Cool roof installations in Pulianthope, Chennai

This research project, led by CBalance with support from CAG, aims to create and test practical cool roof solutions featuring reflective and insulating materials to minimize heat absorption through roofs, help lower indoor temperatures, and reduce heat stress in vulnerable households, especially those without cement (RCC) roofs. The goal is to use sustainable, locally available materials to protect vulnerable people from extreme heat. The solutions will be installed in selected homes, and feedback will be gathered from residents to evaluate the effectiveness of the installations. Based on the results, designs will be improved. Eventually, the project plans to form a women's cooperative made up of local residents who will be trained to provide cool roof solutions to more households, allowing them to earn an income while also improving comfort and health in their communities.

The working principle of the cooling solutions is similar to wearing a cap in the summer. A cap protects our head from direct sunlight during the day, but at night, we can take it off and allow our body to release heat into the cooler surroundings. Following this idea, the project has developed two categories of cooling systems. The first type, called dynamic solutions, includes a mechanism that covers the roof during the day to block heat and then retracts at night to allow the roof to cool by releasing stored heat into the night sky. The second type, called static solutions, involves fixed installations that do not move. These provide constant protection from daytime heat.

Target area

Puliyanthope, a densely populated area in Chennai, was chosen as the project site. Most of the houses in this area have asbestos roofs , making them especially vulnerable to heat. Based on CAG's suggestion and with help from a local consultant, 30 such households were identified.

To begin with, a listening workshop was held with the selected residents to understand their experience of heat stress in their homes. In a second meeting, the project team explained the different cooling solutions and the overall goal of the project. Residents were then asked for their consent to move forward with the next phase. After this, a structural audit was carried out in 25 homes where residents had shown interest and given their approval. Based on the audit findings and the preferences of each household, a suitable cooling solution was selected for each home.

Listening Workshop -1

Listening Workshop - 2

Listening Workshop - 3

Listening Workshop - 4

In the first phase of implementation, the selected cooling solutions were installed in five homes. Before installation, each household filled out a form over seven days to record their experience with heat inside their home. An agreement was signed with selected households, and after installation, the same households provided feedback through a second seven-day survey. This helped the team understand any changes in comfort levels.

To help monitor the intervention, sensors will be installed to measure the thermal performance of the solutions for at least one year. These sensors will track key parameters such as relative humidity (RH), dry bulb temperature (DBT), and wet bulb temperature (WBT). In addition, a local volunteer will manually record this data for a week to support the analysis. A third meeting will

also be held with the five households to gather more detailed feedback on the performance and experience of using the installed solutions.

Following this, the project will move into its second phase. Based on the feedback and performance results from the first five homes, the cooling solutions will be improved if necessary and then installed in ten additional homes. The same process of monitoring and feedback collection will be repeated. A special neighbourhood visit will be organized so that nearby residents can see the installations and hear feedback from the households directly. This will help raise awareness and interest in the solutions among the larger community.

By the end of the first year, the project will finalize a list of suitable solution designs based on the performance data and feedback from both the households and their neighbours. Once the solutions are proven and refined, work will begin to form a women's cooperative made up of residents from the community. These women will be trained in the retrofit process and will offer indoor cooling services to more households in the area. This will create a new source of income for them and help reduce heat stress for others in the community through a sustainable, community-led approach.

This report highlights the successful completion of five cool roof installations in Pulianthope, Chennai.

1. Pipe motor Mechanism.
2. Chain Sprocket Mechanism.
3. Alufoil mounted on an aluminium channel support structure.
4. Alufoil mounted on a steel wire support structure.
5. Galvanized iron sheet with insulation board

I. Pipe motor Mechanism (Installation : Outdoor : Above the roof)

This mechanism allows the tarpaulin sheet to cover the entire roof space exposed to sunlight, providing shade that blocks sunlight from reaching the roof during the day. After sunset, the sheet is folded to expose the roof space, enabling the re-radiation of ambient heat absorbed by the roofing material during the day.

The installation process of this mechanism includes several steps. First, workers build a parapet wall along the corners of the roof space. They then erect a metal frame structure over the parapet wall. Next, they cut and stitch the tarpaulin into a foldable design and paste alufoil foam onto its bottom surface. Iron rods are inserted at the intersections of the stitched sections in the tarpaulin. To enable folding and unfolding, they connect supporting steel wires to a pulley and motor arrangement. Workers secure the foldable tarpaulin, with the iron rods inserted, to the steel wires attached to the pulley and motor mechanism. They connect the motor to a to-and-fro switch box using electrical wiring. Additionally, they install a camera on the rooftop to monitor the folding and unfolding of the tarpaulin sheets from inside the house. Finally, they operate the switch to verify the alignment and orientation of the mechanism, ensuring its proper functionality.

Installed pipe motor mechanism

II. Chain Sprocket Mechanism (Installation : Outdoor : Above the roof)

This mechanism secures the insulation panel to a dynamic structure operated using chain and sprocket handling. During the daytime, the structure remains in a horizontal position (180 degrees) to prevent heat absorption by the roofing material. After sunset, the structure is adjusted to an inclined position (45 degrees) to facilitate the re-radiation of ambient heat absorbed by the roofing material during the day. The installation process of this mechanism includes several steps. Workers construct a parapet wall along the corners of the roof space. They mount the base frame over the parapet wall and fasten insulating material boards to the panel frame. Then, they assemble the panel frame with the base frame using bearings and sprockets. They connect a chain along the panel frame's sprocket to a rotating wheel positioned on the ground for operation. Finally, workers check the alignment and orientation of the mechanism by operating the rotating wheel to ensure it functions correctly.

Installed chain sprocket mechanism

III. Alufoil foam mounted on an aluminium channel support structure (Installation : Indoor : Under the roof)

This static installation involves mounting alufoil foam on an aluminium channel support structure beneath the roof. In this design, the outdoor roof space remains exposed to sunlight, while the under-roof space is covered with alufoil foam to block heat from entering the indoor living area. The installation process of this mechanism begins with fixing aluminum channel mounting strips to the interior wall. Once the mounting strips are securely in place, an alufoil sheet is cut to the required size and fixed over the mounting strips to complete the setup.

Installed alufoil static mechanism mounted on aluminium channel support

IV. Alufoil foam mounted on a steel wire support structure (Installation : Indoor : Under the roof)

This static installation involves mounting alufoil foam on a steel wire support structure beneath the roof. In this design, the outdoor roof remains exposed to sunlight, while the under-roof space is insulated with alufoil foam to block heat from entering the indoor living area. The installation process of this mechanism begins with fixing a steel wire mounting structure to the interior wall beneath the roof. Once the mounting structure is securely in place, an alufoil sheet is cut to the required dimensions and attached firmly over the mounting structure to complete the setup.

Installed alufoil static mechanism mounted on steel wire support

V. Galvanized iron sheet with insulation board mounted on an aluminium channel support structure (Installation : Indoor : Under the roof)

In this static installation, a thick insulation material is applied to the top surface of a galvanized iron sheet, which is mounted on an aluminium channel support structure. This structure is positioned under the roof to block heat from entering the indoor living space. The installation process of this mechanism starts with fixing an aluminum mounting structure to the interior wall beneath the roof. Following this, workers secure an insulating board to the top surface of a galvanized iron sheet. Finally, they assemble the galvanized iron sheet above the aluminum mounting structure to complete the setup.

Galvanized iron sheet with insulation, after installation