Energy Optimised and Sustainable Energy Driven

BUILT ENVIRONMENTS

Democratising access to wellbeing and productive work environments in a climate-stressed world

2021

SELCO FOUNDATION

Why are **inclusive and sustainable** built environments **critical for the poor**?

With **climate change, the inefficiencies of ad-hoc built spaces** are further exacerbated

Summers are hotter, winters are colder and **disasters are frequent with increased intensities**

Poor communities are usually at the receiving end of the **worst impacts** of climate change

Coupled **with poor ventilation, natural lighting and thermal conditions, the cost of building resilience and comfort is high**

Costs associated with **mitigation are recurring and inefficient** leading families and entrepreneurs into a **cycle of poverty**

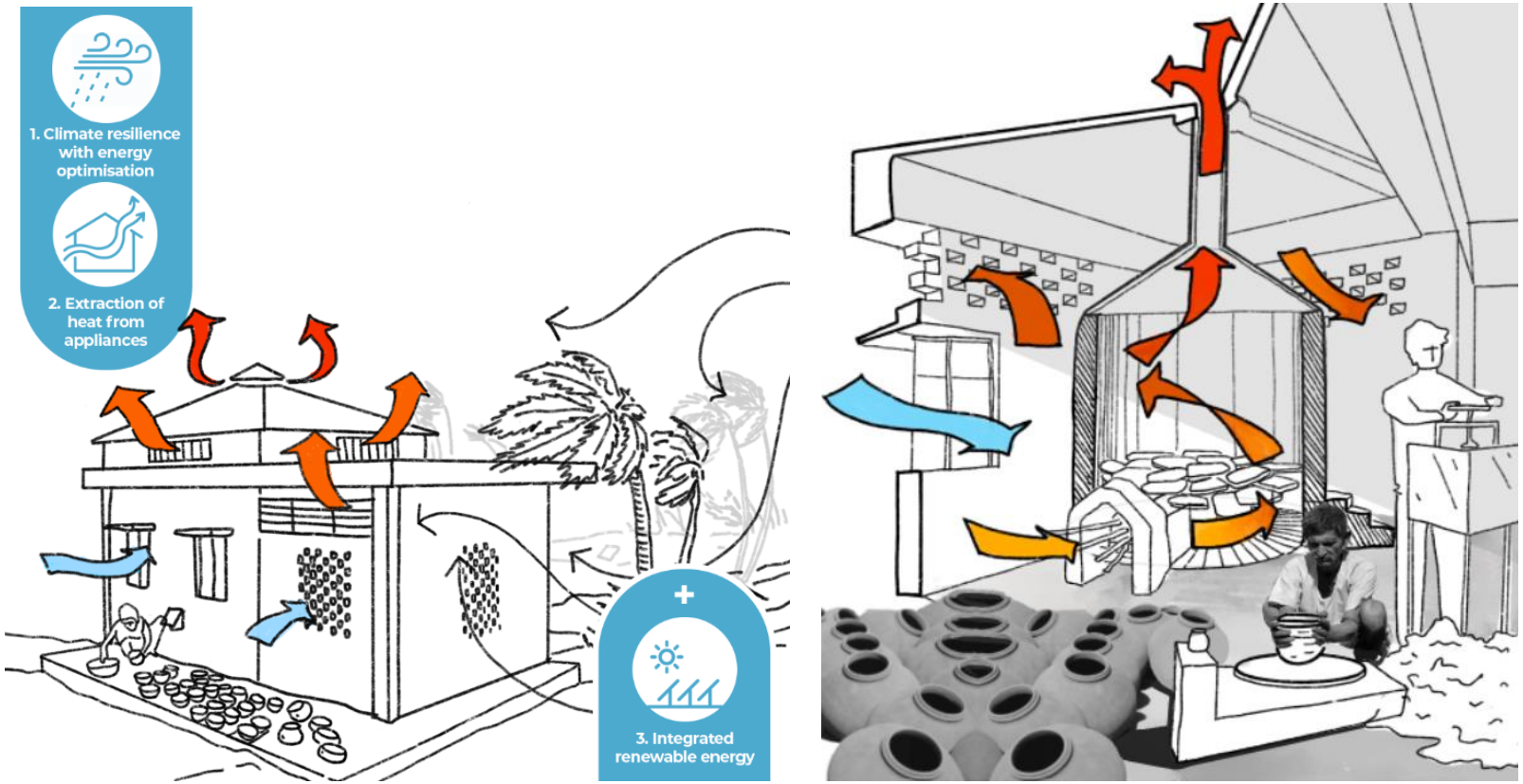
The **energy performance of built environments** are influenced by,

1. Built Envelopes – Material and Technology

2. Indoor **Activities and Function** of space

3. Impacts of **climate change and stresses**

Innovations need to integrate **energy optimisation** in the **application of technologies** and **the environment of built spaces**, with decentralised sustainable energy



Graphics explaining the approach to designing and construction resilient and energy optimised built environments

Programmes are focused on the following **sectors,**

Seen: Cool Homes for Heat Stressed Geographies

Housing across tenure type (migrant communities to permanence), climate and disaster resilience for urban and remote contexts focused on sustainable and local construction and skilling needs

1. Housing

Seen: Roti making enterprises that are organised and cool

Micro-businesses, animal husbandry, handicraft and agricultural built workspaces focused on increasing productivity, income, savings, resilience and aspirations

2. Workspaces

Seen: Last mile infrastructure for care in Arunachal and Jharkhand

Healthcare spaces, educational spaces, rural infrastructure, community centres etc are examples for resilient and long term assets for community

3. Institutions

Flagship programmes are focused on the following **work streams**,

Seen: Construction of insulated RCC filler roof slabs

Focused on sustainable materials and construction methodology for cool roofs, ventilation systems, fenestration designs i.e. windows and ventilators and integrated models for active cooling

1. Passive Cooling

Seen: Optimising traditional built spaces to increase day lighting
Focused on increasing work days and work hours, improving ergonomics, better workflow in layout designs, increasing incomes and reducing expenditure for maintenance and repairs

2. Productivity and Wellbeing

Seen: Disaster (Cyclone) resilient workspaces

Focused on adapting shelter designs to make communities resilient to disasters to save lives and livelihoods.

3. Disaster Resilience

Case Study 1

INSTITUTIONS | HEALTH CARE

Guidelines for Sustainability and Efficiency in Building Design

For Health Sub Centres, Wellness Centres, Primary Health Centres and Community Health Centres

Impacts

- Improved **well-being for staff as well as in-patients**
- Confidence in staff in being able to **delivery quality service**
- **Climate resilience** against heat stress and other environmental factors like flooding, cyclone, earthquake etc
- **Reduction in carbon footprint** of the health infrastructure
- **Reduced dependency on energy by 80%** for active cooling to maintain the required thermal comfort

Example of Existing Health Sub Centres

Model Sub centres with staff accommodation built in partnership with Karuna Trust in Keba, Arunachal Pradesh (A) and YK Mole, Karnataka (B)

Case Study 2

PASSIVE COOL | HOUSING

Climate Responsive Low Income Housing

For Heat Stress, Landslides, Cyclones, Earthquakes etc Resilience and Thermal Comfort

Problem Statement:

- Drought prone region**: Indoor temperatures** at afternoons and summers reaching **39°C to 45°C**
- **Recurring costs** for roof and **wall repairs** during summers and monsoons - > INR 5,000
- **High energy bills** due to daytime consumption
- Lack of access to skilled workforce
- Sustainable materials and Resilient construction require **high capital investment**
- Incremental or unfinished homes
- Lack of credit history and inclusive financing

"During the Covid19 lockdowns, we are able to live comfortably indoors which was ***unbearable during the months of March and April.*** Now it is cool inside and we are able to open our windows during the day." - Rehana, Home Owner

Impact:

- The built interventions have resulted in an indoor temperature difference of over 10°C in comparison to the previous metal roof house.
- 80% loan repayment in Year 1
- Energy bills reduced by 80% for lighting and ventilation

(Before) Energy Dependant and Thermal Discomfort in Homes

(After) Optimised Day lighting and ventilation (interior) and Shaded/ Insulated External facades with Cool Roofing Technology

Case Study 3

DISASTER RESILIENCE | HOUSING

Climate Responsive Low Income Housing

For Heat Stress Relief, Resilience and Thermal Comfort

Problem Statement:

- **Earthquake and Cyclone** prone region: Indoor temperatures at afternoons and summers reaching 39°C
- **Recurring costs for roof and wall repairs** during summers and monsoons - > INR 5,000
- **High energy bills** due to daytime consumption

"During the Covid19 lockdowns, we are able to live comfortably indoors which was ***unbearable during the months of March and April.*** Now it is cool inside and we are able to open our windows during the day." - Rehana, Home Owner

Impact:

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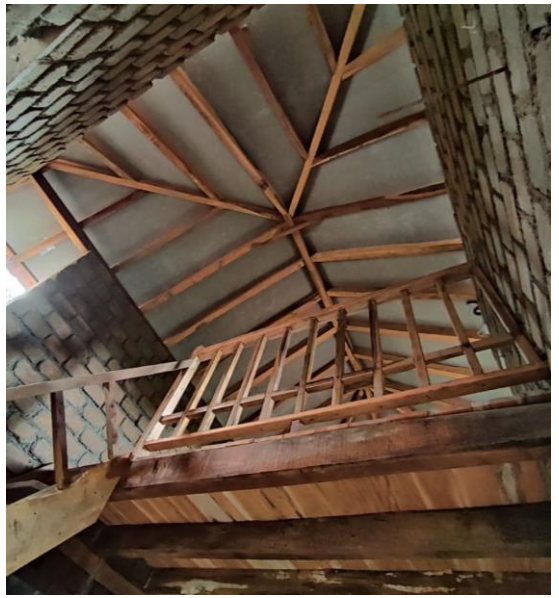
(Before) Prior housing in dilapidated conditions



Improved Housing (After) for Earthquake and Cyclone Prone Regions in Maharashtra

Case Study 4

PASSIVE COOL | HOUSING

Climate Responsive Low Income Housing

For Heat Stress Relief, Resilience and Thermal Comfort

Problem Statement:

- **Landslide and Cyclone** prone region: Indoor temperatures at afternoons and summers reaching 39°C
- **Recurring costs for roof and wall repairs** during summers and monsoons - > INR 5,000
- **High energy bills** due to daytime consumption

"Most of the homes in rural and tribal belts are devastated during monsoons and heavy winds resulting in a cumulative of 2 Crores reinvestment by the government on housing and disaster resilience" – Swapnil Tembe, District Collector – East Garo Hills

Low Income Housing (Before) Landslide and Cyclone Prone Regions in Meghalaya

(After) Resilient Cool Roofing interventions

Case Study 3

PASSIVE COOL | WORKSPACES

Standarising Workplace Layouts for Thermal Optimisation

For Home Based Roti and Other Food Production Entrepreneurs and Financial Institutes

Problem Statement:

- Afternoons and summer months increase **indoor heat up to 40 to 50^{o}C**
- **Increase of 3 to 5^{o}C** further by the presence of **an active heat source** - the cook stove
- **Preventing 4-5 work hours** in the day in a small 100 sq ft area.
- Fatigue due to **poor adaptation** of homes into a workspaces with lack of proper storage, **poor posture** resulting in back strain.
- Natural lighting as low as **10 lux** cause **energy use for 12 to 16 hours** per day.

Impacts

- Improved well-being by
  - **reducing temperatures by 5^{o}C**
  - **indoor air pollution** to **safe levels** of PM2.5 and CO
  - Increased lux levels to >120
- **Productivity increase** by workflow improvement, ergonomics, increasing work hours by **4 hours per day**
- **Income increase** by reducing maintenance and operation costs for roof repairs during monsoon months, reduced energy bills for lighting and ventilation
  - Yearly savings of INR 5,000/-
  - Monthly savings due to offsetting energy needs in daytime
  - 2x Income increase due to shop front improvements

Before: Due to standard construction techniques of tin sheet roofing, low ceiling and lack of openings like windows

After: Cool Roofing Technologies (Modroof) and Improving ergonomics and work flow within the production and store front of a Roti Making Enterprise

Case Study 4

PASSIVE COOL | WORKSPACES

Standarising Workplace Layouts for Thermal Optimisation

For Home Based Potters and Micro Entrepreneurs

Problem Statement:

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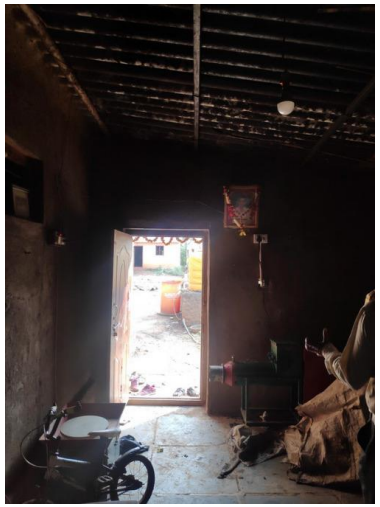

Before: Asbestos roofing, un-plastered walls and low ceilings resulting in dark and heated spaces

After: Cool Roofing Technologies (Plaster of Paris False Ceilings) and Improving ergonomics and work flow within the home and workspace

Case Study 5

DISASTER RESILIENCE | WORKSPACES

Disaster Resilient Workplace for Productivity Increase

For Crafts and Cottage Industries like Pottery, Weaving etc.

Problem Statement:

- **100% destruction** of the Bati Ghar (Pottery Sheds) **during Cyclones** Titli and Fani
- **Loss of ~100 working days** during monsoon and extreme summers
- **60-80% Loss of finished goods** during cyclone months and heavy rains
- Workspaces are traditionally built with mud walls and thatch roofs
- Government rebuilding subsidies are negligible and Entrepreneurs spend years to rebuild
- Yearly cyclones of increasing intensity and frequency make repairs redundant

> "The new Bati Ghar has been critical to us ***restarting our businesses post cyclone Fani devastations***. We feel confident that we will suffer no further losses if there is another cyclone. The pots can be made even during monsoons. The added machines has allowed provided us with additional income" - Chakradhara Bisoi, Potter

Impacts

- 4°C reduction in temperature
- 20% reduction in relative humidity
- Zero(0) Damages - Withstood 2 severe cyclonic storms

Before: Cyclone devastated workspaces

After: Cyclone resilient workspaces and pottery kiln design integrated with solar integrated productive appliances like pottery wheel, blunger and pugmill

Case Study 6 PASSIVE COOL WORKSPACES

Standarising Design Layouts for Reducing Mortality Rates and Improving Produce Quality

For Small scale farmer and FPCs with Animal Husbandry Businesses in Dairy, Poultry, Piggery etc

(Before) Ad-hoc built cow shed with thatch roof and tin sheet envelop

"Earlier unfavorable infrastructure resulting in **high heat stress, caused the death of two calves** and negligible milk production" says Shilpa Chandrashekar from Mandya.

Improved Close Shed (After) for Cattle to reduce heat stress in Mandya, Karnataka

Potential Impacts In dairy:

- **Increase quality of milk** protein and milk solids
- Increased wellbeing for the cattle
- by reducing maintenance and operation costs for repairs

Interiors of the Cool Shed (After) for Cattle

Dept of Animal Husbandry and Veterinary services @AH... · 23h

Replying to @SELCOFoundation @DeputyMandya and 4 others

Appreciate your measures to reduce the heat stress in cattle. Heat stress leading to reduction of milk yield in cattle especially in exotic cows(HF, Jersey) is a fact.
Thank you.

Case Study 7

PASSIVE COOL | WORKSPACES

Standarising Design Layouts for Reducing Mortality Rates and Improving Produce Quality

For Small scale farmer and FPCs with Animal Husbandry Businesses in Dairy, Poultry, Piggery etc

Potential Impacts:

- **In poultry,**
  - **Decrease Mortality rate <8%** by mitigating heat stress and cold stress
  - Reduce losses in summer and winter months every 45 day cycle
  - Reduced dependency on energy for heating and ventilation

Community model Backyard Poultry Shed (Before)

Improved Backyard Poultry Sheds (After)

#8

MIGRANT/ DISPLACED COMMUNITIES

Developing technologies for emergencies and disaster affected/ displaced communities

In housing, health and education

Impacts

- Insulated and modular systems for shelter construction
- Systems can adapt to community status
    - Can be incrementally expanded and made permanent with brick and mortar depending on the change in tenure over years
    - Can be easily dismantled and moved depending on the need
    - Building materials of high value can be dismantled and resold
- Most community institutions can be repurposed during pandemics as spaces for quarantine and/ or care spaces.

(Before) Blue tarpaulin sheet housing and flat pack tents get overheated in the afternoons

Portable and Flat pack insulated and passive cooled educational (A), housing (B) and health (C) spaces for migrant or displaced communities in Belgaum, Gudalur and Bangalore

See more of SELCO's Heat Campaign on Twitter: @SelcoFoundation **and Youtube:**

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