THE INFORMAL HOUSING THERMAL COMFORT PROJECT

1-Year Report

NOVEMBER 2024

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économie, énergie et société

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Description of the Project Activities

1. Community Engagement and Pilot Testing

a. Conducting Workshops:

As a first step, cBalance researched about grassroots Civil Society Organisation (CSO) working in Informal Settlements in Chennai. After initial shortlisting we had meetings with three CSO's namely CAG (Consumer Civic Action Group), IRCDUC (Information & Resource Centre for the Deprived Urban Communities) and CRC(Chennai Resilience Centre). We decided to work with CAG due to their onground presence and longterm relationship with the local communities. Meetings were conducted to explain the intent of the project and project steps to the partner CSO, following which the criteria for site selection were shared with CAG. Based on the criteria, 5 areas Puliyanthope, Thondairpet, Teynampet, Basin bridge, Vyasarpadi were identified. After an initial site visit, Pulianthope was finalised as the site for pilot testing the indoor passive cooling solutions in Chennai. 2 members from cBalance and 3 members from CAG participated in the site visit.

Post selection of the area, household selection criteria was shared with CAG to shortlist the most vulnerable houses. 24 households from the locality were shortlisted based on this predetermined criteria. Initial household survey was conducted to document household details and give them a brief overview of the project and invite them to the listening workshop.

- **Listening Workshop:** The intention of the listening workshop was to understand if heat stress was an issue for the residents and if they were aligned to address the same. The workshop created space for community members to discuss issues they experience across different seasons of the year in addition to sharing any already existing mechanisms in place to address these issues. They were constantly reminded of the vitality of sharing their knowledge and experiences to contribute to the change making process. This encouraged a spirit of 'partnership' and 'co-creation' which was evident during community engagement processes that followed the 'listening workshops' where community members expressed their opinions without inhibition and were vocal about matters that they both agreed and disagreed to.We conducted 4 Listening workshops and the CAG team helped with community mobilisation and organising the workshop logistics.

Fig 1: Listening Workshop

- **Participatory Design Workshop:** Small-scale working models of solutions (Chain Sprocket Alufoil/Ecoboard, Pipe Motor Alufoil, Sliding Alufoil, Rooftop Garden, Wood Wool Panel and PET bottles) were presented to the community as prompts during the participatory design workshops. We invited them to observe, touch, and operate the solution also also shared basic information such as the name and working mechanism of the solution. The invitation to the community was to share their insights and feedback and contribute to co-creating the roofing solutions. While few participants participated enthusiastically, few of them were passive. Efforts to overcome this barrier involved making conscious efforts to remind residents that their opinions matter and that the intention of the workshop was to facilitate a process of working ‘with’ them, since, nobody but they themselves know their context better. We conducted 4 Participatory Design Workshops. Input and feedback from the residents was analysed and integrated to co-create and contextualise the designs.

Fig 2: Participatory Design Workshop

- **Structural Audit:** During the house audits, community members provided insights on the age of their house structures, structural issues, water availability, their house maintenance habits, and other relevant external factors such as the occurrence of animals climbing on their roofs. The community's lived experience was therefore a

crucial part of the audits. The audit helped to decipher which solution may be appropriate for each household.We conducted Structural Audits of 24 households.

Fig 3: Structural Audit

Post the audit we were able to analyse each house based on a few criteria eg. strength of the house, time of construction, solution preference of the households, solution diversity etc. This was vital to support the process of matching a given solution with a given household, which was instrumental in narrowing down on the first 5 partner households to pilot test the cooling solutions.

- **Household Selection and Solution Offering workshop:** We invited the first 5 shortlisted households to the workshop to share the process of household selection. Each resident was informed about the solution offered for their home. Interactions with residents while sharing the list of shortlisted/selected households revealed the varying motivations and doubts that governed people's decisions to accept the suggested prototype retrofitted in their house structures. A transparent approach of sharing the household selection criteria which prioritised households that had weak structures and were structurally suitable for a given thermal comfort prototype, while considering residents' preferences as much as possible, was adopted. A pamphlet was handed over to the other residents which described the workflow of the project and how as a part of phase 2 , installation would be done in 10 more houses at a later stage.

A partnership agreement was shared which detailed the responsibilities of the cBalance team and the resident. The agreement was explained to the resident and signed by the resident, cBalance team and CAG team as a witness.

Fig 4: Household Selection and Solution Offering workshop
(Residents being trained on filling Thermal Comfort Monitoring From)

b. Solution design expansion & low-cost modular passive cooling:

i. We have worked on improving and expanding the existing design set, the details of which are mentioned below:

1. **Chain-Sprocket Mechanism:** This mechanism is an over-the-roof dynamic mechanism designed to achieve thermal comfort by acting as a radiant barrier shielding the rooftop from sun during daytime and losing the heat of the structure during the night through radiation to the night-sky. For the installation in Chennai, a new handling mechanism of the solution was designed and implemented.

Fig 5: Existing Chain-Sprocket Mechanism

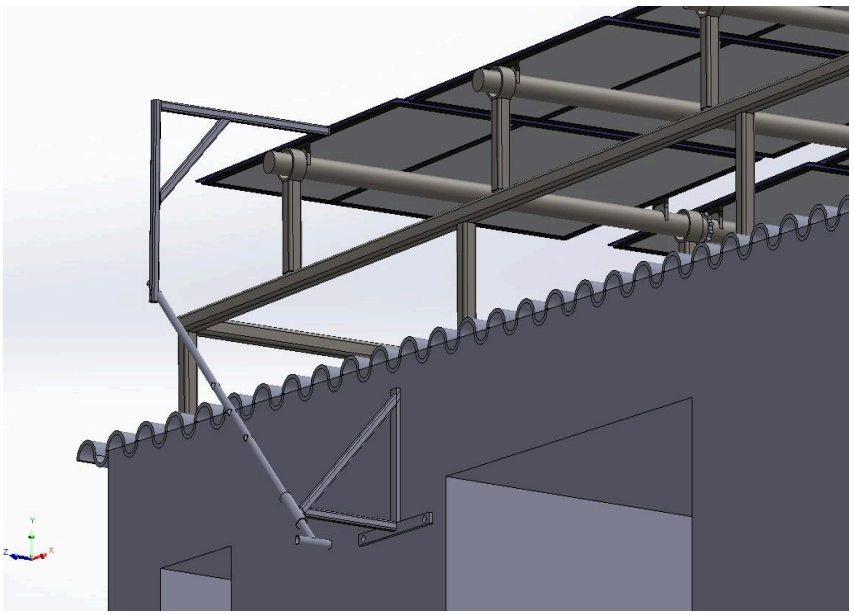

Fig 6: Chain-Sprocket Handling Mechanism Design

2. **Pipe-Motor Mechanism:** This is another over-the-roof dynamic mechanism designed to achieve thermal comfort through radiant barrier & night sky radiation. The design was upgraded significantly as changes were made in the dynamic part, specifically in the method through which the movement happens, with the objective being weight reduction and ease of installation.

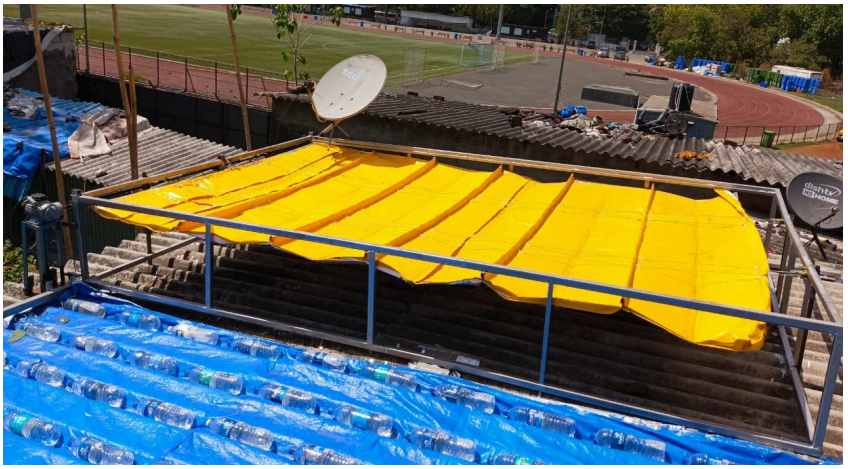

Fig 7: Existing Pipe-Motor Mechanism

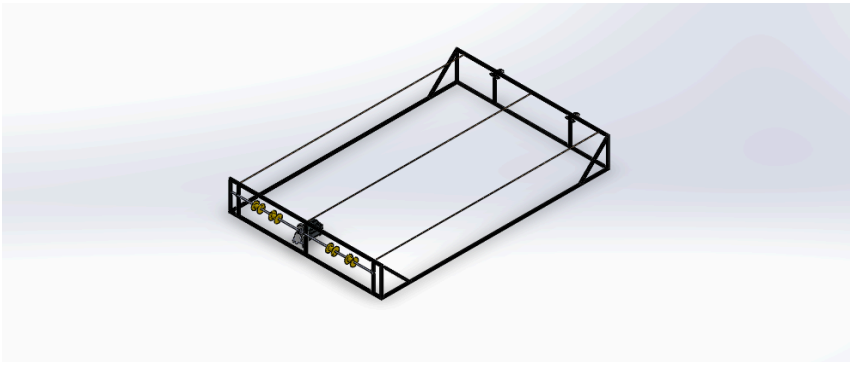

Fig 8: Upgraded Pipe-Motor Design

3. **Alufoil Static:** This is an under the roof static solution which works on the principle of insulation, useful in places where there are space constraints over the roof and the structures are weak. Alufoil is a material with XLPE foam having a thin layer of aluminium sheet attached to it. The foam provides insulation and the thin layer provides a low-emissivity surface hence collectively acting as a thermal comfort provider. Initially, this solution was stuck directly to the roof on the foam side using an adhesive, however a big challenge was observed in case of removal of the material as it would spoil the roof. Hence two new methods were developed to implement this solution.

    a. The GI wire method: In this method, a GI wire mesh was designed to be implemented beneath the roof, with the Alufoil intended to sandwich between the roof and the wire mesh, thereby not disturbing the roof entirely. It is currently being implemented in Chennai.
    b. The flat plate method: In this method, a metal framework was designed with 1” thickness MS strips beneath the roof similar to the method through which false ceiling panels are implemented. The Alufoil is then fixed on this framework. A GI sheet is then fixed beneath it to cover the panels.

Fig 9: Existing Alufoil Static Solution

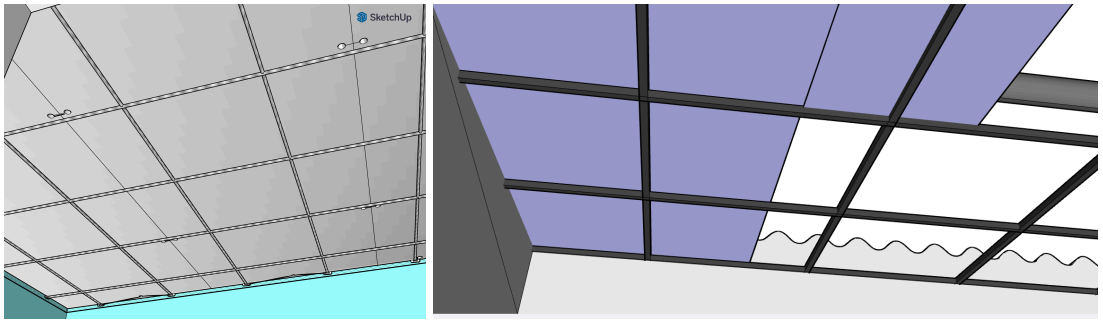

Fig 10: Alufoil Static GI Wire Method (Left) & Flat Plate Method (Right) Designs

4. **MLP Static:** This is another under the roof static solution which works on the principle of insulation, useful in places where there are space constraints over the roof and the structures are weak. Multi-layered Plastic panel is a new material which was manufactured in-house using MLP waste (details in the next section), which acts

as a low-emissivity surface. A metal framework was designed with 1” MS L-angles beneath the roof similar to the method through which false ceiling panels are implemented. The panels are then placed on this framework. GI sheets are fixed from beneath to ensure the MLP panels are not left exposed so as to increase its fire safety.

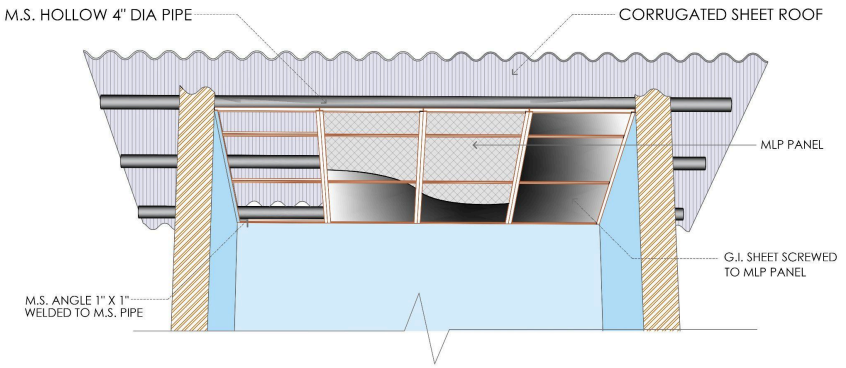

Fig 11: MLP Static Design

5. **Water filled PET Bottles:** This is the simplest and least expensive solution where PET bottles are filled with water and stuck on top of the roof. It works on the principle of thermal mass where the capacity of the roof to retain heat is being increased due to addition of water, which has a high thermal absorptivity. To increase the effectiveness of this solution further, various upgrades to this solution have been planned and are being executed. They are listed below:
   1. Water filled PET bottles coated with rough high-emissivity and low-absorptivity (i.e. white) plasters
   2. Water filled PET bottles filled crates
   3. Water filled PET bottles with reflective inner-bottom
   4. Water filled PET bottles with insulated bottom
   5. Water filled PET bottles with plants
   6. Water filled PET bottles with non-toxic food-grade dyes

   Two modular test beds were constructed to test out the effectiveness of these ideas. They were then compared with the existing design to identify which was more effective in improving thermal comfort.

Fig 12: Existing Water-filled PET Bottle Solution

Fig 13: Water-filled PET Bottles with Plant Experiment

6. **Rooftop Gardening:** In this solution, gardening is done on the rooftop to achieve thermal comfort. The plants provide shading to the roof and the soil acts as a means to increase the thermal mass of the roof thereby increasing its heat absorption capacity. Hence, heat stress reduction is achieved. The existing design was limited to a few types of plants, watering systems and plant placement and supports. Further, 6 different combinations of the solution were designed with different ways of watering the plants dependent upon the water availability, plant placement and support structure based on the roof strength. A method was also designed to select any of the designs depending on the aforementioned variables. Furthermore, an exhaustive plant list was prepared based on the foliage provided, usage type, water requirement, chances to withstand summer heat and local adaptability.

Fig 14: Existing Rooftop Gardening Solution

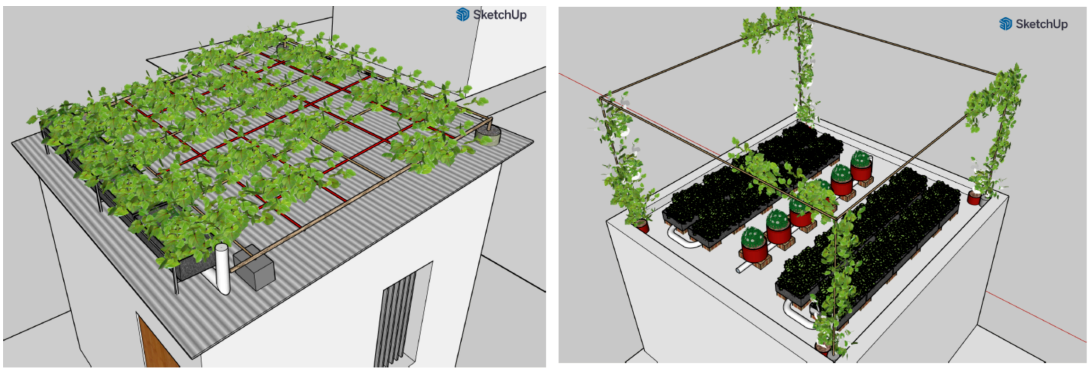

Fig 15: Two Upgraded Design Combinations

7. **Dormer Window:** Dormer window is a ventilation based thermal comfort solution designed to facilitate stack ventilation with additional benefit of providing daylighting in poor lighting conditions. The existing design had a few challenges with leakage

being the primary issue after the roof was cut to install the window, the other major challenge being uncontrolled exposure to sunlight. In the upgraded design we have tried to address both these issues, with the roof no longer needed to be cut, rather replaced and a window provided to provide sunlight control. Going ahead, the new design will be prototyped and implemented.

Fig 16: Existing Dormer Window Solution

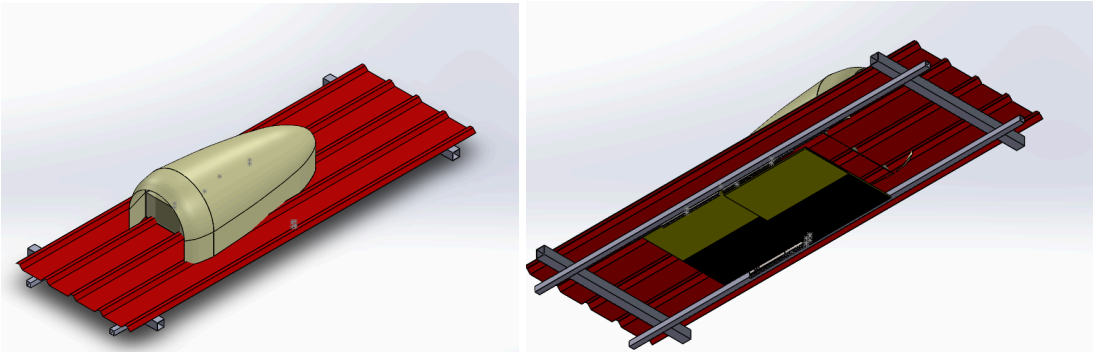

Fig 17: Upgraded Dormer Window Design

8. **Sliding:** This is an over-the-roof dynamic mechanism designed to achieve thermal comfort through radiant barrier & night sky radiation. The mechanism is based on a slider/awning where the movable part slides under the static part with alufoil fixed beneath. This design was created and piloted in Mumbai to test its effectiveness.

Fig 18: Sliding Mechanism

ii. **Modularity:** Our roof cooling retrofits are currently fabricated and installed as one whole piece/set up. For ease of fabrication,installation,and maintenance we determined the need to break down the mega assembly into modular sub parts so that the installation process is easier. We are therefore working in the direction of breaking down our dynamic designs to make them modular, where each sub-section can be broken down into small parts and assembled and disassembled as and when required. In this context, the chain-sprocket mechanism was selected for the development of the first prototype modular solution, to better understand and integrate the modularity principles in the context of our designs. Initially, extensive research was carried out to study modularity in the existing designs and mechanisms. This incited various ideas to transform our current design to a modular one. Designing of a modular prototype for the chain sprocket mechanism was then initiated and carried on with the help and guidance of external design consultants, namely Sarg Design Studio from Pune, Taha Technological Solutions and Abdul Majid Shaikh from Mumbai. Currently, the design is ready and the fabrication of the first prototype is also complete. In the coming months, we will be subsequently building on two future prototypes based on the learnings from the first prototype till we reach the desired quality of the product.

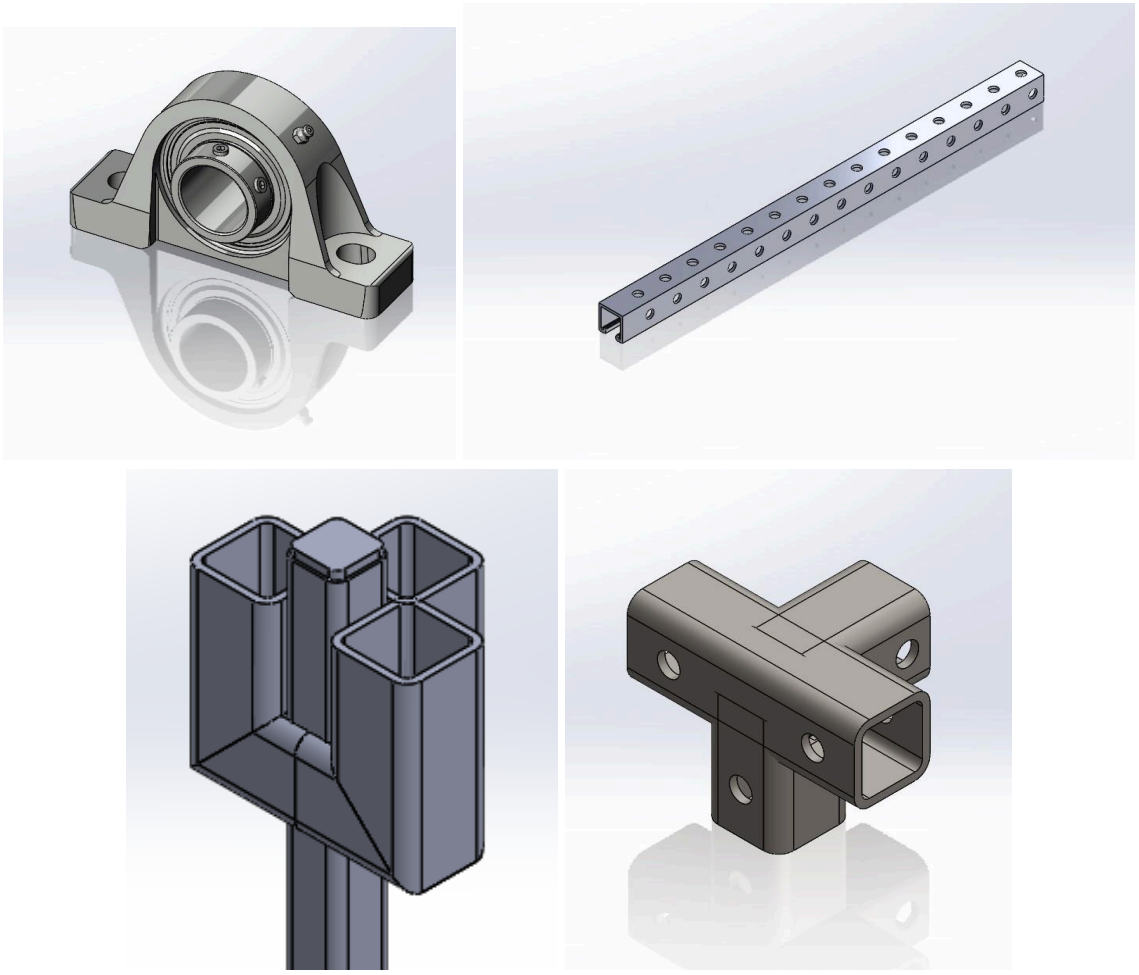

Fig 19: Different Modular Sub-parts Design

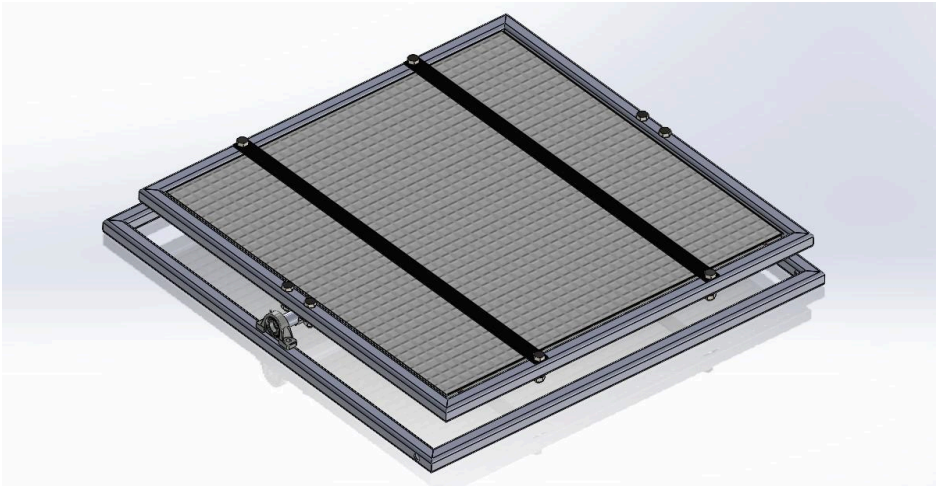

Fig 20: Modular Chain Sprocket Design Assembly of Single Panel

Fig 21: Modular Chain Sprocket First Prototype of Single Panel

c. Exploring replacement of industrial materials with biodegradable hand-crafted materials:

I. **Multi-Layer Plastic (MLP) panels :** We are experimenting with replacing Alufoil, an industrial radiant barrier material with Multi-Layer Plastic (MLP) panels in our installations. According to the Plastic Waste Management (PWM) Rules 2016, Multi-Layer Plastic (MLP) is “any material used for packaging and having at least one layer of plastic as the main ingredient in combination with one or more layers of materials such as paper, paper board, polymeric materials, metalised layers or aluminium foil, either in the form of laminate or co-extruded structure.” The recycling process of Multi layer plastic consumes large amounts of energy, time, and cost. That’s why most of the recycling industry refuses to recycle this waste. Using MLP in our installation is therefore helpful to upcycle the plastic waste generated.

Fig 22: MLP Collection Centre at Pune

The process of making an MLP panel involves the following steps:

1. Bamboo is cut into strips which are then used to create a mesh-like frame.

Fig 23: Cutting Bamboo Strips

Fig 24: Making Bamboo Frame

2. Next, MLP sheets are sorted, cut and joined to create sheets of usable sizes. Six of these MLP sheets are needed for one panel.

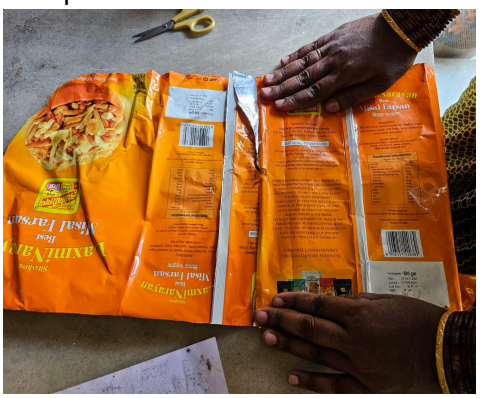

Fig 25: Joining MLP Wrappers to form 3x4 feet sheet

3. Similarly, old jute bags are cut and joined to create sheets according to the size. Finally, the bamboo frame, the MLP sheet, and the jute bag sheet are combined and fastened together using metal staples to create the panel.

Fig 26: Assembling Jute and MLP Sheets on Bamboo Frame

4. The MLP Panel is a composite material composed of 6 layers of MLP, a jute layer, and a bamboo frame. It is fabricated by sandwiching 3 layers of MLP on

each side of the jute layer and the central bamboo frame, which provides structural support.

Fig 27: MLP Panel

In a prototype experiment that we conducted, it was observed that MLP performed better than other radiant barrier materials like Alufoil foam and Alufoil double sided foam. Additionally, MLP panels made the solution modular by reducing in weight and has characterised it by ease of replacability, and repair, too.

II. **Biomass Panels:** In our ongoing research, we are also exploring the potential of biomass-based panels composed of diverse natural materials, such as various grasses, rice husk, fibres, natural adhesives, lime, crop residues and agricultural waste. These panels, designed to operate on insulation principles, are being developed in collaboration with our fabrication partner, GramArt, as a sustainable alternative to industrially produced wood wool panels. Through our partnership with GramArt, we are systematically investigating the optimal composition of biomass panels. We aim to develop panels that exhibit superior insulation performance and durability.

Fig 28 : Women SHG Manually extracting fibres from the soaked plants

Fig 29 : Drying different fibres after extraction

We experimented with different compositions of the following to make strong, durable biomass panels:

1. Sugarcane Fibre Pulp
2. Fenugreek (Methi) Fibre Pulp
3. Cow Dung Pulp
4. Sugar Apple (Sitaphal) Pulp
5. Wood Pulp

Fig 30: Biomass Panels having different compositions of crop residues and fibres as explained above.

In addition to material composition, we are actively collaborating with GramArt on innovative design ideas to fabricate hand-pressed machines. By utilising these machines, women's self-help groups can efficiently produce biomass panels, empowering them economically and promoting sustainable practices.

Fig 3! : Hand operated pressing machine

d. Work with local fabricators and installers to install upgraded prototypes in homes:

We identified 8-10 different fabricators and approached them a couple of times to explain the design and receive quotations from them. Of all of them one fabricator; Praveen of Selva Engineering Works Private Limited in Chennai, seemed most competent with respect to understanding the design and working on it. We signed a contract with him before beginning our work to formalise our arrangement. As a part of Phase 1, we are working with Praveen to install upgraded prototypes in 5 houses. Currently, the MLP panel Chain sprocket installation is almost complete and we are proceeding with the Alufoil Pipe Motor solution for the second house. Installation of Rooftop Gardening, static MLP panels and Alufoil sheet under the roof has been planned,too.

Fig 32: MLP Chain Sprocket

2. Policy & Practice Change

Following is the preparatory work being undertaken to convene roundtables with Heat-Action Plan and Cool Roof Policy Authorities in Chennai and the Tamil Nadu Department of Environment's Green School Program to integrate beneficial solutions and

practices emerging from pilot testing into relevant plans, schemes, guides, manuals etc. , in addition to efforts for engagement with the Tamil Nadu Department of Women and Children to integrate cool roof solution fabrication, installation and maintenance related livelihood activities into the state's National Urban Livelihood Mission (NULM):

a. Evidence Building for Policy Advocacy :

The effectiveness of the installed solutions will be monitored through thermal sensors which will gather temperature and humidity measurements across different seasons of the year and document performance metrics for a period of one year. Sensors will be installed in houses with installed solutions and BAU (Business-As-Usual)/non-solution houses to assess the impact of the solutions. Additionally, households will be asked to fill a subjective assessment form for a period of 7 days pre and post-installation and a critical feedback workshop will be conducted a month after the installations to gather subjective evidence which will be the basis for evidence-based policy recommendations on passive cooling solutions for informal housing structures.

b. Networking and Outreach :

We have had initial meetings with partners from Chennai who work on policy advocacy, namely, IRCDUC(Information & Resource Centre for the Deprived Urban Communities) and CRC(Chennai Resilience Centre). The plan is for the partners to connect us with relevant Heat-Action Plan and Cool Roof Policy authorities in Chennai and the Tamil Nadu Department of Environment's Green School Program authorities. A series of roundtables will be conducted with these authorities to facilitate discussions on the integration of passive cooling solutions emerging from the pilot tested installations into relevant plans, guidelines, manuals, etc as part of government schemes and policies which are aimed at minimising the vulnerability of citizens to heat stress. We will also propose the integration of subsidies for roof cooling retrofits, as applicable, e.g. through existing financial assistance schemes or subsidy schemes for households interested in availing roof cooling retrofit services and service providers who offer these services and are seeking loans from banks, microfinance institutions etc,too. This is to facilitate enhancing the accessibility of low-income communities to roof cooling retrofit services. The policy advocacy partners will also enable conversations with the Tamil Nadu Department of Women and Children to facilitate the process of recommending cool roof solution fabrication, installation, and maintenance-related livelihood activities as part of the state's National Urban Livelihood Mission (NULM).

We have also been speakers at Heat Action related convenings hosted by the Centre for Science and Environment, World Resources Institute, Wipro Foundation, Friedrich Ebert Stiftung (FES) India and a Clean Cool Pune Action Network Launch program hosted by a researcher from the University of Leeds and Dr. Bhanuben Nanavati College of Architecture. These convenings were attended by representatives from grassroots organisations such as Youth for Unity and Voluntary Action (YUVA), Aga Khan Agency for Habitat India, and policy action groups such as World Resources Institute (WRI) and members of the Ministry of Environment, Forest and Climate Change, aligned to work on addressing the issue of heat stress. These engagements are a building block to strengthen support for policy action across diverse Indian states including Tamil Nadu.

c. Policy Review and Recommendations :

We have contributed to the development of a Heat Action Plan for the Pimpri Chinchwad Municipal Corporation (Pg 132-149) , additionally, we have also been invited by the ASCI (Govt. Body) to upgrade the Cool Roof Policy for the State of Telangana. Our

recommendations are currently under review. These efforts will be used to demonstrate our experience on drafting heat action policy recommendations for thermal comfort in informal settlements while engaging with policy action authorities in Tamil Nadu.
In the context of Tamil Nadu based policies, we have initiated work on reviewing and developing policy briefs for the Tamil Nadu Heat Action Plan, The Green Schools Program, the Tamil Nadu Urban Livelihood Mission and the Pradhan Mantri Awas Yojana-Urban (PMAY-U). Our review so far has validated the need and potential to integrating a thermal comfort for informal housing layer across these schemes. The policy review drafts being developed will be refined and contextualised further based on learnings from the evidence building effort (mentioned under point a.) to initiate conversations with administrative authorities.

3. Capacity Building

a. Fabricator Training and devising training content for fabricators and women's cooperatives:

We have trained Meena Rokade, our first female fabricator in Pune to fabricate MLP panels and have worked on developing a MLP panel fabrication manual based on learnings from our experience of training her.

We are also working on developing a 'Fabrication & Installation Manual' which describes the stepwise fabrication and installation procedure for each solution, with supporting pictures for each step, based on our experience of fabrication and installation in other cities.

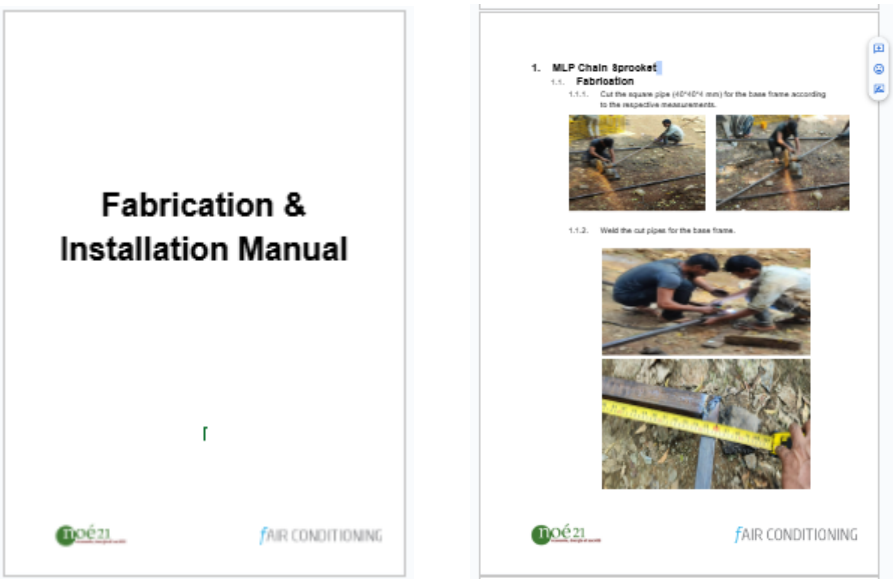

Fig 33 : Cover Page of Fabrication & Installation Manual

The above mentioned manuals will be translated into local languages, and will be helpful for capacity building of local fabricators and women interested in providing thermal comfort retrofit services within their communities through organising themselves as a Heat Action Cooperative in Chennai as we move into the other stages of the project.

Fig 34 : Cover Page of MLP Panel Fabrication Toolkit Manual

b. Community member led small-business and patient no-interest loan model experiment with Jeeralal in Pune :

Given our established rapport with the community and fabrication persons in Pune, we are in the process of planning and pilot testing the operational model for a Rooftop Garden based small-business (for the installation of 10 RTG solutions) led by a local community member in Pune. Jeeralal Yadav, our fabrication lead and installation supervisor in Pune, whom we have worked with earlier, will be leading this experiment in Pune. We had an initial discussion to share the project's objectives and co-create the effort with his input. In consultation with Jeeralal, the cost of fabrication and installation for a 100 square foot rooftop garden is finalised to be approximately INR 20,000. These funds will be used to fabricate and install a rooftop garden solution on 100 square feet of roof space, providing a sustainable, low-cost solution for thermal comfort benefits. As part of this experimental project we will provide zero-interest loans of INR 20,000 to homeowners, repayable over 18-24 months in affordable monthly instalments of INR 800-1000.

For community engagement and to identify suitable households for this experiment, we have collaborated with MASHAL (Maharashtra Social Housing and Action League), a local NGO that has been our active partner in Shindevasti since 2021. MASHAL will leverage their deep-rooted connections and understanding of the community to engage with potential households and ensure their active participation in the project. Preliminary discussions with MASHAL have been completed, and a plan is being worked on to initiate the process of identifying suitable households as the first step.

This experiment will inform our financial and operational models for the Heat Action Cooperatives we will engage with in Chennai.

c. Capacity building for installation maintenance and repair :

We have partnered with MASHAL, our grassroots CSO partner in Pune, to ensure the optimal performance of our cooling solutions during periods of heat stress. As part of this, training sessions were provided to the MASHAL team to assess the installations to ensure that they are functioning optimally to minimise downtime and maximise the solution's lifespan. Training was also conducted on recording maintenance observations and feedback in an online form and for safety supervision in cases where maintenance and repair is to be undertaken for a given solution.

MASHAL now conducts monthly maintenance checks and coordinates necessary repairs. We have a call with their team post every monthly maintenance check visit to discuss their learnings and assessment of maintenance and repair needs for the installation and guide them on addressing the same, as needed. Additionally, bi-annual feedback visits are conducted by their team, to assess user satisfaction and solution effectiveness. We organise quarterly review calls with the MASHAL team to understand capacity building needs and harness their feedback on the quality of support received from our team. The learnings from this capacity building effort and the processes being developed and refined through the same will inform our work in the upcoming project phases in Chennai as we move towards building local capacity in collaboration with the local NGO partner and cooperative groups in the future.

4. Curricula Change

To ensure that architect professionals of the future are equipped with the knowledge, skills, and empathy to address issues related to the climate-crisis and housing related predicaments of residents inhabiting informal settlements in urban India we have been working on a curriculum change advocacy effort with the Board of Studies (BOS) of Architecture Colleges. In order to fulfil this vision we are engaging with Vishweshwaraya Technological University(VTU), Karnataka and Anna University, Tamil Nadu .

a. Vishweshwaraya Technological University (VTU) engagement:

The engagement with Visvesvaraya Technological University (VTU) began in the year 2021. The 2018 pattern curriculum was reviewed and analysed from an informal housing and climate resilient buildings perspectives. A position paper was presented to the VTU BOS members with outcomes of the curriculum review and recommendations for the integration of informal housing and climate resilient buildings as and where applicable.

Based on our recommendations, the VTU curriculum was updated by seamlessly weaving topics on thermal comfort, heat transfer, passive design, climatology, sustainable cooling design and climate justice while also integrating an informal settlement lens. The modules on space design, building materials, and history have been expanded to include the study of informal settlement and connect to their issues empathetically. The topics have been integrated horizontally across all the semesters and across all the subjects spanning 5 years of the course (Refer to the following links for the updated syllabus - (i) B Arch 2021 Syllabus Sem 1 & 2, (ii) B Arch 2021 1-2 semester Syllabus Sem 3-8.). Reference material for the new theory concepts, activities and project deliverables have been included to enable adequate head, heart and hand engagement for students.

The Pedagogy Manual (image below), which describes 160 plus activities of various types, has been developed to handhold the faculty to deliver class lectures on these new topics included in the curriculum. The learnings from this work will be used to drive the curricula change efforts in Tamil Nadu.

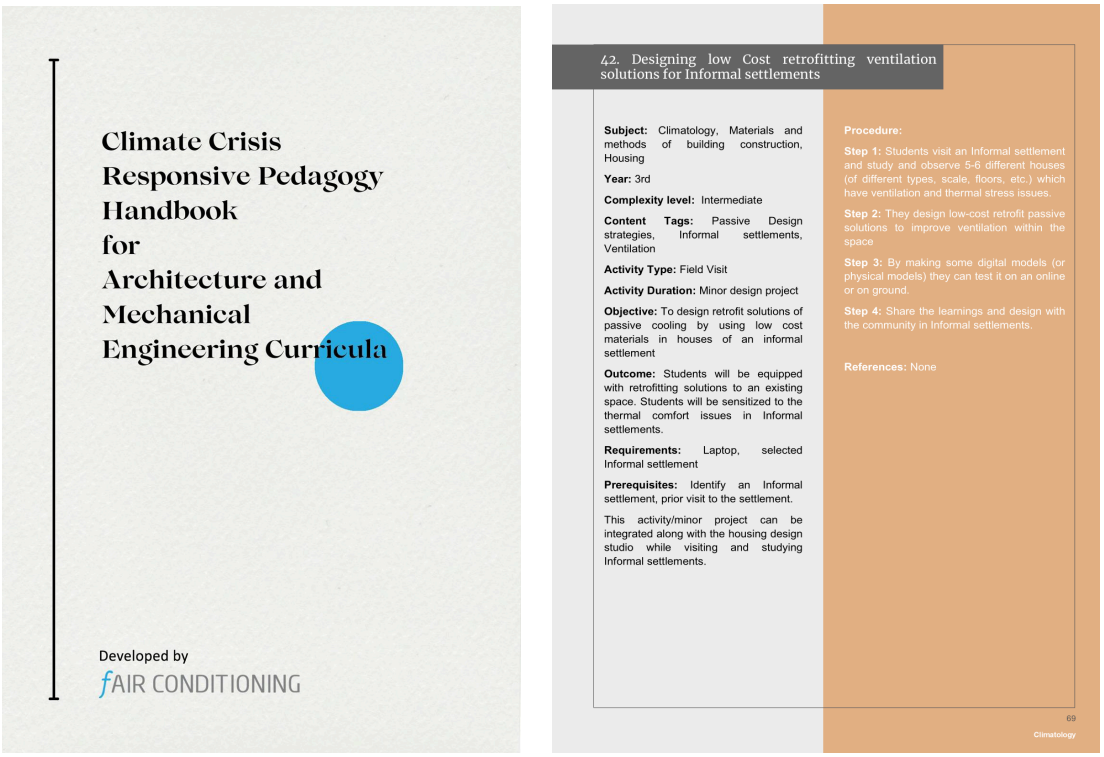

Fig 35: Pedagogy Manual

b. Anna University engagement:

From our initial engagement with Anna University, Tamil Nadu we have learned that the University has completed their curriculum updates for 2025. The University relies solely on the Board Of Studies (BOS) members for curriculum changes, and is not inclusive of any external advisory or consultation. However, it has been suggested that we explore curricula change related collaborations with the affiliated colleges of Anna University. Currently, the Anna University curriculum content is being studied in depth to understand and propose recommendations to the affiliated colleges.

5. Livelihood Generation for Women

a. Research for the establishment of women-led Heat Action cooperatives:

The long term aim of the project is for women-led Heat Action Cooperatives to provide thermal comfort retrofit installation services to their communities. This would be implemented by involving the processes which include house audits, identifying a suitable prototype for a household based on their house structure and budget, fabrication, installation, maintenance and repair. There will be a network of fabrication, installation persons, material suppliers, and financial support entities such as microfinance institutions, local governments etc who support the cooperatives. Women leading the movement for thermal comfort in their vicinities through a cooperative model will generate community centred livelihood opportunities and ensure local autonomy to alleviate their distresses due to heat stress.

In preparation for our work to co-design these co-operatives, we have conducted interviews with 4 organisations with on ground experience of working with cooperative groups (Saath, Mahil Housing Trust, Adhikar and Kutch Mahila Vikas Sangathan) and 3 organisations engaged in vocational training (Barefoot College, Care India and Lend-A-Hand). The interviews highlighted barriers which are usually associated with engaging with women from marginalised patriarchal communities and possible pathways to work through them. Additionally the approach to training which should include elements related to digital literacy, financial literacy, and entrepreneurship training were highlighted. We will use these and more insights derived from interviews to inform our engagement with women from our project communities in TamilNadu. The plan is to identify women interested to co-create a cooperative and facilitate a series of listening and participatory design workshops to map their ideas, challenges and opportunities and co-create a pathway to pilot test governance, operational and economic models for a Women's Heat Action Cooperative.

b. Piloting fabrication training for cooperative members :

As part of the process to understand the supporting ecosystem required for Women’s Cooperatives operating as Thermal Comfort Solutions micro-businesses in Informal Settlements and given our existing connections with women from low-income settlements in Pune, we have begun by training Meena Rokade, to lead the process of fabricating MLP panels. In the month of April 2024 she fabricated 16 panels and the same has been documented in the MLP Panel Fabrication Toolkit Manual. She has trained another woman, Jamuna, on the same and both of them have collectively fabricated close to 50 MLP panels for the chain sprocket installations in Chennai. With the learnings from this set up, we plan to extend this women-led and a women-owned cooperative effort in Chennai next year.

c. Microfinance Institution engagement :

We have existing connections with organisations working in the informal housing space in Pune since 2021. Therefore, with support from our research partner Basera Centre for Research and Governance we engaged in initial conversations with 3 micro finance institutions (Annapurna Pariwar, Parvati Swayamvikas Sahakari Saunstha Ltd, Pune and Lokalyan Nagari Patha Samstha) and 4 micro-credit cooperative societies (Ujjivan Small Finance Bank, Shivakrupa Sahakari Patpedhi , Equitas Small Finance Bank, Kala Shankar Nagari Coop Patpedhi Ltd and Suryoday Small Finance Bank Ltd.) in Pune.

An overview of work undertaken as part of passive cooling roof retrofit installations was presented to these financial institutions followed by interviews to understand basic information about the loan types and criteria offered by them as well as their willingness to :

i. Support seed funding for women's groups interested in operating a small scale business to offer thermal comfort retrofit services within their communities.
ii. Support loans for households interested in installation of roof cooling retrofits (with technical support from women's cooperatives).

Engagement with these institutions revealed that only 1 of the 7 financial institutions is ready to support 'new' micro-business loans, while others are prepared to offer loans only to already established business groups. The process for applying for a new microbusiness loan is for the group to submit a business plan for approval. Additionally, all institutions are willing to offer loans to persons interested in having thermal comfort installations retrofitted to their roofs. These learnings will inform our preparation for engagement with microfinance institutions for cooperative group and individual loans in Tamil Nadu.

d. One-Stop-Shop to support women's cooperatives, their supporting network and residents interested in availing roof retrofit services :

An effort in the direction of supporting Women's Heat Action Cooperatives, is to experiment with the establishment of an online and offline One-Stop-Shop (OSS) which will be openly accessible and function as a technical and finance support facility for cooperatives and supporting their network e.g. fabricators, material supply persons, etc. It will also support residents interested in availing roof retrofit services. This OSS will be operated by FairConditioning for 2-3 years to demonstrate the feasibility of the concept before being offered to other Informal Housing NGOs with a long term mandate of supporting Informal Housing upgrades, or to governmental institutions The OSS will be tasked with:

a) deploying of low-interest patient capital finance from financing partners such as microfinance institutions.

b) providing technical and operational training to cooperatives, fabricators, installers.

c) certifying and registering cooperatives, fabricators, installers and other vital functions to enhance resilience and entrench the sustenance of the OSS model.

We have worked on developing a prototype for the online OSS site. A clickable prototype of the future micro-site to be embedded into the Fairconditioning Portal can be accessed through this link.

Project Team

Sr. No.	Name of Team Member	Project Designation
1	Vivek Gilani	Project Director
2	Anusha Mohan	Project Manager
3	Hasan ul Banna Khan	Project Manager
4	Vinita Rodrigues	Project Manager
5	Savitha Narayanamurthy	Project Manager
6	Vipul Patil	Project Assistant
7	Unais Painat	Project Assistant
8	Maya Seshagiri	Project Assistant
9	Afzal N	Project Assistant
10	Mujahid Khan	Project Assistant
11	Mudabbir Dalal	Project Assistant
12	Saranya Acharya	Project Assistant
13	Dharmesh Patel	Project Assistant
14	Kirti Makhija	Project Assistant
15	Shruti Parth	Project Assistant
16	Vedangi Sohoni	Project Assistant
17	Meena Rokade	Project Assistant
18	Narayan Nagote	Project Assistant