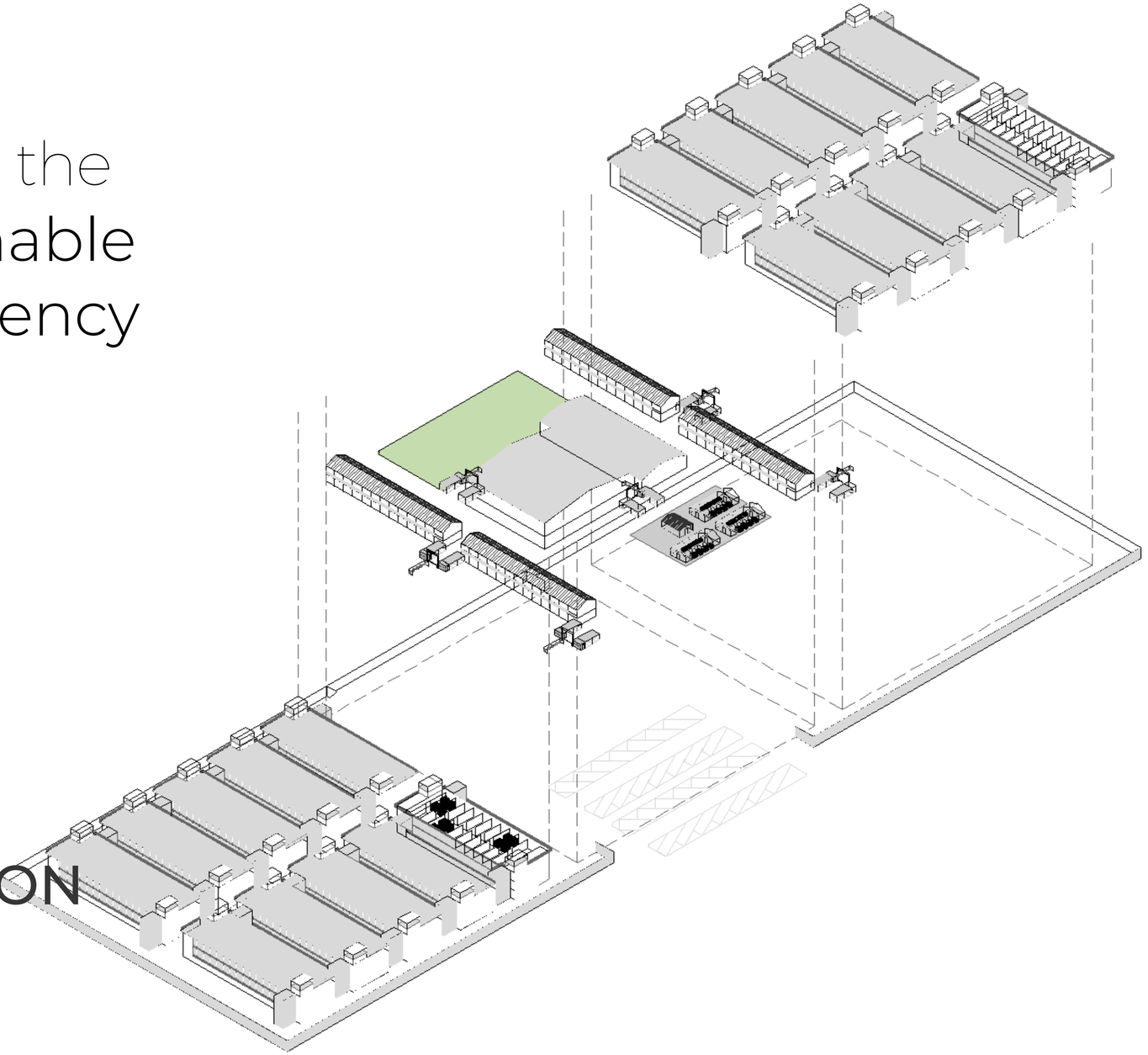
Re-looking Construction Worker Housing through the lens of COVID -19, Sustainable Energy and Energy Efficiency



SELCO FOUNDATION

INDIA - MAY, 2020

Introduction

Climate change, disasters, pandemics, conflict and the unprecedented loss of livelihood opportunities has led to displacement and large scale migration of marginalised communities. Roughly a 100 million Indians have migrated in search of work. One major avenue is the booming infrastructure development projects that invite many skilled and unskilled people to urban areas for work. With the latest assessment the sector provides employment to approx. 50 million people. With the absence of affordable public housing for people at the bottom of the pyramid, catered to their patterns of migration, families and individuals are driven to squatting on empty plots of land or depend on either the government or their employers to provide them with accommodation.

These shelters built need to cater to relieving heat stress, heavy rains and flooding. There is a dire need to optimise the limited space available, create natural ventilation, thermal comfort and use durable and high quality and adaptive materials and construction technology to fit the needs in a post-covid world.

Mitigative measure to prevent spread of the pandemic are through decentralised utilities and services. These prevent cross camp circulation of inhabitants, reduced spatial occupancy/ crowdedness and better density design.

Easy to clean vertical and horizontal surfaces, better ventilation facilities in shared accommodation and service areas and other passive measures like day lighting, shading and insulation to improve overall well being to prevent contamination or infection spread within communities.

The lockdown situation has made construction workers more vulnerable in many ways without systems in place to protect: Losses in employment with the shutdown of all worksites; no income and limited savings leading to hunger and non repayment of debt resulting in the community furthering into poverty; no registration, social securities or BOCW Card resulting in lack of access to subsidies; not being able to pay rents or abandoned in high risk labour colonies leading to degradation of mental and physical health.

There needs to be a shift towards much more contextualised solutions and mapping of typologies to create benchmarks for habitat delivery. With the plethora of issues and hurdles present like land rights, finance, impermanence, there is a need to design sustainable solutions around them to create safety nets and support people with dignified habitats.

Needs and Impacts of Built Environments on Workers' Quality of Life

SHORT TERM - COVID 19 RESPONSE NEEDS AND POTENTIAL IMPACTS

Workers housing are not designed to prevent overcrowded conditions. **Studies show average habitable area per person ranging between 1.5 to 3.5 sqm. In such conditions, attaining acceptable physical distancing proves impossible**. Transit or gathering points need to in **large open areas which are generally lacking in worker settlements. Closed or narrow spaces discourage social distancing.**

Reports also **stress on the need for improved air quality and passive measure for ventilation and daylighting.** Shelters are further made **inhabitable by the lack of windows or in openable fenestrations to the built indoor environment.** Green cover in settlements also help improve overall site level air quality.

The **materials used** to build flooring, walls, door handles etc need to be **easy to clean and durable.**

Compounded with factors of low sanitation services per person. **A ratio of 1:10 or minimum 1:15 needs to be maintained for sanitation services to prevent infection spread and cross contamination.** Servicing and cleaning of these spaces frequently need to also be adhered to.

Isolation or quarantine spaces for the sick need to be established to protect those vulnerable and healthy.

LONG TERM - RISK REDUCTION AND RESILIENCE BUILDING NEEDS & POTENTIAL IMPACTS

Most countries have labour laws and ethics codes that dictate standard guidelines and regulations for sustainable and quality housing for workers. In **the absence of monitoring, either by regulatory bodies at governance or organisation level, habitable conditions are rarely met.**

Another layer to the right to quality of living standards, is the **right to inclusivity for women and workers with vulnerabilities and providing safety nets in the form of childcare, insurance, etc.**

Climate stressors like heat, torrential rains, flash flooding create additional burdens in providing safe and healthy living conditions. Most built spaces are not resilient and negativity impact wellbeing and productivity in individuals.

Providing **serviceable spaces for clean cooking in the form of central or individual kitchens** also helps improve worker health and wellbeing.

Ample spaces for recreation and utilities need to be provided in the form of shops for groceries, personal grooming, money transfer or ATMs, pharmacies and **access to clean drinking water, adequate waste management** also need to be provided.

Worker Housing Typologies

ON-SITE/IN-SITU HOUSING

Housing settlement on construction site land. The community occupies the land till the construction. Less than 100 individuals.

OCCUPANCY
<100 members

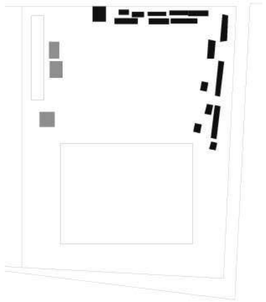
AVG UNIT SIZE
2.5 m x 3 m

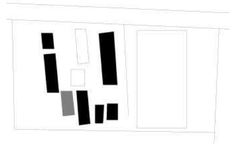
PERSONS PER UNIT
2-7

AREA PER PERSON
1.5 - 2.7 m^2

SETBACKS BETWEEN BUILDINGS
Row type or 3 m maximum

TYPE OF MATERIALS
GI Metal or Asbestos sheets, Tarpaulin, Bamboo or Casuarina Poles, Unfinished or cemented floor





Examples of Layouts

TYPICAL LAND USE
20% built area [80% housing and 20% services] and 80% open area

OFF SITE DORMITORIES

Housing settlement on rented or leased land in walking distance to the construction sites. Grid connection or DG Sets and temporary infrastructure is set up to service the inhabitants for the duration of construction.

TYPE 1

OCCUPANCY
100 - 1000

AREA PER PERSON
1.8 - 2.2 m^2

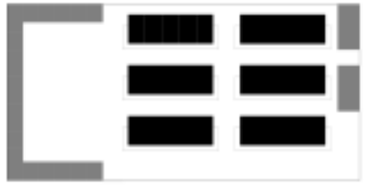
AVG UNIT SIZE
3 m x 6 m

PERSONS PER UNIT
8 - 16

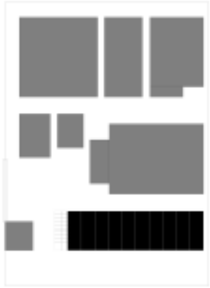
SETBACKS BETWEEN BUILDINGS
Row type or 3 m maximum

TYPE OF MATERIALS
GI Metal sheets with Hollow Cement Blocks, Scaffolding framework, PCC floor plinth

TYPICAL LAND USE
50% built area [70% housing and 30% services] and 50% open area



Examples of Layouts



Worker Housing Typologies

TYPE 2

OCCUPANCY

500 - 2500

AVG UNIT SIZE

3 m x 6 m

AREA PER PERSON

2.8 - 3.7 m^2

PERSONS PER UNIT

8 - 16

SETBACKS BETWEEN BUILDINGS

3 m - 6 m

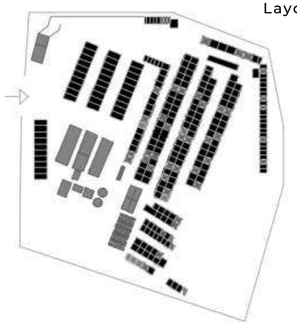
TYPE OF MATERIALS

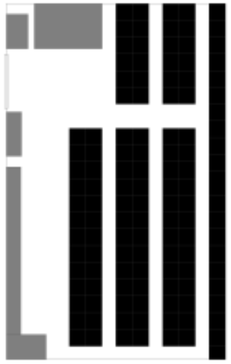
Prefabricated Panels Units

TYPICAL LAND USE

60% built area [70% housing and 30% services] and 40% open area

Examples of Layouts





OFF SITE HOSTELS

Housing settlement built by contracting companies who rent out infrastructure to real estate developers or centrally set up worker housing by developers to cater to multiple construction sites. Grid connection, transformers and permanent infrastructure is set up to service the inhabitants.

OCCUPANCY

>2500

AVG UNIT SIZE

5 m x 7 m

AREA PER PERSON

3.1 - 4.7 m^2

PERSONS PER UNIT

8 - 16

SETBACKS BETWEEN BUILDINGS

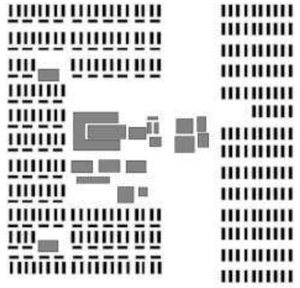
>4.5 m

TYPE OF MATERIALS

Prefabricated or Precast

TYPICAL LAND USE

60% built area [70% housing and 30% services] and 40% open area



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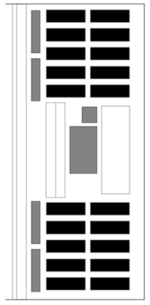


On Ground Practices vs Best Practices/Guidelines

HABITABLE AREA PER PERSON

1 : 0.25 m^2

BEST PRACTICE/GUIDELINE	3.4 - 4.8 m^2
ON-SITE HOUSING	1.5 - 2.7 m^2
OFF SITE DORMITORIES	
TYPE 1	1.8 - 2.2 m^2
TYPE 2	2.8 - 3.7 m^2
OFF SITE HOSTELS	3.1 - 4.7 m^2

NATURAL LIGHTING & VENTILATION

BEST PRACTICE/GUIDELINE

2 windows or 1 window + ventilator system. One-fifth of the floor area

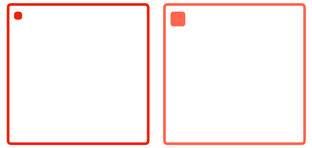
Windows to be shaded with chajjas and louvers. Screened with 16-mesh material

ON-SITE HOUSING

None created

OFF SITE DORMITORIES & HOSTELS

None or 1 window - 1/10th or 1/20th the floor area



KITCHEN SPACES

1 Stove 10 persons

BEST PRACTICE/GUIDELINE

For communal kitchen (2.7 m^2 per family or 8-10 persons or one stove or two families)

0.6 m^2 per person for central kitchen

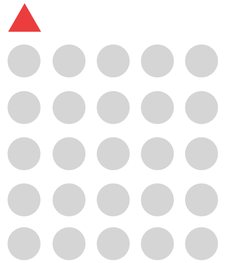
Chimney available

ON-SITE HOUSING

None provided

OFF SITE DORMITORIES

1 per 250 persons communal kitchen



OFF SITE HOSTELS

1 Communal kitchen for 20 people or 1 Central Kitchen

Chimney available

HEALTHCARE/CLINICS & COMMUNITY SPACES

1 Clinic 100 persons

BEST PRACTICE/GUIDELINE

Should accommodate 1/3 of the occupants at a time. 1.2 m^2 per person to be allocated

1 clinic with pharmacy; 1 ward bed for every 300 persons

ON-SITE HOUSING & OFF SITE DORMITORIES

No Community Space or Clinic Provision

OFF SITE HOSTELS

1 to 1.5 m^2 of dining space per person allocated

1 clinic/sick room for the camp - approximately 1000 people

On Ground Practices vs Best Practices/Guidelines

ENERGY & TECHNOLOGY

● 2 persons

BEST PRACTICE/GUIDELINE

Address the energy needs of individuals and families;

1 ceiling fan for 4 Beds/ Bunk Beds or 1 ceiling or pedestal fans per 2 persons based on climate zone.

Light levels in toilet and storage rooms shall be at least 80 to 120 Lux. Kitchens and living quarters, shall be at least 150 to 200 Lux

Common utilities and services with ceiling-type light fixture.

ON-SITE HOUSING

Some cases - Single phase grid with daily power cuts

Battery based lanterns - 1-2 lights (usually dim) and mobile charging.

None

OFF SITE DORMITORIES

Grid with power cuts

Limited time use DG Sets

1 ceiling light, 1 mobile charging and 1 ceiling or pedestal fan **per room**

Occupants may have personal TVs or other appliances

OFF SITE HOSTELS

Grid with power cuts

Limited time use DG Sets

1 ceiling or pedestal fan per room, 1 mobile charging **per person**

Common rooms have other services for TVs, play rooms, shops etc

SANITATION

● 10 persons

△ 1 Urinal

▲ 1 Lavatory

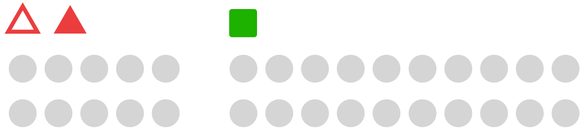
▢ 1 Wash Basin

■ 1 Shower

BEST PRACTICE/GUIDELINE

ON-SITE HOUSING

OFF SITE DORMITORIES



OFF SITE HOSTELS

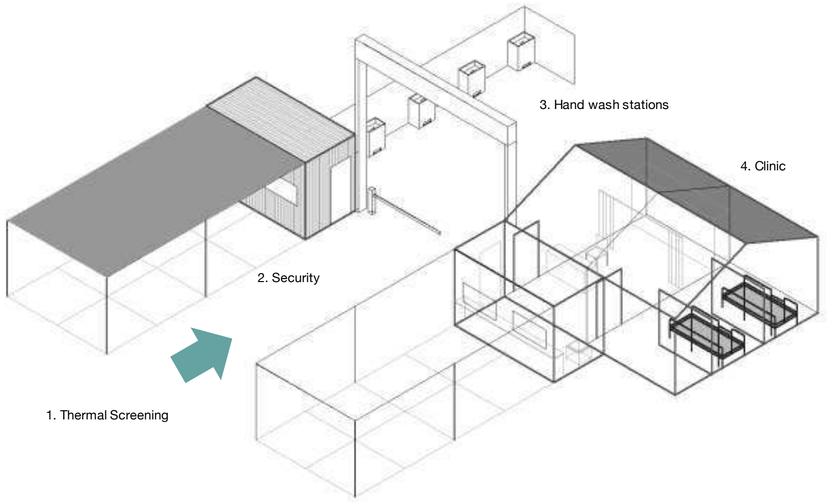
Parameters for Upgradation

SHORT TERM - COVID 19 RESPONSE STRATEGIES

SETTLEMENT LEVEL

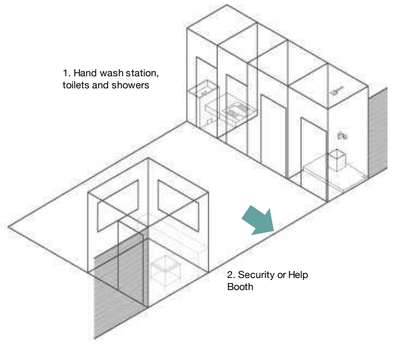
The mobility of people to and fro the housing settlement needs to incorporate thermal screening and hand wash stations. Separate clinic and isolation ward should be set up.

All entry and exit points with security guard chambers needs to be outfitted with IR thermometers to screen everyone entering the settlement. Queueing area need to be shaded and provided with markings for physical distancing. Upon entry, handwashing stations need to be provided. If an inhabitant is screening with fever, clinic/ isolation ward need to be located near to entrance to immediately quarantine them



UNIT/BLOCK LEVEL

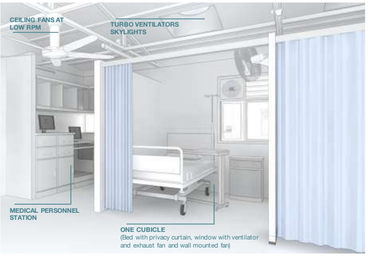
The unit or block level housing has to be provided with decentralised services of hand wash stations, toilets, bathing areas, water supply, energy, recreational and dining spaces.

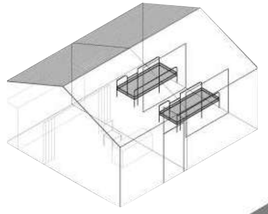


CLINICS & ISOLATION WARDS

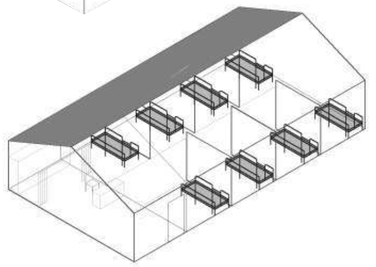
1 Clinic station mandatory per camp

Setting up 1 bed per 300 population for isolation and quarantine





2 Beds for a 600 occupancy camp



8 Beds for a 2400 occupancy camp

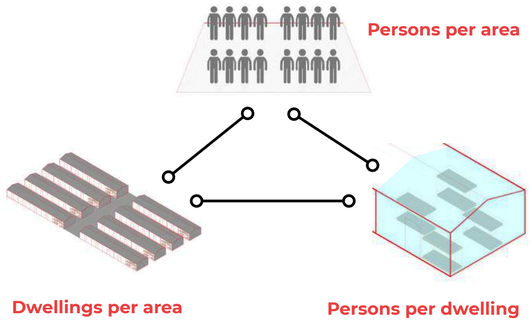
Parameters for Upgradation

LONG TERM - RISK REDUCTION AND RESILIENCE BUILDING STRATEGIES

DESIGNED DENSITY

Occupancy of a unit/ room (living/ sleeping area), open area at site level, Ratio of services/ utilities per person

Strategies to maintain density without overcrowding



'High density' is commonly confused with 'high rise'. **In the cases of labour colonies, high density is usually the result of over crowdedness at a unit level and having low rise residences**. The critical contribution higher densities can make to reducing energy consumption is in lowering the cost of servicing urban areas. As development density increases the per capita cost of providing services such as water, gas, electricity and waste disposal reduces. **In labour colonies, designed density can optimise cost spent per person/ inhabitant.**

DECENTRALISED UTILITIES AND SERVICES

Upgradation of settlement layout by providing Decentralised Utilities and Services

Access to Energy

Access to energy for unit and settlement lighting, cooling. Energy for common utilities and services as well as for WASH, Water, Kitchen usage.

WASH Services

Latrines, not more than 50m from shelter and not closer than 6m. Waste water to be directed towards soak pits. Sufficient hand was and showering units as per population.

Water Supply and Filtration

At every 30 m with sufficient clean supply(90L/person/ day), hands free usage and maintained efficiently

Kitchen, Cooking and Dining

Dedicated entries and exits, Storage facilities, mechanical ventilation, easy to clean surfaces and hand washing stations.

Creches and Childcare Spaces

Provisions of hand washing stations, allowing for staggered timings, insisting on sanitation

Community and Recreation Spaces

Provision of hand washing stations, focus on sanitation and allowing space for social distancing

Stores and Shops

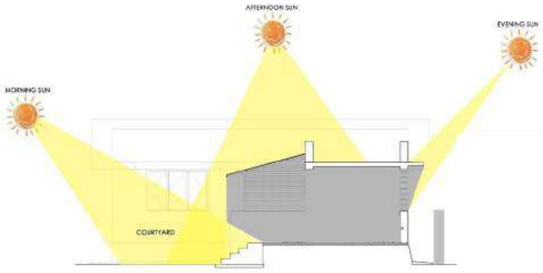
Regulating numbers, controlling queue and using plexiglass and contactless payments.

Waste Management

Dedicated spaces with adequate coverings and forward treatment, collection linkages

PASSIVE DAYLIGHTING AND VENTILATION STRATEGIES

Mapping the sun path diagram and micro climate wind direction to arrive at climate responsive designs to reduce heat gain, improve natural ventilation and optimise on daylighting.



Based on the sun path diagram, **designing shading devices like chajjas, louvers, roof overhangs and courtyards to create spaces for heat relief.** This also helps capture north light for glare free uniform lighting.

Building Technology Status and Potential Upgradations

Based on climate zones (ref: Trewartha classification), climate stressors like heat, rains, floods, cyclones etc, terrain - informed decisions can be made on planning, shape, hierarchy of spaces, fenestration designs and material or insulation selection.

ON-SITE/IN-SITU HOUSING

GI SHEET

LIFETIME	RECOMMENDED OCCUPANCY	ROOM SIZE
<5 Years	2 to 7 persons	3 x 3 m

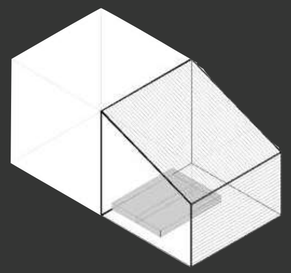
ATTRIBUTES

LABOUR INTENSIVE

CONSTRUCTED IN-SITU

COMMON MATERIALS USED

GI Metal, Asbestos sheets, Hollow Cement Blocks, Tarpaulin, Bamboo/ Casuarina Poles, Scaffolding framework, earth, cemented, PCC floor plinth



INSULATION UPGRADES

White Puf Panel Colour Coated

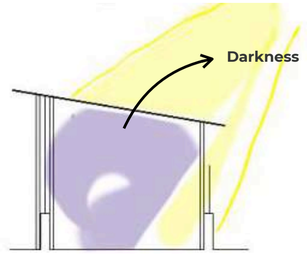
Size: 3.5ft x 10ft
Thickness: 80 mm
U-Value: 0.297 w/m2k

Bamboo Mat Sheet
With reflective surface treatment

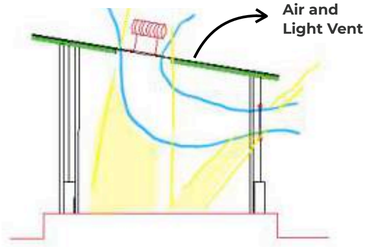
Size: 3.5ft x 10ft
Thickness: 3 mm
U-Value: 5.2 w/m2k

LIGHT AND VENTILATION UPGRADES

Fenestrations



Before Intervention



After Intervention

Turbine Air Ventilator

Material: Aluminium, steel or stainless steel turbines

Location: Mounted on roof

Size: 21”/24”Diameter

OFF SITE HOUSING

PREFABRICATED COMPONENTS

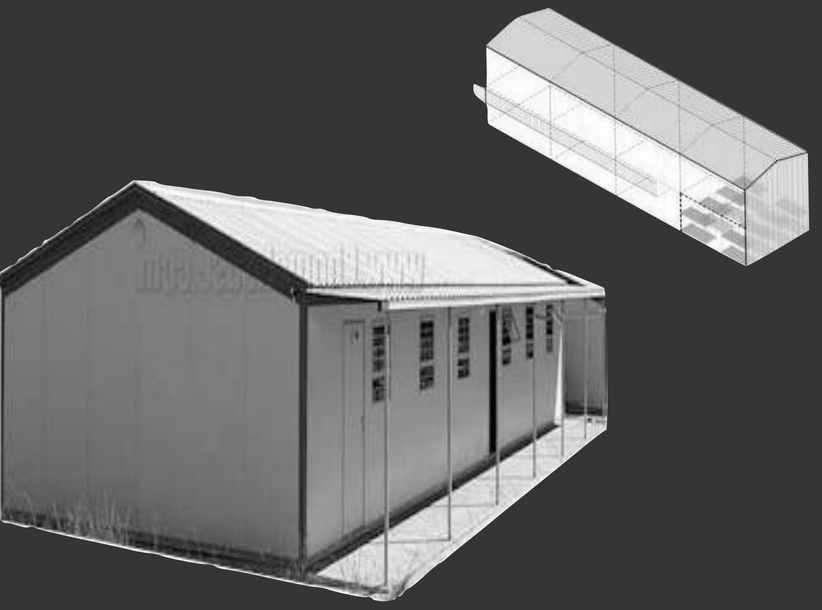
LIFETIME	RECOMMENDED OCCUPANCY	ROOM SIZE
15+ Years	2 to 7 persons	3 x 3 m

ATTRIBUTES

- CUSTOMISED AT WAREHOUSE
- AIR OR CRANE LIFTED
- LARGE SCALE LOGISTICS

COMMON MATERIALS USED

Colour coated metal/ EPS/ PUF panel walls and roofing, MS or light gauge steel frame with PVC sliding window and door



INSULATION UPGRADES

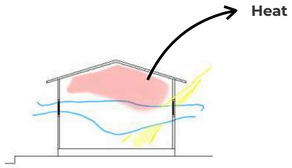
Ekopanely or Ecoboard
Size: 13ft x 6ft
Thickness: 90-120 mm
U-Value: 0.099 w/m2k

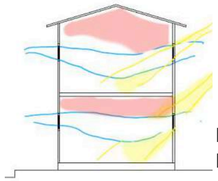
Fibre Glass Insulation
Add on
Thickness: 80-125 mm
U-Value: 0.09 w/m2k

Mineral Wool Slabs
Add on
Thickness: 100 mm
U-Value: 0.25 w/m2k

LIGHT AND VENTILATION UPGRADES

Fenestrations





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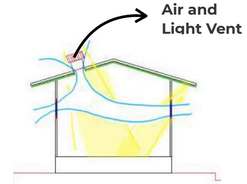
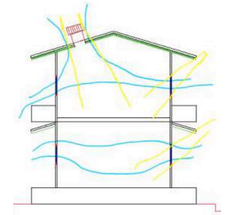


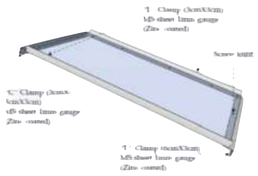


After Intervention

Wall Ventilators

Material: With louvers, shutter made from glass, polycarbonate, UPVC or wood etc

MS framed Polycarbonate or Acrylic Skylight



Customised to site

Case Study - Sustainable Built Environment Breakeven Calculation

The finding stated here were analysed post the assessment of housing settlements across Bangalore and detailed assessment of a labour colony, in collaboration with a developer in Bangalore for **Off site Dormitory type settlement on rental land and grid electricity.**

The **study analysed both spatial planning and efficient use of resources** in the running of a large settlement. It also attempts to cater to the complex cultural and social issues which people face with the hope of proposing a feasible architectural solution which would be appropriate, portable and sustainable. The same has been done by **understanding the lifestyle of the residents occupying these settlements and best practices from other organisations referred to in this report.**

Additionally, a study was done on the **feasibility of implementing the proposed solutions, understanding the transitory nature of such camps that are rebuilt in new locations every 4 to 5 years and curtailing the reuse of the materials to a maximum of 12 years.** The comparison was made between existing conditions and solutions with ideal Built Environments and Efficient Equipment.

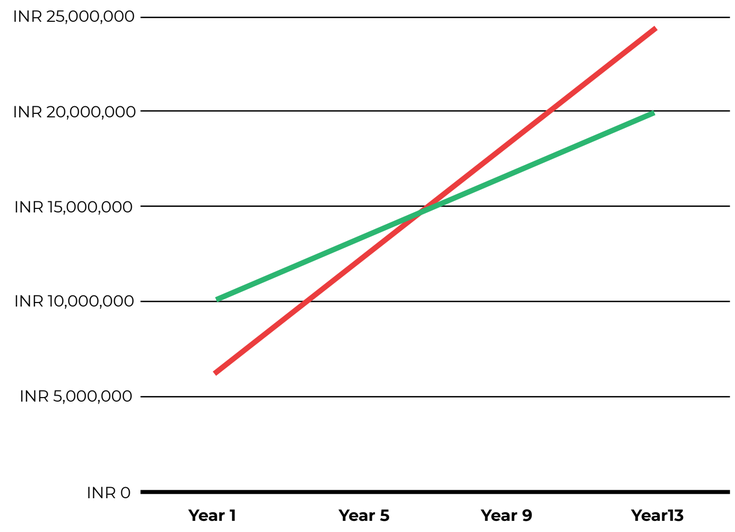
Left: Interior view depicting passive methodology of cross ventilation, daylight and roof insulation and shading that create conditions of thermal comfort and energy efficiency.

Right: Ideal courtyard cluster planning for housing settlements - Circulation from the public to the private is curated. Foyer like conditions at the entrance of each cluster. Shaded semi public spaces for interacting safely while maintaining physical distance. Allows for maximum exterior walls and design of fenestration for cross ventilation.

Case Study - Sustainable Built Environment Breakeven Calculation

Settlement size - 1 Acre / 800 persons	**Life of infrastructure**		**Breakeven Period**
	Current Scenario	Proposed solution	
Built Environment	1 construction cycle** - Including material and labour cost. Excluding maintenance and transportation costs	4 construction cycles (actual 10 cycles) - Including material, labour, maintenance and transportation costs	within 3 construction cycles
Basic Energy for households and street lighting only	1 construction cycle - recurring electricity costs; new electricity connection for each camp/colony	4 construction cycles – One time infrastructure cost; Battery, luminary and fixtures replacement every 8 years, reinstallation every cycle	within 2 construction cycles*
Basic Energy for other utility or recreational only			1 construction cycle*

Inefficient Old Design vs Efficient New Design - Comparison of total accumulated cost for 13 years over various construction cycles

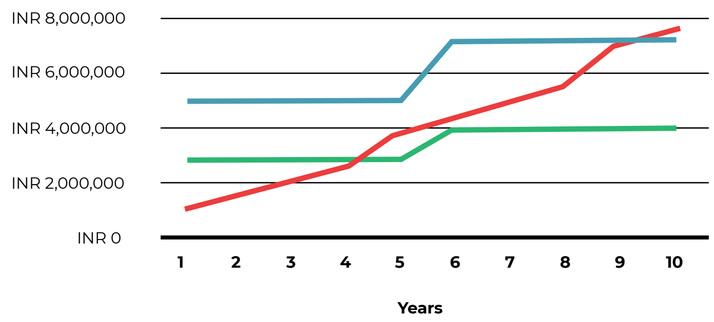


GI Sheet walling with Scaffolding framework with single door and window and concrete base plinth (excluding maintenance and transportation cost)

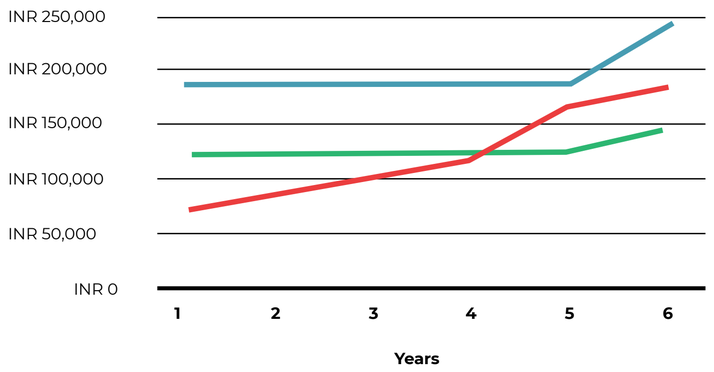
Transitionary (nut-bolt) MS Pipe framework with Bison board walling, one door and two windows with gable clerestory for natural light (including material cost, replacement of sheets and framework, labour and transportation charges)

Case Study - Sustainable Built Environment Breakeven Calculation

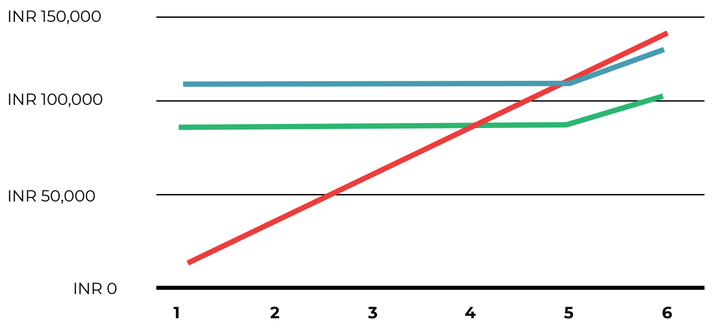
For Housing Units



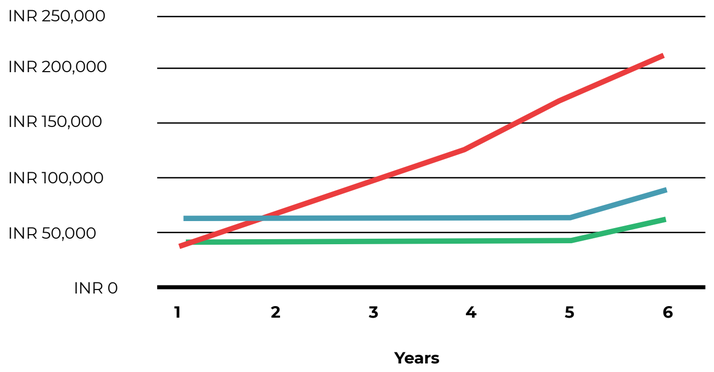
For Kitchen and Dining Units



For WASH Units



For Shops and Other Auxiliary Functions



Grid Cost with Efficient Luminaries and without Sustainable Built Environments

DC Cost with Inefficient Luminaries and with Sustainable Built Environments

DC Cost with Efficient Luminaries and with Sustainable Built Environments

WORKER'S HOUSING, WHITEFIELD
PARTNERED WITH LABOURNET


Solar panels powering the whole colony


Rooms open to the common corridor that connects with the central space

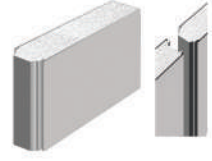

Each room can occupy 4 people comfortably


Optimum storage provided in each room.

MODULE HOUSING FOR 100 WORKER INTEGRATED WITH SUSTAINABLE ENERGY - Case study to outline standardised templates and business models

ENERGY OPTIMIZATION STRATERGIES

- Materials used include insulated aerocon panels and puffed panels for roof. Insulation helps in keeping the space within comfortable range of temperature.



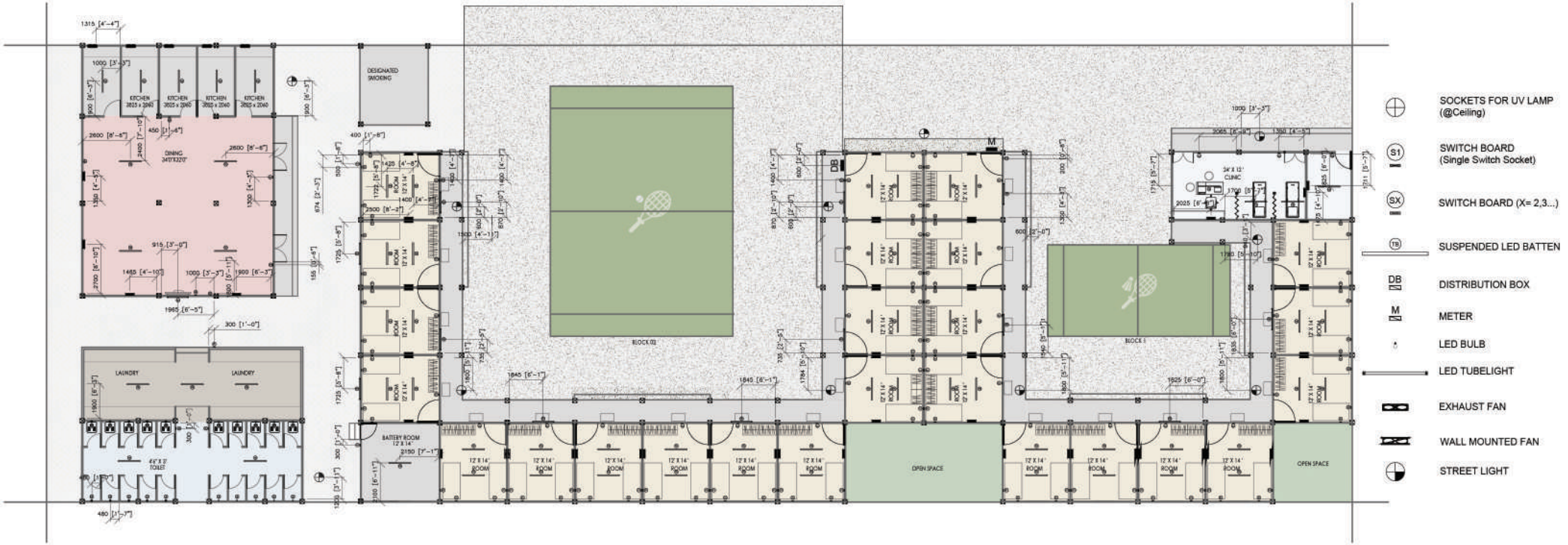
- Solar is used for clean energy and efficient electrical appliances are used.
- Sufficient fenestrations are given and rooms opens towards corridors that reduces the use of atificial lighting and use of fan for ventilation.

Without energy optimizing appliances
52.8 KW/day

With energy optimizing appliances
17.5 KW/day

Saves 66.86% energy per day

WORKER'S HOUSING, WHITEFIELD
PARTNERED WITH LABOURNET

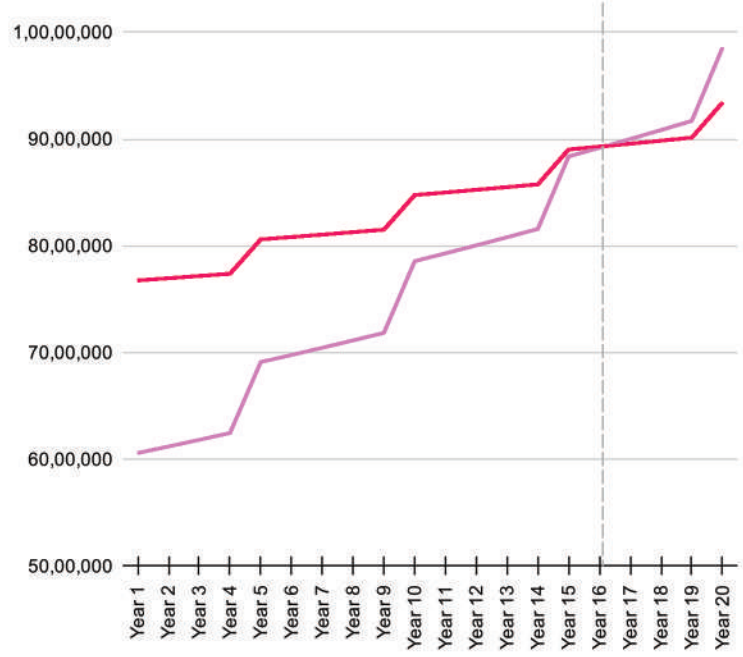


GROUND FLOOR PLAN

ROOMS	LAUNDRY	RECREATION	DINING	WASHROOM	KITCHENS
(4354.3 sq ft)	(525.4 sq ft)	(2012.6 sq ft)	(1118.3 sq ft)	(582.4 sq ft)	(444.6 sq ft)

WORKER'S HOUSING, WHITEFIELD
PARTNERED WITH LABOURNET

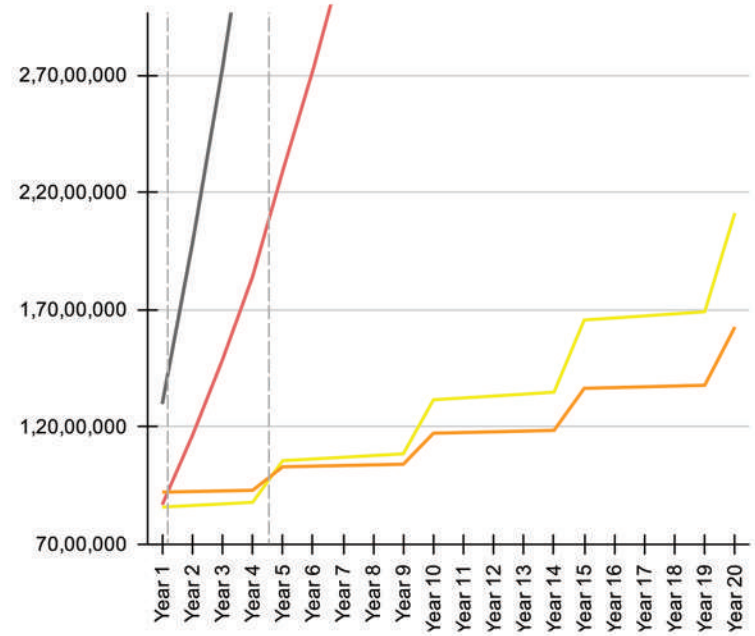
Inefficient Old Design vs Optimum New Design -
Comparison of costs for Built Environment- Breakeven will be acheived at year 16



Business As Usual

Efficient case

Comparison of costs for Energy + Built Environment



Grid cost with inefficient luminaries without BE

Solar cost with inefficient luminaries without BE

DG cost with inefficient luminaries without BE

Solar cost with efficient luminaries with BE

WORKER'S HOUSING, WHITEFIELD
PARTNERED WITH LABOURNET

Re-looking Construction Worker Housing through the lens of COVID -19, Sustainable Energy and Energy Efficiency

Thank You!

For more information please get in touch:

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SELCO FOUNDATION

INDIA - MAY, 2020