

# Staff Housing for Twin Streams Environmental Education Centre-Mtunzini

Residential Project  
Kwa-zulu Natal South Africa  
July 2004



# Introduction

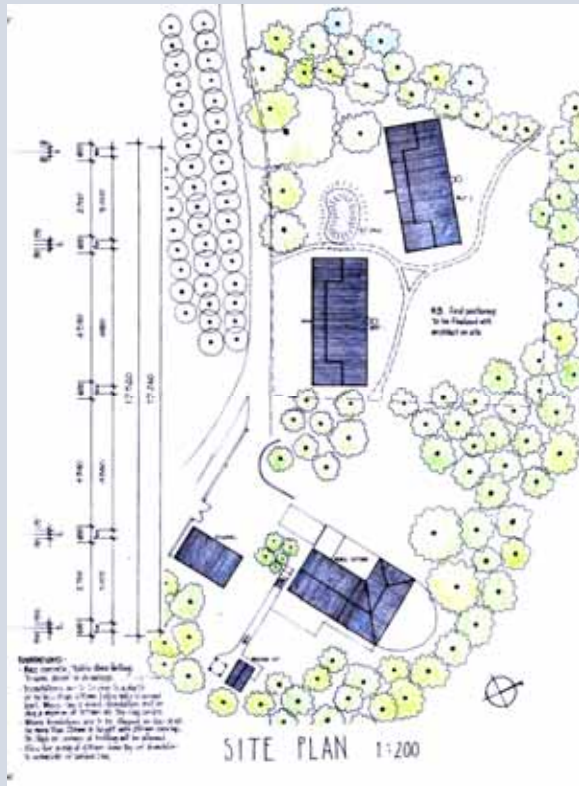
## CLIENT BRIEF:

- Design 2 semi-detached accommodation units.
- Design should accommodate comfortable bachelor apartments with bathrooms and kitchenettes
- To serve as both staff accommodation and as an education tool to demonstrate sustainable living.

## DESIGN TEAM'S PROJECT OBJECTIVES:

- **Simplicity:** the concept must be simple, relative low technology and easy replicable
- **Appropriate:** the methodology must suit the area.
- **Adaptable:** the system must be flexible in order to facilitate different conditions.
- **Job creation:** local unskilled labor can be employed.
- **Educational:** both the process and the finished product must create opportunities to demonstrate alternative or improved methods of construction.
- **Maximize use of natural, locally sourced materials:** reduce environmental impact by eliminating associated transportation and high levels of embodied energy while supporting local economy.
- **Community development:** improved construction methods result in better housing. Better housing creates a healthier community. monies that go into the development should be spent within the local community and area as much as possible.
- **Business development:** identify opportunities for established micro-enterprises.
- **Skills transfer:** local builders can learn better building practices that will result in safer, more durable housing. Labor-based practices rather than machine-based.

# Context



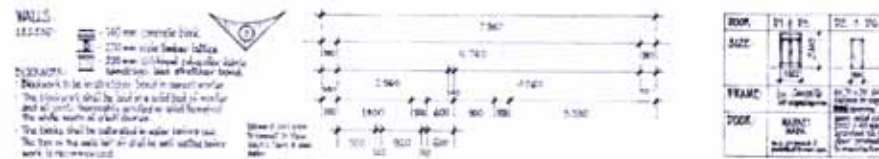
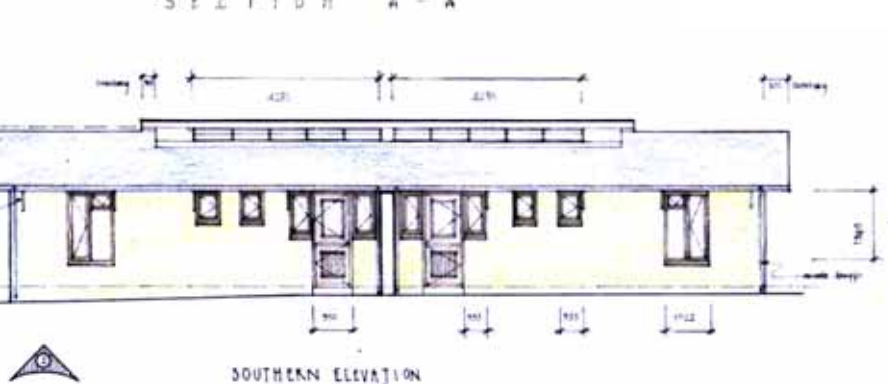
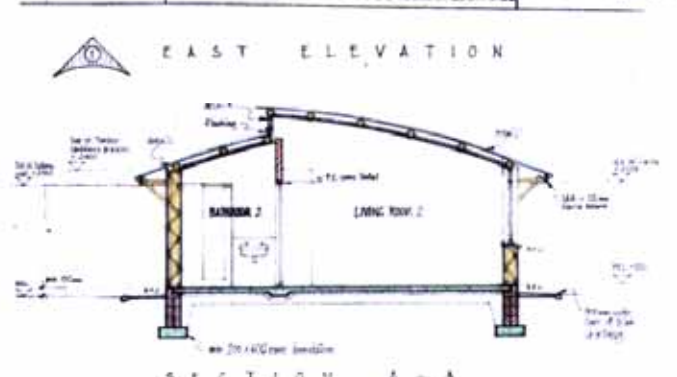
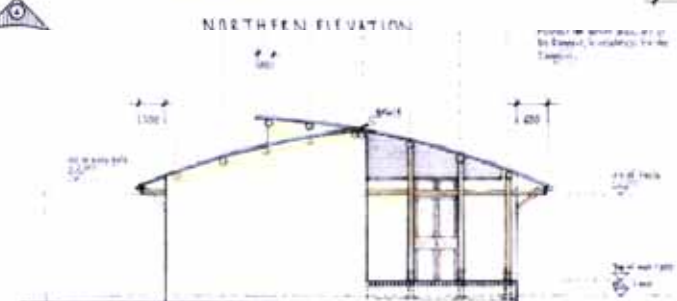
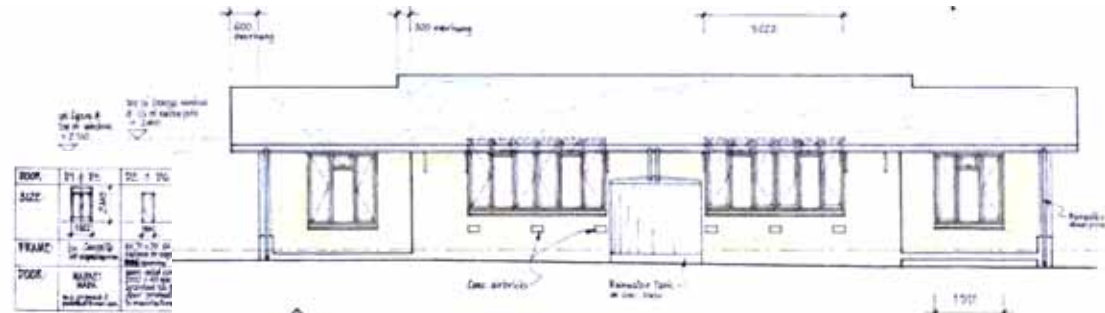
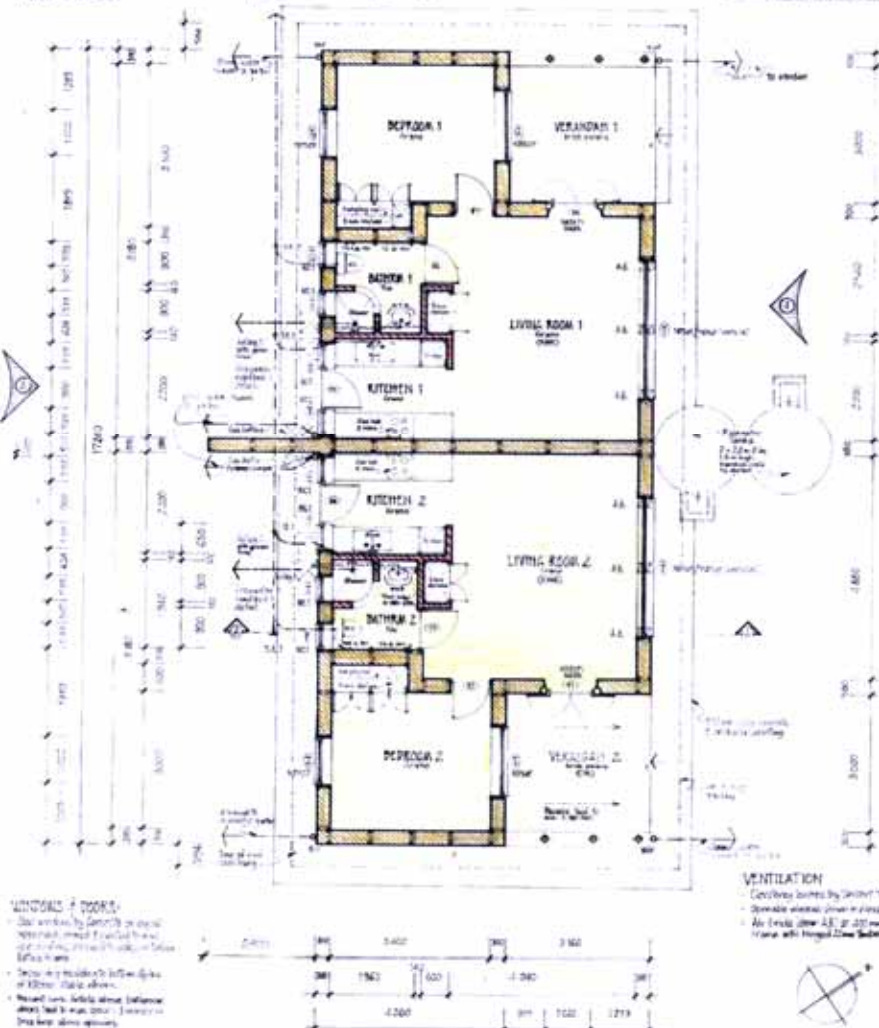
- Located in dune coastal forest area in Northern Kwa-Zulu Natal.
- Situated to side of approach road to existing staff accommodation
- The climate is hot and humid.
- The need to provide good cross ventilation within the building.
- Locally abundant natural building material – sand and timber poles.

# Drawings

**WALLS**  
12.2.2020

240 mm concrete block  
230 mm brick (outside) / 230 mm brick (inside) / 100 mm brick (interior) / 100 mm brick (interior)  
Specifications: best available  
Workwork to be in situ. Detail in section. If the brickwork is to be used in a wall that is over 2m high, the bricks should be laid on a solid base of concrete and all joints, horizontally and vertically, to be staggered. The bricks shall be laid in a water balance cut. The joints in the walls shall be laid with better work to be recommended.

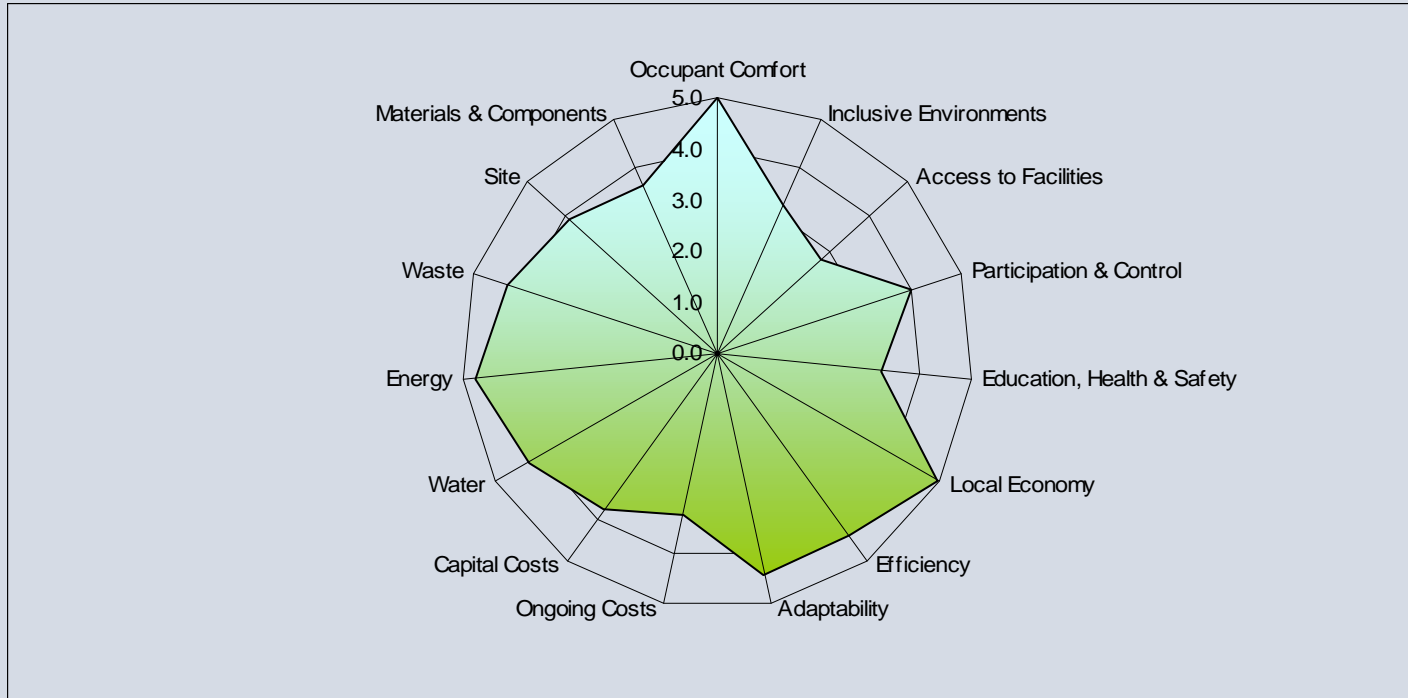
Slab of concrete  
Thickness: 100 mm  
Reinforcement: 4 bars @ 100 mm

# Photographs



# Overall Performance



Overall 4.0

Social 3.6

Economic 4.2

Environmental 4.2

# Social Performance

Social Performance	Social 3.6
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Aspects	Evidence of high performance
<p>1) <b>Educational:</b></p> <ul style="list-style-type: none"> <li>- On site training and education provided to unskilled construction workers.</li> <li>- Local schools and community involvement in building with sand bags</li> <li>- Visible energy and water saving features for showcasing.</li> </ul> <p>2) <b>Local empowerment:</b></p> <ul style="list-style-type: none"> <li>- On site non-toxic treatment of timber poles and saplings felled locally.</li> <li>- Pre- assembly of timber ladders.</li> <li>- Making bamboo rainwater harvesting goods from locally available material.</li> <li>- Sewing and filling of sand bags by local community.</li> </ul> <p>3) <b>User Comfort:</b></p> <ul style="list-style-type: none"> <li>- Sandbag walls provide excellent thermal and acoustic properties.</li> <li>- Openings and design provide for good cross ventilation essential to the hot semi tropical humid climate.</li> <li>- High levels of natural light.</li> <li>- All materials and finishes were specified so as to avoid indoor air pollution.</li> </ul>	<p>1) <b>Environmental Education Showcase:</b></p> <ul style="list-style-type: none"> <li>- Educational asset to Twin Streams Environmental Education Centre.</li> <li>- Has generated much interest within the local community – now dubbed the “Mtunzini eco house.”</li> <li>-Local schools participated in the actual building process – helping to pack and carry some of the sandbags used for the walls.</li> </ul> <p>2) <b>Community Involvement:</b></p> <ul style="list-style-type: none"> <li>-Inclusive labor procurement process – a local community with one of the highest unemployment levels was targeted for job creation.</li> <li>-Micro-enterprise development - sandbag and timber ladders and rainwater tanks being made up by the local community.</li> <li>- The majority of the bulk material was gathered from in and around the site while conventional construction imports most of their bulk material and pre-manufactured component’s with sparse benefit or inclusion for local communities.</li> </ul> <p>3) <b>User Friendly:</b></p> <ul style="list-style-type: none"> <li>-Resources for empirical testing are not available, however excellent thermal and acoustic performance has been confirmed with feedback from users and visits to other sandbag buildings.</li> <li>-Cross ventilation combined with the uplifting effect of a curved roof with stack venting through the clerestory louvers. This ensures good natural ventilation.</li> <li>-The user has manual control of all clerestory louvers, opening windows and air vents.</li> <li>-Good indoor air quality assured through the use of non-toxic materials and finishes as well as good ventilation.</li> </ul>

# Economic Performance

Economic Performance	Economic 4.2
Aspects	Evidence of high performance
<p>1) <b>Local Economy</b>            Maximising local economic benefit with a labour based building system.</p> <p>2) <b>Empowerment</b>            Using local resources in simple ways.</p> <p>3) <b>Building Costs:</b>  <i>Conventional local building costs</i>            – R2 600 per sq. m. for simple design with plastered concrete block            – R3 650 per sq m. for a face brick house  <i>Final built cost - R250 000</i></p> <ul style="list-style-type: none"> <li>• 74 sq m of interior space,</li> <li>• 21 sq m of covered external space</li> <li>• 127 sq m. total coverage built</li> </ul> <p>4) <b>Running costs:</b>            Solar water heating systems, energy efficiency and water wise building practice.</p>	<p>1) <b>Economic self empowerment supports local community economy</b>            - Training and income generating micro-enterprises established.            - Approximately 30 additional jobs or double the amount, were created due to the nature of the construction process.</p> <p>2) <b>The use of most local materials and resources</b> – sand, timber poles and labour – achieved with the development of a sandbag building system.            – The pole roofing structure utilized timbers grown in the local area which were cut and treated on-site with a non-toxic treatment process. This has benefited the local communities economy and stimulated a potential new market within the local region.            – The sewing and filling of the sand bags has created additional work within the local community.            – The guttering and rainwater tank systems utilize locally grown bamboo and provide further jobs and empowerment potential. They actively promote a way towards self reliance within an area of cronic economic and water shortage.</p> <p>3) <b>Reduced Building Costs:</b>            This project has sucessfully reduced its costs while providing additional jobs and improved quality with greater economic sustainability:            – <u>R2 360 per sq m.</u> excluding a further 36% of covered external space. Or <u>R1969 per sq m</u> including the verandah. This cost is with solar water heating installed though the rainwater tanks and photovoltaic panels are still to follow.</p> <p>4) <b>Low running costs</b>            – Solar water heating and energy efficient lighting together with good thermal performance helps minimize running costs to WESSA which runs and pays for the centre.            – A waterless composting toilet, water efficient fittings and greywater recycling and rainwater collection ensures minimal water costs and provides resources out of waste.</p>



# Environmental Performance

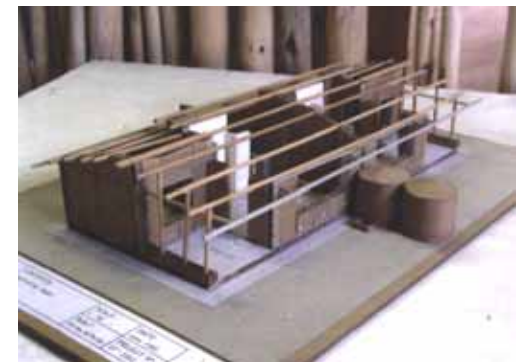
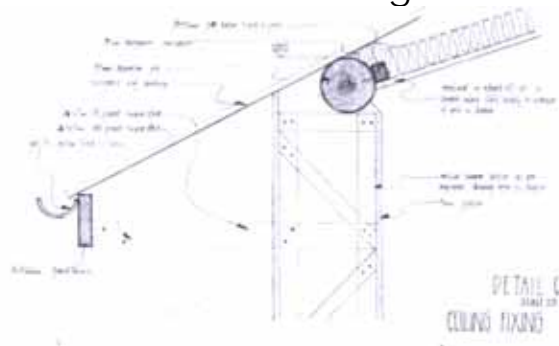
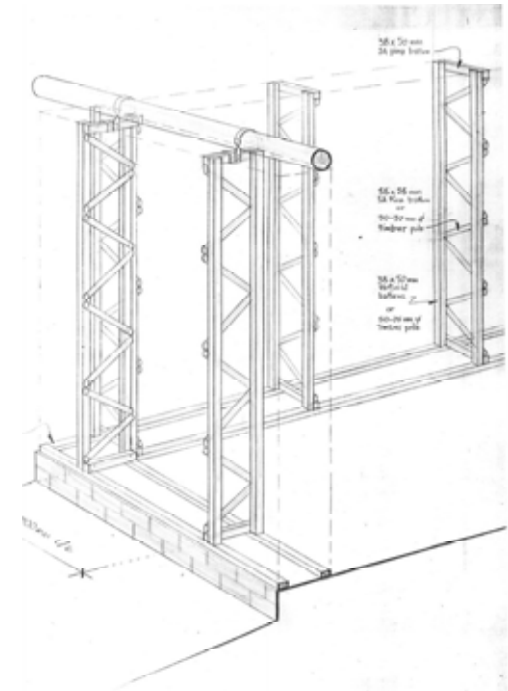
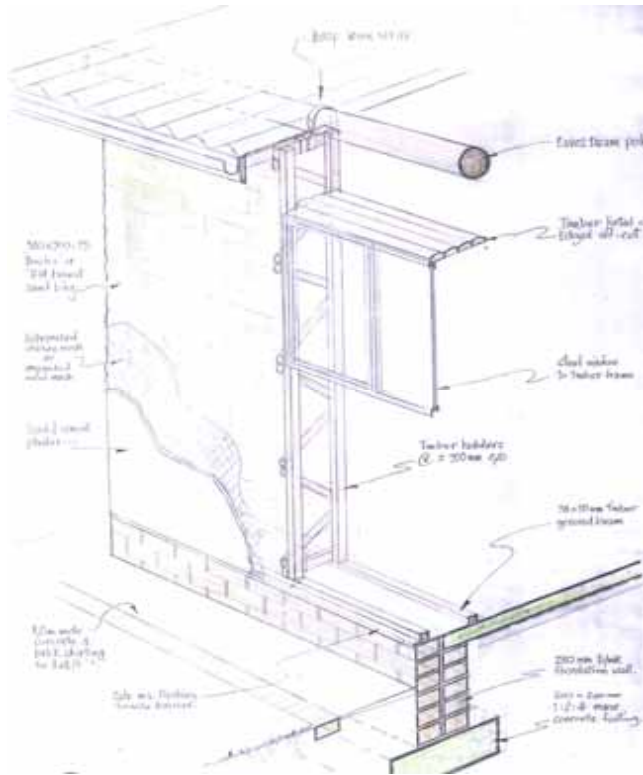
Environmental Performance	Environmental 4.2
<b>Aspects</b>	<b>Evidence of high performance</b>
<p><b>Renewable &amp; Efficient Energy</b></p> <ol style="list-style-type: none"> <li>1) Solar water heating.</li> <li>2) Photo-voltaic panel with energy efficient lighting.</li> <li>3) Natural lighting and ventilation.</li> <li>4) Very low embodied energy.</li> </ol> <p><b>Water Conservation</b></p> <ol style="list-style-type: none"> <li>5) Waterless composting toilet (enviro-loos by Enviro Options).</li> <li>6) Rainwater collection and greywater recycling.</li> <li>7) water efficient appliances i.e. tap aerators and water efficient showers.</li> </ol> <p><b>Healthy building:</b></p> <ol style="list-style-type: none"> <li>8) Non-toxic finishes &amp; timber preservatives.</li> <li>9) High level of natural light &amp; Thermal comfort.</li> </ol>	<p><b>ENERGY</b></p> <ol style="list-style-type: none"> <li>1) It is well documented that solar water heaters will typically save 50-60% of a household's electrical bill.</li> <li>2) All lighting typically accounts for approx. 11% of a household's energy use.</li> <li>3) The plan allows for excellent good cross ventilation and natural ventilation. The curved shape of the roof creates uplift which encourage airflow together with a natural stack effect through glass openable louvered clerestory windows. In addition these enhance the levels of natural light.</li> <li>4) Embodied Energy is said to account for 30 years of a building's energy cycle with this building having used a fraction of this.</li> </ol> <p><b>WATER</b></p> <ol style="list-style-type: none"> <li>5) Toilet flushing typically accounts for a third of a households water use.</li> <li>6) Garden water is said to account for 35% of a household's water use, which is covered by the rainwater tanks and the greywater reuse.</li> <li>7) The water efficient shower's, use 11-12 Litres a minute compared to 20-22 litres per minute typically consumed. Tap aerators cut flow by 50%</li> </ol> <p><b>HEALTH</b></p> <ol style="list-style-type: none"> <li>8) Safty data sheets confirm non-toxicity of finishes and preservatives specified.</li> <li>9) The design way exceeds the typical performance of standard concrete block and concrete roof tile with flat ceilings typical to Mtunzini.</li> </ol>

# Creating a new sand-bag building system

## Promoting micro enterprise / socio- economic development

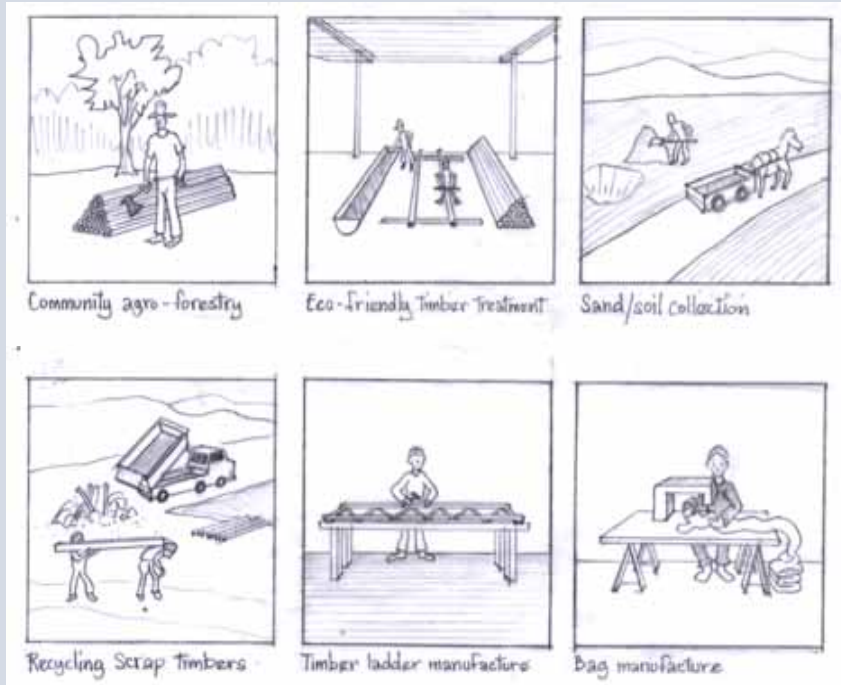
Use of local natural material to maximize the empowerment of community:

- Developed design utilizing available local material i.e. sand & timber poles
- Adapted an existing sand bag system to eliminate prefabricated metal ladders for timber ladders made from recycled timbers and locally harvested saplings.
- Test wall structure built in offices of Eco Design.
- 1:50 scale model was built to facilitate community involvement.
- A sand bag building manual was produced to assist in training.

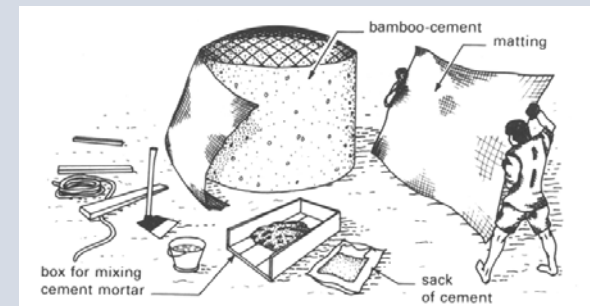


# Involving Community

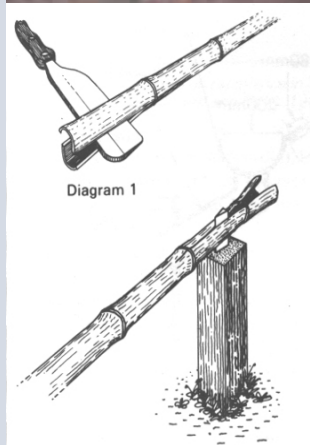
## Micro-enterprise development with use of local material



- Harvesting timber poles
- Treating timber with non-toxic timber preservative.
- Collecting sand
- Salvaging small dimensioned timbers
- Timber ladder manufacture
- Bag manufacture
- Bamboo rainwater goods production.



# A showcase for environmental sustainability



## Renewable & Efficient Energy

- Solar water heating (Solar dome)
- Photo-voltaic panel
- Energy efficient lighting
- Natural lighting and ventilation
- Very low embodied energy

## Water Conservation

- Waterless composting toilet (enviro-loos by Enviro Options)
- Rainwater collection – using a bamboo guttering system and home made bamboo-crete tanks.
- Greywater recycling – reed beds.
- water efficient appliances i.e. tap aerators and water efficient showers.

## Healthy building:

- Non-toxic finishes & timber preservatives
- High level of natural light
- Thermal comfort

# Team & Contact Details

## **Eco Design**

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