



SAVING LIVES

Floating Hospitals
Healthcare for All
Disaster Relief



POVERTY ALLEVIATION

Capacity Building
Access to Services
Micro Entrepreneurship



CLIMATE ADAPTATION

Climate Resilience
Locally Led Adaptation
Mangrove Reforestation



EMPOWERMENT

Education
Awareness of Rights & Ethics
Justice & Gender Equality



FRIENDSHIP

Cyclone Resilient House



Housing and Building Research Institute (HBRI)
Ministry of Housing and Public Works, Bangladesh

Jointly Implemented by:



FRIENDSHIP

FRIENDSHIP Bangladesh

Background

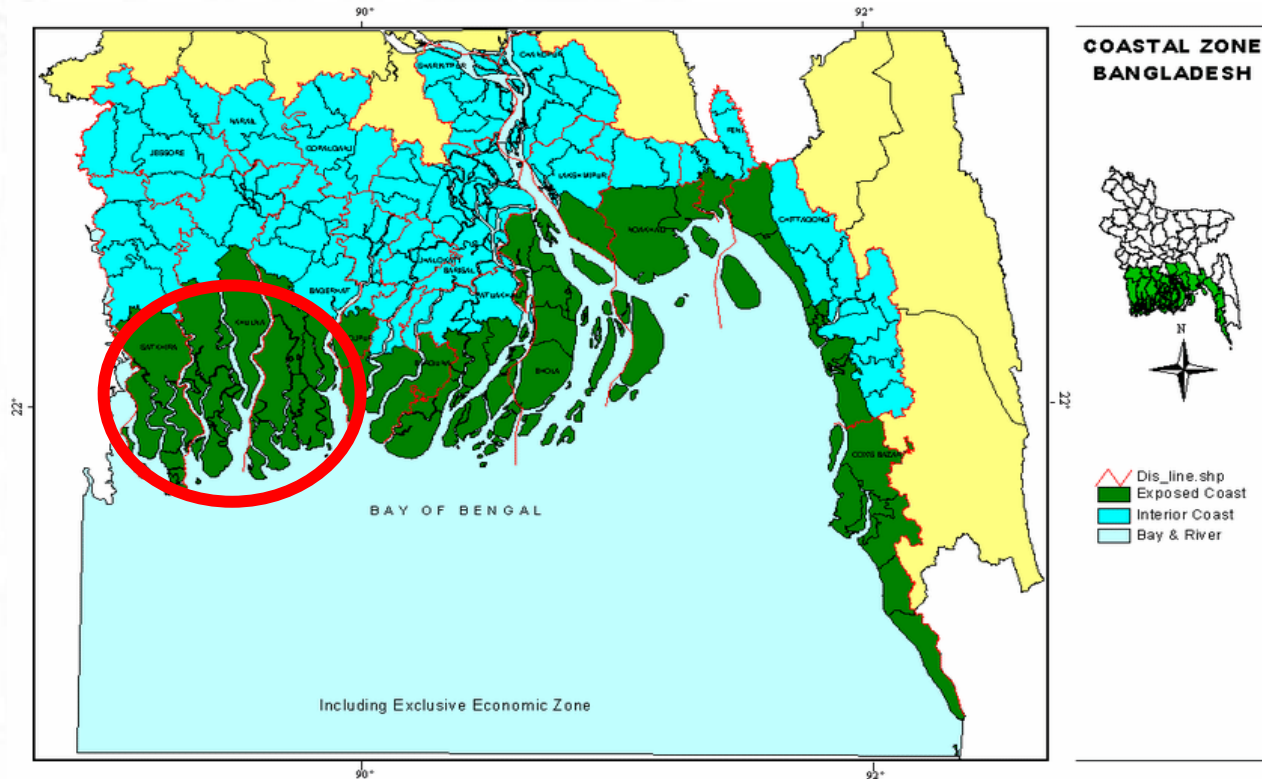
- In 2014, HBRI jointly with FRIENDSHIP and with assistance from Shelter Cluster, Housing Actors developed a research-based guideline named:
- **" STANDARD GUIDELINE FOR RURAL HOUSING IN DISASTER PRONE AREAS OF BANGLADESH "**



- The guidelines are recognized and appreciated at national and international levels. This has been uploaded at site by Shelter Cluster, Prevention web. Reference in use by Universities, GOs, NGOs.
- Intensive training was given to the selective teachers of all government polytechnic institutes on this guideline.
- These cyclone resistant houses has been implemented following this guidelines.

ASSESSMENT SITE

- KOLAPARA , PATUAKHALI
- MONGLA , BAGERHAT
- SHYAMNAGAR , SATKHIRA
- ASHASHUNI , SATKHIRA



Why are we building here?



Name of Location: Chakla Purbo Para,
Pratapnagar, Asasuni, Satkhira
GPS coordinates: 22.3514518 N, 89.2665739 E
Total Number of Household: 259
Distance from Government Cyclone Shelter: 2 KM
Road Surface: Earthen

Asasuni Site Detail



Name of Location: Paschim Patakhali,
Padmapukur, Shyamnagar, Satkhira
GPS coordinates: 22.29384° N, 89.24986° E
Total Number of Household: 334
Distance from Government Cyclone Shelter: 1.5 KM
Road Surface: Earthen and Brick Flat Soling

Shyamnagar Site Detail

Why are we building here?



Name of Location: Dokkhin Ulubunia,
Sonailtala, Mongla, Bagerhat
GPS coordinates: 22.5122351 N, 89.6451914 E
Total Number of Household: 393
Distance from Government Cyclone Shelter: 0.50
KM
Road Surface: Pavement

Mongla Site Detail



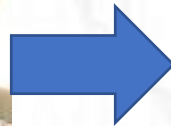
Name of Location: Nazibpur,
Alipur, kalapara, Patuakhali
GPS coordinates: 21°51'47.8"N, 90°06'17.5"E
Total Number of Household: 450
Distance from Government Cyclone Shelter: 3.5 KM
Road Surface: Earthen and Pavement

Kalapara Site Detail

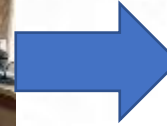
Houses Construction Process at a Glance



MoU Signed
completed on 9th
February'2021



A National level
consultation workshop
held on 4th March'2021



Site visit and community
consultation complete
over March'2021

Existing Houses observation and Community Expectation:

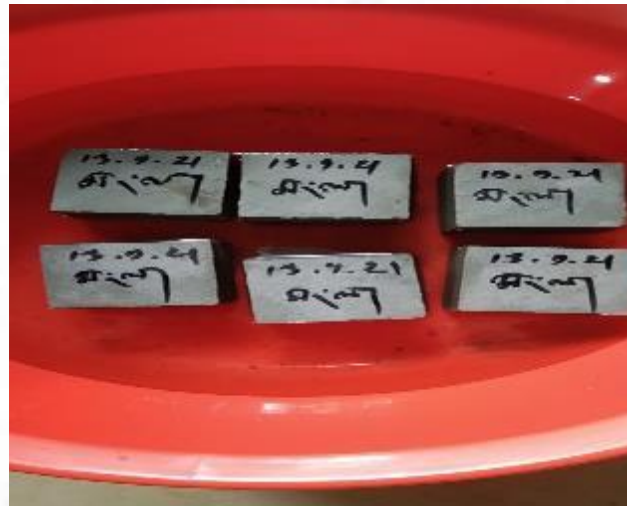
1. House Should be Cyclone Resilient
2. House should be Tidal Surge free
3. All materials should be free from salinity
4. Rain water storage facilities
5. Durable Materials
6. Latrine facilities
7. Low maintenance
8. Affordable cost



Water and Soil quality test at HBRI lab



To check the quality of existing ground and surface water, sand and soil sample are collected from 4 location



All collected samples are tested on HBRI's Laboratory to check the quality and compressive strength of block

Laboratory Test Report

Srl.	Location	Materials	pH	TDS(ppm)	Salinity (ppm)
1	Shyamnagar	Sand	7.82	78	70
		Water (Surface water)	6.10	1573	1595
		Water (Ground Water)	6.55	2096	2210
2	Ashashoni	Sand	8.55	85	80
		Water (Surface water)	6.68	1176	1200
		Water (Ground Water)	6.86	1541	1590
3	Mongla	Sand	7.60	325	310
		Water (Surface water)	6.36	1699	1750
		Water (Ground Water)	6.55	2250	2300
4	Potuakhali	Sand	7.2	107	108
		Water (Surface water)	6.10	171	160
		Water (Ground Water)	8.62	862	870

Existing materials Salinity and Quality Test Report

Laboratory Test Report

the entire sample from the water from groundwater and surface water in a combined ratio of 1:1:1. Therefore,

Srl.	Location	Source of Materials	Proportion	Test Results(P.S.I)		
				7 days	14 Days	28 Days
01	Shyamnagar,padmapukur	Locally collected sand and surface water	1:4	582	510	786
		Locally collected sand and groundwater	1:4	573	645	843
02.	Ashashoni, chakla.	Locally collected sand and surface water	1:4	1107	1237	1280
		Locally collected sand and groundwater	1:4	1086	1100	1300
03.	Mongla	Locally collected sand and surface water	1:4	552	732.10	790
		Locally collected sand and groundwater	1:4	534	742	810
04.	Kolapara,potuakhli.	Locally collected sand and surface water	1:4	564.3	1000	1100
		Locally collected sand and groundwater	1:4	619	1187	1200

Compressive Strength Test of Concrete Block Sample by Using Locally Collected Materials

Consultation Meeting



Field visit data and laboratory test report presented on a National level workshop

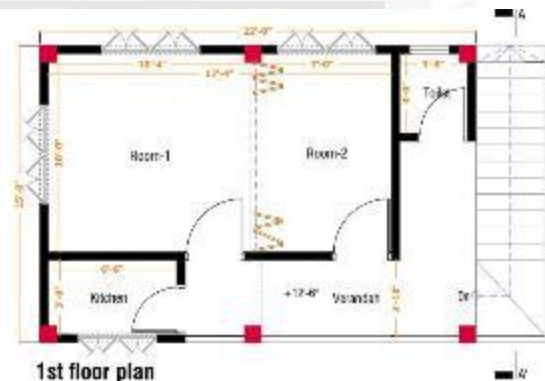
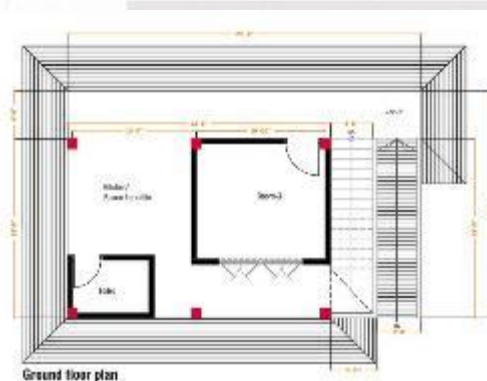


4 draft designs are prepared through participation of all at the same event and one design is initially considered final by consensus of all.

WORKSHOP OUTPUT

- >> Building Height, width **RATIO**
- >> Floor area **RATIO**
- >> **Emergency** capacity
- >> Rigid Frame structure
- >> Raised plinth with **sloped** edge
- >> Roof as **rainwater** catchment area
- >> Use of **Screening**
- >> Earth/Sand bag at plinth

Design of Cyclone Resilient House



Based on field data, community expectation and workshop expert recommendation an Architectural Design Finalize for house construction

Soil test at place of House construction



To determine the bearing capacity of soil sub soil investigation has been completed on 4 coastal location

A4: (TABLE-3): ALLOWABLE BEARING CAPACITY OF SHALLOW FOUNDATION (F.S = 2.50)

Boring No.- 01						
Depth in meter	Depth in feet	S.P.T.	Corrected S.P.T. Value $N-(N-15)/2$	Soil Type	Bearing Capacity (Tsf)	
					For Circular or square Footing	For Continuous Footing
1.52	5.00	1	1.00	C	0.28	0.23
3.04	10.00	1	1.00	C	0.39	0.32
4.56	15.00	4	4.00	S	1.05	0.83
6.08	20.00	5	5.00	S	1.33	1.07

Boring No.- 02						
Depth in meter	Depth in feet	S.P.T.	Corrected S.P.T. Value $N-(N-15)/2$	Soil Type	Bearing Capacity (Tsf)	
					For Circular or square Footing	For Continuous Footing
1.52	5.00	1	1.00	C	0.28	0.23
3.04	10.00	1	1.00	C	0.39	0.32
4.56	15.00	2	2.00	S	0.69	0.55
6.08	20.00	3	3.00	S	0.97	0.79

A5: (TABLE-4): THE SKIN FRICTION & THE END BEARING CAPACITIES OF PILES AS SHOWN IN BELOW (F.S = 3.00).

Boring No.- 01								
Cum depth (meter)	Depth (ft)	Cum depth (ft)	S.P.T.	Corrected S.P.T. Value $N-(N-15)/2$	Average S.P.T.	Soil Type	fsa (Tsf)	qpa (Tsf)
0.00	0	0.00	0	0.00	0.00	C	0.00	0.00
1.52	5	5.00	1	1.00	0.50	C	0.01	0.17
3.04	5	10.00	1	1.00	1.00	C	0.01	0.17
4.56	5	15.00	4	4.00	2.50	S	0.01	4.00
6.08	5	20.00	5	5.00	4.50	S	0.02	5.00
7.60	5	25.00	6	6.00	5.50	S	0.03	6.00
9.12	5	30.00	4	4.00	5.00	S	0.03	4.00

SPT Test Report

Hazard Class Map



Ranking of multi-hazard maps used for preparing the risk-index :

- ❖ Cyclone (high risk-5, risk-3, wind risk- 1)
- ❖ Flood (Severely flooded due to major river floods – 3, flash flood due to major river-2, other flood-1)
- ❖ Riverbank erosion(severe erosion-2, erosion -1)
- ❖ Drought (very severe drought prone areas – 2, severe drought-1)

Legend

- District headquarter
- ▭ District boundary

Hazard class

- Very High (5.00 - above)
- High (4.00 - 4.99)
- Moderate (3.00 - 3.99)
- Low (1.00 - 2.99)
- Very Low (below 1.00)

Table 6.2.8: Basic Wind Speeds, V , for Selected Locations in Bangladesh

Location	Basic Wind Speed (m/s)	Location	Basic Wind Speed (m/s)
Angarpota	47.8	Lalmoinihat	63.7
Bagerhat	77.5	Madaripur	68.1
Bandarban	62.5	Magura	65.0
Barguna	80.0	Manikganj	58.2
Barisal	78.7	Meherpur	58.2
Bhola	69.5	Maheshkhali	80.0
Bogra	61.9	Moulvibazar	53.0
Brahmanbaria	56.7	Munshiganj	57.1
Chandpur	50.6	Mymensingh	67.4
Chapai Nawabganj	41.4	Naogaon	55.2
Chittagong	80.0	Narail	68.6
Chuadanga	61.9	Narayanganj	61.1
Comilla	61.4	Narsinghdi	59.7
Cox's Bazar	80.0	Natore	61.9
Dahagram	47.8	Netrokona	65.6
Dhaka	65.7	Nilphamari	44.7
Dinajpur	41.4	Noakhali	57.1
Faridpur	63.1	Pabna	63.1
Feni	64.1	Panchagarh	41.4
Gaibandha	65.6	Patuakhali	80.0
Gazipur	66.5	Pirojpur	80.0
Gopalganj	74.5	Rajbari	59.1
Habiganj	54.2	Rajshahi	49.2
Hatiya	80.0	Rangamati	56.7
Ishardi	69.5	Rangpur	65.3
Joypurhat	56.7	Satkhira	57.6
Jamalpur	56.7	Shariatpur	61.9
Jessore	64.1	Sherpur	62.5
Jhalakati	80.0	Sirajganj	50.6
Jhenaidah	65.0	Srimangal	50.6
Khagrachhari	56.7	St. Martin's Island	80.0
Khulna	73.3	Sunamganj	61.1
Kurubdia	80.0	Sylhet	61.1
Kishoreganj	64.7	Sandwip	80.0
Kurigram	65.6	Tangail	50.6
Kushtia	66.9	Teknaf	80.0
Lakshmipur	51.2	Thakurgaon	41.4

Table 6.2.14: Description of Seismic Zones

Seismic Zone	Location	Seismic Intensity	Seismic Zone Coefficient, Z
1	Southwestern part including Barisal, Khulna, Jessore, Rajshahi	Low	0.12
2	Lower Central and Northwestern part including Noakhali, Dhaka, Pabna, Dinajpur, as well as Southwestern corner including Sundarban	Moderate	0.20
3	Upper Central and Northwestern part including Brahmanbaria, Sirajganj, Rangpur	Severe	0.28
4	Northeastern part including Sylhet, Mymensingh, Kurigram	Very Severe	0.36

Table 6.2.15: Seismic Zone Coefficient Z for Some Important Towns of Bangladesh

Town	Z	Town	Z	Town	Z	Town	Z
Bagerhat	0.12	Gaibandha	0.28	Magura	0.12	Patuakhali	0.12
Bandarban	0.28	Gazipur	0.20	Manikganj	0.20	Pirojpur	0.12
Barguna	0.12	Gopalganj	0.12	Maulvibazar	0.36	Rajbari	0.20
Barisal	0.12	Habiganj	0.36	Meherpur	0.12	Rajshahi	0.12
Bhola	0.12	Jaipurhat	0.20	Mongla	0.12	Rangamati	0.28
Bogra	0.28	Jamalpur	0.36	Munshiganj	0.20	Rangpur	0.28
Brahmanbaria	0.28	Jessore	0.12	Mymensingh	0.36	Satkhira	0.12
Chandpur	0.20	Jhalakati	0.12	Narail	0.12	Shariatpur	0.20
Chapainawabganj	0.12	Jhenaidah	0.12	Narayanganj	0.20	Sherpur	0.36
Chittagong	0.28	Khagrachari	0.28	Narsingdi	0.28	Sirajganj	0.28
Chuadanga	0.12	Khulna	0.12	Natore	0.20	Srimangal	0.36
Comilla	0.20	Kishoreganj	0.36	Naogaon	0.20	Sunamganj	0.36
Cox's Bazar	0.28	Kurigram	0.36	Netrakona	0.36	Sylhet	0.36
Dhaka	0.20	Kushtia	0.20	Nilphamari	0.12	Tangail	0.28
Dinajpur	0.20	Lakshmipur	0.20	Noakhali	0.20	Thakurgaon	0.20
Faridpur	0.20	Lalmoinihat	0.28	Pabna	0.20		
Feni	0.20	Madaripur	0.20	Panchagarh	0.20		

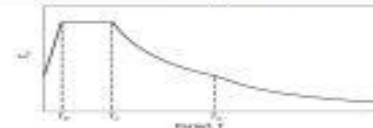
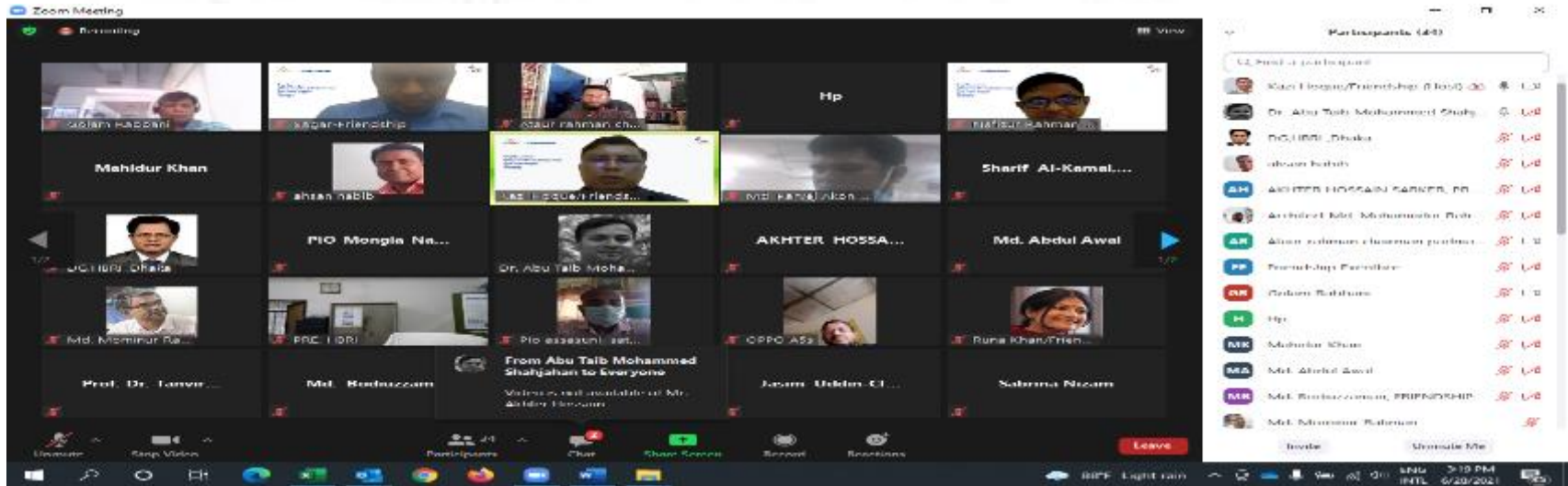


Figure 6.2.25 Typical shape of the elastic response spectrum coefficient C_e

- Consideration of local wind speed as per BNBC 2020 guidelines in house design
- Consideration of local Seismic Zone as per BNBC 2020 Guideline in house design

Design Finalize by Zoom webinar on 10th August

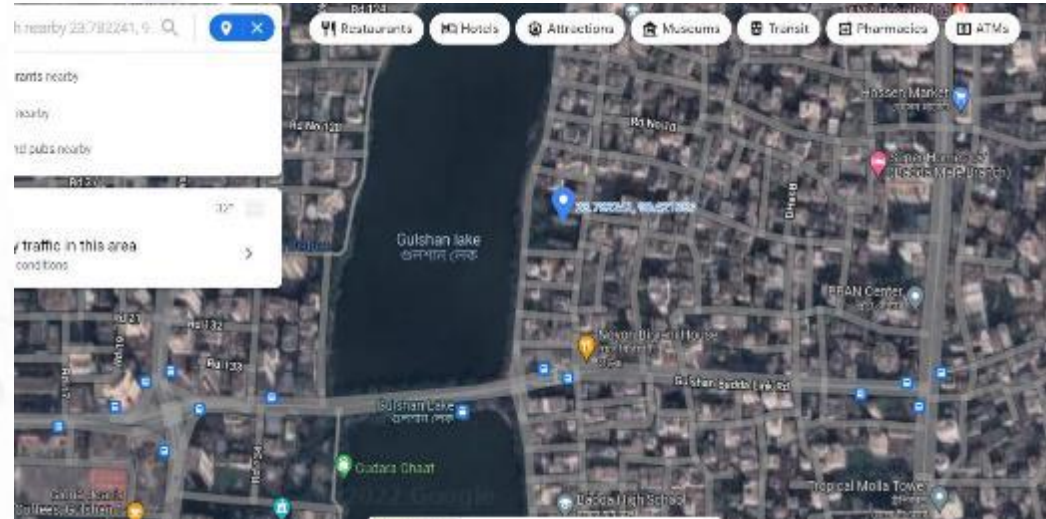


Technology transfer in community:



Ferro-cement Channel Manufacturing

Reference: Housing Authority Staff Quatre on Gulshan-1 (Constructed on 1984)



Using Local Resources and Alternative Technologies



Sand collected from nearby river for block manufacturing



Sand, cement and chemical (ASTM C-494) mixing by hand for block manufacturing



Mortars are fed into dies to produce blocks



Completed Blocks



Block strength tested in HBRI lab.

Laboratory Test Report of Hollow Block

Sl. No.	Test	Result (psi)	Average compressive strength (psi)	Remarks
01.	Compressive Strength	750	790	Unsealed Sample
		815		
		810		
02.	Water absorption	6.8%	6.8%	
		6.7%		
		7.1%		

Compressive Strength and Water Absorption Test Report

Houses Construction Process at a Glance



Layout Finalize



Earthwork on Excavation



All Frame & Structures works



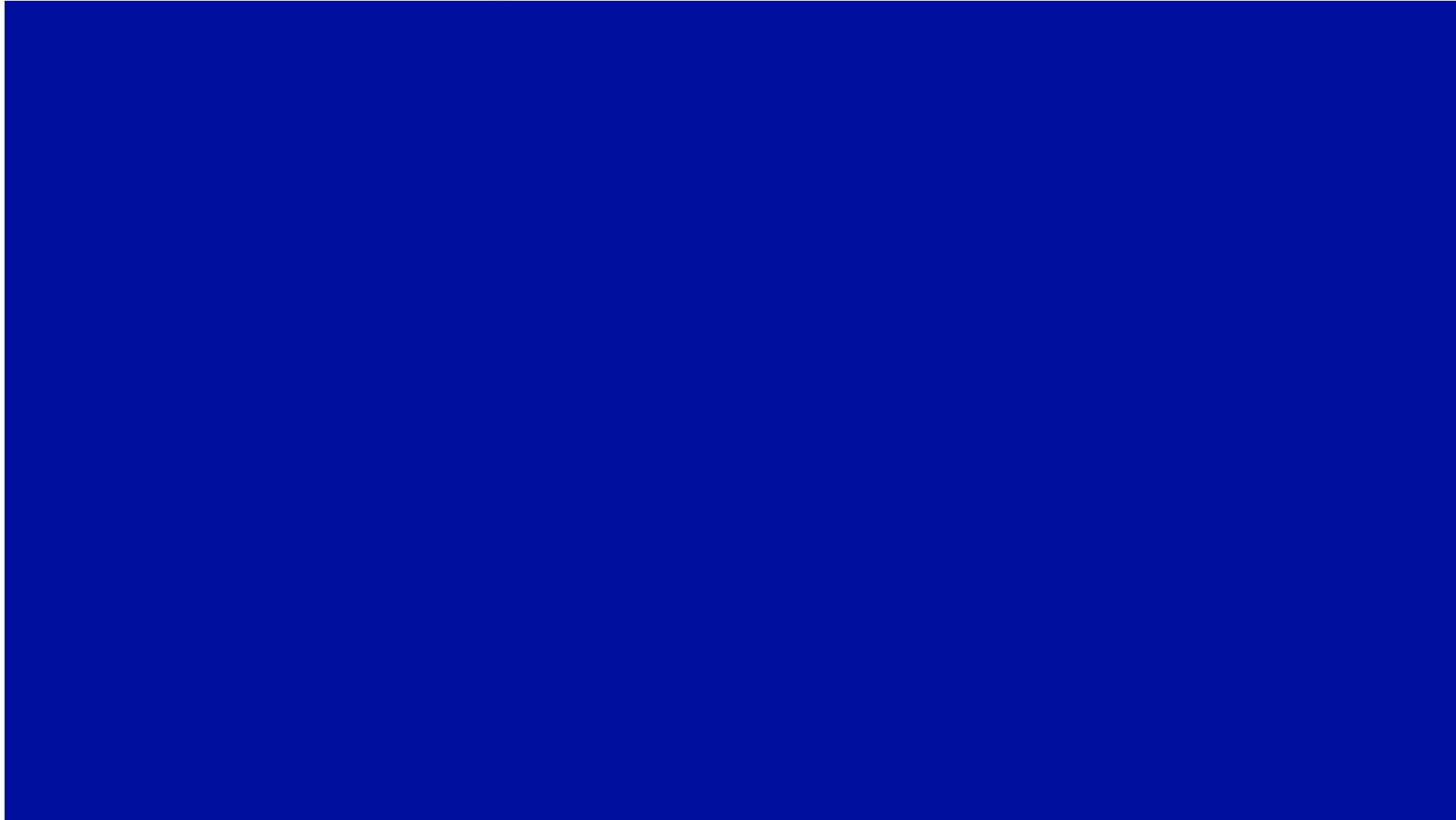
Block, Ferro-Cement Channel and Stair Installed in Building



Houses Construction Process at a Glance



Completed Houses



Site visit by Govt. Official



Mr. Md. Yeanur Rahman, UNO Assasuni has visited Cyclone Resilient House

Mr. Aktar Hosain, UNO Shyamnagar has visited Cyclone Resilient House



Different between Traditional Building vs Cyclone Resilience House:

Srl	Facilities and Advantage	Answer
01	Environmentally Friendly materials use	Yes
02	Wind Load Capacity	Maximum 240-260 Km/hr
03	Salinity and rust resistant	Yes
04	Rain water harvesting facility inside the building	Yes (Permanently 3600 Ltr. Capacity)
05	Safe from tidal surges (Floor height formation From Previous Highest Tidal surges level to 8 feet)	Yes
06	Secure in cyclone period	Yes
07	Toilet and safe water supply in times of disaster	Yes
08	Cattle space during cyclone period	Yes
09	Maintenance and Repair	Simple and cost effective
10	Unit cost (Approximate)	1450/sft

Reflection on Community

Srl. No	Name of Person	Detail Address	Upazila	District	Status
01	Hasan Shekh	Chowridanga, Mithahali	Mongla	Bagerhat	On going
02	Md. Zakir	Moylapota Mor, Mongla Port Munciple Area	Mongla	Bagerhat	On going
03	Md. Zakaria Shekh	Chowridanga, Mithahali	Mongla	Bagerhat	Start soon
04	Md. Shohag	East side of Tiger Hotel, Mongla Port	Mongla	Bagerhat	Start soon
05	Md. Alauddin Shaikh	Ulubunia. Parikhali	Mongla	Bagerhat	On going
06	Md. Habibur Rahman	Chakla Purbo Para, Prapatnagar	Asasuni	Satkhira	Start Soon
07	Md. Shariful Shekh	Majherati	Koira	Khulna	Start Soon
08	Yusuf Mahori	Nojibpur, Mohipur	Kalapara	Patuakhali	Start Soon
09	Himu	Rahmatpur	Kalapara	Patuakhali	Start Soon

Challenges/Required Issues

- Materials transportation big challenges due to the remote locations.
- Shortage of construction labour.
- Construction materials price are Increase due to the international political unrest.
- A new technology transfer among unskilled manpower.

Way Forward

- The houses will conduct the research of HBRI and various public and private universities for the next 2 years.
- Capacity development of local community who will be involved to construct those house.
- Technical assistance will be provided to those interested in constructing these houses.
- Advocacy with different GO and NGO to promote this concept.

Thank You