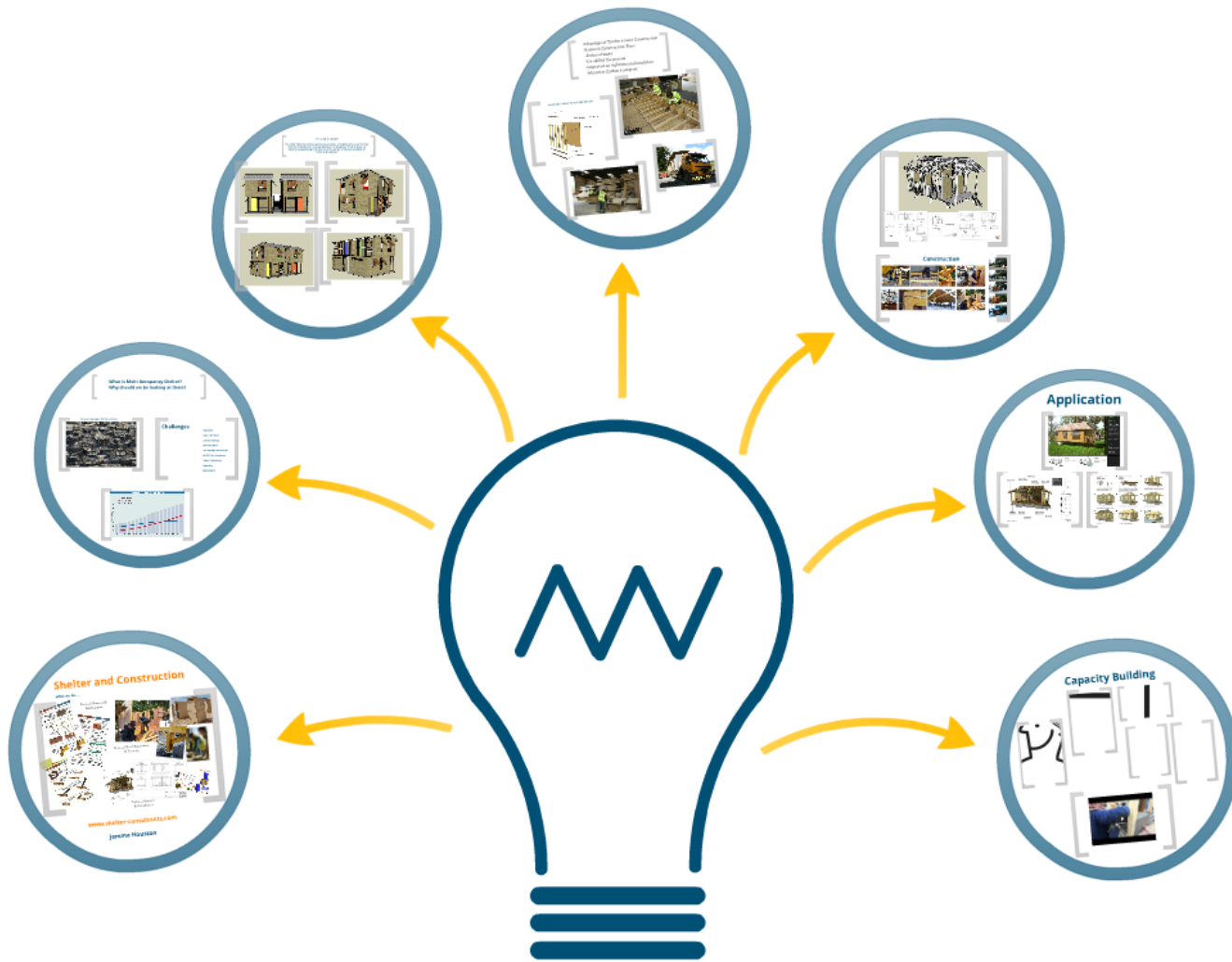


Multi Occupancy Shelter

Shelter and Construction

OXFORD
BROOKES
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building trust
international



Multi Occupancy Shelter

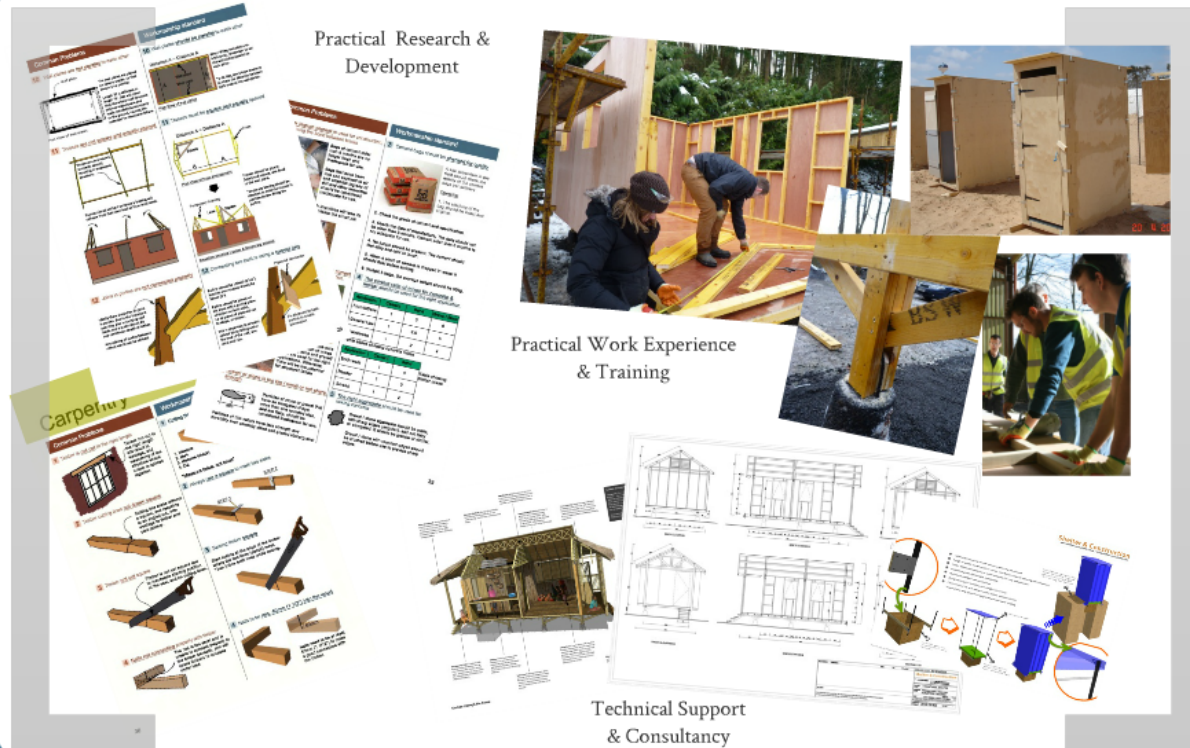
Shelter and Construction

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BROOKES
UNIVERSITY

building trust
international

Shelter and Construction

What we do.....



www.shelter-consultants.com

Jemma Houston

What we do.....

Practical Research & Development

Common Problems

10. **Wall plates are not parallel to each other**

The wall plates are placed on uneven ground, or the length of the wall plates is not correct.

11. **Trusses are not square and equally spaced**

Trusses are not square, or the spacing between them is not correct.

12. **Joints in rafters are not connected properly**

Many rafters should be connected to the wall plate, and the joints should be properly connected.

Workmanship standard

10. **Wall plates should be parallel to each other**

Distance A = Distance B

11. **Trusses must be square and equally spaced**

Distance A = Distance B

12. **Connecting two rafters using a correct joint**

Use a correct joint to connect two rafters.

Common Problems

1. **Concrete cement is used for construction**

2. **Check the grade of cement and specification**

3. **Concrete bags should be checked for quality**

4. **No lumps should be present**

5. **When a pinch of cement is dropped in water**

6. **The correct ratio of mixes for concrete**

Proportion	Cement	Sand	Aggregate
Foundation	1	3	3
General Use	1	2.5	3
Workload	1	2	4

7. **Use a correct joint to connect two rafters**

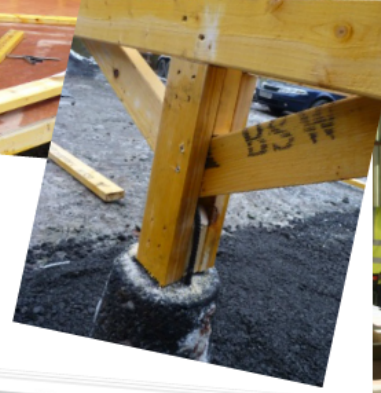
8. **Use a correct joint to connect two rafters**

9. **Use a correct joint to connect two rafters**

10. **Use a correct joint to connect two rafters**



Practical Work Experience & Training



Carpentry

Common Problems

1. **Timber is not cut to the right length**

2. **Timber cutting lines not drawn straight**

3. **Timber not cut square**

4. **Nails not connecting properly with timber**

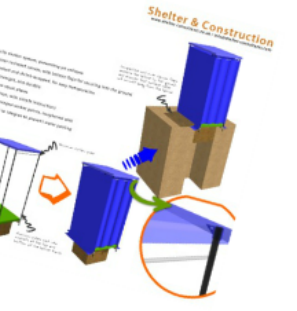
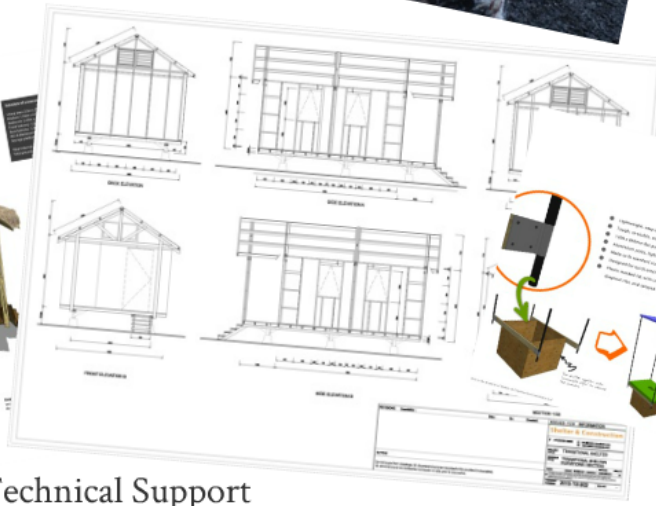
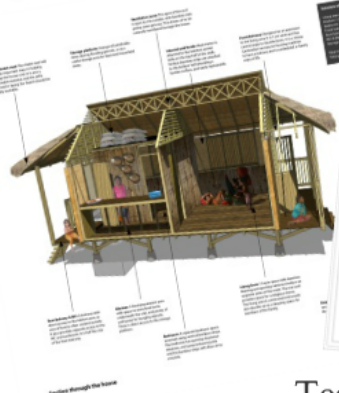
Workmanship

1. **Cutting for**

2. **Always use a square to mark two sides**

3. **Sawing timber straight**

4. **Nails to be 40mm (1 1/2") into the wood**



Technical Support & Consultancy

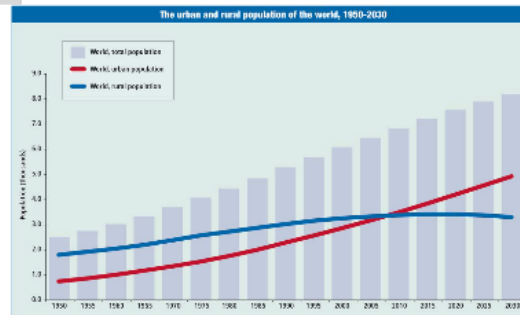
What is Multi Occupancy Shelter? Why should we be looking at them?

We need to prepare for the next one!



Challenges

- Basic Skills
- Basic Hand Tools
- Limited Materials
- Minimise Waste
- Fast & Simple Construction
- On & Off Site Production
- Robust Connections
- Adaptable
- Upgradeable



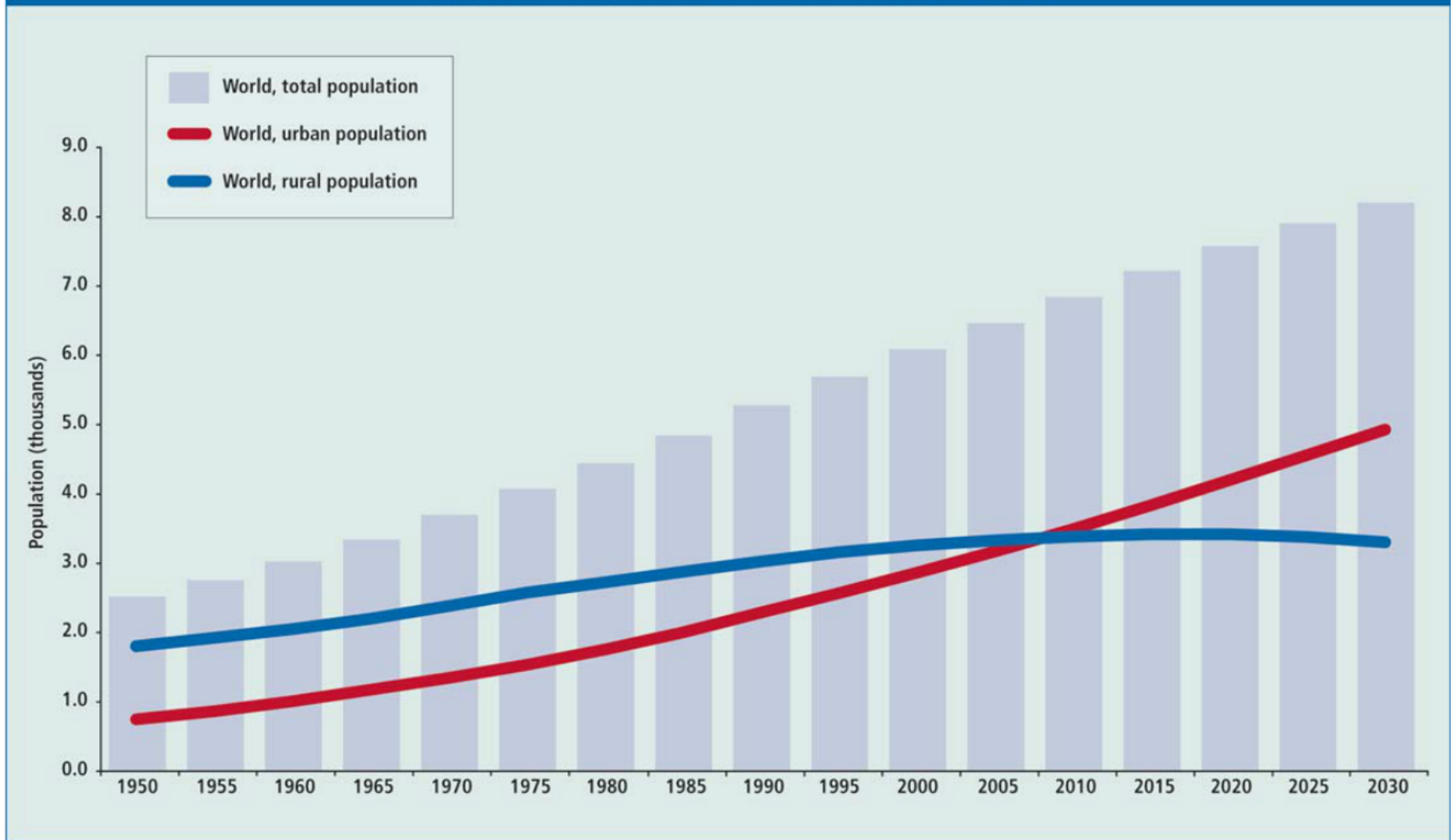
What is Multi Occupancy Shelter? Why should we be looking at them?

prepare for the next one!



Challenges

The urban and rural population of the world, 1950-2030



We need to prepare for the next one!

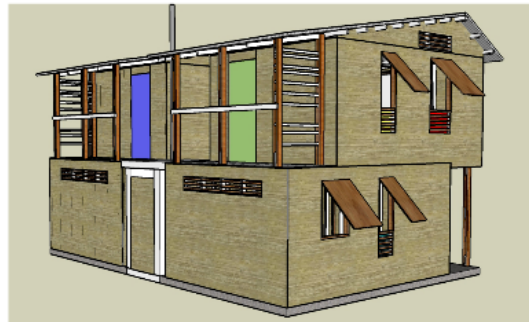
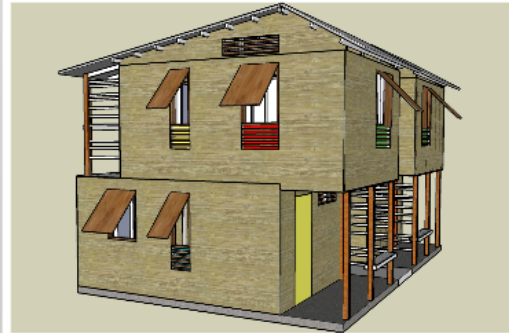


Challenges

- **Basic Skills**
- **Basic Hand Tools**
- **Limited Materials**
- **Minimise Waste**
- **Fast & Simple Construction**
- **On & Off Site Production**
- **Robust Connections**
- **Adaptable**
- **Upgradeable**

THIS IS NOT A PRODUCT!

The timber frame shelter prototype illustrates a robust and simple construction method, which can be rapidly and effectively deployed in an emergency. This shelter solution demonstrates good design and construction detailing intended as an exemplar for humanitarian agencies"



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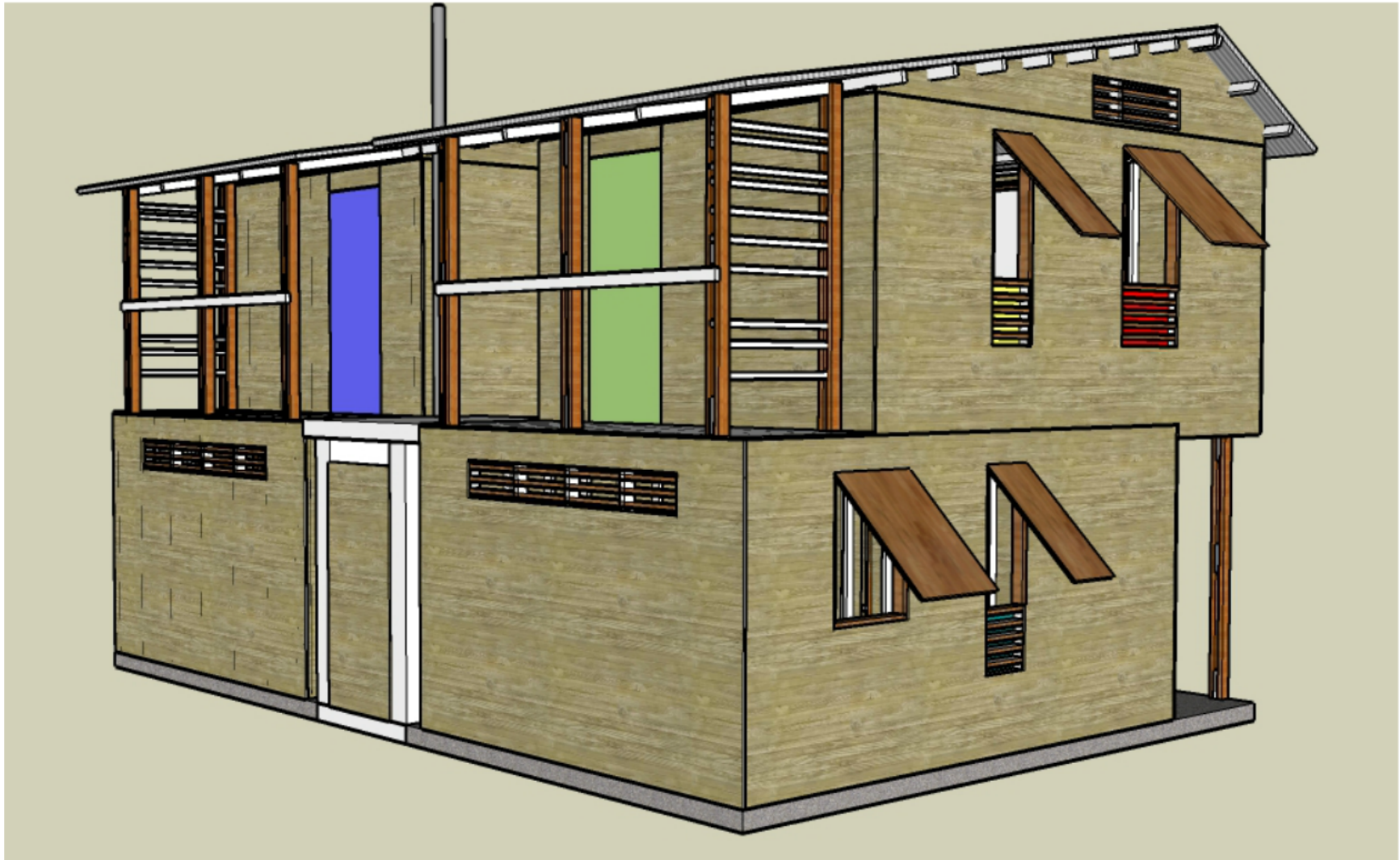
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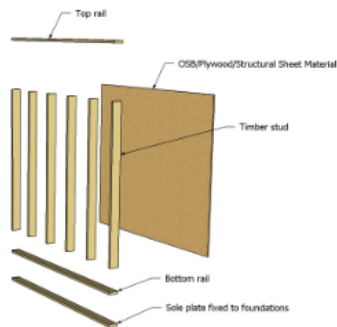




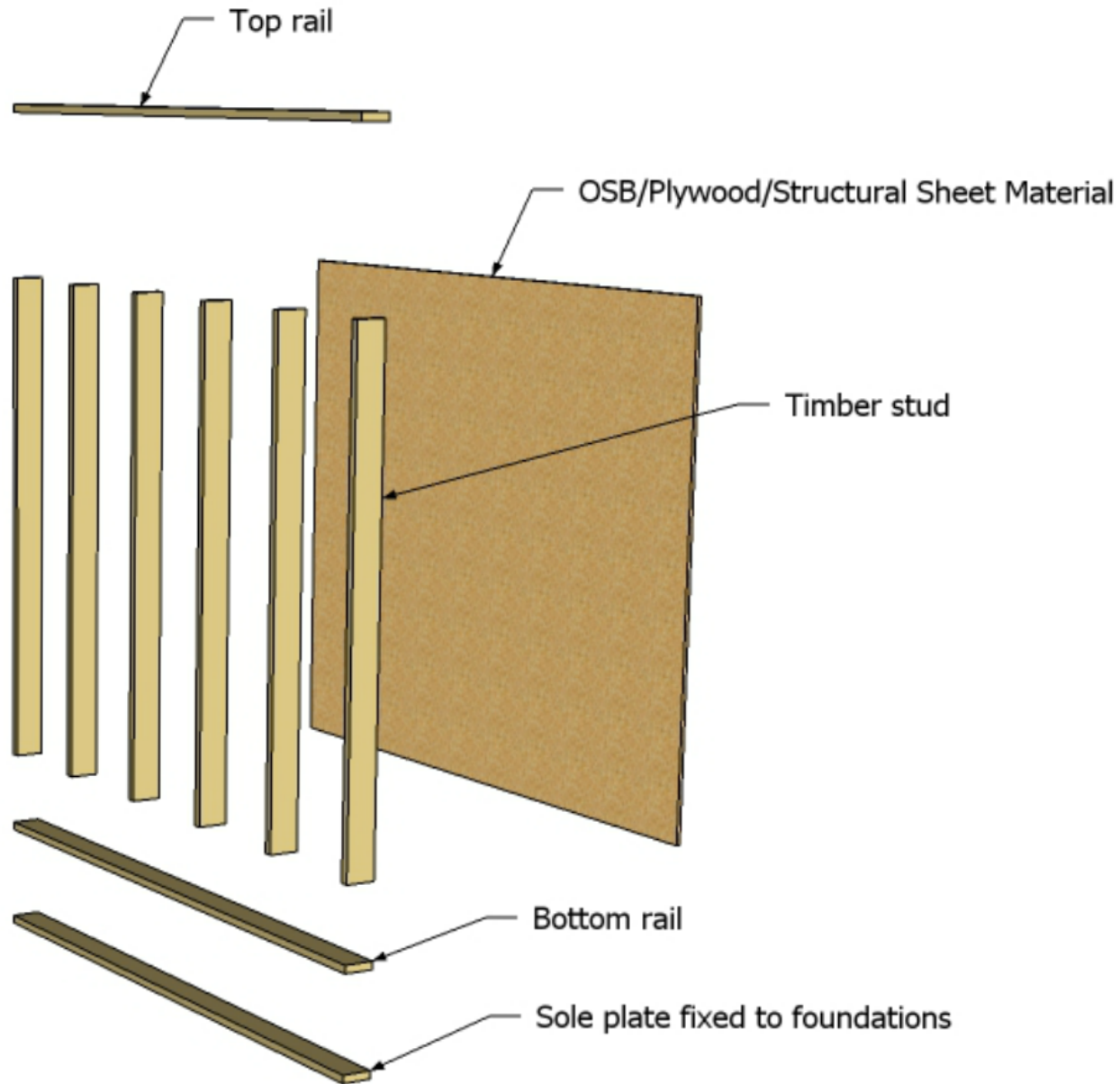
Advantage of Timber Frame Construction

- Reduced Construction Time
- Reduced waste
- De-skilled the process
- Improved air tightness and insulation
- Minimise Carbon Footprint

OPEN PANEL TIMBER FRAME CONSTRUCTION



OPEN PANEL TIMBER FRAME CONSTRUCTION



Advantage of Timber Frame Construction

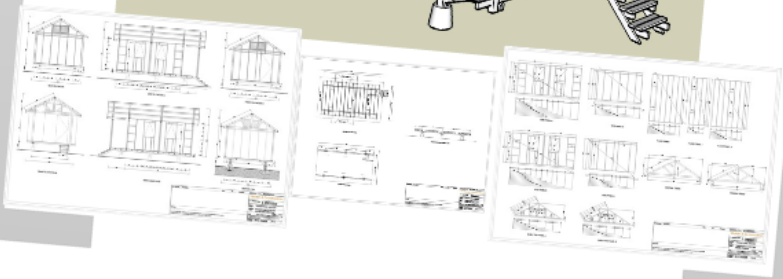
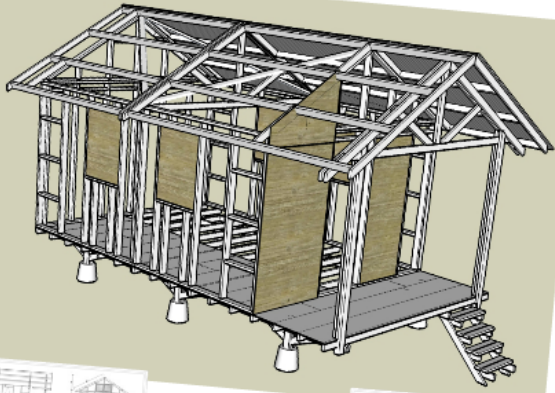
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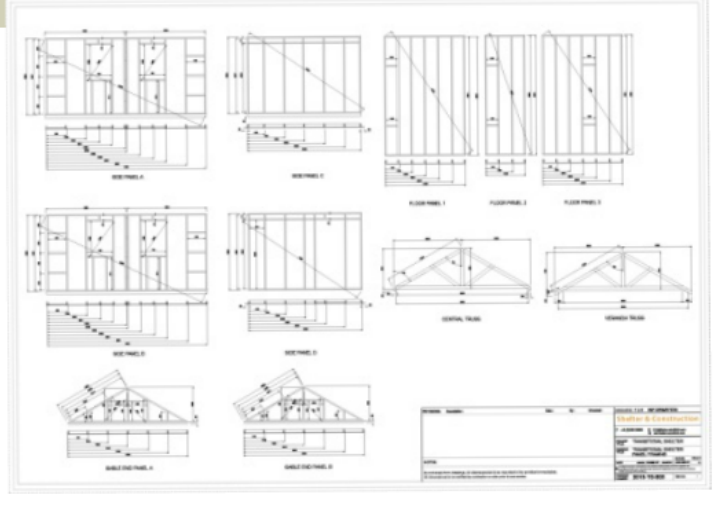
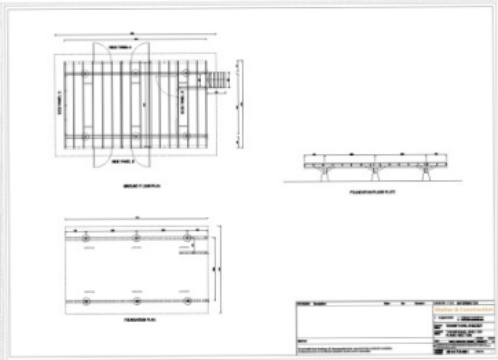
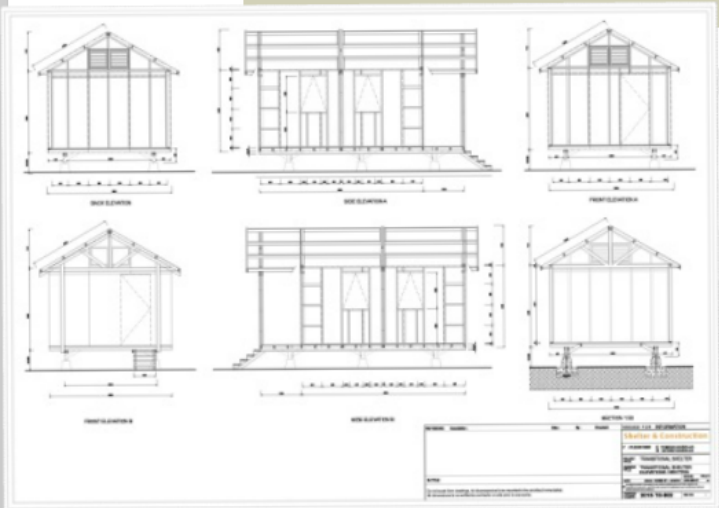
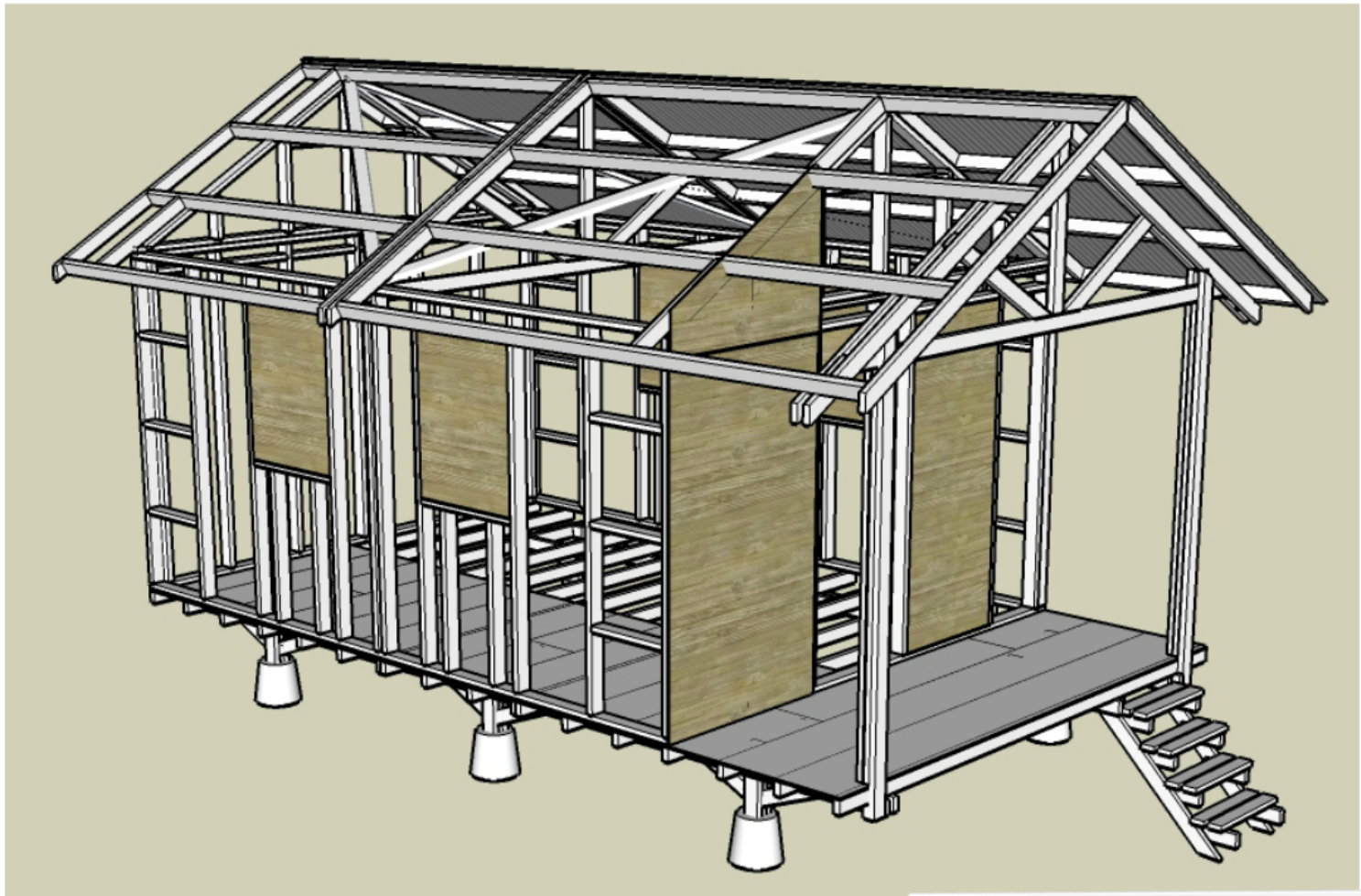






Construction





Construction



Application



CAMBODIAN Sustainable HOUSE
Open Panel Platform Frame

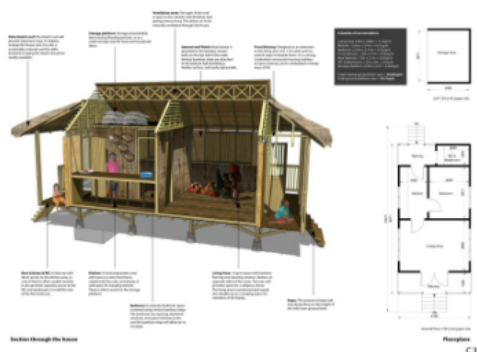
Key Features

- Traditional Cambodian architecture
- Eco-friendly materials
- Open panel platform frame
- Sustainable design
- Low cost
- Easy to build
- Suitable for rural areas
- Suitable for urban areas
- Suitable for semi-urban areas
- Suitable for coastal areas
- Suitable for mountainous areas
- Suitable for highland areas
- Suitable for lowland areas
- Suitable for all areas

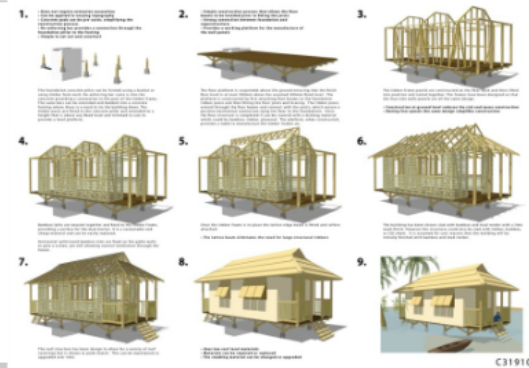
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C31910



Section through the house
Floor plan
C31910



1. Foundation
2. Platform
3. Wall frame
4. Roof frame
5. Roof structure
6. Roof tiles
7. Exterior wall
8. Exterior finish
9. Final house
C31910



CAMBODIAN Sustainable HOUSE. Open Panel Platform Frame

The design utilizes principles of Open Panel Platform Frame timber construction. This simplifies the construction process and allows the use of small section timber. This form of construction is widely used for both on and offsite manufacture and construction. The design can be adapted for varying topography and flood level.

The architecture draws inspiration from buildings generally found in Cambodia. The front entrance opens to the main reception room. A door then leads to a walk through kitchen with a door off to a bedroom. Above the bedroom is a storage area, which can also be used as an emergency platform for people and possessions should there be extraordinary flood events. From the kitchen a door leads to the back porch with a door to a washroom and toilet.

Given the climate, the building provides thermal comfort by minimising thermal mass and maximising ventilation. The raised platform allows air to circulate and also provides some storage space for tools, materials, and other possessions.

Benefits:

- Principles of construction can be applied to most designs
- Does not require specialist skills
- Can be constructed using basic hand tools
- Does not require the use of power tools. The type of fixings required for the structure is limited to nails only
- Utilises one section dimension of timber
- That the building can be adapted or extended in the future
- Makes use of local materials
- Allows for self building



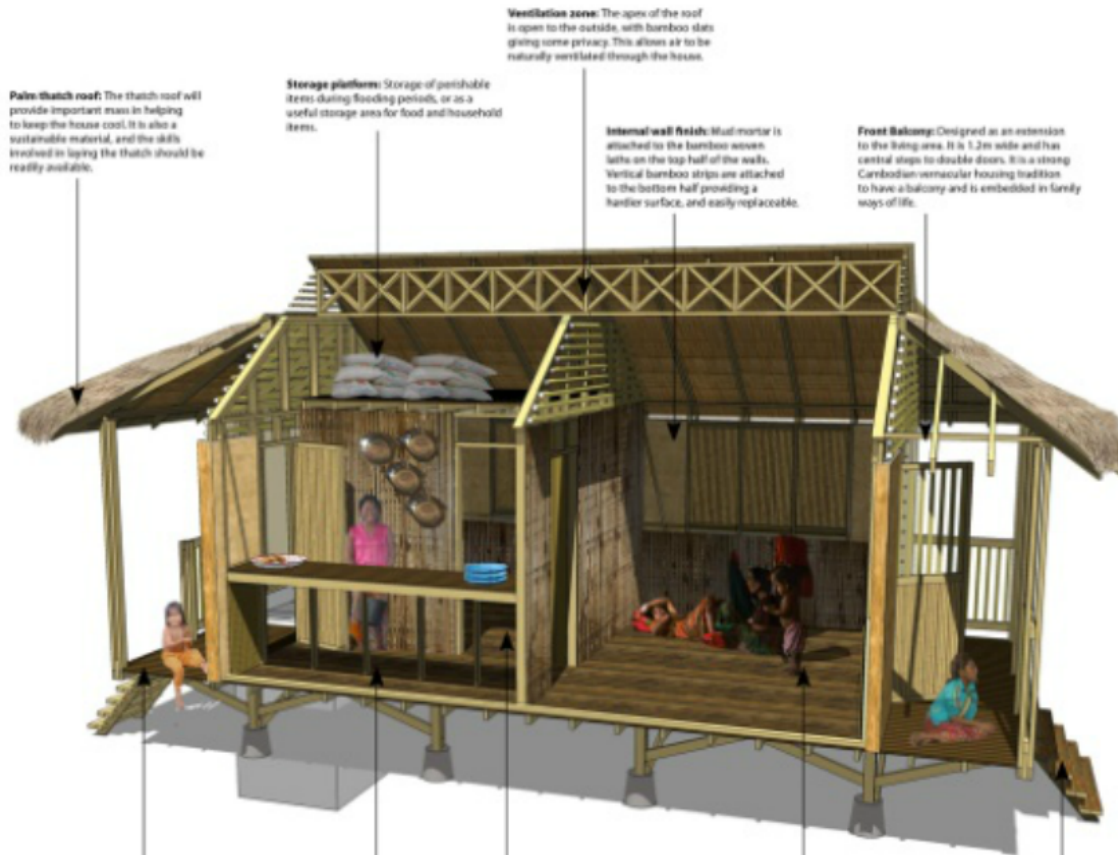
Hilly Terrain

The structure of the house can be easily adapted to work on any terrain. By simply changing the length of the foundation posts and bracing it is possible to ensure that a level platform is always achievable.



Flood Regions

The height of the house can be easily adapted to meet the flood height by changing the height of the posts connected to the foundations. The foundations and posts can be completely submerged for temporary periods of time.



Palm thatch roof: The thatch roof will provide important mass in helping to keep the house cool. It is also a sustainable material, and the skills involved in laying the thatch should be readily available.

Storage platform: Storage of perishable items during flooding periods, or as a useful storage area for food and household items.

Ventilation apex: The apex of the roof is open to the outside, with bamboo slats giving some privacy. This allows air to be naturally ventilated through the house.

Internal wall finish: Mud mortar is attached to the bamboo woven lattice on the top half of the walls. Vertical bamboo strips are attached to the bottom half providing a harder surface, and easily replaceable.

Front Balcony: Designed as an extension to the living area. It is 1.2m wide and has central steps to double doors. It is a strong Cambodian vernacular housing tradition to have a balcony and is embedded in family ways of life.

Rear balcony & WC: A balcony with direct access to the kitchen area, as a lot of food is often cooked outside. It also provides separate access to the WC and washroom. It is half the size of the front balcony.

Kitchen: A food preparation area with space to store food items underneath the unit, and plenty of wall space for hanging utensils. There is direct access to the storage platform.

Bedroom: A separate bedroom space screened using vertical bamboo strips. The bedroom has opening shuttered windows, and space between joints and the bamboo strips will allow air to circulate.

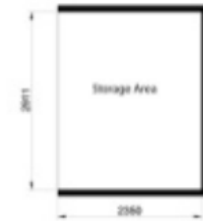
Living Area: 11 sqm space with bamboo flooring and opening window shutters on opposite sides of the room. The rear wall provides space for a religious shrine. The living area is communal and would also divide up as a sleeping space for members of the family.

Steps: The amount of steps will vary depending on the height of the stilts from ground level.

Section through the house

Schedule of accommodation

Living area:	3.0m x 2.00m = 11.2sqm
Kitchen:	1.55m x 2.91m = 4.51sqm
Bedroom:	2.25m x 2.91m = 6.55sqm
Front balcony:	1.2m x 4.1m = 4.92sqm
Rear balcony:	1.2m x 2.1m = 2.52sqm
WC & Washroom:	1.2m x 2.2m = 2.64sqm
Storage platform:	2.35m x 2.01 = 4.72sqm
Total internal ground floor area = 34.66sqm	
Total ground/platform area = 34.7sqm	



Left 1:50 @ A2 paper size



Ground floor 1:50 @ A2 paper size

Floorplans

C31910

1.

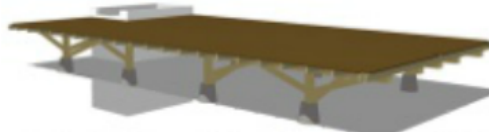
- Does not require extensive excavation
- Can be applied to varying topography
- Concrete pads can be pre-cast, simplifying the construction process
- Re-enforcing bar provides a connection through the foundation pillar to the footing
- Simple to set out and construct



The foundation concrete pillar can be formed using a bucket or using timber form work. Re-enforcing bar casts is into the concrete providing a connection to the post of the timber frame. The same bars can be extended and bedded into a concrete footing where there is a need to tie the building down. The timber posts are fitted to the concrete pillar and extended to a height that is above any flood level and trimmed to size to provide a level platform.

2.

- Simple construction process that allows the floor beams to be levelled prior to fitting the joists
- Strong connection between foundation and superstructure
- Provides a working platform for the manufacture of the wall panels



The floor platform is suspended above the ground ensuring that the finish floor level is at least 500mm above the assumed 300mm flood level. The platform is constructed by first attaching floor beams to the foundation timber posts and then fitting the floor joists and bracing. The timber posts extend through the floor beams and connect with the joists, which ensure a positive mechanical connection tying the floor to the foundations. Once the floor structure is completed it can be covered with a decking material which could be bamboo, timber, plywood. The platform, when constructed, provides a table to manufacture the timber frames on.

3.



The timber frame panels are constructed on the floor deck and then lifted into position and nailed together. The frames have been designed so that the four side walls panels are all the same design.

- Construction at ground level reduces the risk and eases construction
- Having four panels the same design simplifies construction

4.



Bamboo laths are woven together and fixed to the timber frame, providing a surface for the mud mortar. It is a sustainable and cheap material and can be easily replaced.

Horizontal split/round bamboo slats are fixed on the gable walls to give a screen, yet still allowing natural ventilation through the house.

5.



Once the timber frame is in place the lattice ridge beam is fitted and rafters attached.

- The lattice beam eliminates the need for large structural timbers

6.



The building has been shown clad with bamboo and mud render with a lime wash finish. However the structure could also be clad with timber, bamboo, or CGI sheet. It is assumed for cost reasons that the building will be initially finished with bamboo and mud render.

7.



The roof structure has been design to allow for a variety of roof coverings but is shown as palm thatch. This can be maintained or upgraded over time.

8.



- Uses low cost local materials
- Materials can be repaired or replaced
- The cladding material can be changed or upgraded

9.



Capacity Building

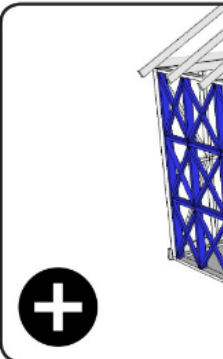
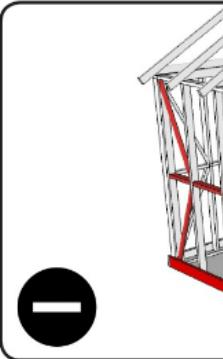
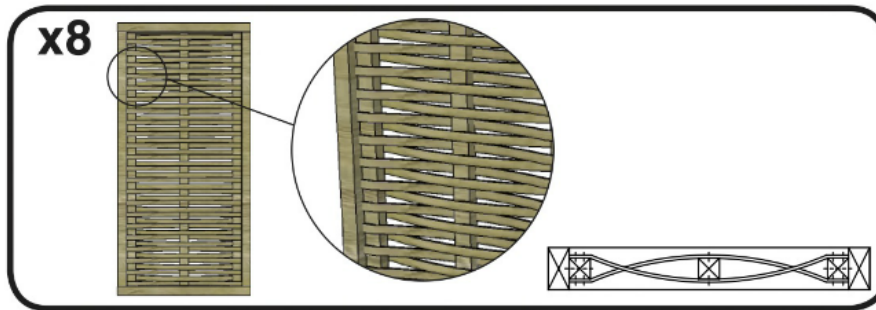
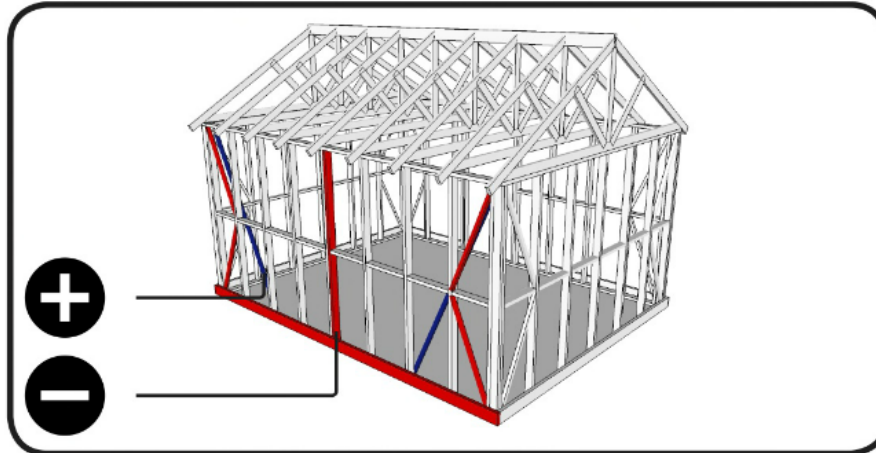
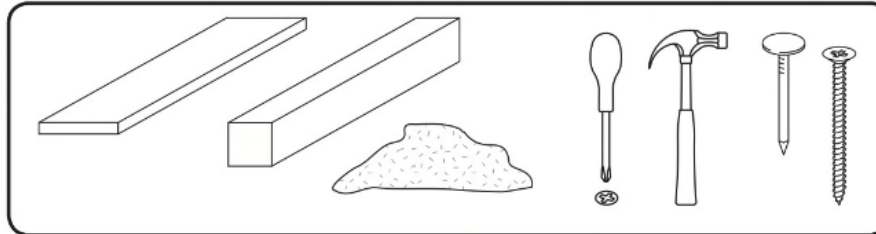
The image displays six instructional cards for building structures, arranged within a large blue circular frame. Each card is enclosed in a grey L-shaped corner frame.

- Clissade:** Features a title, a cost icon (\$), a house icon, and a lock icon. It includes a list of materials, a set of icons (triangle, circle, square, etc.), a 3D wireframe model of a rectangular structure, and a detail view of a wall section labeled 'x6'.
- Dhajji:** Features a title, a cost icon (\$), a house icon, and a lock icon. It includes a list of materials, a set of icons, a 3D wireframe model of a rectangular structure, and a detail view of a wall section.
- Plastic Bottle:** Features a title, a cost icon (\$), a house icon, and a lock icon. It includes a list of materials, a set of icons, a 3D wireframe model of a rectangular structure, and a detail view of a wall section.
- Wire Mesh Structure 1:** Shows a 3D wireframe model of a rectangular structure with a gabled roof.
- Wire Mesh Structure 2:** Shows two 3D wireframe models of rectangular structures, one with a gabled roof and one with a flat roof.
- Wire Mesh Structure 3:** Shows a 3D wireframe model of a rectangular structure with a gabled roof.

At the bottom center, there is a video player showing a person in a blue sweater working on a structure. The video player has a play button and a 'YouTube' logo.

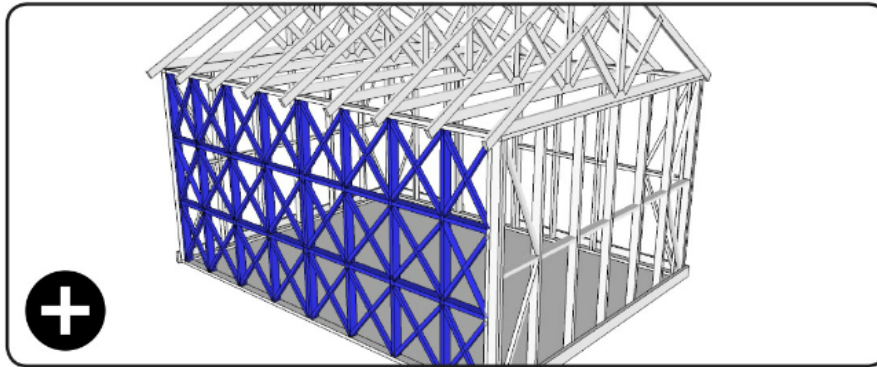
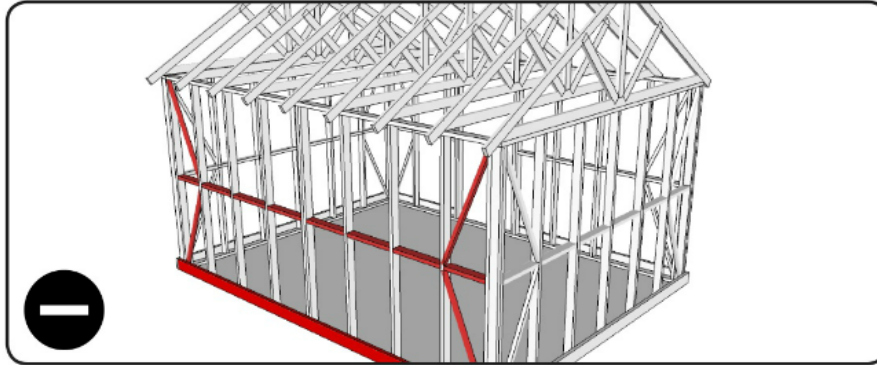
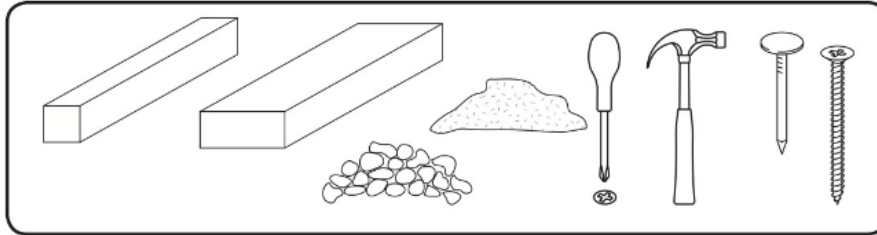
Clissade

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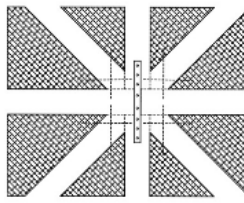
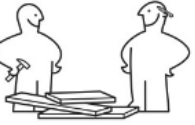


Dhajji

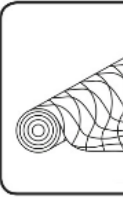
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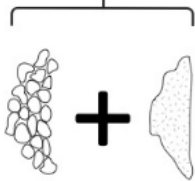
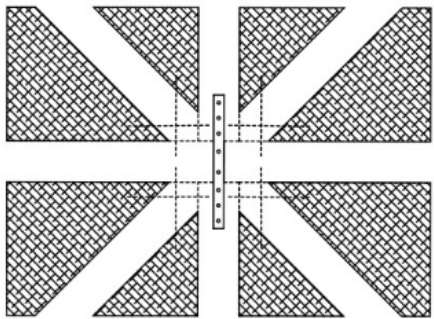
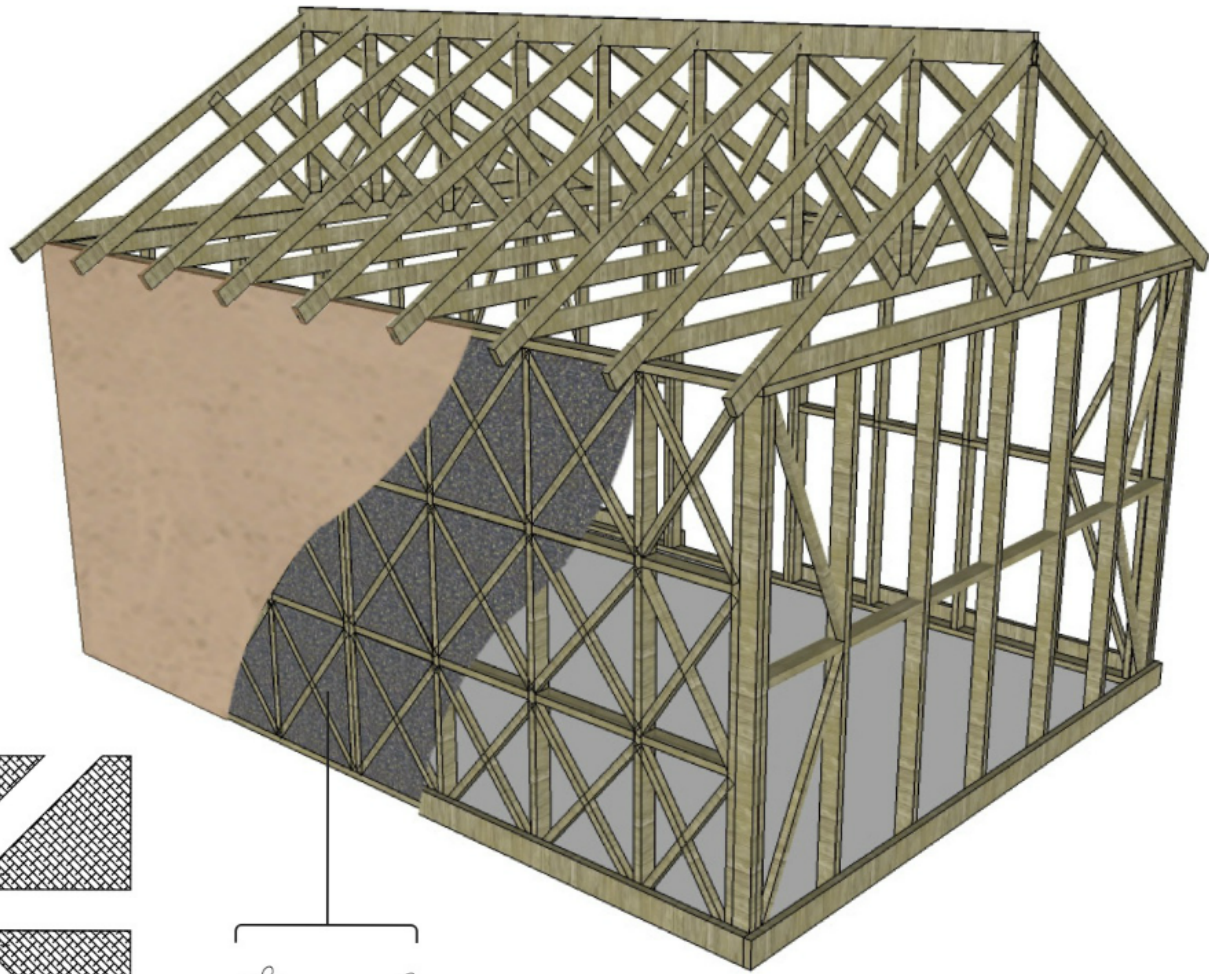


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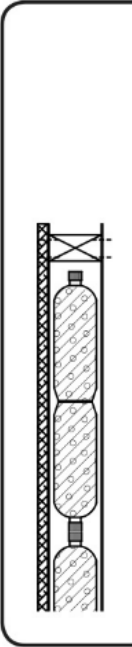
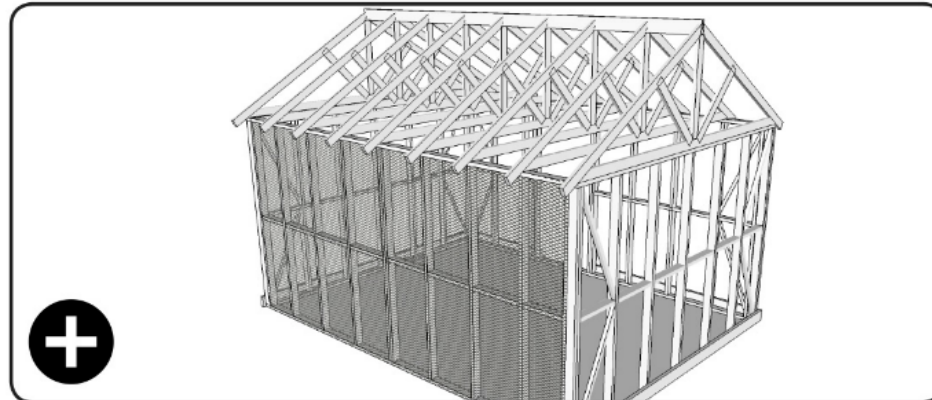
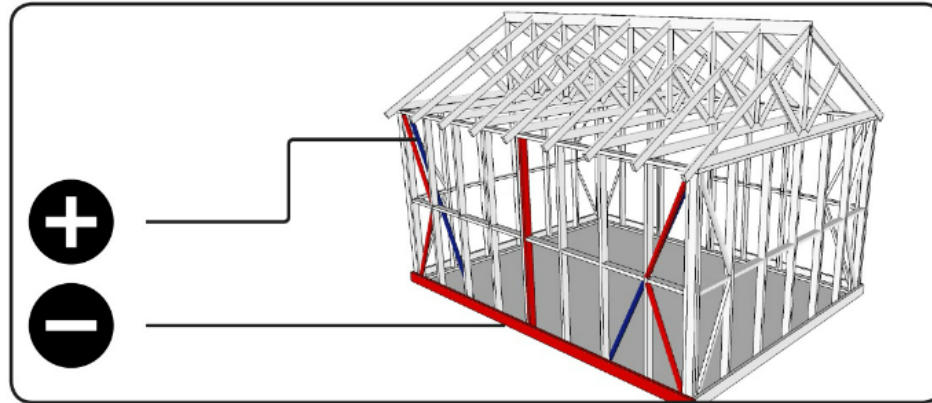
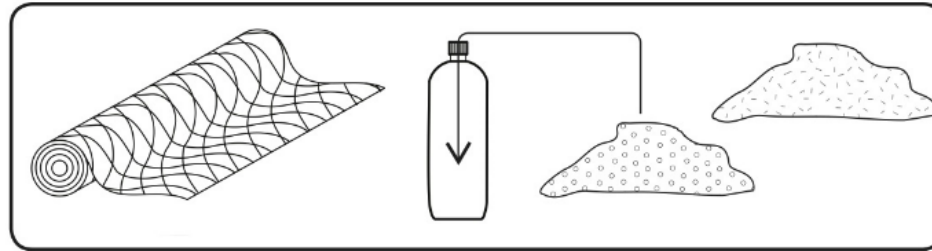
Plas
vertical method

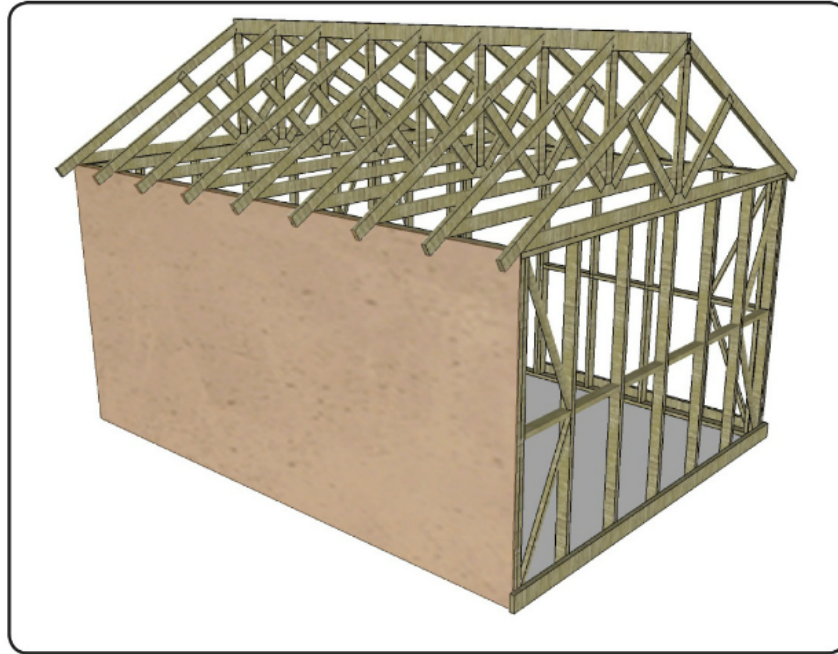
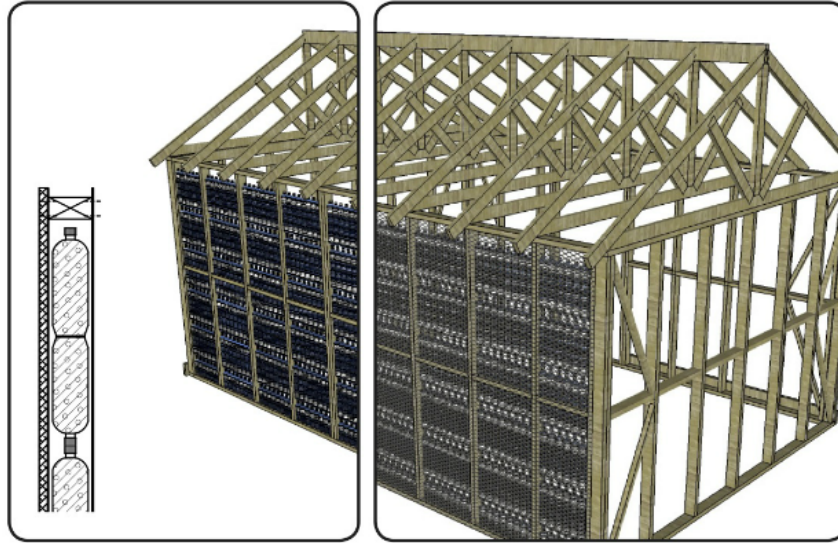
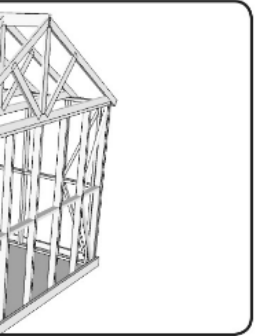
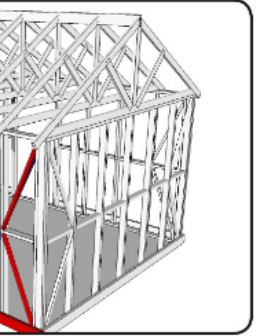
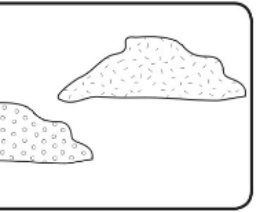




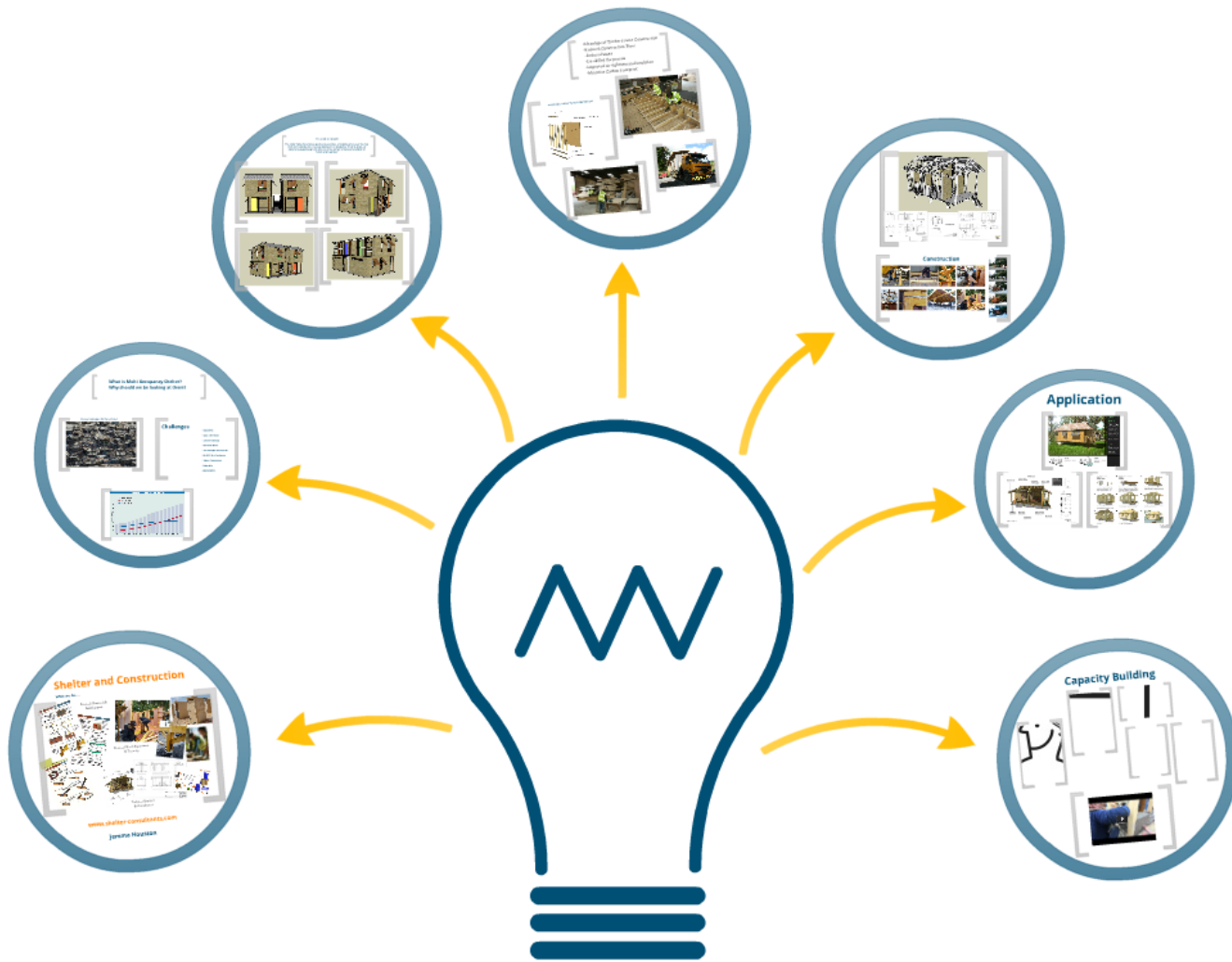
Plastic Bottle

vertical method









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