relocation and resettlement and is part of the USHA survey for land and property rights. Each evicted household received 35,000 rupees as compensation during relocation. The settlement features a linear organization with basic infrastructure, including individual toilets and piped water connections. Standardized dwellings, predominantly 12 x 20 structures, exhibit variations in roofing materials such as polythene, tin, and cement sheets. The demography reflects diversity, encompassing tribal communities and families from Andhra Pradesh, Gujarat, West Bengal, and other parts of Orissa,

engaged in occupations like driving, shopkeeping, labour, and domestic work. While the houses weathered the 2019 cyclones relatively well, occasional repairs, costing Rs. 1000-1200 per cement sheet, are reported, with construction materials purchased from Bharatpur at retail prices and metal columns procured second hand.

Jalimunda, a settlement comprising approximately 410 dwellings, originated as a modest cluster of 11 houses 60 years ago, on land owned by the agriculture department. Initially, the area was a dense forest surrounded by fields. The settlement, belonging to the mundal and santhal communities, reflects traditional building techniques now diminishing over time. Classified as notified settlement under the JAGA mission, Jalimunda's demography is primarily adivasis, with households containing 6-13 members. Occupations, not strictly gendered, depend on transportation and distance feasibility, including roles such as domestic workers, cleaners, and rag pickers. Dwellings, typically serving for sleep and household activities, have mud walls plastered with cow dung and straw, while thatched roofs supported by bamboo frames are becoming challenging to source locally. Water connections are widespread, but sanitation services vary, with common toilets for some households. Traditional dwellings undergo yearly mud coatings and thatch replacements, taking one month and three days, respectively. Recent constructions use hollow bricks and cement sheets due to thatch unavailability.

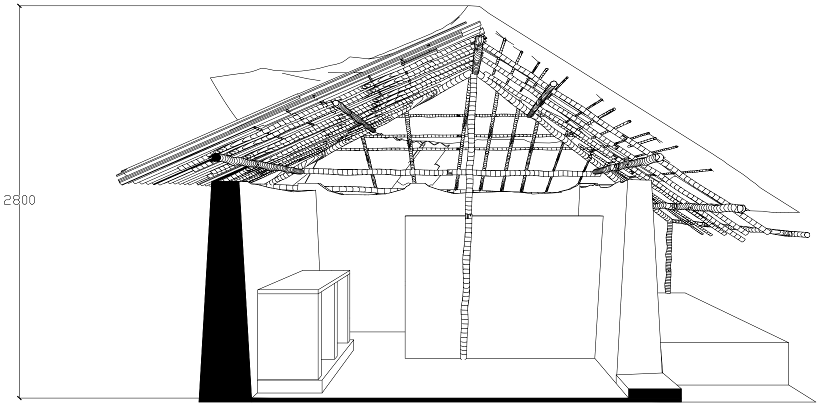
BH1 Jalimunda

Name: Nitu
Age: 37
Housing Tenure: Temporary (Kutcha)
Structure Type: Semi Detached
Area: 60 sq. mts
Family Size: 15 (Including extended family)
Family Income: Rs. 70000
Family Occupation: Social work, Media

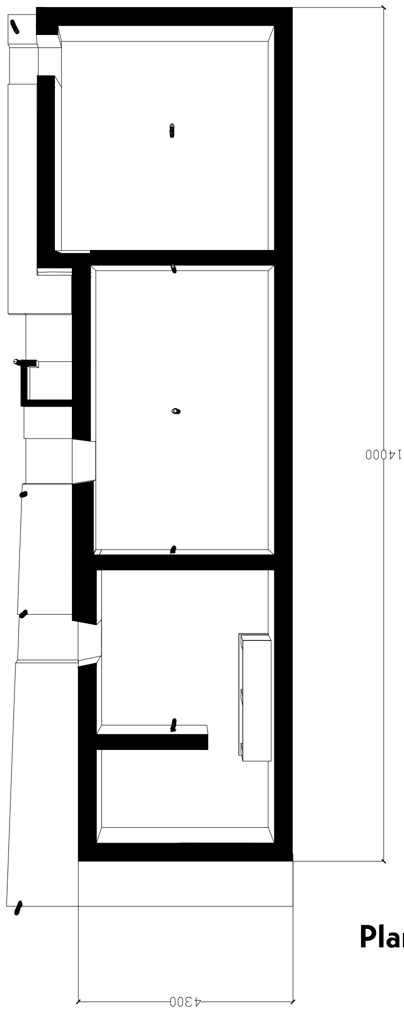
I live in Jalimunda, a settlement that embodies the Santhal and Gond communities, representing a wealth of generational knowledge in constructing houses. These dwellings not only meet the residents' needs, evident in their construction and organization, but also actively adapt to climate conditions over time through the choice of materials. Back in 1967, my husband's grandparents built our house as one of the original 11 in the area. It has undergone minimal alterations or reconstructions, even enduring challenges like cyclones, including the super-cyclone of 1999. Despite living in a cyclone-prone environment, we haven't substantially reconstructed the house. Initially, it had mud walls and a thatch roof, and we've been replacing the thatch every three years without major structural damages. After the 2019 super-cyclone Fani damaged the back wall, we introduced cement sheets, and more recently, a cement plinth was added outside.

The only consistent changes we've made involve regularly replacing bamboo poles in the frame structures and thatch bundles on the roof whenever they get damaged. The lifespan of the thatch roof is 2-3 years, mainly due to damage from cyclonic winds and rains. In response to recent damages, we've used cement sheets for wall repairs. The major concern we have is occasional flooding to the plinth level during heavy rains.

Documentation



Section



1. Verandah
2. Living Space
3. Cooking Area

Plan

Issues & Challenges

Coping Mechanisms

Leakage/ Seepage

Urban Flooding

Cyclones

Pests

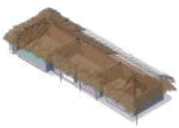
Polythene sheets are used to prevent the entry of rainwater

Mud walls used to prevent indoor heating

Raised cement plinth which prevents the entry of rainwater

Timeline

Increments over time



Year	1967	2010
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Family migrated to Jalimunda	Minor damage to the thatched roofing
Response	Dwelling constructed using locally procured materials	Locally procured bundles of thatch were used to replace the roofing
Cost	NA	Rs. 10,000 -12,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

		S	S	S	U	U	U	S	U
		Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	New	Rs. 380-650/ Sheet	Self-Built
	Timber beam	■■□□□	■■■□	■■□	Infrequent	New	-	Self-Built
	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	New	Rs. 600/ Sheet	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	Locally prpcured	-	Self-Built
	Thatch	■□□□□	■□□□	■□□	Frequent	Locally procured	-	Self-Built
	Polythene	■□□□□	■□□□	■□□	Frequent	New	-	Self-Built
WALL	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Self-Built
	PCC	■■□□□	■■■■	■■■	Infrequent	New	Rs. 300-360/Bag	Self-Built
STRUCTURE	Timber section	■■□□□	■■■□	■■□	Infrequent	New	-	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	New	Rs. 200-300/pole	Self-Built
	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Self-Built
FLOOR	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Self-Built
	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 300-360/Bag	Self-Built

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

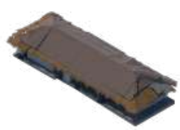
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

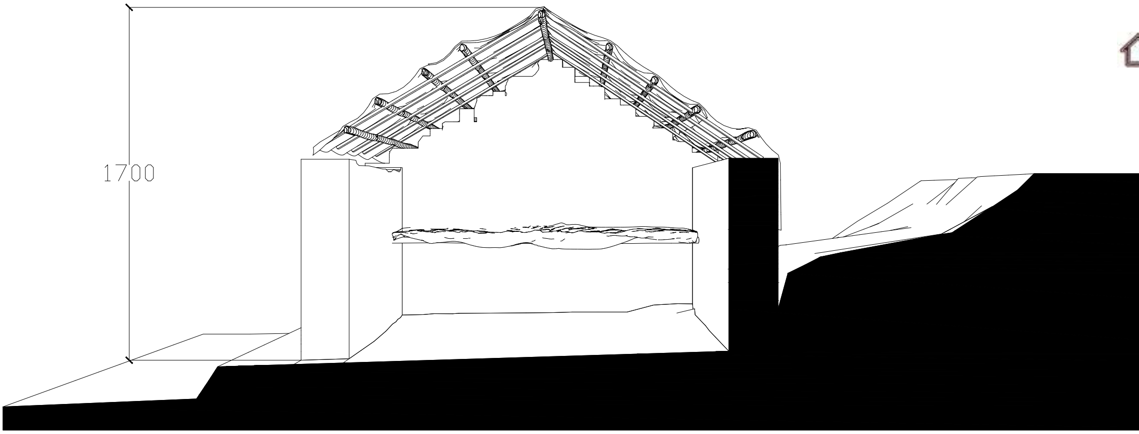
		
2019	**2021**	**2023**
Self-Owned	Self-Owned	Self-Owned
Self-Built	Self-Built	Self-Built
Significant damage to the roof	Progressive weakening of the mud plinth	
Cement sheets used to partially replace the thatch on the roof	Plinth rebuilt using cement and raised in height to prevent waterlogging	Present status of the dwelling
NA	NA	
Self-Financed	Self-Financed	

BH2 Do Muhin (Tribal Community)

Name: Jyoti
Age: 22
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Semi Detached
Area: 9 sq. mts
Family Size: 3
Family Income: Rs. 10000
Family Occupation: Labour
House Investment - building, maintenance and upgrades: Rs.2761

My house is in a settlement called Do Muhin that has variance in terms of the materials used, manner of building and level of consolidation, all of which are determined by the time period at which they were built, the tenure of the household and circumstances of construction. In some regards, viewed within the overall pattern of the settlement, there are visible differences observed between dwellings towards the interior, which have been incremented and consolidated over years and the newer dwellings towards the outskirts, where the houses are more recent, heterogeneous in terms of their demography and have lower levels of consolidation. We built the house in 2019, on highly precarious land on the edge of a canal, as we were not been able to assert to more secure land. Our house is built using bricks and mortar sourced from a nearby kiln, with a bamboo frame structure supporting polythene sheets for roof, our house has not undergone any changes, but was rebuilt once, after the cyclone in 2019. Most of the materials were re-used. At the present, our house is prohibitively low in height, and experiences high indoor heating levels, and so we are compelled to sleep outside and carry out many of our activities outside, which raise concerns regarding safety and security. During the rains, the roof allows water to seep into the house. The polythene sheets are replaced every 1-2 years. The house orientation is adjacent to a road, so there is little usable space for us, forcing us to cook, clean and wash by the canal edge. We aspire to rebuild the house as a more robust, taller structure.

Documentation

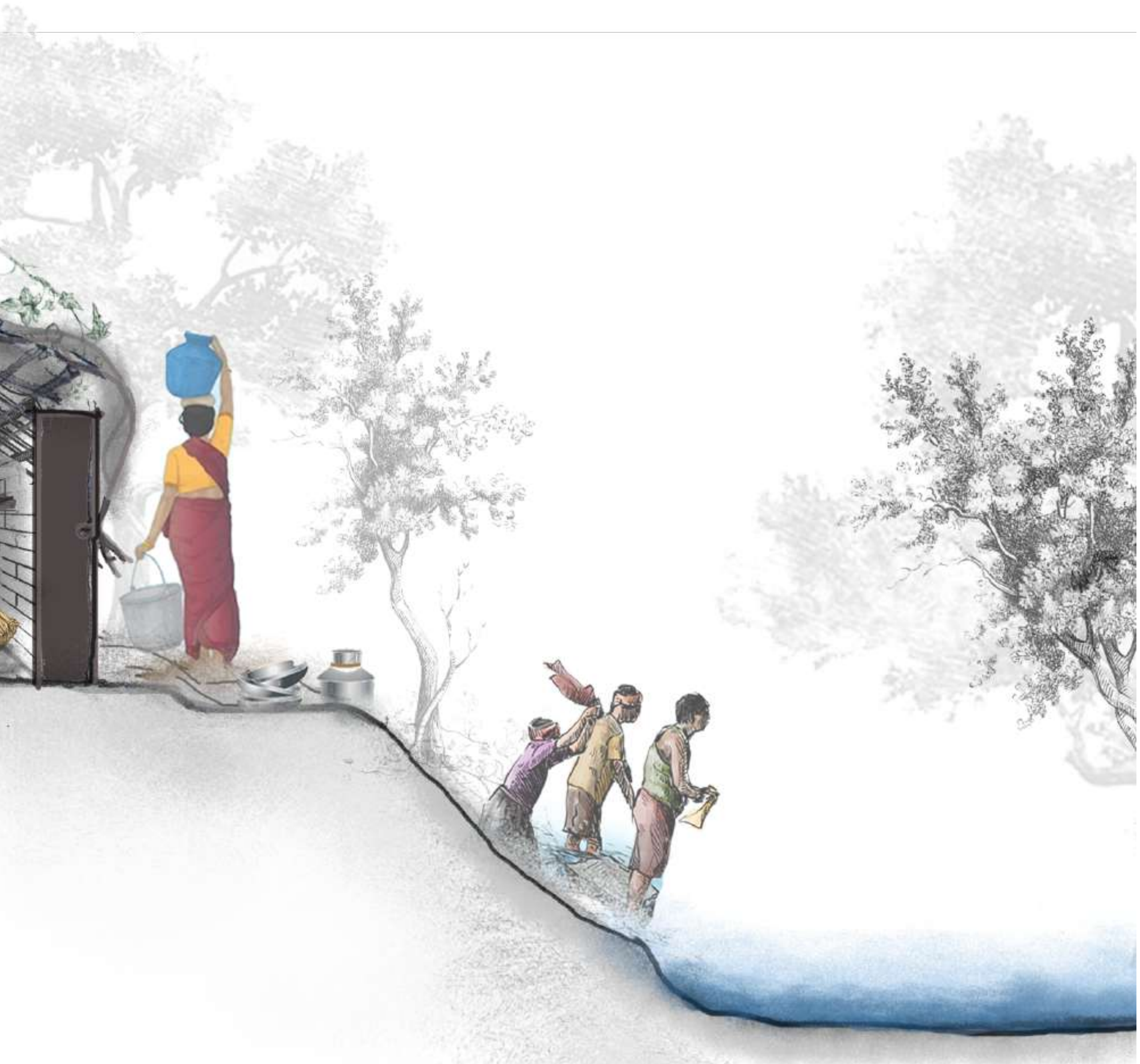


Section

Plan

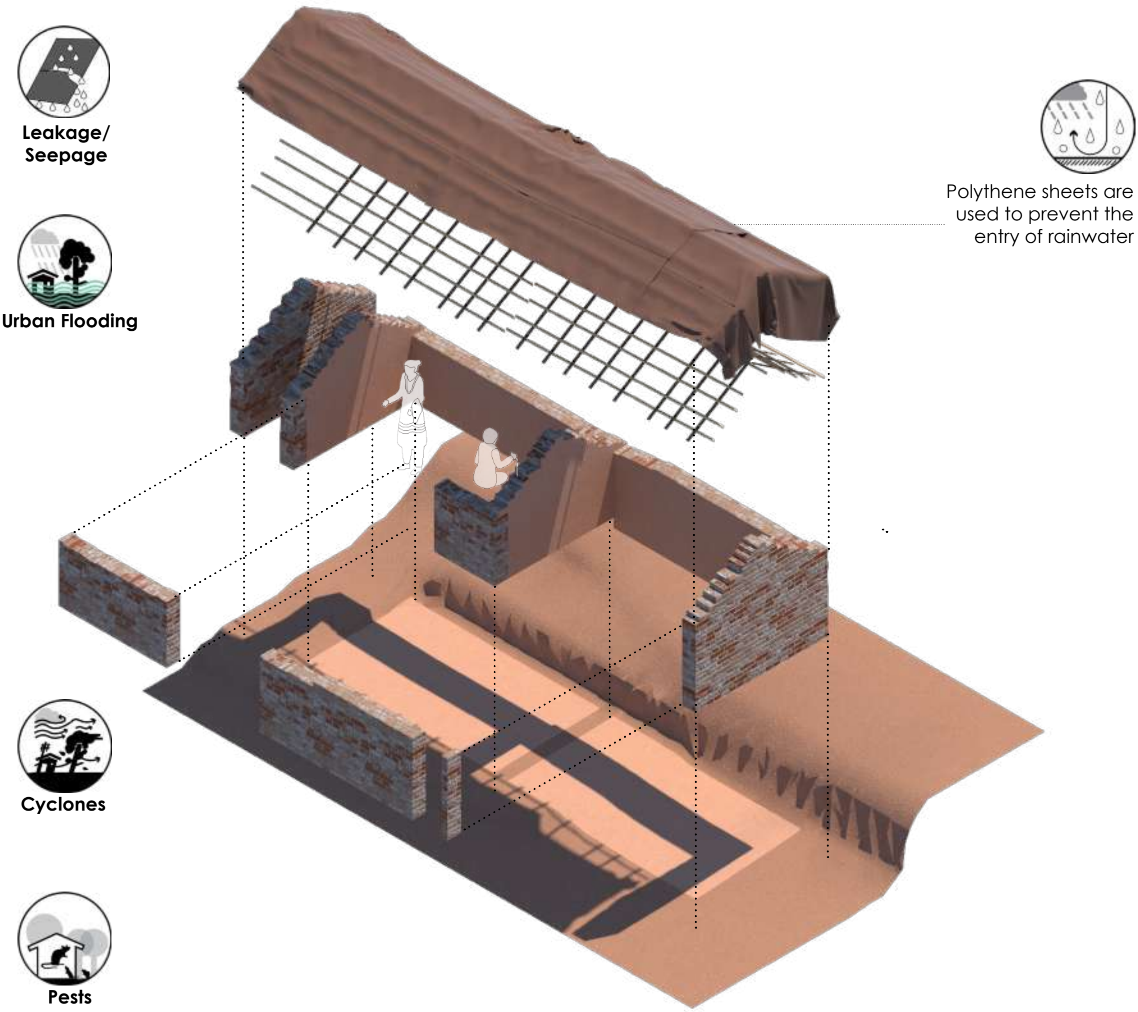
1. Entry
2. Living Space
3. Cooking area

Dwelling BH2, Do Muhin, Bhubaneshwar. Living in a dwelling cladded in a roof of thatch and creepers, sandwiched between a road and a steep canal, the family carries out their daily activities, which include, cooking, washing, bathing, among everything else, in these narrow spaces they call a home. The dwelling is used solely as a sleeping space, as the lack of an electricity connection prevents wider use



Issues & Challenges

Coping Mechanisms



Timeline

Increments over time

Year	2018	2019
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Family migrated to Do-muhin	Damage due to cyclone (2019)
Response	Dwelling built using locally procured and salvaged materials	Rebuilt using locally procured, re-used and salvaged materials
Cost	NA	NA
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	Material	Thermal Conductivity	Shelf-life	Durability	Maintainence	Procurement	Cost	Execution
	S	S	S	U	U	U	S	U
ROOF	Timber beam	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Polythene	■□□□□	■□□□	■□□	Frequent	Salvaged	-	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-Built
WALL	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Self-Built
STRUCTURE	Brick	■■□□□	■■■■	■■■	-	New	Rs. 6-7/ piece	Self-Built
FLOOR	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Self-Built

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

Kalivihar

Warm-humid

CUTTACK

6,06,007
Population

9,00,000
Projected Population

3.35%
Avg annual growth rate:

192.5 Sq. Km
Area Of Municipal Corporation

Latitude° N 20.4625 Longitude ° E 85.8830

Total Slum Population
1,29,471

Total Slum Population
21%

Slum Dwelling Units
32,106

Slum Pockets
264

36m
elevation
above Sea Level

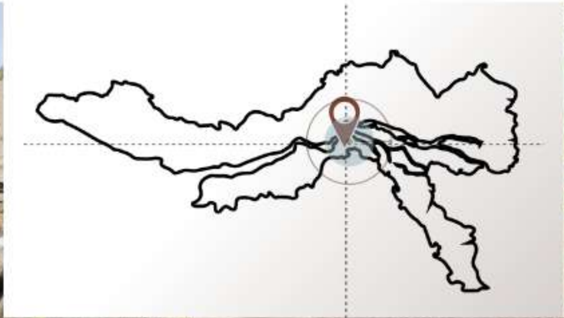
Max
31°C

10°C
Min

Avg Rainfall
1598 mm

Cuttack: Navigating the Microclimate Challenges of Kalivihar

Cuttack, the former capital of Odisha state, the capital was shifted to Bhubaneswar in the year 1949 as the city restricted growth due to its geographical location on the Mahanadi delta. Cuttack has 264 slums in the city. Due to the delta region of river Mahanadi the city experiences flooding during the monsoon season, which has led to the displacement of residents and damage to property in the years 2008, 2010 and 2013. In Kalivihar settlement it was mentioned during the interviews that strong winds and heavy rainfall associated with cyclones damages the temporary and semi-permanent structures in slum areas. The settlement is oriented both onward direction of sun exposure and wind direction which results in maximum exposure of both the components making the dwelling units and residents vulnerable to various incidents. The thick vegetation is another safety feature that protects the settlements from both sun exposure and harsh winds. Thatch used as roofing material fly away and also possess risk of electrocution and corrugated metal sheets, commonly used, torn off, leading to leaks and structural damage.

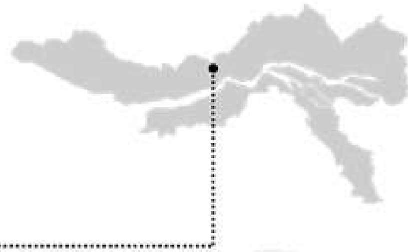


Cuttack's Micro Market

In the micro market of Cuttack, a diverse range of materials is prevalent, primarily catering to the construction and upkeep of dwellings, especially in slum areas. The predominant materials used encompass a combination of (a) polythene, thatch, tin, and cement sheets for roofing, (b) bamboo frames or mud for walls, and (c) mud or cement for flooring. Bamboo, a key component in construction, has seen a surge in prices in recent years, with a single piece costing around Rs. 300, sourced from Mani Mandir. Disposed construction materials find their way into the market from locations such as Naya Pada and Trishulya, contributing to the resource pool for the economically disadvantaged.

Thatch, a commonly used roofing material, is procured at a standardized rate of Rs. 7 per bundle, a price point that remains relatively consistent across various cities. The essential construction trio of cement, sand, and stone, locally referred to as 'Bali,' is obtained from Khannagar. It's noteworthy that the sourcing of sand used to be from the riverbed until mining operations restricted access for private use. This change has likely impacted the dynamics of construction material acquisition in the region. Plastic sheets and tarpaulin, integral components for various purposes, are acquired from Ravenshaw College, adding to the diverse palette of materials utilized in the local construction scene. The availability and sourcing of these materials not only reflect the socio-economic conditions but also mirror the adaptability and resourcefulness of the community in addressing their housing needs.

CUTTACK



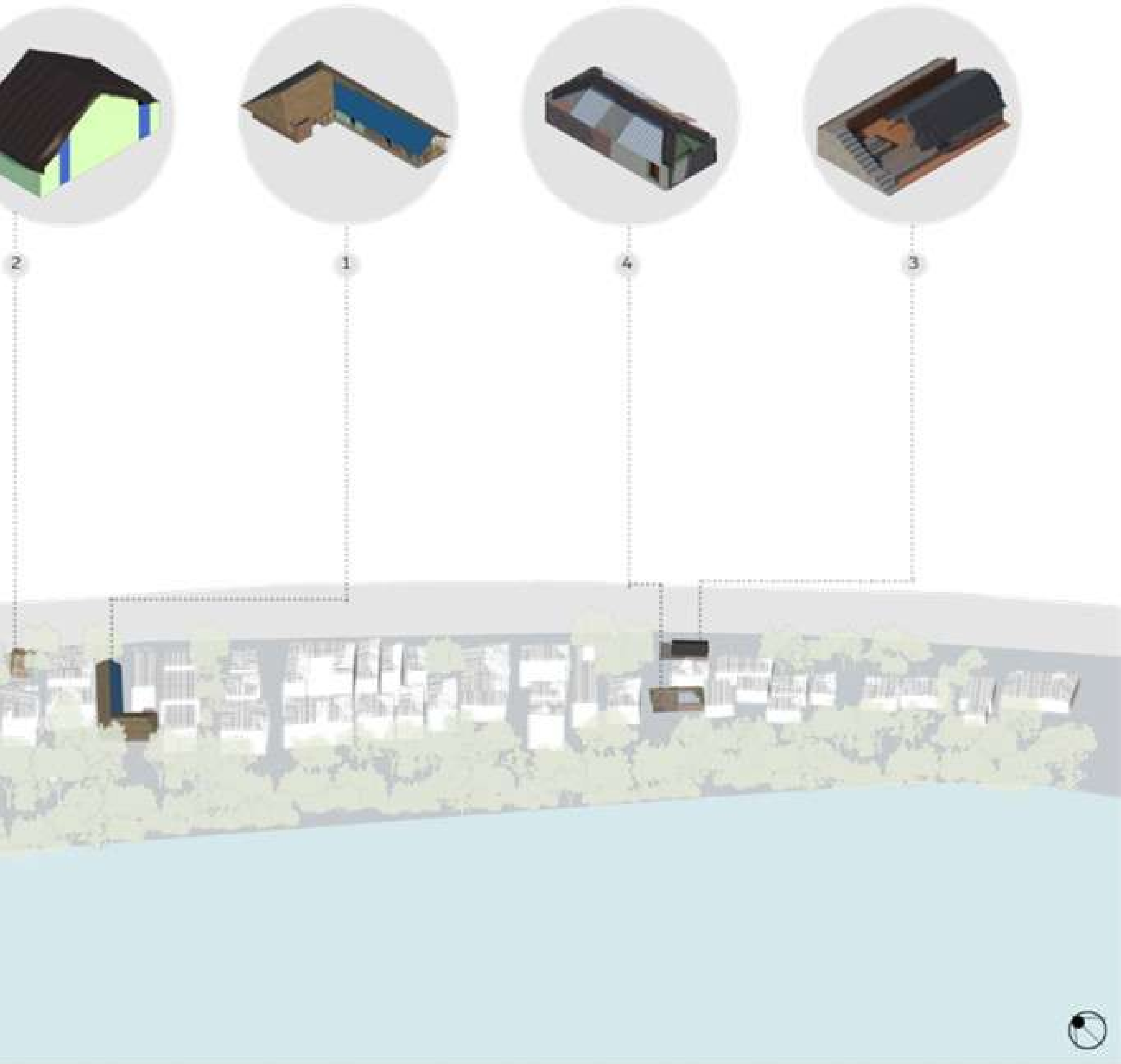
Kalivihar

20°27'6.33"N 85°53'3.38"E

Area of the Settlement
1.44 Ha (3.55 acres)

Location of Settlement
Near River

Total No. of Dwelling Units
322 DU (approx.)


2
1
4
3



A Comprehensive profile of settlement in Cuttack

South of the city, along the Mahanadi river, is where Kaalivihar settlement is located. The state irrigation department owns the land on which it is built. The community is situated far below the level of the road; the area was formerly a riverbed when the river was at its fullest capacity. There are people of many ethnicities living in the settlements, which are 1.5 km long and located along the ring road. Some Adivasis and inhabitants of Cuttack's neighbouring cities are also included in the settlement. Established around 50 years ago, it currently accommodates 322 dwellings with a population ranging from 1000 to 1500 individuals. Occupations vary between genders; men predominantly work as laborers or drivers, while women are engaged in domestic work and house help roles. Despite possessing Aadhar cards and electricity bills, residents lack conclusive evidence of dwelling tenure. Kalivihar is classified as a notified slum. Migration to Kalivihar occurred as people sought employment in Cuttack but faced challenges securing stable housing. The settlement predominantly features semi-permanent houses constructed from materials like mud, bamboo frames, and various roofing materials, including polythene sheets, cement sheets, and thatch. Tin and GCI sheets are sparingly used. Semi-pucca houses, constructed with secondhand materials, are common. Roof maintenance, particularly due to damage in summers, is a recurring expense, with an average annual spending of up to Rs. 3000. Cement sheets, are priced at Rs.1500 rupees when new and Rs. 700 in the second-hand market. Household sizes vary significantly, ranging from 3 to 10 members, with approximately one-third of houses being rented or leased. Floods pose a constant threat, submerging up to 4-5 ft. of the settlement during monsoons, necessitating temporary relocation. The aftermath involves a week-long cleaning process to remove sludge, waste, and pollutants deposited around the settlement.

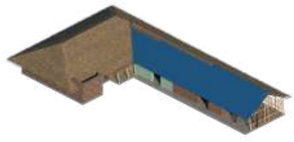
C1 Kalivihar

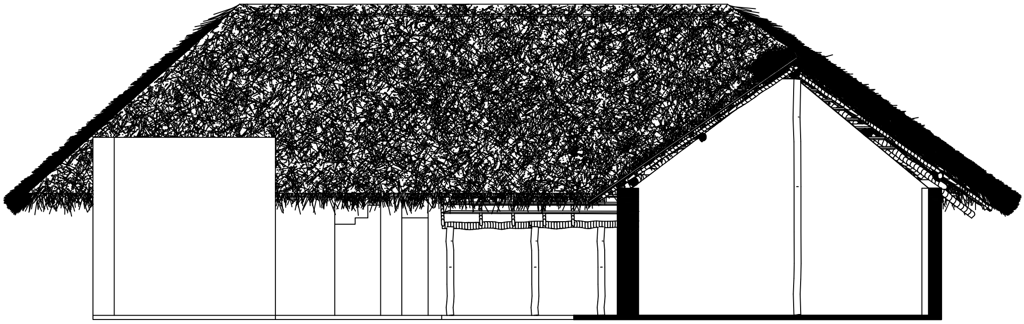
Name: Kavita
Age: 35
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Attached
Area: 180 sq. mts
Family Size: 4
Family Income: Rs. 15000
Family Occupation: cowherder and dairy farming
House Investment - building, maintenance and upgrades: Rs.124624

I live in Kalivihar with my family of four. Our house is situated adjacent to the settlement's inner boundary, right next to the road. We are a family of dairy farmers and cowherds, and our dwelling, which includes a cowshed at one end, was constructed in the early 1980s. During its initial construction, we utilized mud for the walls and plinth and thatch for the roofs. Over the years, we incorporated polythene sheets onto the thatch as an extra layer of protection against rain and cyclonic winds. The construction cost us a total of Rs.30,000.

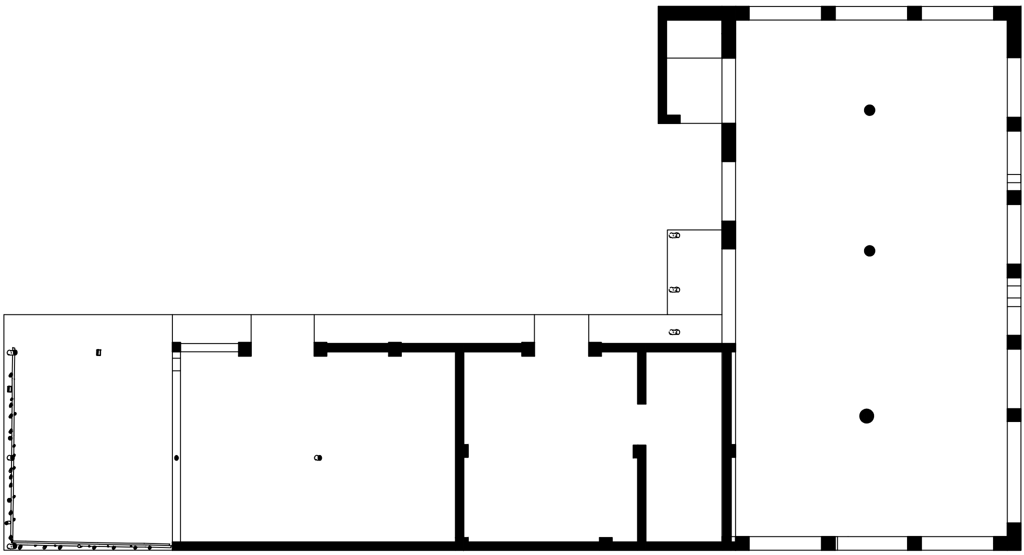
As the years passed, our house underwent several modifications in response to wear and tear, as well as unforeseen incidents that required reconstruction. In 2004, we had to rebuild the entire house after the thatch roof caught fire due to a short circuit in the high-tension lines passing over our house, incurring a cost of Rs. 15,000. In 2016, for damage to of the mud walls, we constructed brick walls on all sides. More recently, in 2021, we replaced half of the roof with GI sheets as the thatch could no longer withstand the conditions. Between 1999 and 2019, despite two cyclones hitting Orissa, we did not make any major alterations to our house. One recurring issue we face is the inflammability of the thatch and the persistent challenge of cyclonic winds and rains, leading to frequent investments in replacing the roofing material. During rains, our family is compelled to seek refuge elsewhere or take our belongings to the adjacent road due to our dwelling getting flooded. To cope with these challenges, we use plastic and tarpaulin sheets to shield the house from rain, but their effectiveness is limited due to the settlement's topography. We also use ropes to secure the roof, preventing the sheets from being dislodged by strong winds.

Documentation





Section

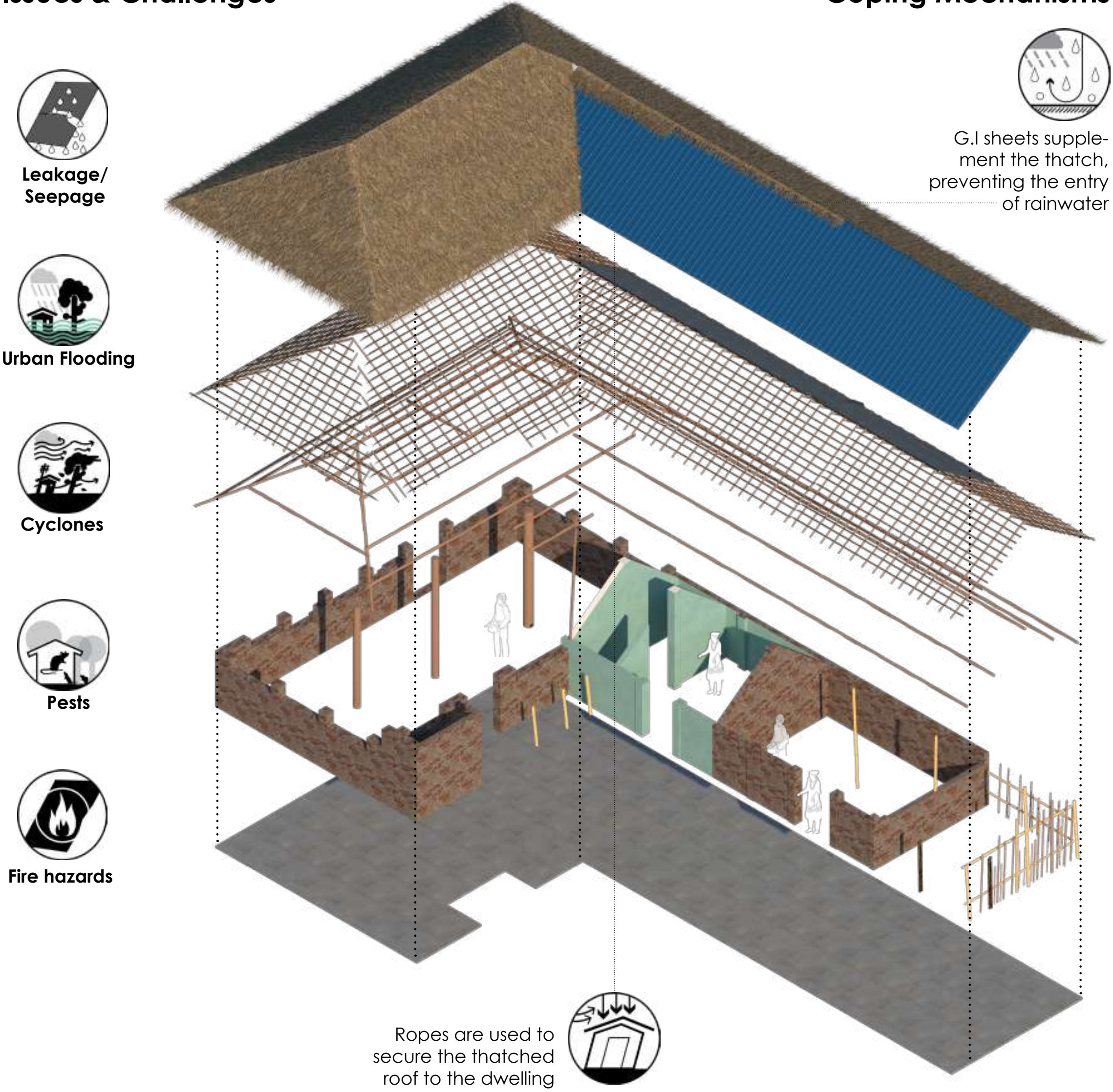


Plan

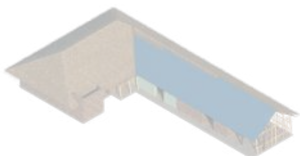
1. Storage for cow dung and firewood
2. Living Space
3. Cooking area
4. Cow shed
5. Washroom

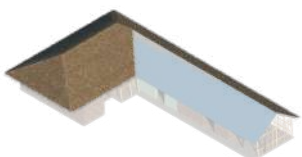
Issues & Challenges

Coping Mechanisms



Timeline





Increments over time

Year	**1976-1982**	**2004**
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built + Skilled labour	Self-Built + Skilled labour
Need	Family migrated to Kalivihar, Cuttack	Fire damage to the roof
Response	Dwelling constructed	thatch replaced on the roof and supplemented with corrugated metal sheets
Cost	Rs. 30,000	Rs. 15,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	Material (S)	Thermal Conductivity (S)	Shelf-life (S)	Durability (U)	Maintainence (U)	Procurement (U)	Cost (S)	Execution (U)
ROOF	Timber beam	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	New	Rs. 600/ Sheet	Skilled Labour
	Bamboo	■■□□□	■■■■	■□□	Frequent	New	Rs. 200-300/Pole	Self-Built
	Thatch	■□□□□	■□□□	■□□	Frequent	Locally procured	-	Skilled Labour
	Polythene	■□□□□	■□□□	■□□	Frequent	Salvaged	-	Self-Built
	Flex Banner	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
WALL	Plaster	■■□□□	■■■□	■■□	Infrequent	New	Rs. 300-360/Bag	Skilled Labour
	PCC	■■□□□	■■■■	■■■	Infrequent	New		Skilled Labour
	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Skilled Labour
STRUCTURE	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Skilled Labour
	Timber section	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Skilled Labour
	Timber Column	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Skilled Labour
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 6-7/ Piece	Skilled Labour
FLOOR	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Self-Built
	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 300-360/Bag	Skilled Labour

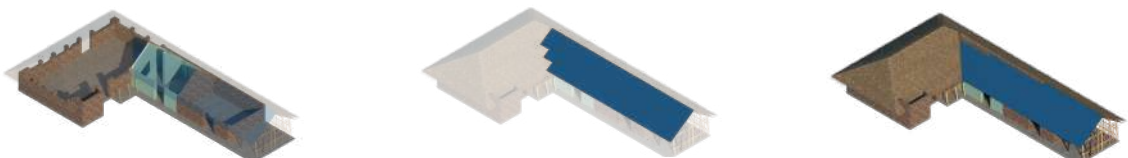
Thermal Conductivity:
- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability
- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U



2016	2021	2023
Self-Owned	Self-Owned	Self-Owned
Self-Built + Skilled labour	Self-Built + Skilled labour	Self-Built + Skilled labour
Progressive damage to the mud walls	Further damage to the roof	
Walls rebuilt using bricks and cement	Roofing partially replaced with new GCI sheets	Present status of the dwelling
Rs. 7000	Rs. 20,000	
Self-Financed	Loans	

C2 Kalivihar

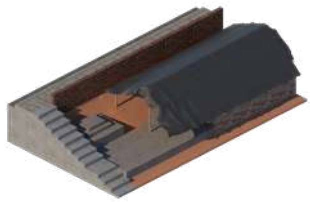
Name: Vasanti
Age: 50
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Detached
Area: 22 sq. mts
Family Size: 4
Family Income: Rs. 7000
Family Occupation: House help, rickshaw puller
House Investment - building, maintenance and upgrades: Rs. 32765

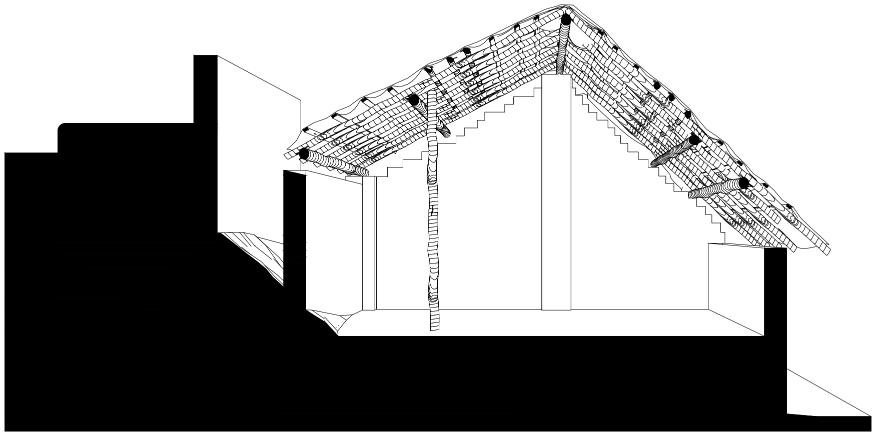
In Kalivihar, where I currently reside, our living conditions showcase varying levels of precarity in our houses, leading to visible climate-induced risks for us. Additionally, these variations highlight a subtle hierarchy in our social organization, particularly evident in the distinctions we make between 'tribal' and 'adivasi'. This distinction is explicitly expressed through the clear delineation of physical boundaries within our settlement.

Constructed in 1999 after the super cyclone, our house stands on an unstable plinth, anchored to a brick wall along the main road. The other walls, initially made of mud, were gradually replaced with salvaged bricks from nearby construction sites by 2010. The thatch roof, prone to damage, was replaced with polythene within the first 1-2 years of construction. However, this material requires replacement every 3 years, especially during the harsh summers when the polythene sheets become brittle and start crumbling. The bamboo frame supporting the roof is also susceptible to water damage and is changed as deemed necessary by my family. The mud plinth failed within the initial two years and was replaced with a sturdier cement construction in 2001.

Our dwelling faces challenges, particularly during heavy rains and cyclonic winds, resulting in repair costs reaching up to 15,000 rupees, as was the case during the 2019 cyclone, Fani. During heavy rains, my family and I relocate to a nearby school with our possessions, as our settlement becomes uninhabitable. Indoor heating poses an issue, and to combat this, we utilize a semi-enclosed space in front of our house for our daily activities.

Documentation





Section

Plan

1. Living Room
2. Kitchen and Bed room


I hope we have taken every-thing , I dont know what would become of our home when we return...

Dwelling C2, Kalivihar, Cuttack. Monsoons and cyclones bode poorly for the inhabitants, who despite measures to build dwellings at higher elevations live in highly precarious and vulnerable conditions. Depicted here is an incident narrated to us, where a cyclone in the year 2022 forced everyone in the settlement, including inhabitants of the dwelling C2 to relocate to the road they live adjacent to.

Issues & Challenges

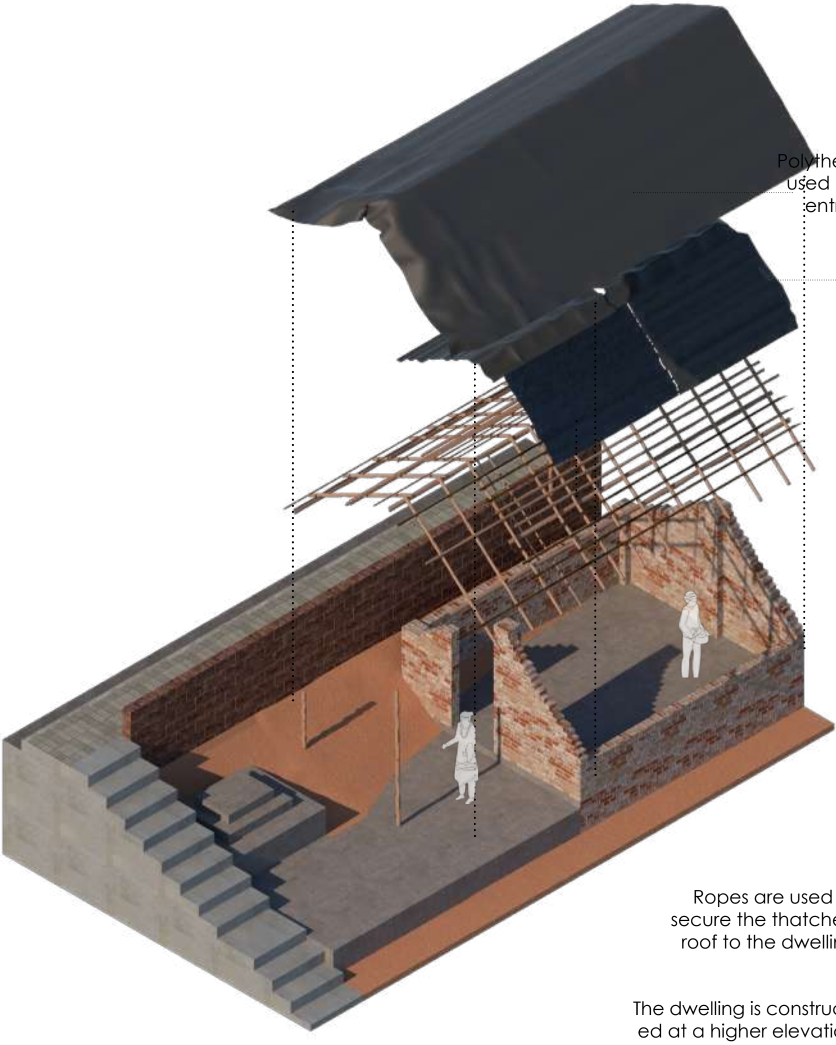

Leakage/ Seepage


Urban Flooding


Cyclones


Pests

Coping Mechanisms

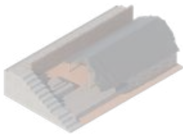


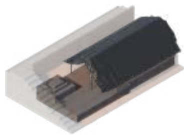

Polythene sheets are used to prevent the entry of rainwater


Ropes are used to secure the thatched roof to the dwelling


The dwelling is constructed at a higher elevation to avoid flooding

Timeline





Increments over time		
Year	**1996**	**1999**
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built+Skilled labour
Need	Family migrated to Kalivihar	Shack destroyed
Response	Dwelling intially built as a low-lying structure next to the river bank	Dwelling rebuilt using new materials at a higher elevation, adjacent to a road
Cost	NA	Rs. 40,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	Material	Thermal Conductivity (S)	Shelf-life (S)	Durability (U)	Maintainence (U)	Procurement (U)	Cost (S)	Execution (U)
ROOF	Timber beam	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-Built
	Polythene	■□□□□	■□□□	■□□	Frequent	Second-Hand	-	Self-Built
WALL	Brick	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 6-7/ Piece	Skilled Labour
STRUCTURE	Brick	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 6-7/ Piece	Skilled Labour
FLOOR	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Self-Built
	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 300-360/Bag	Skilled Labour

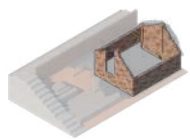
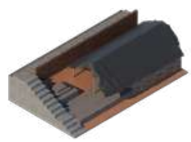
Thermal Conductivity:
- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability
- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

2001	2010	2019
Self-Owned	Self-Owned	Self-Owned
Self-Built+Skilled labour	Self-Built+Skilled labour	Self-Built+Skilled labour
Damage to the thatched roof	Structural damage to the walls	
Thatched roof layered with Polythene sheets to address the leakage of water	Walls rebuilt using bricks and mortar, materials salvaged from construction sites	Present status of the dwelling, rebuilt after the 2019 cyclone
Rs. 3000	NA	Rs. 15,000
Self-Financed	Self-Financed	Self-Financed

C3 Kalivihar

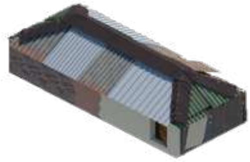
Name: Gulab
Age: 50
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Detached
Area: 39 sq. mts
Family Size: 7
Family Income: Rs. 25000
Family Occupation: cowherder and dairy farming
House Investment - building, maintenance and upgrades: Rs. 20264

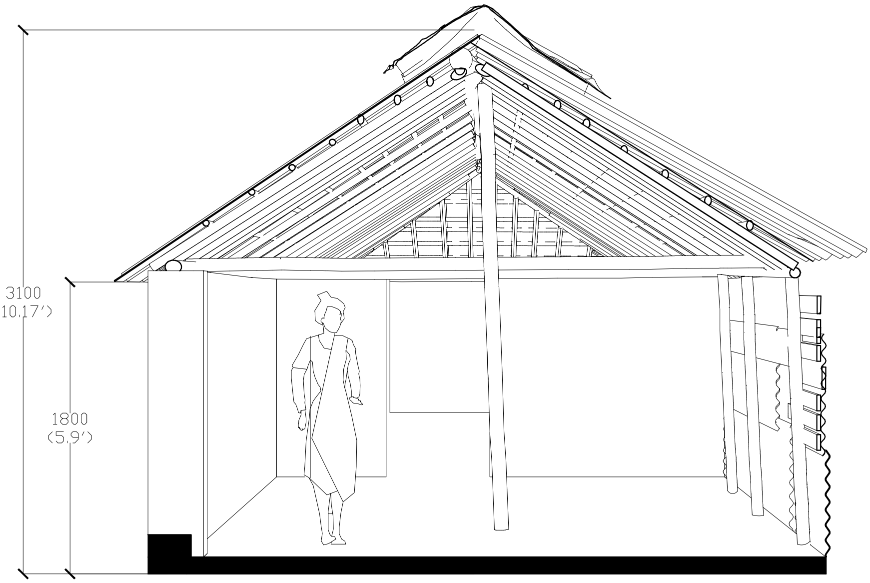
We reside in Kalivihar, our house was built around 1972, initially comprised a small single room with mud walls, a bamboo frame, and a thatched roof. Over the years, the thatch suffered damage, leading to its replacement with tin and polythene sheets in 1982 to withstand the rains. As our family grew (I came to Kalivihar upon marrying into my husband's family), we expanded by adding a room in the early 1990s. This additional space now serves as our common living area, with a bamboo frame covered with polythene sheets.

After the super cyclone in 1999, we had to rebuild the entire house. The old mud walls were replaced with bricks and cement, and the polythene sheets in the added room gave way to tin. In 2010, we replaced the bamboo frame structure entirely and switched the roof to tin sheets from a nearby market. During this renovation, we also remade the mud plinth with cement, addressing its recession into the ground. The 'Fani' in 2019 caused significant damage to the roof, but we managed to recover and reinstall materials where possible.

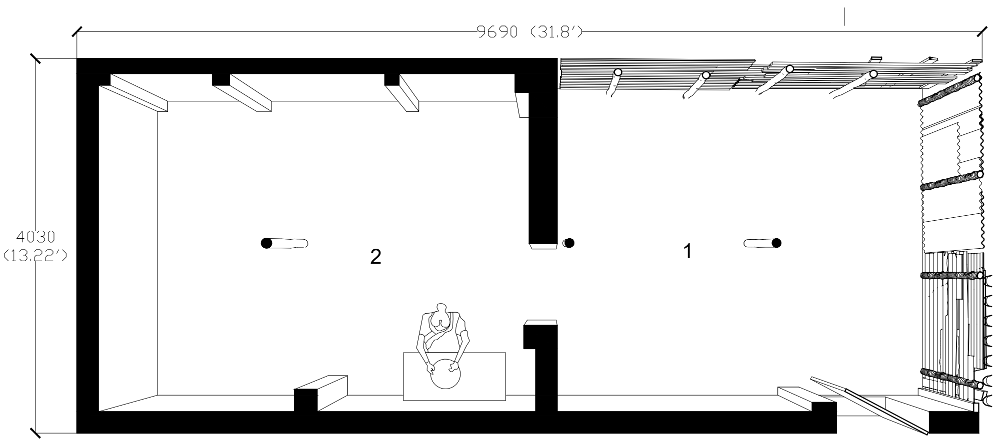
During the monsoons, we encounter various challenges, including cyclonic winds and heavy rains. To cope with these issues, we use bricks, cement blocks, and pieces of wood to secure the tin roofing sheets against cyclonic winds. Additionally, we employ polythene sheets on the walls to prevent rainwater from entering during the monsoons. Over the years, trees have fallen on our dwelling, causing substantial damage to the roof.

Documentation





Section

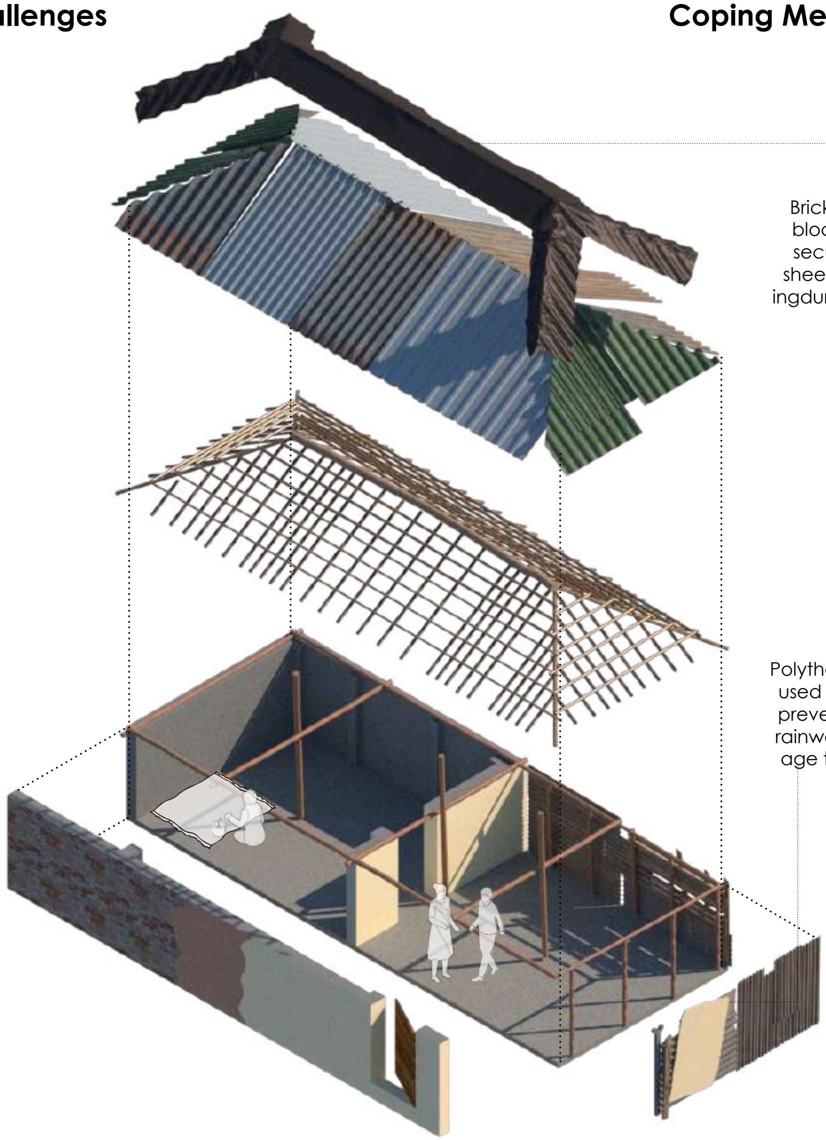


Plan

1. Living Room
2. Kitchen and Bed room

Issues & Challenges

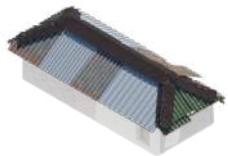
Coping Mechanisms



Bricks and cement blocks are used to secure the roofing sheets to the dwell-ingduring high winds

Polythene sheets are used on the walls to prevent the entry of rainwater and dam-age to the dwelling

Timeline

Increments over time		
Year	**1972**	**1982**
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built+Skilled labour	Self-Built+Skilled labour
Need	Family migrated to Kalivihar	Damage suffered by the roof
Response	Dwelling constructed using materials purchased in the second-hand market	Thatch replaced with tin and polythene sheets to prevent rainwater seepage
Cost	NA	Rs. 30,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	Material [S]	Thermal Conductivity [S]	Shelf-life [S]	Durability [U]	Maintainence [U]	Procurement [U]	Cost [S]	Execution [U]
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Salvaged	-	Self-Built
	Corrugated Tin Sheet	■■■■■	■■■□	■□□	Frequent	Second-Hand	Rs. 600/ Sheet	Self-Built
	Polythene	■□□□□	■□□□	■□□	Frequent	New	-	Skilled Labour
WALL	PCC	■■□□□	■■■■	■■■	Infrequent	New	Rs. 300-360/Bag	Skilled Labour
	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Salvaged	-	Self-Built
	MDF	■■□□□	■■□□	■□□	Frequent	Second-Hand	-	Self-Built
	Plywood	■■□□□	■■□□	■□□	Frequent	Second-Hand	-	Self-Built
	Cement Board	■■□□□	■■■■	■■■	-	Salvaged	-	Self-Built
STRUCTURE	Brick	■■□□□	■■■■	■■■	-	New	Rs. 6-7/ Piece	Skilled Labour
	Bamboo	■■□□□	■■■■	■□□	Frequent	Second-Hand	Rs. 200-300/Pole	Self-Built
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Second-Hand	-	Skilled Labour
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 300-360/Bag	Skilled Labour

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

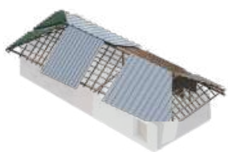
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

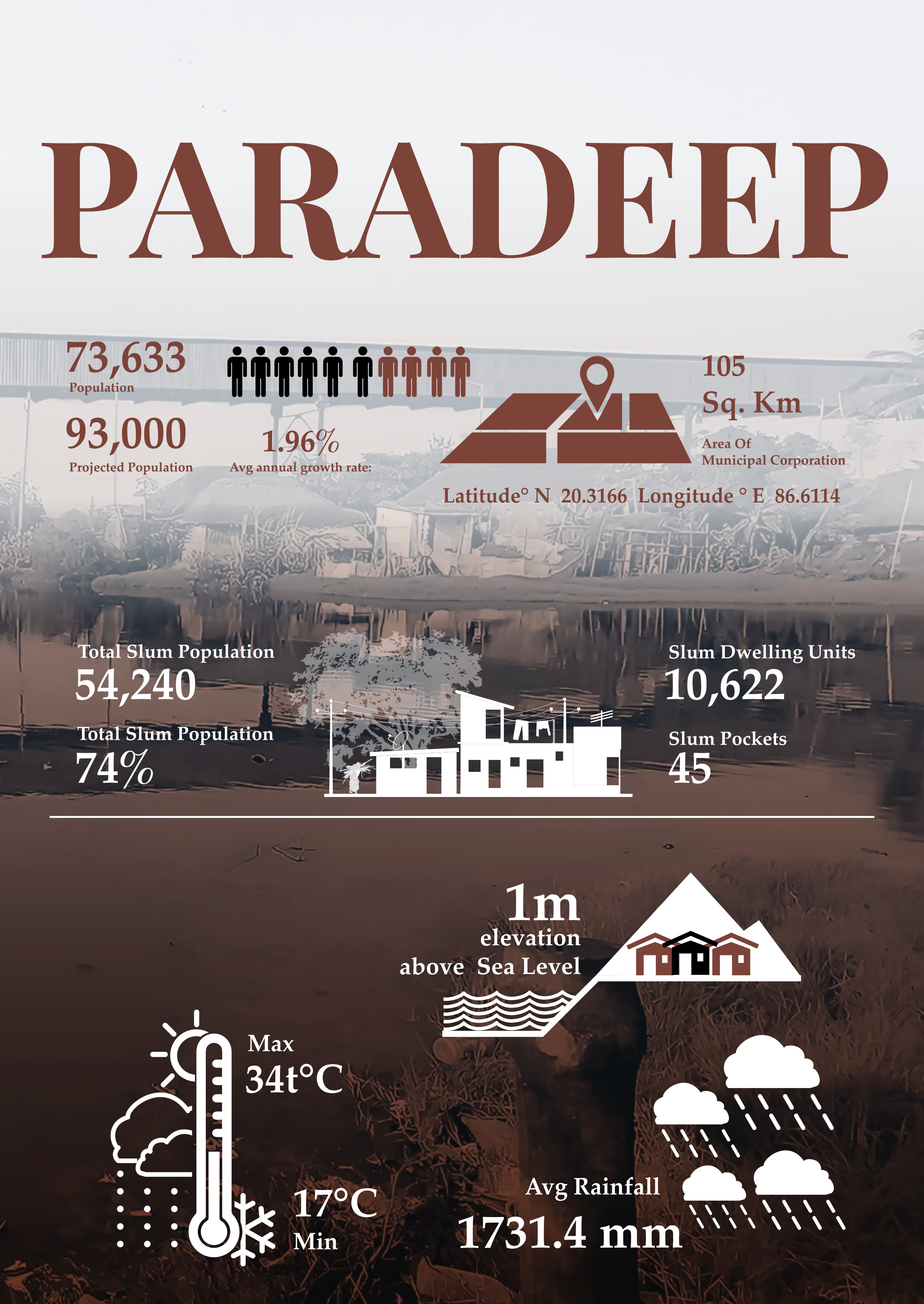
Users perspective: U



1999	2010	2019
Self-Owned	Self-Owned	Self-Owned
Self-Built+Skilled labour	Self-Built+Skilled labour	Self-Built+Skilled labour
Damage suffered during a cyclone	Damage suffered by the roof	Damage during cyclone
Dwelling structure and walls rebuilt, roofing sheets replaced	Roof rebuilt on a new bam-boo frame structureusing new GCI sheets	Present status: Dwelling re-built using new and re-used materials
Rs. 60,000	NA	Rs. 15,000
Self-Financed	Self-Financed+Loans from SHGs	Self-Financed+Loans from SHGs

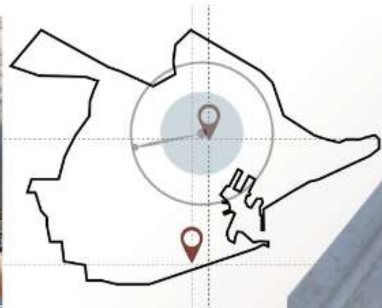
Keutapada
Lokpada

Warm-humid


PARADEEP
73,633
Population
93,000
Projected Population
1.96%
Avg annual growth rate:
105
Sq. Km
Area Of
Municipal Corporation
Latitude° N 20.3166 Longitude ° E 86.6114
Total Slum Population
54,240
Total Slum Population
74%
Slum Dwelling Units
10,622
Slum Pockets
45
1m
elevation
above Sea Level
Max
34t°C
17°C
Min
Avg Rainfall
1731.4 mm

Paradeep: Navigating the Microclimate Challenges of 2 Informal Settlements

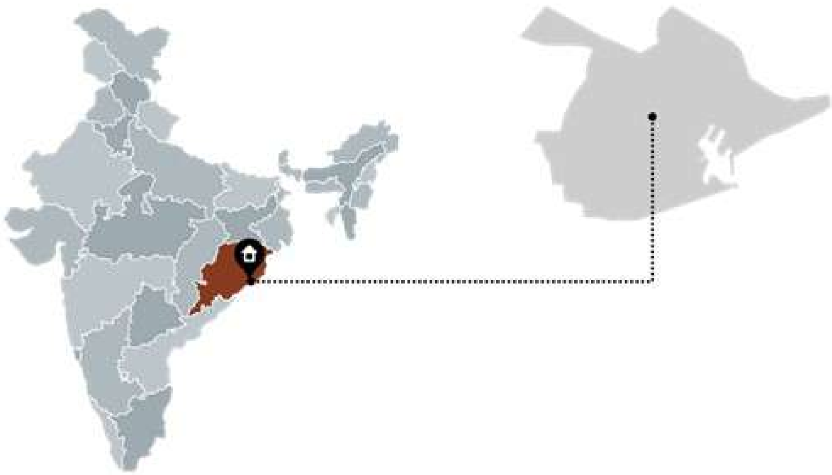
Paradeep is a port city located in the state of Odisha, India. It is situated on the Bay of Bengal and is known for its port, which is one of the major ports on the east coast of India. The city has warm and humid climate and has 45 slums. The region is prone to various natural hazards. The Bay of Bengal is known for experiencing cyclones, and Paradeep has witnessed several cyclones over the years. Cyclones bring strong winds, heavy rainfall, and storm surges that can cause widespread damage. In slum areas, the houses made of lightweight materials, cyclones have led to the collapse of temporary constructed structures. Heavy rainfall during the monsoon season can result in flooding, affecting slum areas that are often situated in low-lying regions. Floodwaters can damage mud or makeshift housing and erode the foundation of these structures. Two settlements are selected for intervention for labs; Keutapada and Lokpada. In Keutapada, the 1999 super cyclone completely submerged the settlement and its houses. Tsunamis were also mentioned. The few houses which have pucca walls (Bricks and cement) were mostly made in the years following the 1999 super cyclone, gradually. Many began collecting materials then and over the years consolidated their houses. Prior to 1999, most of the house had a simple bamboo frame cladded with polythene. In Lokpada, during cyclones and floods during rains, people first secure their papers, documents, ornaments, ration and other close belongings and relocate to a nearby area at a higher elevation. During the 'fani', some houses were completely demolished, while some remained standing. Those which were made of more robust materials or had permanent walls were able to sustain the cyclone, while many others, especially ones built using polythene were washed away and had to be rebuilt. Mud plinths, which is the case for most of the dwellings, also wash away, which fundamentally weaken the structure of the houses.



Paradeep's Micro Market

In the micro market of Paradeep, residents acquire cement and tarpaulin from the municipal market. Tin sheets and plastic sheets are obtained from nearby shops or various locations within the city. Locally sourced or salvaged materials, including wood, foam, and nets, play a crucial role in meeting construction and shelter needs.

PARADEEP



Area of the Settlement

24.9 Ha (61.6 acres)

3.4 Ha (8.4 acres)

Total No. of Dwelling Units

600 DU (approx.)

300 DU (approx.)

Lokpada

20°17'35.28"N 86°39'10.64"E

Keutapada

20°15'3.24"N 86°38'27.01"E

A Comprehensive profile of settlements in Paradeep

Keutapada settlement selected for documentation for the lab is spread in 3 wards with 1500 dwelling units, one intervened for the lab has 300 dwelling units. The community, primarily reliant on fishing, faces a highly seasonal income dynamic, prompting families to seek alternative livelihoods. Winters yield better earnings, reaching Rs. 5000-6000, while summers witness a decline to Rs. 2000-3000. Monthly household expenses cover food, education, healthcare, and miscellaneous costs. Residual income often goes into home repairs, crucial due to vulnerability to cyclones. Various organizations, including self-help groups like Mahila Milan, offer financial aid. Microfinancing institutions provide loans at a 2% interest rate, with monthly savings averaging around 100 rupees. Repairs, necessitated by cyclones, involve changing bamboo, tarpaulin, and polythene sheets. The settlement comprises approximately 10 self-help groups across three wards. Loans, capped at Rs. 1-2 lacs, are granted sequentially. Climatic risks, like cyclones and floods, damage homes, disrupt lives, and force temporary relocations. Financial constraints, especially in daily-wage families, hinder housing improvements. Incremental investments occur over 30 years. Temporary houses use bamboo frames and thatch, requiring yearly repairs. Coping mechanisms include using fishing nets for roofing and recycling materials. Dwelling sizes vary, influenced by subjective conditions and irregular land parcel sizes.

Lokpada settlement located in Atharabanki selected for documentation for the lab has 600 dwelling units. The settlement is vulnerable to cyclones and floods, residents face challenges in securing their homes during natural disasters. The financial constraints of families, predominantly relying on a single earner, limit their ability to enhance dwelling conditions. Most houses are constructed with less structurally robust materials, such as cement sheets and thatch, due to affordability issues. The settlement, established 15 years before the 1999 cyclone, comprises mainly Bengali immigrants seeking better livelihoods. During disasters like the super cyclone, casualties were significant, forcing evacuations.

Dwellings feature mud walls and roofs for 70% of houses, while others use more durable materials like fibreboards and wooden planks. Livelihood opportunities vary, with some engaged in port-related work and others in stitching, labour, or transportation. Water supply is communal, collected from government taps, and stored inside houses. Toilet construction is under the SBM program for individual houses. Labour costs for construction vary based on skills. Houses are built with bamboo frames, thatched roofs, and temporary enclosures until finances allow more robust construction. The community relies on cultural practices, such as material exchanges, for support during house construction. Despite challenges, the resilient community strives to adapt, with the construction of a house taking approximately one month. Thatch lasts 3-4 years, while polythene sheets need replacement every six months, costing Rs. 1,000 each.

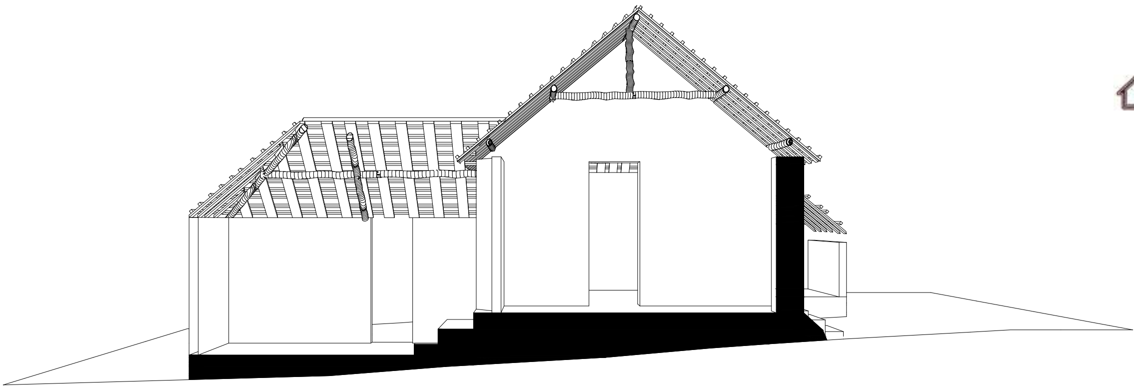
PA1 Keutapada

Name: Manosi
Age: 49
Housing Tenure: Temporary (Kutcha)
Structure Type: Detached
Area:30 sq. mts
Family Size: 3
Family Income: Rs. 10000
Family Occupation: Fisherman, fishmonger
House Investment - building, maintenance and upgrades: Rs.122381

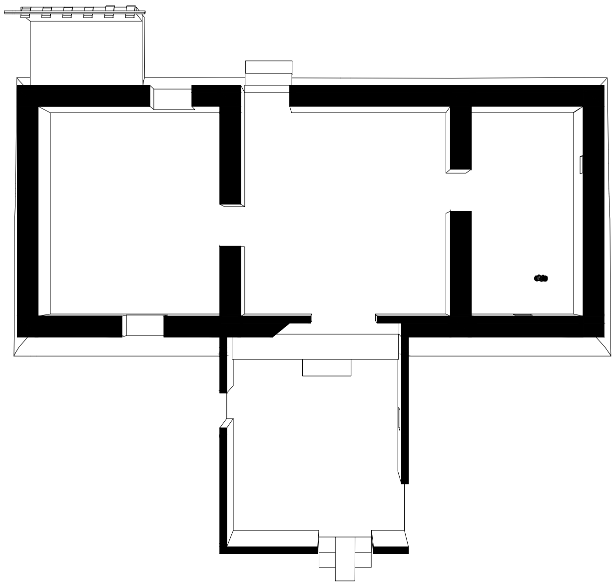
I live in Keutapada, where our house stands as one of the unique cases in Paradeep. Back in the year 2000, my husband and I, along with our son, acquired the house at a nominal cost. This decision arose after the destruction of our previous house in Lokpada due to the 1999 super cyclone, compelling us to relocate. We have relocated ourselves here from Cuttack. Our house stands as one of the earliest structures in the settlement, predating the migration of numerous individuals from Orissa and nearby states to Paradeep. The construction style is distinctive, unlike many other houses that have undergone significant changes. The walls are crafted from wattle and daub, a rudimentary bamboo frame plastered with mud. The roof comprises a bamboo frame layered with thatch and polythene sheets.

Since its purchase, our house has undergone few alterations. In 2005, we added a large semi-open verandah, which became a space for my husband to conduct his tuition classes. Our routine expenses for the house primarily focus on aesthetics and are influenced by cultural habits, such as repainting the walls every Dussehra. The thatched roof is replaced every 2-3 years, while the polythene sheets are renewed every 5-6 years. Fortunately, flooding is not a concern as our house is elevated on a marginally raised plinth. However, the cement suffered significant damage in 2019 during Cyclone 'Fani,' necessitating repairs. To cope with these challenges, we utilize polythene sheets to make the roof impermeable to water, inadvertently protecting the thatch from significant damage during the rains. Additionally, discarded fishing nets are repurposed to secure the roof and shield it from cyclonic winds.

Documentation



Section



Plan

1. Verandah
2. Temple
3. Living Room
4. Bedroom

Dwelling PA1, Keutapada, Paradeep. The changes that dwellings undergo reflect both, decisions that are driven by necessity and those that are shaped by aspiration. the dwelling shown here was incremented by the addition of a room to help the family run tuition classes for young children. Every year, fishing nets salvaged from the shore are used to secure the dwelling's thatched roof

Issues & Challenges

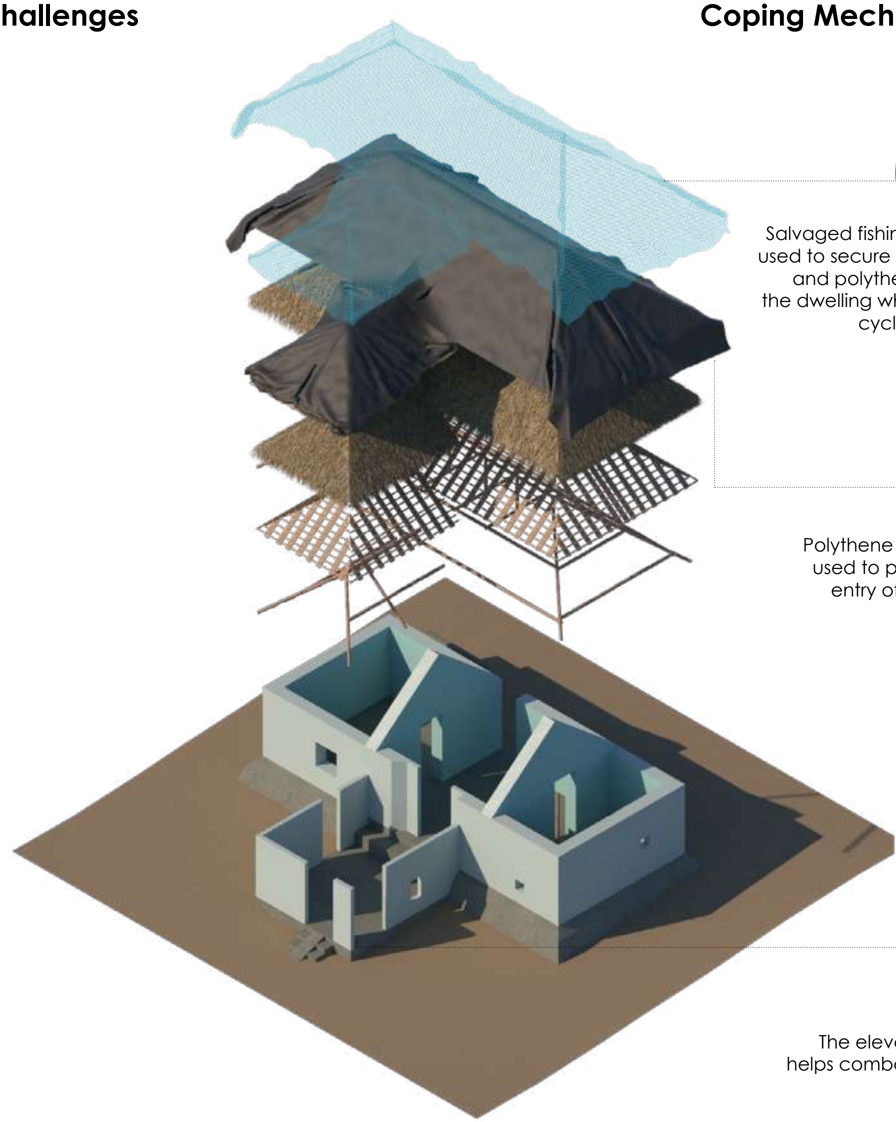
Leakage/ Seepage

Urban Flooding

Cyclones

Pests

Indoor heating



Coping Mechanisms

Salvaged fishing nets are used to secure the thatch and polythene roof to the dwelling when facing cyclonic winds

Polythene sheets are used to prevent the entry of rainwater

The elevated plinth helps combat flooding

Timeline

Increments over time		
Year	2000	2005
Tenure Arrangement	Self-Owned	Self-Owned
Construction	-	Self-Built+Skilled labour
Need	Family migrated to Keutapada	Additional space required
Response	Single room dwelling purchased	Semi-open verandah constructed using locally procured bamboo and mud
Cost	Rs. 3500	Rs. 30,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Timber beam	■■□□□	■■■□	■■□	Infrequent	New	-	Skilled Labour
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	New	-	Skilled Labour
	Bamboo	■■□□□	■■■■	■□□	Frequent	New	Rs. 200-300/Pole	Skilled Labour
	Thatch	■□□□□	■□□□	■□□	Frequent	New	Rs. 6-7/ Bundle	Skilled Labour
	Polythene	■□□□□	■□□□	■□□	Frequent	New	-	Self-Built
	Tarpauline	■■□□□	■■□□	■■□	Frequent	New	-	Self-Built
WALL	Plaster	■■□□□	■■■□	■■□	Infrequent	New	Rs. 300-360/Bag	Skilled Labour
	Mud	■□□□□	■■□□	■■□	Frequent	New	Rs. 800/ m^3	Self-Built
	PCC	■■□□□	■■■■	■■■	Infrequent	New	Rs. 300-360/Bag	Skilled Labour
STRUCTURE	Brick	■■□□□	■■■■	■■■	-	New	Rs. 6-7/ Piece	Skilled Labour
	Timber section	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Skilled Labour
	Bamboo	■■□□□	■■■■	■□□	Frequent	Second-Hand	Rs. 200-300/Pole	Self-built
FLOOR	Mud	■□□□□	■■□□	■■□	Frequent	New	Rs. 800/ m^3	Self-Built
	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 300-360/Bag	Skilled Labour

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

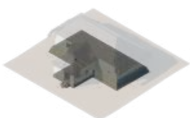
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U



2020	2023
Self-Owned	Self-Owned
Self-Built+Skilled labour	Self-Built+Skilled labour
Damage to the cement plinth	
Repairs to the cement plinth and dwelling walls	Present status of the dwelling
NA	
Self-Financed	

PA2 Lokpada

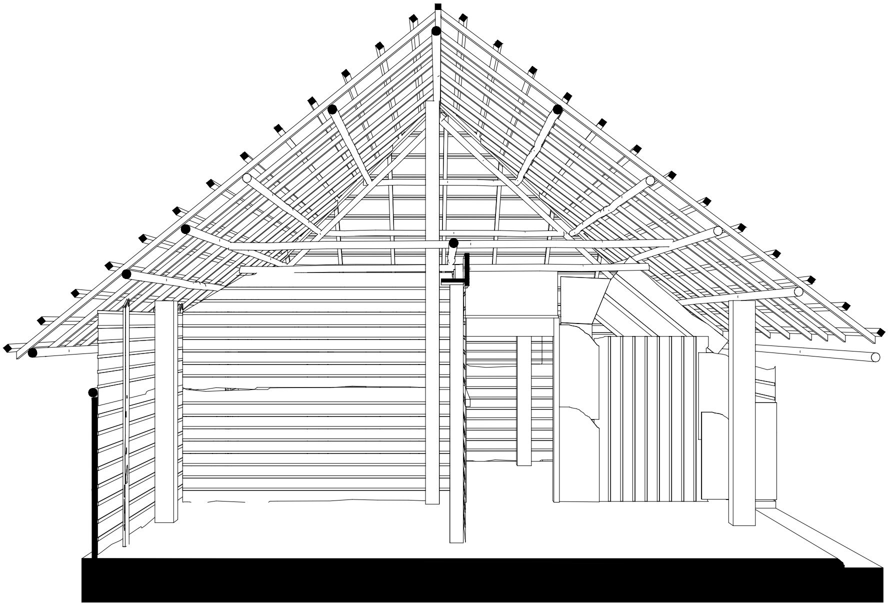
Name: Sushmita
Age: 25
Housing Tenure: Temporary (Kutcha)
Structure Type: Detached
Area: 50 sq. mts
Family Size: 4

Family Occupation: Domestic worker, dockworker
House Investment - building, maintenance and upgrades: Rs. 60000

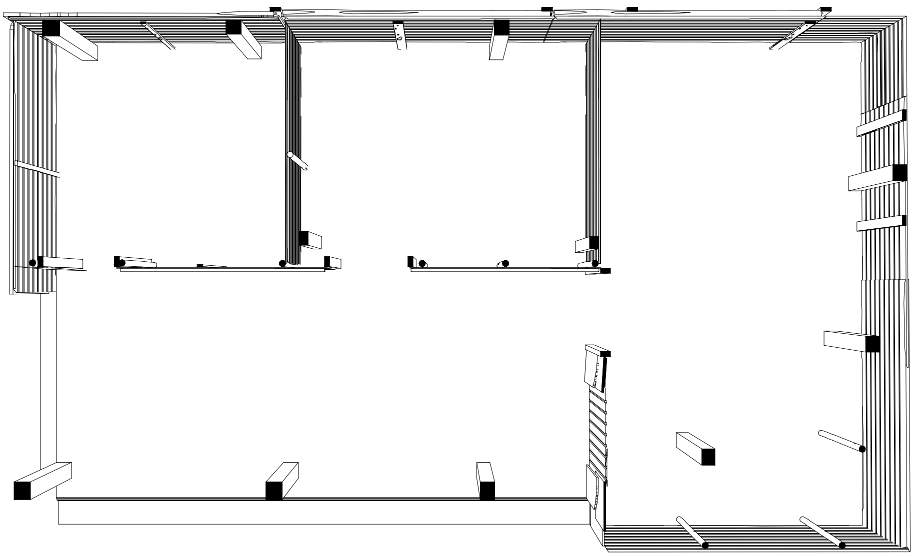
As a family of four, we had constructed our home a few years before the super cyclone in 1999. Although there were minimal modifications to the house in the subsequent years, the combination of wear and tear and an expanding family size after my marriage in 2011 prompted us to make significant improvements in 2019. These enhancements were not only a response to the urgent need for better living conditions but also a proactive measure following the destructive cyclones 'Fani' and 'Titli,' which wreaked havoc on both houses and the entire settlement.

Despite the house's size remaining unchanged since its initial construction, the mud walls and thatched roofing had suffered considerable structural and functional damage over the years. In 2019, we replaced all the walls with tin sheets supported by wooden planks, incorporating insulation boards obtained from ships and iceboxes between them. Similarly, the roof was fortified with polythene sheets and pieces of cloth to reinforce the thatch. To provide additional support, we used cement pillars salvaged from construction sites. Addressing the issues and coping mechanisms, after the cyclones in 2018-19, the tin sheets underwent extensive damage due to exposure to iron oxide from the nearby goods line. The insulation sheets were also harmed during this period, leaving only a single layer of tin sheets protecting the house. Consequently, indoor heating became a recurring challenge, exacerbated by the prevalent humidity in Paradeep.

Documentation

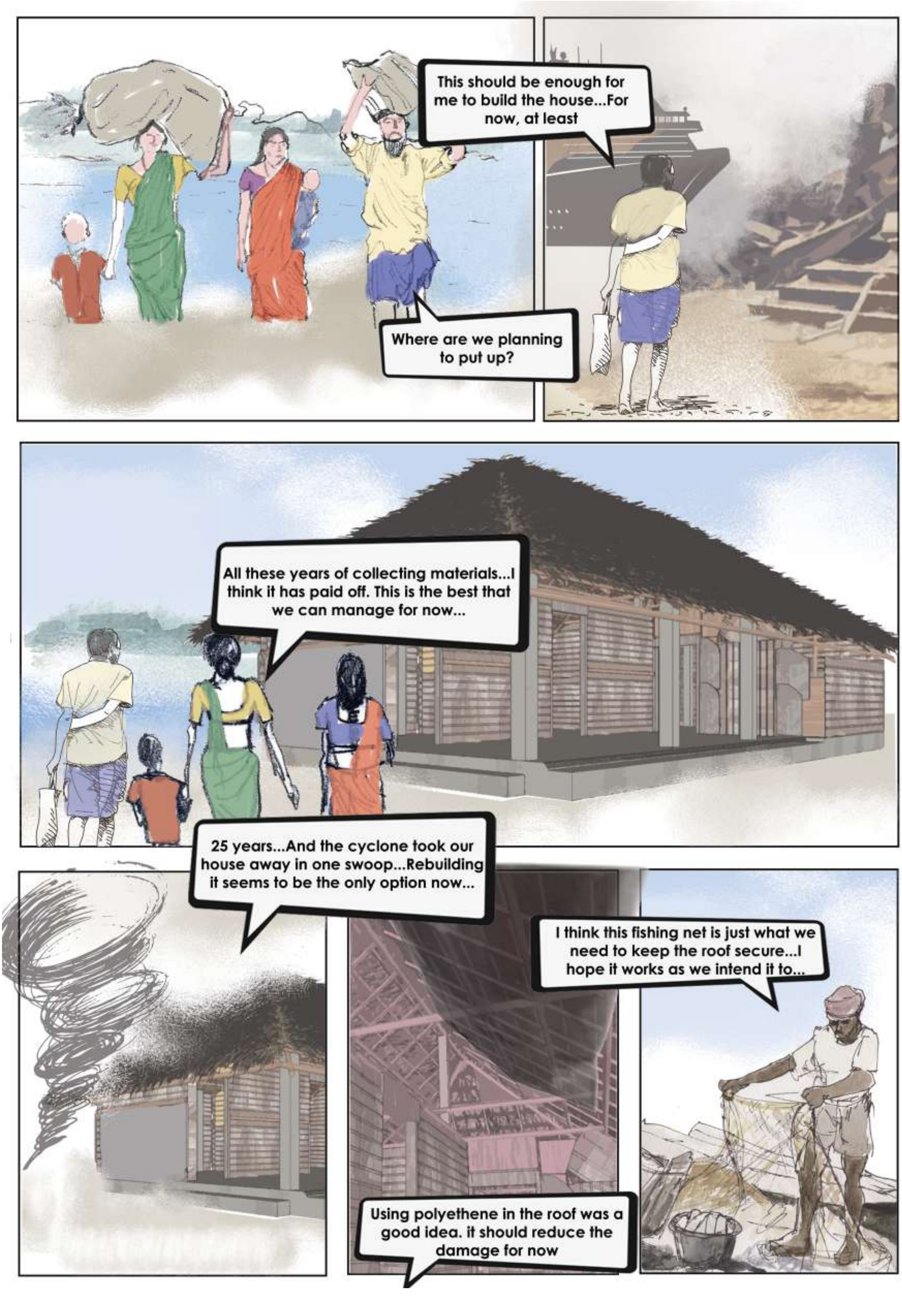


Section



Plan

1. Verandah
2. Temple
3. Kitchen
4. Bedroom


This should be enough for me to build the house...For now, at least
Where are we planning to put up?
All these years of collecting materials...I think it has paid off. This is the best that we can manage for now...
25 years...And the cyclone took our house away in one swoop...Rebuilding it seems to be the only option now...
Using polyethene in the roof was a good idea. it should reduce the damage for now
I think this fishing net is just what we need to keep the roof secure...I hope it works as we intend it to...

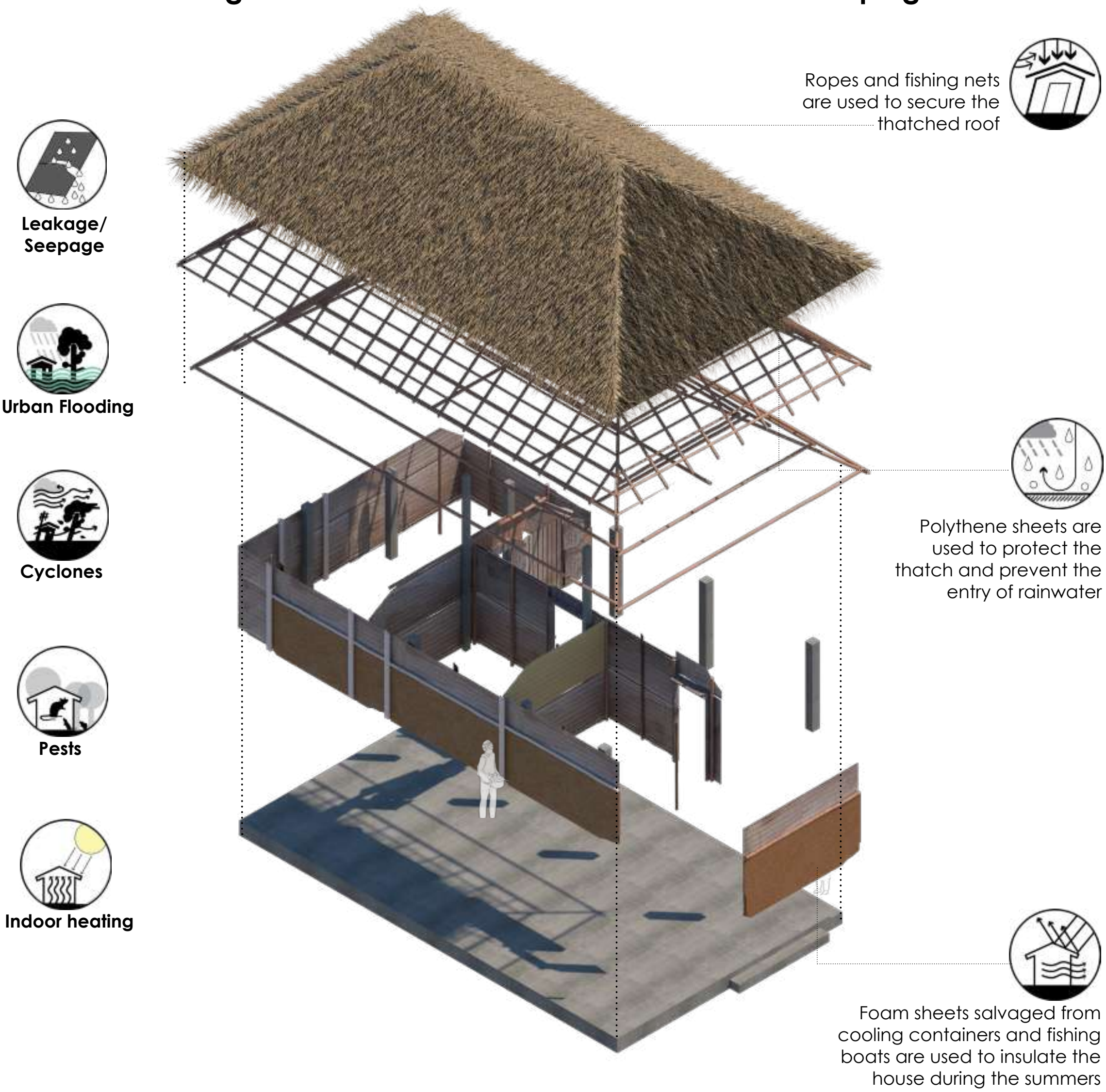

Its coming up quite well! I think the roof should last a while now...


The rain has saturated the thatch completely and made our dwelling unliveable...


Securing a cloth under the roof has helped a lot as the loose thatch is not a problem anymore!

Issues & Challenges

Coping Mechanisms



Timeline

Increments over time

Year	**1990s**	**2012**
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built+Skilled labour
Need	Family migrated to Lokpada	Damage suffered by the walls
Response	Dwelling built using locally procured materials	Dwelling walls rebuilt using an assortment of locally procured and salvaged material
Cost	Rs. 60,000	NA
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	Material	Thermal Conductivity [S]	Shelf-life [S]	Durability [U]	Maintainence [U]	Procurement [U]	Cost [S]	Execution [U]
ROOF	Timber beam	■■□□□	■■■□	■■□	Infrequent	New	-	Self-buit
	Timber Plank	■■□□□	■■■□	■■□	Infrequent	New	-	Self-buit
	Bamboo	■■□□□	■■■■	■□□	Frequent	New	Rs. 200-300/Pole	Self-buit
	Thatch	■□□□□	■□□□	■□□	Frequent	New	Rs. 6-7/ Bundle	Self-buit
	Polythene	■□□□□	■□□□	■□□	Frequent	New	-	Self-buit
WALL	Tarpauline	■■□□□	■■□□	■■□	Frequent	New	-	Self-buit
	Bamboo	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-buit
	Foam Insulated Metal Sheets	■□□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-buit
STRUCTURE	Timber section	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-buit
	Bamboo	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-buit
	Cement Column	■■□□□	■■■■	■■■	-	Salvaged	-	Self-buit
FLOOR	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Self-buit
	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 300-360/Bag	Self-buit

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

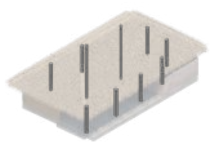
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

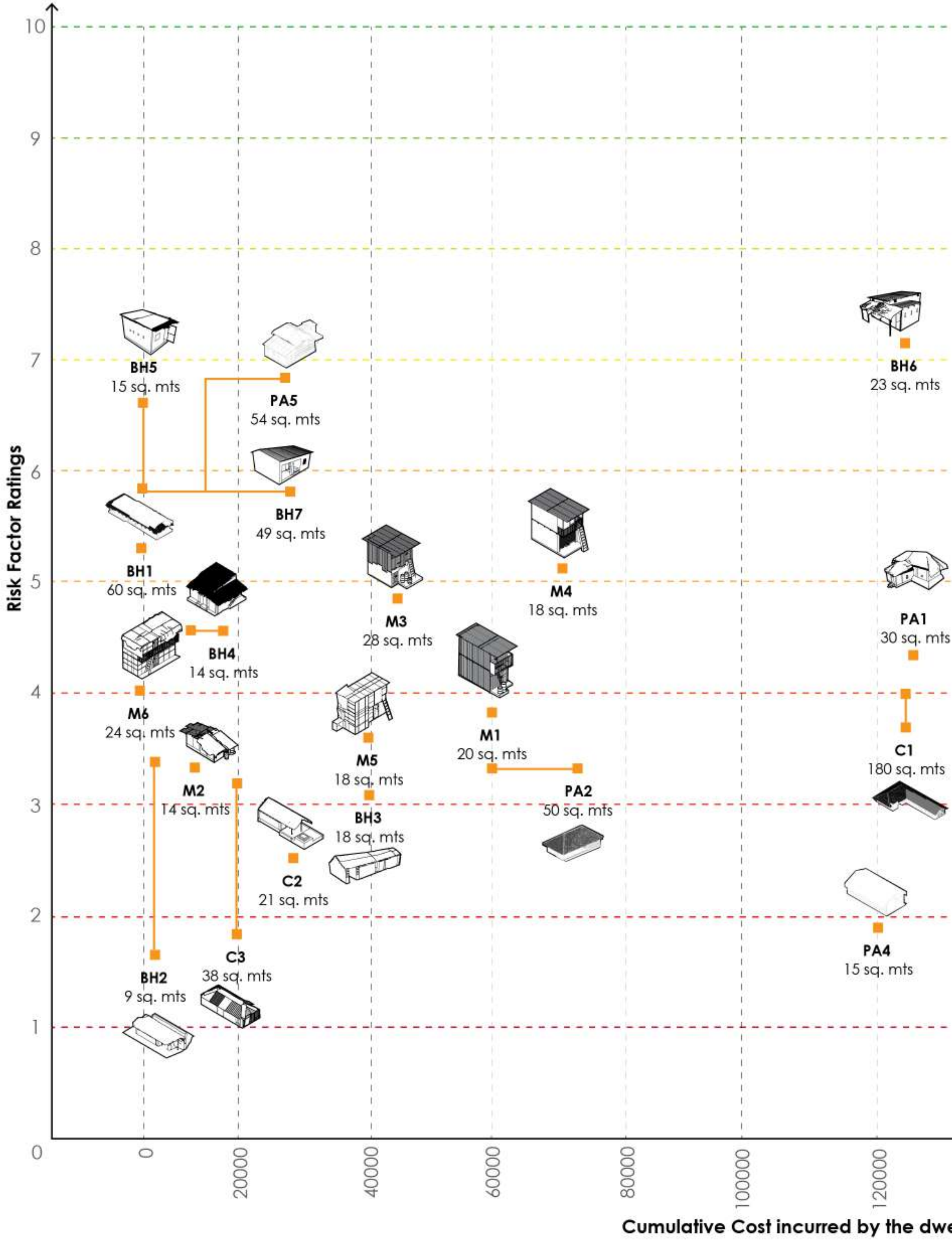
Users perspective: U



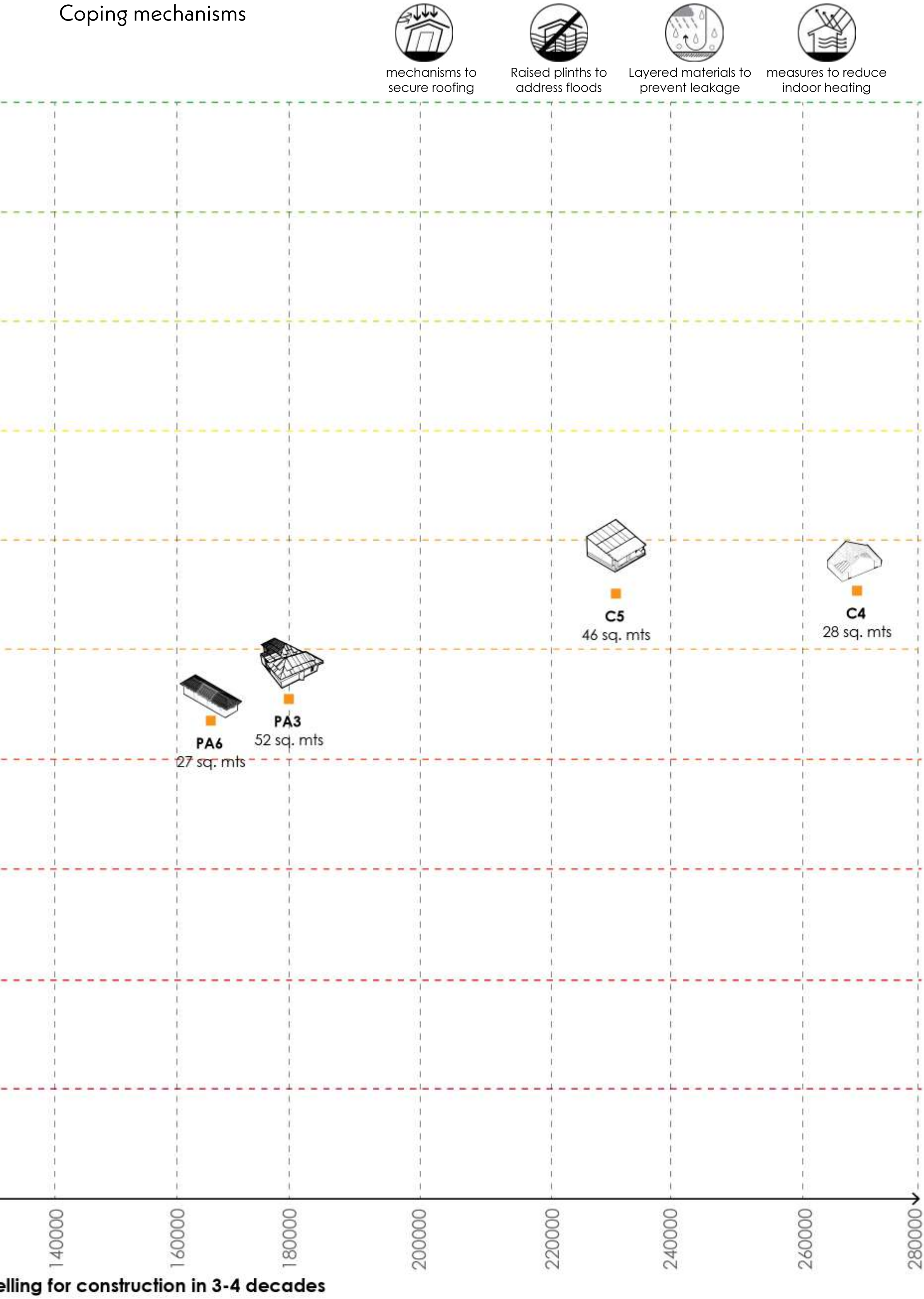
2019	2020	2023
Self-Owned	Self-Owned	Self-Owned
Self-Built+Skilled labour	Self-Built	Self-Built
Damage suffered by the roof	Structural damage	
Thatched roof replaced and supplemented with polythene sheets internally	Wood and cement columns installed to support the roof	Present status of the dwell-ing
NA	NA	
Self-Financed	Self-Financed	

Climate comfort and decadal costs incurred
Microclimate: Warm-Humid

D.U area (Min): **9 sq. mts**
D.U area (Max): **180 sq. mts**



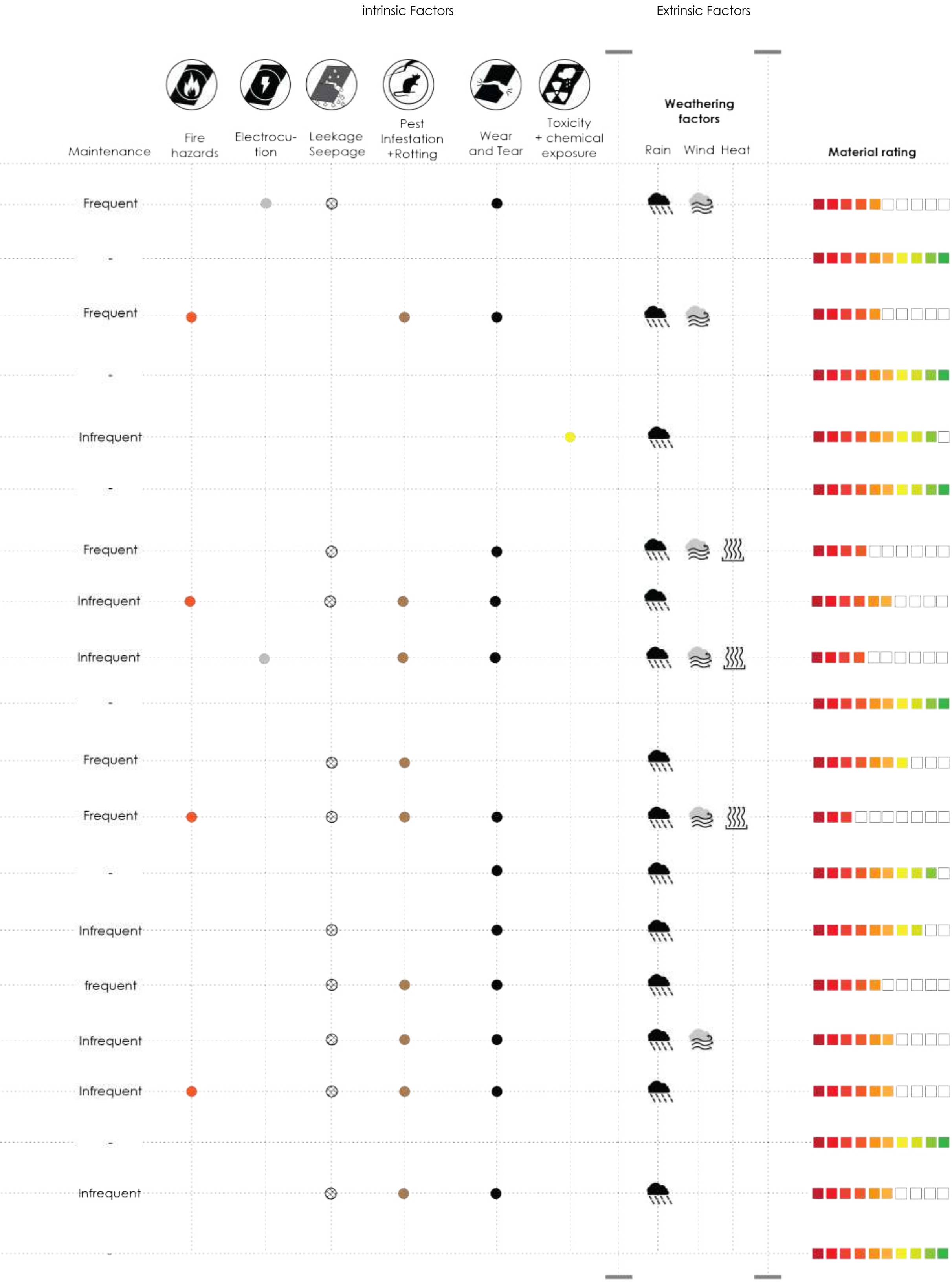
Coping mechanisms



Dwelling materials in the Warm-Humid Microclimate

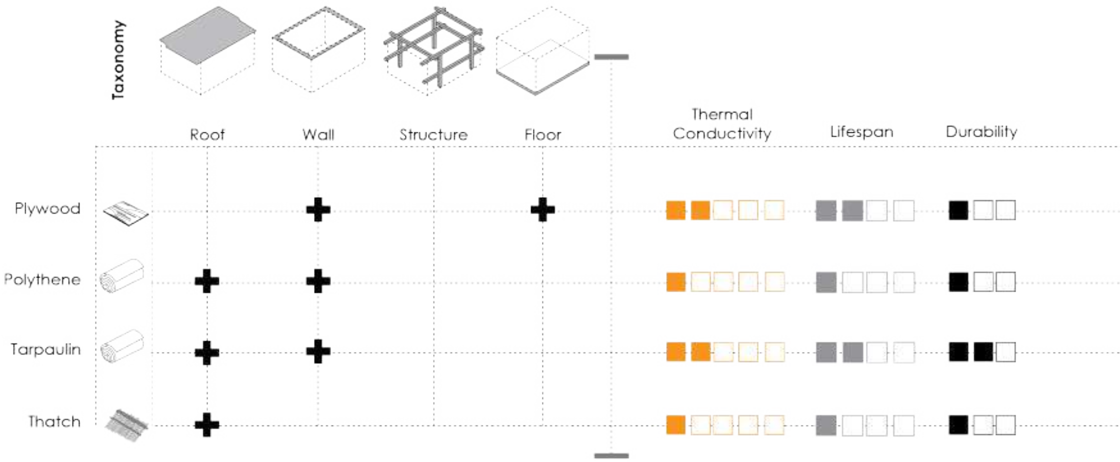
Analysing compositions and impacts

Taxonomy	Roof	Wall	Structure	Floor	Thermal Conductivity	Lifespan	Durability
Corrugated Tin Sheet	✚	✚			■■■■■	■■■□	■□□
AAC Blocks		✚	✚		■■□□□	■■■■	■■■
Bamboo	✚	✚	✚		■■□□□	■■■■	■□□
Brick		✚	✚		■■□□□	■■■■	■■■
Cement Board		✚	✚		■■□□□	■■■■	■■■
Cement Column		✚	✚		■■□□□	■■■■	■■■
Corrugated Cement sheet	✚	✚			■■□□□	■■■□	■□□
Flex banner	✚				■■□□□	■■■□	■■□
Foam Insulated Metal Sheets		✚			■□□□□	■■■□	■□□
Kota Stone				✚	■■□□□	■■■■	■■■
Mud		✚	✚	✚	■□□□□	■■□□	■■□
MDF		✚			■■□□□	■■□□	■□□
MS beams and section	✚		✚		■■□□□	■■■■	■■■
PCC		✚	✚	✚	■■□□□	■■■■	■■■
PCC Flooring (Thin)				✚	■■□□□	■□□□	■■□
Plaster		✚			■■□□□	■■■□	■■□
Timber	✚	✚	✚	✚	■■□□□	■■■□	■■□
Ceramic Tiles				✚	■■□□□	■■■■	■■■
Wattle and Daub		✚			■□□□□	■■■□	■■□
Vitrified Tiles				✚	■■□□□	■■■■	■■■


intrinsic Factors
Extrinsic Factors
Weathering factors
Maintenance
Fire hazards
Electrocu-tion
Leekage Seepage
Pest Infestation +Rotting
Wear and Tear
Toxicity + chemical exposure
Rain
Wind
Heat
Material rating
Frequent
-
Frequent
-
Infrequent
-
Frequent
Infrequent
Infrequent
-
Frequent
Frequent
-
Infrequent
frequent
Infrequent
Infrequent
-
Infrequent
-

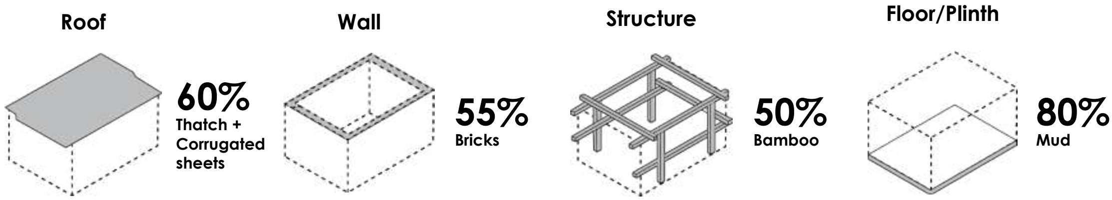
Dwelling materials in the Warm-Humid Microclimate

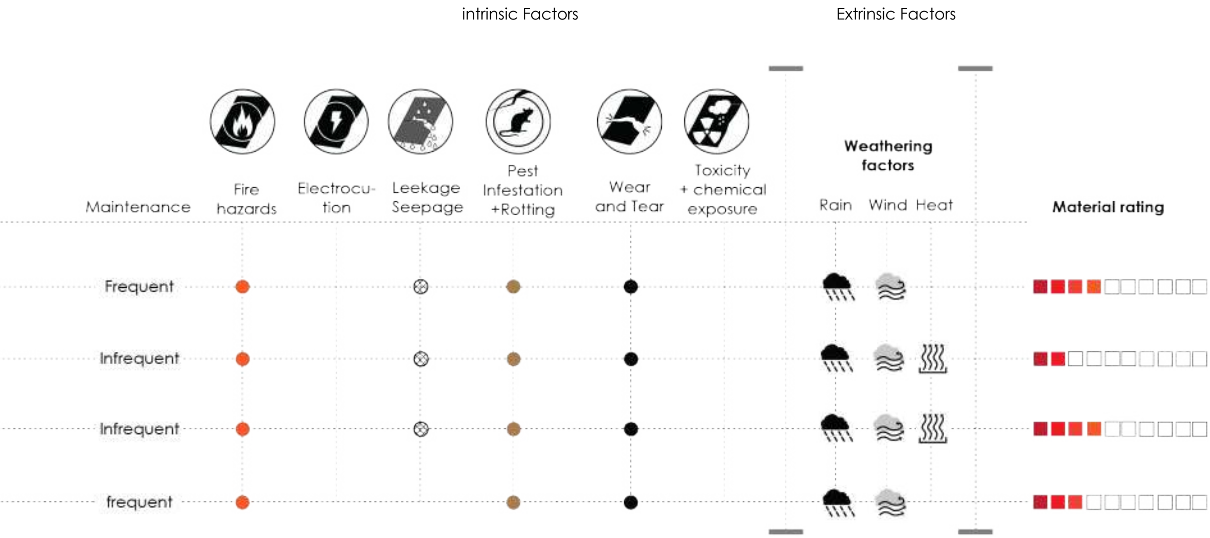
Analysing compositions and impacts



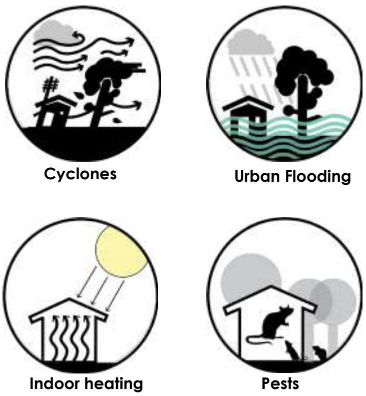
At a glance

The table above lists all the materials that are being used to construct the 24 dwellings documented across Mumbai, Bhubaneshwar, Cuttack and Paradeep in the warm-humid microclimatic zone and are mapped according to the taxonomy in which their use is prevalent.

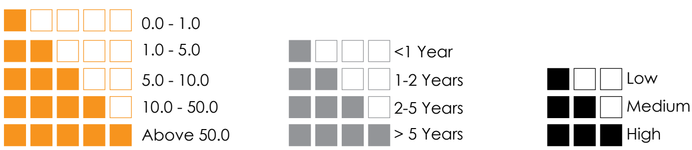




Contextual challenges: Warm-humid

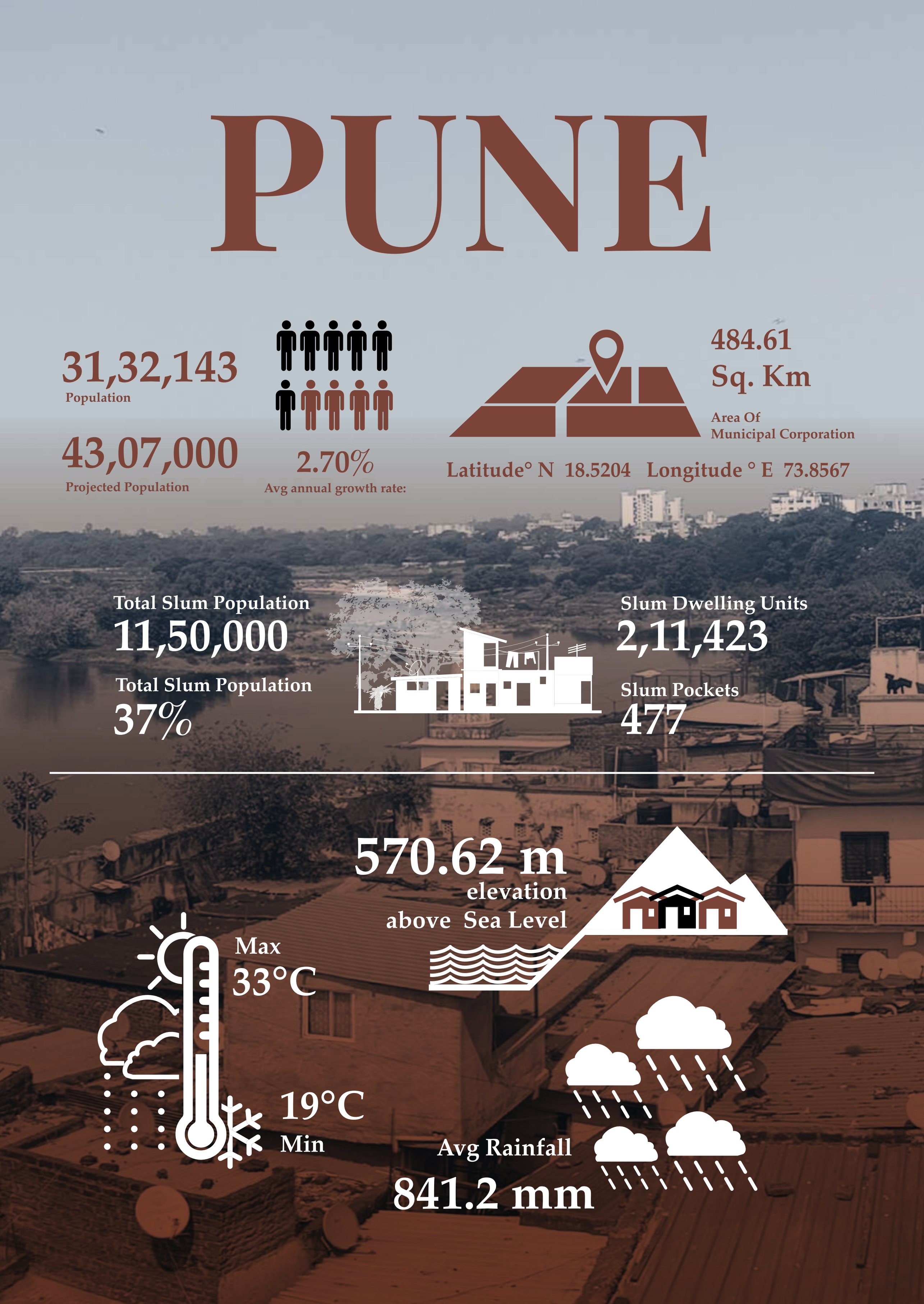


Legend



Mulamutheshwar
Rajiv Gandhi Nagar
Shanti Nagar

Composite


PUNE
31,32,143
Population
43,07,000
Projected Population
2.70%
Avg annual growth rate:
484.61
Sq. Km
Area Of
Municipal Corporation
Latitude° N 18.5204 Longitude ° E 73.8567
Total Slum Population
11,50,000
Total Slum Population
37%
Slum Dwelling Units
2,11,423
Slum Pockets
477
570.62 m
elevation
above Sea Level
Max
33°C
19°C
Min
Avg Rainfall
841.2 mm

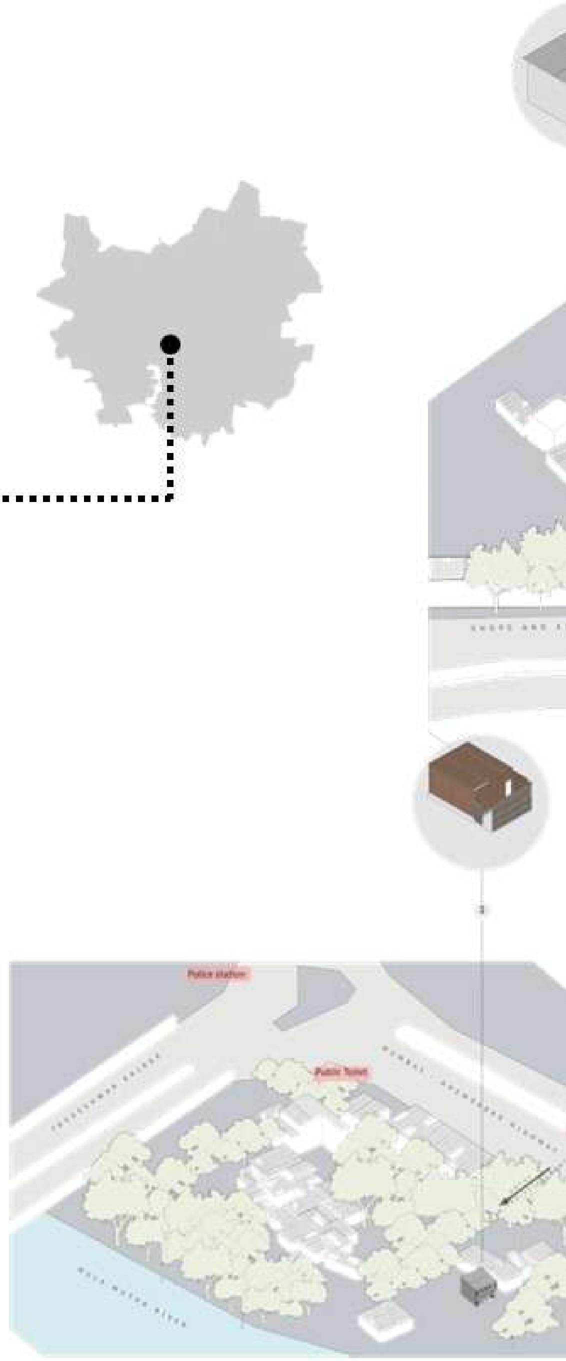
Pune: Navigating the Microclimate Challenges of 3 Informal Settlements

Pune a city of Maharashtra, often referred to as the Oxford of the East has composite climate. The city has undergone significant changes in the last three decades due to the rapid expansion of industrial areas. The city encounters hot and dusty winds in the summer and hailstorms during the winter. Despite being at a higher altitude, Pune experiences cold nights even in the hottest months. Pune, like many Indian cities, and has experienced various hazards over the years. One of the most prevalent challenges is the increasing frequency and intensity of extreme weather events. The city is susceptible to flooding during the monsoon season due to rapid urbanization, inadequate drainage systems, and encroachment on water bodies. Flash floods and waterlogging have become recurrent issues, causing significant disruptions in the lives of Pune's residents. Another hazard Pune has faced is heatwaves. Climate change has contributed to an increase in the frequency and intensity of heatwaves in the region. Slums of the city characterized by dense housing, are particularly susceptible to the adverse effects of extreme heat. Lack of proper ventilation and access to cooling facilities in these areas can lead to heat-related illnesses and discomfort for the residents. Additionally, Pune is situated in a seismically active zone, making it susceptible to earthquakes. While the region has not witnessed a major seismic event in recent years, the potential threat looms large. Pune city has 477 slums. The settlements that are intervened as part of the labs are Mula Mutheswar, Rajiv Gandhi Nagar and Shanti Nagar. In terms of construction materials, prevalent choices include metal sheets for roofing, plywood, brick, and bamboo for binding, while mortar is used for walls. Additionally, cement, ceramic tiles, and kota stones are commonly employed for flooring.

Pune's Micro Market

In Pune's Micro Markets it was documented that people who live informally choose metal sheets for the roofs and a variety of materials for the supports and walls, as they are less expensive than the other in the market. Various types of wood, mostly silver oak and eucalyptus were used extensively for supporting columns and rafters. Most the locals purchase building supplies made at the New Timber market. In contrast to other cities, Pune charges more for used materials when compared to brand-new ones. This is because the second-hand materials come from demolishing traditional houses in Pune and are made of hardwood. The variety of plywood and metal sheets available means that residents have a lot of options. Since most homes have shared walls, the transportation costs of the materials are often split by several households when the supplies are purchased.

PUNE



Area of the Settlement

0.58 Ha (1.44 acres)

0.23 Ha (0.56 acres)

2.3 Ha (5.8 acres)

Location of Settlement

Near River

Near Bus Stand

Near River

Total No. of Dwelling Units

60 DU (approx.)

120 DU (approx.)

1000 DU (approx.)

Rajiv Gandhi N

18°32'15.03"N 73°51'43.82"E

Mula Mutheshwar

18°32'41.21"N 73°53'8.11"E

agar

Shantinagar

18°34'6.54"N 73°52'27.63"E

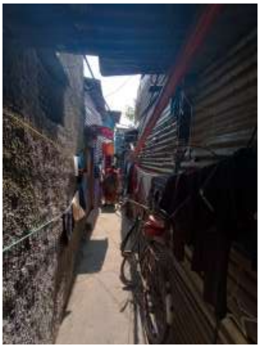
A Comprehensive profile of settlements in Pune

As part of the lab intervention, three settlements—Mulamutheshwar, Rajiv Gandhi Nagar, and Shantinagar—were selected for profiling. Mulamutheshwar, also known as Tadigutha, is a slum by the Mula Mutha river, covering 0.58 hectares (1.44 acres). It comprises 5% temporary, 70% semi-permanent, and 25% permanent housing, totaling 60 dwelling units. Rajiv Gandhi Nagar, near the bus stand, spans 0.23 hectares (0.56 acres) with 20% temporary, 65% semi-permanent, and 15% permanent housing, totaling 120 units. Shantinagar, close to the river, spans 2.3 hectares (5.8 acres), featuring 10% temporary, 80% semi-permanent, and 10% permanent housing, totaling 1000 units.

A significant challenge in Pune's communities is the tenure of ownership, primarily residing in rental homes, impeding upgrades. Galvanized iron corrugated sheets are commonly used for roofing and walls, facilitating rainwater drainage. Shared walls necessitate angled roofs for airflow, though bamboo frames and GI sheet walls pose challenges in door installation, prompting safety concerns. G.I sheets, while affordable, lack durability in Pune's variable weather, pushing a trade-off between short-term affordability and long-term sustainability.

Shared walls limit ventilation, causing suffocation and breathing issues, especially in high-temperature summers with inadequate cross ventilation. Basic amenities' absence in Rajiv Gandhi Nagar impacts living costs and material choices. In Mula Mutheswar and Shantinagar as both are near to river water logging during monsoons is tackled with high plinths due to terrain and water proximity. Frequent urban flooding affects residents' quality of life, yet permanent houses serve as shelters during calamities.

In response to challenges, residents' resort to tarpaulin sheets and PVC flex banners for rain and sun protection, also by painting roofs. Growing indoor plants helps maintain thermal comfort, showcasing a resourceful approach to dwelling conditions.



PU1 Mulamutheshwar

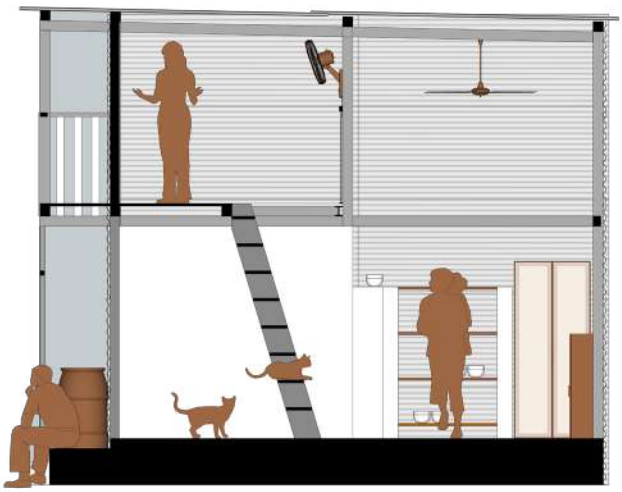
Name: Santoshi
Age: 42
Housing Tenure: Temporary (Kutcha)
Structure Type: Detached
Area: 48 sq. mts
Family Size: 7

Family Occupation: Metro watchman
House Investment - building, maintenance and upgrades: Rs.140500

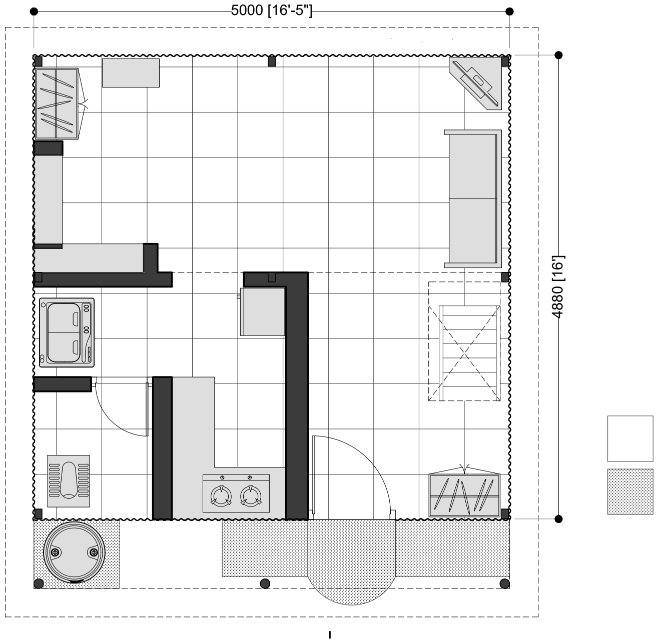
Our house has a corrugated tin sheet roof, which tends to make it hot inside during the summer and noisy when it rains. To address the issue of water leakage through holes, I've placed a tarpaulin over it, but unfortunately, it doesn't last long. We opted for wooden joists to support the tin roof because they effectively keep the house cool and are also cost-effective. Additionally, we use them to hang our lights. We've incorporated open windows high up in our house to release hot air, preventing it from becoming too stifling during hot weather. The floor is made of Kota stone to withstand the intense heat. Our house is designed with a simple structure, featuring a concrete base, walls constructed from bricks and mud, and a metal roof. The kitchen and bathroom walls are adorned with smooth plaster and paint.

The main walls consist of corrugated tin sheets supported by wooden structures. While corrugated tin sheets are budget-friendly, they may not withstand a severe storm, so there's a potential risk of them falling. To address this, we've added a layer of plywood on top of wooden joists to create a second floor. While plywood may not be as robust as hardwood, it remains a cost-effective solution. Additionally, a wooden handrail has been installed on the balcony for safety and aesthetics.

Documentation



Section



1. Foyer
2. Living/Sleeping Space
3. Kitchen
4. Toilet
5. Storage space
6. Water Storage

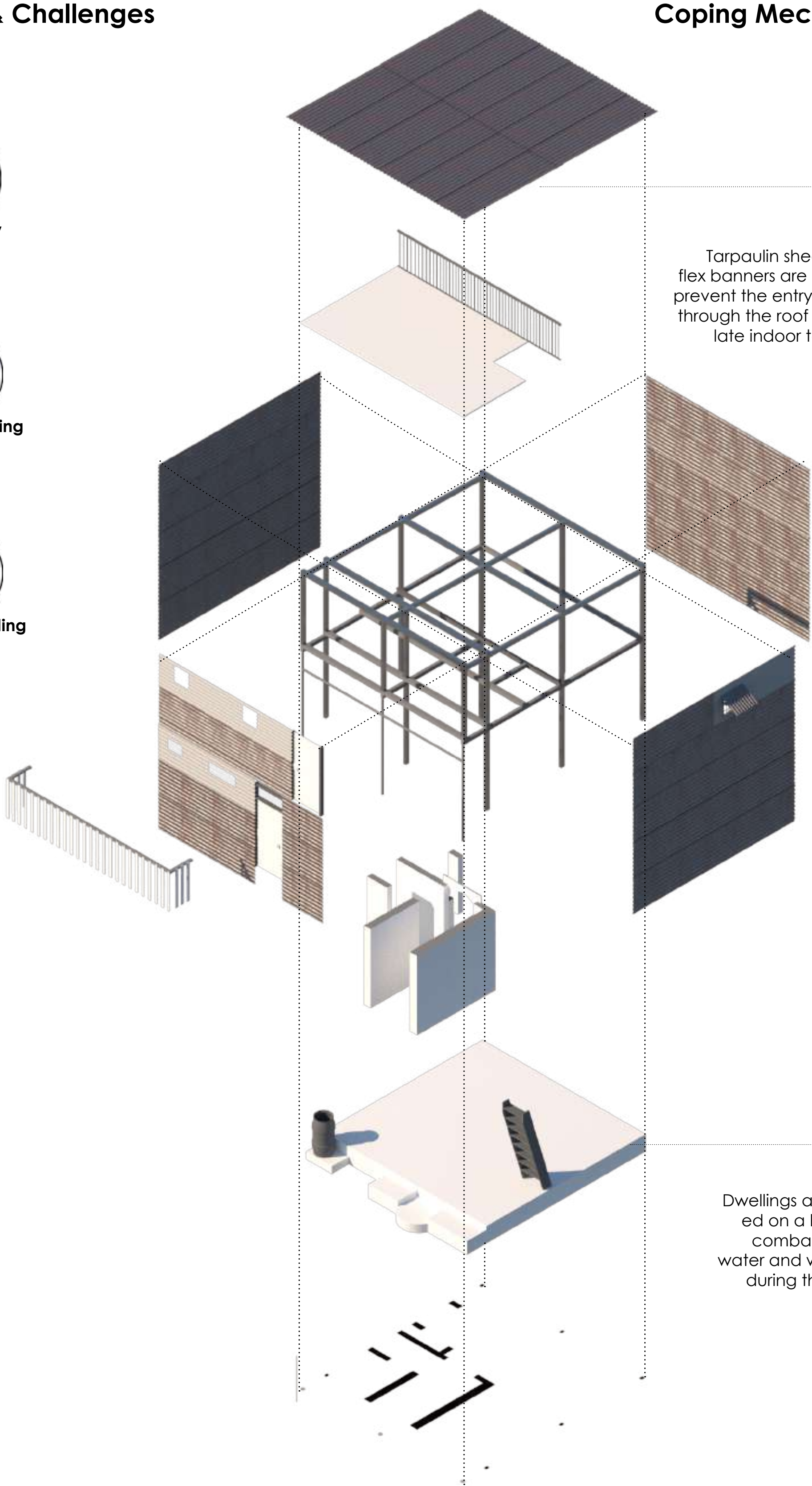
Plan

Issues & Challenges

Leakage/ Seepage

Indoor heating

Urban Flooding



Coping Mechanisms

Tarpaulin sheets aND PVC flex banners are used to both prevent the entry of rainwater through the roof and to regulate indoor temperatures

Dwellings are constructed on a high plinth to combat the entry of water and waterlogging during the monsoons

Attributes of materials

	Material (S)	Thermal Conductivity (S)	Shelf-life (S)	Durability (U)	Maintainence (U)	Procurement (U)	Cost (S)	Execution (U)
ROOF	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	New	Rs. 300/ Sheet	Skilled Labour
	Tarpauline	■■□□□	■■□□	■■□	Frequent	Second-Hand	-	Self-Built
WALL	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	New	Rs. 300/ Sheet	Self-Built
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 8/ Piece	Skilled Labour
STRUCTURE	Wooden planks	■■□□□	■■■■	■□□	Frequent	Second-Hand	Rs. 6/ Piece	Self-Built
	MS Section	■■□□□	■■■■	■■■	-	New	Rs. 90/kg	Skilled Labour
FLOOR	Plywood	■■□□□	■■□□	■□□	Frequent	Second-Hand	-	Self-Built
	Kota Stone	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 100/ piece	Skilled Labour

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

Durability

■□□ Low
■■□ Medium
■■■ High

Supply side perspective: S

Users perspective: U

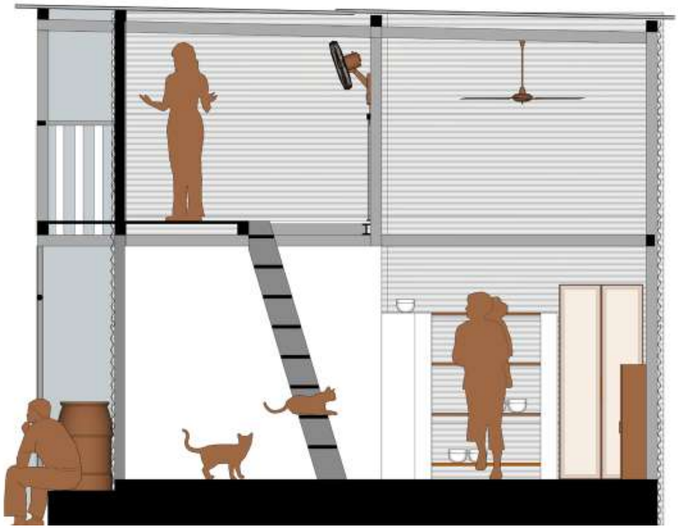
PU2 Rajiv Gandhi Nagar

Name: Shama
Age: 52
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Semi Detached
Area: 40 sq. mts
Family Size: 4
Family Occupation: Scrap dealer, Housewife
House Investment - building, maintenance and upgrades: Rs.128000

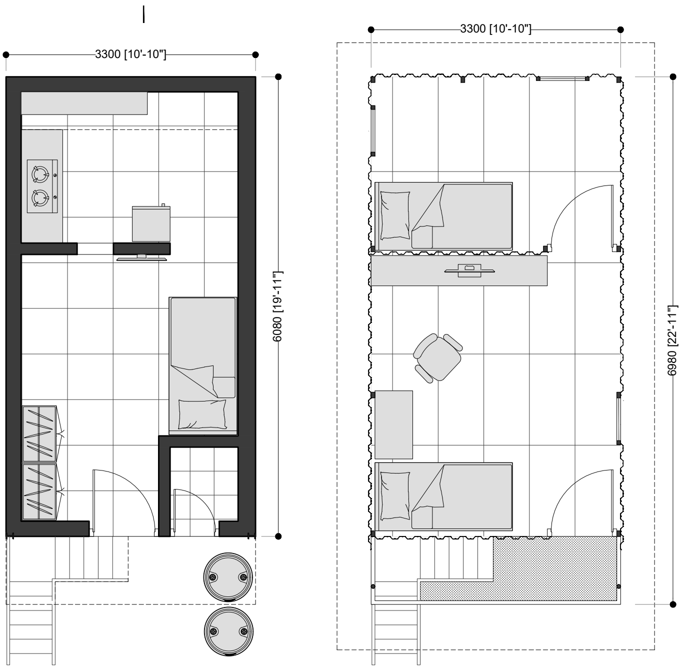
I live in a house where we've constructed the roof using corrugated tin sheets. When it rains, we cover it with plastic sheets to prevent water from leaking through the holes. Unfortunately, these plastic sheets don't last long and require frequent replacement. To support the metal roof, we've employed Mild Steel (MS) hollow sections. Sometimes, we purchase new ones, but when affordability is an issue, we opt for used ones from the local market. These beams not only support the roof but also serve as holders for our lights.

The floor inside our house consists of a stone slab with a steel beam underneath and a layer of concrete on top. To enhance its appearance without breaking the bank, we use colorful tiles sourced from construction waste. Essentially, my house is like a box with a concrete bottom, metal walls, and a metal roof. The lower walls are built with bricks, effective at keeping heat out but making it uncomfortably hot inside without proper airflow. The upper walls are made of the same corrugated tin sheets as the roof, which unfortunately do not withstand heavy storms. Our balcony features a railing made of square metal pipes and we use the balcony as a storage space for paper waste.

Documentation



Section



1. Foyer
2. Living/Sleeping Space
3. Kitchen
4. Balcony
5. Water Storage
6. Study Sleeping Space
7. Storage

Plan

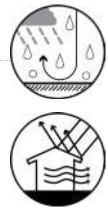
Issues & Challenges

Leakage/ Seepage

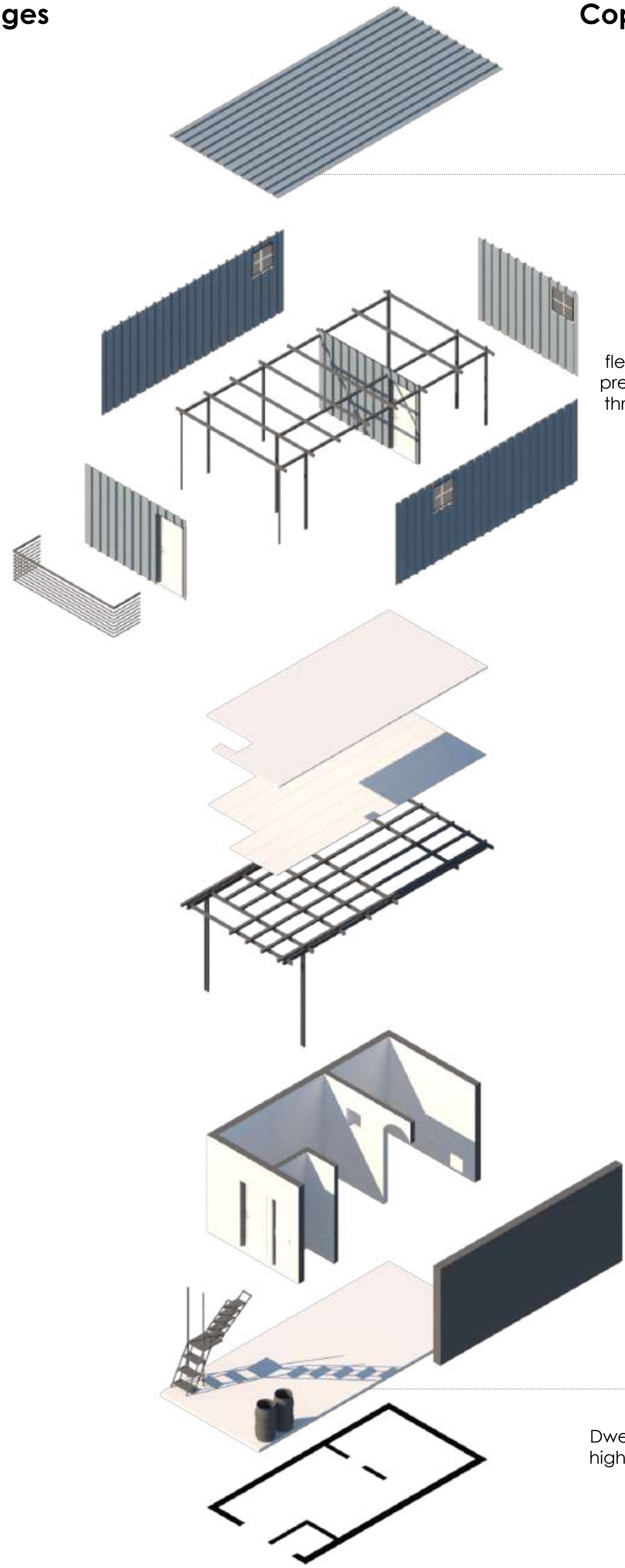
Indoor heating

Urban Flooding

Coping Mechanisms



Tarpaulin sheets aND PVC flex banners are used to both prevent the entry of rainwater through the roof and to regulate indoor temperatures



Dwellings are constructed on a high plinth to combat the entry of water and waterlogging during the monsoons

Attributes of materials

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Rs. 300/ Sheet	Rs. 300/ Sheet	Self-Built
WALL	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Second-Hand	Rs. 300/ Sheet	Self-Built
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 8/ Piece	Skilled Labour
	Plaster	■■□□□	■■■□	■■□	Infrequent	New	-	Skilled Labour
STRUCTURE	MS Section	■■□□□	■■■■	■■■	-	Second-Hand	Rs. 90/KG	Skilled Labour
	MS I beam	■■□□□	■■■■	■■■	-	Second-Hand	-	Skilled Labour
FLOOR	Vitrified Tiles	■■□□□	■■■■	■■■	-	New	-	Self-Built
	Kota Stone	■■□□□	■■■■	■■■	-	Second-Hand	-	Self-Built

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

Durability

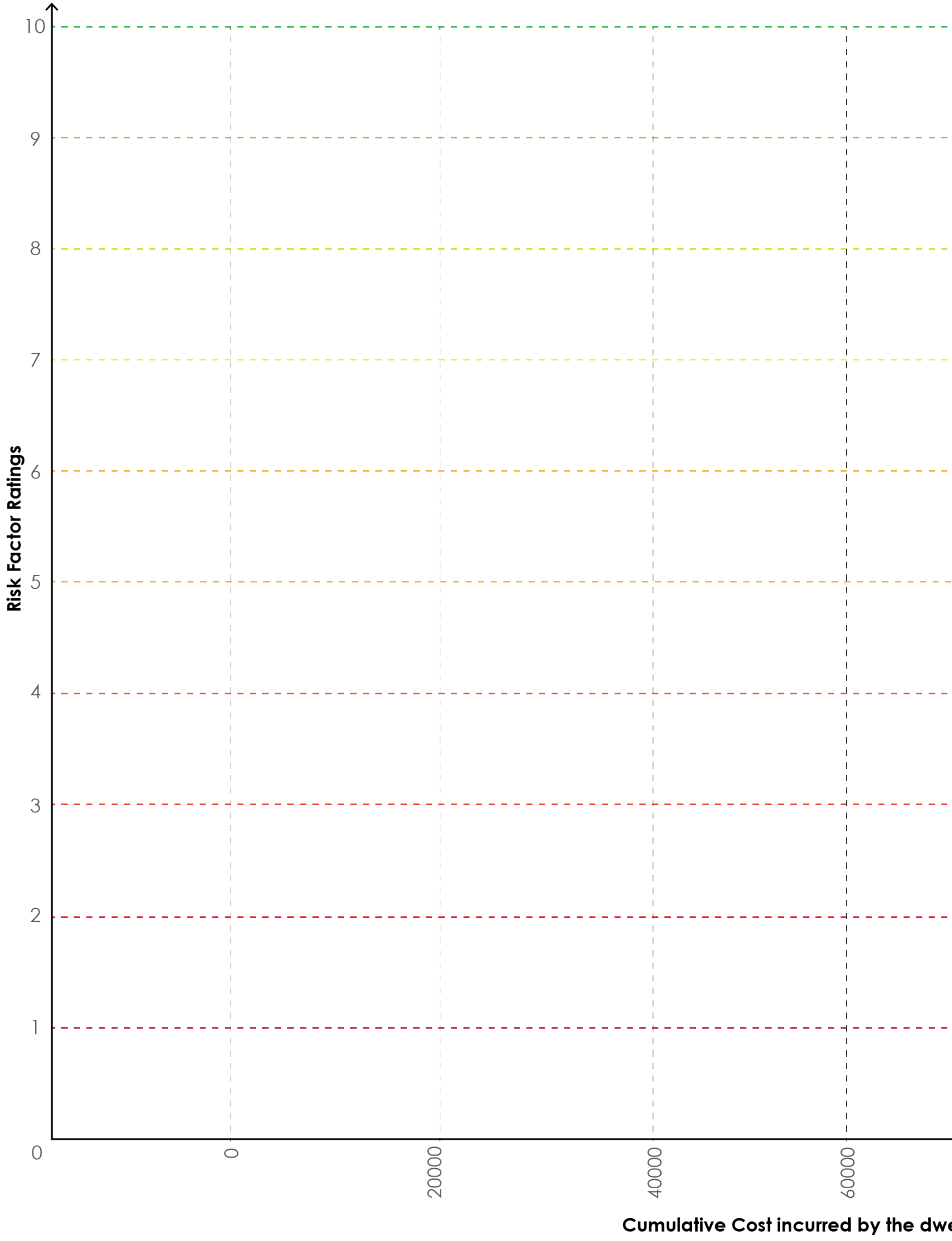
■□□ Low
■■□ Medium
■■■ High

Supply side perspective: S

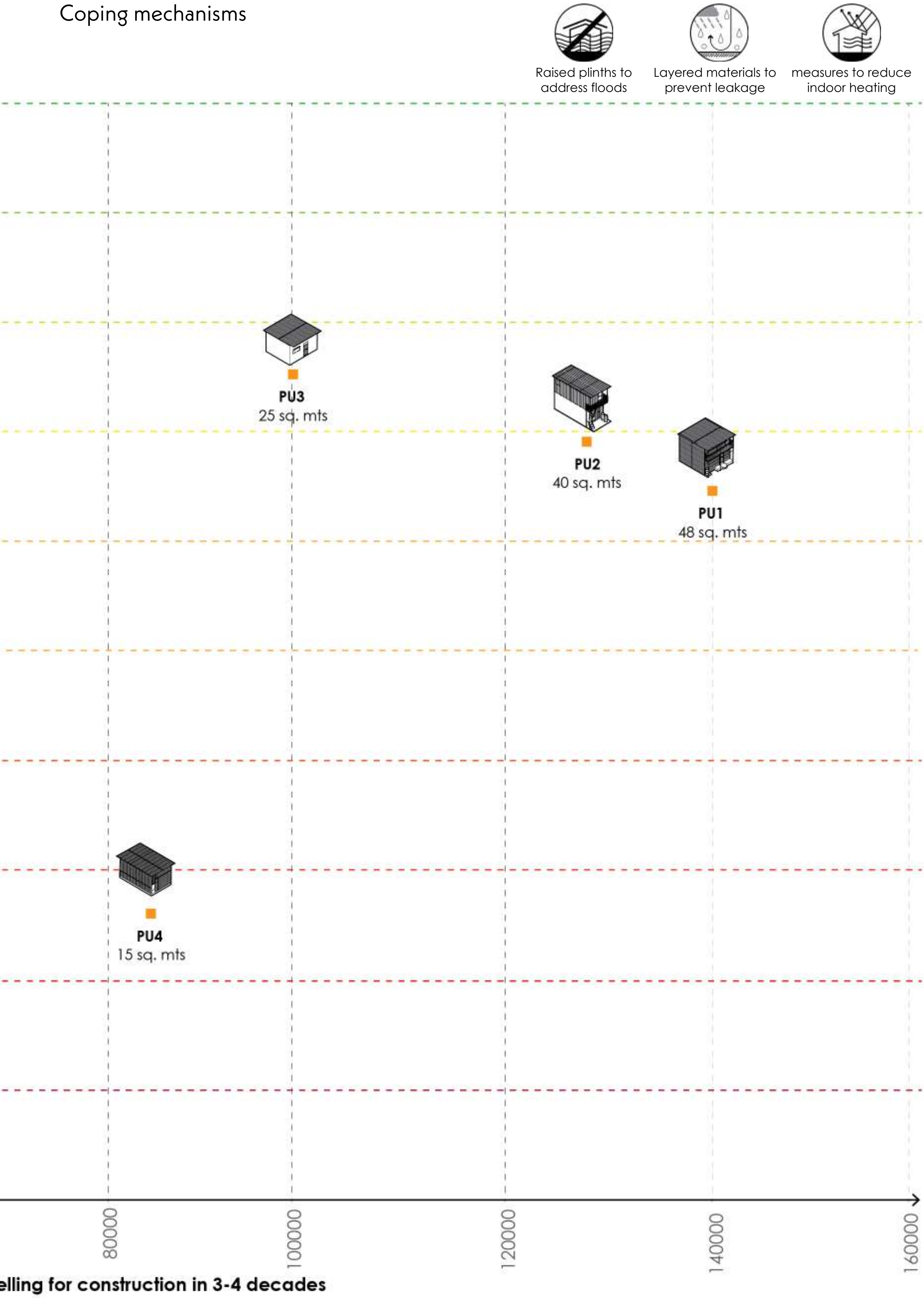
Users perspective: U

Climate comfort, and decadal costs incurred:
Microclimate: Composite

D.U area (Min): **15 sq. mts**
D.U area (Max): **48 sq. mts**

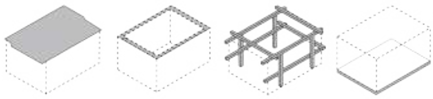


Coping mechanisms



Dwelling materials in the composite Microclimate

Analysing compositions and impacts

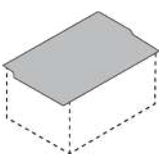


Taxonomy	Roof	Wall	Structure	Floor	Thermal Conductivity	Lifespan	Durability
Brick		+			■■□□□	■■■■	■■■
Corrugated Tin Sheet	+	+			■■■■■	■■■□	■□□
G.I. Corrugated sheet	+	+			■■■■■	■■■■	■■□
Kota Stone				+	■■□□□	■■■■	■■■
MS beams and section			+		■■□□□	■■■■	■■■
Brick					■■□□□	■■■■	■■■
Plaster		+			■■□□□	■■■□	■■□
Laminated Ply		+		+	■■□□□	■■■□	■■□
Plywood		+		+	■■□□□	■■□□	■□□
Vitrified Tiles				+	■■□□□	■■■■	■■■
Wooden planks			+		■■□□□	■■■■	■□□
Tarpaulin	+				■■□□□	■■□□	■■□
Flex banner	+				■■□□□	■■■□	■■□
PCC				+	■■□□□	■■■■	■■■

At a glance

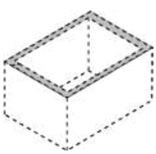
The table above lists all the materials that are being used to construct the 4 dwellings documented across pune in the composite microclimatic zone and are mapped according to the taxonomy in which their use is prevalent.

Roof



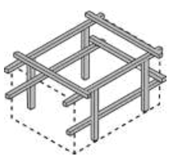
75% G.1. Corrugated sheets

Wall



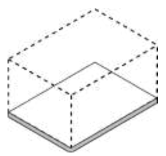
75% Bricks+ Plaster

Structure

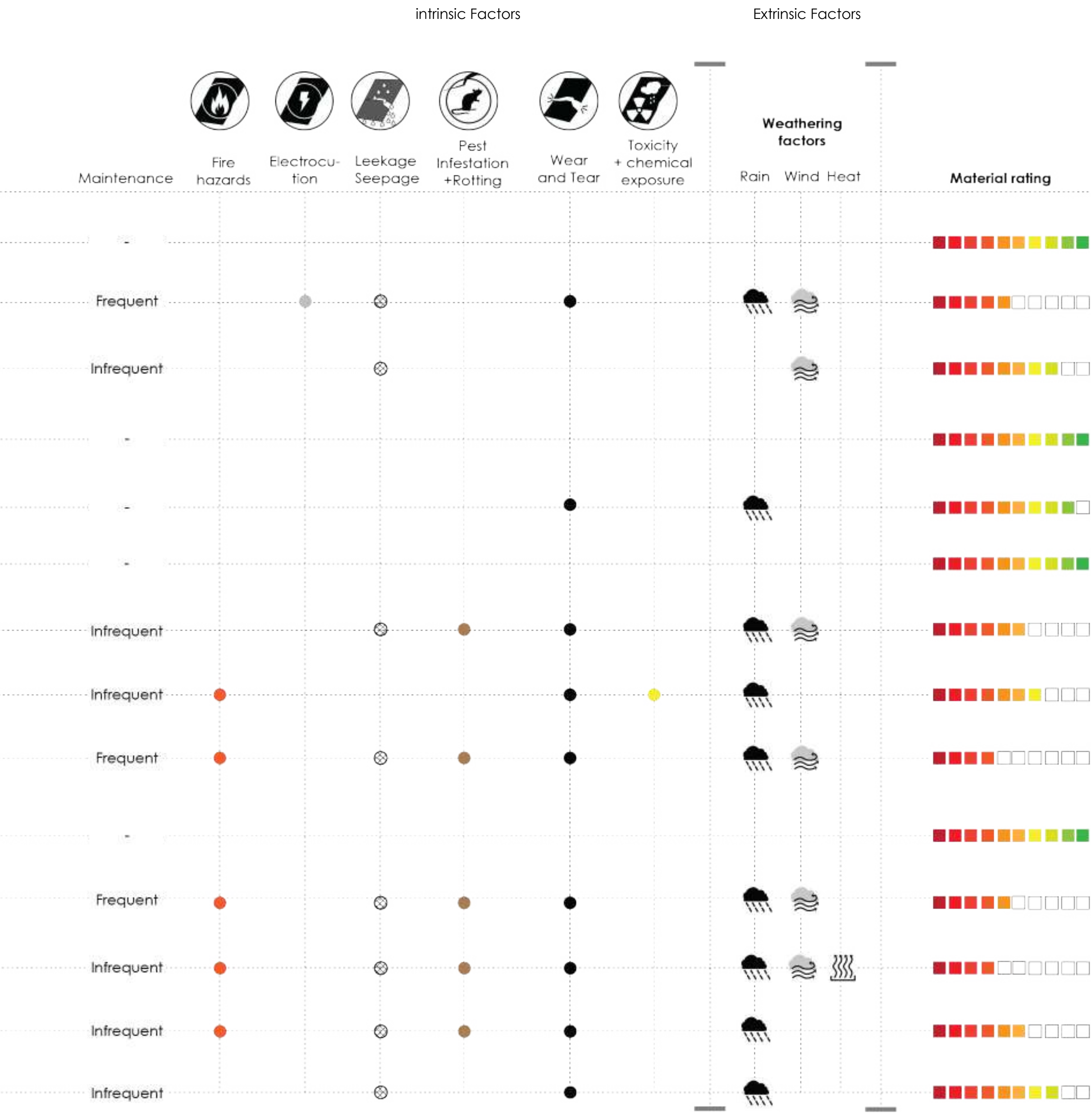


75% Mild steel Hollow sections

Floor/Plinth



50% Vitrified Tiles/Kota Stone

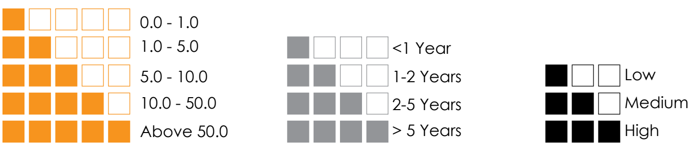


Contextual challenges: Composite

Urban Flooding

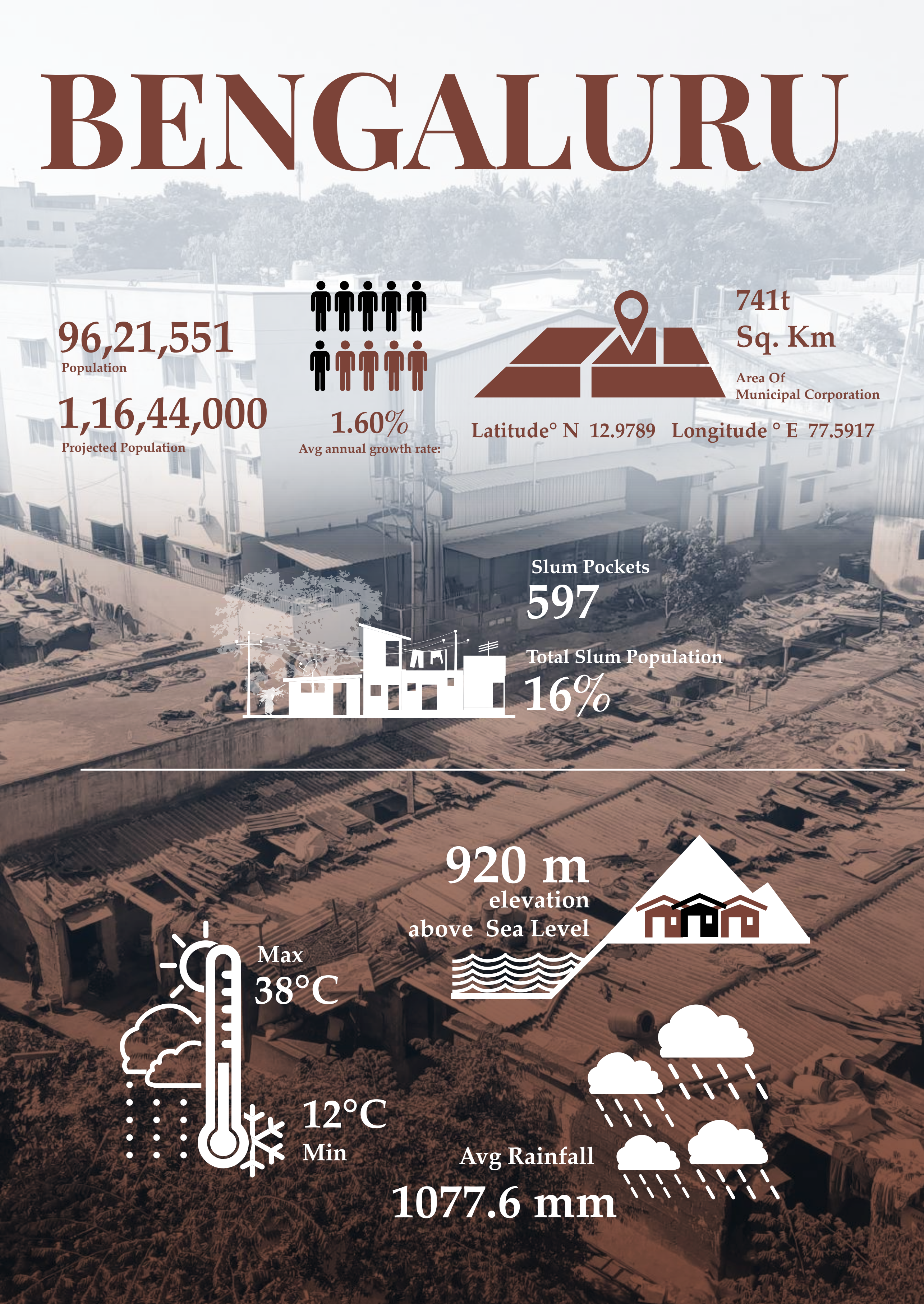
Indoor heating

Legend



Siddharth Colony
Devrajas Colony

Temperate


BENGALURU
96,21,551
Population
1,16,44,000
Projected Population
1.60%
Avg annual growth rate:
741t
Sq. Km
Area Of
Municipal Corporation
Latitude° N 12.9789 Longitude ° E 77.5917
Slum Pockets
597
Total Slum Population
16%
920 m
elevation
above Sea Level
Max
38°C
12°C
Min
Avg Rainfall
1077.6 mm

Bengaluru: Navigating the Microclimate Challenges of 2 Informal Settlements

Bengaluru is one of the largest cities of India often referred to as the Silicon Valley of India. There are 597 slums in Bengaluru and materials commonly used in slums of Bengaluru range from makeshift structures using corrugated sheets, bamboo, and tarpaulin to more permanent but often substandard structures made of brick and mortar. These materials, while cost-effective, may not adhere to the necessary safety standards, making the dwellings susceptible to structural failures and hazards.

The climatic conditions in Bengaluru further exacerbate the challenges associated with substandard construction materials. The city experiences a tropical savanna climate, characterized by distinct wet and dry seasons. The monsoon rains, which are prevalent during certain periods, can lead to waterlogging and flooding, particularly in low-lying slum areas. Substandard construction materials may not withstand the rigors of heavy rainfall, resulting in structural damage and posing a threat to the safety of residents. Additionally, Bengaluru has faced various hazards, including floods, excessive heat, and water scarcity. The inadequate infrastructure and subpar construction materials in slums exacerbate the impact of these hazards on vulnerable communities.

Siddharth Colony and Devrajas Colony, two settlements in Bengaluru inhabited by waste pickers, confront a distinctive array of challenges. The history of these communities is overshadowed by recurring fire incidents linked to their proximity to a chemical industrial hub. Additionally, Devrajas Colony faces the unique issue of being situated on agricultural land, leading to roof damage from falling trees and floors riddled with rodent holes.

Despite the uncertainty surrounding land tenure, residents find a sense of security in the absence of eviction threats. Cement corrugated sheets and AAC blocks are regarded as secure due to their durability and resistance to weathering. On the contrary, concerns arise with the use of timber beams and bamboo, primarily related to fire hazards and structural instability.

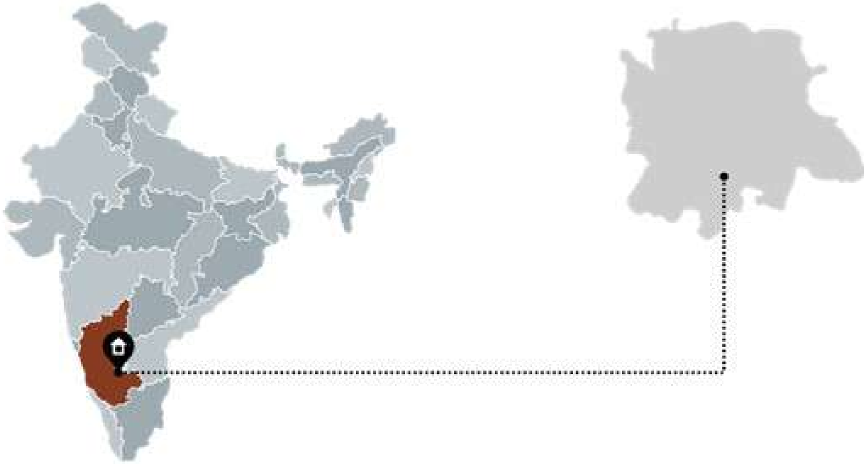
Bengaluru's Micro Market

In the bustling micro-market of Bengaluru, slum dwellers of both the settlements face unique challenges when it comes to improving their living conditions. Even if they manage to save enough money for their dwelling improvements, the availability of construction materials depends on their livelihoods, local development practices, and building methods.

Many of these families earn a living as construction laborers or waste pickers, and their income fluctuates based on the opportunities available. This uncertainty adds an extra layer of complexity to the already challenging task of acquiring materials for dwelling repairs and enhancements. Interestingly, many families source materials from demolition or construction sites, creating a network that spans their places of work, such as waste sorting areas.

Kamakshi Palya serves as a notable example of how the network of material acquisition operates. Scrap yards along the street, connected to demolition contractors and construction companies, supply a variety of materials for individual and commercial use. Timber poles from scaffoldings, for instance, are repurposed and sold to slum dwellers or reused in nearby construction projects. Wooden planks and scrap wood pieces undergo processing and are either sold at market prices or broken down and sold in bulk by weight. Cement sheets, a primary roofing material, pose challenges due to water and wind susceptibility. Second-hand sheets are acquired from factories or godowns at minimal prices, often because of minor damage. However, the market is geographically concentrated, leading to prohibitive transportation costs for some residents. In areas like Devrajaras colony, where second-hand cement sheets are only available in distant locations like Goripalya, and so residents are bound to explore all pathways, including construction sites, to gather materials for regular and urgent repairs. The availability and affordability of materials are intricately linked to the residents' sites of livelihood, emphasizing the importance of understanding the interconnected dynamics in this micro-market.

BENGALURU



Area of the Settlement

0.14 Ha (0.35 acres)

0.25 Ha (0.62acres)

Location of Settlement

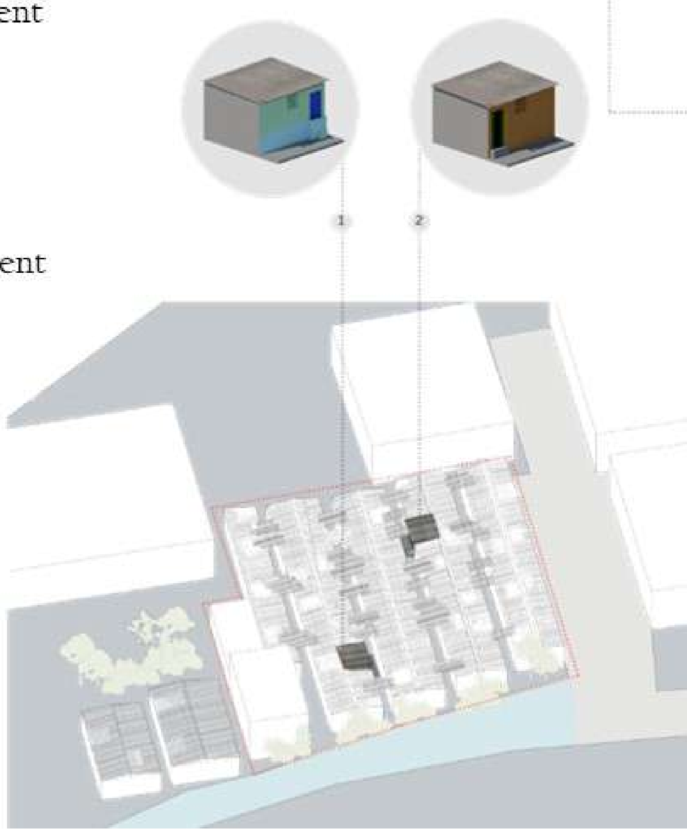
In Industrial Estate

Near overbridge

Total No. of Dwelling Units

100 DU (approx.)

110 DU (approx.)



Siddharth Colony

13° 0'59.43"N 77°30'3.88"E

Devrajas Colony

12°59'10.41"N 77°31'7.18"E

A comprehensive profile of settlements in Bengaluru

Siddharth Colony in Peenya, a settlement established three decades ago, primarily accommodates waste pickers who migrated from Gulburg in search of employment in nearby factories. Comprising 100 houses, the settlement displays a standardized pattern in both dwelling structures and design. A significant event in the settlement's history occurred approximately 15-20 years ago when a fire, ignited by an open stove in one of the houses, rapidly engulfed the dwellings due to chemical leak in industries adjacent. Initially the houses were frame structures covered with tarpaulin and plastic sheets - tents. Despite offers from local politicians, the development board, or the government to relocate the residents following the fire, the inhabitants resisted the idea, fearing displacement from their livelihood sites. Instead, a local politician proposed constructing houses for them. The land was divided into 100 parcels, and residents were provided with construction materials. The resulting standardized dwellings, constructed using bricks and cement, exhibit variations in flooring materials (mud or cement) and employ cement sheets for roofing. Divergent opinions exist among respondents regarding the benefactors behind the construction initiative. The residents, however, feel relatively secure due to the protection offered by local politicians, the enumeration of houses, and the settlement's location in the industrial area of Peenya.

Devrajaras colony, a settlement that emerged approximately 35-40 years ago on former agricultural land in Summanahalli, originated when people relocated from a nearby colony. Driven by the prospect of employment amidst a surge in local construction projects, a group of individuals gathered their kin to join them. Their primary focus was securing work as construction laborers on the main road and the flyover, under construction at that time. Today, the livelihoods of the 110 families, primarily immigrants from Northern Andhra Pradesh, Bellary, and Pakala, revolve around male employment in construction and truck driving, while women are predominantly involved in waste picking and segregation. Despite the insecure tenure conditions of the agricultural land, the settlement has received basic services through local

politicians and NGOs. The Slum slum is officially notified. The area's sanitation facilities consist of a single 8-seater community toilet provided by Water Aid, while water for daily use is sourced from 12 common taps. Dwellings are constructed using salvaged materials such as plastic and tarpaulin sheets, PVC flex banners, cement sheets, and timber poles obtained from waste picking yards and construction sites. Residents face vulnerabilities, including the annual replacement of roofs damaged by rains and high winds. Coconut trees pose a threat, and rodents damage polythene and tarpaulin sheets. Mud floors, susceptible to burrowing pests, are reinforced with a thin layer of cement, although its effectiveness is limited. Residents acquire materials for dwelling construction from nearby shops and sites, transporting them personally. The construction of a dwelling, carried out by the residents themselves, takes 1-2 months. Many residents, employed in the transportation of construction materials, gather materials from demolition and construction sites, informed about their locations through their work.

Cement corrugated sheets and AAC blocks are regarded as secure due to their durability and resistance to weathering. On the contrary, concerns arise with the use of timber beams and bamboo, primarily related to fire hazards and structural instability. During adverse weather conditions, such as rain, cement sheets and tarpaulin sheets are employed, while mud floors are upgraded to cement to prevent water seepage. Nevertheless, health risks persist due to exposure to rain, wind, and rodents. Cost-effective enhancements are made using materials sourced from construction sites, waste picking areas, and second-hand markets.

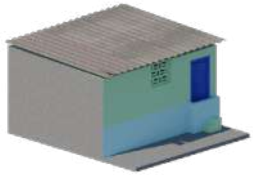
BE1 Siddharth Colony

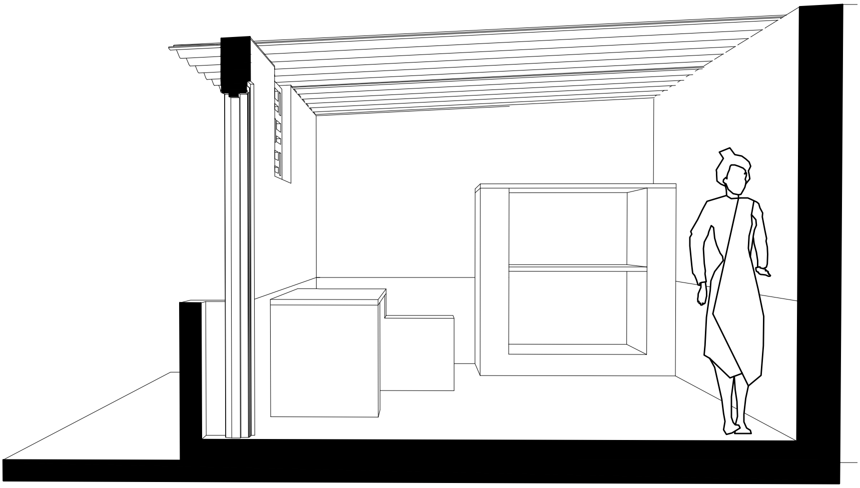
Name: Monamma
Age: 42
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Attached
Area: 11 sq. mts
Family Size: 4
Family Occupation: Waste Picker
House Investment - building, maintenance and upgrades: Rs.6716

Around 20 years ago, I, along with my family, constructed the house that we live in. This was approximately 5 years after the tent we used to live in previously was destroyed in the fires due to chemical leak that ravaged Siddhartha Colony. The rebuilding process incurred no costs for us, as families like ours, displaced by the calamity, were informally rehabilitated through the efforts of local politicians. Consequently, not many of us had significant financial investments during this period. Donated materials, such as cement blocks, were utilized, and mud floors were used to construct our house. We salvaged cement sheets from our workplaces for roofing, while scrap wood was repurposed for doors. Over the following years, we made essential improvements in response to our evolving needs. The mud floors, vulnerable to water soaking, were promptly reconstructed using cement—a direct response to the seasonal floods in the settlement.

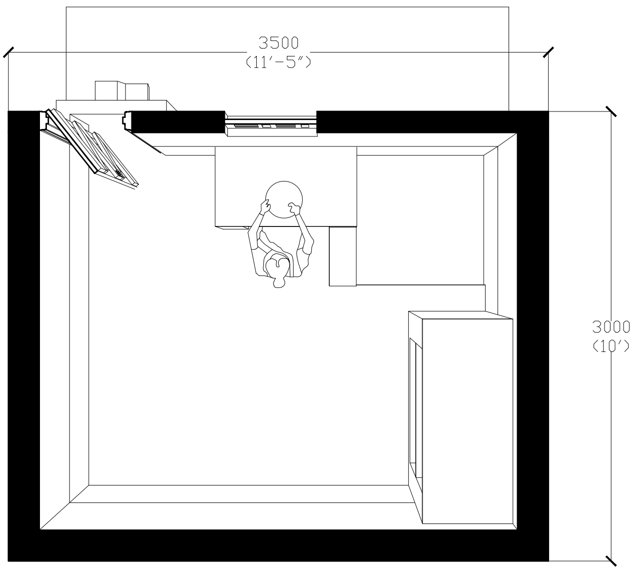
In the course of these developments, a corner of our house was transformed into a private washing area as part of the family's investment, ranging from 1000 to 2000 rupees. Additionally, in 2020, we built a bund in front of our house to combat floods and prevent sludge from the adjacent canal from entering our house. This adjustment was observed in most other houses. Despite our efforts, the bunds we constructed have proven ineffective in preventing water from entering our house. Flooding, heightened indoor temperatures due to cement roofs exposed to direct sunlight, elevated ambient temperatures from nearby factories, and the absence of an electrical connection, exacerbating the indoor heating are issues faced by us. However, clusters of houses collectively employ shading devices made from various materials to cover the narrow walkways between the houses and so we sleep, and do our day to day activities outside the house.

Documentation





Section



Plan

1. Multipurpose Room

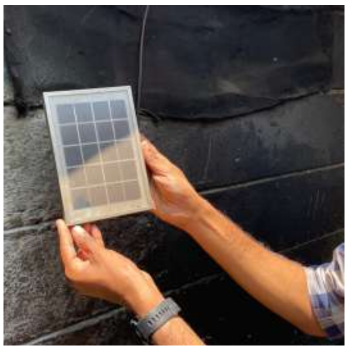
Dwelling BE1, Siddhartha Colony, Bengaluru. Narrow streets, a putrid canal and poorly ventilated single room dwellings comprise the daily lives of people who breath the air of heavy industries that envelope their settlement. Activities, personal and collective, take place in these small enclaves that exist in the spaces between their dwellings.

BE2 Siddhartha Colony

Name: Devamma
Age: 50
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Detached
Area: 11 sq. mts
Family Size: 7
Family Occupation: Waste picker (Paper), Construction labours
House Investment - building, maintenance and upgrades: Rs.5775

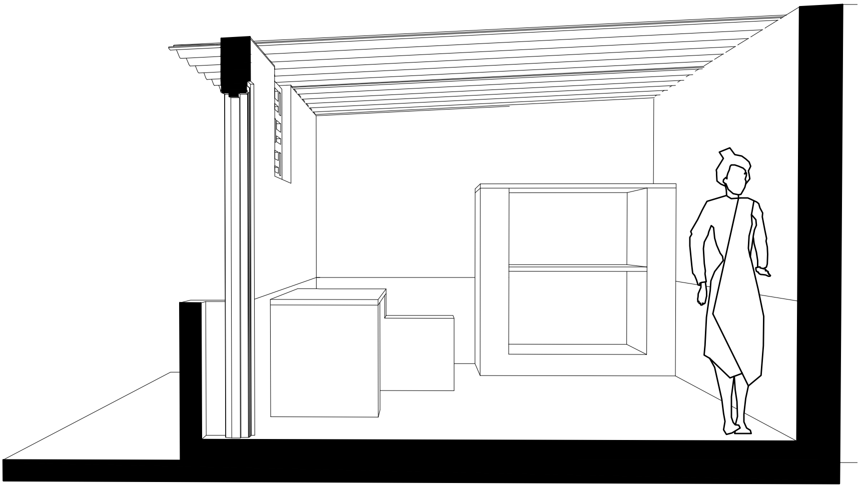
In the year 2000, I, along with my family, migrated to Siddhartha Colony in search of work. During that time, we constructed a shack using timber poles, thatch, and tarpaulin sheets. By 2003, we got, a semi-pucca structure similar to others in the settlement, but the fire incident destroyed almost all the houses.

Since then, there have been no significant improvements. The standardization of dwellings in the settlement, coupled with constraints such as limited space, financial limitations, and insecure tenure conditions, hinders our ability to invest in enhancements. When our roofs are damaged, we replace the materials using salvaged items from waste picking yards and construction sites. Our dwelling faces various issues, including flooding, excessive indoor heating caused by cement roofs exposed to sunlight, and higher ambient temperatures due to surrounding factories. The absence of an electrical connection exacerbates these problems and so to cope up with that we have installed a solar panel to meet the needs.

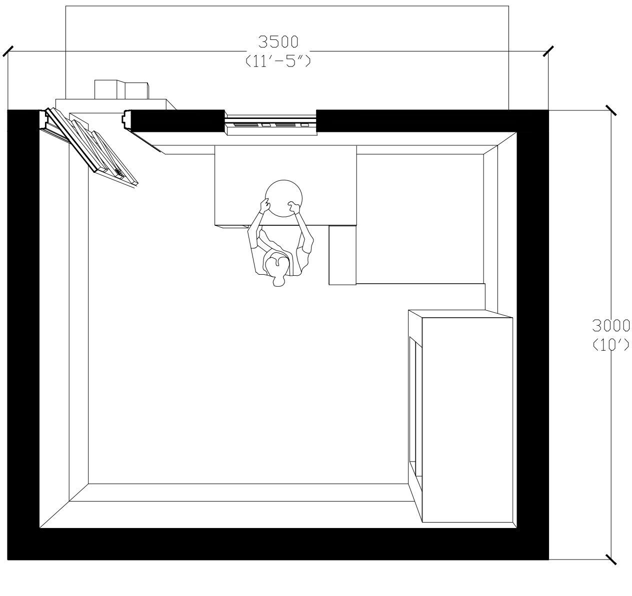


However, we collectively address some issues by adding shading devices in the narrow walkways between houses. Tarpaulin sheets are used to mitigate rain, although their effectiveness is limited.

Documentation



Section



Plan

1. Multipurpose Room

Issues & Challenges **Coping Mechanisms**

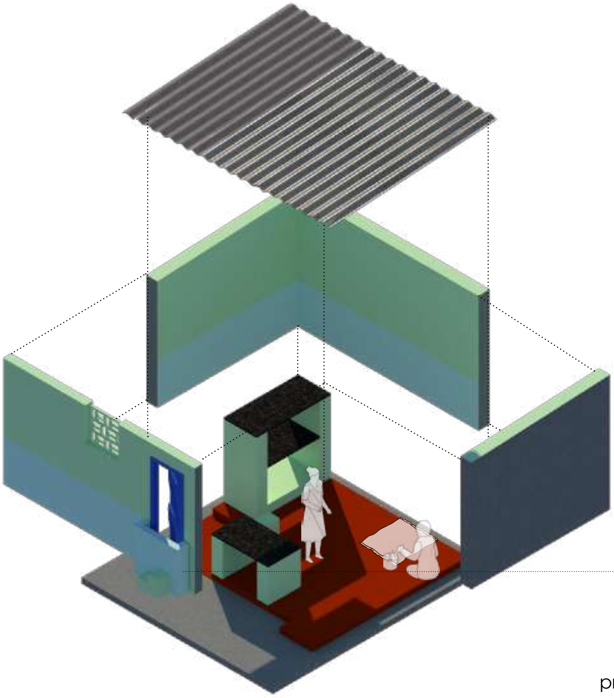
Leakage/ Seepage

Urban Flooding

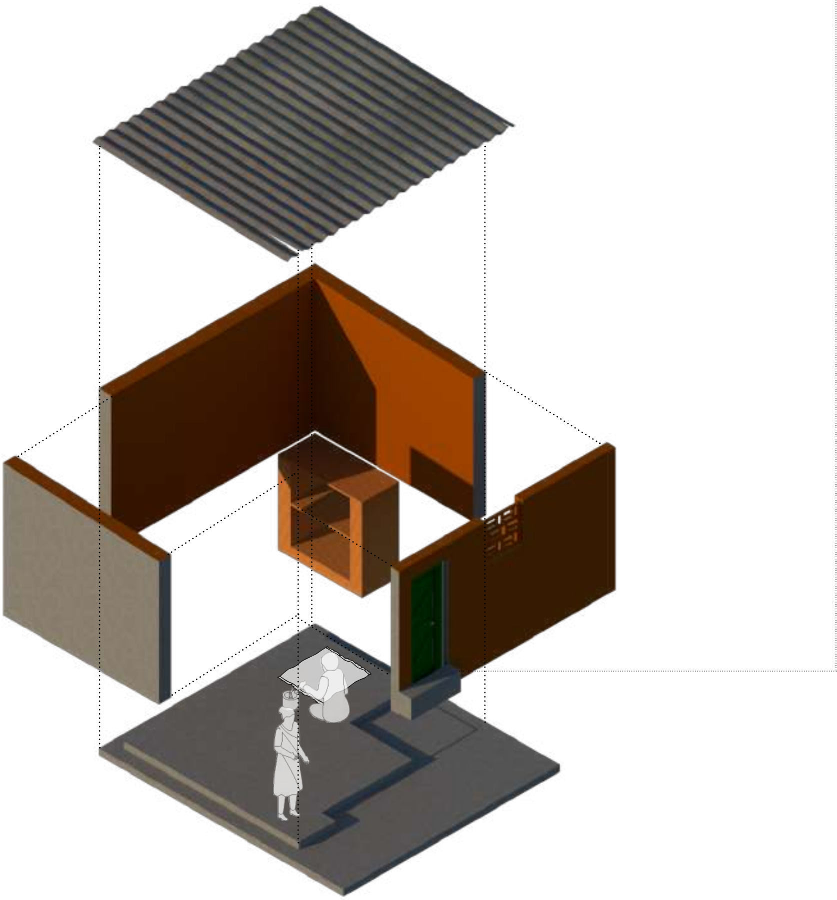
Electrocution

Pests

Indoor heating



Raised Bunds have been buillt in front of the houses to prevent the entry of rainwater during the monsoons



Attributes of materials

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Donated	-	Self-Built
WALL	Plaster	■■□□□	■■■□	■■□	Infrequent	Donated	-	Self-Built
STRUCTURE	AAC blocks	■■□□□	■■■■	■■■	-	Donated	-	Self-Built
FLOOR	PCC	■■□□□	■■■■	■■■	Infrequent	Donated	-	Self-Built

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Donated	-	Self-Built
WALL	Plaster	■■□□□	■■■□	■■□	Infrequent	Donated	-	Self-Built
STRUCTURE	AAC blocks	■■□□□	■■■■	■■■	-	Donated	-	Self-Built
FLOOR	PCC	■■□□□	■■■■	■■■	Infrequent	Donated	-	Self-Built

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

Durability

■□□ Low
■■□ Medium
■■■ High

Supply side perspective: S

Users perspective: U

BE3 Devarajas

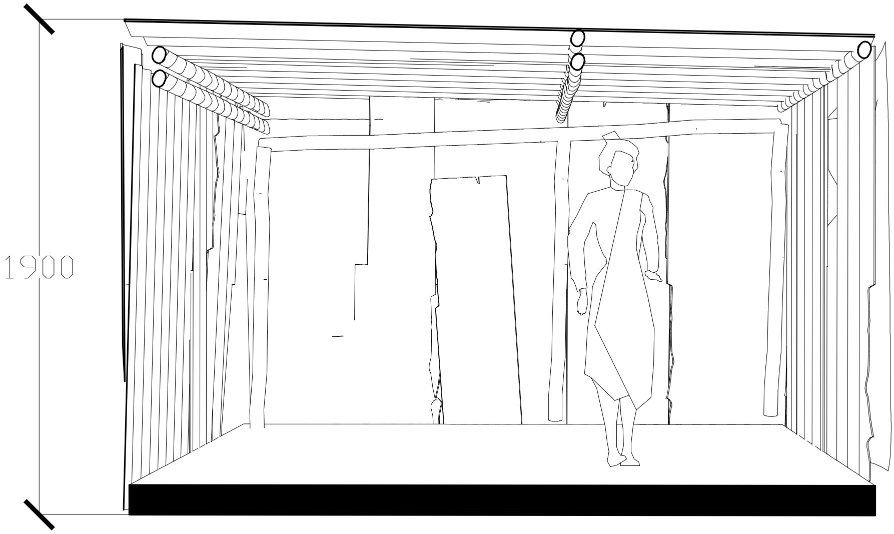
Name: Lakshmi
Age: 28
Housing Tenure: Temporary (Kutcha)
Structure Type: Attached
Area: 5 sq. mts
Family Size: 4
Family Occupation: Waste picker

I live in Devarajas colony and our house recently underwent a change. My brother built this dwelling originally, just like the others around here. It had timber and tarpaulin tent back in 2008. In 2015, we rebuilt it using cement sheets and a few other materials, and we replaced the mud flooring with cement. Functionally, the house has changed; it was a single unit until five months ago when we partitioned it to make space for two separate families.

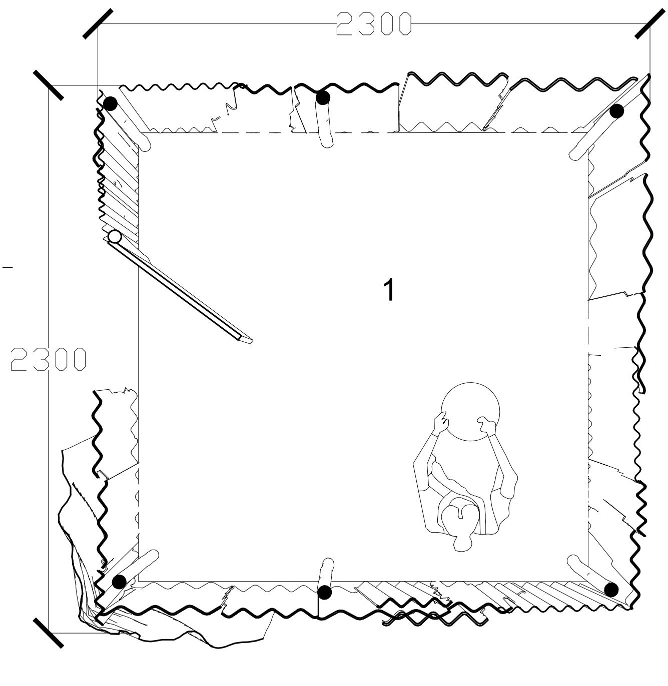
We often reuse sheets after the rains, replacing them only when they're irreparably damaged. The last replacement was during the 2022 monsoons. One major issue is that the rains damage the cement sheets, causing them to dislodge from the frame. Another problem, common to all houses here, is indoor heating. The cement sheets don't cool off sufficiently at night, and this is worsened by the unreliable electricity supply.

To cope with these challenges, we often engage in activities outside. The narrow walkways between the dwellings serve as a makeshift community space for the larger family to interact and carry out activities. During the rains, we use polythene and tarpaulin sheets and salvage PVC flex banners for protection from waste picking yards.

Documentation



Section

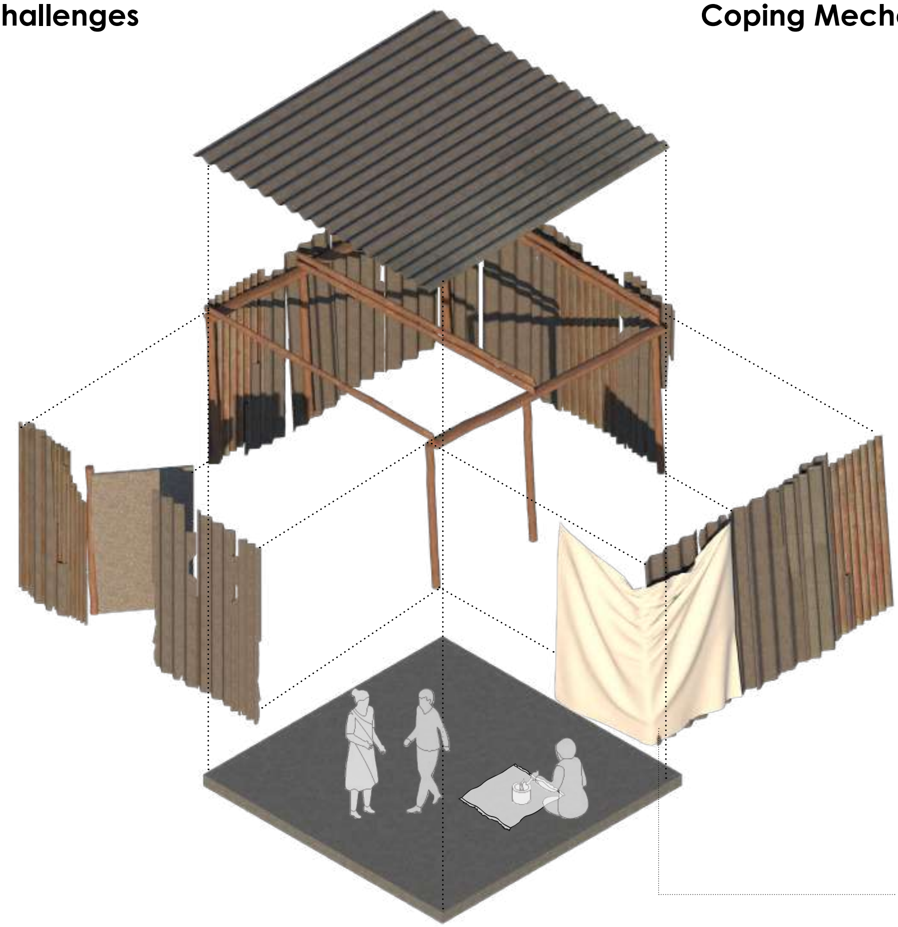


Plan

1. Multipurpose Room

Issues & Challenges

Coping Mechanisms



Polytnene, PVC flex banners and Tarpau-line sheets are all used in varying propor-tions to prevent the entry of rainwater into the dwelling

Timeline

Increments over time	
Year	**2008**
Tenure Arrangement	Self-Owned
Construction	Self-Built
Need	Family migrated to Devrajaras
Response	Dwelling built using salvaged materials
Cost	NA
Financing Mechanism	Self-Financed

Attributes of materials

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Salvaged	-	Self-Built
WALL	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Salvaged	-	Self-Built
	Flex Banner	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
STRUCTURE	Bamboo	■■□□□	■■■■	■□□	Frequent	Second-Hand	Rs. 70-260/Pole	Self-Built
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	Salvaged	-	Self-Built

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

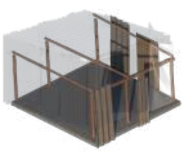
■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

Durability

■□□ Low
■■□ Medium
■■■ High

Supply side perspective: S

Users perspective: U



2015	**2022**
Self-Owned	Self-Owned
Self-Built+Skilled labour	Self-Built+Skilled labour
Severe structural damage to the shack	Damage suffered by the walls
Dwelling rebuilt on a new frame and cement plinth. Cement sheets used for walls	Cement sheets replaced
NA	NA
Self-Financed+Hand-loans	Self-Financed+Hand-loans

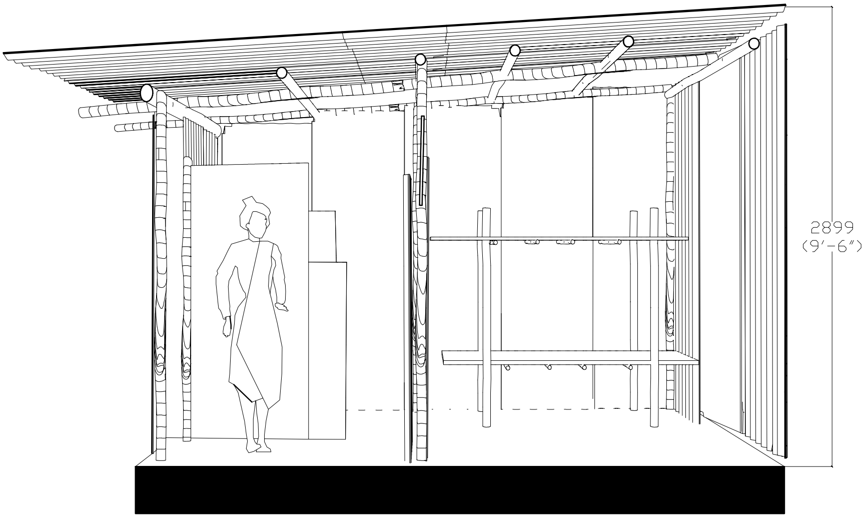
BE4 Devarajas

Name: Marakka
Age: 22
Housing Tenure: Temporary (Kutcha)
Structure Type: Attached
Area: 18 sq. mts
Family Size: 5
Family Occupation: Waste picker, construction labour
Family Income: Rs.36000
House Investment - building, maintenance and upgrades: Rs. 26119

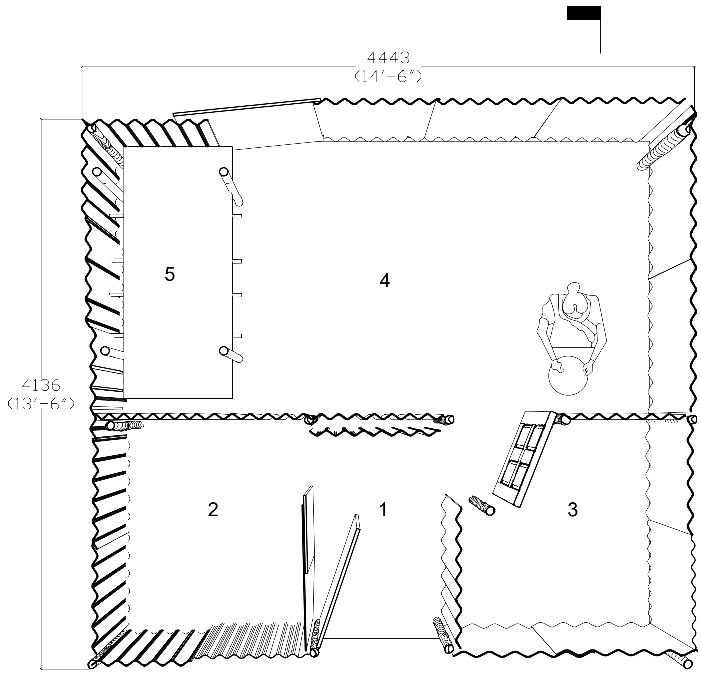
I work as a waste picker, and alongside my spouse, who is a construction labourer, we constructed our house in Devrajas colony with tent back in 2003. It wasn't until 2013 that we rebuilt it using cement sheets. Over time, the mud flooring had eroded, so we reinforced it with scrap tiles. To address the roof height reduction caused by the timber poles sinking into the ground, we placed the cement sheets vertically, saving us some costs.

After enduring nearly two decades of damage, we decided to rebuild the house entirely. In 2022, we raised the mud plinth by approximately 45 cm, reinforcing it with cement and adding tiles. We replaced the cement sheets and bamboo poles, increasing the roof height. Despite these improvements, we still use tarpaulin and plastic sheets to prevent water dripping from the roof. We face challenges such as unreliable electricity and indoor heating from the use of cement sheets. To cope, we often move activities outside or to better-ventilated spaces within the house.

Documentation



Section

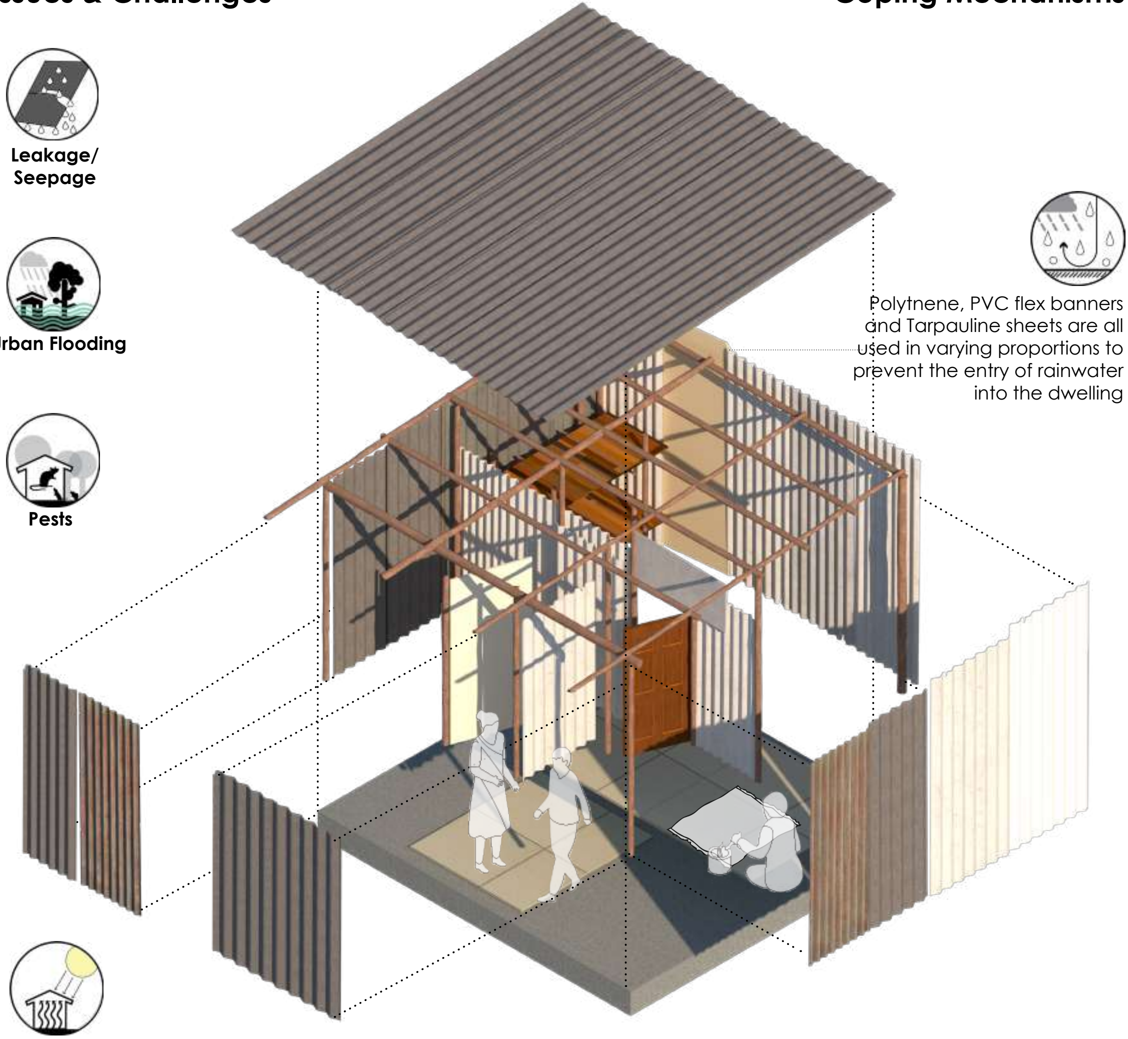


Plan

1. Entry Foyer
2. Water Storage
3. Cooking area
4. Multipurpose room
5. Loft

Issues & Challenges

Coping Mechanisms



Timeline

Increments over time

Year	2003	2013
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built+Skilled labour
Need	Family migrated to Devrajaras	water seepage through the roof
Response	'Tent' built using Timber poles and polythene sheets salvaged from wasteyards	cement sheets were re-placed, tiles laid on the floor to address water seepage
Cost	NA	NA
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	Material	Thermal Conductivity	Shelf-life	Durability	Maintainence	Procurement	Cost	Execution
		S	S	U	U	U	S	U
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	Rs. 250-350/ Sheet	Self-Built
WALL	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	Rs. 250-350/ Sheet	Self-Built
STRUCTURE	Bamboo	■■□□□	■■■■	■□□	Frequent	Second-Hand	Rs. 70-260/Pole	Self-Built
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 380-470/Bag	Skilled Labour

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

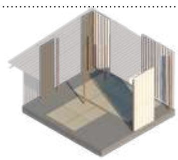
■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

Durability

■□□ Low
■■□ Medium
■■■ High

Supply side perspective: S

Users perspective: U



2017	2022
Self-Owned	Self-Owned
Self-Built+Skilled labour	Self-Built+Skilled labour
Damage to the frame structure	Redcution in dwelling height
Timber poles and cement sheets replaced using newly bought materials	Plinth height raised, flooring tiles replaced along with cement sheets being used in the walls
NA	Rs. 20,000
Self-Financed	Self-Financed

BE5 Devarajas

Name: Marikka
Age: 36
Housing Tenure: Temporary (Kutcha)
Structure Type: Semi Detached
Area: 14 sq. mts
Family Size: 5

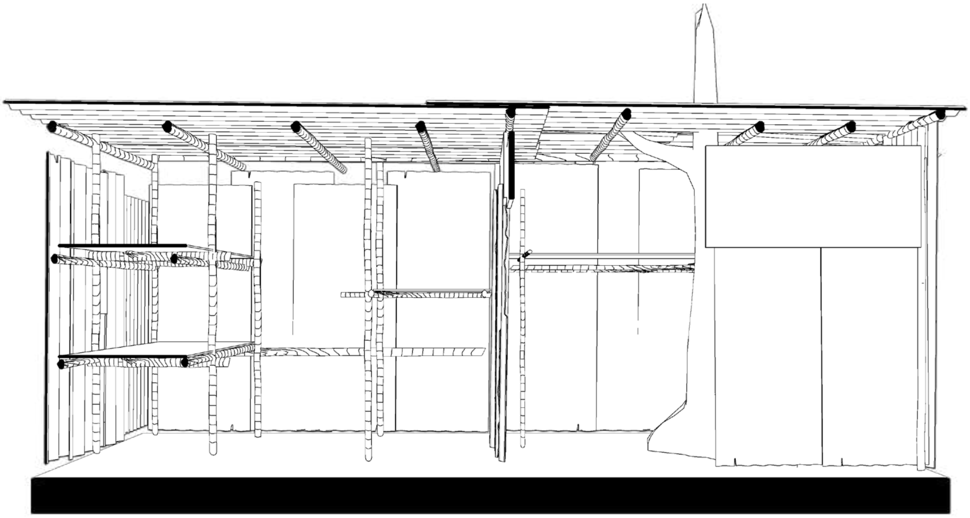
Family Occupation: Mason, Tractor driver
Family Income: Rs.30000 (variable income)
House Investment - building, maintenance and upgrades: Rs. 27588

I am a construction labourer living here with my spouse, who operates a tractor. We have two children, but they study in the village. Twelve years ago, we sold our farmland in the village and migrated here in search of work and to earn a wage. Initially, we constructed a basic 'Tent' House using timber poles and tarpaulin sheets.

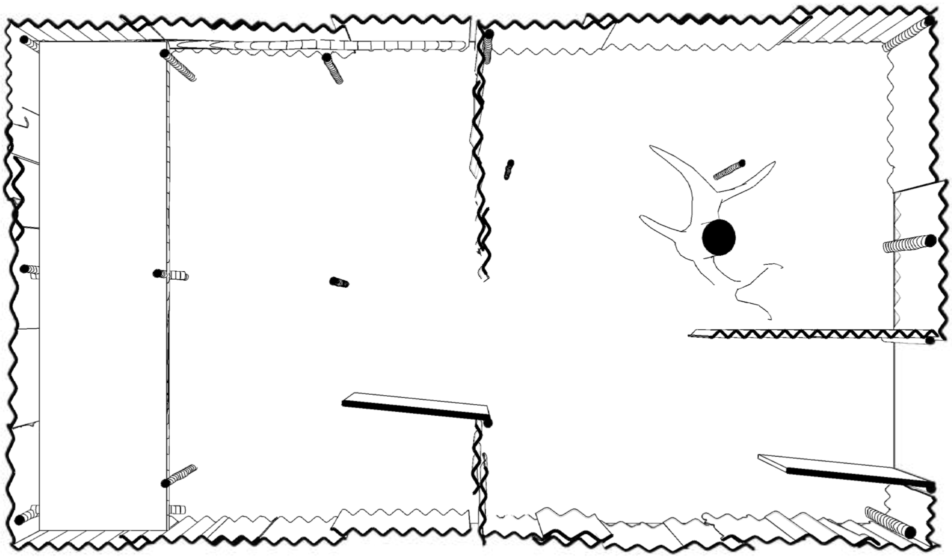
Over time, we rebuilt the house, maintaining its original size. The plinth was elevated by 4 inches and coated with cement to prevent rainwater from seeping in. The frame structure was reconstructed, and salvaged cement sheets from demolition sites were used for the walls and roof. Unfortunately, the cement sheets became dislodged due to heavy rains and winds, but we replaced and reused them on the roof. To counter the rains, we employed flex banners and tarpaulin sheets. We often use salvaged materials, including doors from lofts. The tradition of intricately painting the plinth is upheld in our settlement.

However, our houses face various challenges. As our settlement is situated on agricultural land, a tree trunk is within our house, leading to termite issues. There are cracks in the roofs, and the floors are damaged due to pest infestation. Water drips from the roof, especially where a tree trunk is an obstruction (with a bucket underneath to catch the water). Additionally, coconuts falling on the roof during storms cause damage.

Documentation



Section



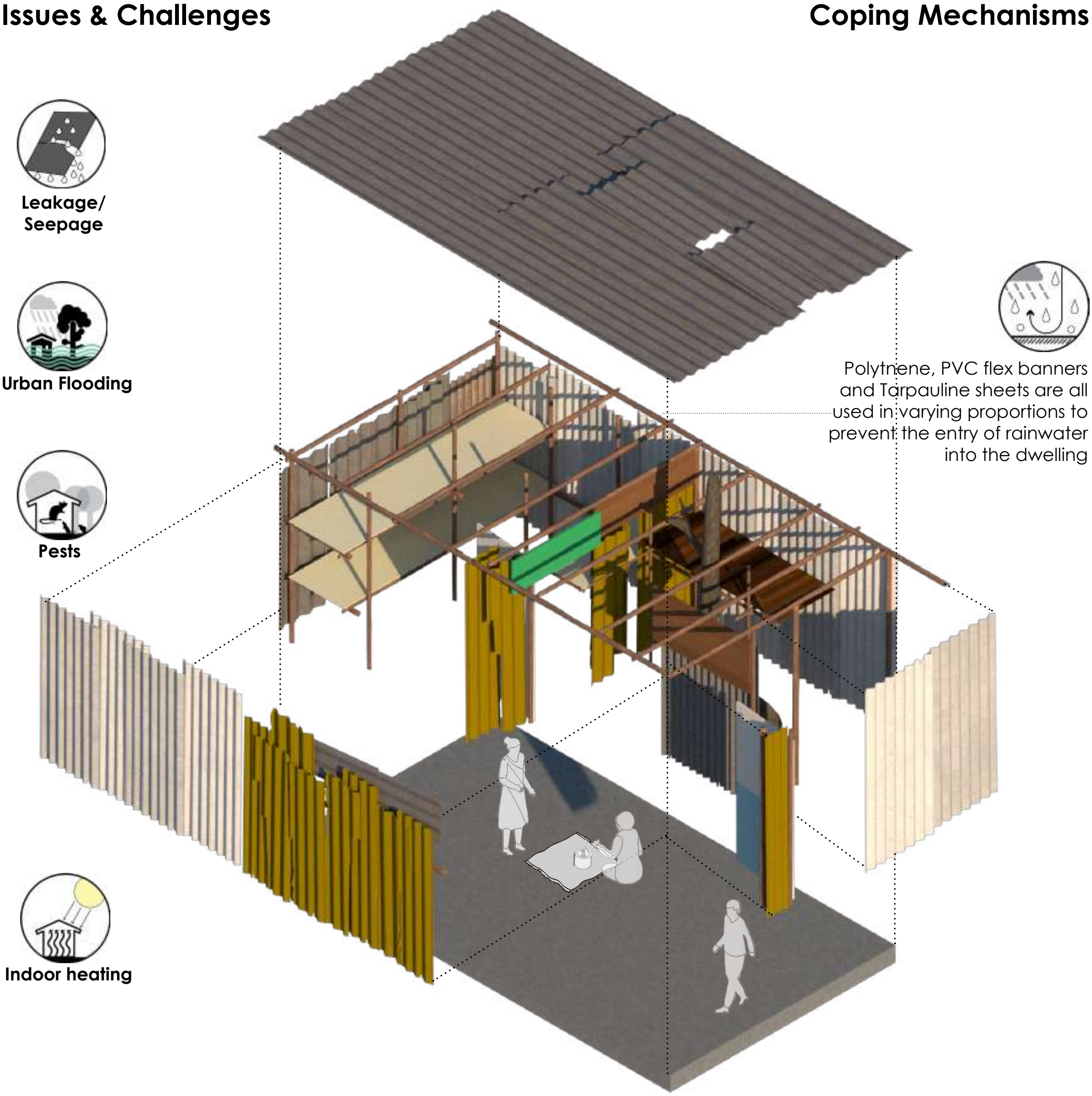
Plan

1. Kitchen
2. Multipurpose room

Dwelling BE5, Devrajaras, Bengaluru. Damaged roofs and floors are characteristic of the dwellings in this settlement, where salvaged and waste materials have been long used to animate the piece-meal processes that constitute dwelling building and attempts at building resilience to a harsh environment

Issues & Challenges

Coping Mechanisms



Timeline

Increments over time	
Year	**2010**
Tenure Arrangement	Self-Owned
Construction	Self-Built
Need	Family migrated to Devrajaras
Response	'Tent' built using salvaged materials
Cost	Rs. 3000
Financing Mechanism	Self-Financed

Attributes of materials

	Material	Thermal Conductivity [S]	Shelf-life [S]	Durability [U]	Maintainence [U]	Procurement [U]	Cost [S]	Execution [U]
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Salvaged	-	Self-Built
WALL	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Salvaged	-	Self-Built
	MDF	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built
	Timber board	■■■■■	■■■■	■■■	Infrequent	Salvaged	-	Self-Built
STRUCTURE	Bamboo	■■□□□	■■■■	■□□	Frequent	Second-Hand	Rs. 70-260/Pole	Self-Built
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 380-470/Bag	Self-Built

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

Durability

■□□ Low
■■□ Medium
■■■ High

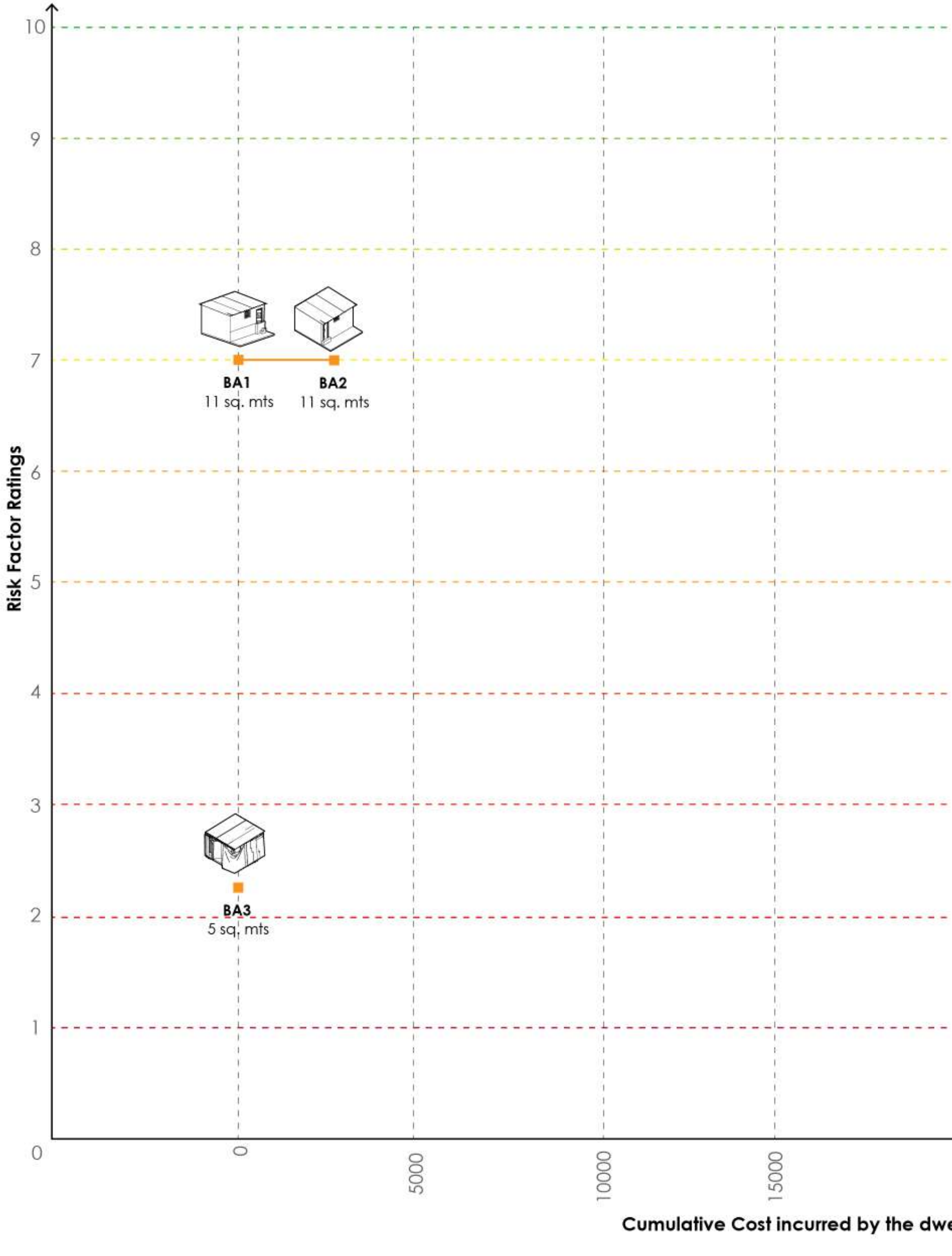
Supply side perspective: S

Users perspective: U

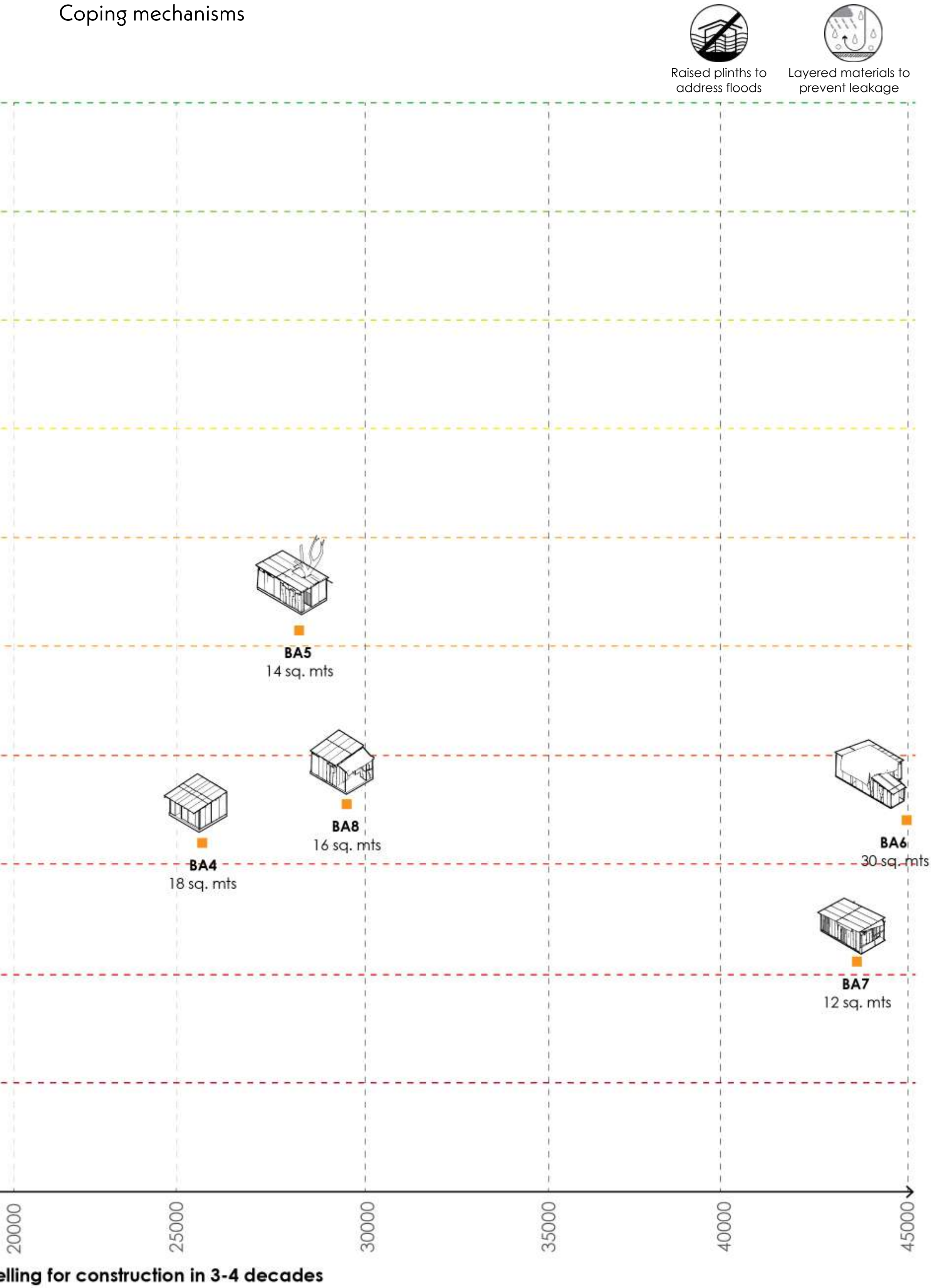
2018	2021	2023
Self-Owned	Self-Owned	Self-Owned
Self-Built+Skilled labour	Self-Built	Self-Built
Structura; damage to the shack	Damage to the roof	
Dwelling rebuilt on a cement plinth using new materials	Cement sheets on the roof replaced and supplemented using polythene	Present status of the dwelling
Rs. 15,000	NA	
Self-Financed	Self-Financed	

Climate comfort and decadal costs incurred:
Microclimate: Temperate

D.U area (Min): **5 sq. mts**
D.U area (Max): **30 sq. mts**



Coping mechanisms



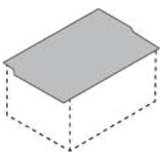
Dwelling materials in the Temperate Microclimate
Analysing compositions and impacts

Taxonomy	Roof	Wall	Structure	Floor	Thermal Conductivity	Lifespan	Durability
AAC Blocks		✚	✚		■■□□□	■■■■	■■■
Bamboo			✚		■■□□□	■■■■	■□□
Cement Board		✚			■■□□□	■■■■	■■■
Corrugated Cement sheet	✚	✚			■■□□□	■■■□	■□□
MDF		✚			■■□□□	■■□□	■□□
Polythene	✚				■□□□□	■□□□	■□□
Tarpaulin	✚				■■□□□	■■□□	■■□
Flex banner	✚	✚			■■□□□	■■■□	■■□
PCC				✚	■■□□□	■■■■	■■■
Plaster		✚			■■□□□	■■■□	■■□
Plywood		✚			■■□□□	■■□□	■□□
Timber	✚	✚	✚		■■□□□	■■■□	■■□
Neoprene sheets	✚				■□□□□	■■■■	■■□

At a glance

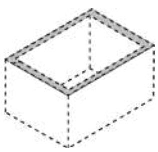
The table above lists all the materials that are being used to construct the 8 dwellings documented across Bengaluru in the Temperate microclimatic zone and are mapped according to the taxonomy in which their use is prevalent. .

Roof



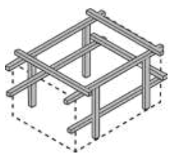
100% Cement Corrugated sheets

Wall



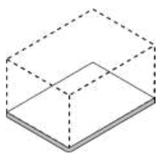
75% Cement Corrugated sheets

Structure

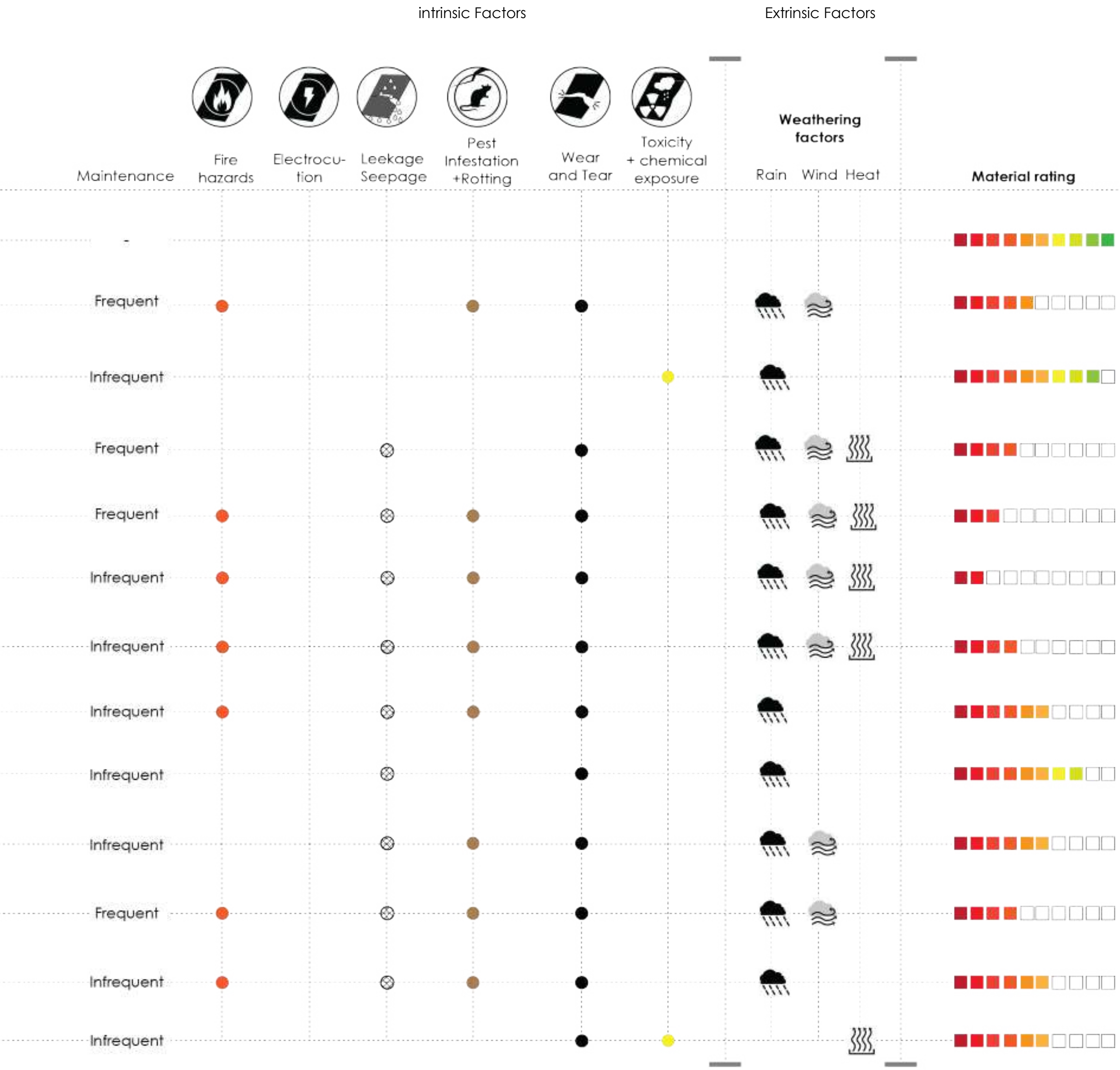


60% Bamboo

Floor/Plinth



100% Plain cement concrete (PCC)



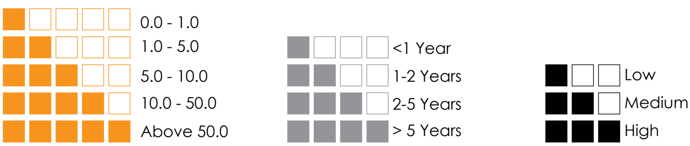
Contextual challenges: Temperate

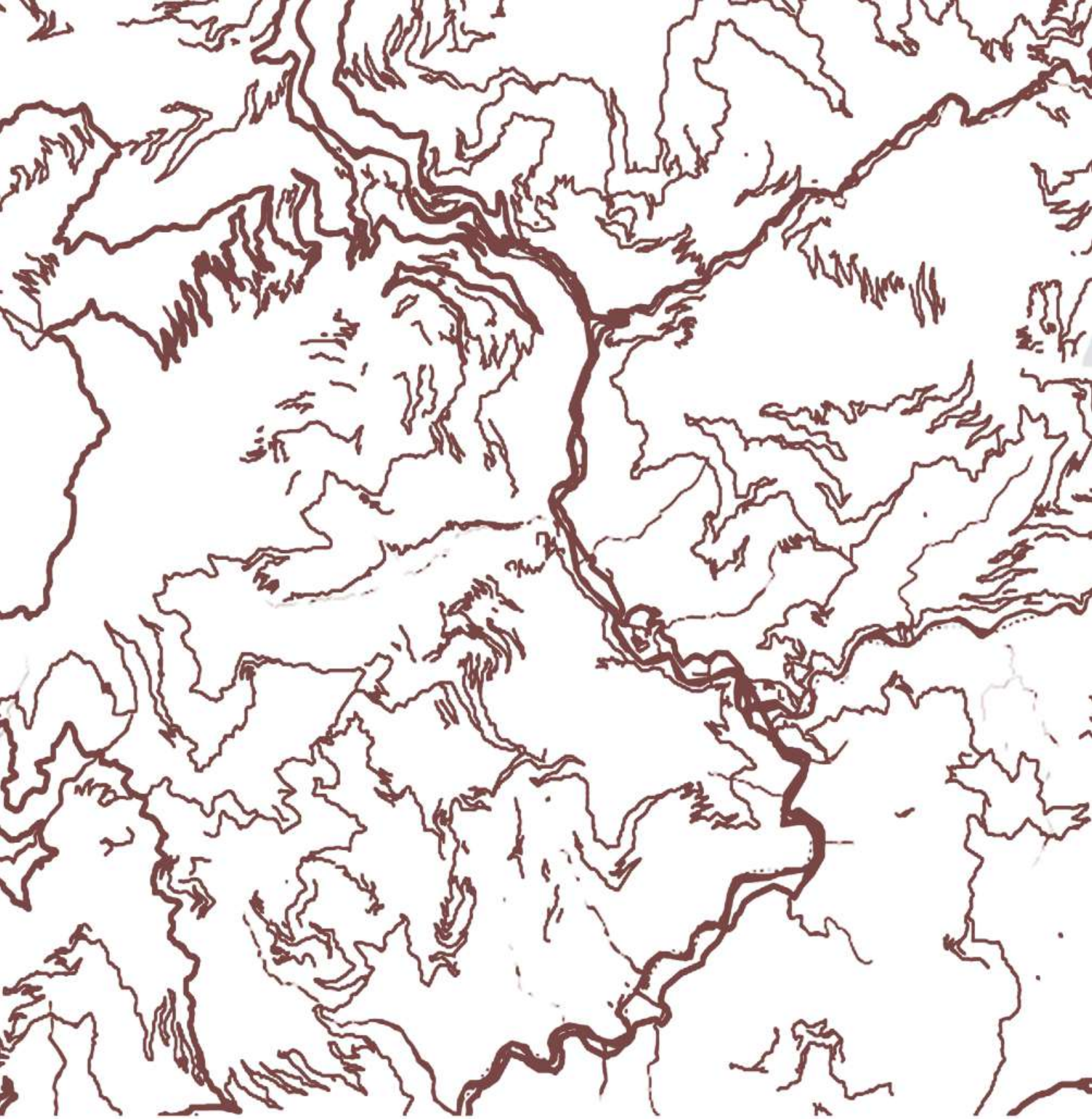

Urban Flooding


Pests


Indoor heating

Legend





Cold

Suryagaon

GANGTOK

1,00,286
Population

1,36,000
Projected Population

2.57%
Avg annual growth rate:

19.20
Sq. Km
Area Of
Municipal Corporation

Latitude° N 18.5204 Longitude ° E 73.8567

Total Slum Population
23,580

Total Slum Population
24%

Slum Dwelling Units
6,085

Slum Pockets
58

1650 m
elevation
above Sea Level

Max
33°C

19°C
Min

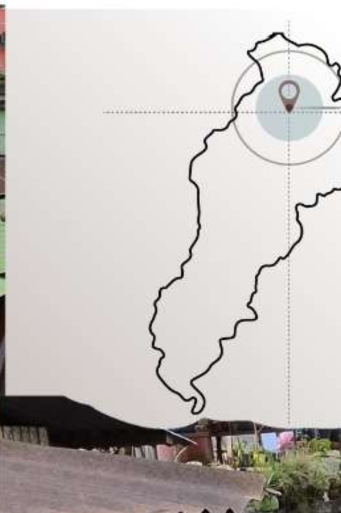
Avg Rainfall
3574 mm

Gangtok: Navigating the Microclimate Challenges of Suryagaon

Gangtok is the capital and the largest town of the Indian state of Sikkim. It is located in the eastern Himalayan range, nestled within the mountains. Gangtok experiences a cold climate due to its elevation. The climate is characterized by mild temperatures throughout the year, with cool winters and pleasant summers. The city receives heavy rainfall during the monsoon.

Gangtok city has 58 slums. The hilly terrain, combined with heavy rainfall during the monsoon, poses a significant risk of landslides and slums located on steep slopes are the most vulnerable. Inadequate housing in slums may not provide sufficient insulation, exposing residents to harsh weather conditions. Gangtok faces issues such as landslides, flooding and temperature extremes.

Informal settlements often consist of poorly constructed shelters. The combination of heavy rainfall, landslides, and flooding can result in the degradation of these structures, leading to safety concerns. In the Suryagaon settlement, intervention revealed a host of challenges stemming from climatic factors, includes leaking roofs, waterlogging, and flooring cracks caused by heavy rainfall and landslides. These issues not only jeopardize the physical safety of residents but also contribute to stress and inconvenience. The presence of the "Jhora," a steep water stream flowing through the settlement, further compounds problems by affecting the soil stabilization of dwelling units' foundations. The construction materials used, such as mud, bamboo, and vinyl sheets, suggest that the residences may not be adequately equipped to withstand temperature-related stress, rainfall, and water damage. The frequent need for repairs and material replacements implies a lack of durability in the construction of dwellings, leaving them vulnerable to climatic risks.

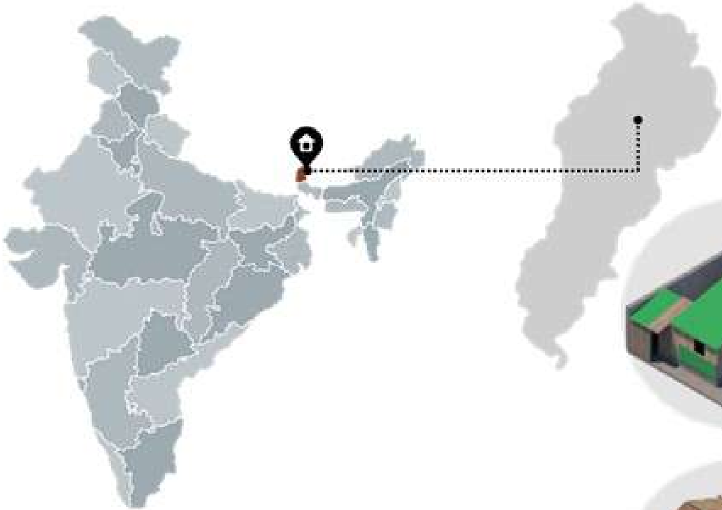


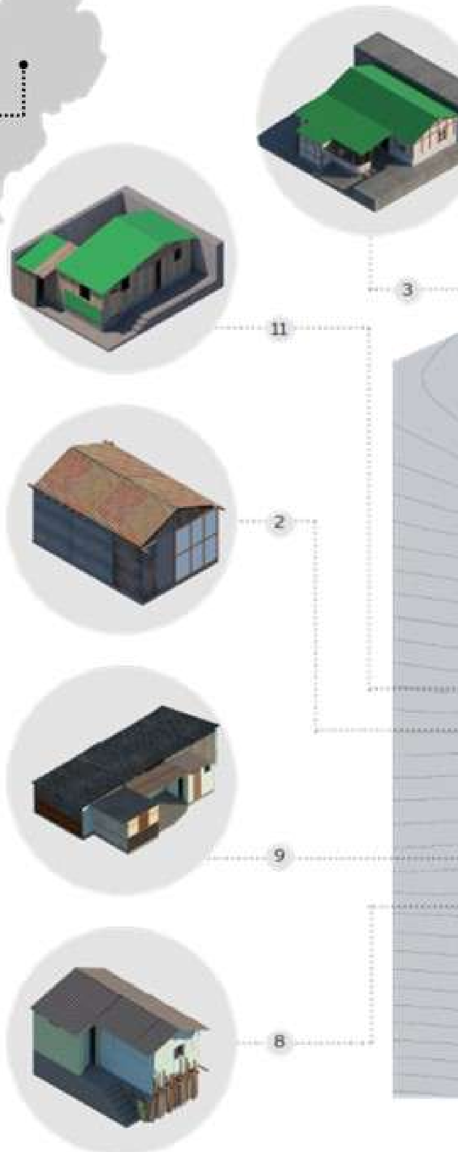
Gangtok's Micro Market

Gangtok has a diverse range of sources for construction materials and it was found that households in Suryagaon settlement with residents engaged in manual labour obtained materials from their worksites or took loans from contractors. Government programs, particularly distributed Galvanised corrugated iron (GCI) sheets for roofing, reducing the need for separate purchases. Newly constructed households' post-earthquake were exceptions, reporting individual purchases of tin/GCI sheets. Bamboo poles, crucial for the primary structural elements, were commonly purchased from Siliguri through local vendors, priced between Rs. 300-450 per pole. GCI sheets were supplied by the government, but Lal Bazaar shops were the local alternatives. Timber poles for Ikra walls came from diverse sources, reflecting a notable shift from traditional practices, such as collecting mud and timber from the surroundings. The diminishing green cover, caused by settlement expansion, impacted this practice.

When interacted with a central Sikkim material vendor near Lal Bazaar it was revealed that there is lack of direct transactions between formal material shops and the construction/labour markets in outskirts. Materials were obtained through secondary sources, incurring additional costs like carrying charges, especially significant on steep slopes. Moreover, there seemed to be a disconnect between informal settlement building practices and the market; vendors were unaware of Ikra construction and offered no services for it. Second-hand materials and construction waste were available at lower costs in Shichey, and first-hand vendors did not offer materials on deposit or repayment over time. The mountainous terrain and challenging road conditions in and around Gangtok further amplify the difficulty of loading and unloading activities, necessitating specialized equipment and skilled labour.

GANGTOK





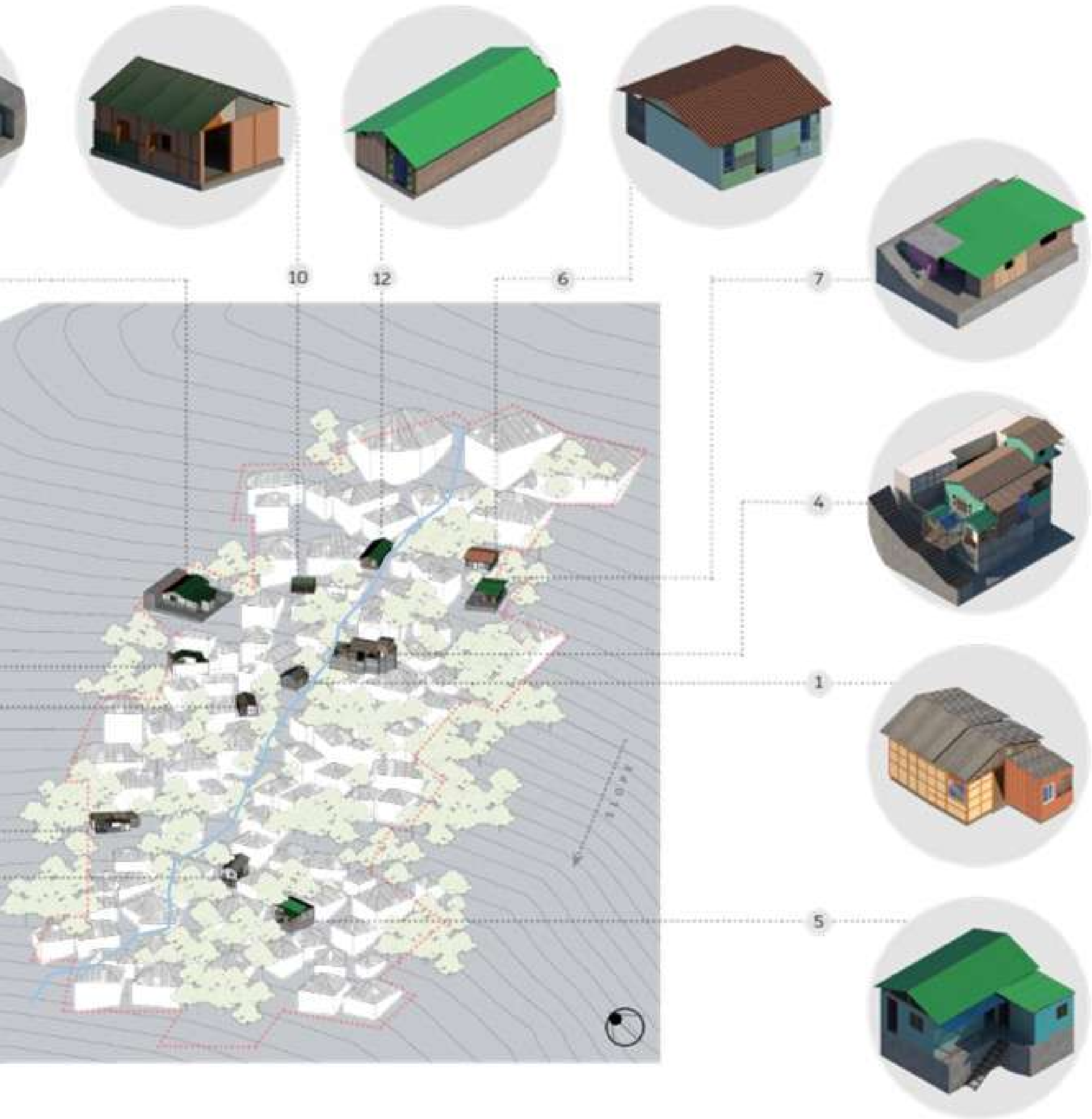
Suryagaon

27°20'29.48"N 88°36'31.69"E

Area of the Settlement
1.14 Ha (2.82 acres)

Location of Settlement
Near Jhora (a gully)

Total No. of Dwelling Units
65 DU (approx.)


10
12
6
7
4
1
5





A Comprehensive profile of settlement in Gangtok

Suryagaon, situated in Gangtok, is an informal settlement comprised of 65 dwelling units. The land ownership is under the purview of the pinery reserve and forest department, designating it as a notified slum. Positioned on an inclined terrain, the settlement is bisected by a drain. The majority of residents sustain their livelihoods through employment in government offices or as laborers, masons, housekeepers, sweepers, and gardeners. All inhabitants hail from Sikkim and migrated to this location due to affordability constraints in other areas.

The settlement's terrain is characterized as a sinking zone with clayey soil, further complicated by persistent rainfall issues resulting in seepage, leaking roofs, and waterlogging. Dwellings at lower elevations face heightened susceptibility to these challenges, exacerbated by the presence of the 'jhora,' a steep open drain flowing through the settlement. Structural concerns are prevalent, including cracks in flooring due to temperature-related stress and variations. This often results in ruptures in foundations and cement flooring, requiring extensive repairs that surpass the actual damage extent. Many households' resort to using vinyl sheets to mitigate these issues. The construction materials, such as Ikra walls, timber pole frames, and woven bamboo, plastered with mud or cement, require frequent replacement or repair due to their vulnerability to water damage. Bamboo poles, a crucial component of the dwelling's structure, are also prone to deterioration.

The challenging conditions necessitate changing building materials every 3-4 years, with GCI sheets and cement plastered walls having a longer lifespan of 4-5 years or more. Despite most increments being covered by savings, substantial investments often require residents to take loans. Annual repair costs range from Rs.20,000 to 30,000, making it financially challenging for most families. The cost of rebuilding or making substantial changes to dwellings can range from Rs. 1.8 to 6 lacs, with larger houses requiring up to Rs. 12 lacs. Carrying charges for transporting materials to the settlement on the steep slope further contribute to the financial burden. Financial assistance is available through institutions like

Bandhan Finance, offering loans at 6% interest, while private banks charge 12%. Private lenders and hand loans are seldom used due to formalities and document requirements, which many residents lack, such as proof of tenure and property papers. Construction methods vary, with approximately 30 dwellings using Ikra (a traditional technique of weaving bamboo) walls and wooden frames, while others have been rebuilt using bricks and cement. Galvanised corrugated iron (GCI) sheets are predominant for roofing, a practice initiated in 1995 and continued after the earthquake in 2011 under the Rajiv Awas Yojana (RAY).

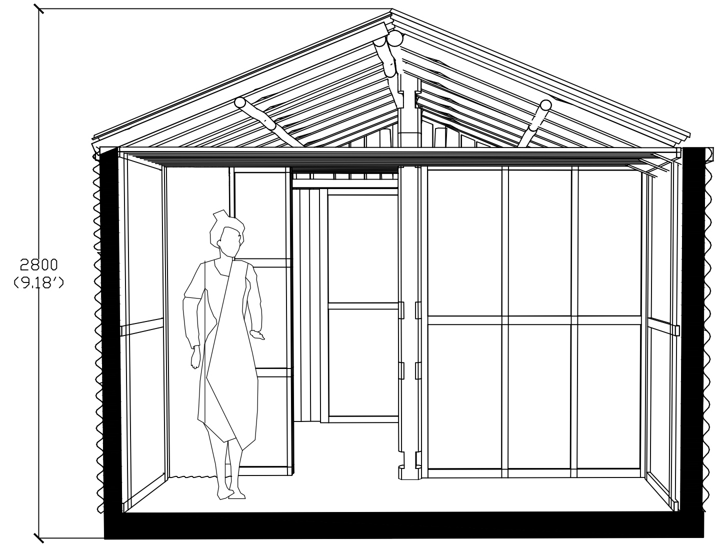
G1 Suryagaon

Name: Debi
Age: 50
Housing Tenure: Temporary (Kutcha)
Structure Type: Detached
Area: 17 sq. mts
Family Size: 4
Family Occupation: Babysitter
Family Income: Rs.7000
House Investment - building, maintenance and upgrades: Rs. 553986

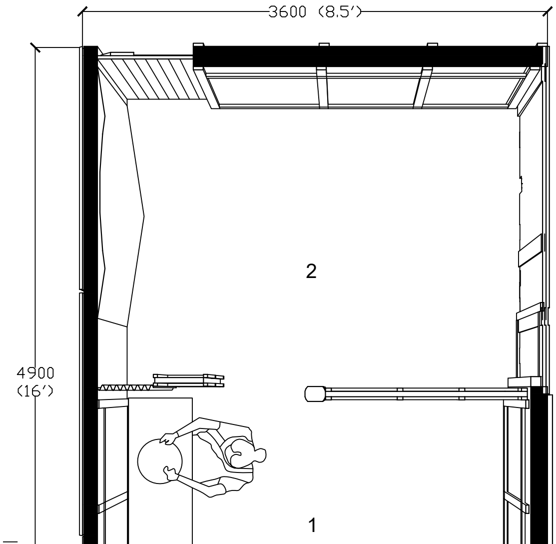
I relocated to Suryagaon from lower Sichey area shortly after the birth of my second child, coinciding with my spouse abandoning our family. Since then, the process of fortifying our home has been shaped by considerations for my children and the risks posed by the climate, resulting in largely incremental efforts.

In its current state, my house mirrors each of these endeavors, prominently evident in the diverse materials comprising its different parts. Initially, it was a basic bamboo-and-metal-sheet shack. In 2001, government-donated sheets replaced the old ones, and a cement floor was added to enhance resilience against flooding and seepage. Some walls were reconstructed using timber and bamboo during this period, left unplastered. After the 2011 earthquake, the house underwent a complete reconstruction. The first expansion occurred in 2014, driven by privacy concerns with my now-adolescent children, leading to the construction of an external room that now doubles as the kitchen. The metal roofing sheets, damaged for over a decade, were replaced in 2020. Currently, an attached toilet, washroom, and an envisioned common living room are under construction. Environmental issues, particularly floods during rains, pose significant challenges. The challenging topography of the settlement makes houses at lower levels, including mine, especially vulnerable. To cope up we employ plastic and tarpaulin sheets to shield the mud Ikra walls (a traditional technique of weaving bamboo) and roofing sheets from seepage.

Documentation



Section



Plan

1. Kitchen and Living room
2. Bed room

Dwelling G1, Suryagaon, Gangtok. Despite the challenges faced in the procurement of materials, dwellings have reached a considerable level of consolidation. Seen here is an example of it; materials collected over time, some bought, others donated have been used to build a house that has survived earthquakes and several landslides

Issues & Challenges

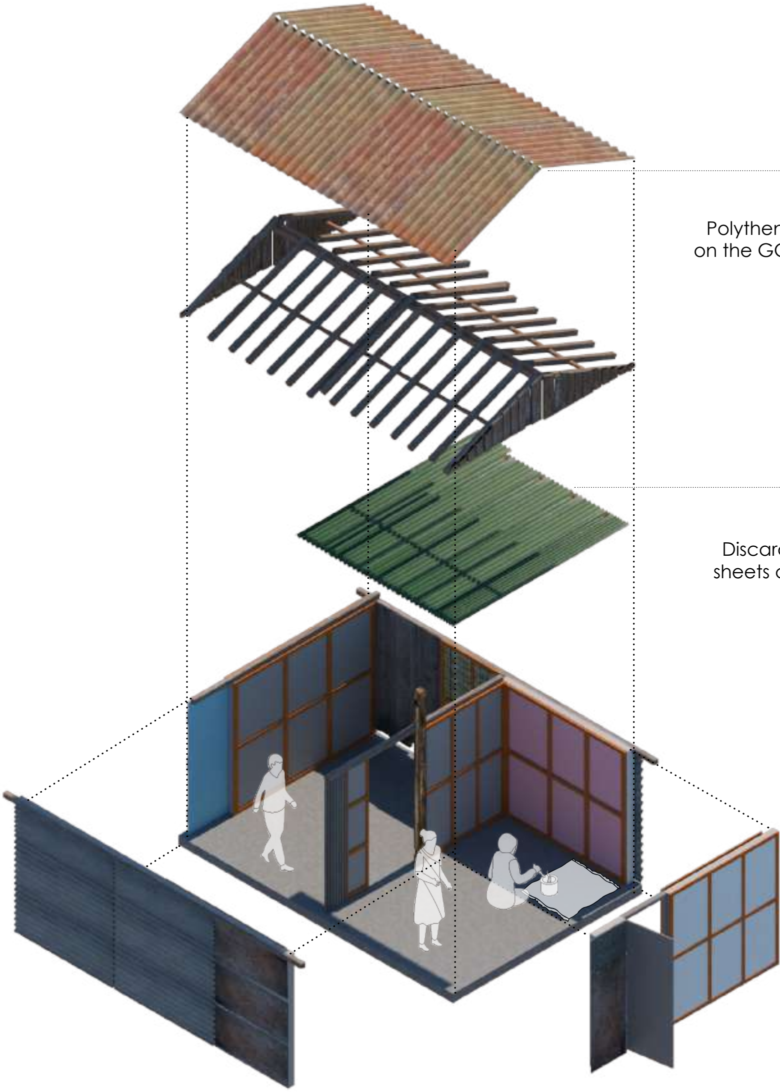
Coping Mechanisms

Leakage/ Seepage

Cold Indoors

Urban Flooding

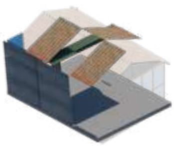
Landslides



Polythene sheets are layered on the GCi roof to prevent the entry of ranwater

Discarded or salvaged GCI sheets are used as insulation

Timeline



Increments over time		
Year	1999-2001	2011
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built +Skilled labour	Self-Built +Skilled labour
Need	Family migrated to Suryagaon	2011 eathquake: Dwelling damaged
Response	Shack Built using a Bamboo frame structure and Tin sheets on a mud-cement Plinth	Dwelling rebuilt using new materials
Cost	Rs. 60-70,000	Rs. 1,50,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	S Material	S Thermal Conductivity	S Shelf-life	U Durability	U Maintainence	U Procurement	S Cost	U Execution
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Donated	-	Skilled Labour
WALL	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Skilled Labour
	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Donated	-	Self-Built
	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Second-Hand	-	Self-Built
	Plaster	■■□□□	■■■□	■■□	Infrequent	New	Rs. 460-490/Bag	Skilled Labour
STRUCTURE	Timber Column	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Skilled Labour
	Bamboo	■■□□□	■■■■	■□□	Frequent	Second-Hand	Rs. 200-400/Pole	Skilled Labour
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 460-490/Bag	Skilled Labour

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

		
2014	**2020**	**2023**
Self-Owned	**Self-Owned**	**Self-Owned**
Self-Built +Skilled labour	**Self-Built**	**Self-Built**
Additional living space	**Damage to the Roofing sheets**	
Room built, adjoining the house to serve as a kitchen and sleeping space	**New GCI sheets donated by the GMC installed on the roof**	**Present status of the dwelling**
Rs. 18,000	**NA**	
Self-Financed	**Self-Financed**	

G2 Suryagaon

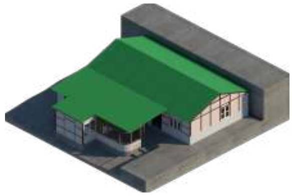
Name: Mankumari
Age: 68
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Detached
Area: 70 sq. mts
Family Size: 7
Family Occupation: Govt. Job
Family Income: Rs.15000
House Investment - building, maintenance and upgrades: Rs. 1211811

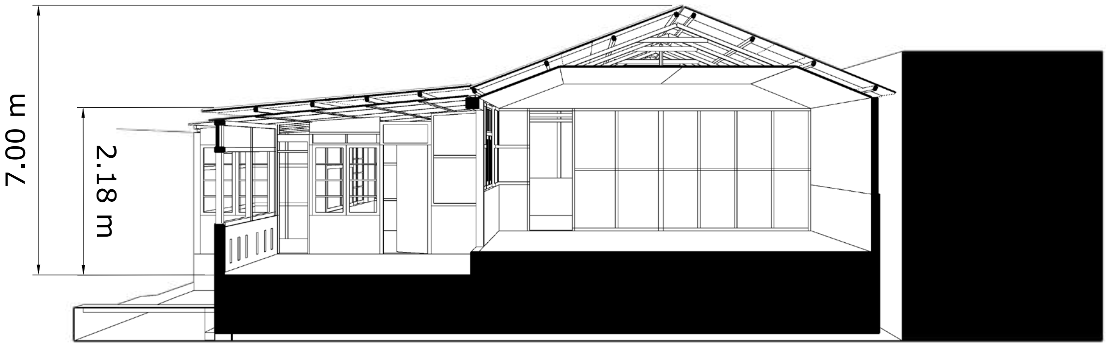
I migrated to Suryagaon and settled in a dwelling originally constructed with Ikra walls, bamboo, and mud. Initially, it comprised only two lateral rooms with a roof made of tin sheets. Over time, the dwelling has undergone significant transformation, now featuring plastered Ikra walls, an insulated roof made of tin sheets and plywood planks, a far cry from its original state.

The evolution of the house reflects the utmost consolidation and improvement achievable within the constraints of financial resources and the topography of the site. In its initial construction in 1995, the dwelling had precarious, naked Ikra walls that required frequent repairs due to water damage. In 2001, these walls were rebuilt using bricks and cement. Substantial investments were made between 2001 and 2004, resulting in the remaking of the flooring with cement and the addition of a large verandah and a separate room to the once simple shaded frontage.

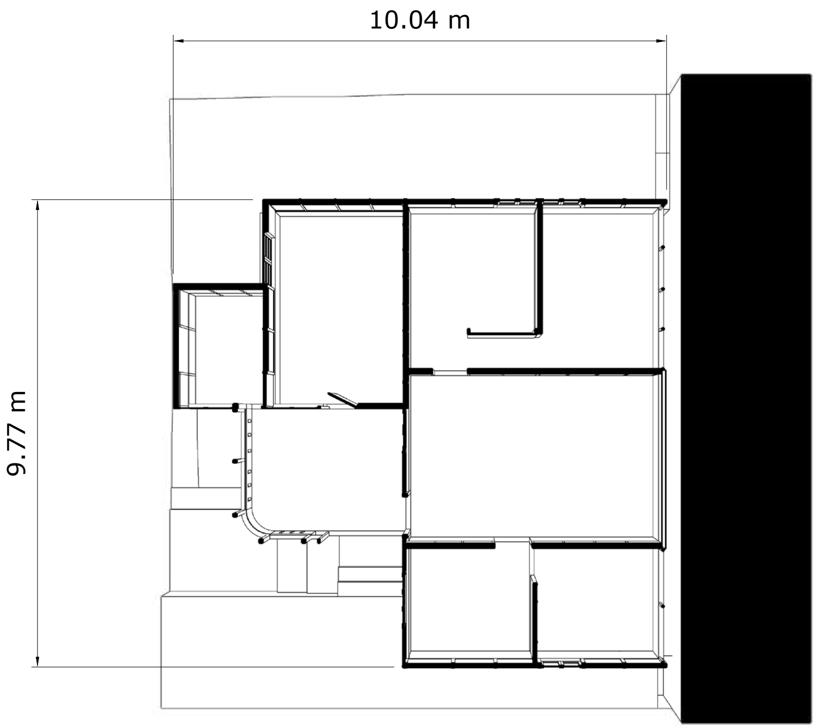
Further enhancements continued, including the installation of plywood planks in 2014 for insulation against the cold. Vinyl sheets were also applied on the floor to provide additional protection against the cold. Despite these improvements, the house faces challenges. While flooding is not an issue due to the raised plinth, water damage and seepage persist, leading to repeated investments for wall repairs. Even with the rebuilt walls, significant damage remains, incurring perceived imminent costs for the family. Indoor temperatures remain uncomfortable throughout the year. To cope with the frigid weather, plywood sheets and vinyl sheets are employed. Additionally, plastic sheets are occasionally used to shield the walls from rain and rapidly flowing water.

Documentation





Section



Plan

1. Verandah
2. Living space
3. Cooking area
4. Bedroom
5. Prayer room
6. Washroom

Issues & Challenges

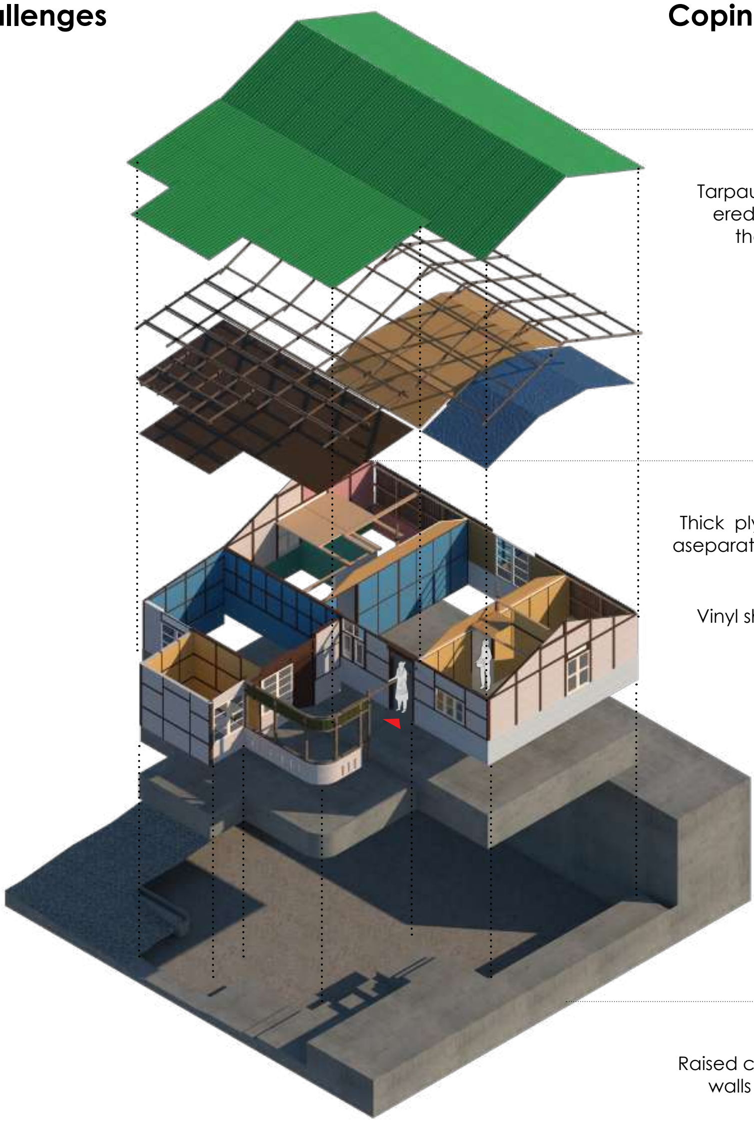
Coping Mechanisms

Leakage/ Seepage

Cold Indoors

Urban Flooding

Landslides



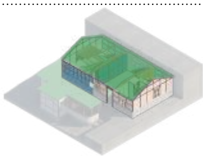
Tarpauline is occasionaly layered on the roof to prevent the leakage of rainwater

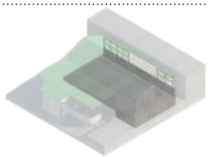
Thick plywood sheets are used aseparate layer to provide insulation to the dwelling

Vinyl sheets are used to keep the floors warm

Raised cement plinth and brick walls to prevent the entry of rainwater

Timeline





Increments over time		
Year	1995	1998
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built +Skilled labour	Self-Built +Skilled labour
Need	Family migrated to Suryagaon	Water seepage+Damage
Response	Dwelling built using Bamboo-Mud walls and a mud plinth. Tin roofing sheets.	Walls around the dwelling rebuilt using bricks and mortar
Cost	Rs. 45,000	Rs. 100,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

		S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Donated	-	Skilled Labour
	Plywood	■■□□□	■■□□	■□□	Frequent	New	Rs. 75/Kg	Skilled Labour
	Tarpauline	■■□□□	■■□□	■■□	Frequent	New	-	Self-Built
WALL	Wooden planks	■■□□□	■■■■	■□□	Frequent	New	-	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	New	Rs. 200-400/Pole	Self-Built
	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Donated	-	Self-Built
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 12/ Piece	Skilled Labour
	Plaster	■■□□□	■■■□	■■□	Infrequent	New	Rs. 460-490/Bag	Skilled Labour
STRUCTURE	Timber beam	■■□□□	■■■□	■■□	Infrequent	Salvaged	Rs. 700-780/ Plank	Skilled Labour
	Timber section	■■□□□	■■■□	■■□	Infrequent	New	Rs. 700-780/ Plank	Skilled Labour
	PCC	■■□□□	■■■■	■■■	Infrequent	New	Rs. 460-490/Bag	Skilled Labour
FLOOR	PCC	■■□□□	■■■■	■■■	Infrequent	New	Rs. 460-490/Bag	Skilled Labour
	Vynil Sheets	■■□□□	■■■□	■■■	Infrequent	New	-	Self-Built

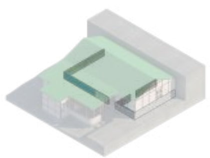
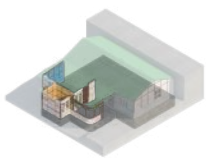
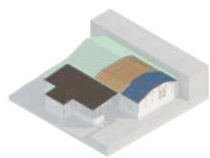
Thermal Conductivity:
- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability
- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

		
2000	**2001-2004**	**2014-2018**
Self-Owned	Self-Owned	Self-Owned
Self-Built +Skilled labour	Self-Built +Skilled labour	Self-Built +Skilled labour
Water damage to the Ikra walls	Need for additional living space	Cold Indoor temperatures
Lower portions of the bamboo-mud walls rebuilt using bricks and mortar	Floor rebuilt using PCC, external toilet, verandah and living room constructed	Plywood insulation and Vinyl sheets installed to insulate dwelling
Rs. 35,000	Rs. 60,000	Rs. 20,000
Self-Financed	Self-Financed	Self-Financed

G3 Suryagaon

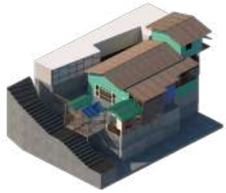
Name: Sandeep
Age: 45
Housing Tenure: Semi Permanent
Structure Type: Detached
Area: 73 sq. mts
Family Size: 6
Family Occupation: Labour, Cook
Family Income: Rs. 15000
House Investment - building, maintenance and upgrades: Rs. 262000

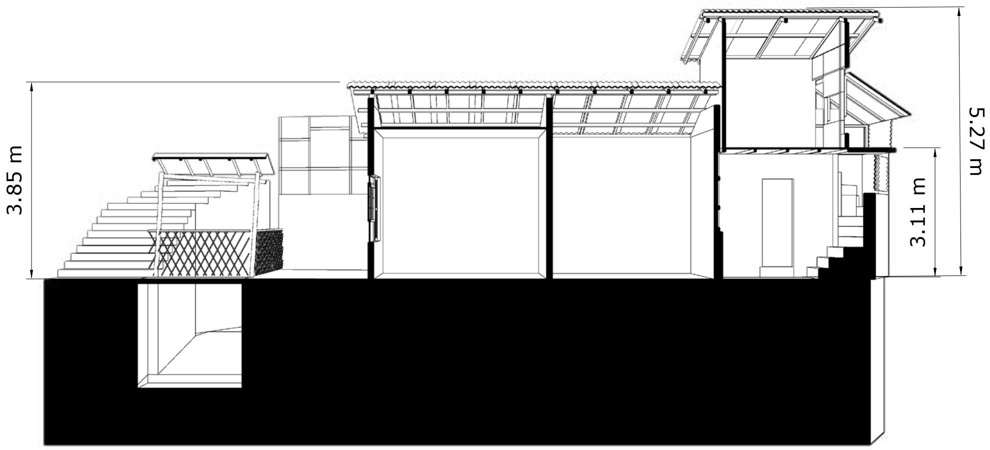
I migrated to Suryagaon from a neighbouring village when my children entered adolescence, raising concerns about the need for more space and privacy. Initially, in 2001, I constructed a basic bamboo-framed shack with coconut husk and thatch for walls, and plastic sheets for the roof to shield us from the rains.

Over the years, between its initial construction and early 2013, I worked on improving the dwelling. I laid a foundation using sacks of cement from the central canal and started expanding the house by cutting through the rock to which it was anchored. The major transformations occurred between 2014 and 2017. In 2014, I expanded the single room to accommodate my growing children and extended the front with a dog kennel on one side and a shaded area (formerly a toilet) on the other. During this time, I reinforced the flooring with cement to enhance its strength, addressing the precarious location near the canal.

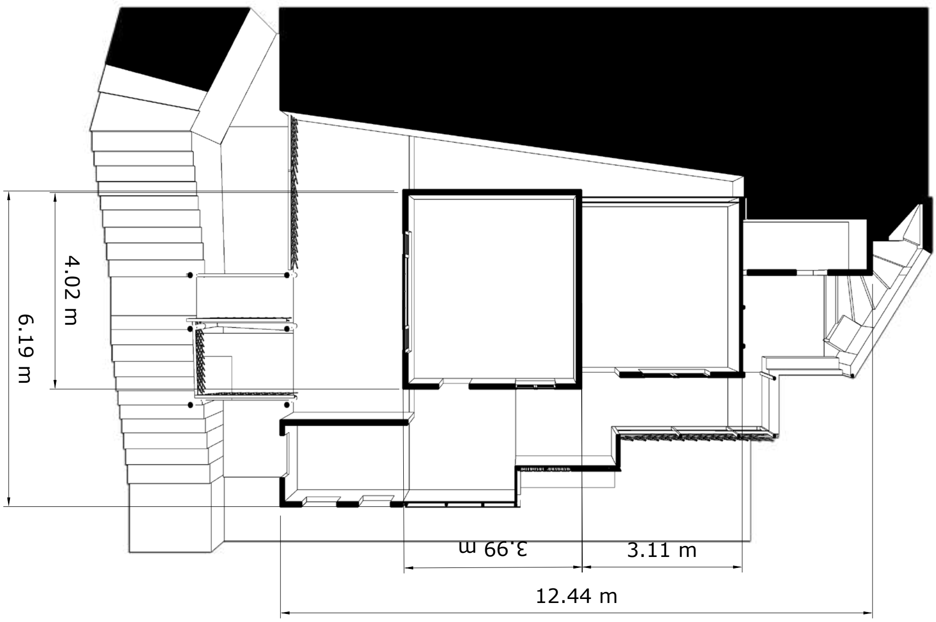
From 2014 to 2017, I collected materials from vendors in Gangtok, culminating in the addition of a separate room constructed with plywood, an internal toilet through the Swachh Bharat Mission (SBM) scheme, and an extra floor for my son. In 2018, I secured a loan to build a separate kitchen within the house. Despite these improvements, the house faces challenges such as flooding and rain-induced structural damage, necessitating frequent repairs. To cope with this, I employ plastic sheets and PVC flex banners on the exterior walls to protect the cement plum walls from water and prevent damage to the plywood, addressing the ongoing threat of water-related issues.

Documentation





Section



1. Verandah
2. Living space
3. Cooking area
4. Bedroom
5. Prayer room
6. Washroom
7. Music Studio

Plan

Dwelling G3, Suryagaon, Gangtok. Built next to the 'Jhora', a rapid stream of water that splits the settlement, this view of the dwelling represents the changes it has undergone in the past years; First built as a bamboo shack, one that has turned into a dog kennel now, The dwelling has transformed into an assemblage of spaces serving a multitude of functions and needs

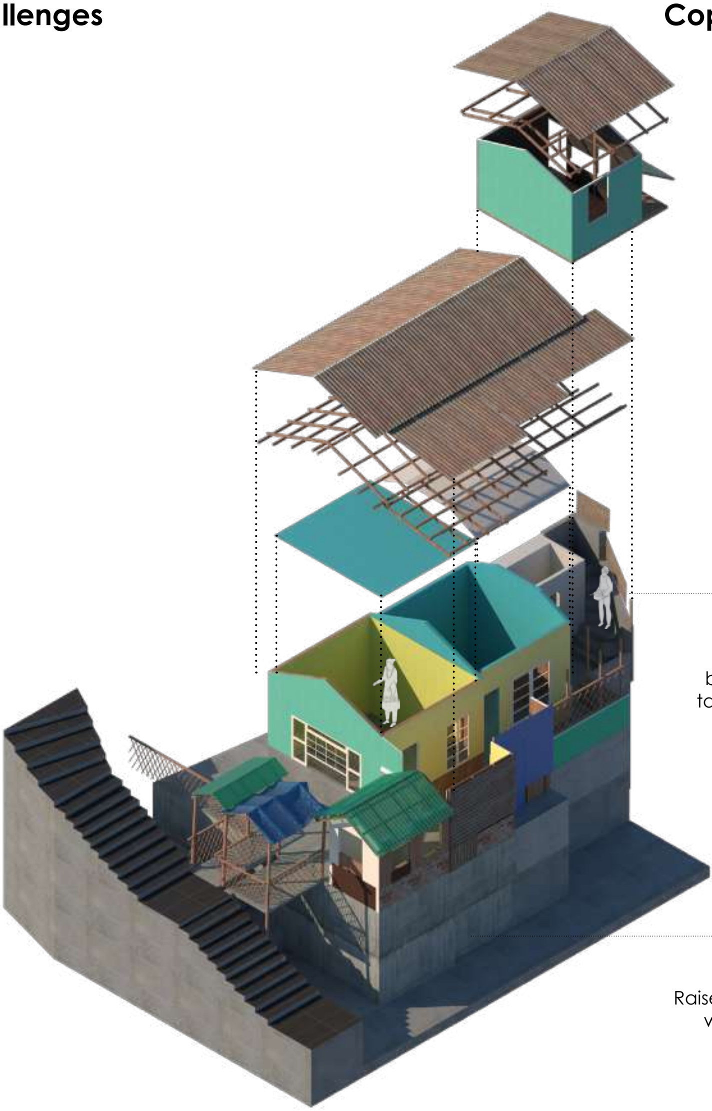
Issues & Challenges

Leakage/
Seepage

Cold Indoors

Urban Flooding

Landslides

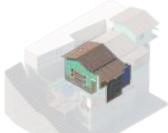
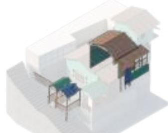


Coping Mechanisms

Tarpauline and PVC flex banners are used on the retaining walls to protect them against the rains

Raised cement plinth and brick walls to prevent the entry of rainwater

Timeline

Increments over time		
Year	**2001**	**2013-14**
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Family migrated to Suryagaon	Additional living space
Response	Shack built using locally procured bamboo, thatch and Polythene sheets	Additional room Built using bricks, mortar and plywood, frontage built using cement.
Cost	NA	NA
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	Material (S)	Thermal Conductivity (S)	Shelf-life (S)	Durability (U)	Maintainence (U)	Procurement (U)	Cost (S)	Execution (U)
ROOF	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Donated	-	Self- Built
	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built
WALL	Timber Plank	■■□□□	■■■□	■■□	Infrequent	Salvaged	-	Self-Built
	Plywood	■■□□□	■■□□	■□□	Frequent	Salvaged	-	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-Built
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 12/ Piece	Self-Built
	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Donated	-	Self-Built
STRUCTURE	Wooden planks	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-Built
	PCC	■■□□□	■■■■	■■■	Infrequent	New	Rs. 460-490/Bag	Self-Built
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 460-490/Bag	Self-Built
	Cement Bags		■■■■	■■■	-	New	Rs. 460-490/Bag	Self-Built

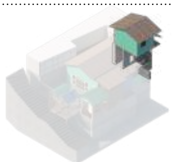
Thermal Conductivity:
- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

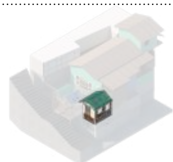
Shelf Life (Years):
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability
- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U





2017	2018
Self-Owned	Self-Owned
Self-Built	Self-Built
Need for an additional room and private toilet	Need for a separate Kitchen space
Sheets comprising the dwelling walls and structure replaced	Kitchen space built using new materials, fresh kota stones installed on the flooring
NA	Rs. 1,85,000
Self-Financed	Self-Financed+Loans

G4 Suryagaon

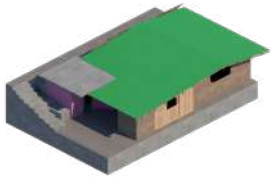
Name: Shubha
Age: 43
Housing Tenure: Temporary (Kutcha)
Structure Type: Detached
Area: sq. mts
Family Size: 6
Family Occupation: service
Family Income: Rs.12000
House Investment - building, maintenance and upgrades: Rs. 130296

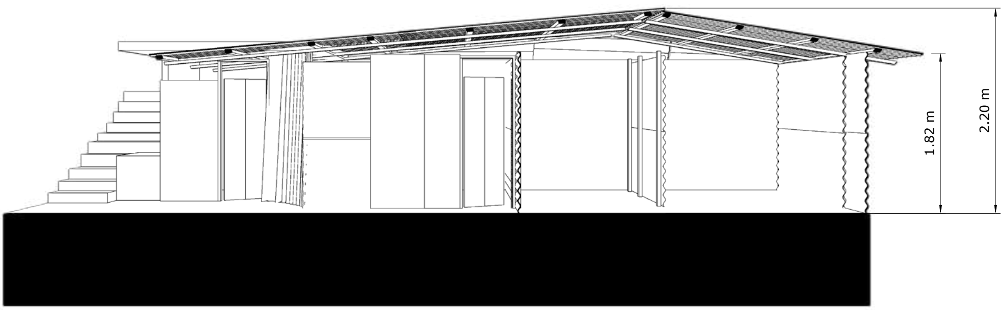
I relocated to Suryagaon and established a residence on the opposite side of the jhora (a gully with running water) in 2007. The decision to build this dwelling was prompted by the anticipated expansion of our family. It stands as the newest among the various residences occupied by the Sundas family in Suryagaon, experiencing a notable increase in size since its initial construction.

Upon its inception in 2007, the walls were constructed using cement sheets arranged around a wooden frame, while the roof was composed of plastic and tarpaulin sheets. Despite the earthquake of 2011 causing minimal harm to the dwelling itself, the cliff face on which it was situated sustained considerable damage, leading to immediate repairs within our household. During this restoration period, we replaced the sheets forming the walls, reinforced the floor with cement, and substituted the polythene/tarp on the roof with GCI sheets provided by the government. In anticipation of further family growth and the necessity to segregate functional spaces within the house, a new room was added, connected to an outdoor washing area, along with the construction of a toilet. Over the recent years, we fortified the floor with vinyl sheets to counteract the cold and protect the already precarious foundation. It's worth noting that the sheets, unlike the Ikra walls, have a relatively short lifespan, requiring replacement every 2-3 years, in addition to ongoing yearly repair work. Looking ahead, we have plans to construct a retaining wall to enhance the structural integrity of the dwelling.

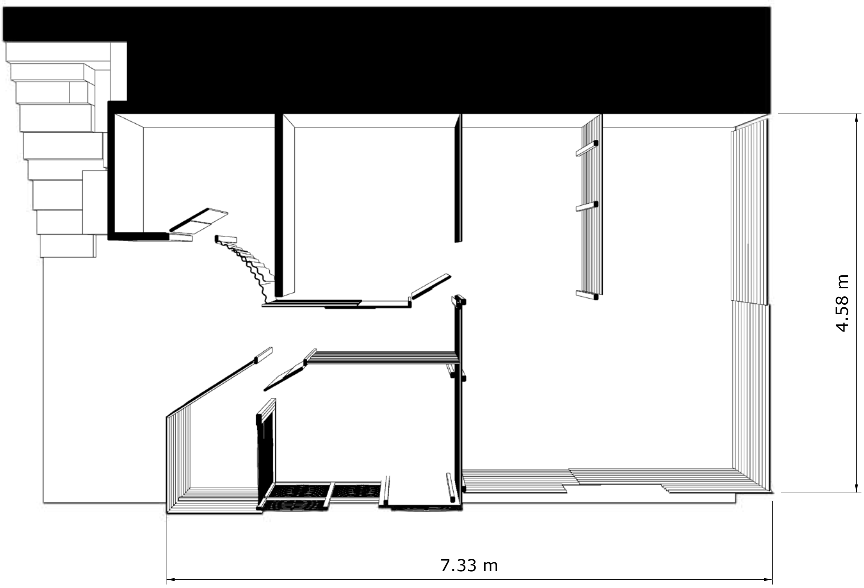
The challenges we face primarily stem from the geographical location of the dwelling and the unstable condition of the soil it rests upon. Despite the application of cement layers, water seepage remains a common issue, exacerbated by the compromised integrity of the initially constructed cement layer. To address leakages from the roof, we employ plastic and tarpaulin sheets, while vinyl sheets serve as a coping mechanism for the floor, providing insulation against cold weather and potential damage. Despite these measures, the precarious state of the house necessitates ongoing adaptation to the challenges posed by rains and strong winds throughout the year.

Documentation





Section



Plan

1. Verandah
2. Living space
3. Storage
4. Bedroom
5. Kitchen
6. Washroom

Issues & Challenges

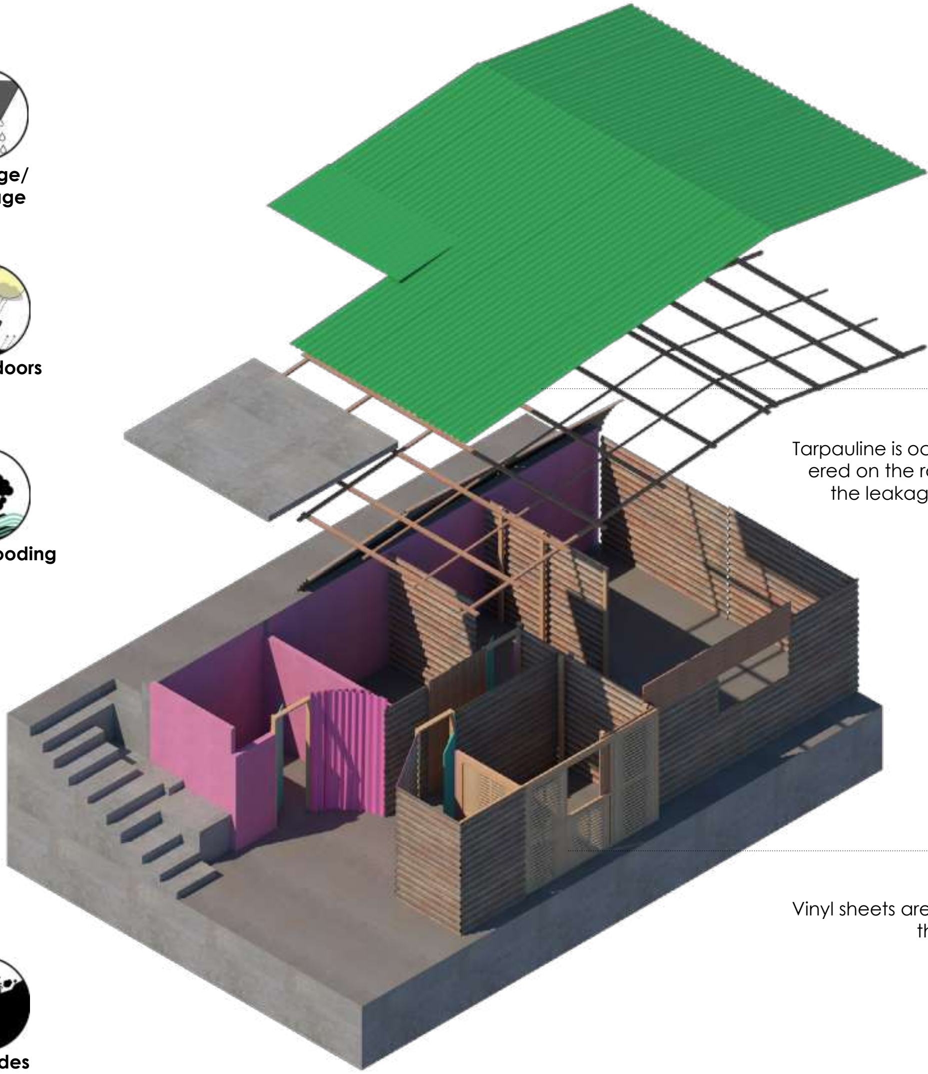
Coping Mechanisms


Leakage/
Seepage


Cold Indoors


Urban Flooding

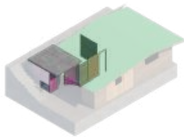

Landslides




Tarpauline is occasionaly layered on the roof to prevent the leakage of rainwater


Vinyl sheets are used to keep the floors warm

Timeline



Increments over time	
Year	**2007**
Tenure Arrangement	Self-Owned
Construction	Self-Built
Need	Family shifted within the settlement
Response	One-room dwelling built using re-used and salvaged cement sheets
Cost	NA
Financing Mechanism	Self-Financed

Attributes of materials

	Material	Thermal Conductivity	Shelf-life	Durability	Maintainence	Procurement	Cost	Execution
	S	S	S	U	U	U	S	U
ROOF	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Donated	-	Self-Built
WALL	Wooden planks	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	New	Rs. 200-400/Pole	Self-Built
	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Donated	-	Self-Built
	Brick	■■□□□	■■■■	■■■	-	New	Rs. 12/ Piece	Self-Built
	Plaster	■■□□□	■■■□	■■□	Infrequent	New	Rs. 460-490/Bag	Self-Built
STRUCTURE	Wooden planks	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	Second-Hand	Rs. 12/ Piece	Self-Built
	PCC	■■□□□	■■■■	■■■	Infrequent	New	Rs. 460-490/Bag	Self-Built
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 460-490/Bag	Self-Built
	Vynil Sheets	■■□□□	■■■□	■■■	Infrequent	New	-	Self-Built

Thermal Conductivity:

■□□□□ 0.0 - 1.0
■■□□□ 1.0 - 5.0
■■■□□ 5.0 - 10.0
■■■■□ 10.0 - 50.0
■■■■■ Above 50.0

Shelf Life (Years):

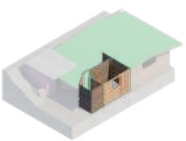
■□□□ <1 Year
■■□□ 1-2 Years
■■■□ 2-5 Years
■■■■ > 5 Years

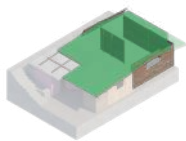
Durability

■□□ Low
■■□ Medium
■■■ High

Supply side perspective: S

Users perspective: U





2016	2016
Self-Owned	Self-Owned
Self-Built	Self-Built
Increase in family size	Severe damage to the roof
Additional room constructed, thereby separating functions and spaces	Roofing sheets replaced and supplemented with Polythene sheets to address water leakage
Rs. 25,000	Rs. 25,000
Microfinance loans	Microfinance loans

G5 Suryagaon

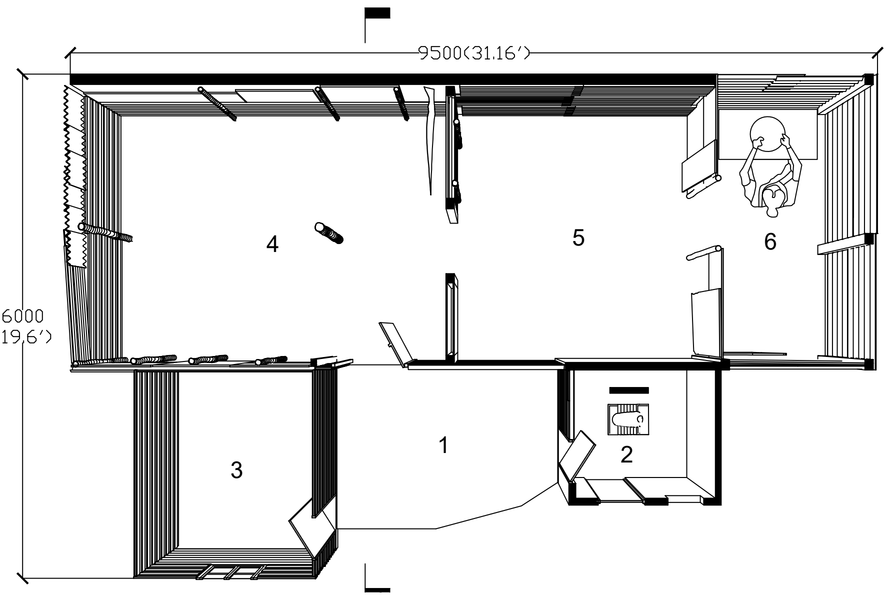
Name: Ashok
Age: 47
Housing Tenure: Temporary (Kutcha)
Structure Type: Detached
Area: 57 sq. mts
Family Size: 6
Family Occupation: Private, Lal Bazaar
Family Income: Rs. 15000

I live here with my family, having migrated to Suryagaon. This is evident in the fact that since the construction of our house in 1992, there have been no significant changes in its form or materials. Initially, it was a simple shack with a mud floor, walls made of pieces of cloth, cement sheets, and plastic panels around a bamboo pole frame. In 1998, due to water damage and rot, we replaced the bamboo poles and some wall sheets. To prevent rainwater from dripping inside and combat leakage, we started using plastic sheets on the interior. The 2011 earthquake prompted further changes; we reinforced the walls with cement sacks and replaced bamboo poles on a slightly stronger cement floor. Since then, the floor has suffered extensive damage, leading to waterlogging and seepage. However, due to financial constraints, the bamboo poles have yet to be replaced despite the urgent need to do so.

Currently, we estimate the rebuilding costs for our house to be in the range of 30-35,000 rupees. Our main issues include flooding, waterlogging, and roof leakage. Occasionally, strong winds dislodge roofing sheets, requiring recovery or replacement. All the materials used for our house are salvaged from construction sites or procured locally. To cope with these challenges, we use cement sacks and weighted objects to secure the roof in place. Additionally, we install plastic sheets annually to prevent water from leaking through the roof.

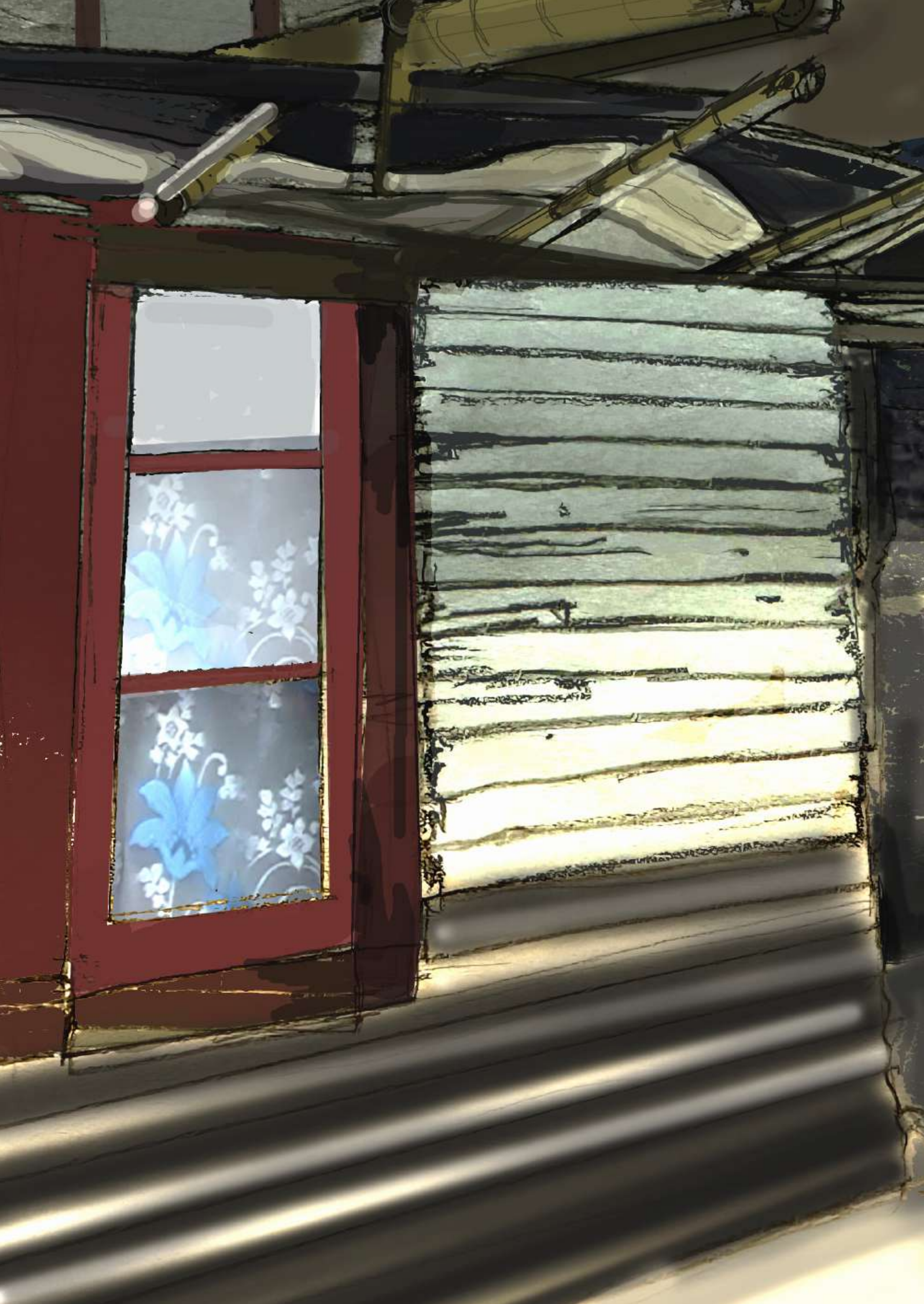
Documentation

Section



Plan

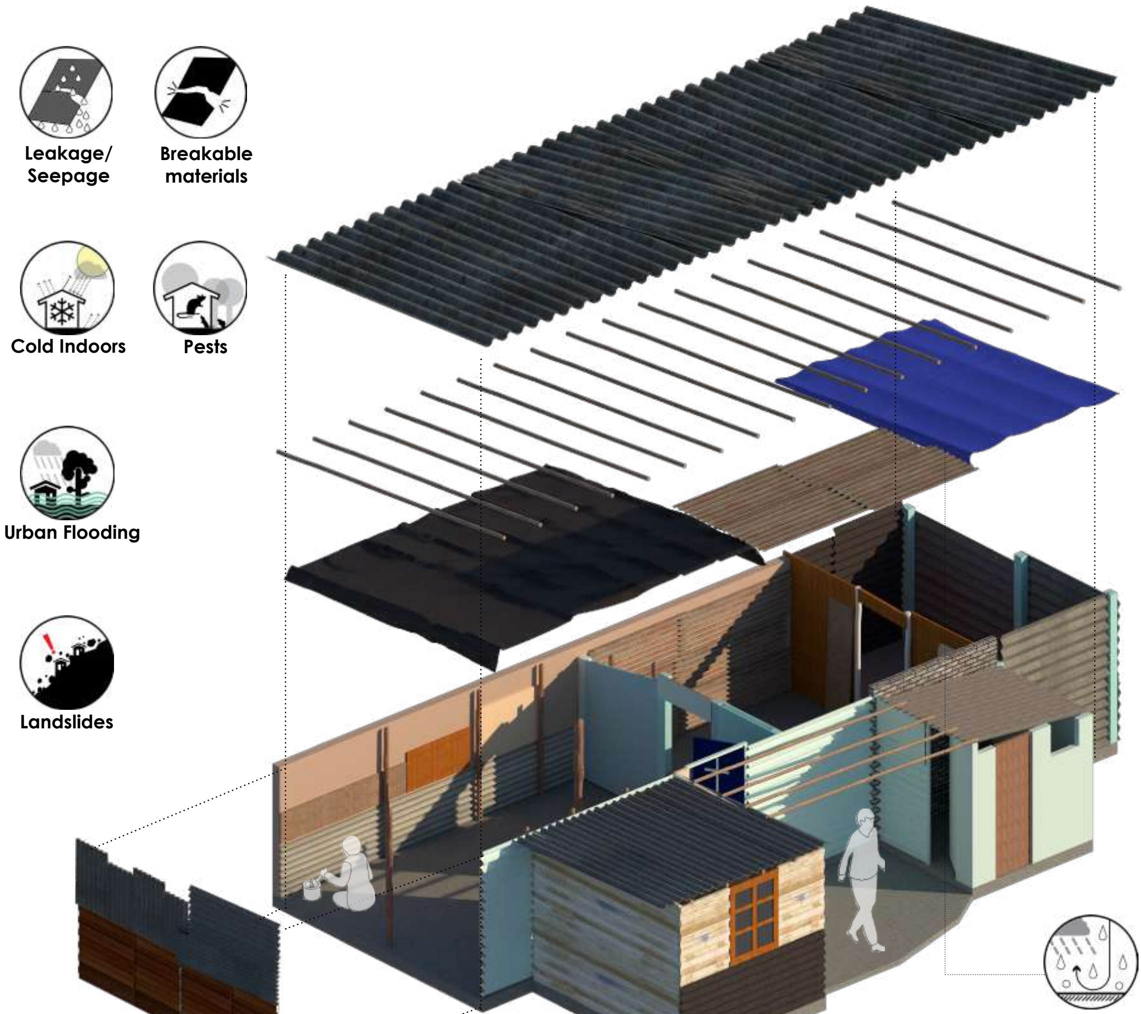
1. Verandah
2. Toilet
3. Bed room
4. Living room
5. Bedroom
6. Kitchen




Dwelling G5, Suryagaon, Gangtok. Precarious environmental and topographical conditions dramatically reduce the lifespan of a dwelling and its components. Financial constraints introduce further challenges. Roofs are often built with cheap materials which are easily damaged, detrimentally impacting their resilience to the elements. Though Coping mechanisms such as plastic sheets are prevalent , they are seldom as effective as imagined
It is high time we change our roof, I do not think it would hold up much longer
I agree, we should, but it is increasingly difficult to carry everything and the carrying charges are very expensive...

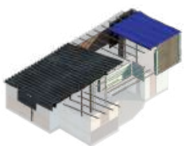
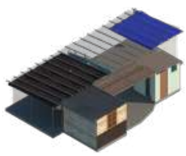
Issues & Challenges

Coping Mechanisms



Polythene and Tarpauline sheets are used to protect the roof and the dwelling against rainwater

Timeline

Increments over time		
Year	1992	1998
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Family migrated to Suryagaon	damage due to water-logging
Response	Dwelling built using highly precarious materials; polythene, cloth and plywood sheets	Polythene, Tin and Cement sheets replaced in the roof
Cost	NA	NA
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

	S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Donated	-	Self-Built
	Polythene	■□□□□	■□□□	■□□	Frequent	New	-	Self-Built
WALL	Brick	■■□□□	■■■■	■■■	-	New	Rs. 12/ Piece	Self-Built
	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Donated	-	Self-Built
	Wooden planks	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-Built
STRUCTURE	Wooden planks	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-Built
	Bamboo	■■□□□	■■■■	■□□	Frequent	Second-Hand	Rs. 200-400/Pole	Self-Built
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 460-490/Bag	Self-Built

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

Durability

- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U

2011	2023
Self-Owned	Self-Owned
Self-Built	Self-Built
Dwelling destroyed in earthquake	
Rebuilt on a fresh frame structure and new cement sheets, supplemented with polythene	Present status of the dwelling
NA	
Self-Financed	

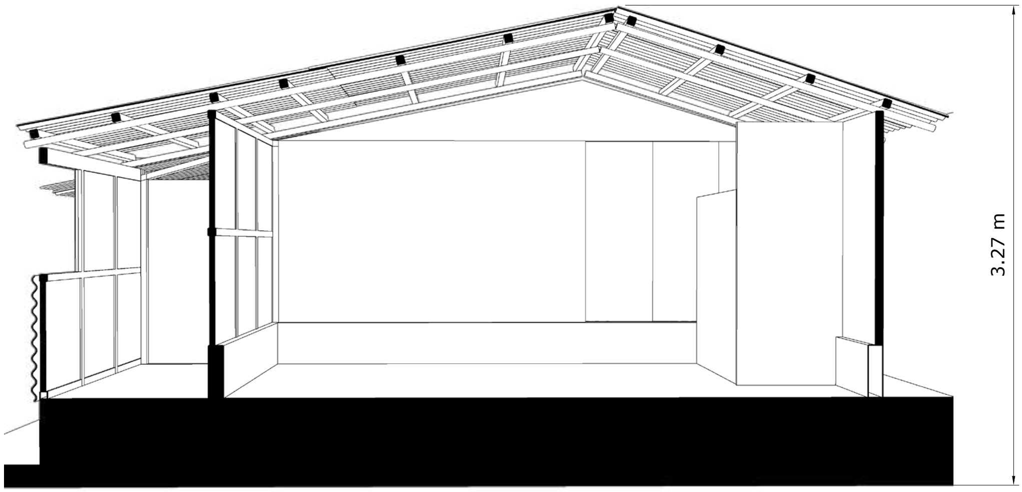
G6 Suryagaon

Name: Lakpa
Age: 42
Housing Tenure: Semi Permanent (Semi Pucca)
Structure Type: Detached
Area: 18 sq. mts
Family Size: 6
Family Occupation: Labour
Family Income: Rs.12000
House Investment - building, maintenance and upgrades: Rs.149890

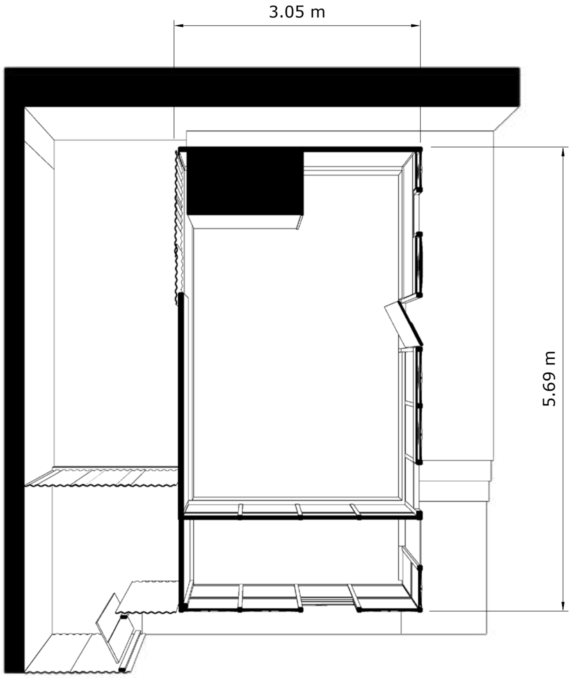
I with my family live here since 2010. Initially we constructed our house between 2010 and 2012, the house was a makeshift shack, pieced together with materials collected over a two-year period. The house featured a precarious roof made of plastic and tarpaulin sheets supported by bamboo poles, forming the basic framework. The walls were crafted from second-hand tin sheets. The first significant alterations occurred in 2018 when the front and side walls, originally made of tin sheets, were replaced. The discarded tin sheets, along with plywood, found a new purpose as the material for the back walls. Furthermore, the flooring underwent a transformation with the introduction of cement. Subsequent changes in 2021 involved the construction of Ikra walls on two sides, while the back wall retained its original composition. The dwelling now consists of three walls, the last one serving as a partition made of plywood and plastic sheets, creating a separation between the kitchen space and a sizable vertical 'plum' at the rear.

The most recent upgrades in 2022 included plastering the Ikra walls with cement on the interior while leaving them exposed on the exterior. Despite these improvements, persistent issues with flooding and water seepage remain, with a particular concern regarding the risk posed by the plum wall at the back. To address these challenges, we implemented coping mechanisms such as using plastic sheets on the walls to prevent water leakage in the roof.

Documentation



Section



Plan

1. Verandah
2. Living Space
3. Storage
4. Bedroom

Issues & Challenges

Leakage/
Seepage

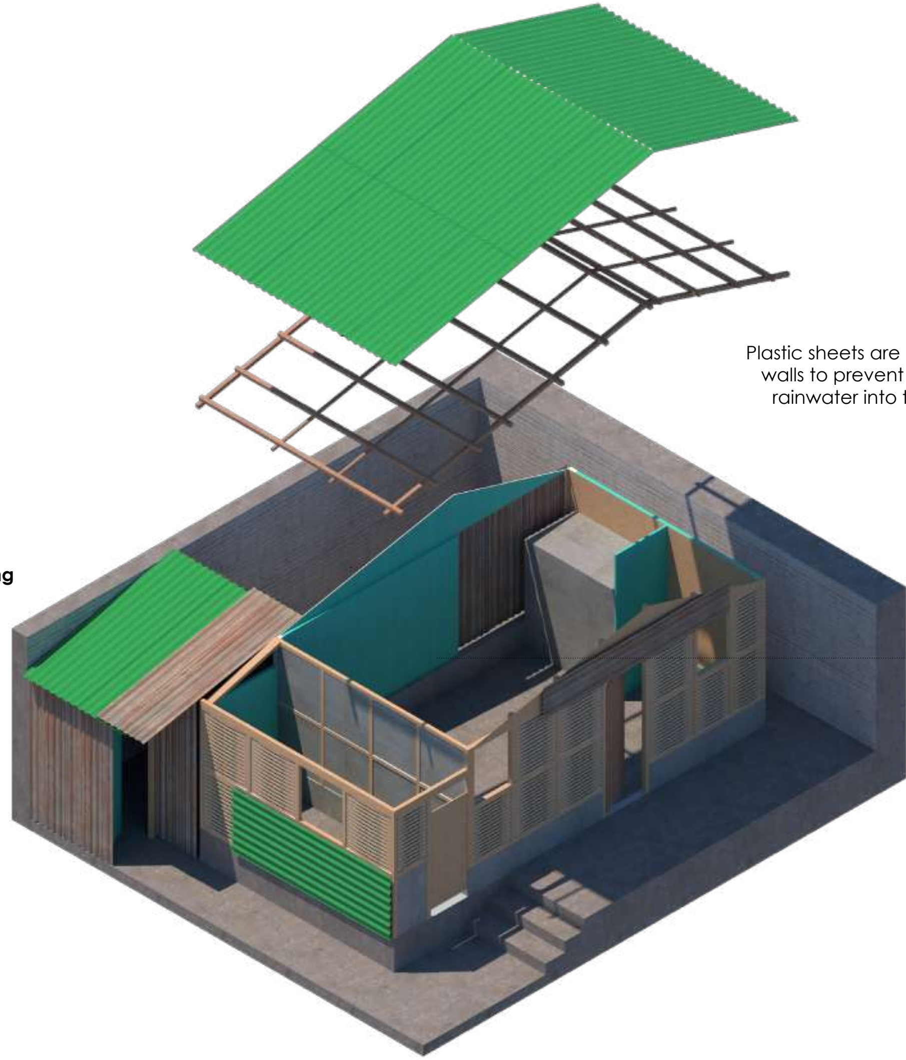
Cold Indoors

Urban Flooding

Landslides

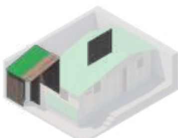
Coping Mechanisms

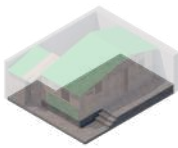
Plastic sheets are used on the walls to prevent the entry of rainwater into the dwelling



Timeline

Increments over time





Year	2010	2018
Tenure Arrangement	Self-Owned	Self-Owned
Construction	Self-Built	Self-Built
Need	Increase in the family size	Damage to floor due to water-logging
Response	Single-room dwelling built using plastic sheets and plywood	Floor/plinth rebuilt using cement. Plastic sheets used to replace plywood walls
Cost	Rs. 12,000	Rs. 70,000
Financing Mechanism	Self-Financed	Self-Financed

Attributes of materials

		S	S	S	U	U	U	S	U
	Material	**Thermal Conductivity**	**Shelf-life**	**Durability**	**Maintainence**	**Procurement**	**Cost**	**Execution**
ROOF	Corrugated Cement sheet	■■□□□	■■■□	■□□	frequent	Donated	-	Self-built
WALL	Wooden planks	■■□□□	■■■■	■□□	Frequent	Salvaged	-	Self-built
	Bamboo	■■□□□	■■■■	■□□	Frequent	New	Rs. 200-400/Pole	Self-built
	Mud	■□□□□	■■□□	■■□	Frequent	Locally procured	-	Self-built
	G.I. Corrugated Sheet	■■■■■	■■■■	■■□	Infrequent	Donated	-	Self-built
	Plaster	■■□□□	■■■□	■■□	Infrequent	New	Rs. 460-490/Bag	Self-built
STRUCTURE	Timber sections	■■□□□	■■■□	■■□	Infrequent	New	Rs. 700-780/ Plank	Self-built
FLOOR	PCC flooring (Thin)	■■□□□	■□□□	■■□	Frequent	New	Rs. 460-490/Bag	Self-built

Thermal Conductivity:

- ■□□□□ 0.0 - 1.0
- ■■□□□ 1.0 - 5.0
- ■■■□□ 5.0 - 10.0
- ■■■■□ 10.0 - 50.0
- ■■■■■ Above 50.0

Shelf Life (Years):

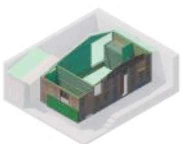
- ■□□□ <1 Year
- ■■□□ 1-2 Years
- ■■■□ 2-5 Years
- ■■■■ > 5 Years

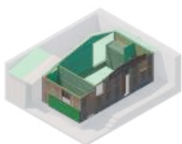
Durability

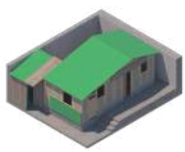
- ■□□ Low
- ■■□ Medium
- ■■■ High

Supply side perspective: S

Users perspective: U



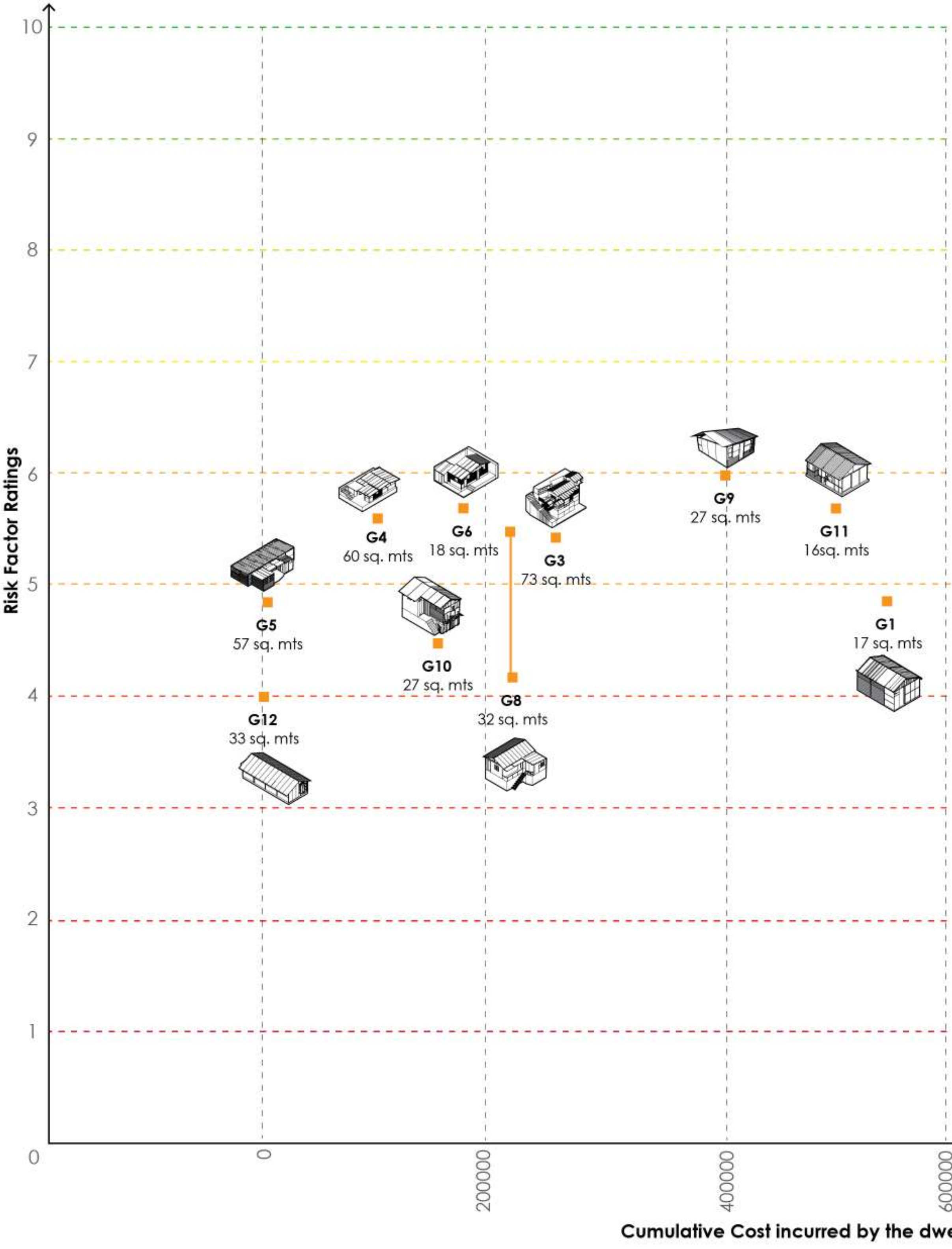




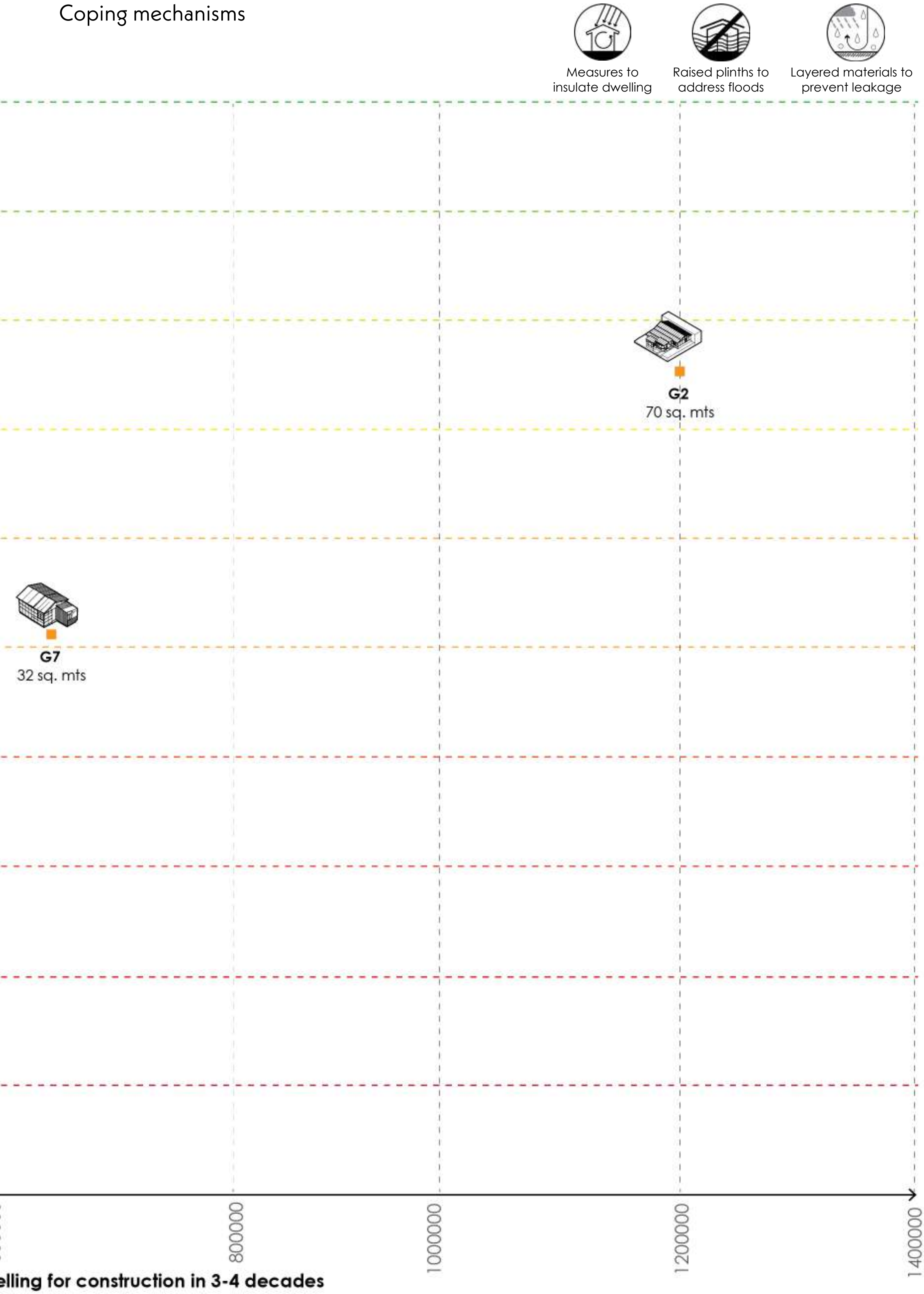
2018	2021	2023
Self-Owned	Self-Owned	Self-Owned
Self-Built	Self-Built	Self-Built
Poor resilience of Tin sheets to the cold	Concerns of structural stability	
Walls rebuilt using the ikra technique (Mud plaster on interwoven bamboo frames)	Exposed bamboo walls plastered with cement	Present status of the dwell-ing
Rs. 30,000	NA	
Self-Financed	Self-Financed	

Climate comfort and decadal costs incurred
Microclimate: Cold

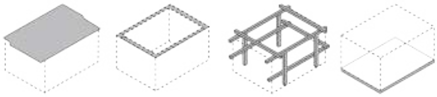
D.U area (Min): **15 sq. mts**
D.U area (Max): **73 sq. mts**



Coping mechanisms



Dwelling materials in the Cold Microclimate
Analysing compositions and impacts

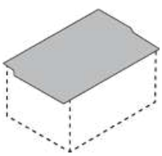


Taxonomy	Roof	Wall	Structure	Floor	Thermal Conductivity	Lifespan	Durability
Bamboo		✚	✚		■■□□□	■■■■	■□□
Brick		✚			■■□□□	■■■■	■■■
Cement Bags				✚		■■■■	■■■
Corrugated Cement sheet		✚			■■□□□	■■■□	■□□
Foam Sheets				✚	■□□□□	■■■□	■□□
G.I. Corrugated sheet	✚	✚			■■■■■	■■■■	■■□
Mud		✚			■□□□□	■■□□	■■□
Plaster		✚			■■□□□	■■■□	■■□
PCC			✚	✚	■■□□□	■■■■	■■■
Polythene	✚	✚		✚	■□□□□	■□□□	■□□
Tarpaulin	✚				■■□□□	■■□□	■■□
Vinyl sheets				✚	■■□□□	■■■■	■■■
Wooden planks		✚	✚		■■□□□	■■■■	■□□
Timber		✚	✚		■■□□□	■■■□	■■□
Plywood	✚	✚			■■□□□	■■□□	■□□

At a glance

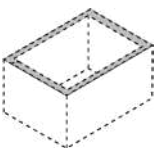
The table above lists all the materials that are being used to construct the 12 dwellings documented across Gangtok in the Cold microclimatic zone and are mapped according to the taxonomy in which their use is prevalent. .

Roof



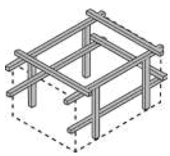
100% G.1. Corrugated sheets

Wall



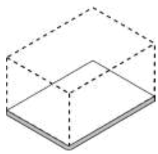
80% G.1. Corrugated sheets

Structure

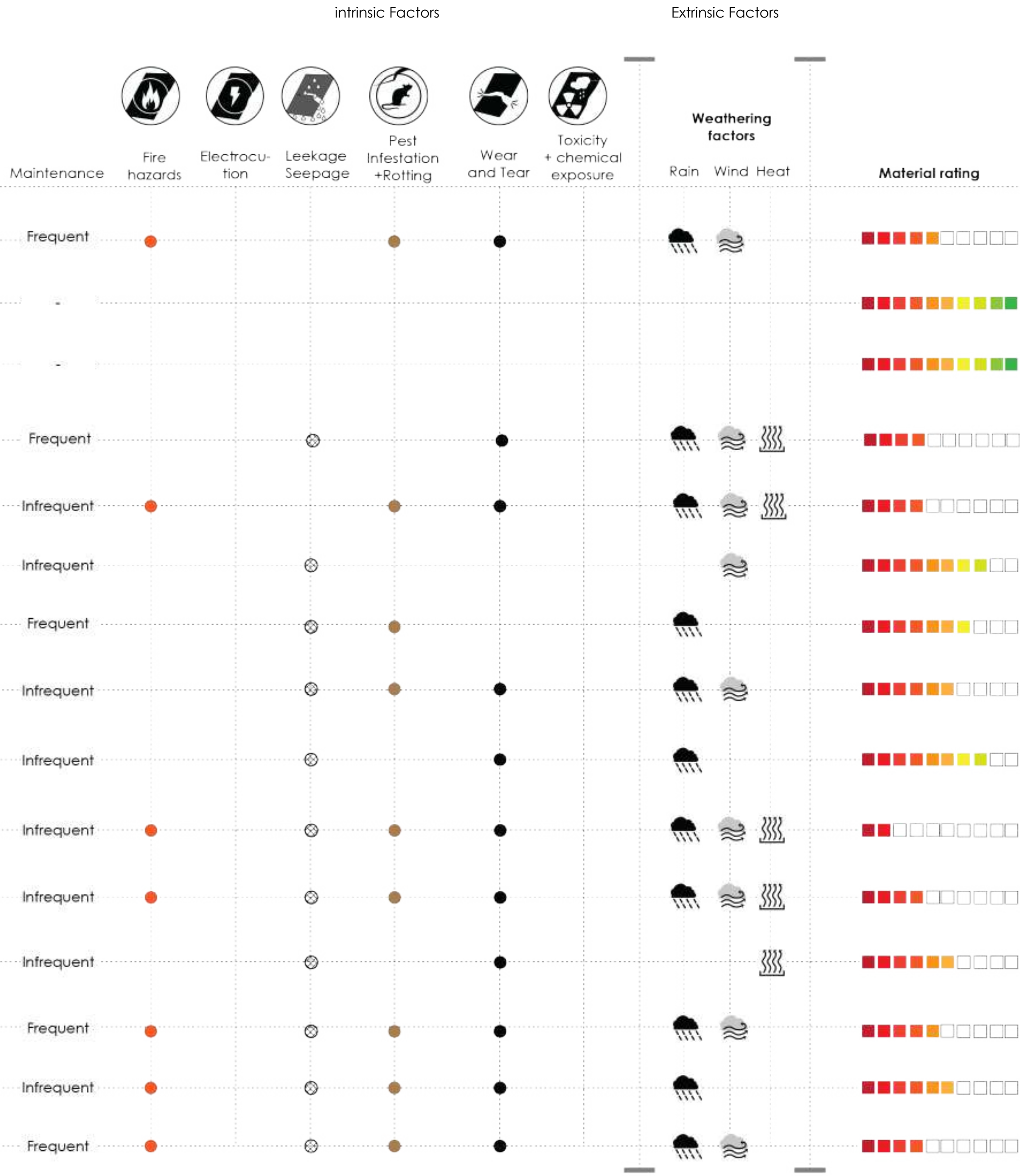


90% Wood + Bamboo

Floor/Plinth

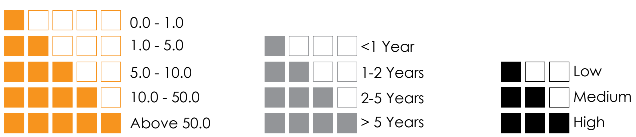


100% Plain cement concrete (PCC)



Contextual challenges: Cold

Legend



“

I think there is an assumption that the communities leading these situations are ignorant and the don’t have solutions. But if you go to every community, they have ways that they address these, there are ways that they adopt. And the challenge has always been, how do you take whatever communities are doing in terms of adaptation and how do you take their solutions and make them better.

Joseph Muturi,
Chairperson, SDI

6

Learnings from the Labs

In this Campaign for Roof Over Our Heads, we have two elements - Advocacy and action on the ground. The 9 labs conducted in India are part of the campaign's action on the ground and the ROOH Secretariat planned the Phase I by developing a criterion for selection as part of the Framework. This involves establishing connections with partners and women's groups, strategically identifying cities and informal settlements within different climate zones and initiating documentation and data analysis. The 5 'A's of Affordability, Acceptability, Accessibility, Adaptability, and Availability is the base for the analysis of the data.

The first year of the ROOH campaign helped to understand the ground realities of various issues and challenges faced by vulnerable communities and the poor in informal settlements, issues related to infrastructure development, health and habitat, the challenges and struggles of people living in informality to survive and maintain their housing with the increasing frequency of extreme climate events.

Residents of these informal settlements are mostly daily wage laborers and often salvage, borrow, and mostly buy second hand materials and face the constant struggle to survive in the harsh conditions due to extreme winds, rain, cold and seek for coping mechanisms/solutions in very difficult circumstances. They constantly make institutive choices based on what is available and affordable to them. Through settlement assessments, focus group discussions

(FGDs) and individual interviews with families from the communities in the 9 labs, it was found that local solutions vary from community to community, across neighbourhoods (population density, ethnicity, etc.) within the same geography and city to city.

As people migrate to cities in search of better opportunities and livelihoods, Informal settlements are often born out of necessity. The absence of tenure security and proper documentation has significant and far-reaching consequences, particularly in informal settlements. It creates a domino effect that affects not only the residents of these settlements but also the broader community and the governments. Lack of tenure leads to more spending for everyone. One of the primary repercussions is the inability to secure investments or loans for housing and infrastructure development. This situation perpetuates a cycle of financial stress and hinders progress for the residents. The labs attempt to understand the logic of how communities made choices and the chronology of the choices made in building a house and the investments made as a response to the various challenges they faced over a period. The Roof Over Our Heads campaign aims to break this cycle by exploring alternatives to existing issues and co-produce solutions with the communities. By providing access to financial mechanisms and exploring alternatives to building materials for housing through the labs and building capacities of the residents, artisanal masons and labourers within the settlements who form the construction ecosystem, the campaign can converge traditional wisdom and professional skills to help residents upgrade their houses incrementally, through alternative designs, construction techniques and materials ensuring that they are relatively more durable, comfortable, and resilient habitats. ROOH is about exploring towards alternative habitats.

We all KNOW that "*improved housing conditions SHOULD contribute to the legal recognition of these settlements. When homes are constructed with proper materials and conform to safety and environmental standards, it becomes more likely that authorities will acknowledge and legitimize these settlements. This transformation is vital for the residents, as it grants them security and rights they have long been denied*." If this was the case, the incentives to improve habitat while cities provide amenities and services will make neighbourhoods more resilient.

This database not only becomes a benchmark for the alternatives that need to be explored going forward while consolidating and supporting what is seen as an innovation that is already in use. It also facilitates a deeper insight into the logic behind their usage. The idea of the analysis is not to develop the "best" solutions but to examine what works locally, is replicable and has the highest impact against the climate challenges that households face living in informal settlements.

Climate Stressors in each Lab:

Hot Dry Climate:

- Ahmednagar, Maharashtra - High temperatures, fire hazards, structural instability
- Surat, Gujarat - Urban flooding, high temperatures, leakage during rains, structural instability.

Warm Humid Climate:

- Mumbai, Maharashtra - Heat stress, heavy rains, cyclonic winds, humidity, fire incidents, structural instability.

- Bhubaneshwar, Odisha - Rains, flooding, indoor heat, cyclonic winds, safety concerns.
- Cuttack, Odisha - Flooding, cyclonic winds, rain, heat, fire incidents, safety concerns.
- Paradeep, Odisha - Cyclonic winds, floods, indoor heat, humidity, soil erosion, health risks.

Composite Climate:

- Pune, Maharashtra - Cyclonic winds, heat, rain, urban flooding

Temperate Climate:

- Bengaluru, Karnataka - Rain damage, winds, electrocution, urban flooding, safety risks.

Cold Climate:

- Gangtok, Sikkim - Heavy rainfall, landslides, water damage, soil erosion, safety risks.

These stressors can manifest in various forms and impact different climatic regions differently.

Critical considerations in constructing a home encompass financial resources, suitable land, and critical elements such as location, eviction potential, and existing infrastructure. These aspects play pivotal roles in the decision-making process when contemplating the construction of a house.

The general observations are: Through discussions in the 17 informal settlements in the 9 cities, it is evident that corrugated tin sheets are the most prevalent choice for temporary structures. Most preferred are tin sheets followed by cement sheets and tarpaulin sheets in order of preference. They are readily available in nearby markets, both in new and second-hand conditions, and can be salvaged from nearby areas or workplaces, making them a practical option. For semi-permanent structures, materials like red fired bricks, fly ash bricks, and ACC blocks are commonly used. These materials are preferred by individuals with higher incomes and or ability to borrow from sources, even though they come at a higher cost.

Weather conditions, including heat, rain, and wind, pose significant challenges for building materials in these urban settlements. High temperatures cause materials to crack and degrade, while rain leads to rot and rust. Strong winds can displace roofing and lightweight structures. Maintenance costs vary, often exceeding initial savings on cheaper materials, impacting quality and resilience against natural disasters resulting in an increase in overall cumulative costs invested in upgrading or maintaining the house over time.

In the comprehensive documentation for the 9 labs, a wide array of materials used for various building components were identified. There are 19 different materials used for roofs, 27 for walls, 12 for the structural framing of houses, and 17 for floors in the 68 households that were selected for interventions. This diversity reflects the varied tapestry of construction practices and material choices across different climate regions and communities. It underscores the importance of considering local conditions and community needs when selecting the right materials.

Developing a framework from reflections of the settlement's histories

Almost in all reflections the past historical elements of the settlement are a critical element to understand to explore the present and the future. SDI instruments of settlement profiles and household surveys track the journey of households from their village to the city and this pathway is full of amazing journeys of constant fear of evictions, demolitions that lead to locating their homes in other locations or rebuilding in the same place after the scrutiny post demolition is over. It produced a construction strategy that is initially makeshift…i.e., it can be dismantled of facing evictions, but gradually consolidating with eternal materials that continue to be dismantled… only when there is some signal that while threats of eviction continue there is no recent threat and actual demolition that domal brick motor etc begin to get used.

May housing activists and researchers place these issues in front of the ROOH teams during worships and round tables. And the team often repeats what the women tell them "We must have a place we call our home. If they break it, we must rebuild it. We don't have options. From this challenge we take the cue of what ROOH should do minimally. Within what expanded options ROOH produces together with the women and their neighbourhoods it must address the challenge of protecting the household from extreme weather. Together the market for materials the potential for affordable loans and construction systems experiments with households to produce the resilience that is needed.

Execution of building materials, construction, and its financing

Self-building and self-financing often imply that residents in informal settlements not only lack access to formal housing options but also reflect the scarcity of options available to them. Based on the data collected in all the 17 settlements in 9 cities, to understand the economic vulnerability, 35% of people have self-built and self-financed the construction of their houses whereas, 35% of houses are self-constructed and for 7% of houses, skilled labours had been called for the construction. This data is essential for informed and targeted interventions that can attempt to improve living conditions, reduce vulnerabilities, and hopefully promote sustainable development in these areas. It will seek to ensure that policies and programs regarding materials finance and construction techniques are tailored to the specific needs of these communities and can be replicated as and when they produce impact.

Procurement of Building Materials:

Discussions and conversations with local communities, indicated the basis of choices made by households of materials and already a clear indication that they took heed of the climate zones and by factors such as material availability in the market and the affordability of different acquisition methods.

In settlements, acquiring building materials involves a complex interplay of socio-economic and environmental conditions. Several distinct methods for obtaining materials were identified, each of which directly impacted the durability and maintenance of the materials used in the house.

In the study of what material was purchased and how it was procured the documentation included:

34 % Purchase New from the market.

29 % Acquire second-hand materials through direct purchase.

5 % Borrow materials from local individuals, such as friends, relatives, or neighbours.

28 % Salvage materials from nearby sources, which could include debris from construction sites or unattended areas.

4 % Receive materials as contribution or donations from MLAs (local politicians) or NGOs, etc or borrowed from friends, relatives, or neighbours.

Cumulative costs incurred for investments adjusted for inflation up to 2023 made in 68 households in 17 settlements in 9 city labs reveal a diverse financial landscape for households across various climatic regions in India. In Ahmednagar and Surat, situated in hot and dry climates, expenditures range from Rs.10,000.00 to 3,37,927.00 (approx. US$ 120 to 4052), reflecting the need for a wide spectrum of investments to cope with extreme weather conditions. For Mumbai, Bhubaneshwar, Cuttack, and Paradeep, areas with warm and humid climates, costs span from Rs. 2,761.00 to 2,66,960.00, (approx. US$ 33 to 3200) indicating the financial considerations associated with these regions. In Pune, with its composite climate, the cumulative investments range between Rs. 85,000.00 to 1,40,500.00 (approx. US$ 1019 to 1685). In Bengaluru, known for its temperate climate, households allocate Rs. 5,775.00 to 45,000.00 (approx. US$ 70 to 450) while in Gangtok, nestled in the cold climate zone, expenses range from Rs. 1,30,296.00 to 12,11,811.00 (approx. US$ 1562 - 14530) highlighting the varying financial commitments necessary to adapt to local weather conditions. These figures underscore the significance of accounting for climate when planning investments in households across India.

In the context of assessing the quality and suitability of materials used in informal settlements, a comprehensive evaluation has been done from the data collected in all the 9 cities. The following parameters determine individual ratings for each dwelling's building material for the given microclimate where the emphasis given to each parameter is based on challenges and priorities as described by the residents during the interviews. This plays a pivotal role in determining the overall material rating and consequently the risk associated with each dwelling unit. This methodology has been carefully designed to address the unique challenges and constraints faced in such environments.

Life Span (20% of the Rating):

The life span of the materials used in a dwelling unit carries significant weight in the assessment, accounting for 20% of the overall rating. Materials that are expected to last longer are preferable, as they contribute to the stability and sustainability of the shelter. To quantify this, a rating system has been developed based on the expected life span of materials, ranging from less than a year to more than five years. This parameter acknowledges that longer-lasting materials are more resilient and secure for the occupants. However, there is an increased cost attached to it.

Durability (30% of the Rating):

The durability of the materials is given 30% of the overall rating. Durability is categorized into three levels: low, medium, and high. High-durability materials are more likely to withstand the stressors of everyday life, offering better protection to the inhabitants. This parameter reflects the reality that materials with higher durability contribute to the long-term safety and stability of the dwelling unit. Again, prices increase for more durability.

Vulnerability to Potential Hazards (30% of the Rating):

This parameter assesses the susceptibility of materials to various hazards, emphasizing the safety of the occupants. It carries a 30% weight in the overall rating. The vulnerability of materials to hazards such as fire, electrocution, leakage/seepage, pest infestation, rotting, breakage, structural damage, wear and tear, and chemical exposure is considered. A lower vulnerability rating indicates that the materials are better equipped to protect against these risks.

Weathering Factors (20% of the Rating):

Resilience of materials against weather conditions is a vital component, accounting for 20% of the overall rating. The assessment considers the impact of heat, wind, and rain on the materials. Materials that can withstand adverse weather conditions are rated higher, as they are less likely to deteriorate over time due to exposure to the elements.

In addition to the primary parameters mentioned above, two other factors play a supplementary role in the assessment. The nature of execution, which considers whether skilled laborers were involved in the construction process or if it was self-built, contributes to the overall rating. Similarly, the nature of material procurement, whether the materials were bought or donated new, bought second-hand, or salvaged, is also considered.

The final rating is calculated by multiplying the individual ratings for each of these parameters and reflects the overall risk associated materials used in the dwelling unit. This multi-faceted approach ensures that a comprehensive evaluation is conducted, considering both the durability and the specific vulnerabilities of the materials. By assigning different weights to each parameter, the methodology places the most emphasis on those factors that are most critical for the safety and longevity of the house, thereby providing a framework for assessing material suitability in informal settlements.

The dwelling ratings for 68 dwelling units intervened from 17 informal settlements are an aggregate of the individual material ratings subject to the mode of procurement (wherein materials may be bought new, purchased second hand or salvaged from waste etc) and the manner of their execution, both of which have implications for the lifespan, durability, and the ability of the materials to withstand weather conditions and hazards. The factor by which the procurement and execution affect the rating of the material are based on empirical data. The final ratings given to the dwellings are an aggregate of the ratings of all the materials that have been used in its construction. 38% of the dwelling units i.e., 26 units out of 68 intervened have ratings above 5 and dwellings with a higher rating are indicative of a more robust and resilient construction, having been made with superior materials (Those which have a longer effective lifespan, are more durable, less susceptible to intrinsic or extrinsic hazards), generally purchased new from the first-hand market and built through skilled labour or contractors. 68% of the dwelling units i.e., 42 units out of 68 have ratings below 5. Conversely, dwellings with a lower rating are indicative of a construction which is highly vulnerable to climatic and environmental stressors, are susceptible to intrinsic and extrinsic hazards and weathering factors. Such dwellings have also been built poorly, and comprise of materials which have a lower effective lifespan and are less durable since they have been procured in the second-hand market or salvaged from waste-yards.

What Building Materials are we looking for?

In the challenging landscape of the 17 informal settlements, identifying any ideal material to address housing vulnerabilities demands a nuanced approach. Striking the balance between climate proficiency, a harmonious blend of scientific knowledge and local wisdom, and the imperative for immediate solutions is paramount that demonstrates impact value AND is available and affordable. The material chosen must exhibit incrementality to allow adaptability and accommodate needs that are often incremental in nature. Moreover, it emphasizes the interrelation of materials used, and contributes to an inclusive, contextually driven, and resilient environment.

Sustainability and climate responsiveness are non-negotiable, underpinned by financial viability and rapid implementation, ensuring tangible and measurable results. This endeavour must be locally led, promoting co-production rather than a top-down approach.

Success for the ROOH Action on the ground would be described as creating a process that helps in developing assessments and examining possibilities with regards to creating more resilient habitats for the urban poor. Labs facilitate the creation of a database that documents options that are working and why locally and regionally and how they can be taken up by others. The campaign draws attention to get city governments and financial institutions to provide and fund basic infrastructure and services for the urban poor.

Whether the solution leans towards conventional or green, the key goal is to enhance the resilience of the residents, empowering them to actively participate in their own locally led adaptation process. Only when the solution demonstrates its accessibility affordability and robustness will the scalability and rapid usage become possible. Until that happens the quest to make it happen continues.

Let's Talk the Talk and Walk the Walk!

This cartoon was created LIVE by Rohan Chakravarty during the launch of the campaign for Roof Over Our Heads at COP27

7

Looking Back Building Forward

Looking back

Roof Over Our Heads (ROOH), was conceived through issues and expectations that emerged out of the web-based discussions of women leaders from SDI during the Covid-19 lockdowns[xxix]. It was also a time when many of the affiliate NGOs and federations of SDI were examining how to combine challenges that they faced in development challenges of insecure habitat on an ongoing basis with the challenge of climate change. The five asks of what the women leaders of SDI wanted had the potential for allowing us to explore how the two aspects of development and climate change could come together in the lives of urban slum dwellers living in informality in the global south.

There was also a realisation that global debates must focus on each element of climate change separately from development, which meant that the development professionals and communities constantly had to intrude in these discussions to demand a reality check that everything that was discussed came together in the lives of the poor and vulnerable people. Equally shocking was the realisation that while the rhetoric sought accountability towards these vulnerable communities, the actual activities, mechanisms, and programs to ensure inclusion, solutions, finances, technology, and the knowledge the vulnerable themselves needed to be resilient was absent in practical action. At least in the urban context.

ROOH has the potential to become a flagship learning process which can provide knowledge that can influence education and experimentation and exploration for the development professionals, as well as for the constituencies that need to engage in production of new knowledge and practical action to begin a journey with a focus on resilient homes for resilient neighbourhoods.

The labs follow historic practices within SDI where the affiliates and communities experiment with seeking accountability of strategies and solutions to local communities, create data sets that work locally and globally, and scale information and knowledge creation based on evidence that every local group and network produces. This gets aggregated nationally and globally. Explorations by some mature SDI city federations and groups produce solutions that are shared through peer exchanges and help for women's groups and communities to make representations to the cities, national governments, and global institutions.

The formula is simple and powerful. *Explore and produce solutions with women's groups and communities that they can undertake for themselves, and demand investments and contributions from duty bearers, state and non-state, to produce impactful and productive investments to make change happen at scale.*

The labs in ROOH's program are micro local initiatives and the campaign is the call for action from national and global organisations to acknowledge this process, contribute finances, knowledge, and policy investments to assist and support the women in informal neighbourhoods.

The legitimacy of this process emerges from both ends, locally and globally and the process elements get discussed, and the need confirmed within SDI and other social movements. The labs and the campaign go hand in hand. Each deepening and demonstrating the urgent need for change at both ends. The Race to Resilience (RtR) and the wholehearted support from the Climate Champions of the last three years for the concept and strategy and need has facilitated the ambition to both create a foundation for change that seeks to help people future proof their homes, and demand the attention of the global stakeholders and now ROOH is a part of the RtR family of programmes. The launch of ROOH at COP27 at Sharm al Sheikh in Egypt represents a critical milestone where partnerships supporting ROOH were celebrated and the challenge of now linking each COP as a yearly milestone gives the ROOH family an event to report the activities undertaken during the year and proposed plans for the next year.

The activities leading to COP28.

SPARC manages the secretariat of ROOH based in India but increasingly professionals and community leaders across countries are playing roles and making seminal contributions. Together everyone contributes to both the labs and campaign directly and indirectly as both aspects of this programme deepen and strengthen each other. Round tables, and bilateral discussions connect communities and campaign linked activities. Much of the campaign activities such as round table participation in webinars helps to deepen insights about what ROOH does, with assistance and support from all affiliates of SDI and partners in the north and south. In 2023 members of ROOH attended the London Climate Week and the New York Climate Week in person and attended the other climate weeks in Africa, in the MENA region and in the Asia region virtually. Many partnerships e.g., with Arup[xxx], Holcim[xxxi], GCoM[xxxii], IIED[xxxiii], Reall[xxxiv], and TECHO, Huairou Commission, International Alliance of Waste Picker's and ACHR are being drafted; while some are to develop labs, others will be working on the campaigns and supportive engagements to strengthen the labs with new materials and strategies.

ROOH's process is evolving and emerging. Its processes are clear as is its commitment to keep women and local communities at the centre of the processes. This changes the nature of how this amazing range of support networks make their contributions on how to assist and support a process which clearly seeks the creation of resilient homes to cope with extreme weather without any pre-planned solution. So far:

1. Nine labs have been initiated in India as documented in earlier chapters. The purpose of doing this first urgently as we develop the strategy has many reasons. First, the need to build evidence demonstrating a powerful research tool with women's collectives that they will ultimately own. This process creates a systemic way to identify labs with local federations and women's collectives; how they emerge, who is involved, and what they do together. Secondly ROOH needed to demonstrate that the data and assessments produced as benchmark information are data sets that are universally acceptable and can be produced in collaboration with women's collectives; and which could then support others to answer to make assessments of the resilience requirements for extreme weather. Thirdly this data is the benchmarked as data against which the changes made and their value and impact will get measured. Most importantly, the data itself helps demonstrate direct and indirect research and action needed will be undertaken in the next four stages to complete the process of the labs. While it provides the foundation for the labs, it also maintains the possibility of incorporating and building on all variations of expanding local inquiries across countries and regions.

2. There are three engagements in the last year that reflect how ROOH links labs and global partnerships. The visit of the Arup team to Mumbai to look at a lab in Mumbai; the workshop in Philippines with the Holcim cement and building material company and the network of SDI affiliates, Philippines that works with the Homeless Peoples Federation Philippines (HPFPI); and the engagement in Indonesia with community organisations and universities. All of these will help the future possibilities to demonstrate how different stakeholders can produce impactful solutions to link global support organisations to the labs while opening new possibilities for us to engage with the larger ongoing activities for climate change to link and meet with many new stakeholders. Meanwhile the ongoing engagement to deepen and widen the network and partnerships continue.

Building Forward

2023 provides ROOH with a very wide, increasingly deeper foundation to plan for the next year. In brief, the first of the labs in India move to stage two and three to further develop the process to share it with others. Developing strategies and actions to set up in at least 3 countries in Asia, Africa, and Latin America where the experience of local women's groups and their partner organisations and the team from the secretariat will plan and initiate labs through a training of trainers. As has been the practice within the Indian alliance of SPARC, NSDF, Mahila Milan and SDI affiliates, originators of an evolving strategy share the process with others who evaluate it and then further share it with others. This will produce trainers to assist and support networks in each region that will work to expand the outreach in their continents and help others as well if it all works out financially and agreements with the organisational partnership are set up to initiate, 15 to 30 labs in 2024.

There will be support activities to begin work with finance, materials, designs, and construction systems seeking to assist in the development of labs. Developing dialogues with mayors and national government to include these ideas and strategies in climate action plan of cities and nationally in parallel to creating material for educational institutions, northern and southern through engagements with students as well as exploring ways to embed what we learn in the labs into curriculums will also be explored. As in the case of the labs we will initiate the strategy in India and look at how this can be exported to other countries. All these discussions will include our regional and global partners and need their support and engagements.

Fund raising for our labs and campaign and administering these grants is budgeted to be US$ 12 million. This is an urgent priority. It comes with challenges as ROOH is committed to demonstrate how it embodies the LLA principles. For all engaged with ROOH, it starts with a leap of faith. Community groups and their networks must take a leap of faith to explore this strategy. Their reflections on the risks they need to take and how they will mitigate them need to be addressed. The campaign's challenge to cities that must face the reality of expanding informality needs sustained engagement locally and globally. Much of that is linked to the historical land ownership systems that exclude any possibility of secure tenure. There will also be many failures which have to be acknowledged and learnings emerging from them are to be discussed as much as the successes. Change in such long drawn historical deficits don't happen easily.

Discussions have begun to locate financing partners who want to work with the communities and need to explore the potential of digitalised financing mechanisms, learn and share risks, and build the path of our journey together.

"

ROOH draws attention to the absence of good quality, resilient homes, and habitats, particularly for those living in informality, and that is why it is a quest to improve these. Thus, under ROOH campaign we could develop themes such as: Water from My Tap; Clean Power from My Socket; Good Governance at My Door; and Sanitation and Waste Collection for My Street.

- David Howlett
Senior Advisor,
Climate Champions Team

Apart from donors we also look for partner institutions who will locate roles in this process of communication, research monitoring and evaluation. A paradox for all strategies and programmes that seek to facilitate locally driven solutions is that most countries in the global south where we will have labs have restrictive legal frameworks that don't allow transfer of funds from one southern country to the other, also since their currencies are weak, donations in US$ or Euros get eroded when exchanged to local currencies. Thus, serious partnerships of southern partners with northern partners who can assist ROOH in this process is critical. ROOH needs help not only to distribute funds but to work with back donors to also follow the LLA principles.

Round tables on the web virtually, and physical meetings will continue and will be for general information and news of progress as well as for various constituencies to build and share possibilities to assist the ROOH labs. These also help those (affiliates) undertaking the labs and their networks to share their knowledge and experiences with each other.

Gradually, the city, national, regional, and continental level climate events provide a possibility to showcase and share the work of ROOH as more and more of us participate physically and on the web.

The activities that are undertaken are themselves vital to the process, so everything gets communicated and built on. This is crucial to ensure that ROOH collectively fulfils its commitment to make this work urgently for communities. ROOH will embrace the risks, the failures, and each aspect of the processes that does not work despite the care and commitments made. Realistically "wicked" problems get neglected inter-generationally and neighbourhoods in cities are stuck in informality.

ROOH representatives are always asked so "what's your solution?" There are no easy solutions and no pithy answers. These are the foundational challenges that the ROOH network and movement is trying to produce. Does not knowing at the start of a programme mean it will fail? No one working in the ROOH process believes that! Yet ignoring concerns does not mean that we don't include in the campaign the reality check of how in the next decade solutions must be coproduced and every insight, every possibility that is explored will build bridges to solutions. ROOH is a marathon and not a 100-meter dash. It has huge legal, financial, and political barriers which have contributed to this immense deficit in the first place. Patience, humility, and perseverance is what is needed collectively. ROOH and its wide range of stakeholders can embark on this journey collectively, steadily and with care.

“

If 30 to 50% of the world’s population in urban areas lives in slums then there’s something wrong with the system that criminalizes their existence. And the reality of more and more people coming into an organized world requires us to transform what is the goal of the state, what is the role of the community what is the role of professionals. And I think that this campaign allows us to go beyond our professional niches, to actually see whether we have the courage to sit with women and work with them.

Sheela Patel
Global Ambassador
Race to Resilience and Race to Zero

About the Author

Sheela Patel is the founder director of the Society for Promotion of Area Resource Centres (SPARC), an NGO based in Mumbai, that has been working since 1984 to support community organisations of the urban poor in their efforts to access secure housing and basic amenities and seek their right to the city. SPARC has been working in alliance with two Community Based Organizations – National Slum Dwellers Federation (NSDF) and Mahila Milan (women’s collectives in slums) that are active in 70 cities in different states of India. Since 1999, she has also been Secretary and Chief Executive of SPARC Samudaya Nirman Sahayak (SSNS), a non-profit company set up to assist slum communities to take on construction projects nationwide, specifically focused on building homes and sanitation facilities. Sheela is one of the founders of SDI, a transnational social movement of the urban poor in Asia, Africa, and Latin America. She previously served as the chairperson of SDI’s board.

Sheela is a founder amongst many, of SDI, a transnational social movement of the urban poor in Asia, Africa and Latin America, whose board she previously chaired. Patel is widely recognised – nationally and internationally – for bringing the issues of urban poverty, housing, and infrastructure to the attention of governments, bilateral and international agencies, foundations, and various organizations. She has contributed many articles on the work of SDI and the Indian Alliance of SPARC, NSDF and Mahila Milan and participates in local, national, and international events on behalf of the urban poor, occasionally serving on committees for policies on issues impacting them.

She has contributed numerous articles on the work carried out by SDI and the Indian Alliance of SPARC, NSDF, and Mahila Milan. She actively participates in local, national, and international events, advocating on behalf of the urban poor, and occasionally serves on committees responsible for shaping policies that impact these communities.

In recognition of her exceptional contributions, Sheela Patel received the United Nations Habitat Award in 2000. In 2006, she was honoured with the Outstanding Contribution towards Mumbai Vision 2015 Award by the Observer Research Foundation. The David Rockefeller Bridging Leadership Award was bestowed upon her in 2009. In 2011, she was conferred with the prestigious Padmashree award by the Government of India. Furthermore, she was chosen as the recipient of the 2023 Lawrence C Nussdorf Urban Leadership Prize by PennIUR.

Apart from her remarkable achievements, Sheela Patel served as a Commissioner for the Commission for Adaptation to Climate Change from 2018 to 2020. Presently, she holds the position of trustee at the International Institute of Environment and Development (IIED) and serves as a Global Ambassador for Race to Zero and Race to Resilience. She is also a Member of the Club of Rome and the External Advisory Group of Digi-NEB. Additionally, she serves as a Board Member for the Climate-KIC Foundation.

About Society for the Promotion of Area Resource Centres (SPARC)

The Society for Promotion of Area Resource Centres (SPARC) is one of India's foremost NGOs advocating for the rights of the country's urban poor. Established in 1984, SPARC began by working with the poorest and most vulnerable of Mumbai's urban poor – people living on the pavements of Mumbai. SPARC helped set up a network of women's collectives called Mahila Milan which means "Women Together" in Hindi and is a decentralized network of collectives of poor women that manage credit and savings activities in their communities. It is a recognition of the enormous potential that women's groups have in transforming relations within society and in improving the lives of poor families. Mahila Milan empowers women to become active leaders in the community and urban development sector. In 1986, SPARC also partnered with the National Slum Dwellers Federation (NSDF), a community-based organization whose membership is largely made up of community groups and leaders that live in informal settlements around India (approximately 750,000 households as of 2010). Established in 1974, NSDF has a history of organizing the poor against demolitions, mobilizing the poor to come together, articulating their concerns, and finding solutions to the problems they face as well as attempting to secure the basic amenities of water, sanitation, and such for the urban poor.

Together SPARC, NSDF and Mahila Milan are known as the alliance and work on issues of urban housing and infrastructure and aim to create institutional arrangements which mobilize large numbers of the urban poor and to support and strengthen their organizations. The overall goal for these community-driven organizations is to become an important part of the city system so that the poor can directly participate to produce collective solutions for affordable, secure housing, sanitation, and other infrastructure. Today, the Alliance works to produce collective solutions for affordable housing, sanitation, and other issues in over 58 cities and 9 states in India.

The Alliance works in various ways towards expanding and building the capacities of the slum communities. It undertakes training to strengthen the collective leadership capabilities of the organisations of the urban poor and to ensure that women have equal rights to participate in decision-making. This involves facilitating peer exchanges between poor communities and their leaders, encouraging community-led enumerations and surveys that can become the basis for dialogue, planning and action for change and supporting and advocating for community-initiated and driven projects and programmes. Furthermore, the Alliance works on pro-poor policy changes and strengthening dialogues, relationships, and discussions between the poor and their local, regional, and national authorities. They enable slum communities in accessing basic services and amenities, improved sanitation, housing, and secure tenure while developing their skills and confidence to negotiate with the government and other resource providers.

In 1998 the Alliance set up a not-for-profit company called SPARC Samudaya Nirman Sahayak (SSNS) which provides financial and technical tools for building houses and toilets for slum dwellers in collaboration with communities, professionals, and government to impact policy and practice for large scale change in India.

The Indian Alliance is also a founding member of Slum Dwellers International (SDI), a transnational network of the urban poor in over 30 countries.

A Tribute To Jockin, My Teacher
Celine D'Cruz

Principles of Community Organization according to Jockin Arputham
(President, National Slum Dwellers Federation, India & SDI)

1. Begin with the poorest and most vulnerable communities to ensure all are included.
2. The greater the vulnerability, the greater the motivation of the community to act and bring change.
3. Women are natural organizers. Their instinct to protect their children and families make them invaluable agents of change.
4. By creating separate and safe spaces for women to organize, young and older women learn to redefine their relationship with traditional male leaders.
5. Organizing communities according to the land they occupy makes it easier to organize large numbers of urban poor in the city.
6. Money+ Information = Power. Collecting savings and information are fundamental tools to mobilize communities, build their collective power, find workable solutions, open the doors, and build trust with government.
7. When communities can organize city-wide, they bring together their collective knowledge and resources to leverage external resources and address their collective needs of housing and basic services.
8. Caring for each other develops capacity to think about each others' problems and solutions and builds trust. When there is trust organised communities can solve big & small problems.
9. Regular community meetings and exchanges builds relationships and opens the space for collective learning, reflection and builds expertise.
10. When communities can implement real projects, they build capacity to show and influence policy & practice and recognised by government.

Everything is workable when communities are organized!

Celine D'Cruz, began her career with the alliance of SPARC, NSDF and Mahila Milan and worked closely with Jockin in building federations of the urban poor in Asia and Africa and contributed these amazing Principles of Community Organization according to Jockin Arputham. More details can be found in the book **"Jockin has not left the Room"**[xxxv] *where some of the people he influenced have written an essay about their association with him and have committed to maintain his strong commitment to facilitate women's collectives and their federations to lead from below.*

Abbreviations

AAC	Autoclaved Aerated Concrete
ACHR	Asian Coalition of Housing Rights
Al-Zn	Aluminium-Zinc coated
COP	Conference of Parties of the UNFCC
CORE	Community Organized Relief Effort
CURE	Centre for Urban and Regional Excellence
DU	Dwelling Unit
FCDO	Foreign, Commonwealth and Development Office
GCoM	Global Covenant of Mayors
GI/GCI	Galvanised Iron/Galvanised Corrugated Iron
GIS	Geographic Information System
GRP	Global Resilience Partnership
HC	Huairou Commission
HPFPI	Homeless people federation Philippines
IAWP	International Alliance of Waste Pickers
IIED	International Institute for Environment and Design
LLA Principles	Locally Led Adaptation Principles
LAC Region	Latin America and Caribbean region
MENA Region	Middle East North Africa Region
MDG	Millennium Development Goals
MS	Mild Steel
NBC	National Building Code (India)
NGO	Non-Governmental Organisation
NSDF	National Slum Dwellers Federation
PVC Sheets	Poly Vinyl Chloride Sheets
RAY	Rajiv Awas Yojana
RCC	Reinforced Cement Concrete
ROOH	Roof Over Our Heads
RtR, RtZ	Race to Resilience, Race to Zero
SBM	Swachh Bharat Mission
SDI	Slum Dwellers International
SDG	Sustainable Development Goals
SHG	Self Help Group
SMC	Surat Municipal Corporation
SPARC	Society for the Promotion of Area Resource Centres
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USHA	Urban Slum Household Area Survey
WGBC	World Green Building Council

Glossary

Parameters considered for Analysis of data collected from the Labs:

Building Material Risks Hazards: Building material hazards refer to the physical and environmental conditions that may detrimentally affect the durability, lifespan or the effectiveness of the material used to build the dwelling, and introduces several risks to the inhabitants in terms of safety and health.

- **Breakage:** Materials that are prone to breakage and structural damage, thereby decreasing the dwelling's structural constitution and increasing the risk for its inhabitants.
- **Electrocution:** Materials that are prone to conducting electricity after coming into contact with electrical lines and run the risk of electrocution and related risks.
- **Fire hazards:** The inflammability of materials to the extent that they increase the likelihood of an accidental fire.
- **Leakage and seepage:** Materials that are prone to allowing the leakage or seepage of rainwater and resultantly, constitute a structural weakness of the dwelling making it less resilient during the monsoons or during instances of urban flooding.
- **Pest Infestation:** Materials that attract and facilitate the presence of pests, such as rodents, bandicoots, insects or other animals which contribute to a reduction in the materials durability.
- **Rust:** Materials such as metal sheets which are susceptible to oxidation and have a severely lowered lifespan in warm and humid climates. When used on roofs or walls, they are prone to breakage, seepage and other types of hazards.
- **Rot:** Materials such as timber planks and bamboo poles which are prone to decomposition due to bacterial and fungal activity, thereby reducing their effectiveness and lifespan as structural members of the dwelling. This is observed most commonly in warm and humid climates, although frequent rain and the seepage of water can have the same effects in cold climates.
- **Toxicity and chemical exposure:** Materials that contain hazardous substances or emit harmful fumes, posing health risks to occupants.
- **Wear and Tear:** The resistance of a material to wear and tear caused by regular use, abrasion, heavy storm, or friction is an important durability indicator. Materials that can maintain their appearance and functionality despite continuous use are considered more durable.

Cost of the Material: Refers to the market price of the materials per standard unit based on the supply side survey.

Cumulative Cost: Cost incurred by residents since the beginning when Dwelling unit was constructed till date (includes all the retrofitting and upgradation costs)

Durability: Durability refers to materials ability to withstand climate, wear decay i.e. any form of damage or deterioration.

- **High:** Largely Unaffected by climate and environmental factors, requires less maintenance and is structurally sturdy and permanent vis-a-vis the lifespan of the house.

- **Medium:** Moderately affected by climate and environmental factors, repairs are frequent though replacement is infrequent. Structurally reliable under moderate climatic conditions.

- **Low:** Affected by climate and environmental factors, repair and replacement is frequent and structurally unsound. Highly susceptible to weathering and unable to protect inhabitants against extreme climatic conditions.

Execution: Execution refers to the manner in which the material has been fitted for construction, maintenance or repair on to the dwelling.

- **Self-Built:** Refers to when the material is installed by the inhabitants of the dwelling with no external assistance.

- **Skilled-labour:** Refers to when skilled laborers/ masons are enlisted to undertake/assist in the construction of the dwelling, an increment or to undertake repairs and maintenance. Skilled labour is often expensive, and is involved typically when the work requires advanced masonry skills.

- **Unskilled Labour:** Refers to when laborers adept at a single aspect of construction, such as masonry or carpentry are enlisted to construct a dwelling or undertake repairs. They are less expensive and generally hired when the work is at a smaller scale, and involves temporary materials.

Maintenance:
Maintenance refers to the frequency and extent to which materials have to be repaired or replaced to preserve or extend their intended use in the dwelling.

- **Infrequent:** 3-6 years
- **Frequent:** 0-3 years

O & M Cost: Cost incurred per annum on the operation and maintenance of the dwelling and any repair costs associated with the materials.

Procurement:
Acquisition refers to the modes through which the materials were procured by the users.

- Bought second-hand: The materials were bought from second hand-vendors, recyclers and scrap dealers or other inhabitants seeking to dispose of materials that are being replaced with new materials in their dwellings. The materials are substantially cheaper in the second hand-market, though they are less durable, have a shorter effective lifespan and are more susceptible to weathering factors and hazards.

- New: The materials were bought new from local first-hand wholesale or retail shops, and retain their full lifespan, are durable as advertised and are more resilient to weathering factors and hazards.

- Procured locally: These materials are sourced or harvested locally, and are not purchased from the market. Certain materials like thatch, mud and timber are procured locally in cases where they are available, seen in areas where they build houses through vernacular techniques, though this is a diminishing trend in context of the entry of formal markets and urbanization in the case of many settlements.

- Salvaged: The materials are procured from waste/dump-yards, landfills or construction sites where they have been disposed of. They are characterized by a very short effective lifespan, are not durable and are highly susceptible to weathering factors and hazards. Accordingly, they are required to be replaced or maintained more frequently.

Shelf-life:
The shelf life refers to the actual lifespan of the materials derived from user perspective in accordance with their physical properties. A period during which material remains suitable for use.

Thermal Conductivity:
Thermal conductivity denotes the heat absorption property of the material, and accordingly, their applicability as insulators which has implications for indoor temperatures in dwellings. Thermal conductivity refers to the ability of a given material to conduct/transfer heat. It is generally denoted by the symbol 'k' Materials with high thermal conductivity are used in heat sinks whereas materials with low thermal conductivity are used as thermal insulators.

Weathering factors:
Weathering factors include heat, wind, humidity and rain that refers to larger climatic conditions of the context that affect the effectiveness and feasibility of the material used in constructing the dwelling.

References & Links

i https://sparcindia.org/pdf/Jockin-has-not-left-the-room_compressed.pdf

ii https://www.icccad.net/our-team/saleemul-huq/

iii The COPs (Conference of Parties of the UNFCC) are the biggest and most important annual climate-related conferences on the planet.
In 1992, the UN organised the Earth Summit in Rio de Janeiro, Brazil, in which the UN Framework Convention on Climate Change (UNFCCC) was adopted and its coordinating agency - what we know now as the UN Climate Change secretariat - was put into place. In this treaty, nations agreed to "stabilize greenhouse gas concentrations in the atmosphere to prevent dangerous interference from human activity on the climate system". So far, 197 different parties have signed it.
Since 1994, when the treaty entered into force, every year the UN has been bringing together almost every country on earth for global climate summits or "COPs", which stands for 'Conference of the Parties'.
During these meetings, nations have negotiated various extensions of the original treaty to establish legally binding limits on emissions, for example, the Kyoto Protocol in 1997 and the Paris Agreement adopted in 2015, in which all countries of the world agreed to step up efforts to try and limit global warming to 1.5°C above pre-industrial temperatures, and boost climate action financing.
https://unfccc.int/process-and-meetings/what-are-united-nations-climate-change-conferences

iv https://sdinet.org

v https://campaignforrooh.org ; https://linktr.ee/roof_over_our_heads_2022

vi https://youtu.be/NSzXsocBlUo?si=V7bBswh6FMtJompC

vii United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420). New York: United Nations.

viii https://www.iied.org/what-women-want-part-one
https://www.iied.org/what-women-want-part-two-map-vulnerability-climate-change
https://www.iied.org/we-also-want-greens-our-meals-community-gardens-philippines

ix https://unhabitat.org/slum-almanac-2015-2016-0
https://unhabitat.org/sites/default/files/2022/06/wcr_2022.pdf

x Beyer, Robert; Milan, Andrea. 2023. Climate Change and Human Mobility: Quantitative evidence on global historical trends and future projections. UN Migration (IOM) Global Data Institute. https://www.migrationdataportal.org/sites/g/files/tmzbdl251/files/2023-06/Final5_2023%20Climate%20Change%20and%20Human%20Mobility.pdf

xi https://climatechampions.unfccc.int/what-is-the-race-to-resilience/

xii https://campaignforrooh.org, https://www.youtube.com/@campaignforrooh/videos

xiii http://www.achr.net
xiv Report on Housing Policies and Practices in the Asia Region, Part 2. ACHR, Oct 2018
http://www.achr.net/upload/downloads/file_07072020142623.pdf
xv https://www.iied.org/10211iied
xvi https://www.globalresiliencepartnership.org
xvii https://racetozero.unfccc.int/race-to-resilience-launches/
xviii https://climatechampions.unfccc.int/un-climate-change-high-level-champions/#:~:text=Mahmoud%20Mohieldin%20and%20Her%20Excellency,Champions%20for%20COP27%20and%20COP28.
xix https://linktr.ee/roof_over_our_heads_2022
xx https://globalrec.org
xxi https://huairou.org
xxii https://us.techo.org
xxiii https://www.britannica.com/science/Koppen-climate-classification
xxiv https://censusindia.gov.in/census.website/
xxv https://sparcindia.org/pdf/articles/hsgexhib.pdf
xxvi https://www.habitat.org/ap
xxvii https://buildchange.org
xxviii The statistics, figures, and information provided in the labs for all settlements are derived from on-ground interviews, focused group discussions with communities, and market surveys.
xxix https://www.iied.org/what-women-want-part-one
https://www.iied.org/what-women-want-part-two-map-vulnerability-climate-change
https://www.iied.org/we-also-want-greens-our-meals-community-gardens-philippines
https://youtu.be/77RK6iXaJnQ?si=sT3FgYRhSWu-J75B (Roof Over Our Heads – Voices of the women)
https://youtu.be/51_uyT3H_Jo?si=K_TqSpgLYUv2-OM_(Roof Over Our Heads, produced by GRP)
xxx https://www.arup.com
xxxi https://www.holcim.com
xxxii https://www.globalcovenantofmayors.org
xxxiii https://www.iied.org
xxxiv https://reall.net
xxxv https://sparcindia.org/pdf/Jockin-has-not-left-the-room_compressed.pdf

Credits

Advisors:
David Howlett
Sheela Patel
Rahul Mehrotra
Sejal Patel
Smit Vyas

ROOH Team:
Nihar Johari
Siddhi Mehta
Aryan Iyer
Khoosh Prajapati
Bhakti Shaparia
Nandana L.S

SPARC Core Support:
Smruti Jukur
Vinod Rao
Sharmila Gimonkar
Maria Lobo
Indu Agarwal
Admin Staff | SPARC

Mahila Milan Support On-Site:
Banoo Sheikh Ansari
Bilkis Arif Khureshi
Kumari Patra
Lakmi priya Barika
Malti Ambre
Manoja Manjari Chhatray
Meena Ramani
Mumtaz Sheikh
Nitu Chakhia
Rehana Sadik Sheikh
Rehmatullah Memon
Savita Jaywant
Savita Sonawane
Shantaben Chawan
Shibani Mohanty
Sujata Sasane
Swapna Behera
Vandana Gir

Partners support On Site:
Gangtok Lab | CURE
Siddharth Pandey

Bengaluru Lab | Hasiru Dala
Akbar A
Pavankumar B
Sowmya Sridhar
Shivrajamma, Facilitator
Usha, Facilitator

Support in Sketches & Illustrations
Chanda Patel
Zalak Shah
Archana Marwaha
Vivek Panchal
Aradhana Paralikar

Special Thanks to
Residents
Skilled Labourers
Contractors
Vendors
from all informal settlements

ROOH is an endeavour that strives to empower women in vulnerable communities that are informal and located in towns and cities in the global south, to assess the vulnerability of their homes to extreme weather produced by climate change. The campaign seeks to build adaptation strategies with the present informal neighbourhoods in cities to improve their resilience while drawing attention to the challenge of climate migrants coming to cities and the anticipated increase in urbanization in the coming decades.

The network of learning labs will work to promote cross-city collaboration where communities will be assisted by professionals to develop alternative strategies to transform, design and construct homes that are resilient, low-carbon, and energy-efficient, through improved designs, access to better construction strategies, and materials that are affordable and finance that is accessible.

ROOH seeks to involve a wide range of stakeholders, from women from informal neighbourhoods, educational institutions, local and national governments, and financiers, designers, and city mayors, to create locally driven resilience solutions. The campaign's journey is marked by a commitment towards non-hierarchical processes that provide everyone a seat at the table to explore this enormous challenge and to work together.

This book illustrates the journey undertaken during the first year of the Campaign and provides a brief outline of the structure of the Campaign for Roof Over Our Heads, and the initial stages of implementation on the ground.

EBook ISBN 978-93-5996-446-1
9 789359 964461