

- Case Study Title: Vocational training centre - *Snehadaan*



Project Name	Snehadaan
Location	Carmelaram, Bengaluru, Karnataka, India
Climate Zone	Tropical Savanna Climate/ @RGQ@D: Zone 3A (Warm-Humid)
Latitude/Longitude	12°54'06.3"N 77°43'00.5"E
Building Type	Public/ educational - vocational training centre
Floor Area [sqm]	168 square metres
Building Height [m]	5.40 M
Number of Storeys	1
Completion Year	2018
Project Team	Architects: Rosie Paul, Sridevi Changali and Shubha B A

\*mock-up experiments and other research-based experiments could be included as case study, aside from actual building construction projects if similar information could be provided.

## 1. Project Description

### Project Overview

The project was built to promote an inclusive workshop space for imparting training and mentoring for People Living with HIV (PLHIV). Located in the suburbs of Bengaluru, the project comprises a candle-making workshop with ancillary spaces, including a display unit, a shop, and a seminar hall, envisioned as an inclusive space to showcase the charitable trust's various activities. The building was designed to sit nestled in between the existing trees on the site. A plot of approximately 180 square meters was demarcated within the 40468.6 square

metre property for the centre. The building was constructed within a constrained budget of 20 lakh Indian Rupees ( $\approx$  22,758 USD). The project embodies a simple, clean aesthetic that allows for simple, locally sourced materials.

## 2. Climate & Site Context

Basic Climate Conditions		
Temperature	Annual Average	24°C
	Annual Range	15°C (coolest in January) - 34°C (hottest in April)
Relative Humidity	Annual Average	Around 65%
	Annual Range	45% (March) to 79% (August)
Annual Degree-Days (ASHRAE Standard 169-2020)		HDD18°C: Relatively low, typically under 200 Heating Degree Days CDD10°C: Significant, over 1000 Cooling Degree Days
Climate Analysis		
<p>Bengaluru has a tropical savanna climate with moderate to high humidity, warm year-round temperatures, and a pronounced monsoon that brings rain and higher humidity between June and September. The weather demands passive cooling techniques due to the substantial diurnal temperature range and consistent outdoor airflow. This climate calls for design strategies addressing both heat gain mitigation and humidity control. Hence, the design utilises the comfort of Bengaluru's climate through thermal mass for passive cooling, natural daylighting, and ventilation, and to reduce energy demand.</p>		
Site Analysis		
<p>Snehadaan is situated on a 40468.6 square metre green property, densely planted and surrounded by trees. The built space was conceptualised to preserve all the trees on the site with open courts and shared areas weaving around natural vegetation. The site's topography and green cover support drainage, enhance microclimate comfort, and provide natural shading. It is situated in a low-density suburb of Bengaluru's urban fabric, benefiting from cross-breeze.</p>		

Passive Cooling Strategies (please tick implemented passive cooling strategies)
<input checked="" type="checkbox"/> Building Orientation & Form (site orientation, building shape, etc.) <input checked="" type="checkbox"/> Envelope Design (insulation, air-tightness, shading, window system, thermal mass, etc.) <input checked="" type="checkbox"/> Natural Ventilation (cross ventilation, stack ventilation, night ventilation, etc.) <input type="checkbox"/> Evaporative Cooling (direct/indirect evaporative cooling, etc.) <input type="checkbox"/> Ground Cooling (geothermal, ground-coupled systems, basement/underground space, etc.)

- Radiative Cooling (cool roof, night sky radiation, radiant barriers, reflective surfaces, etc.)
- Nature-based Solutions (green roof/wall, tree shading, etc.)
- Others (human behavior, clothing, semi-passive (fans, etc.))

Description (please describe one strategy per box – you can add more boxes below if needed)

**Building Orientation and Form (Respecting the site contours and tree cover)**

Snehadaan’s building orientation and form have been thoughtfully designed to respond to its site characteristics, its user community and climate. The campus spans 40468.6 square metres, yet a small portion has been chosen for this vocational centre, centred around a large tree. The tree defines the spatial and visual core, ensuring no trees are cut during construction. The primary unit (workshop space) is oriented along the East-West axis to optimise natural daylight. This orientation maximises natural light and reduces heat gain. The building is a modest L-shape, compact and simple in volume, with minimal footprint. The building's layout provides easy wheelchair access to all spaces and integrates an external verandah that connects them, promoting airflow and circulation while creating shaded transitional zones. The building's positioning and form respect the contours and vegetation, while promoting natural ventilation and daylight, forming the backbone of the project’s passive design strategy.

**Envelope Design (CSEB: thermal mass, shading, minimal openings on harsh exposures):**

The envelope of Snehadaan artfully balances thermal performance, privacy and affordability. It uses Compressed Stabilised Earth Blocks (CSEB) made from on-site sourced Earth, substantially reducing raw material costs while providing high thermal mass for temperature moderation. Narrow openings, only 2 feet wide, maintain occupant privacy and limit solar heat gain. Louvres extend continuously from the lower wall to the roof level to facilitate stack-effect ventilation, promoting airflow while visually shielding users. A large clerestory with fixed glass has been incorporated on the north and east facades, bringing in natural light deep inside without compromising privacy or thermal comfort. The simple, climate-responsive envelope showcases how material and form can serve multiple needs effectively.

**Natural Ventilation (cross and stack ventilation):**

Snehadaan optimises natural ventilation through an appropriate combination of linear louvred windows and strategically placed openings that utilise cross- and stack-ventilation. The continuous vertical louvres made of repurposed pine crate wood span the height of the walls, allowing air to enter at lower levels and exit near the roof through Clerestory windows, creating a strong stack effect that draws warm air out. The building's L-shaped layout facilitates cross-ventilation, with openings strategically placed along primary wind-flow directions and on the external walls to promote cross-ventilation within the rooms. The ventilation design benefits from the site’s location and the preserved tree canopy, which cools incoming air. The design maintains thermal comfort without dependence on heavy mechanical cooling. The high openings also enhance visual connection with the green canopy outside. In conclusion, the ventilation strategy promotes user comfort and supports occupant dignity.

**Nature-based solutions (retained tree canopy for shading, green buffer)**

Nature plays a central role in cooling Snehadaan by preserving and integrating pre-existing tree canopies, which provide extensive shading for building surfaces and outdoor spaces. The

site's large trees create a cool microclimate by intercepting solar radiation, lowering the interior air temperature, thus moderating heat stress for the building and its users. Vegetative buffers also improve air quality and reduce noise, supporting a tranquil environment. Filtered daylight and shaded transitions through courtyard and verandah spaces seamlessly blend indoor and outdoor spaces.

### 3. Passive Cooling Design Details 4. Active Components

#### Active (Hybrid) Cooling Strategies

(please describe one strategy per box – you can add more boxes below if needed)

The building's strategic orientation, design, and form eliminate the need for air conditioning. During the peak summer season, when temperatures reach 33°C, conventional ceiling fans are occasionally used as a semi-passive system to achieve optimal air circulation within the interior spaces. Snehadaan, a charitable organisation, works with the recognition of financial resources; hence, the building was conceived to minimise expenditure on resource use.

### 5. Performance Data

#### Cooling Energy Use

The building does not use mechanical cooling; instead, passive cooling strategies maintain thermal comfort, eliminating the need for air conditioning. Hence, the building achieves a near-zero cooling energy use.

#### Indoor Thermal Comfort

The feedback from occupants indicates that the centre achieves comfortable interior conditions with minimal reliance on artificial lighting and ventilation systems, thereby contributing to a sustainable, energy-efficient environment.

### 6. Financial Data

#### Cost Benefits

The conscious selection and use of local materials significantly influence thermal comfort and humidity regulation, particularly using earth-based elements. Furthermore, strategically placed windows enhance natural light and ventilation, thereby improving the overall living environment. It is essential to consider the orientation and position of trees relative to the building, as their removal could inadvertently increase radiant heating, affecting indoor temperature control. By harmonising these factors, the operational costs were reduced substantially.

\*Please try to extract passive cooling cost and savings; however, if it is difficult, please annotate the premise. (e.g., the calculation includes the cost for both passive heating and cooling, etc.)

## 7. Passive Cooling Operation

### Maintenance Requirement

Maintenance is minimal, with periodic cleaning and basic upkeep of fans. The building does not require any specialised maintenance, thus supporting long-term sustainability and affordability.

## 8. Lesson Learnt / Recommendations

### Technical Challenges, Solutions and Achievement

The project has been devised with three verticals in mind: optimal working conditions, privacy for the user community —an essential part of the client brief — and efficient resource use with a minimal building footprint. The site's tree guided the working layout; this approach helped the design focus on creating a comfortable microclimate. The earthen walls, paired with linear vertical louvred windows, provide ventilation and a safe environment for the users (PLHIV).

### Financial Challenges, Solutions and Achievement

The project's budget was limited, necessitating the adoption of cost-effective strategies. Consequently, the utilisation of in-situ materials and locally sourced resources. The approach included repurposing wood, engaging local labour, and applying minimal building finishes. The community played an active role in the construction process, significantly reducing costs by using local workers and materials.

### Other Challenges, Solutions and Achievement

The project employed local labour and utilised on-site-sourced materials, specifically soil. Furthermore, windows will be produced on-site to ensure quality and meet project specifications within the budget.

## 9. Free Description

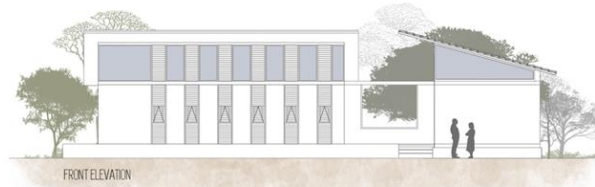
### Free Description

- **Replicability:** The use of earth as a material is universally accessible, enabling the production of blocks with local machinery and facilitating ease of replication.
- The implementation of skilled design and meticulous window sizing effectively addressed the project requirements.
- Additionally, by utilising existing on-site trees rather than removing them, the building is nestled among the trees to provide natural shade, thereby helping cool the environment.
- The use of modular units helps control the budget and construction process. The workshop unit (larger wing) of the centre is an expanded model of the smaller two units, housing the reception and the conference room. Thus, modularity with grounded building materials amplified its scalability and replicability.

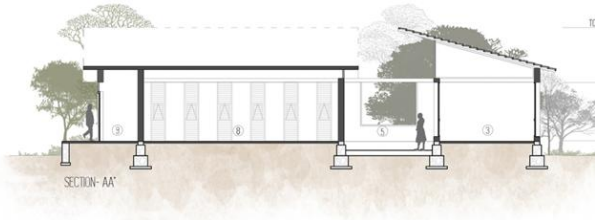
## 10. Annex

Supporting documentations

## SNEHADAAN



FRONT ELEVATION



SECTION- AA'

TOP OF SLOPING ROOF  
LEVEL LEVEL  
PLANT LEVEL  
GROUND LEVEL

- LEGEND
- 3 Display area
  - 5 Courtyard
  - 8 Candle making workshop
  - 9 Toilets



## SNEHADAAN

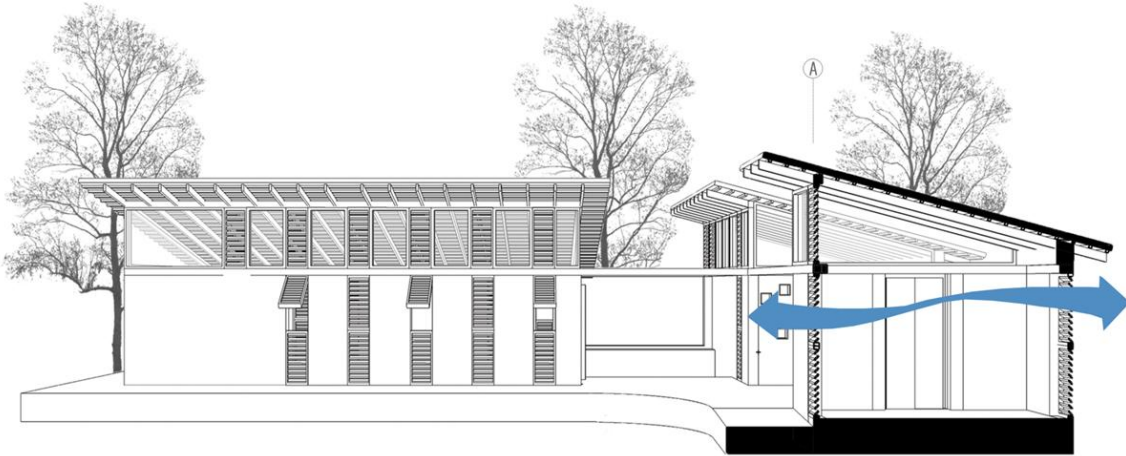
TOTAL BUILT UP – 168 SQ.M  
CONSTRUCTION COST – \$135 per SQ.M

- LEGEND
- 1 Multipurpose hall
  - 2 Entrance verandah
  - 3 Display area
  - 4 Store
  - 5 Courtyard
  - 6 Passage
  - 7 Verandah
  - 8 Candle making workshop
  - 9 Toilets



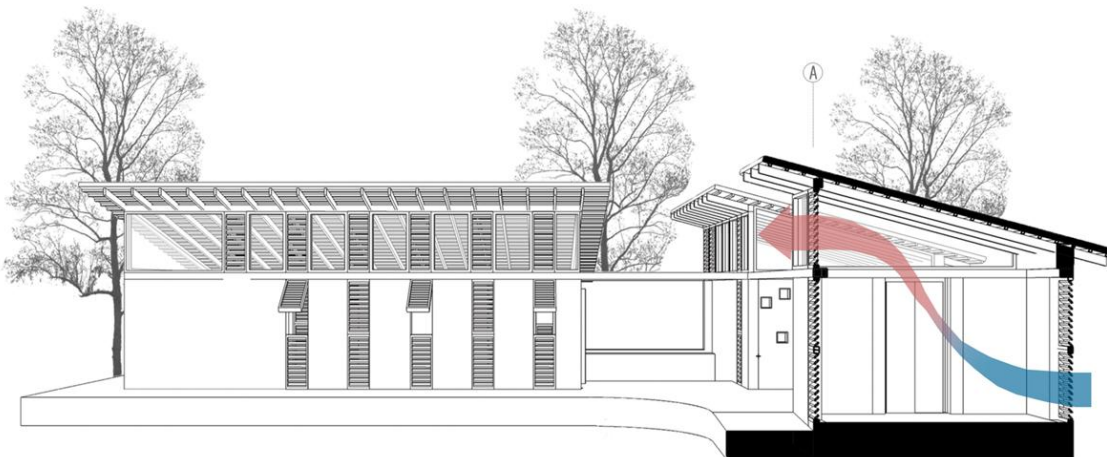
## SNEHADAAN

CROSSVENTILATION



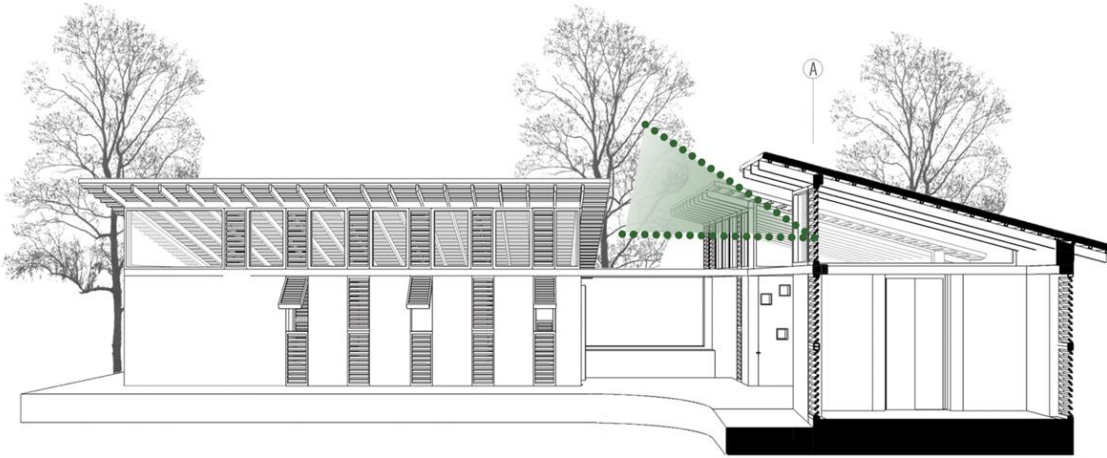
## SNEHADAAN

STACK EFFECT

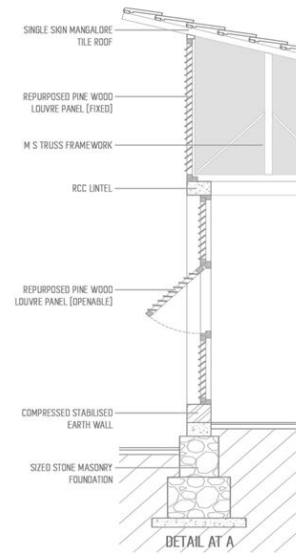


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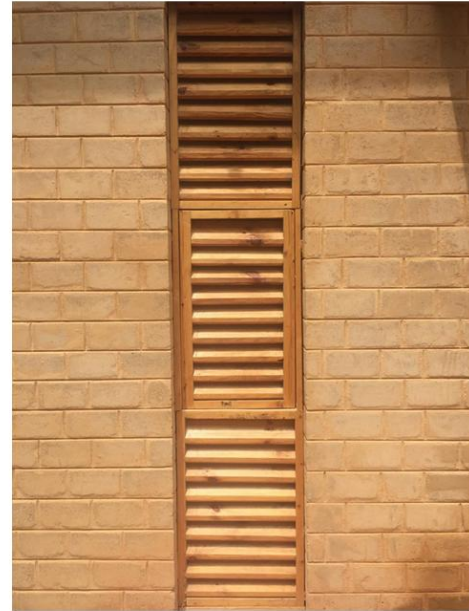
VISUAL CONNECTION



# SNEHADAAN



SNEHADAAN



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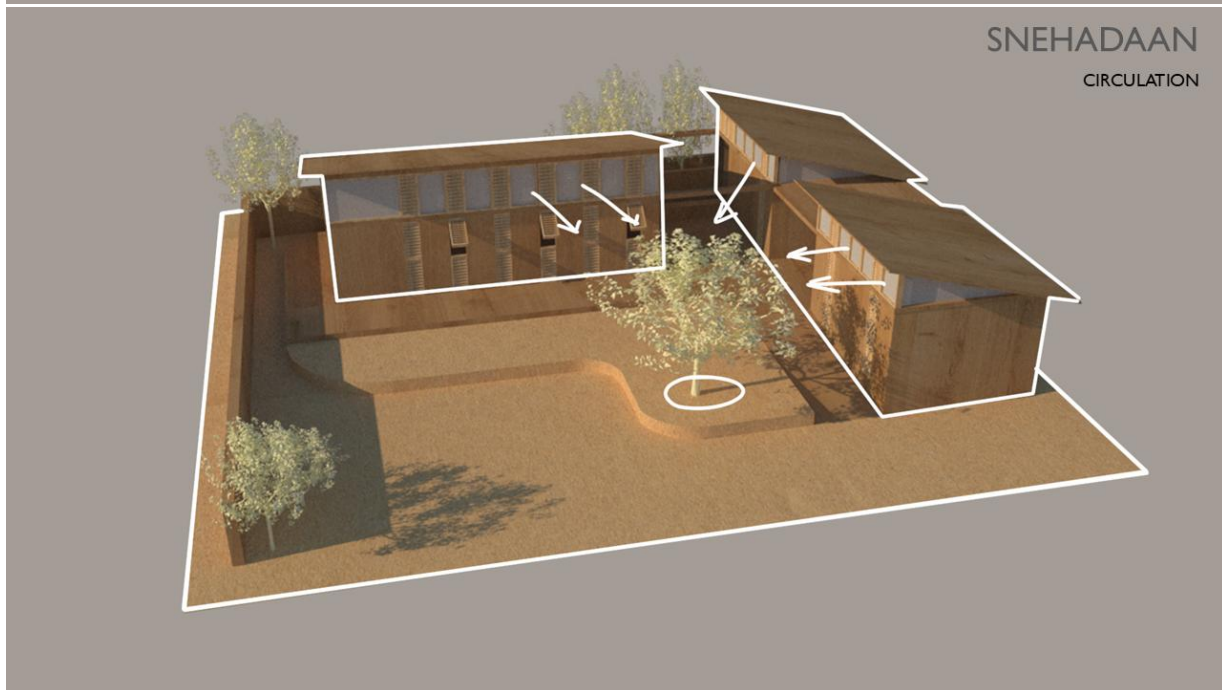
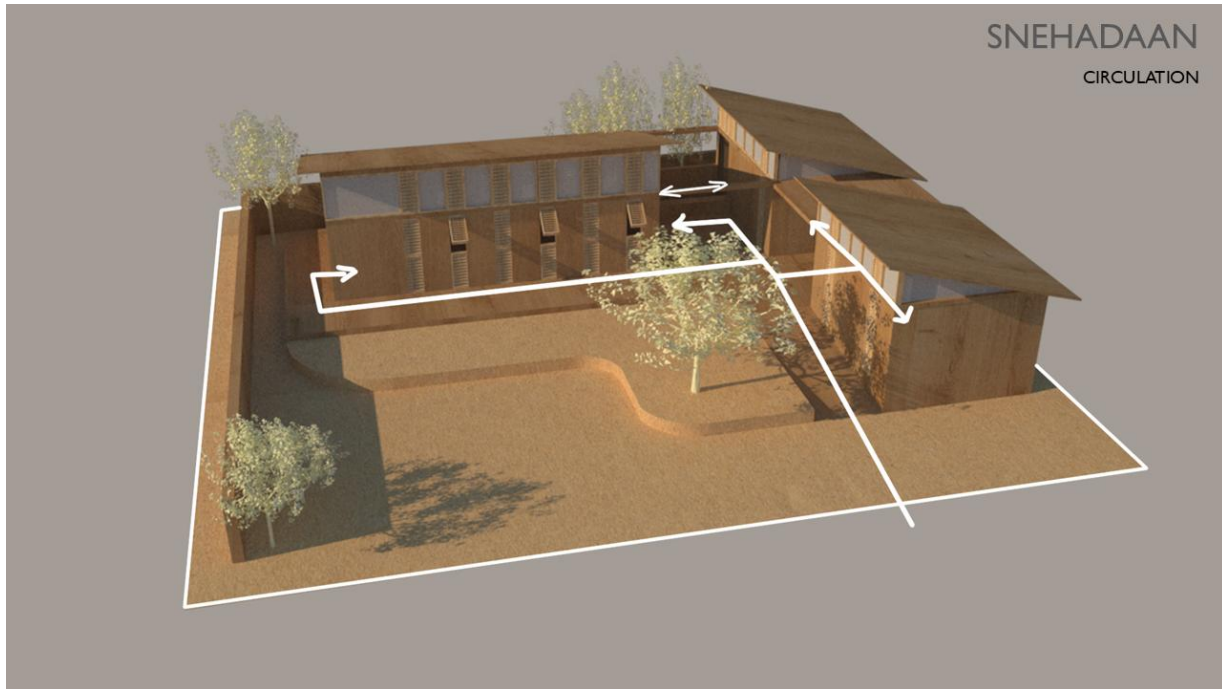


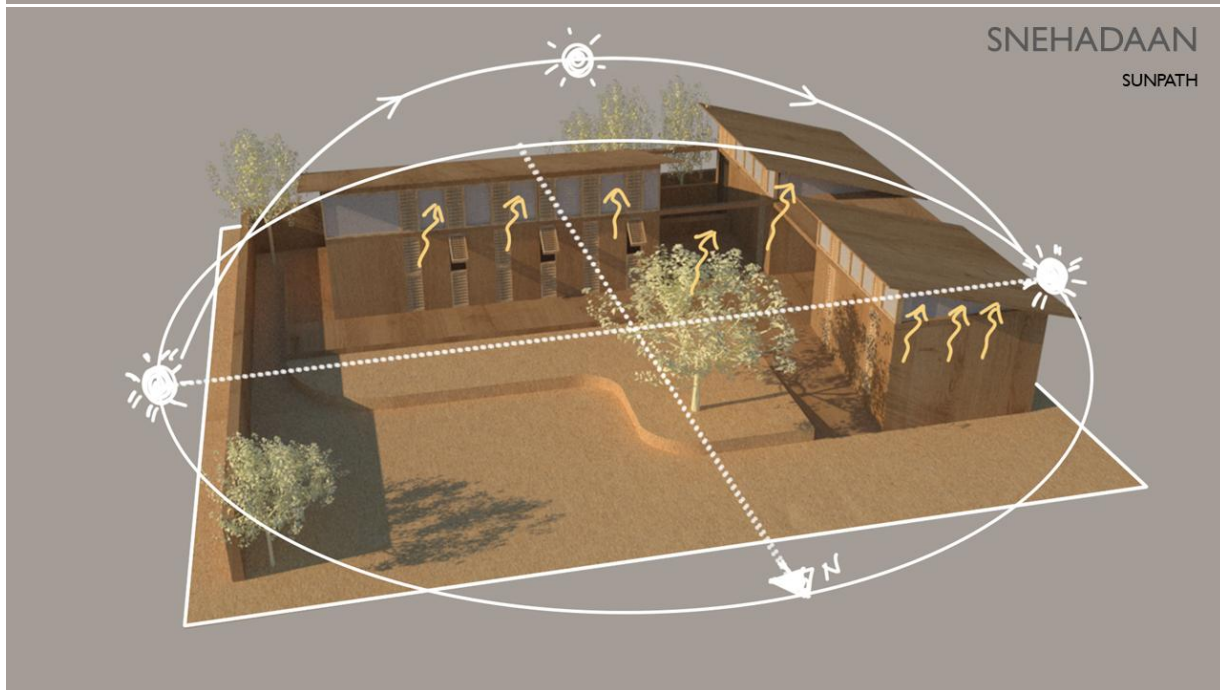
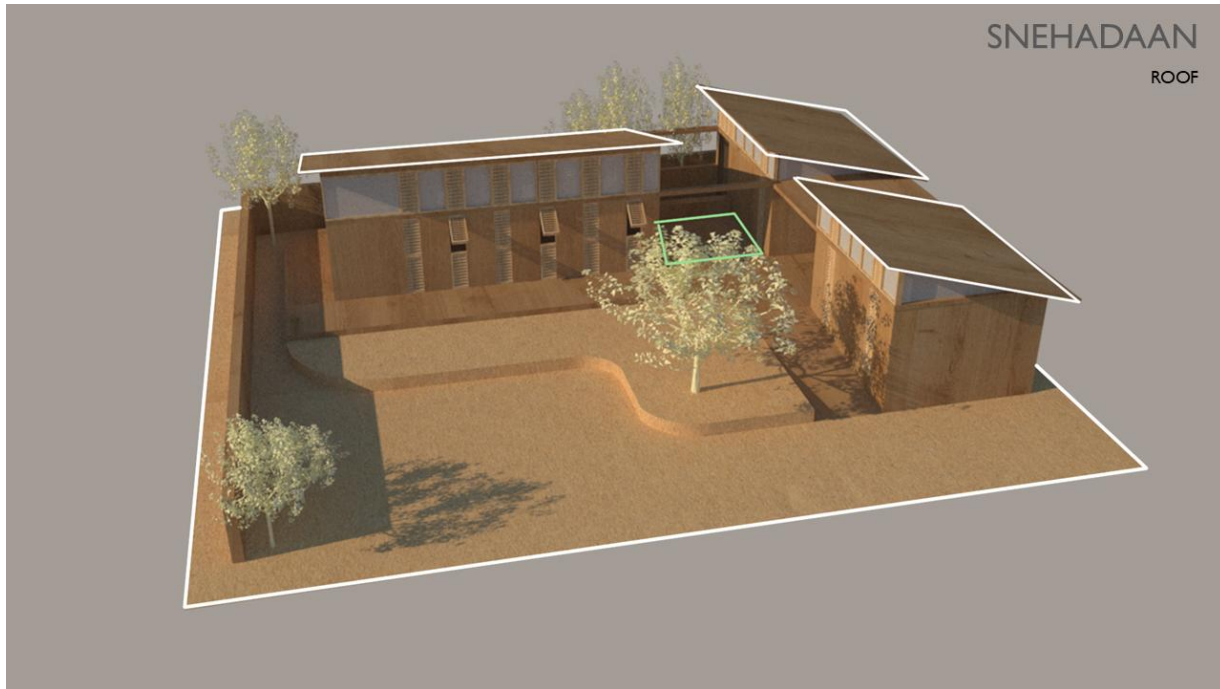
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## 11. Citation

### Citation

1. <https://www.ashrae.org/technical-resources/standards-and-guidelines>
2. [https://openei.org/wiki/ASHRAE Climate Zones](https://openei.org/wiki/ASHRAE_Climate_Zones)
3. <https://www.materiaaward.com/en/portfolio-item/snehadaan-professional-training-center/>
4. <https://www.masonsinkstudio.com/snehadaan.html>

5. Paul, R., & Changali, S. (2019, July 24–26). A study of the socio-economic, cultural and environmental impact of the use of unconventional building materials in conventional building typologies. Paper presented at the 18th International Conference on Non-Conventional Materials and Technologies (18th NOCMAT 2019), Nairobi, Kenya.

## 12. Contact

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