

PROTOTYPE CYCLONE RESILIENT SHELTER

A large part of Bangladesh suffers from devastating tropical cyclones frequently due to its unique geographic location. The funnel-shaped northern portion of the Bay of Bengal causes tidal bores, when cyclones make landfall and thousands of people living in the coastal areas are affected. The issue of climate change has also increased this phenomenon to a larger extent. In this regard Practical Action Bangladesh started a two-year project from December 2010 to November 2012 on cyclone resistant and flood adapted affordable housing design project at two coastal regions of Bangladesh named Satkhira & Bagerhat.



Project Brief

The project was implemented with a view to develop capacity of the local masons, builders and carpenters on climate resilient design factors and incorporation of low-carbon technologies in construction with the use of locally available materials. As a part of this, a comprehensive study was conducted at selected areas of Satkhira and Bagerhat the two prominent coastal regions of Bangladesh. The study consisted in two parts which were-

1. Technical part to gather indigenous knowledge about locally available and environment friendly low-cost construction materials.
2. Social part to collect people's views, experience and perception considering the result of cyclone Sidr and Aila that happened in Bangladesh in 2007 and 2009.

After studying 4 prototype Cyclone Resilient House Models were developed through field study in SIDR & Aila affected areas using different combination of materials. In the design scheme, considerations were mainly to follow indigenous practices, cost-effectiveness, flood and cyclone resistant techniques and to look for locally available building material. Prototype houses included rain water harvesting system, solar LED home system & improved kitchen areas with cook stove.

Project Principles

- Affordable Houses
- Ecologically Balanced Architecture
- Integrated Design Scheme
- Knowledge Sharing
- Reducing Aid-Dependency

Objectives & Challenges

- Study of the house designs: in terms of materials, joineries and details.
- Study of the house designs: in terms of workmanship, durability from weathering, corrosion, resistance against
- Design of sample houses for rebuilding after the study phase, with different combination of locally available

Existing Condition



Raised plinth to protect from flood water

Traditional wall made of treated nipa palm tree, on high raised mud plinth

Protection of wooden pillar base & attachment to mud plinth

Window made of local Goran wood embedded in mud wall

Windows at various levels for maximizing cross ventilation



Low drooping eaves of roof area designed to reduce uplift during storm. Existing verandah provides room for household activities



Use of asbestos roof in existing house hold has been seen, which is carcinogenic and compromises health safety issues, and example of mud plinth wall erosion



Example of typical house made by NGO, Absence of verandah, CI sheet walls & pitch roof is vulnerable and poses risk during storm



Agricultural land has been converted into shrimp farming pond due to increased salinity in water

Interventions



Site visit



Community participation with Design team



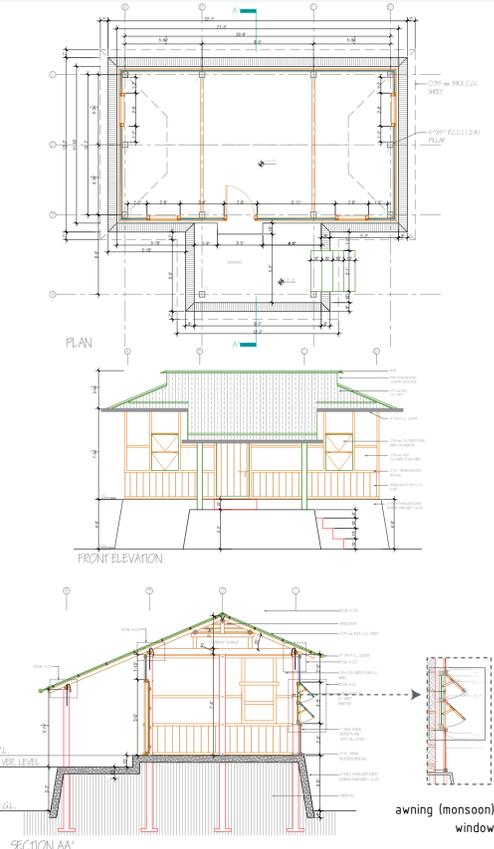
Community participation with Design team

Design Scheme

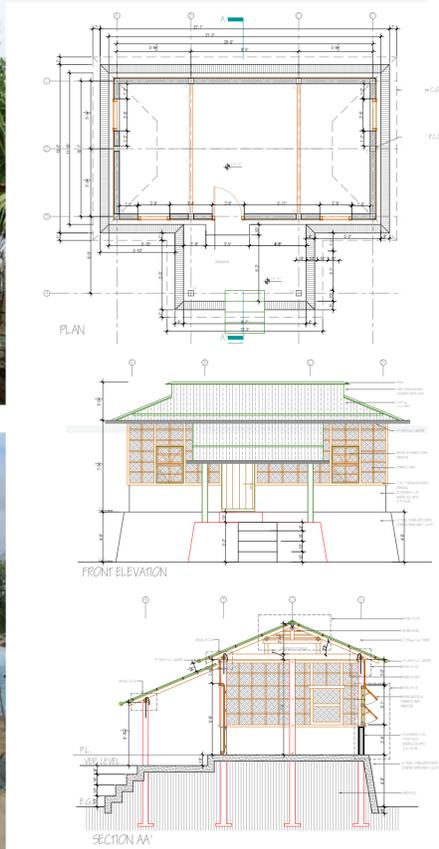
In the design of prototype houses the key ideas were to follow indigenous practices specially for flood & cyclone resistant techniques. The existing houses were studied in terms of materials, joineries, details and durability with respect to weathering, corrosion, resistance against strong wind, tidal action & ground erosion. The project also envisaged for participatory design approach, an approach to design that invited all stakeholders into the design process as a means of better understanding, meeting, and sometimes preempting their needs.

Design Types

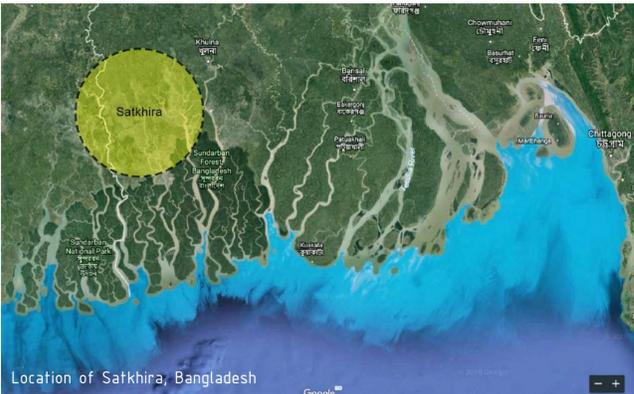
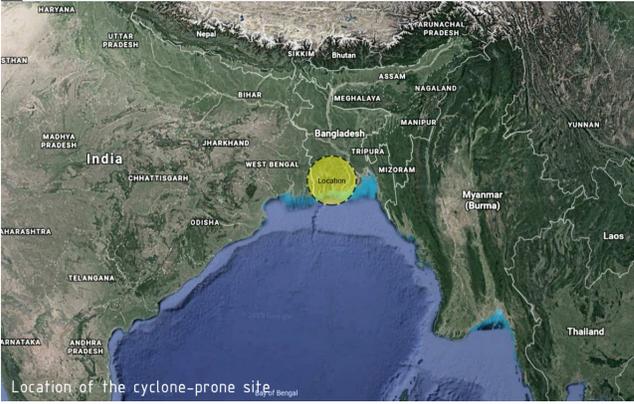
Type A



Type B



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Key Issues of the Community

After the devastating effects of cyclone Sidr and Aila, some areas of Satkhira and Bagerhat have become almost barren due to increase in salinity in water. The areas constituted of large species of different types of trees. Usually trees act as wind-breaks by reducing the speed and strength of winds thereby providing protection for houses. They also help to minimize the impact of storm surges. But indiscriminately cutting of trees by local population have resulted in deforestation which poses risk during storm. Deforestation has also increased the land erosion in the area. From the survey it was found that mud is sometimes used for plinth and wall construction. But the locals informed that the binding quality of mud is reduced due to long stagnation of saline water. Scarcity of drinking water is also a major problem of the region due to increased salinity in surface & underground water.



Design Options

Size of the House

The size of the house is 24' X 12' with a verandah of 12' X 8'. The size of the house has been determined after observing the social needs and average family size, consisting a large room which can be divided into 2 room partitions. One room is considered as a living zone for husband, wife and children. Four design types (A, B, C, D) have been done with the use and combination of various materials.

Plinth

High raised (4' high) tapered plinth have been incorporated in design. The main problem for plinth is mud erosion due to water logging. The material options that are considered to encounter this problem for the construction are as follows.

- (ECS): An 8 inch layer of stabilized earth with 5% cement & sand in 1:2 ratio
- (FC) Ferro cement and (ECSG.) Earth Stabilized with Cement and Sand

Wall

- (BM) Bamboo mat is widely used in the area. It ensures better cross ventilation and thus considered as possible design material. Wooden cross bracing is used to ensure structural stability.
- (MWG) Mud wall reinforced with Goran wood sticks is also widely used in the area and therefore considered as a design material. There are examples of houses with this material. Mud wall also ensures better thermal comfort.
- (MBCS) Mud block stabilized with 5% cement and sand can be used as wall material as per discussion with HBRI.

Column

6. (PR) After studying different options Pre Cast 6"RCC column is considered in the design. As per discussion with the local and international experts in the symposium the section of 6" X 6" has been considered for the RCC column.

Window

- (WB) Wood and bamboo mat is used as window material in combination with Bamboo Mat and Mud walls.
- (GW) In case of Mud walls the Goran wood sticks embedded in mud walls serves as windows.

Door

9. (WD) Wooden doors made of locally available wood is considered as design material.



Roof Material

- (CI) CI sheet of proper thickness (0.35 mm) is used.
- (GP) Locally available Golpata from Sunderbans is also used as one of the options for roof. Golpata needs replacement after 4 to 5 years.
- (SCT) Satkhira Clay tiles is also considered as a material option. provided the roof framing to be done with MS angle.

Roof Frame

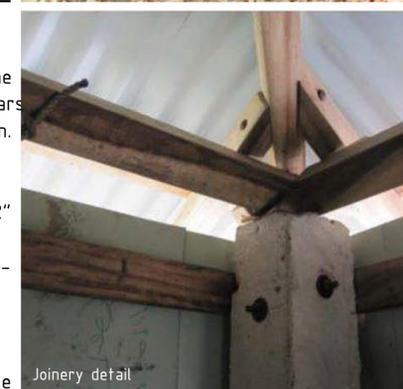
- (GW) Locally available Goran wood with a cross section of 2" X 2" is used.
- (MSA) Ms angle is also used but subject to proper welding & construction.

Renewable Energy and Rain Water Harvesting

Solar Energy is considered in the design scheme for electricity. A permanent water tank is considered to collect rain water from the gutters fitted in the pitch roof of the houses. Besides this some portable reverse umbrella type rain water collector fitted in mud and plastic containers is used in the design scheme. This is specially effective for the house with GolPata since gutter cannot be provided there.

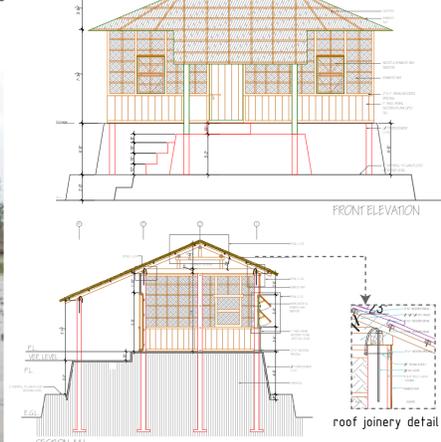
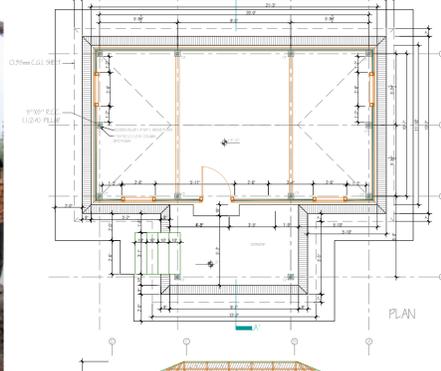
Sanitation, Landscape and Vegetation

Two twin pit sanitary latrine has been provided in the design scheme to fulfill the sanitary requirements. Spaces have been provided in the design scheme to accommodate trees which can grow in saline water. The vegetative belt around, will protect the houses from cyclone and storms. Besides this spaces have been provided to accommodate vegetable garden. The rooftop of the houses can accommodate pumpkin cultivation.



Design Types

Type C



Type D

