CHAPTER 1

BACKGROUND AND HISTORY OF THE PROJECT

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1-1 Background and History of the Project

Cyclone Sidr, one of the largest cyclones ever recorded, hit Bangladesh from November 15 to 16, 2007, causing damage in 30 out of the country's 64 districts. According to the announcement made by the Bangladeshi government on December 17 that year, the number of people affected by the cyclone was 8,920,000, the number of fatalities was 3,363, and 871 persons were recorded as missing. Damage was especially severe in the four districts (Pirojpur, Patuakhali, Bagerhat and Barguna) where the cyclone made landfall.

JICA dispatched the Bangladesh Cyclone Disaster Reconstruction Needs Assessment Study Team from December 8 to December 18 to facilitate the smooth implementation of grant aid for disaster prevention and reconstruction, and the Study Team gauged the extent of damage, confirmed medium and long-term needs concerning recovery and reconstruction, and examined the support (financial cooperation and technical cooperation) required in the recovery and reconstruction stage. Based on the results of the needs assessment, out of the medium and long-term support needs, there is an absolute deficiency in the number of cyclone shelters and, considering reports that many residents were unable to evacuate during Sidr too, this is the area that requires the highest priority support. Accordingly, in response to the request from the Government of Bangladesh for Grant Aid for Disaster Prevention and Reconstruction, an outline design study regarding the construction of cyclone shelters will be implemented in the four worst affected prefectures.

The original request dated December 17, 2007 included the construction of 40 cyclone shelters and 40 km of access roads, however, in February 2008, 50 schools were presented as candidate sites for cyclone shelters and these contents were confirmed in the minutes signed on March 4, 2008.

Table 1-1 List of Candidate Sites as of March 2008

No		District	Upazila	Union	Code No.	Name of school
1	A1	Pirojpur	Zianagar	Balipara	502031108	Badarpur Govt. Primary School
2	A2	Pirojpur	Zianagar	Balipara	502031106	Maddha Char Balashar Govt. Primary School
3	A3	Pirojpur	Zianagar	Balipara	502031111	Pachim Kolaron Govt. Primary School
4	A4	Pirojpur	Sadar	Kalakhali	502030403	Pantadubi-2 Govt. Primary School
5	A5	Pirojpur	Sadar	Kalakhali	502030407	Daudpur Chalpakuria Govt. Primary School
6	A6	Pirojpur	Sadar	Shariktala	502030608	Keshorota Govt. Primary School
7	A7	Pirojpur	Sadar	Sikdarmollik	502030106	Jugkhola Muria Govt. Primary School
8	A8	Pirojpur	Mathbaria	Gulisakhali	502050208	Kabaturkhali Govt. Primary School
9	A9	Pirojpur	Mathbaria	Shaplaza	502051105	Nali Charakgachia Govt. Primary School
10	A10	Pirojpur	Bhandaria	Telikhali	502040307	32 No. Harinpala-2 Govt. Primary School
11	A11	Pirojpur	Bhandaria	Bhandaria	502040606	72 No. Uttar Purbo Bhandaria Govt. Primary School
12	A12	Pirojpur	Kawkhali	Kawkhali	502010310	28 No. Choto Biraljuri Govt. Primary School
13	A13	Pirojpur	Kawkhali	Saina Ragunatpur	502010204	14 No. Maddha Sonakur Govt. Primary School
14	B1	Patuakhali	Galachipa	（Amkhola） ***Char Montaz****	505020106	Algi Tafalbaria Govt. Primary School cum Cyclone Shelter.
15	B2	Patuakhali	Galachipa	(Rangabali) ***Uttor Char****	505020604	Amlibari Govt. Primary School cum Cyclone Shelter.
16	B3	Patuakhali	Galachipa	Char Bishaws	505021404	Purbo Char Bishaws Govt. Primary School cum Cyclone Shelter.
17	B4	Patuakhali	Dosmina	Rongopaldi	505030401	Patarchar Govt. Primary School cum Cyclone Shelter
18	B5	Patuakhali	Mizagonj	Mazidbaria	505060109	Voyang Govt. Primary School cum Cyclone Shelter
19	B6	Patuakhali	Kolapara	Dhankhali	505010903	Uttar Debpur Govt. Primary School cum Cyclone Shelter
20	B7	Patuakhali	Kolapara	Dulasar	505010703	Charchapoli Govt. Primary School cum Cyclone Shelter
21	B8	Patuakhali	Kolapara	Khaprabangha	505010607	Maherpur Govt. Primary School cum Cyclone Shelter
22	B9	Patuakhali	Sadar	Chotobeghai	505041203	Mati Bhanga Govt. Primary School cum Cyclone Shelter
23	B10	Patuakhali	Bauphal	Konaskdia	505050206	49 No. Kolta Govt. Primary School cum Cyclone Shelter
24	B11	Patuakhali	Bauphal	Madonpura	505050305	65 No. Purba Madonpura Govt. Primary School cum Cyclone Shelter.
25	B12	Patuakhali	Bauphal	(Nazirpur) ***Kalaiya****	(505050913) ***505050602****	***Purba Kalaiya**** (Charrayshaeb) Govt. Primary School cum Cyclone Shelter.
26	C1	Barguna	Betagi	Sarisamari	504050708	Gabtali Govt. Primary School
27	C2	Barguna	Patharghata	Patharghata Sader	504020709	27 No. Badurtala Govt. Primary School
28	C3	Barguna	Patharghata	Patharghata Sader	504020707	25 No. Simlatala Govt. Primary School
29	C4	Barguna	Patharghata	Kathaltoli	504020106	56 No. Burjukpur Govt. Primary School
30	C5	Barguna	Patharghata	Charduani	504020302	12 No. Sairabad Govt. Primary School
31	C6	Barguna	Sadar	Noltona	504031008	Nishanbaria Govt. Primary School
32	C7	Barguna	Sadar	M.Baliatoli	504030910	Sonbunia Govt. Primary School

No		District	Upazila	Union	Code No.	Name of school
33	C8	Barguna	Sadar	Noltona	504031003	Garjonbunia Govt. Primary School
34	C9	Barguna	Amtali	Borobogi	504010905	Sakhina Govt. Primary School
35	C10	Barguna	Amtali	Borobogi	504010901	Satonpara Govt. Primary School
36	C11	Barguna	Amtali	Pochakoirdin	504010806	Gabtali Govt. Primary School
37	C12	Barguna	Amtali	Arpangasia	504010205	Baliataia Govt. Primary School
38	C13	Barguna	Bamna	Ramna	504040306	Goalghata Govt. Primary School
39	D1	Bagerhat	Sharankhola	Khontakata	212090103	South Nalbunia Govt. Primary School
40	D2	Bagerhat	Sharankhola	Khontakata	212090105	B. Janerpar Govt. Primary School
41	D3	Bagerhat	Sharankhola	Dhansagor	212090104	B. Dhansagor Govt.Primary School
42	D4	Bagerhat	Morrelgonj	Putikhali	210070403	Sonakhali Govt. Primary School
43	D5	Bagerhat	Morrelgonj	Hoglabunia	210071006	80 No. B. Pathtamara Govt. Primary School
44	D6	Bagerhat	Morrelgonj	Ramchandrapur	210070202	31 No. Small Kumerkhali Govt. Primary School
45	D7	Bagerhat	Morrelgonj	Panchakaron	210070308	13 No. South Kharykhali Govt. Primary School
46	D8	Bagerhat	Sadar	Bemorta	210040210	Bergazalia Govt. Primary School
47	D9	Bagerhat	Sadar	Bemorta	210040202	Aurjunbahar Govt. Primary School
48	D10	Bagerhat	Mongla	Chandpai	210060203	Chandpai Govt. Primary School
49	D11	Bagerhat	Mongla	Mithakhali	210060306	Kasherdanga Govt. Primary School
50	D12	Bagerhat	Rampal	Vospatia	210080904	Dalipara Govt. Primary School

* Lettering in parenthesis was replaced to bold lettering in italics indicates because of communication mistakes.

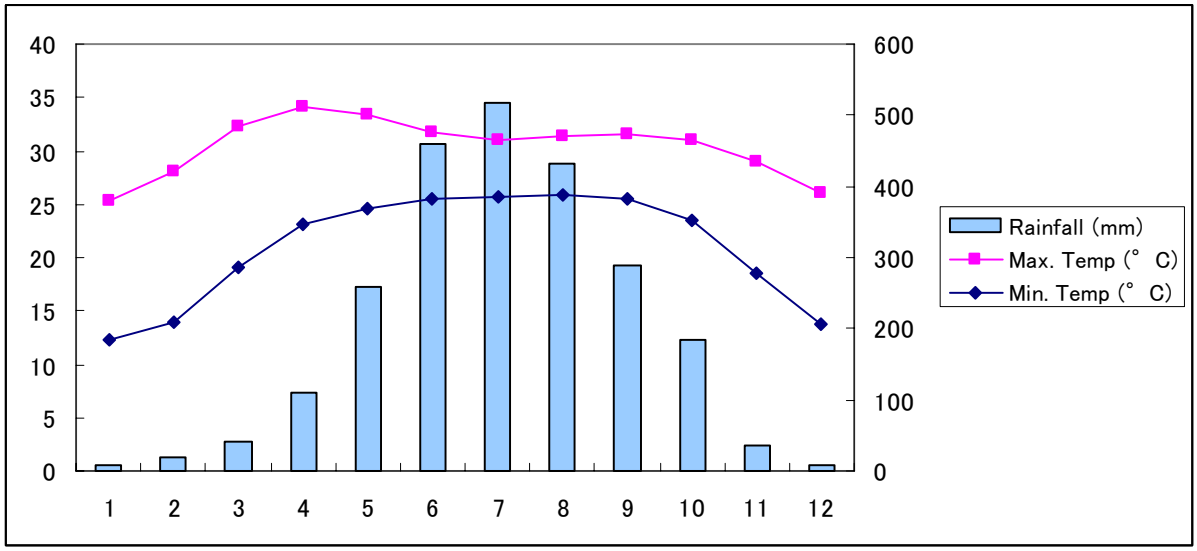
1-2 Natural Conditions

(1) Geographical Features

Bangladesh is located in South Asia between north latitude 20°21″～26°38″and east longitude 88°01″～92°41″; it shares borders with India to the west and the north and with Myanmar to the southeast, while the southern side of the country faces onto the Bay of Bengal. The national land area is 147,570km^2 and the population is 144.3 million (according to the World Bank 2006). The national land of Bangladesh consists of the world's largest delta formed by the three great rivers of the Ganges, Brahmaputra and Megna, and alluvial plains with elevation of no more than 9 m comprise 80% of the country. Almost all of the national land area is lowland with elevation of 10 m or less, and countless rivers and their tributaries run the length and breadth of the country.

(2) Meteorological Conditions

Bangladesh has a typical subtropical monsoon climate generally comprising cool and arid winters (October to March), hot and humid summers (April to May) and a rainy season (June to September) when short bursts of torrential rain and cyclones occur. Coastal areas are confronted with the greatest damage due to the combination of land submersion caused by storm surges, coastline erosion and cyclone damage. These areas are in a rainy zone with annual rainfall reaching 2,500~3,000 mm, and approximately 90% of this is concentrated into the rainy season. Moreover, cyclones frequently strike the country before and after the rainy season.



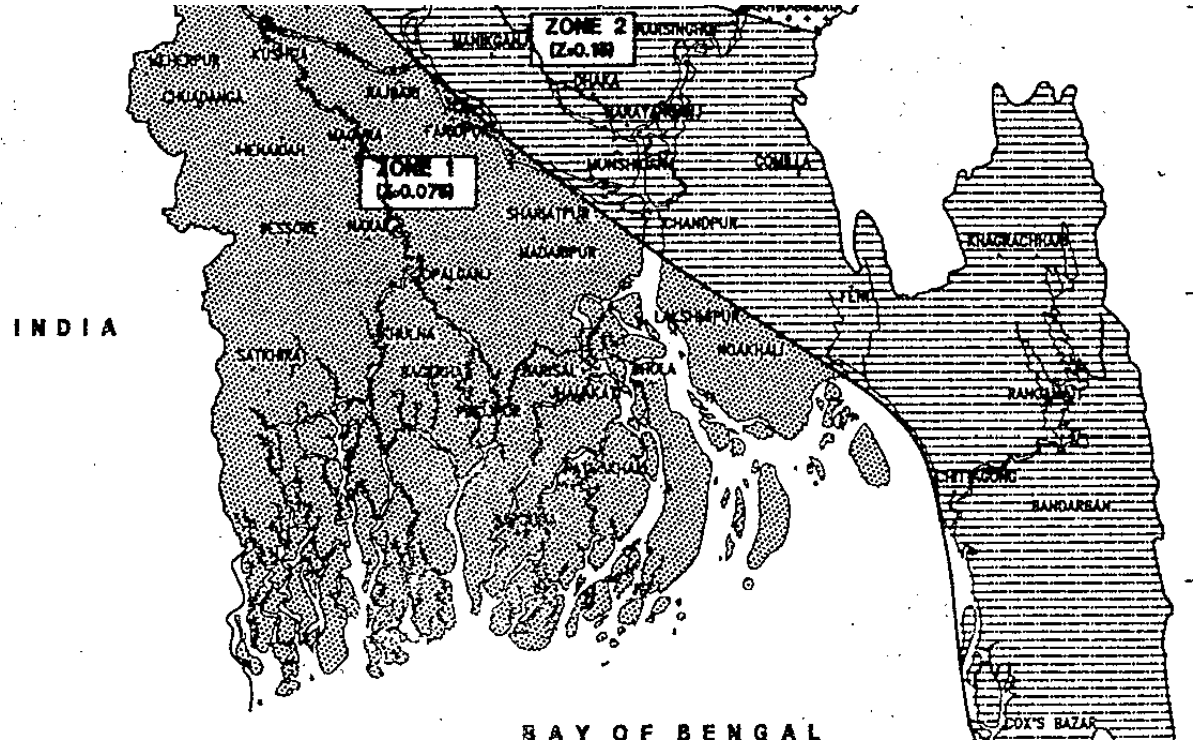
(Source: Bangladesh Meteorological Department)

Figure 1-1 Bangladesh Maximum and Minimum Temperatures and Precipitation

(3) Earthquakes

There are no official records of major earthquakes occurring in Bangladesh. The Project target area stretches from the south to the southwest of the country and belongs to a low probability seismic zone compared to other countries in Southwest Asia.

The project area is covered in the Seismic Zone 1 in the Bangladesh National Building Code.



Source: Bangladesh National Building Code (BNBC)

Figure 1-2 Bangladesh Earthquake Zones

1-3 Environmental and Social Considerations

The Project entails the construction of cyclone shelters cum primary schools on the sites of existing primary schools in mainly rural villages. Septic tanks will be installed for toilets and will basically have no negative environmental impacts. Moreover, materials containing asbestos will not be used.

CHAPTER 2

CONTENTS OF THE PROJECT

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2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Goals

(1) Superior Plan

Bangladesh announced the National Strategy for Economic Growth, Poverty Mitigation and Social Development in March 2003 as the national programme to take the place of the sixth five-year plan. Within this it continues to treat poverty mitigation and development of human resources as priority sectors, while “mitigation of damage from natural disasters” has also been added. In particular, concrete measures for averting and mitigating risk of natural disasters for people living in risk areas are proposed as follows:

- Preparation of action plans and guidelines for disaster prevention and management
- Improvement in the practical capability of management personnel regarding measures and warnings for averting danger as well as relief and recovery activities following disasters.
- Construction of social infrastructure including shelters and telecommunications facilities in villages

Frequently occurring cyclones have caused immense losses of precious human life, livestock and property in the low-lying alluvial belt of Bangladesh facing onto the Bay of Bengal. Following the major disaster that occurred in 1991, the Master Plan concerning multipurpose cyclone shelters was compiled in July 1993 with the cooperation of the World Bank and the UNDP. It was planned to construct cyclone shelters that could also be used as education facilities at normal times. Moreover, the National Plan for Disaster Management 2007-2015 is currently being formulated.

(2) Current Conditions and Problems in the Target Sector

Whereas cyclones in the past largely struck the eastern part of Bangladesh, Cyclone Sidr made landfall in the central part of the country and caused extensive damage to areas classed as Risk Areas and High Wind Areas (less hazardous than High Risk Areas) according to the said Master Plan. So far approximately 1,700 cyclone shelters have been constructed through support from various donors, however, Bangladesh is still said to be in need of a further 2,000 shelters.

In particularly, it is urgently necessary to promote the construction of cyclone shelters and mitigate the risk of cyclone damage for residents living in the Project target areas, which have a shortage of such shelters and suffered massive damage during Cyclone Sidr despite not even

being ranked as High Risk Areas. At the same time, through constructing multipurpose cyclone shelters that can be used as education facilities at normal times in schools that have suffered cyclone damage and have a shortage of classrooms, it is necessary to provide classrooms that offer safety during disasters and thereby improve the primary education environment.

(3) Objectives of the Project

The Project aims to mitigate damage incurred by residents during cyclone disasters through constructing multipurpose cyclone shelters in the four districts (Pirojpur, Patuakhali, Bagerhat and Barguna) that were hardest hit by Cyclone Sadr.

<Superior Goal>

Improvement in the lifestyles of residents living around cyclone shelters

<Project Goal>

Mitigation of the risk of cyclone damage for residents living around cyclone shelters.

<Anticipated effects of the target project>

Construction of multipurpose cyclone shelters

<Indicators of project outputs>

1) Increase in the number of people evacuated when cyclone warnings are issued
2) Increase in the number of pupils receiving lessons in safe and proper classrooms

2-1-2 Outline of the Project

(1) Contents of the Request to Japan

1) Construction of 40 multipurpose cyclone shelters
2) Construction of 40 km of access roads

(2) Status of the Target Project

The Project intends to construct facilities for the mitigation of cyclone damage in order to realize the said superior goal. As a result, it is anticipated that the risk of suffering damage due to cyclone disasters will be reduced for citizens living around the cyclone shelters. Within this, the target project aims to construct multipurpose cyclone shelters in the target areas. Concerning the construction of 40 km of access roads, it has been agreed that this will be undertaken by the Bangladeshi side.

(3) Undertakings of the Recipient Country

- Securing of land
- Demolition and removal of deteriorated buildings and obstructions on the cyclone shelter

construction sites
- Payment of taxes
- Payment of bank commission fees
- Cooperation to supervision of the works

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Concept

In view of the request of the Government of Bangladesh and the findings of the needs assessment survey, field survey and discussions, the Project was compiled based on the following principles.

- The shelters shall comprise structures that are capable of withstanding the strong winds and storm surges of cyclones.
- Based on the standard design for cyclone shelters cum primary schools in Bangladesh, the facilities shall serve as shelters during cyclones and as primary schools at normal times.
- In consideration of the local climate characterized by high temperatures and high humidity, facilities shall be designed with good natural ventilation and shade against sunlight.
- Effort shall be made to utilize local resources (materials and human resources, etc.) and reduce costs through adopting rational designs.
- Quality shall be secured through conducting appropriate supervision during design and works execution.

Since it is vitally important that the completed facilities are maintained in good condition at normal times, the Project shelters shall be constructed on the sites of public primary schools, where it is possible to make sufficient use of the existing facility management organizations. Out of 50 schools that were indicated by the Bangladesh side, 38 schools have been selected for shelter construction based on 10 selection criteria including availability of construction site, existence of evacuation facilities or sites (either existing or planned), existence of facilities management committees, and so on.

(1) Criteria for Selecting Target Schools

The Project shall target the four districts of Pirojpur (5 upazilas), Patuakhali (6 upazilas), Barguna (5 upazilas) and Bagerhat (6 districts) covering 22 upazilas in total. The Bangladeshi request initially targeted 50 schools in the four districts, however, based on the findings of the field surveys, the following selection criteria were adopted to arrive at a more appropriate project scale.

Schools that contain or are adjacent to existing cyclone shelters capable of use, and schools that have solid public structures capable of handling evacuations shall be omitted. However, sites where the capacity of evacuation facilities is far less than the population requiring evacuation,

and primary schools where the number of classrooms is far too few compared to the number of students shall be targeted.

When building sites do not offer sufficient area to construct the new cyclone shelters, such sites shall be omitted from the project.

Table 2-1 Site Selection Criteria

1.	The site shall be the site of a government primary school which is managed by the central government.
2.	The site shall be located in the cyclone affected area.
3.	The site shall not have a solid building or hill of sufficient size and height to provide a reliable evacuation site within a 1.5km radius of the site.
4.	The site shall have a sufficient land area for the construction of a multipurpose cyclone shelter and the central government shall have secured land ownership of the site.
5.	It is highly unlikely that the site will be eroded by a change of the river course. (*See A).
6.	The site shall not be associated with a similar project or plan of the Government of Bangladesh or a foreign aid organization or a donor country for cyclone shelter construction.
7.	The site shall allow access by vehicle or boat for the transportation of construction materials to the site.
8.	The site shall have an operating primary school with teachers, administrative staff and students and it is judged that the facilities to be newly constructed will be fully used as primary school facilities during normal times.
9.	The site shall already have a school management committee (SMC) capable of maintaining the new facilities and equipment.
10.	There is a killa (*See B) near the site or it is possible to construct a killa near the site according to the needs of the inhabitants by Bangladesh side.

A: The LGED and the Study Team will collaborate to study the risky site of erosion to be excluded.
B: A killa is mounding area for the temporary evacuation of livestock, etc. at the time of a cyclone.

(2) Omitted Schools and Reasons for Omission

Upon adopting the aforementioned selection criteria, the following 12 schools were omitted from the Project. Quality of access, which is one of the major selection criteria, is a problem for all the schools. In reality, though, construction works were deemed to be possible because all the schools consist of reinforced concrete buildings, albeit single story structures. Similarly, all the areas in question have suffered major cyclone damage in the past and were deemed to be cyclone risk areas. Accordingly, the target schools were narrowed down upon determining the order of priority based on the two points of 1) existence of multi-story buildings deemed capable of serving as evacuation facilities on or adjacent to the existing school site, and 2) availability of construction site.

Table 2-2 List of Schools Omitted from the Project

No.	School	District	Upazila	Reason
No.4	Bantadobi GPS	Pirojpur	Sadar	Insufficient site area for shelter construction
No.10	Harinpala-2 GPS	Pirojpur	Bhandaria	The existing cyclone shelter on the school grounds is deemed adequate for evacuation purposes.
No.18	Voyang GPS	Patuakhali	Mizagonj	The primary school is combined with a relatively large senior high school building, and this is deemed adequate for evacuation purposes.
No.20	Charchapoli GPS	Patuakhali	Kolapara	A deteriorated cyclone shelter already exists on the school grounds and the school itself is a 2-story building, so these facilities are deemed adequate for evacuation purposes.
No.28	Simlatala GPS	Barguna	Patharghata	The primary school only has 63 students and exists on the same site as a senior high school, however, this is a 2-story building and is deemed adequate for evacuation purposes.
No.33	Garjonbunia GPS	Barguna	Sadar	The primary school is combined with a relatively large 2-story senior high school building, and this is deemed adequate for evacuation purposes.
No.39	South Nalbunia GPS	Bagerhat	Sharankhola	The existing cyclone shelter on the school grounds is deemed adequate for evacuation purposes.
No.40	Janerpar GPS	Bagerhat	Sharankhola	The existing cyclone shelter on the school grounds is deemed adequate for evacuation purposes.
No.41	Dhansagor GPS	Bagerhat	Sharankhola	The existing cyclone shelter on the school grounds is deemed adequate for evacuation purposes.
No.47	Aurjunbahar GPS	Bagerhat	Sadar	The site area is too restricted to allow construction works.
No.49	Kasherdanga GPS	Bagerhat	Mongla	A 2-story secondary school exists next to the primary school, and this is deemed adequate for evacuation purposes.
No.50	Dalipara GPS	Bagerhat	Rampal	The site is restricted and at risk from erosion because it faces onto a river; therefore, it is deemed unsuitable for new facility construction.

(3) Deep Wells

(3)-1 Conditions in the Study Target Areas

As deep well models, the ground-installed No. 6 pump type, which is common in Bangladesh, and the Tara-II pump type that possesses high pumping capacity can be considered. In the Project, an appropriate pan shall be compiled upon implementing comparison from the viewpoints of cost, pumping capacity and maintenance while considering the characteristics of the cyclone shelters.

Almost all deep wells at the target schools use the No. 6 pumps (1.5 inch diameter) that are widely used in the local area. The features of No. 6 pump and Tara-II pump deep wells are as indicated in Table 2-3, however, in plans to install pumps on the second floors of shelters so that they can be used during cyclones, it is better to adopt Tara-II pumps because they have higher pumping capacity than No. 6 pumps. However, since Tara-II pumps have hardly ever been adopted and no operators handle this type of pump in the Project target area, it has been confirmed that problems will remain in terms of operation and maintenance following supply and it will not be easy to procure spare parts and so on. Moreover, since schools are locked at

nighttime and on school holidays, local citizens will not be able to use pumps if they are installed on the second floors of schools. On the other hand, No. 6 pumps, which are widely adopted in the local area, are cheap and easy to maintain; moreover, since the field survey's findings show that School Management Committees (SMCs) can afford to maintain these pumps and have long experience in their use, No. 6 pumps shall be adopted in the Project. In cases of two-story buildings, the students can pump water from ponds or wells by bucket and save it for use in toilets at normal times. During cyclones, toilets can be used by keeping more pumped water on hand. Also, pumps can be saved from submersion during flooding by installing them 90 cm above the ground on pilotis floors. Wells that are independently installed above ground have previously been damaged by floating debris during cyclones, however, risk of damage can be reduced through installing on pilotis.

Moreover, during the rainy season and at times of cyclones, it shall be planned so that rainwater above stairways is directed towards water collection tanks and piped to sinks alongside toilets for reuse.

(3)-2 Confirmation of Aquifers on the Candidate Project Sites

Concerning the existence of aquifers on the candidate project sites, Table 2-4 shows the findings obtained in interviews with the Executive Engineer in the headquarters of the Department of Public Health Engineering (PHE) and the results confirmed by the Executive Engineer in each union.

The details are as follows.

Pirojpur : Out of 13 sites, 6 sites were confirmed to have aquifers (275 m or deeper) suited to deep wells. The other sites, however, have no aquifers suitable for providing potable water.

Patuakhali : All 12 sites were confirmed to have aquifers (285 m or deeper) suited to deep wells.

Barguna : Out of 13 sites, 6 sites were confirmed to have aquifers (270 m or 285 m or deeper) suited to deep wells. The other sites, however, have no aquifers suitable for providing potable water.

Bagerhat : Out of 12 sites, only 2 sites were confirmed to have aquifers (228 m or deeper) suited to deep wells. The other sites, however, have no aquifers suitable for providing potable water.

Accordingly, out of the original 50 candidate project sites, only 26 were confirmed to have aquifers appropriate for the excavation of deep wells.

Table 2-3 Comparison of Deep Wells

	Type of Well	Cost	Pump Head	Maintenance	Overall Assessment	Remarks (Well Structure)
If installed above ground	No. 6 pump	○ Cost is cheap.	○ Pump head is 25 ft (7.6 m), therefore, the pump can comfortably raise water if installed on the ground.	○ This type is widely used in the southwest of Bangladesh especially the 4 districts targeted in the project; accordingly, the setup for procuring spare parts and conducting repairs is in place.	○ There are numerous cases of ground installation and the cost of this is cheap. This type of pump may be rendered useless after a cyclonic storm surge.	<Current conditions> Excavation diameter: 4” Depth: Approx. 300m Casing / screen: ϕ 1.5” It is not usually installed with gravel packing and sealing, however, there is a risk of contamination.
If installed on the shelter 2nd floor	No. 6 pump	○ Cost is cheap.	× Since the pump head is only 25ft (7.6 m), this is insufficient to raise water if installed on the second floor of a shelter at a height of 4 m or more.	○ This type is widely used in the southwest of Bangladesh especially the 4 districts targeted in the project; accordingly, the setup for procuring spare parts and conducting repairs is in place.	× Water is produced soon after installation, however, the pump soon breaks down because it can’t withstand the pressure.	<Current conditions> Excavation diameter: 4” Depth: Approx. 300m Casing / screen: ϕ 1.5” It is not usually installed with gravel packing and sealing, however, there is a risk of contamination.
	Tara-II pump	△ Cost is much higher than No. 6 pump.	○ Since the pump head is high (120 ft ≒36m), the pump can comfortably raise water even when installed on the second floor of a shelter.	× Although this pump takes VLOM (Village Level Operation & Maintenance) into account, it is not widely used in the southwest of Bangladesh. It is difficult to procure spare parts and the repair setup is not established on the upazila and district levels.	× The maintenance setup including purchase of spare parts following construction is a problem.	Excavation diameter: 6” Depth: 300m Casing: 3”/1.5” Screen: 1.5”

Legend ○: Good, △: Conditional, ×: Poor

(3)-3 Outline

The current conditions regarding aquifers and wells are as indicated below. Table 2-4 shows the general situation.

- In the four target districts, aquifers exist at depths of 250m~400m (300 m is common), and since there are generally no rock formations at such depths, the aquifers can be reached by manual excavation.
- Aquifers do not exist in some areas (see the DPHE materials for an outline).
- In Bagerhat and Pirojpur, there are no Tara-II pumps at all. No. 6 pumps are used in all cases here.

- An operator that handles Tara-II pumps can be found in Khulna, however, it doesn't understand the technical contents of the pumps.
- Shallow wells in half of the districts in Bagerhat draw water containing salt and arsenic, although there are some shallow wells that don't have this problem. (However, risk of bacterial contamination is high).
- No. 6 pumps cannot be installed on the second floors of shelters because they don't have sufficient head. Two such pumps were observed in the field survey, however, they were both broken.
- Tara-II pumps are expensive, require many parts, entail high maintenance costs and are difficult to maintain.

Table 2-4 Deep Well Aquifers in the Study Target Area

No		District	Upazila	Union	School	Existing well condition	Deep aquifer
1	A1	Pirojpur	Zianagar	Balipara	Badarpur Govt. Primary School	○ Shallow	×
2	A2	Pirojpur	Zianagar	Balipara	Maddha Char Balashar Govt. Primary School	× no well	×
3	A3	Pirojpur	Zianagar	Balipara	Pachim Kolaron Govt. Primary School	× no well	×
4	A4	Pirojpur	Sadar	Kalakhali	Pantadubi-2 Govt. Primary School	△ Broken	○ (Aquifer:275m)
5	A5	Pirojpur	Sadar	Kalakhali	Daudpur Chalpakuria Govt. Primary School	× no well	○ **(Aquifer:275m)**
6	A6	Pirojpur	Sadar	Shariktala	Keshorota Govt. Primary School	○ Deep	○ (Aquifer:275m)
7	A7	Pirojpur	Sadar	Sikdarmollik	Jugkhola Muria Govt. Primary School	× no well	×
8	A8	Pirojpur	Mathbaria	Gulisakhali	Kabaturkhali Govt. Primary School	△ Broken	×
9	A9	Pirojpur	Mathbaria	Shaplaza	Nali Charakgachia Govt. Primary School	× no well	×
10	A10	Pirojpur	Bhandaria	Telikhali	32 No. Harinpala-2 Govt. Primary School	× no well	×
11	A11	Pirojpur	Bhandaria	Bhandaria	72 No. Uttar Purbo Bhandaria Govt. Primary School	× no well	○ **(Aquifer:275m)**
12	A12	Pirojpur	Kawkhali	Kawkhali	28 No. Choto Biraljuri Govt. Primary School	○ Deep	○ (Aquifer:275m)
13	A13	Pirojpur	Kawkhali	Saina Ragunatpur	14 No. Maddha Sonakur Govt. Primary School	× no well	○ **(Aquifer:275m)**
14	B1	Patuakhali	Galachipa	Char Montaz*	Algi Tafalbaria Govt. Primary School cum Cyclone Shelter.	○ Deep	○ (Aquifer:285m)
15	B2	Patuakhali	Galachipa	Uttor Char*	Amlibari Govt. Primary School cum Cyclone Shelter.	× no well	○ **(Aquifer:285m)**
16	B3	Patuakhali	Galachipa	Char Bishaws	Purbo Char Bishaws Govt. Primary School cum Cyclone Shelter.	× no well	○ **(Aquifer:285)**
17	B4	Patuakhali	Dosmina	Rongopaldi	Patarchar Govt. Primary School cum Cyclone Shelter	× no well	○ **(Aquifer:285)**
18	B5	Patuakhali	Mizagonj	Mazidbaria	Voyang Govt. Primary School cum Cyclone Shelter	○ Deep	○ (Aquifer:285/300m)
19	B6	Patuakhali	Kolapara	Dhankhali	Uttar Debpur Govt. Primary School cum Cyclone Shelter	× no well	○ **(Aquifer:285m)**
20	B7	Patuakhali	Kolapara	Dulasar	Charchapoli Govt. Primary School cum Cyclone Shelter	× no well	○ (Aquifer:285m)
21	B8	Patuakhali	Kolapara	Khaprabangha	Maherpur Govt. Primary School cum Cyclone Shelter	×no well (○Mosque)	○ **(Aquifer:285m)**
22	B9	Patuakhali	Sadar	Chotobeghai	Mati Bhanga Govt. Primary School	×	○

No		District	Upazila	Union	School	Existing well condition	Deep aquifer
					cum Cyclone Shelter	no well	**(Aquifer:285m)**
23	B10	Patuakhali	Bauphal	Konaskdia	49 No. Kolta Govt. Primary School cum Cyclone Shelter	○ Deep	○ (Aquifer:285m)
24	B11	Patuakhali	Bauphal	Madonpura	65 No. Purba Madonpura Govt. Primary School cum Cyclone Shelter.	△ Broken (○Shallow)	○ **(Aquifer:285m)**
25	B12	Patuakhali	Bauphal	Kalaiya	Purba Kalaiya Govt. Primary School cum Cyclone Shelter.	× no well	○ **(Aquifer:285m)**
26	C1	Barguna	Betagi	Sarisamari	Gabtali Govt. Primary School	× no well	○ **(Aquifer:270m)**
27	C2	Barguna	Patharghata	Patharghata Sader	27 No. Badurtala Govt. Primary School	△ Broken	×
28	C3	Barguna	Patharghata	Patharghata Sader	25 No. Simlatala Govt. Primary School		×
29	C4	Barguna	Patharghata	Kathaltoli	56 No. Burjukpur Govt. Primary School	△ Broken	×
30	C5	Barguna	Patharghata	Charduani	12 No. Sairabad Govt. Primary School	× no well	×
31	C6	Barguna	Sadar	Noltona	Nishanbaria Govt. Primary School	× no well	×
32	C7	Barguna	Sadar	M.Baliatoli	Sonbunia Govt. Primary School	○ Deep	×
33	C8	Barguna	Sadar	Noltona	Garjonbunia Govt. Primary School	△ Broken	×
34	C9	Barguna	Amtali	Borobogi	Sakhina Govt. Primary School	△ Broken	○ **(Aquifer:297/300m)**
35	C10	Barguna	Amtali	Borobogi	Satonpara Govt. Primary School	×no well (○ high school)	○ **(Aquifer:297/300m)**
36	C11	Barguna	Amtali	Pochakoirdin	Gabtali Govt. Primary School	○ Deep	○ (Aquifer:297m)
37	C12	Barguna	Amtali	Arpangasia	Baliataia Govt. Primary School	× no well	○ **(Aquifer:297m)**
38	C13	Barguna	Bamna	Ramna	Goalghata Govt. Primary School	○ Deep	○ (Aquifer:286m)
39	D1	Bagerhat	Sharankhola	Khontakata	South Nalbunia Govt. Primary School	○ Shallow	×
40	D2	Bagerhat	Sharankhola	Khontakata	B. Janerpar Govt. Primary School	△ Broken	×
41	D3	Bagerhat	Sharankhola	Dhansagor	B. Dhansagor Govt.Primary School	○ Shallow	×
42	D4	Bagerhat	Morrelgonj	Putikhali	Sonakhali Govt. Primary School	× no well	×
43	D5	Bagerhat	Morrelgonj	Hoglabunia	80 No. B. Pathtamara Govt. Primary School	△ Broken	×
44	D6	Bagerhat	Morrelgonj	Ramchandrapur	31 No. Small Kumerkhali Govt. Primary School	× no well	×
45	D7	Bagerhat	Morrelgonj	Panchakaron	13 No. South Kharykhali Govt. Primary School	× no well	×
46	D8	Bagerhat	Sadar	Bemorta	Bergazalia Govt. Primary School	× no well	○ **(Aquifer:228m)**
47	D9	Bagerhat	Sadar	Bemorta	Aurjunbahar Govt. Primary School	△ Broken	○ (Aquifer:228m)
48	D10	Bagerhat	Mongla	Chandpai	Chandpai Govt. Primary School	× no well	×
49	D11	Bagerhat	Mongla	Mithakhali	Kasherdanga Govt. Primary School	△ Broken	×
50	D12	Bagerhat	Rampal	Vospatia	Dalipara Govt. Primary School	× no well	×

Legend: ○: A suitable aquifer exists; ×: No suitable aquifer exists (either there is no aquifer or it contains salt)
Shaded areas indicate selected schools.

(3)-4 Current Conditions and Necessity of Existing Deep Wells

The necessity of new deep wells shall be organized upon considering the current conditions of

deep wells and potable water and existence of aquifers in the study target schools. Schools in areas where there is no aquifer and schools that already have a deep well in good working order shall be omitted from the Project.

2-2-1-2 Design Concept Regarding the Natural Conditions

(1) Meteorological Conditions

In consideration of the meteorological conditions, the following concept shall be adopted:

- The execution period shall be set upon giving full consideration to the fact that work cannot be conducted during the rainy season.
- Considering the need to avoid damage caused by cyclone winds and the fact that shelters are used for evacuation during cyclones, roofs shall be made from reinforced concrete slabs. Lime terracing shall be applied to provide waterproofing.
- Iron windows and frame fittings shall be adopted in order to limit damage caused by cyclone winds.
- Since many of the construction sites are located along the coast, salt damage specifications shall be adopted for the paint materials used on interior and exterior walls.
- Since many districts located near the sea, concrete of specifications for salinity tolerance will be used.

(2) Wind Velocity

As a result of conducting analysis on past cyclone wind velocities and probable wind velocity, a wind velocity of 260 km/h (72.0 m/sec) will be adopted as the design wind velocity based on the Bangladesh National Building Code (BNBC).

(3) Seismic Load (horizontal force of inertia)

According to the BNBC, the country is divided into three seismic zones and the coefficient of the horizontal force of inertia is stipulated for each.

Zone 1 (south)	0.075
Zone 2 (center and east)	0.15
Zone 3 (north)	0.25

The Project target sites are located in Zone 1, where the coefficient is 0.075 in the BNBC guidelines.

In the Project design, there is not much difference between the load from cyclonic wind pressure and the seismic load. In the structural calculation, the dominant load will be adopted.

(4) Tide Level

With respect to storm surge analysis, by applying the method used in the Master Plan of the Multipurpose Cyclone Shelter Programme, tide level H1 (m) at cyclone shelter construction sites calculated according to the 50-year probability water level is as follows.

＜Tide level calculation results＞

H1 = H50 - (X-1) K + hw

H1: Tide level on site (m)
H50: Design surge height, 50-year return period (m) { 6.2 （C; Barguna, B: Patuakhali） / 5.3 （A; Pirojpur, D: Bagerhat）
X: Distance from coastline (km）
K: Rate of decrease in surge height (m/km) 0.33
hw: Amplitude of local wave from mean water level (m) ⇒ hw = [H50 - (X-1) K] * 1/4
hw = 1 （when hw < 1）

H1': 0 （when H1<0）
= H1 （when H1<H50）
= H50 （when H1>H50）

Site		H50 (m)	X (km)	K (m/km)	hw (m)	H1 (m)	**H1' (m)**
1	A1	5.3	55	0.33	1.00	-11.52	**0.00**
2	A2	5.3	58	0.33	1.00	-12.51	**0.00**
3	A3	5.3	58	0.33	1.00	-12.51	**0.00**
4	A4	5.3	85	0.33	1.00	-21.42	**0.00**
5	A5	5.3	82	0.33	1.00	-20.43	**0.00**
6	A6	5.3	72	0.33	1.00	-17.13	**0.00**
7	A7	5.3	85	0.33	1.00	-21.42	**0.00**
8	A8	5.3	40	0.33	1.00	-6.57	**0.00**
9	A9	5.3	40	0.33	1.00	-6.57	**0.00**
10	A10	5.3	52	0.33	1.00	-10.53	**0.00**
11	A11	5.3	67	0.33	1.00	-15.48	**0.00**
12	A12	5.3	80	0.33	1.00	-19.77	**0.00**
13	A13	5.3	82	0.33	1.00	-20.43	**0.00**
14	B1	6.2	20	0.33	1.00	0.93	**0.93**
15	B2	6.2	10	0.33	1.00	4.23	**4.23**
16	B3	6.2	45	0.33	1.00	-7.32	**0.00**
17	B4	6.2	36	0.33	1.00	-4.35	**0.00**
18	B5	6.2	45	0.33	1.00	-7.32	**0.00**
19	B6	6.2	27	0.33	1.00	-1.38	**0.00**
20	B7	6.2	1	0.33	1.55	7.75	**6.20**
21	B8	6.2	14	0.33	1.00	2.91	**2.91**
22	B9	6.2	46	0.33	1.00	-7.65	**0.00**
23	B10	6.2	70	0.33	1.00	-15.57	**0.00**
24	B11	6.2	63	0.33	1.00	-13.26	**0.00**
25	B12	6.2	60	0.33	1.00	-12.27	**0.00**
26	C1	6.2	35	0.33	1.00	-4.02	**0.00**
27	C2	6.2	6	0.33	1.14	5.69	**5.69**
28	C3	6.2	8	0.33	1.00	4.89	**4.89**
29	C4	6.2	24	0.33	1.00	-0.39	**0.00**
30	C5	6.2	20	0.33	1.00	0.93	**0.93**
31	C6	6.2	8	0.33	1.00	4.89	**4.89**
32	C7	6.2	3	0.33	1.39	6.93	**6.20**
33	C8	6.2	10	0.33	1.00	4.23	**4.23**
34	C9	6.2	2	0.33	1.47	7.34	**6.20**
35	C10	6.2	10	0.33	1.00	4.23	**4.23**
36	C11	6.2	20	0.33	1.00	0.93	**0.93**
37	C12	6.2	24	0.33	1.00	-0.39	**0.00**
38	C13	6.2	40	0.33	1.00	-5.67	**0.00**
39	D1	5.3	45	0.33	1.00	-8.22	**0.00**
40	D2	5.3	42	0.33	1.00	-7.23	**0.00**
41	D3	5.3	50	0.33	1.00	-9.87	**0.00**
42	D4	5.3	64	0.33	1.00	-14.49	**0.00**
43	D5	5.3	60	0.33	1.00	-13.17	**0.00**
44	D6	5.3	68	0.33	1.00	-15.81	**0.00**
45	D7	5.3	68	0.33	1.00	-15.81	**0.00**
46	D8	5.3	76	0.33	1.00	-18.45	**0.00**
47	D9	5.3	72	0.33	1.00	-17.13	**0.00**
48	D10	5.3	78	0.33	1.00	-19.11	**0.00**
49	D11	5.3	80	0.33	1.00	-19.77	**0.00**
50	D12	5.3	84	0.33	1.00	-21.09	**0.00**

According to the above results, the 50-year probability tide level at two sites is 6.2 m and, considering ground height of approximately 1 m, the surge level will be 5 m; however, judging from the vestiges of storm surges during Cyclone Sidr and interviews with residents, the storm

surge at this time didn't reach this high. Accordingly, the standard design of GL+4.2m is considered to be safe. Even in the event where a storm surge of 6 m elevation (GL+5 m) occurs, breast walls of 1.2 m in height should be sufficient to stop it.

2-2-1-3 Design Concept Regarding the Socioeconomic Conditions

Most of the residents in the target area are engaged in agriculture or fisheries (in the coastal areas) and live on the poverty line. Since more than 90% of the residents are Muslims, under the PDEP-II standard design, men and women are separated through the clear division of facilities including toilets between the left and right sides of central stairs. In particular, storerooms to the rear of toilets can be reserved for people who are especially concerned about male and female segregation. The side-corridor type layouts in the Project conform to this requirement, where in the case of middle corridor layouts, male and female toilets shall be partitioned so that booths don't face directly onto corridors and toilet doors are kept apart.

2-2-1-4 Design Concept Regarding the Local Construction Industry and Local Contractor

(1) Basic Concept

Since construction materials can be procured in Bangladesh and there are no materials that need to be procured from third countries, all the construction materials shall be procured locally. Providing that locally widespread construction methods (brick masonry, reinforced concrete construction) are adopted, it has been confirmed that good quality building materials can be locally procured in sufficient quantities. Concerning cement, since manufacturing plants are located around the Project sites, it will be important to buy directly from the plants upon confirming quality control conditions. Moreover, concerning reinforcing bars, either local products or imports (from India and so on) are available. The reinforcing bars from third countries are cheap, good quality and can be procured locally. Concrete produced by ready-mixed concrete manufacturers shall not be procured because such companies are not located near the Project sites and access to the sites is impossible.

(2) Fine Aggregate and Coarse Aggregate

Since it is difficult to obtain good quality aggregate (crushed stone and sand) in Bangladesh, burnt bricks are frequently crushed to gravel size and used as aggregate for concrete, however, this is far weaker than general aggregate. According to the results of compression testing, the compressive strength of concrete using brick chips is approximately 67% (180kg/cm^2) that of ordinary aggregate, and when execution accuracy and management capacity are also taken into account, this level declines even further. Moreover, the adverse impacts on concrete of brick impurities are a cause for concern, and many of the school buildings that were built 20 or so

years ago show clear signs of peeling and damaged concrete and have main reinforcing bars rusted to breaking point. Therefore, from the viewpoint of securing quality, brick chip aggregate shall not be adopted in the Project.

Table 2-5 Sample Compression Test Results

Type of test sample	28-day strength (MN/m^2)	Comparison ②／①
① Brick chip sample	27.78	66.7%
②Ordinary aggregate sample	18.52	

Source of data: LGED

Also, good quality aggregate in Bangladesh can only be obtained in the Sylhet region in the north of the country, but this is some 800 km away from the Project sites. General building contractors are prohibited from purchasing this aggregate, and a system is adopted whereby specialist transportation companies make deliveries to each district, which keeps a set quantity always on hand in a central location. The building contractors in each district are able to purchase good quality aggregate from these stock points.

(3) Concrete Mixing Water

Many parts of the Project target area become submerged during the monsoon rainy season. Moreover, although there are numerous rivers, they do not readily provide water that contains no impurities and can be used for concrete mixing, so water from lakes and groundwater is used for this purpose. Since clean concrete mixing water is indispensable for securing good quality, inspections of water quality shall be implemented on each site. However, considering that it would be geographically impossible to secure good quality water resources if water was found to contain salt in such inspections, it will also be compulsory to install simple desalination devices or filtration units.

(4) Concept regarding Transportation of Equipment and Materials and Geographical Characteristics

The Project target areas are concentrated into the south of Bangladesh and the Bay of Bengal delta region, where damage from cyclones is extreme and where access to many of the sites is impeded by numerous rivers. Accordingly, it is impossible to carry in construction materials over land routes, and since it is necessary to first transport items by river and then rely on manual labor after landing, it will be necessary to properly set the cost and schedule of transporting materials from the central areas of each district to the remote areas. Moreover, since sites for landing construction materials are not constructed, it will be necessary to include the installation of temporary piers and access roads in the temporary works costs of the project.

(5) Securing of Materials Storage Areas

During the monsoon season from June to September, torrential downpours cause many areas to become submerged to depths of between 50~80 cm. Accordingly, it will be impossible to continue construction work during the rainy season, and care will be required to secure materials storage areas. In the Project, it is intended to commence construction works from October, however, since it will be impossible to finish the building frame works before then, in addition to paying attention to the cement and aggregate transportation plans, sites for storing construction materials shall be secured through building banked areas of certain size to heights sufficient for avoiding flood damage.

(6) Utilization of Local Contractors

Bangladesh is thought to possess a certain degree of construction technology because there are more than 1,000 construction operators in the country and the capital Dhaka has high-rise buildings of up to 20 stories. Moreover, since this is an emergency disaster relief undertaking, the basic principle is to utilize local operators, while paying attention to the following points.

The major construction companies are concentrated in the metropolitan region, however, there are no companies with excellent execution capability in rural areas. Since there is a strong possibility that rural operators will win orders in the tender process, it will be necessary to carefully discern the execution capability of such companies. There are approximately 30 construction companies in Barguna and 40 companies in Patuakhali, and of these around five companies are S (special) class and 15 companies are A-class enterprises. The LGED as a rule requires companies of A-class status or higher in the construction of cyclone shelters, however, all such companies only have around 15 employees and they usually need to recruit extra local workers according to the size of works. Moreover, since such companies only have limited numbers and types of construction machinery, it is difficult for them to implement works on multiple sites. It is thought that single companies can simultaneously handle no more than two shelters of the size planned in the Project, however, in remote areas with poor access conditions, companies may only be able to manage one school each. In past orders for cycle shelter construction, as a rule the LGED has implemented tender of one school building per company. Therefore, in the Project too, upon appropriately judging the execution capacity of construction companies and taking the geographical features of Project sites into account, a lot ordering plan conditional on no more than two or three works sites per company shall be compiled in order to utilize local contractors.

(7) Utilization of Local Labor

Bangladesh is thought to possess a certain level of technology because numerous construction projects and road works including bridges over rivers are implemented, however, because the

Project sites are remote areas, it is difficult to secure skilled workers who are sufficiently knowledgeable about construction works. Due to the geographical constraints in the target areas, situations where the construction operators dispatch a few employees and recruit local farmers to help with execution will be inevitable, however, in order to secure a certain degree of quality, full time engineers who possess know-how of construction works and leadership skills shall be dispatched to the local works sites to oversee the work.

(8) Utilization of Local Consultants

General consulting companies in Bangladesh are rare, while there are numerous small-scale consultants. However, since quality control criteria have not been established and it is difficult to expect high technical capability, the Project concept shall be to realize a uniform level of quality through ensuring thorough technical guidance by Japanese consultants.

2-2-1-5 Design Concept Regarding the Maintenance Capability of the Implementing Body

The LGED will be the implementing agency for the construction works; the DPE under MoPME will assign teachers. Mainly the local administration on the upazila level and SMCs and will be in charge of daily operation and maintenance. The LGED, DPE and local administration conduct the operation and maintenance of numerous cyclone shelters cum primary schools. After handing over the Project facilities, effort shall be made to reinforce operation and maintenance capacity through conveying the important points.

2-2-1-6 Design Concept Regarding the Grade of Facilities

Facilities shall be of a grade that satisfies necessary functions and meets the minimum required level of durability based on the standard design in Bangladesh. Such finishing specifications shall comprise mortar trowel work for floors, mortar trowel work and painting for walls, and mortar trowel work and painting for ceilings.

2-2-1-7 Design Concept Regarding Construction and Procurement Methods and Works Schedule

The concept regarding construction and procurement methods and the works schedule shall be as follows.

- Works shall be started from the beginning of the dry season.
- Consideration shall be given to the fact that some sites will become inaccessible and execution efficiency will decline a lot during the rainy season.
- Since manual labor will be relied on in the transportation and construction works, this will require a lot of time and two dry seasons will be needed.

• Generally make use of construction materials that are cheap and can be procured locally.

2-2-1-8 Design Concept Regarding Environment

Concerning the environment, materials containing asbestos will not be used in the Project. Existing facilities sometimes include asbestos materials. When demolishing such buildings, care shall be taken to remove materials with asbestos without scattering. The Bangladeshi side will be responsible for conducting the final disposal of waste materials without harming the local environment.

2-2-2 Basic Plan

2-2-2-1 Contents and Scale

The scale of facilities shall basically be as follows according to the Second Primary Education Development Plan (PDEP-II) reflecting the past and future standard design. Each shelter will accommodate between 1,600~1,700 people during emergencies.

Ground floor : Pilotis (only open space with no rooms except a stairway)
Second floor : 3 classrooms (6.1 x 5.45 m x 3), 1 teachers' room (6.1 x 5.45 m), men's and women's toilets, storeroom (side-corridor)
Roof : Stairway and open space for evacuation use during storm surges (only provide storerooms in facilities with middle corridors)

In this standard design, since it should be very difficult to maintain deep well hand pumps installed on the second floors in the target areas, the installation for pumps has been modified to the ground floor. Moreover, since some sites do not provide sufficient space to build facilities with these lengthwise dimensions, a middle corridor layout (15.7 m x 15.4 m, capacity for approximately 1,360 evacuees) is designed.

Even though the cyclone shelters are not large enough to cater to the evacuation populations of between 2,000~3,000 people within a 1.5 km radius, they can make a major contribution to reducing the disaster risk for residents. The scale of the shelters is kept uniform because of the desire to construct shelters over a wide area. This three-classroom type design is suitable for Bangladeshi primary schools, which conduct five grades of primary education and are frequently combined with pre-school education, in 2-shift systems (3 classrooms x 2-shift = 6 classes). As for the structure of facilities, elevated floor reinforced concrete structures that are durable and can withstand cyclones shall be adopted.

The following table shows a comparison of design criteria between the grant aid of 2003, the fifth Multipurpose Cyclone Shelter Programme of Japanese Grant Aid, and the Project.

The classroom area is 33.2 m^2 and capacity per classroom is 40~46 students rising to a maximum allowable figure of 50. The teachers' room area is 33.2 m^2.

Table 2-6 Design Criteria Comparison Chart

Item	5th Grant Aid Project in 2003	MoPME in 2007	This Project
Classrooms	Students: 50, 7.0 x 4.8 m = 33.8 m^2 0.67 m^2/student	Students 40～46 (50 in reality) 6.1 x 5.45 m=33.2 m^2 0.665 ～0.831m^2/student	Students 40～46 (50 in reality) 6.1 x 5.45 m=33.2 m^2 0.665 ～0.831m^2/student
Number of classrooms	3, 4, 5 classrooms	3 classrooms	3 classrooms
Teachers' room	7.0 x 4.8 m =33.6 m^2	6.1 x 5.45 m =33.2 m^2	6.1 x 5.45 m =33.2 m^2
Storeroom	3.5 x 4.8 m =16.8 m^2	3.25 x 4.6m x 2 classrooms = 29.9 m^2	3.25 x 4.6m x 2 classrooms = 29.9 m^2 (side corridor) 9.6 x 4.5 m =43.2 m^2 (middle corridor: outside
Corridor	Inner width 2.5 m (middle corridor)	Inner width 2.5 m (side corridor)	Inner width 2.5 m (side corridor) Inner width 3.0 m (middle corridor)
Stairs	Inner width 1.7m	Inner width 2.4m	Inner width 1.9 m
Toilets	Men's and women's, 4 booths each Septic tank, infiltration pit	Men's and women's, 2booths each Septic tank, infiltration pit	Men's and women's, 2 booths each Septic tank, infiltration pit
Electric installation	None	None	None
Wells, pumps	Deep well, 1 Tara-II pump on the 2nd floor	Deep well, 2 No. 6 pumps on the 2nd floor	Deep well, 1 No. 6 pump on the ground floor
Units of evacuees	Indoors: 2 ft^2 (0.185m^2) Roof: 8 ft^2 (0.743m^2)	Indoors: 0.25m^2 (~ 0.5 m^2) (Stairs 50%)	Indoors: 0.25m^2 (Stairs and roof 50%)
Evacuation capacity	3 classrooms: 1,703 4 classrooms: 1,793 5 classrooms: 2,081	3 classrooms: Approx. 1,700	3 classrooms: Side-corridor type: 1,660 Middle corridor type: 1,367
Ground floor	GL +0.7m	GL +0.9m	GL +0.9m
2nd floor	GL +4.0~6.5m	GL +4.2m	GL +4.2m

Since the target schools have no water supply systems, deep wells are required in the facilities whether they are used as cyclone shelters cum primary schools. The deep wells shall be installed on the ground floor of schools so long as they don't already have a well and are situated over an deep aquifer possessing good water quality.

A PEDP-II School at Patuakhali

Water will basically be drawn up by bucket and stored. Pumping tests using motor-powered pumps cannot be implemented. Only schools where good quality water can be expected based on water quality data from nearby deep wells will be selected, however, in cases where salt or arsenic, etc. are detected in water quality inspections, the pumped water shall only be used as toilet flushing water.

The following table shows the scale and evacuation capacity of each type of facility.

Table 2-7 Scale and Capacity of Project Shelters by Type

Side-corridor type

	Area (m2)	Width (m)	Length (m)	Quantity	Adjustment	Evacuation capacity	Reduction
Ground floor							
Total area	298.5	9.10	32.80	1			
Stairs	27.5	4.50	6.10	1			
Pilotis	271.0	9.10	32.80	1	-27.5		
2nd floor							
Total floor area	298.5	9.10	32.80	1			
Classrooms	99.7	6.10	5.45	3		399	
Teachers' room	33.2	6.10	5.45	1		133	
Storeroom	29.9	3.25	4.60	2		120	
Corridor	78.9	3.00	26.30	1		302	-14
Stairs	27.5	4.50	6.10	1		110	50%
Toilets	29.3	3.25	4.50	2			
Roof							
Total area	298.5	9.10	32.80	1			
Stairs	27.5	4.50	6.10	1		55	50%
Open space	271.0	9.10	32.80	1	-27.5	542	50%
Floor area excluding pilotis	353.4					1,660	
Floor area including pilotis	624.4						
						0.25	m^2/person

Middle corridor type

	Area (m2)	Width (m)	Length (m)	Quantity	Adjustment (m^2)	Evacuation capacity	Reduction
Ground floor							
Total area	241.8	15.70	15.40	1			
Stairs	27.5	4.50	6.10	1			
Pilotis	214.3	15.70	15.40	1	-27.5		
2nd floor							
Total floor area	241.8	15.70	15.40	1			
Classrooms	99.7	6.10	5.45	3		399	
Teachers' room	33.2	6.10	5.45	1		133	
Storeroom	52.5	3.50	15.40	1	-1.4	210	-8
Corridor	27.5	4.50	6.10	1		55	50%
Stairs	28.9	4.50	6.10	1	1.4		
Toilets							
Roof	241.8	15.70	15.40	1			
Storeroom	43.2	9.60	4.50	1		173	
Stairs	27.5	6.10	4.50	1		55	50%
Open space	171.1	15.70	10.90	1		342	50%
Floor area excluding pilotis	339.9					1,367	
Floor area including pilotis	554.2						
						0.25	m^2/person

The number and scale of schools in the Project are as follows.

Table 2-8 Study Target Schools and Project Target Schools

District	Study target	Project target	Total building area (m^2)	Number of deep wells	Remarks
Pirojpur	13 schools	11 schools	6,868.4	3	Including 3 middle corridor type school
Patuakhali	12 schools	10 schools	6,173.8	8	Including 2 middle corridor type school
Barguna	13 schools	11 schools	6,798.2	4	Including 1 middle corridor type school
Bagerhat	12 schools	6 schools	3,676.2	1	Including 1 middle corridor type school
Total	50 schools	38 schools	23,516.6	16	Including 7 middle corridor type schools

Table 2-9 Outline of the Project Target Schools (1)

New Site Number	Old Site Number		District	Upazila	Union		Name of School	Population in the service area	Existence of cyclone shelter in and around the site	Public solid multistory building in the radius of 1.5km	Number of pupils	Number of pupils including pre-school	Number of existing classrooms	Number of existing teachers room	Number of casualties by Cyclone Sidr	Height of tidal surge by Cyclone Sidr (m)	Usual flood level (m)	Type of cyclone shelter to be constructed	Number of classrooms to be constructed in the project	Total floor area (㎡)	Condition of deep aquifer and provision of deep well	Number of desk/chair for 2 pupils (set)	Number of desk/chair for teacher (set)	Capacity of evacuee (persons)
						No.																		
PR1	1	A1	Pirojpur	Ziana gar	Balipara	50203 1108	Badarpur Govt. Primary School	2,500	No	No	102	135	3	1	19	4.2	0.8	side corridor	3	624.4	No	60	4	1,660
PR2	2	A2			Balipara	50203 1106	Maddha Char Balashar Govt. Primary School	1,500	No	No	93	118	3	1	5	4.2	0.9	middle corridor	3	554.2	No	60	4	1,367
PR3	3	A3			Balipara	50203 1111	Pachim Kolaron Govt. Primary School	3,000	No	No	130	147	3	1	0	4.6	1.2	side corridor	3	624.4	No	60	4	1,660
PR4	5	A5			Kalakhali	50203 0407	Daudpur Chalpakuria Govt. Primary School	3,000	No	No	75	88	3	1	2	3.0	0.6	side corridor	3	624.4	○	60	4	1,660
PR5	6	A6			Shariktala	50203 0608	Keshorota Govt. Primary School	4,000	No	No	108	120	3	1	2	4.5	1.2	side corridor	3	624.4	Existing	60	4	1,660
PR6	7	A7			Sikdarmollik	50203 0106	Jugkhola Muria Govt. Primary School	3,000	No	No	77	92	3	1	12	3.0	0.9	side corridor	3	624.4	No	60	4	1,660
PR7	8	A8		Mathbaria	Gulisakhali	50205 0208	Kabaturkhali Govt. Primary School	5,000	No	No	115	143	3	1	12	3.0	0.6	middle corridor	3	554.2	No	60	4	1,367
PR8	9	A9			Shaplaza	50205 1105	Nali Charakgachia Govt. Primary School	9,000	No	No	83	100	3	1	7	2.0	0.3	side corridor	3	624.4	No	60	4	1,660
PR9	11	A11		Bhandria	Bhandria	50204 0606	72 No Uttar Purbo Bhandaria Govt. Primary School	1,500	No	No	154	184	3	1	0	4.6	0.6	middle corridor	3	554.2	○	60	4	1,367
PR10	12	A12		Kawkhali	Kawkhali	50201 0310	28 No.Choto Biraljuri Govt. Primary School	20,000	No	No	80	92	3	1	0	3.0	0.3	side corridor	3	624.4	Existing	60	4	1,660
PR11	13	A13			Saina Ragunatpur	50201 0204	14 No.Maddha Sonakur Govt. Primary School	10,000	No	No	168	202	3	1	1	3.6	0.4	side corridor	3	624.4	○	60	4	1,660
PT1	14	B1	Patuakhali	Galachipa	Char Montaz	50502 0106	Algi Tafalbaria Govt.Primary School cum Cyclone Shelter	4,000	No	No	270	330	4	1	0	1.5	0.3	side corridor	3	624.4	Existing	69	4	1,660
PT2	15	B2			Uttor Char	50502 0604	Amlibari Govt.Primary School cum Cyclone Shelter	6,000	No	No	115	215	5	1	3	2.7	0.4	middle corridor	3	554.2	○	60	4	1,367
PT3	16	B3			Char Bishaws	50502 1404	Purbo Char Bishaws Govt.Primary School cum Cyclone Shelter	5,000	No	No	180	250	3	1	0	2.6	0.4	side corridor	3	624.4	○	60	4	1,660
PT4	17	B4		Dosmina	Rongopaldi	50503 0401	Patarchar Govt.Primary School cum Cyclone Shelter	12,000	No	No	118	168	4	1	6	2.0	0.3	side corridor	3	624.4	○	60	4	1,660
PT5	19	B6		Kolapara	Dhankhali	50501 0903	Uttar Debpur Govt. Primary School cum Cyclone Shelter	5,000	No	No	105	125	3	1	0	2.7	0.3	side corridor	3	624.4	○	60	4	1,660
PT6	21	B8			Khapraban gha	50501 0607	Maherpur Govt. Primary School cum Cyclone Shelter	7,000	No	No	200	240	3	1	1	2.6	0.5	side corridor	3	624.4	○	69	4	1,660
PT7	22	B9		Sadar	Chotobeghai	50504 1203	Mati Bhanga Govt. Primary School cum Cyclone Shelter	8,000	No	No	265	345	4	1	35	2.2	0.3	middle corridor	3	554.2	○	69	4	1,367
PT8	23	B10		Baupahal	Konaskdia	50505 0206	49 No. Kolta Govt. Primary School cum Cyclone Shelter	12,000	No	No	163	213	6	1	4	2.0	0.5	side corridor	3	624.4	Existing	69	4	1,660
PT9	24	B11			Madonpura	50505 0305	65 No. Purba Madonpura Govt. Primary School cum Cyclone Shelter	15,000	No	No	290	325	4	1	3	2.5	0.3	side corridor	3	624.4	○	69	4	1,660
PT10	25	B12			Kalaiya	50505 0602	Purba Kalaiya Govt. Primary School cum Cyclone Shelter	12,000	No	No	374	444	5	1	50	2.7	0.3	side corridor	3	624.4	○	69	4	1,660

Table 2-10 Outline of the Project Target Schools (2)

New Site Number	Old Site Number		District	Upazila	Union	No.	Name of School	Population in the service area	Existence of cyclone shelter in and around the site	Public solid multistory building in the radius of 1.5km	Number of pupils	Number of pupils including pre-school	Number of existing classrooms	Number of existing teachers room	Number of casualties by Cyclone Sidr	Height of tidal surge by Cyclone Sidr (m)	Usual flood level (m)	Type of cyclone shelter to be constructed	Number of classrooms to be constructed in the project	Total floor area (㎡)	Condition of deep aquifer and provision of deep well	Number of desk/chair for 2 pupils (set)	Number of desk/chair for teacher (set)	Capacity of evacuee (persons)
BR1	26	C1	Barguna	Betagi	Sarisamari	50405 0708	Gabtali Govt. Primary School	5,000	No	No	190	202	4	1	5	1.5	0.3	side corridor	3	624.4	○	69	4	1,660
BR2	27	C2		Patharghata	Patharghata Sader	50402 0709	27 No. Badurtala Govt. Primary School	6,000	No	No	181	221	3	1	9	2.5	0.3	side corridor	3	624.4	No	69	4	1,660
BR3	29	C4			Kathaltoli	50402 0106	56 No. Burjukpur Govt. Primary School	3,500	No	No	121	146	3	1	7	1.8	0.4	side corridor	3	624.4	No	60	4	1,660
BR4	30	C5			Charduani	50402 0302	12 No. Sairabad Govt. Primary School	12,000	No	No	157	187	5	1	12	1.8	0.5	middle corridor	3	554.2	No	60	4	1,367
BR5	31	C6		Sadar	Noltona	50403 1008	Nishanbaria Govt. Primary School	2,000	No	No	119	138	3	1	60	3.0	0.4	side corridor	3	624.4	No	60	4	1,660
BR6	32	C7			M.Baliatoli	50403 0910	Sonbunia Govt. Primary School	2,300	No	No	190	232	3	1	110	3.1	0.3	side corridor	3	624.4	No	60	4	1,660
BR7	34	C9		Amtali	Borobogi	50401 0905	Sakhina Govt. Primary School	2,050	Y	No	301	336	2	1	200	3.1	0.6	side corridor	3	624.4	○	69	4	1,660
BR8	35	C10			Borobogi	50401 0901	Satonpara Govt. Primary School	8,000	No	Y	441	481	8	1	44	1.8	0.6	side corridor	3	624.4	○	69	4	1,660
BR9	36	C11			Pochakoirdin	50401 0806	Gabtali Govt. Primary School	3,000	No	No	192	242	3	1	14	1.9	0.3	side corridor	3	624.4	Existing	60	4	1,660
BR10	37	C12			Arpangasia	50401 0205	Baliataia Govt. Primary School	2,109	No	No	224	294	2	1	14	3.0	0.4	side corridor	3	624.4	○	69	4	1,660
BR11	38	C13		Bamna	Ramna	50404 0306	Gadaghata Govt. Primary School	2,400	No	No	191	235	5	1	0	1.9	0.5	side corridor	3	624.4	Existing	60	4	1,660
BG1	42	D4	Bagerhat	Morrelgonj	Putikhali	21007 0403	Sonakhali Govt. Primary School	3,000	No	No	167	222	3	1	5	1.7	0.6	side corridor	3	624.4	No	60	4	1,660
BG2	43	D5			Hoglabunia	21007 1006	80 No. B. Pathtamara Govt. Primary School	5,500	No	No	180	220	3	1	3	1.5	0.5	middle corridor	3	554.2	No	60	4	1,367
BG3	44	D6			Ramchandrapur	21007 0202	31 No Small Kumerkhali Govt. Primary School	8,000	No	No	70	92	3	1	0	1.5	0.5	side corridor	3	624.4	No	60	4	1,660
BG4	45	D7			Panchakaron	21007 0308	13 No South Kharykhali Govt. Primary School	3,000	No	No	91	109	3	1	52	2.5	0.6	side corridor	3	624.4	No	60	4	1,660
BG5	46	D8		Sadar	Bemorta	21004 0210	Bergazalia Govt. Primary School	3,500	No	No	59	76	2	1	8	3.5	0.5	side corridor	3	624.4	○	60	4	1,660
BG6	48	D10		Mongla	Chandpai	21006 0203	Chandpai Govt. Primary School	5,000	No	No	323	353	8	1	0	3.2	0.5	side corridor	3	624.4	No	69	4	1,660
Total								224,859			6,462	7,862	137	38	705				114	23,235.8	16	2,388	152	61,029

In each classroom, between 20~23 pair desk and chair sets for students shall be provided for standard class sizes of 40~46 students (there are currently only 20 sets in schools with up to 200 students and 23 sets in schools with 201 or more students).

Teacher's desk and chair sets shall be provided for four teachers (1 principal and 3 teachers) and one cabinet shall be provided for storing papers.

Table 2-11 Outline of Furniture

Furniture	Per school	Number of schools	Total	Unit
Student's pair desks and chairs	*60*	*26*	*1,560*	Set
	69	*12*	*828*	Set
	Total	38	2,388	Set
Teacher's desks and chairs	4	38	152	Set
Teachers' cabinet	1	38	38	Set

2-2-2-2 Layout Plan

All sites are topographically flat and no steep slopes are not in the sites.

Some of the sites contain ponds, farmland and lowland and it is better to avoid building on such parts of poor bearing capacity, however, if there is no other choice, earth filling will be considered. Also, facilities will be arranged so that school yards can be secured as much as possible.

Since most schools will have 2-shift system, corridors shall basically be arranged in the east-west direction so that they avoid the afternoon sun.

Layouts shall be arranged so that good links with existing school buildings can be realized as much as possible.

2-2-2-3 Building Plan and Design

(1) Floor Plan

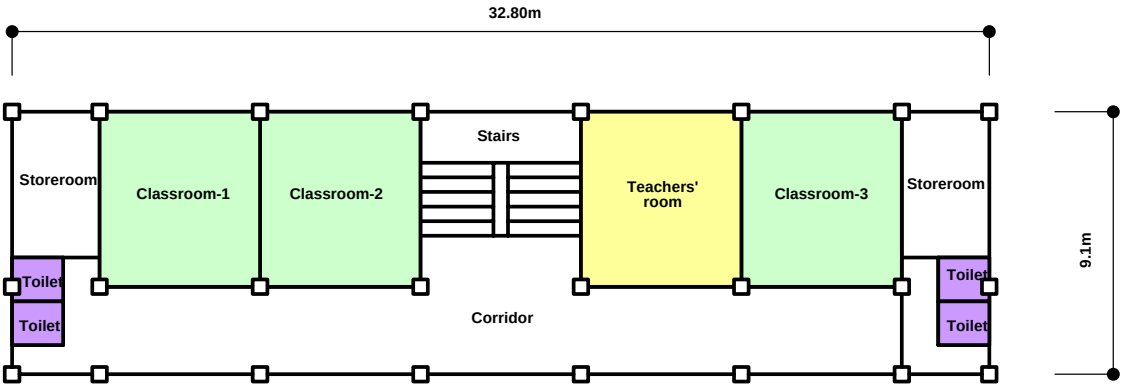
The standard design in PEDP-II consists of a pilotis type, two-story reinforced concrete structure containing three classrooms, one teachers' room, boys and girls toilets and a storeroom. This shall basically be conformed to, but with the following revisions.

- The width of staircases shall be kept to 4.5 m (not unnecessarily wide).
- The pumps on the second floor shall be placed on the ground floor.

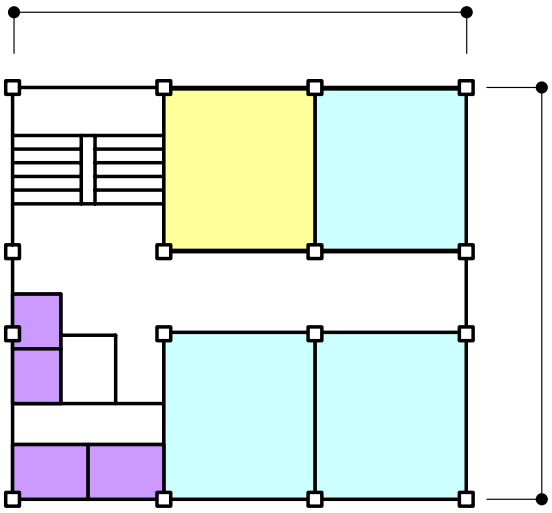
On sites where the longitudinal dimensions cannot be secured, the middle corridor type design, where the classrooms and teachers' room are arranged on both sides, shall be adopted. The size of rooms shall be the same as in facilities with side-corridors, however, the corridor width shall be made 50 cm wider and the storeroom shall be provided on the roof.

In consideration of high temperatures and high humidity, facilities shall be designed with good natural ventilation and shade against sunlight. Also, to make use of rainwater, a tank shall be installed and pipes installed up to faucets in front of the toilets.

Since the local Muslim teaching calls for men's and women's toilets to be clearly partitioned, the two types shall be installed at opposite ends of corridors. In the middle corridor type facilities, entrances to the boys and girls toilets shall be positioned not next to each other but apart. Moreover, toilet bowls shall not be positioned on the east-west axis facing Mecca.



Side-corridor type



Middle corridor type

(2) Cross-Sectional Plan

According to the standard design in Bangladesh, the height of the ground floor is GL+0.9 m, the second floor height is GL+4.2 m, and floor height is 3.3 m. Even in the event where a high wave of 6 m elevation (GL+5 m) exceeding the second floor height of GL+4.2 m should occur, breast walls of 1.2 m should be able to prevent washing-out.

There are some sites where the cyclone storm surge height is less than 1 m, however, if the height of second floors is reduced in line with this, this will compromise the use of ground floors at normal times. Therefore, second floor height has been set at a constant level.

(3) Building Structure and Foundation Plan

(3)-1 Outline

- The buildings are multipurpose shelters. During cyclones, the second floors and roofs will be used to evacuate people, while at normal times, second floor parts will be used for primary schools.
- Storm surge height is projected as high as the floor on second stories. Since storm surge waves contain salt, measures to counter salt damage shall be considered.
- Since the Project buildings are evacuation facilities, in accordance with the Bangladesh National Building Code (BNBD), the level of importance of structures shall be I (I = 1.25).

(3)-2 Applicable Criteria

- Basically, the Bangladesh National Building Code (BNBC) shall be applied. Also, ACI, ASTM, BSI, JIS, AIJ and so on shall be applied as required.

(3)-3 Structural Type of Buildings

Buildings are broadly divided into reinforced concrete structures and steel structures. Since the Project buildings are intended to function as evacuation facilities, they need to be strong enough to resist strong winds and earthquakes. Moreover, they need to possess sufficient durability to withstand tidal waves, salt damage and other external environmental factors. Steel structures do not possess good resistance against salt damage because of the nature of that material. Moreover, finishing materials need to possess the localized toughness to withstand cyclone wind speeds of up to 72 m/sec as envisaged in the Project, however, in this case the finishing will not fit well and will be costly. On the other hand, reinforced concrete provides high resistance against cyclones. Through raising the salt damage resistance of concrete and applying finishing materials that are resistant to salt damage, it is possible to enhance salt damage resistance relatively easily and at low cost.

Accordingly, building structures in the Project shall be the reinforced concrete type.

(3)-4 Used Materials

In accordance with the BNBC, the following materials shall be used:

- Concrete

Plain concrete	:	fc'=15 N/mm^2
Structural concrete	:	fc'=21 N/mm^2

- Reinforcing bars

Thin (d13 or less)	:	40grade	fy=276 N/mm^2
Thick (D16 or more)	:	60grade	fy=415 N/mm^2

Moreover, the stress levels of each type of material shall be multiplied by 1.33 times with respect to short-term situations (live load during evacuation, wind load, seismic load).

(3)-5 Design Load

(a) Fixed Load

Table 6.2.2 indicates fixed load according to the BNBC. Moreover, other criteria shall be applied according to necessity.

(b) Live Load

Tables 6.2.3 and 6.2.4 indicate live load according to BNBC.

Roof	:	1.5	kN/m^2
Classroom	:	3.0	kN/m^2
Teachers' room	:	2.5	kN/m^2
Toilets	:	2.0	kN/m^2
During evacuation	:	4.8	kN/m^2 (short-term load)
Others	:	4.0	kN/m^2 (balconies, corridors, storerooms, stairways, etc.)

(c) Wind Load

According to BNBC, Wind load shall be as follows:

$qz=Cc*Ci*Cz*Vb^2$

Where:

Qz: Wind pressure at height z (kN/m^2)

Cc: Velocity and wind pressure conversion coefficient: $Cc=47.2*10^{-6}$

Ci: Coefficient of importance of structure

Cz: Coefficient according to height and surrounding conditions

Vb: Basic wind velocity (km/h): 260 km/h

Wind velocity in each district:

Bagerhat: 252 km/h

Barguna: 260 km/h

Patuakhali: 260 km/h

Pirojpur: 260 km/h

(d) Seismic Load

Seismic load is calculated as shown below.

$V=Z*I*(C/R)*W$

Where,

V: Horizontal shearing force

Z: Local seismic coefficient

I: Coefficient of importance of structure

R: Response correction coefficient

W: Total building weight (during earthquake)

C: Ground characteristics and coefficient concerning proper period of building

All target schools in the Project belong to Zone 1 according to the seismic classifications, and the local seismic coefficient is Z = 0.075.

(e) Load Combinations

Load combinations are as follows:

- Fixed load + live load
- Fixed load + live load + seismic load (short-term)
- Fixed load + live load during evacuation+ wind load (short-term)

(3)-6 Structural Plan of Buildings

- Since second floors will be used as primary school classrooms, the direction of beams will be determined according to the classroom size, and pillars will be spaced at intervals of 5.45 m.
- The span direction will also be determined according to the classroom size, and pillars will be spaced so that the necessary corridor width can be secured.
- Concerning stairways, the effective stair width shall be 1.7 m and pillars will be spaced at intervals of 4.5 m.
- Relatively heavy bricks will be used for partitions, and crossbeams and beams will be arranged so as to receive the brick walls.
- All walls except for balustrade walls will be brick masonry, and structural frames will be analyzed as frame structures in both the longitudinal direction and span direction.
- Concerning foundations, highly rigid underground beams will be arranged in order to enhance the rigidity of foundations and mitigate the impact of uneven settlement.

(3)-7 Salt Damage Countermeasures in Structures

As was mentioned earlier, there is concern over salt damage to structures in view of the site location conditions and the effects of frequently occurring floods and tidal waves. In the buildings that were studied during the field survey too, some buildings were found to be suffering from cracked concrete, peeling concrete over reinforcing bars and extreme corrosion of reinforcing bars, although detailed investigation is required in order to identify the

causes.

Reinforcing bars embedded in the concrete that composes reinforced concrete structures have a thin oxide coating on the surface that passivates them and protects them from corrosion, however, infiltration by carbon gases and other acidic substances in the atmosphere gradually destroys the concrete alkalinity and leads to the progression of corrosion. Moreover, if excessive levels of chlorides exist in concrete when it is being placed, chloride ions will accelerate the corrosion of reinforcing bars. Accordingly, it is extremely important to take salt damage countermeasures in concrete structures. Effective methods for countering salt damage are as follows.

①	Implement measurement of chlorides as an important quality control item during execution. As the control criteria, limit chloride ions to 0.3 ～0.6kg/m^3 or less. The level of chloride ions can be measured by a measuring device or by a Quantab (chloride test strips).	Can be done on the Project sites.
②	Through using concrete with low slump (no more than 55% water cement), the unit cement density increases, thereby enabling uniformly dense concrete to be made and enhancing resistance to the chemical substances of salt and corrosion of reinforcing bars in concrete.	Can be done on the Project sites.
③	Protect the structure through coating the surface (waterproof effect). As a waterproof agent, asphalt paint is effective and can be procured locally.	Can be done on the Project sites.
④	Set the covering thickness over reinforcing bars thicker than ordinarily prescribed.	Can be done on the Project sites.
⑤	Use an appropriate antirust agent.	Can be done on the Project sites, but control is difficult.
⑥	It is possible to use acid-resistant cement (last furnace cement or moderate-heat Portland cement, etc.), however, it is difficult to procure these types of cement in Bangladesh.	Cannot be done on the Project sites.
⑦	Use reinforcing bars that have been specially treated for corrosion, e.g. galvanized steel iron bars and resin coated bars, etc.	Securing and managing materials is difficult so this is not realistic in the Project area.

(3)-8 Foundation Plan

(a) Type of Foundations

The building foundations are an important structural element that must accurately convey the building weight to the ground, offer protection against uneven subsidence and cracking, etc., and impart no impact on the superstructure safety. Moreover, foundations must be designed with safety regarding horizontal load during cyclones and earthquakes. Common types of foundations are as follows.

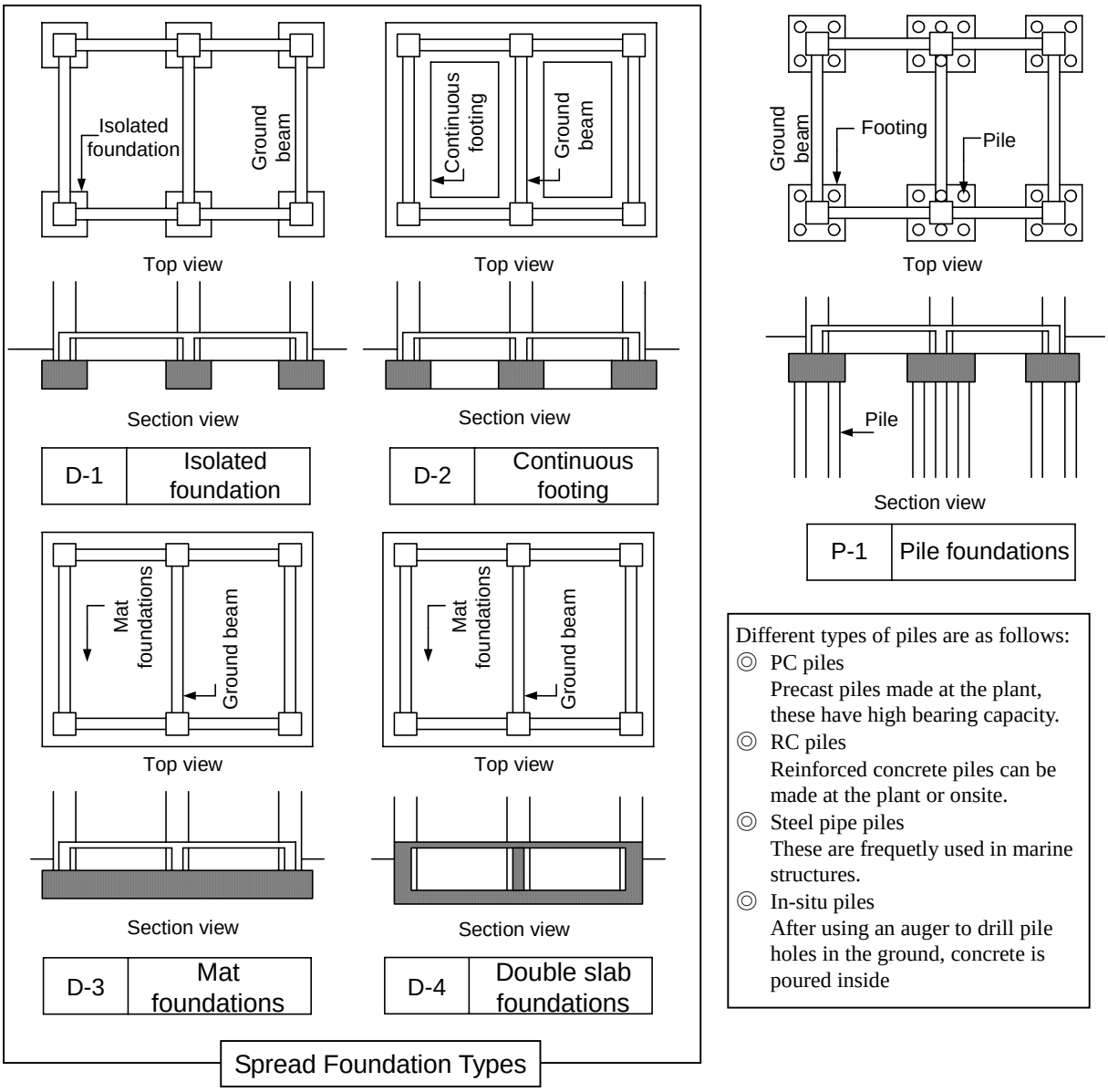


Figure 2-1 Types of Foundations

Out of these types, isolated foundations, continuous footing, mat foundations and double slab foundations are classed as spread foundations. Accordingly, in the Project, spread foundations and pile foundations shall be compared and the best type selected according to the geological state of the Project sites.

(b) Ground conditions

Foundations shall be appropriately designed upon implementing geological investigation and making a comprehensive judgment of safety, ease of execution, general applicability, execution capability of the local contractors and cost, etc. corresponding to the ground conditions.

Since the Project area belongs to a tidal delta, it is thought that the ground quality is very soft. According to the BNBC, the provisional allowable bearing capacity of ground with respect to lightweight structures is as indicated in Table 2-12.

Ground Type	Allowable Bearing Capacity (kPa or 1/10 t/m^2)
Soft rock, shale	440
Coarse fragment, coarse fragment mixed with sand, coarse fragment with silty sand	400
Sand, sand with coarse fragment, silty sand	200
Fine sand	100
Silt, clayey silt, clayey sand	150
Clay, sandy clay	150
Loose clay	100
Extremely loose clay	50

The allowable bearing capacity judging from the type of ground is estimated to be 50~100kPa, and this complies with the findings of the geological survey implemented in the Project.

(c) Examination of Foundations

Foundations are broadly divided into two types, i.e. spread foundations and pile foundations. Spread foundations entail installing foundations directly onto the ground so that the building load is directly transmitted from the base of the foundations to the ground. Spread foundations are further divided into isolated foundations, where foundation slabs are installed at the bases of pillars, and mat foundations, where slabs are installed over the outer shape of the building. On the other hand, pile foundations entail hammering concrete or steel pillar-shaped piles into the ground and putting the building onto top of them so that they can bear the building weight. Depending on the way in which load is transmitted from piles to the ground, pile foundations are further divided into bearing piles and friction piles. Since the foundations are an important element for supporting buildings, it is necessary to select efficient and feasible types upon considering the results of geological surveys, the capacity of local contractors and the local geographical conditions. The following table gives a comparison of possible foundation types for the Project buildings, i.e. spread foundations and in-situ pile foundations (installed by boring holes with an auger set in a turret, setting reinforcing bars and placing concrete).

Table 2-13 Comparison of Foundation Methods

Item	Spread Foundations	Pile Foundations
Structure	• This type offers higher foundation rigidity and greater protection against uneven subsidence. • If appropriate bearing ground cannot be obtained at a shallow level, the foundations go deeper. • If an earth floor is adopted on the ground floor, the load placed on the foundations increases; therefore a slab structure is adopted.	• Even if underground beams are used to enhance rigidity of foundations, the structure is subjected to uneven subsidence. • The foundation base is uniform irrespective of the quality of ground near the surface. • If the ground quality is poor, the number of piles is increased and the foundations become larger.
Assessment	○	△
Materials used	• Excavator. • Concrete mixer • Large items of equipment cannot be carried by boat.	• Pile driving scaffold and auger • Winch • Bucket • Excavator • Concrete mixer The amount of excavation is far less than in the case of spread foundations, so manual excavation is possible.
Assessment	△	○
Ease of execution	• Since ground is excavated to the foundation depth over the whole building outer shape, the amount of excavated earth is large. Also, there is a lot of residual earth that needs to be disposed. • Since large equipment cannot be carried by boat, the works period is extended, however, efficiency can be increased by recruiting more laborers. • Ground under the floor on the ground floor becomes a dead-end, so floor openings are required to conduct work. A floor opening is required for each part surrounded by underground beams. • Since the foundations require large quantities of concrete with a lot of placing joints, water sealability is adversely affected. • The foundation works period is roughly 1.5 months.	• Moving the pile driving equipment requires time and effort. • Compared to spread foundations, pile works are additionally required, thereby leading to a longer works time. Earth works and concrete works quantities are far smaller than in the case of spread foundations, so efficiency is not improved simply by recruiting more laborers. • The foundation works period is roughly 2.0 months.
Assessment	○	△
Capability of local contractors	- Bangladesh is thought to have high engineering levels because numerous medium and high-rise buildings have been built in Dhaka, however, buildings in regional cities are no higher than 7 or so stories while 2~3 story buildings are the highest in rural parts. In the southern districts of the country, there are a few hundred S-class and A-class companies. - Mat foundations do not require any special works method and can be comfortably handled by companies belonging to these classes. - The specifications and costs entailed in pile foundation works are given in detail in the PWD materials, indicating that this is a commonly adopted method. S-class and A-class construction companies have sufficient capacity to handle such works.	
Assessment	○	○
Applicability to the Project area	• Spread foundations are the most commonly adopted foundation type, however, mat foundations are adopted in cases of relatively large-scale buildings. Since mat foundations thus require excavation machinery and large amounts of concrete materials, they are not applicable to sites with poor access to vehicles. However, this method has been adopted in some cyclone shelter works in the past.	• In regional cities, pile foundation works using this approach are adopted in some cases, however, in sites that are inaccessible to vehicles, there are no large-scale buildings and applicability is poor.
Assessment	○	△

Item	Spread Foundations	Pile Foundations
Economy	• Spread foundations are more expensive than isolated foundations because of the large amounts of excavated earth and residual earth, although they are more economical than pile foundations (because the pile works are not required). • Rough foundations works cost: 4,200,000Tk.	• Pile works are far more expensive than other works. The foundation works cost is about the same as the cost of mat foundations. • Rough foundations works cost: 8,800,000Tk.
Assessment	○	△
Conditional overall assessment	• Mat foundations are difficult to execute on ground floors, however, this problem can be overcome depending on the findings of geological survey. Mat foundations are better than pile foundations in terms of works schedule and economy, and if bearing ground can be secured near the surface, the mat foundation approach should be adopted. • Meanwhile, if the ground is not strong enough to support the load of mat foundations, pile foundations should be adopted.	

(d) Setting of Foundations

Ground conditions on the Project sites are generally poor. The shelter foundations can be divided into either spread foundations (isolated foundations, continuous foundations, or mat foundations) or pile foundations depending on the geological makeup and bearing capacity of ground; however, the appropriate foundation type shall be determined based on the findings of boring surveys and indoor tests. When examining the works method, since the BNBC only offers reference design criteria for building foundations, design shall be implemented according to Japanese foundation structure design criteria.

The unit load over total facilities, which provides the basis for selecting the foundation type, is approximately 7.5t/m^2. Therefore, in cases where the allowable bearing capacity at the base of foundations is no less than 7.5t/m^2 and the compression settling amount is no more than 15 cm, spread foundations shall be adopted. In other cases, pile foundations shall be adopted.

Bearing ground when adopting pile foundations shall have an N value of no less than 20 and a strata thickness of no less than 5 m. The bearing capacity of piles shall be obtained from adding the bearing capacity at the tip to the frictional force. If no bearing ground is available, friction piles that utilize the frictional force around piles shall be adopted.

The foundation types for the respective site are shown in the following table.

Table 2-14 Setting of Foundations

New Site No.	O/D Study Site No.	District	Upazila	Union	Code	Name of School	Foundation			Depth: Bearing Capasity
							Pile	Mat	Isolated Column Footing	
PR1	1 A1	Pirojpur	Zianagar	Balipara	50203 1108	Badarpur Govt. Primary School	●			1～8m : 33～66KN/m2
PR2	2 A2				50203 1106	Maddha Char Balashar Govt. Primary School	●			12m : 120KN/m2
PR3	3 A3				50203 1111	Pachim Kolaron Govt. Primary School	●			10m : 100KN/m2
PR4	5 A5		Sadar	Kalakhali	50203 0407	Daudpur Chalpakuria Govt. Primary School	●			10m : 1994KN/m2
PR5	6 A6			Sharikt ala	50203 0608	Keshorota Govt. Primary School	●			8m : 1801KN/m2
PR6	7 A7			Sikdarm ollik	50203 0106	Jugkhola Muria Govt. Primary School	●			10m : 2123KN/m2
PR7	8 A8		Mathbaria	Gulisak hali	50205 0208	Kabaturkhali Govt. Primary School		●		1～6m : 99～33KN/m2
PR8	9 A9			Shaplaz a	50205 1105	Nali Charakgachia Govt. Primary School	●			9m : 1029KN/m2
PR9	11 A11		Bhandaria	Bhandri a	50204 0606	72 No Uttar Purbo Bhandaria Govt. Primary School	●			9m : 1415KN/m2
PR10	12 A12		Kawkhali	Kawkhal i	50201 0310	28 No.Choto Biraljuri Govt. Primary School	●			12m : 770KN/m2
PR11	13 A13			Saina Ragunat pur	50201 0204	14 No.Maddha Sonakur Govt. Primary School		●		2～7m : 66～99KN/m2
Subtotal							9	2	0	
PT1	14 B1	Patuakhali	Galachipa	Char Montaz	50502 0106	Algi Tafalbaria Govt.Primary School cum Cyclone Shelter	●			2～5m : 33～82KN/m2
PT2	15 B2			Uttor Char	50502 0604	Amlibari Govt.Primary School cum Cyclone Shelter		●		1～5m : 33～66KN/m2
PT3	16 B3			Char Bishaws	50502 1404	Purbo Char Bishaws Govt.Primary School cum Cyclone Shelter			●	1～4m : 99～132KN/m2
PT4	17 B4		Dosmina	Rongopa ldi	50503 0401	Patarchar Govt.Primary School cum Cyclone Shelter	●			12m : 2574KN/m2
PT5	19 B6		Kolapara	Dhankha li	50501 0903	Uttar Debpur Govt. Primary School cum Cyclone Shelter		●		1～8m : 33～66KN/m2
PT6	21 B8			Khaprab angha	50501 0607	Maherpur Govt. Primary School cum Cyclone Shelter		●		2～8m : 49～82KN/m2
PT7	22 B9		Sadar	Chotobe ghai	50504 1203	Mati Bhanga Govt. Primary School cum Cyclone Shelter		●		1～6m : 33～99KN/m2
PT8	23 B10		Bauphal	Konaskd ia	50505 0206	49 No. Kolta Govt. Primary School cum Cyclone Shelter	●			19m : 1029KN/m2
PT9	24 B11			Madonpu ra	50505 0305	65 No. Purba Madonpura Govt. Primary School cum Cyclone Shelter	●			13m : 1287KN/m2
PT10	25 B12			Kalaiya	50505 0602	Purba Kalaiya Govt. Primary School cum Cyclone Shelter		●		1～4m : 33～82KN/m2
Subtotal							4	5	1	

New Site No.	O/D Study Site No.		District	Upazila	Union	Code	Name of School	Foundation			Depth: Bearing Capasity
								Pile	Mat	Isolated Column Footing	
BR1	26	C1	Barguna	Betagi	Sarisamari	50405 0708	Gabtali Govt. Primary School	●			9m : 1673KN/m2
BR2	27	C2		Patharghata	Patharghata Sader	50402 0709	27 No. Badurtala Govt. Primary School		●		2～5m : 49～82KN/m2
BR3	29	C4			Kathaltoli	50402 0106	56 No. Burjukpur Govt. Primary School		●		1～6m : 33～66KN/m2
BR4	30	C5			Charduani	50402 0302	12 No. Sairabad Govt. Primary School		●		1～4m : 33～49KN/m2
BR5	31	C6		Sadar	Noltona	50403 1008	Nishanbaria Govt. Primary School	●			17m : 1158KN/m2
BR6	32	C7			M.Baliatoli	50403 0910	Sonbunia Govt. Primary School		●		1～4m : 33～49KN/m2
BR7	34	C9		Amtali	Borobogi	50401 0905	Sakhina Govt. Primary School	●			1～4m : 33～49KN/m2
BR8	35	C10				50401 0901	Satonpara Govt. Primary School	●			1～5m : 33～82KN/m2
BR9	36	C11			Pochakoirdin	50401 0806	Gabtali Govt. Primary School	●			10m : 1287KN/m2
BR10	37	C12			Arpangasia	50401 0205	Baliataia Govt. Primary School		●		1～5m : 33～66KN/m2
BR11	38	C13		Bamna	Ramna	50404 0306	Gadaghata Govt. Primary School		●		1～6m : 16～99KN/m2
Subtotal								5	6	0	
BG1	42	D4	Bagerhat	Morrelgonj	Putikhali	21007 0403	Sonakhali Govt. Primary School	●			18m : 1287KN/m2
BG2	43	D5			Hoglabunia	21007 1006	80 No. B. Pathtamara Govt. Primary School	●			15m : 1994KN/m2
BG3	44	D6			Ramchandrapur	21007 0202	31 No Small Kumerkhali Govt. Primary School	●			18m : 1944KN/m2
BG4	45	D7			Panchakaron	21007 0308	13 No South Kharykhali Govt. Primary School	●			12m : 2316KN/m2
BG5	46	D8		Sadar	Bemorta	21004 0210	Bergazalia Govt. Primary School	●			12m : 2316KN/m2
BG6	48	D10		Mongla	Chandpai	21006 0203	Chandpai Govt. Primary School	●			12m : 1029KN/m2
Subtotal								6	0	0	
Total								**24**	**13**	**1**	

(4) Building Equipment Plan

Since the target schools have no water supply systems, deep wells are required in the facilities whether they are used as cyclone shelters cum primary schools. The deep wells shall be installed on the ground floor of schools so long as they do not already have a well and are situated over an aquifer possessing good water quality. Pumps shall be the No. 6 hand pump type of simple structure and easy maintenance. Since there are no rock formations in the target areas, wells shall be installed by manually excavating holes with a diameter of 6 inches, inserting PVC pipes with

inner diameter of 1.5 inches and applying gravel packing and sealing. Water will basically be drawn up by bucket and stored. Pumping tests using motor-powered pumps cannot be implemented. Only schools where good quality water can be expected based on water quality data from nearby deep wells will be selected, however, in cases where salt or arsenic, etc. are detected in water quality inspections, the pumped water shall only be used for toilet flushing.

In order to make use of rainwater, elevated tanks shall be installed and water shall be piped to the faucets just before toilets. However water runs short during the dry season without wells.

(5) Finishing

Based on standard design criteria in Bangladesh, the following durable finishing methods shall be adopted.

Portion	Finish
Floor	Mortar trowel work
Pillars, walls	Mortar trowel work and painting (inner walls: brick)
Ceiling (second floor)	Mortar trowel work and painting
Roof waterproofing	Lime terracing (general waterproofing in Bangladesh)
Doors, windows	Steel and painting (frames too) (windows have iron grilles)
Ground floor entrance	Accordion shutters made from steel

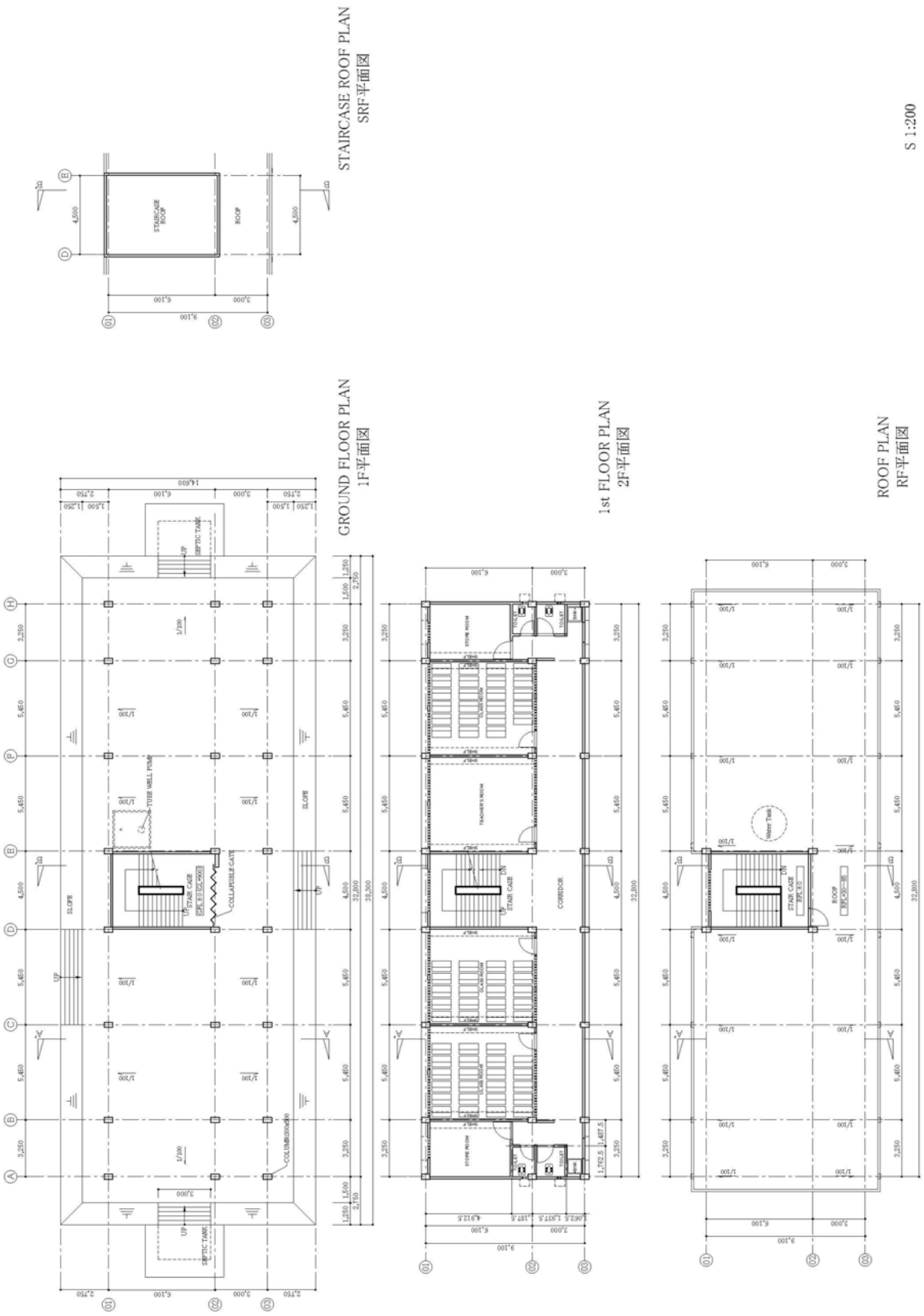
(6) Furniture

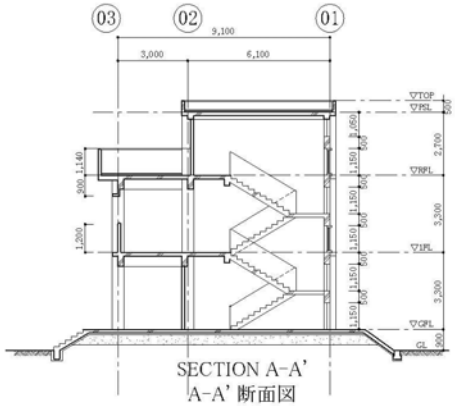
Based on standard design criteria in Bangladesh, the following furniture specifications shall be adopted.

Furniture	Specifications
Pair desks and benches for students	Wood top and steel frame
Teacher’s desk and chair	Wood top and steel frame
Teachers’ cabinet	Made from steel, 4 levels

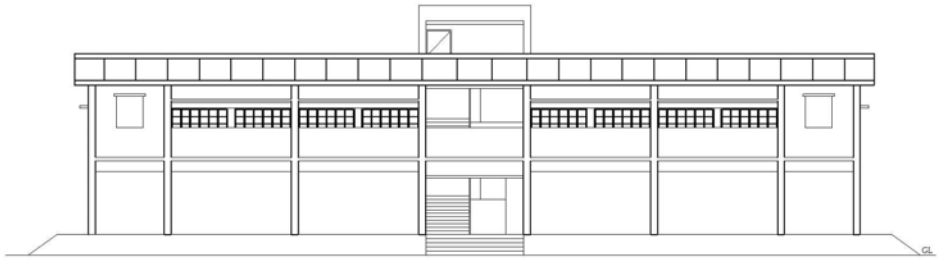
Typical completed renderings, floor plans and sectional plans for cyclone shelters of the scale and structure described above are as indicated in the separately attached drawings.

2-2-3 Outline Design Drawings



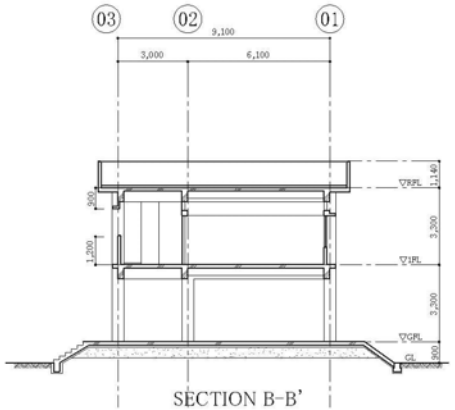


SECTION A-A'
A-A' 断面図

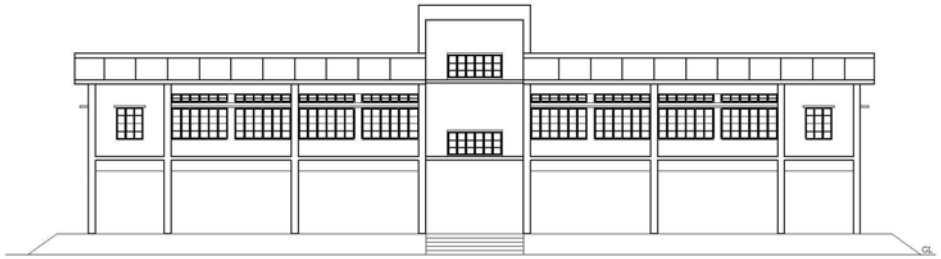


FRONT ELEVATION
立面図

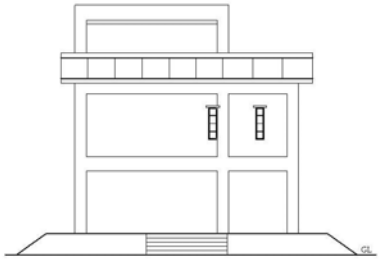
SIDE ELEVATION
側面図



SECTION B-B'
B-B' 断面図

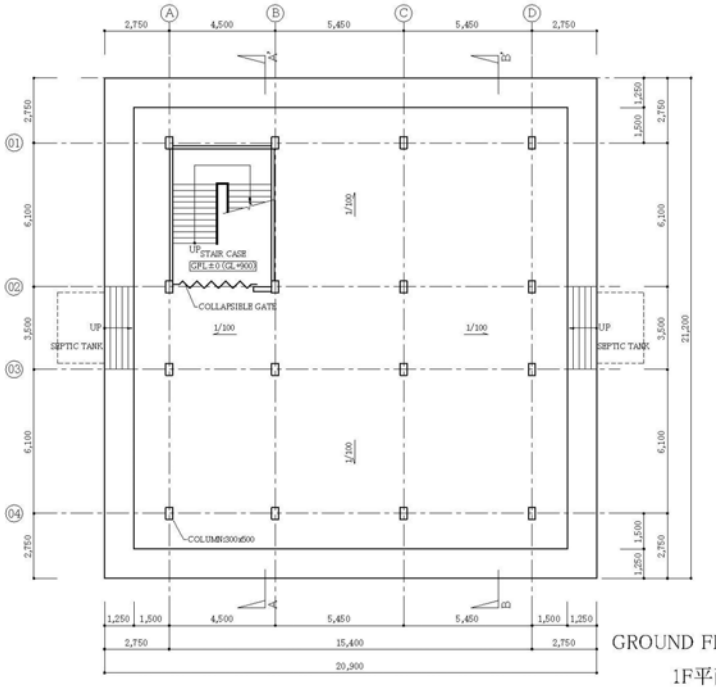


RIER ELEVATION
立面図

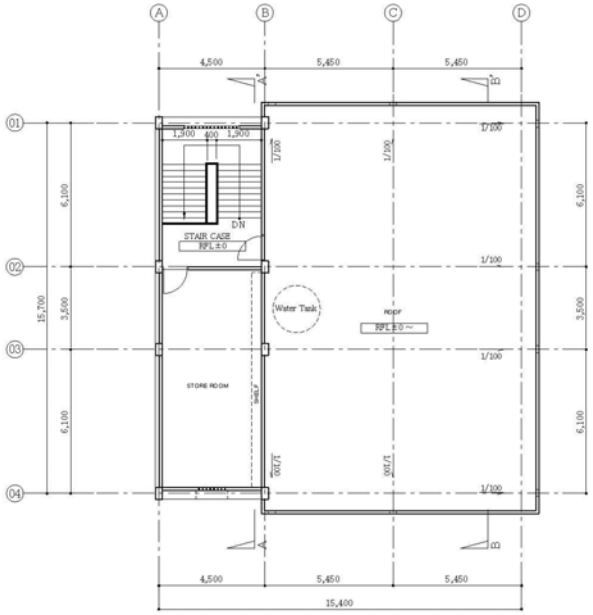


SIDE ELEVATION
側面図

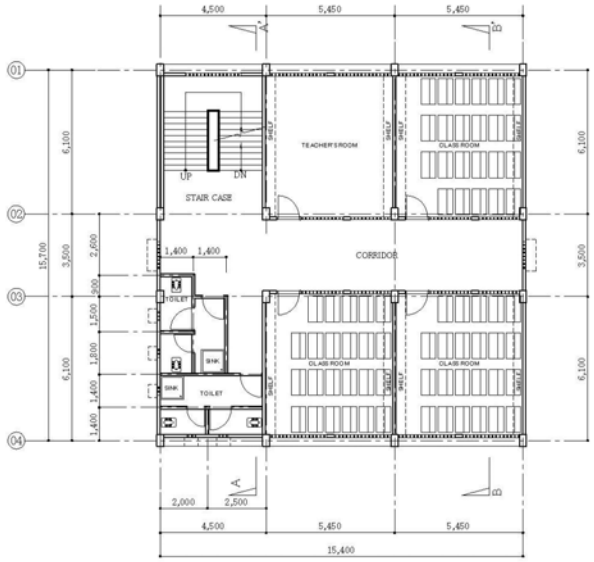
S 1:200



GROUND FLOOR PLAN
1F平面図



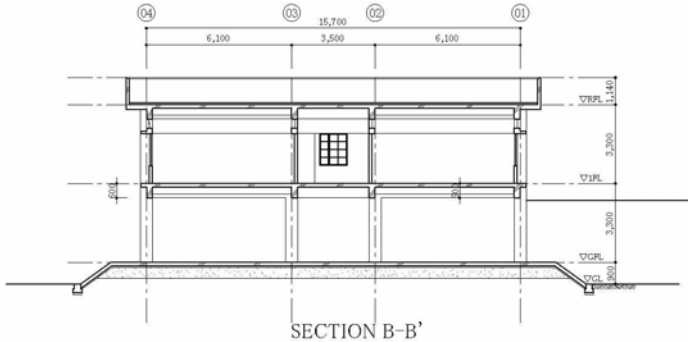
ROOF PLAN
RF平面図



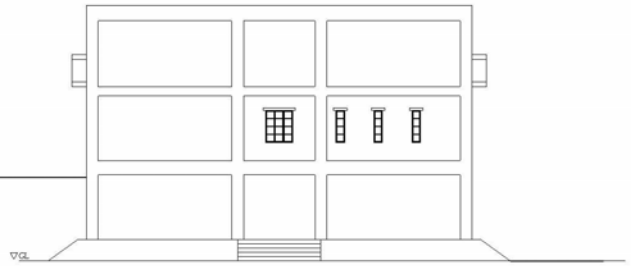
1st FLOOR PLAN
2F平面図

STAIRCASE ROOF PLAN
SRF平面図

S 1:200

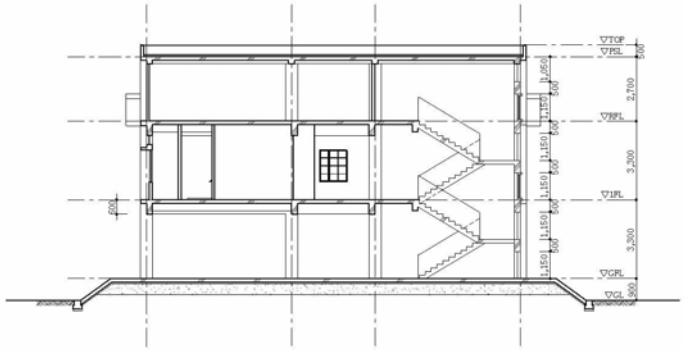


SECTION B-B'
B-B' 断面図

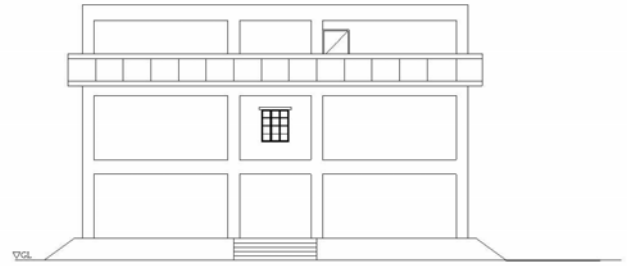


SIDE ELEVATION
側面図

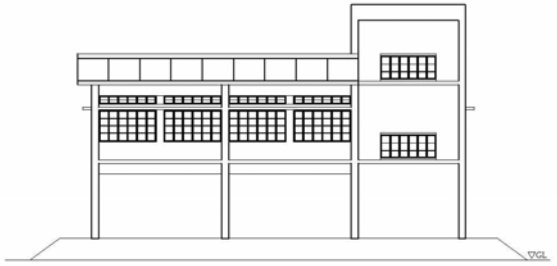
FRONT ELEVATION
立面図



SECTION A-A'
A-A' 断面図

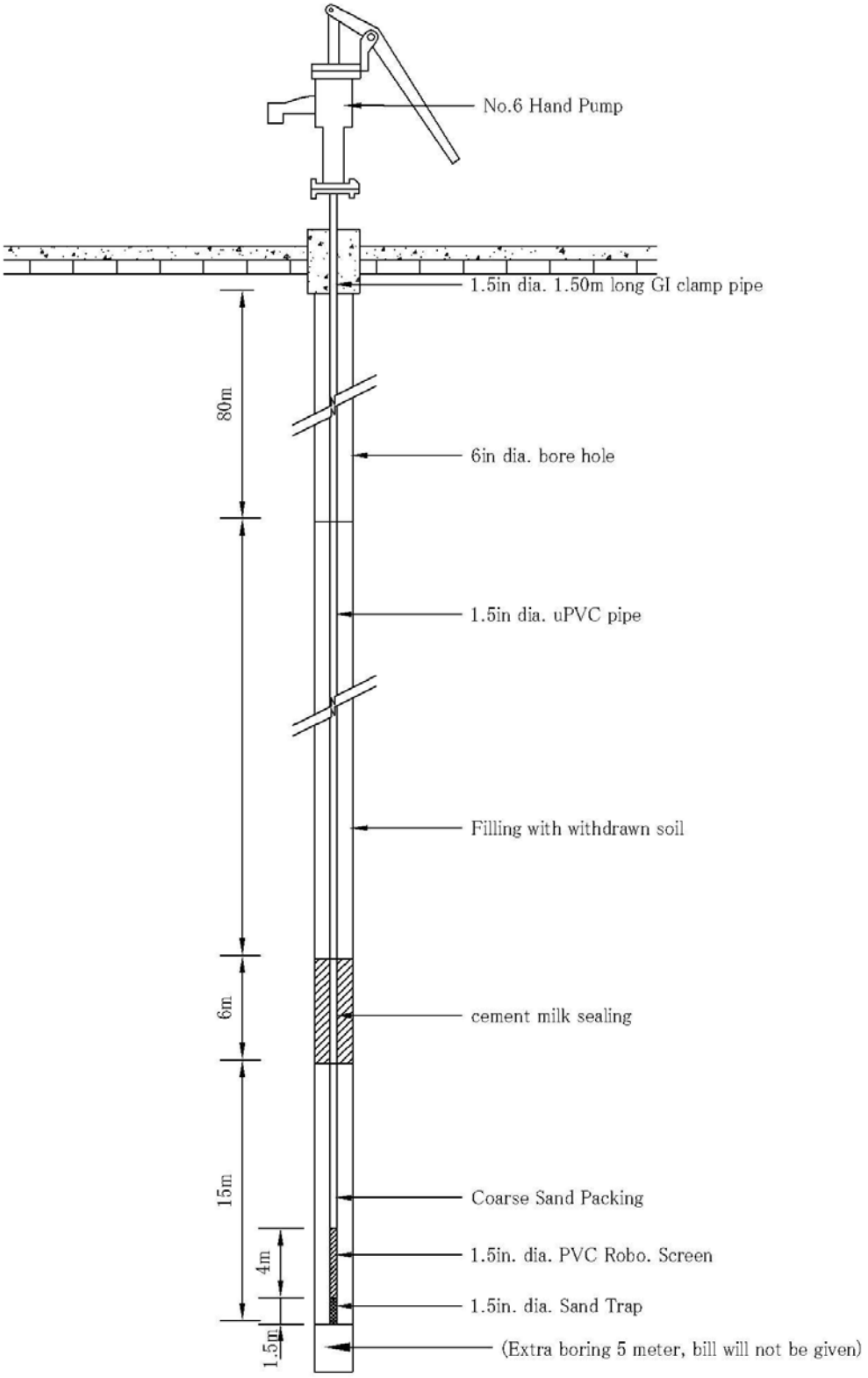


SIDE ELEVATION
側面図



RIER ELEVATION
立面図

S 1:200



DRAWING OF A TYPICAL DEEP TUBE-WELL
深井戸標準図

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project will be implemented according to the scheme of the Government of Japan's Grant Aid for Disaster Prevention and Reconstruction (programme type). Unlike general grant aid, since it is possible that local contractors will execute the works, it will be necessary to strengthen the works supervision and technical guidance by the Japanese consultants in order to ensure quality control, schedule control and safety management.

(1) Implementation Setup

Following the Exchange of Notes (E/N) concerning the grant aid, the Government of Bangladesh will consign the procurement agent to procure the works supervision consultant and works contractors. The works supervision consultant and works contractors will bind contracts with the procurement agent and implement their respective tasks.

1) Responsible Agency

The responsible agency for the Project is Local Government Division (LGD) under the Ministry of Local Government, Rural Development and Cooperative (MLGRD&C).

2) Implementing Agency

The Project implementing agency is the Local Government Engineering Department (LGED). The Project will be implemented as a Grant Aid for Disaster Prevention and Reconstruction undertaking based on the procurement agency agreement that is signed by the LGED as the implementing agency on the Bangladeshi side and the Japanese procurement agent.

The primary related agencies on the Bangladeshi side are as follows:

- Ministry of Food and Disaster Management (MoFDM)
- Economic Relations Division (ERD)
- Local Government Division (LGD) under Ministry of Local Government, Rural Development & Cooperatives (MLGRD&C)
- Local Government Engineering Department (LGED)
- Ministry of Primary & Mass Education (MoPME)

Out of these agencies, the LGED is the engineering arm of the MLGRD&C and implements the construction and maintenance of cyclone shelters in Bangladesh. Since the LGED has excellent organization and execution capability, smooth implementation can be anticipated if it becomes the contract partner with the procurement agent. In addition, an inter-government

conference comprising representatives from the main related government agencies on both sides will be established to discuss items requiring confirmation on the national level. Moreover, a working group will be set up between the LGED, JICA Bangladesh office and procurement agent in order to check on progress and discuss any technical points, etc. that require confirmation.

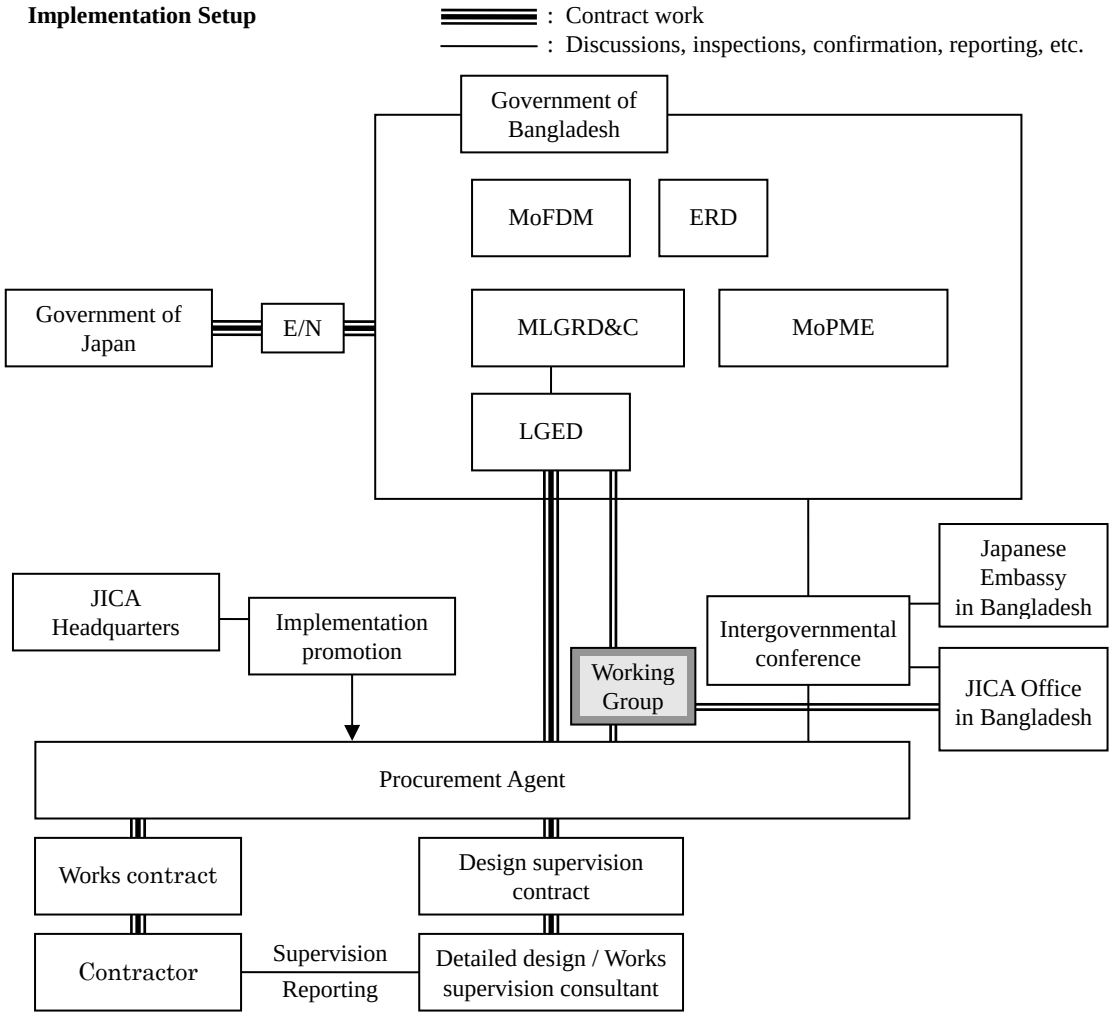


Figure 2-2 Project Implementation Setup

(1) Procurement Agent

1) Implementation Contents

The consultant that implemented the Outline Design Study will prepare the reference materials for preparing tender documents and supply them to the implementing agency on the Bangladeshi side. After that they will be handed over as the tender documents to the procurement agency, and the tender procedure and implementation works of the Project will begin. The procurement agent will be recommended by the Government of Japan to the

Bangladeshi side and will conduct general supervision as the mandatory of the responsible agency to ensure that the components of the main works contract are appropriately and smoothly carried out.

Work during the implementation design period (tender procedures period) will comprise the agency agreement, bank arrangements, establishment of a local office, preparation of tender documents pertaining to building contractor contracts, distribution of tender documents, implementation of tender and assessment, and contracting work with building contractors.

During the works supervision period, the resident manager dispatched from the Japanese procurement agent will conduct confirmation of the implementation contents (including payments and fund control and planning of use of residual funds), report on progress to both governments and maintain constant discussion, coordination and reporting with the Bangladeshi side. To this end, it will recruit local engineering supervisors and clerical staff.

2) Implementation Setup

- Implementation design period (tender procedures period)

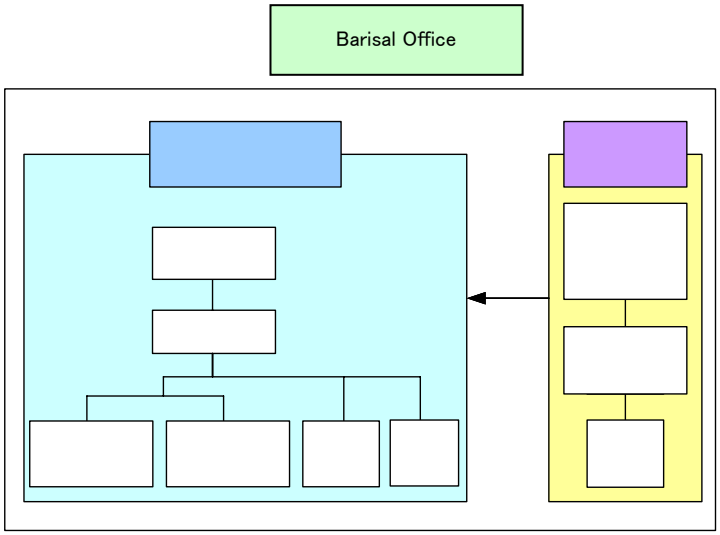
  Activities during this period will comprise the coordination of tender documents, confirmation of specifications and assessment of tenderers, however, since it is expected that there will be numerous tender lots due to the local construction situation, local assistant personnel will be recruited. Furthermore, since it will be necessary to respond to technical inquiries regarding the tender documents and evaluate the technical propriety of tender proposals, the Japanese consultant will offer assistance in technical areas.

- Works supervision period

  The procurement agent will conduct general supervision during the execution period, however, since the Project sites are 38 primary schools dotted around four districts in the south of Bangladesh and traveling between sites would be very time consuming, three local engineers will be recruited to help with the smooth implementation of the supervision work. One of these engineers will be in charge of Patuakhali, one will be in charge of Barguna and one will be in charge of Bagerhat and Pirojpur.

  - Implementation setup during tender

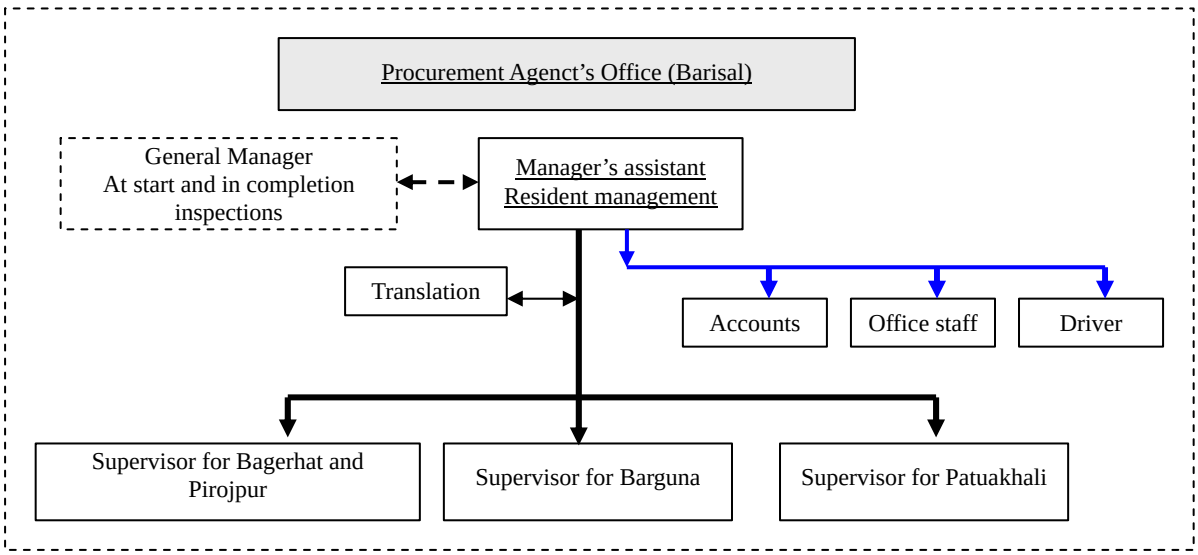
    Since it is scheduled to implement the tender in Barisal, an office will be opened here to smoothly implement the tender work and review work. This office will be staffed by the Japanese general supervisor, his assistant and two local contract supervisors. Moreover, since it will be necessary to respond to technical inquiries and to implement review and assessment of the technical parts of proposals, the Japanese consultant will assist the procurement agent.



- During works supervision

Procurement agent and works supervision setup

A public procurement agency in Japan, acting as the procurement agent for the Government of Bangladesh, will conduct the various procurement work including the selection of and handling of contract procedures, etc. with the works supervision consultant and works contractors. At the same time, this agency will control and confirm the work contents and performance of the works supervision consultant and works contractors and, on behalf of the Government of Bangladesh, handle financial arrangements including the making of payments to the works supervision consultant and works contractors and supervise the implementation of work by these agencies. The office of the procurement agent will be moved to Barisal from Dhaka.



4) Works Supervision Consultant

The consultant that is selected by the procurement agent as the technical consultant will act as the works supervision consultant in overseeing the works. In addition to supervising the quality, progress and safety, etc. of works, the works supervision consultant will assess the work progress of contractors.

5) Contractors

The contractors selected by the procurement agency will implement works based on their contracts.

(2) Works Execution

Bangladesh does not have many construction operators who possess the technical capacity required to implement the Project works, however, none of the required equipment and materials need to be imported and all the necessary items can be procured locally. Accordingly, assuming that local contractors can handle the works specifications, the works contractors will be selected through international tender also open to local companies, and the successful bidders will be utilized as the works contractors.

The major components of the Project comprise the construction of cyclone shelters cum primary schools as well as deep well works, however, considering the large number of target schools and the fact that the target sites are concentrated in the delta region in the south of the country, consideration shall be given to introducing appropriate lot packaging of the works upon taking the geographical characteristics and execution capacity of operators into account.

(3) Works Supervision

The Project, to be implemented as a single grant aid project, entails the simultaneous implementation of works at 38 schools scattered over the four districts of Pirojpur, Patuakhali, Bagerhat and Barguna. The sites are dotted around and separated by numerous rivers in the Bay of Bengal delta region which suffers the most acute damage in cyclones. Moreover, although Bangladesh has some construction companies that possess a certain degree of technical prowess, the construction companies in regional areas are generally small and do not have excellent levels of execution capacity and quality control capacity. Accordingly, it will be necessary to efficiently implement quality control, progress control and safety control, etc. on each site. The procurement agent, acting on behalf of the Government of Bangladesh, will conduct implementation supervision for the overall Project, while a newly selected Japanese consultant will supervise the technical aspects of each component upon considering the utilization of local consultants and retired members of local infrastructure offices where the cyclone shelters are being built.

(4) Mode of Ordering Public Works in Bangladesh

1) Tender and Works Contract Procedures

Bangladesh implements numerous public works projects including roads and bridges, etc. The LGED alone orders more than 200 projects per year. Public works are first advertised in at least two national or local newspapers; tenderers are ranked according to their financial capacity and works record, etc., and operators acquire tender qualifications according to the scale of each works. Assessment is implemented following implementation of the tender, however, if the value of the works order is no more than 1.0 million U$, approval is required from the LGED Chief Engineer. For contracts worth between 1.0~3.6 million U$, approval is required from the Minister, while for projects worth more than 3.6 million U$, approval is required from the Purchase Committee (composed of five ministers and chaired by the Minister of Finance). In the Project, following discussions with the Bangladeshi side, it has been confirmed that approval is only required from the LGED Chief Engineer.

2) Size of contract amount concerning Cyclone Shelters

Since Bangladesh does not have many operators capable of completing a certain amount of works over a set period and considering the geographical characteristics of the scheduled works sites, orders are basically limited to one school per company. In cases of large scale works, approval is required from the Purchase Committee. The fact that this procedure can take an unexpectedly long time is another major reason for limiting orders to one school per company.

3) Type of Contract

Works contracts in Bangladesh mainly consist of BQ contracts, which are based on works quantities, and batch contracts (lump-sum contracts). In the Project, it is scheduled to adopt the batch contract method. Also, the foreign exchange contract (US dollar contract) approach is a possible method.

2-2-4-2 Implementation Conditions

(1) Construction Sites

All the project sites are separated by numerous major rivers and the ocean, and almost all the sites are inaccessible to materials and construction machinery transported overland. Since many of the target areas become submerged during the monsoon season, the execution plan and procurement plan shall be compiled with consideration given to the following points.

1) Transportation method: Adopt water transportation for moving construction equipment and materials from urban areas in each district to each site.

2) Transportation capacity: Since river transportation is popular and this is mainly conducted in

small boats with capacity of 3~5 tons, transportation is time-consuming. For reference purposes, the weights of construction materials required for a standard cyclone shelter (2-story, 3 classrooms + 1 teachers' room + storeroom + toilets and mat foundations) are as follows. In addition, construction machinery such as concrete mixers should be carried in.

Table 2-15 Weight of Construction Materials (Rough weights per standard shelter)

Material	Weight (Unit: tons)	Remarks
Cement	145	Amount of concrete is approximately 470m^3
Reinforcing bars	70	150kg/m^3
Aggregate	850	Sand and gravel
Formwork	30	Timber
Finishing materials	15	Floor materials, fittings, etc.
Total	1,110	

3) Transportation cost: The Project sites in Bagerhat and Pirojpur are located within an approximately 25 km radius of the central cities. In Barguna, it is approximately 40 km to the furthest Project site in the south, while in Patuakhali the sites are dotted within a 60 km radius of the central city. Particularly in Barguna and Patuakhali, materials transportation is difficult and it is necessary to consider the appropriate transportation cost. Rough marine transportation costs according to the market survey conducted by the Study Team are as follows (provisional):

- Patuakhali District: 300~500 Tk/metric ton
- Barguna District: 300~600 Tk/metric ton

4) Construction of landing stages: Landing work is conducted by a large number of landing the boat directly onto the bank, however, because specific landing stages are not established, it is necessary to consider the provision of temporary piers and footholds.

5) Transportation period: Since it is impossible to transport materials between June and September, this fact will need to be reflected in the scheduling.

6) Storage of materials: Since many of the construction sites are in remote areas that have no fences and so on, works personnel can freely enter and leave the sites. Moreover, since there is frequent torrential rain, works stores will be need to be provided on elevated land prepared by banking. These sites shall be secured by surrounding with barbed wire fencing and the like.

(2) Construction Operators

Bangladesh is thought to possess a certain degree of construction technology because there are more than 1,000 construction operators in the country and the capital Dhaka has high-rise buildings of up to 20 stories. Moreover, since this is an emergency disaster relief undertaking, the basic principle is to utilize local operators, however, attention shall be paid to the following points.

The major construction companies are concentrated in the metropolitan region, however, there are no companies that possess excellent execution capability in rural areas. Since there is a strong possibility that rural operators will win orders in the tender process, it will be necessary to carefully discern the execution capability of such companies. There are approximately 30 construction companies in Barguna and 40 companies in Patuakhali, and of these around 5 companies are S-class (special class) and 15 companies are A-class enterprises. The LGED as a rule requires companies of A-class status or higher in the construction of cyclone shelters, however, all such companies only have around 15 employees and they usually need to recruit extra local workers according to the size of works projects. Moreover, since such companies only have limited numbers and types of construction machinery, it is difficult for them to implement works on multiple sites. It is thought that single companies can simultaneously handle no more than two or three shelters of the size planned in the Project, however, in remote areas with poor access conditions, companies may only be able to manage one school each. In past orders for cyclone shelter construction, as a rule the LGED has implemented tender of one school building per company. Therefore judging the execution capacity of construction companies and taking the geographical features of Project sites into account, a lot ordering plan conditional on no more than two works sites per company shall be compiled in order to utilize local contractors.

(3) Materials Procurement

Construction materials in the Project do not include any special items and can all be procured in Bangladesh, however, since difficulty will arise concerning the procurement of concrete aggregate and good quality mixing water, attention shall be paid to the following points.

1) Fine Aggregate and Coarse Aggregate

Since it is difficult to obtain good quality aggregate (crushed stone and sand) in Bangladesh, burnt bricks are frequently crushed to gravel size and used as aggregate for concrete, however, this is far weaker than general aggregate. According to the results of compression testing, the compressive strength of concrete using brick chips is approximately 67% (180kg/cm^2) that of ordinary aggregate, and when execution accuracy and management capacity are also taken into account, this level declines even further. Moreover, the adverse impacts on concrete of brick impurities are a cause for concern, and many of the school buildings that were built 20 or so years ago show clear signs of peeling and damaged concrete and have main reinforcing bars rusted to breaking point. Therefore, from the viewpoint of securing quality, brick chip aggregate shall not be adopted in the Project.

Table 2-16 Sample Compression Test Results

Type of test sample	28-day strength (MN/m^2)	Comparison ②／①
① Brick chip sample	27.78	66.7%
② Ordinary aggregate sample	18.52	

Source of data: LGED

Also, good quality aggregate in Bangladesh can only be obtained in the Sylhet region in the north of the country, but this is some 800 km away from the Project sites. General building contractors are prohibited from purchasing this aggregate, and a system is adopted whereby specialist transportation companies make deliveries to each district, which keeps a set quantity always on hand in a central location. The building contractors in each district are able to purchase good quality aggregate from these stock points.

2) Concrete Mixing Water

Many parts of the Project target area become submerged during the monsoon rainy season. Moreover, although there are numerous rivers, they do not readily provide concrete mixing water that contains no impurities, so water from lakes and groundwater is used for this purpose. Since good quality concrete mixing water is indispensable for securing good concrete quality, water quality inspections shall be implemented at each site. However, considering that it would be geographically impossible to secure good quality water resources if water was found to contain salt in such inspections, it is necessary to use concrete with salt damage resistance specification.

(4) Safety Control

Since many of the Project sites are in remote areas, it is likely that large numbers of local farming folk, who have little know-how about construction, will be recruited in the works. Moreover, if anybody gets injured, since it is difficult to gain immediate access to hospitals, it will be necessary to take ample care regarding safety control. In particular, attention shall be given to the following points while particularly striving to nurture the safety control awareness of general laborers and to uphold the control setups.

1) Since mobile phones can be used in all the Project sites, establish an emergency communications network of Japanese officials, Bangladeshi officials, hospitals and police, etc., and thoroughly ensure that related persons are aware of it.

2) Enforce morning assemblies and make sure that the day’s work contents are always confirmed and safety instructions given before the start of work.

3) At the end of work, conduct thorough site patrols to confirm that scaffolding, supports, handrails and so on provide a safe working environment.

4) In cases of poor weather, if it is possible that access road conditions may deteriorate and lead to slips, falls or overturning, etc., always inspect access points and keep them in good condition. Moreover, in cases where overseas transportation routes are expected to be rough, suspend the transportation of materials.

5) Since primary schools already exist on the Project sites and school lessons will be conducted while the works are going on, build temporary fences to keep school personnel apart from works areas.

6) Always keep first aid boxes on hand in site offices.

7) Since there are many curious children, assign multiple guardsmen at important points.

2-2-4-3 Scope of Works

The scope of the works of the Japanese side (the grant aid portion) and the implementing agency on the Bangladeshi side are as indicated in the following table.

Table 2-17 Scope of Works

No.	Item	Japan	Bangladesh	Remarks
1	Securing of construction sites		●	
2	Leveling of construction sites, and demolition works	◆	●	According to necessity
3	Installation of fences and gates		●	
4	Parking area works	—	—	
5	Road works			
	1) Inside sites	—	—	
	2) Outside sites (access roads)		●	
6	Construction works	●		Supervision cooperation①
7	Electrical works, water supply works, drainage works			
	1) Electrical works			
	a. Transmission line works		●	Up to sites
	b. Distribution works	—		Within sites
	c. Receiving panel and distribution panel works	—		
	2 Water supply works			
	a. City water (public water supply) works		●	Up to sites
	b. Distribution pipe works, water tank works	—		Within sites
	3 Drainage works			
	a. Sewage pipe works (sanitary sewage, rainwater)		●	Up to sites
	b.			
	4 Furniture (desks, chairs)			
	a. General furniture		●	
	b. Desks, chairs (teachers, students)	●		
8	Bank account opening commission and A/P commission based on the B/A		●	
9	Customs procedures (*)			
	1) Marine (Air) transportation of the products from Japan to the recipient country (*)	●		
	2) Tax exemption and custom clearance of the products at the port of disembarkation (*)		●	
	3) Internal transportation from the port of disembarkation to the project sites (*)	—	●	
10	Provision of conveniences for imports (*)		—	
11	Bearing of duties and taxes (*)		●	
12	Maintenance (*)		●	
13	Works costs not included in the grant aid (*)		●	

Note: B/A:Banking Arrangement

● : Indicates the responsible party

◆ : Earth filling if necessary

— : Not applicable

① :LGED will cooperate for work supervision in collaboration with the engineers of Japanese side.

2-2-4-4 Works Supervision Plan / Procurement Supervision Plan

(1) Need for Works Supervision

The Project, to be implemented as a single grant aid project, entails the simultaneous implementation of works at 38 schools scattered over the four districts of Pirojpur, Patuakhali, Bagerhat and Barguna. The sites are dotted around and separated by numerous rivers in the Bay of Bengal delta region which suffers the most acute damage in cyclones. Moreover, although Bangladesh has some construction companies that possess a certain degree of technical prowess, the construction companies in regional areas are generally small and do not have excellent levels of execution capacity and quality control capacity. General consulting companies are also limited in Bangladesh. Although there are numerous small-scale consultant firms and it is possible to secure a certain level of engineers required for supervising works sites, quality control standards are not in place and it is difficult to expect high technical levels. Accordingly, in order to ensure that uniform quality levels are achieved in the Project, it will be necessary to conduct thorough technical guidance using numerous Japanese consultants. In particular, it may be a good idea to assemble the assistant engineers of the Japanese consultant and stage an orientation workshop to teach the works supervision points and methods, reasons for securing quality and method of filling out works supervision documents, and thereby thoroughly ensure uniformity of the works supervision methods.

(2) Implementation Setup

① Implementation Design Period (tender period)

The tender procedures will be implemented by the procurement agent, however, since it will be necessary to answer technical queries about the tender documents and evaluate the technical propriety of proposals from tenderers, a Japanese consultant shall provide assistance for the technical aspects. Accordingly, the Japanese consultant shall be dispatched to Bangladesh at the start of the tender and during the evaluation stage.

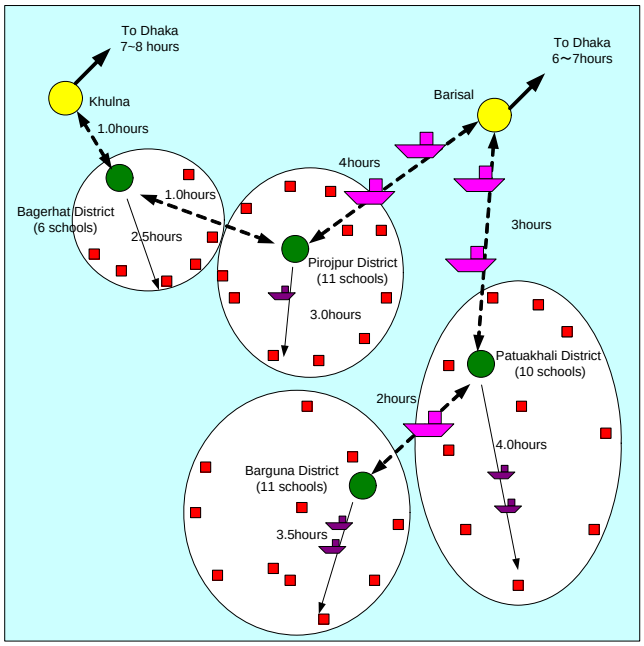
(Note: Concerning utilization of the Japanese consultant following the tender work, the final decision will be made by the Government of Japan upon taking the Project contents and level of difficulty, wishes of the Bangladeshi side and overall Project budget into account. Moreover, concerning the works supervision contract following the decision to execute the grant aid based on the E/N, in the event where a Japanese consultant is utilized, since it will be necessary to ensure the technical consistency of the outline design study and outline design work and the executed contents, JICA will recommend the said consultant to the Government of Bangladesh).

② Works Supervision Period

During the period of works execution, the consultant will conduct the necessary site guidance and technical guidance primarily comprising quality supervision, schedule supervision and safety control, etc. required for implementation of the Project. It will also report on the progress and contents of work to the procurement agent and agencies on the Government of Bangladesh side. Moreover, in cases where technical problems arise, it will hold discussions, conduct examination and propose solutions.

Monthly meetings shall be held in attendance with LGED Executive Engineer on district level, the consultant of the Procurement Agent and contractors, and weekly meetings shall be held in attendance with LGED Upazila Engineer or his representative, the assistant engineer of the consultant of the Procurement Agent and contractors. Local LGED Engineers including assistants will visit the construction sites of the project frequently. In particular, supervision will be strengthened by on-site checking during concrete casting etc.

③ Important Points to Consider



The figure on the right indicates the locational relationship of the sites in the four districts. This will greatly influence the works supervision setup. The nearest major cities are Barisal and Khulna, where accommodation facilities can be found. Bagerhat and Pirojpur are connected by relatively good roads and are separated by approximately 1.0 hour by car. However, there are no roads that directly link Pirojpur, Patuakhali and Barguna, and it takes between 7~8 hours to backtrack to Barisal and take a ferry from there. Concerning distances from the central cities of each district, the sites in Bagerhat and Pirojpur districts are separated by around 2.5~3 hours, whereas the sites in Patuakhali are dotted all over the district and it takes around 4~5 hours to reach the furthest site. In all cases, it is necessary to use a combination of vehicle, boat and motorbike to reach the sites.

④ Works Supervision Setup

As can be seen, gaining access to the Project sites in the four target districts will be difficult.

In particular, the numerous sites (10 or 11 schools) in Patuakhali and Barguna districts are widely dispersed and it would take a lot of time to travel between the sites. Even if one resident supervisor were dispatched to each district, he could visit no more than two neighboring sites per day and it would only be possible to visit each site once every 7 or 10 days.

The situation regarding poor access is similar in Pirojpur and Bagerhat districts too, however, because the sites here are more centralized and can be reached in around 3 hours at most, it will be possible for one resident supervisor to look after both districts.

Moreover, since local construction firms do not have excellent technical capability, local engineers shall be recruited and permanently assigned to sites in order to ensure thorough quality control.

Regarding the supervision setup, supervision offices will be opened in Patuakhali, Barguna and Bagerhat districts. The office in Patuakhali will supervise works at the 10 shelters in that district as well as act as the general supervision office and main liaison center for all four districts during the Project term including the monsoon season. Accordingly, this office will be permanently staffed by the Japanese resident supervisor and chief supervisor (local engineer), while during the rainy season it will be the workplace of nine local engineers from each site.

No supervision work will be conducted during the rainy season and the supervision setups will comprise 10 and 9 members (Japanese resident supervisor and local engineers) respectively.

(Note: The Japanese resident supervisor and local engineers assigned to Patuakhali district office will be permanently assigned because they will need to monitor site conditions during the rainy season too.)

2-2-4-5 Quality Control Plan

(1) Basic Concept

The consultants shall supervise the works and equipment/materials procurement to ensure that work is finished on schedule, and they shall supervise and instruct the contractors to ensure that the quality, work progress and equipment/materials delivery deadlines stipulated in the contracts are secured and that the site works are executed safely.

Bangladesh does not have any works supervision and quality control standards or any written control standards and execution control guidelines. LGED branch offices possess equipment for conducting concrete compressive strength and aggregate particle size tests as well as soil quality

test apparatus and other basic test equipment, and they implement works control activities, however, judging from the geographical features of Bangladesh and the technical levels of locally employed laborers, it will be important to provide technical guidance to contractors on sites. Moreover, site workshops will be staged as much as possible in order to prepare control standards and transfer technology based on quality control standards in Japanese criteria.

(2) Quality Control Items

No special construction materials are adopted in the Project, and building plans have been compiled in accordance with local works methods. Control will be implemented according to the following items to ensure that the facilities under construction and the manufactured and supplied materials satisfy the quality levels and work progress that are required in the contract documents.

① Checking of working drawings and specifications of the used materials

It will be compulsory to present the working drawings for confirmation prior to the construction works. Moreover, specifications and purchase certificates will need to be presented for the supplied materials to make sure that quality is certainly secured.

② Visiting of equipment and materials manufacturing and production sites or checking of inspection results

Where necessary, the manufacturing or production plants of purchased construction materials will be visited to implement inspections, confirm the quality of raw materials and check product inspection certificates, etc.

③ Supervision and confirmation of performance and finish

On construction sites, technical supervision and on-the-spot inspections will be implemented and any defects will be thoroughly fixed. In performance inspections, final work performance will be checked against the contents of shop drawings.

④ Inspection records

Regarding the locally recruited consultants, instruction will be provided in control guidelines and they will be required to keep inspection records for each structural member and process in order to ensure that definite supervision is efficiently implemented.

⑤ Table 2-18 indicates the main quality control items.

Table 2-18 Primary Quality Control Plan

Type of Work	Management Item	Testing (Inspection) Method	Testing Frequency
Foundation works	Bearing strength	Plate bearing test	One place of each spread foundation
	Pile supporting layer	Comparison between excavated soil and boring data; measuring	For each pile
	Pile bearing test	Loading test	Test piles
Earth works	Compaction	Visual inspection	All foundation bases
	Incoming soil quality inspection	Particle size test	Quarry: 1 site
Formwork	Performance	Dimensional inspection and photographs	All members
	Materials inspection	Plate thickness, quality and deformation	All members
	Assembly inspection	Visual check (gaps, reinforcing material, spacers)	All members
Reinforcing bar works	Tensile strength	Tensile strength test	Once for each size
	General quality	Mill sheet inspection	Once for each size
	Bar arrangement inspection	Number of bars, diameter, spacing, joint length, setting length, covering thickness	Prior to concrete placing, all points
Concrete works	Aggregate particle size	Sieve-analysis test	Once
	Test mixing	Blending, water-cement ratio, compressive strength, slump and salt content	Once
	Compressive strength	Compressive strength test	Once for each region
	Slump	Slump test	Once for each region
	Water quality test	Salt concentration	Once
Reinforcing bars	Tensile strength	Tensile strength test	Once for each size
	General quality	Mill sheet inspection	Once for each size
	Bar arrangement	Bar arrangement inspection	Prior to concrete placing
Brick work	Brick quality	Plant inspection	Once
Doors and windows	Quality of doors and windows	Visual inspection; measuring	When carrying in
Furniture and fixtures	Quality of furniture and fixtures	Visual inspection; measuring	When carrying in

(3) Schedule Control

In order to ensure that contractors adhere to the delivery deadlines stipulated in the contracts, the consultants shall compare the implementation schedule contained in the contract with the actual works progress every month, and when delays are forecast, they shall prompt the contractors, seek the submission of countermeasure plans and offer guidance to ensure that the works and equipment and materials deliveries are completed within the agreed periods. Comparison of the planned schedule and actual progress shall be conducted according primarily to the following items.

① Confirmation of works performance
(construction materials procurement situation and state of works progress)

② Confirmation of equipment and materials delivery performance
(construction equipment, materials and fixtures)

③ Confirmation of temporary works and preparations for construction machinery (according to necessity)

④ Confirmation of numbers of engineers, skilled workers and laborers, etc.

2-2-4-6 Procurement Plan

Since the procurement of equipment and materials required for the Project is included in the works contracts, procurement will be conducted based on agreements between the procurement agent and works contractors. Architectural structures, equipment works, electrical equipment and deep wells are included in the facilities plan, and according to the site surveys, it will be possible to procure all the necessary equipment and materials in local markets.

Table 2-19 shows the equipment and materials procurement sources.

Table 2-19 Equipment and Materials Procurement Sources

Item	Country of Origin			Remarks
	Bangladesh	Japan	3rd Country	
[Materials]				
Portland cement	○			
Concrete aggregate	○			
Reinforcing bars			○	India, etc.
Concrete blocks	○			
Timber and formwork	○			
General steel materials			○	India, etc.
Steel fittings			○	India, etc.
Paint			○	India, etc.
Temporary installation materials	○			
Furniture	○			
[Construction machinery]				
Vehicles			○	India, etc.
Dump trucks			○	India, etc.
Concrete mixers			○	India, etc.
Concrete plants			○	India, etc.
Ratio (%)	80 %	0 %	20 %	

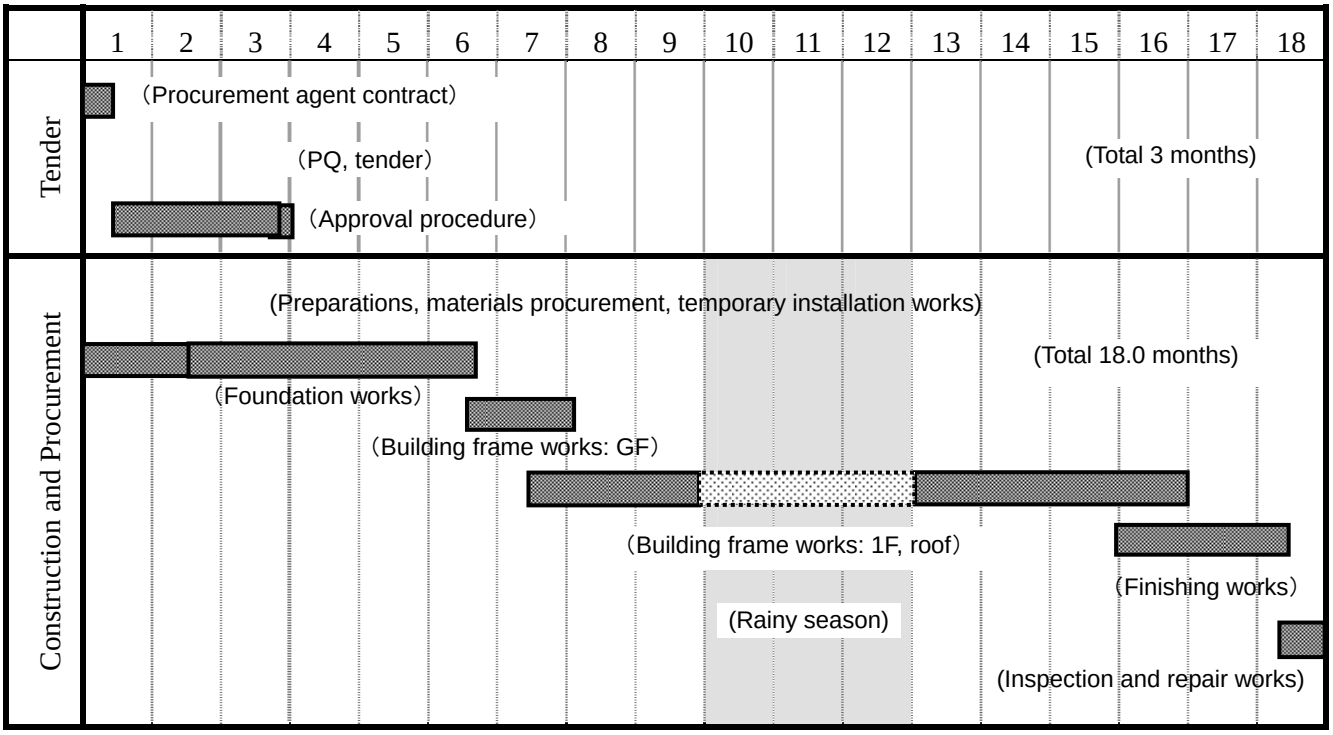
2-2-4-7 Implementation Schedule

The Project implementation schedule following the E/N is as indicated below.

Since Bangladesh has buildings of up to 20 stories, its construction operators are thought to possess a certain degree of technical capability, however, construction operators in regional areas are almost all small-scale enterprises employing between 15~20 workers, and there are hardly any operators that are capable of implementing works simultaneously on multiple sites. Since the Project sites are

concentrated in the southern delta region with poor access, it will be hard for a single large contractor to undertake all the works. Moreover, in view of the fact that existing cyclone shelters have mostly been ordered on the basis of one facility per operator, the works here shall be divided into lots of no more than two sites per contractor upon considering the scale of the Project activities, the capacity of local works contractors and local characteristics, etc. As a result, it is expected that orders will be divided into between 25~30 lots.

Table 2-20 Project Implementation Schedule



(1) Important Points to Consider in the Schedule Planning

(a) Removal of Existing Buildings and Obstacles

At three of the targeted schools, cyclone damage and deterioration have rendered the existing buildings unfit for entry, and since the demolition of these buildings and disposal of resulting waste materials are included in the Bangladeshi scope of works, they will not be included in the main construction works schedule.

(b) Preparation Period

A preparation period has been taken into account for procurement of construction equipment and materials and labor, preparation of schedule plans and working drawings, installation of equipment and materials stores, rest facilities for workers, dormitories and site offices, and confirmation of the sites and surrounding areas.

(c) Foundation Works

In cases of pile foundations, piles shall be cast in place. Concerning the number of piles, between 85~100 square concrete piles are estimated in each building. Judging from the local execution capacity, it will take approximately 1.2 months to manufacture piles and 1 month to put them in place, thus amounting to approximately 2.2 months for the pile works alone. The total works period including treatment of pile heads, excavation and foundation works is approximately 4.0 months.

(d) Rainy Season

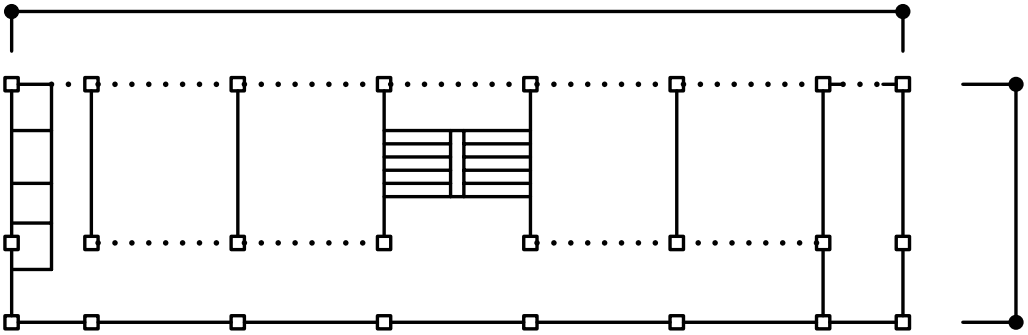
Bangladesh is prone to torrential rains between June and September and many of the Project target areas are subject to flooding damage during this time. Moreover, road transportation becomes difficult and rough seas often lead to the cancellation of ferries traveling to Barguna and Pirojpur. Accordingly, since sure progress cannot be expected during this period, it will not be counted as part of the works schedule.

(e) Execution Capacity

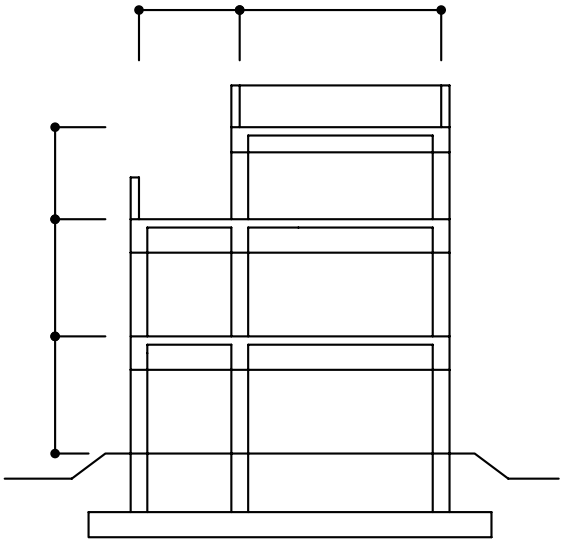
Construction operators in Bangladesh are thought to possess a certain degree of execution capacity, however, since the Project sites are remote rural areas and it is expected that local residents will be employed in a lot of cases, the works schedule shall be set taking into account the possibility that local execution capability is not excellent.

(f) Formulation of the Execution Period

The execution period was formulated based on the works quantities and work capacity of local contractors. The standard type of cyclone shelter to be adopted in the Project comprises a two-story school building as indicated below, and the construction period is estimated at approximately 18 months including the rainy season. (Total area: approximately 597.0m^2, concrete quantity: approximately 470 m^3)

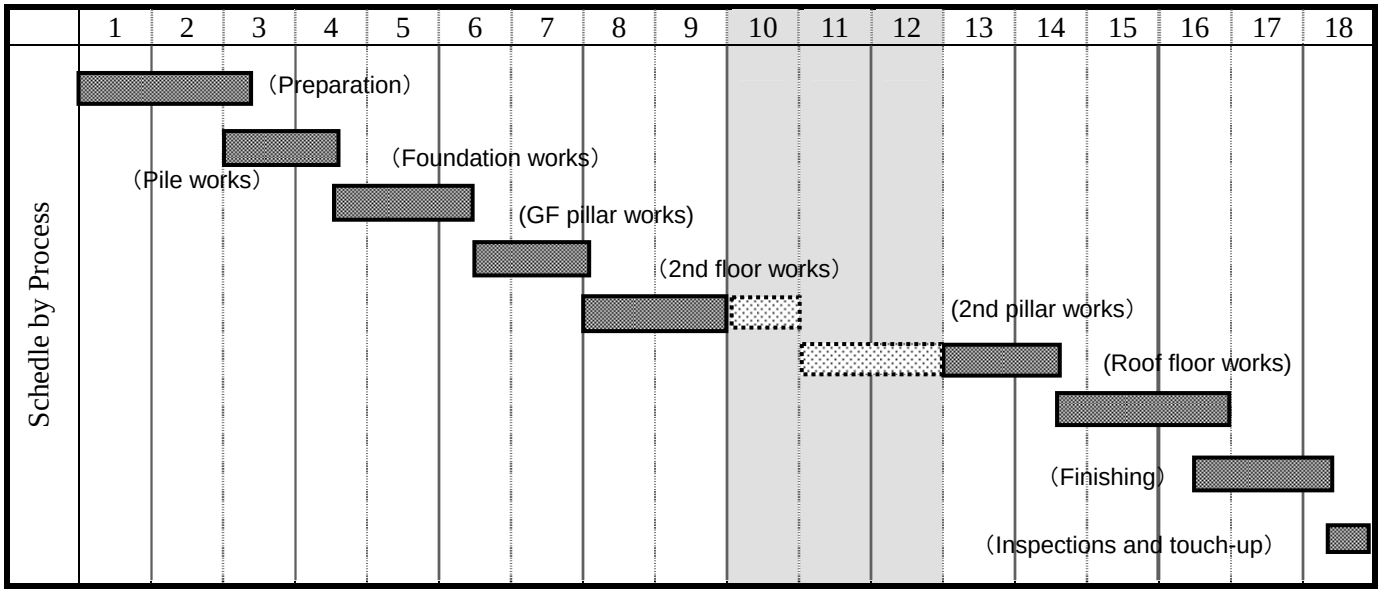


2nd Floor Plan



Cross Section

Table 2-21 Two-story School / Cyclone Shelter Works Schedule (18 months)



(g) Other Important Points to Consider

Bangladesh has the following 20 annual public holidays and government holidays.

Although not a holiday, Ramadan lasts for 28 days prior to Eid-ul-Fitor, and work efficiency levels fall dramatically during this period.

Moreover, elections are planned between October and December 2008, and there is a possibility that government functions will be suspended before and after these.

Table 2-22 Bangladesh Public Holidays in 2008

Public holidays

Sl	Name	Date	Day	Number of Holidays
1.	International Mother Language Day and Martyrdom Day	21st. Feb.	Thu.	01 Day
2.	Holy Eid-e-Milladulnabi	21st. Mar.	Fri.	01 Day
3.	National Liberation Day	26th Mar.	Wed.	01 Day
4.	May Day	1st May	Thu.	01 Day
5.	Full Moon	20th May	Tue.	01 Day
6.	Jonmaostami	24th Aug.	Sun.	01 Day
7.	Jimatul Bida	26th Sep.	Fri.	01 Day
8.	Eid-ul-Fitor	2nd Oct.	Thu.	01 Day
9.	Sri Sri Durga Puja (Dosomi)	9th Oct.	Thu.	01 Day
10.	Holy Eid-ul-Azha	9th Dec.	Tue.	01 Day
11.	Victory Day	16th Dec.	Tue.	01 Day
12.	Birthday of Jesus Christ (Christmas Day)	25th Dec.	Thu.	01 Day
Public holidays				12 Days

Government holidays

Sl	Name	Date	Day	Number of Holidays
1.	Moharum (Asura)	19th. Jan.	Sat.	01 Day
2.	Bangla Ney Year 1415	14th Apr.	Mon.	01 Day
3.	Holy Shabe-Borat	17th Aug.	Sun.	01 Day
4.	Shabe-Kador	28th Sep.	Sun.	01 Day
5.	Eid-ul-Fitor	1st & 3rd Oct.	Wed. & Fri.	02 Days
6.	Holy Eid-ul-Azha	8th & 10th Dec.	Mon. & Wed.	02 Days
Government holidays				08 Days

2-3 Obligations of the Recipient Country

Following the E/N, the Bangladeshi side will undertake the following works based on cooperation between the responsible agency and each implementing agency.

2-3-1 General Items

1. Opening an account with a Japanese bank to enable payments to be made to the procurement agent, works supervision consultants and contractors from the grant aid. This also includes payment of commissions arising from such payments.
2. Securing of rapid landing and exemption of tariffs in the event where equipment and materials procured with the grant aid are imported.
3. According Project officials (Japanese nationals and third country nationals) such conveniences as may be necessary for their safe entry into Bangladesh and stay therein.
4. Exempting Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Bangladesh with respect to the supply of the products and services.
5. Proper maintenance and use of the facilities and equipment restored under the Japanese grant aid.
6. Payment of all expenses which are not covered by the Japanese grant aid.
7. Implementation of separate budget measures and effort to sustain the restoration works regarding components that cannot be undertaken with the grant aid.

2-3-2 Items of Special Note

1. Materials store yards and space for temporary installations shall be provided free of charge.
2. Sites for the disposal of sediment and waste construction materials arising in the works shall be provided free of charge.
3. Since the Project basically entails restoration and includes no sites with construction in separate areas, environmental impact assessment is considered to be unnecessary.
4. Permission for construction shall be obtained from the landowners and related authorities.

2-4 Project Operation Plan

2-4-1 Operation and Maintenance at Normal Times

The MoPME will be the competent authority for the operation and maintenance of the cyclone shelter-cum-primary school buildings after their completion and the DPE, a subordinate organization of the MoPME, will be in charge of the actual operation of these facilities. Government primary schools are run by education offices set up at the division, district and upazila levels (see Section 2-2-3

concerning organization). The following officers are assigned to each education office:

- Divisional Education Officer: DEO
- District Education Officer: DEO
- Upazila Education Officer: UEO
- Assistant Upazila Education Officer: AUEO

Divisional Education Officers (DEOs) are actually controlled directly by the Director of the DPE in Dhaka. The authority of the divisional education office is rather limited as illustrated by the fact that, for example, budget requests are directly made by each DEO to the Director of the DPE.

On the upazila level, an Upazila Primary Education Committee consisting of the members listed in Figure 2-3 is organized. This committee has the roles of channeling requests for the maintenance budget, assisting the operation and management of primary schools in the upazila and solving the financial, educational and management problems of each school in addition to having the power to decide the priority ranking of schools in the upazila for distribution of the maintenance budget.

The Assistant Upazila Education Officer (AUEO) is the main provider of information on primary schools in the upazila to the upazila primary education committee. Each AUEO supervises some 20 primary schools within its area of jurisdiction (Upazila) and visits approximately 10 primary schools every month for monitoring purposes. Based on the information obtained by monitoring, the AUEO prepares a priority list of primary schools in need of repair and submits this list to the Upazila Primary Education Committee.

- Conditions of school buildings
- Enrolment situation of school-age children
- School Management Committee (SMC) activities
- State of cleaning of classrooms and toilets, etc.
- Teaching contents by teachers

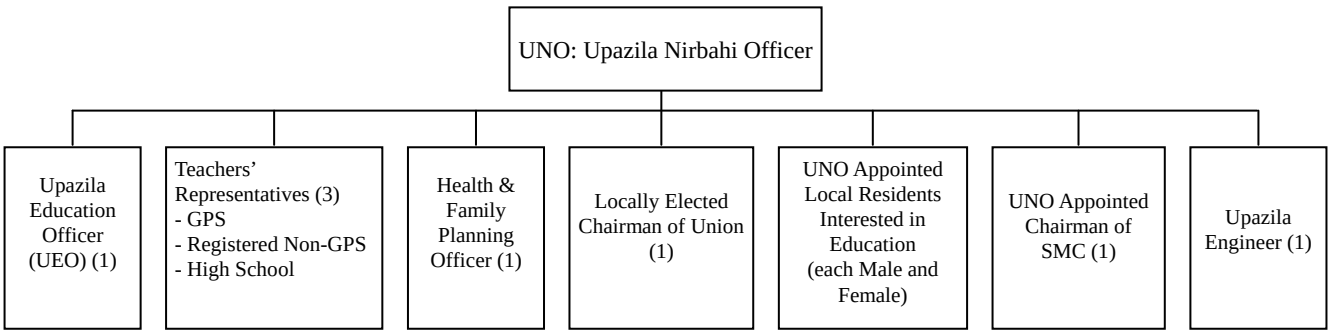


Figure 2-3 Organization of Upazila Primary Education Committee

Each school has its own School Management Committee (SMC, see Figure 2-4) which meets once a month. This SMC is responsible for the support and supervision of teachers and also for school maintenance. When a school is in need of repair, the SMC submits the relevant proposal to the Upazila Primary Education Committee.

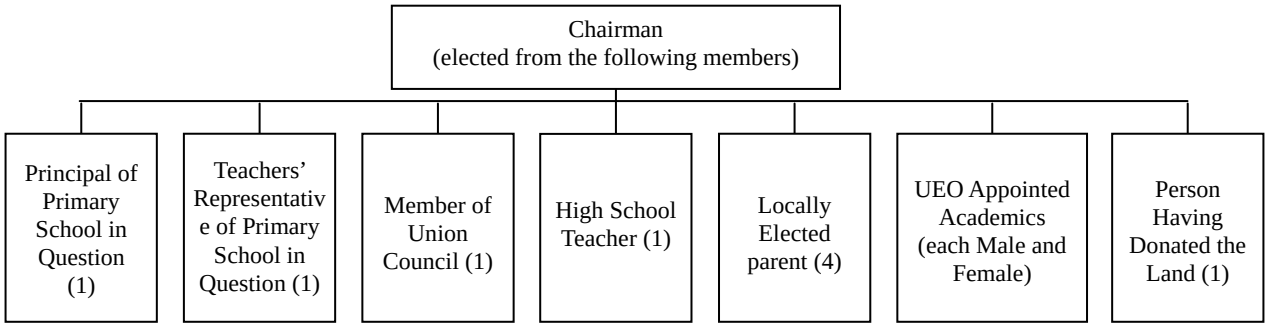


Figure 2-4 Organization of SMC

Even though the roles of the SMC are set forth, its actual ability and willingness to be involved in school management vary from one school to another. Both the divisional and district education offices are intermediaries between the central government and the Upazila education offices and cannot be said to play an actual role in operation and maintenance. The authority of the divisional offices in particular is limited in this regard.

The budget for the maintenance of government primary school facilities is secured at the central government level (ordinary and development budgets). Very limited budgetary funding for maintenance is available at the local level (Upazila primary education offices and primary schools).

[School Level Improvement Plan: SLIP]

In order to drastically improve the quality of primary school education on the level of schools including operation and maintenance of facilities, the MoPME is currently implementing the School Level Improvement Plan (SLIP) on a trial basis in 13 upazilas within the Second Primary Education Programme (PEDP-II). This plan establishes a SLIP Committee (see Figure 2-5) of union level officers in each school and delegates full responsibility for the compilation of education implementation plans to the schools, while at the same time vigorously promoting the following contents regarding the operation and maintenance of school facilities, improvement of the education environment and teaching of all knowledge pertaining to character needed by students.

- Decentralization of the planning work into the school level
- Planning on the local level (school level) based on real conditions

- Development of the educational environment of the school as well as the level of education
- Preparing children through giving pre-primary education before they are admitted into the primary school
- Creating equality in the primary education and decreasing the existing discrepancies
- Making the school child-friendly (nurturing mental and physical health, cooperation between boys and girls, joy in education, self-confidence and self-respect, and providing safe drinking water and toilets)
- Increasing the teaching quality of teachers, to make them cooperate with the parents and local people, and to make local people think that they are the owners of the school
- Bringing the teachers, students, parents and local people into the activities of the school
- Encouraging local people to take part in the development of the school and thus make the education a key to poverty alleviation.

In order to advance the above measures, the DPE is currently working on preparing a corrected proposal that includes the SLIP budget under PEDP-II. The following budget is intended for government primary schools (37,000 schools) under this, however, the final budget will be decided according to the trial SLIP results implemented in the said 13 upazilas.

The DPE currently estimates a budget of 3 billion Tk (including 1.25 billion Tk for maintenance) for SLIP, and if this plan is approved by the donor countries, it will be implemented at all government primary schools over the next two years (September 2008 to October 2009). This works out as 81,000 Tk (including 33,700 Tk for maintenance) per school. The items that are included in the SLIP are as follows.

- Textbooks, basic teaching materials and education guidelines
- Teaching materials kit expenses
- Social participation costs
- Repair and maintenance costs
- Development subsidies

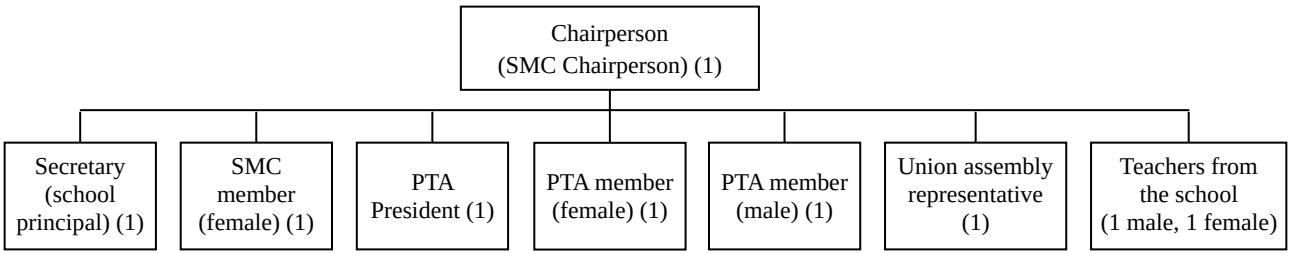


Figure 2-5 SLIP Committee Organization Chart

[Routine Maintenance]

Most of the ordinary budget is used to cover the salaries of teachers and administrative staff and the maintenance budget is only available for routine maintenance (such as the repair of furniture, windows and pumps as well as the replacement of parts; see Tables 2-23 and 2-24). Up to 30,000 Tk (up to 500,000 – 700,000 Tk as the total amount for one Upazila) is distributed to each school in need of simple maintenance work.

If the abovementioned SLIP is implemented, since the Project schools are also government primary schools, routine maintenance costs will be paid out of the SLIP budget.

Table 2-23 Breakdown of Current Budgetary Expenditure for Primary Education (2007)

Teacher/Staff Salaries	Teacher Training	Distribution of Textbooks	Repair and Management	Indirect Cost
95.7%	2.0%	0.1%	0.4%	1.8%

Source: MoPME

Table 2-24 Transitions in the Maintenance Budget
(Including Travel Expenses, Tax, Water and Electricity Tariffs, etc.) for Primary Schools

(Unit: million TK)

Year	2005~2006	2006~2007	2007~2008
Primary school maintenance costs	450	550	500

Source: MoPME data

Depending on the scale of the perceived maintenance cost, the maintenance budget is requested to the upazila primary education office but such request is not necessarily approved because of the budgetary limit. There is no mechanism to save up the necessary funds at each school.

Apart from the central government budget, there are frameworks for funding the maintenance budget on the local level. One of these is the Annual Development Programme (ADP), which gives funding priority mainly to the communications and agricultural sectors but not so much to education. Another is called the upazila polishad fund, the revenue of which comes from rents, bazaars and auctions. According to the Upazila Primary Education Committees, however, although these funds can be used to finance repair work at primary schools, there is no precedents of such use because of the low priority of school repairs.

As another part of the routine maintenance of primary school facilities, cleaning is conducted prior to lessons in the case of single system schools and prior to and after lessons in the case of dual system (primary school and kindergarten) schools.

[New Construction or Rebuilding of Schools]

The cost of the rehabilitation or rebuilding of primary schools or the construction of new primary schools is funded out of the development budget. An upazila education office can apply for funding from the central government with an upper limit and lower limit of 250,000 Tk and 100,000 Tk respectively per school. When repairs are essential despite the non-appropriation of the repair budget, a project fund is set up to finance the work.

2-4-2 Operation and Maintenance at Time of Cyclone

According to guidance from the DPE, the operation and maintenance of facilities is carried out under the cooperative setup of disaster management committees and SMC established on the local level [districts, upazilas, unions (below the upazilas)] and made up of government officials and civilians. Disaster management committees were also partially active during Cyclone Sidr, however, further strengthening will be necessary.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Costs to be borne by the Bangladeshi side

Rough project cost: 137,200,000 TK (approximately 220 million yen)

The undertakings and costs on the Bangladeshi side are as follows.

Table 2-25 Rough project Cost on the Bangladeshi Side

Undertaking	Quantity	Cost (1000 TK)	Remarks
Securing of construction sites		—	
Demolition and removal of obstructions at 3 schools (A8, B1, B8)	680m^2	1,000	LGED
Works supervision cooperation	1 set	69,000	LGED
Payment of taxes	1 set	67,000	LGED
Payment of bank fees	1 set	200	Ministry of Finance
Total		137,200	

The cost burden of 137,200,000 Tk on the Bangladeshi side is equivalent to 0.34% of the LGED funding (40,160,000,000 Tk : 2007) and is thus thought to be affordable.

(2) Estimation Conditions

US$1 =¥109.16 (May Cabinet rate)

¥1 = 1.591 Tk

2-5-2 Operation and Maintenance Cost

Since the shelters will be used as primary schools at normal times, the MOPME will be the competent authority for the operation and maintenance of the facilities after their completion, and the DPE, a subordinate organization of the MOPME, will be in charge of the actual operation.

DPEs are organized at the district, upazila and union levels, while Upazila Primary Education Committees (UPC) chaired by the upazila administrative chiefs and comprising 10 government officials, teachers and residents are established at the upazila level. The UPC has the roles of deciding the maintenance priority ranking of schools based on the results of monitoring at each school, channeling requests for the maintenance budget, assisting the operation and management of primary schools in the upazila and solving the financial, educational and management problems of each school. Also, each school has its own School Management Committee (SMC), which is composed of 11 members of teachers and parents, etc. and is responsible for the support and supervision of teachers and also for school maintenance.

Concerning routine maintenance costs, part of the aforementioned DPE ordinary budget is used. Moreover, SMCs frequently conduct maintenance based on contributions made by parents and influential donors.

According to the following table, the annual facilities operation and maintenance cost is estimated as 38,625,000 Tk, which is equivalent to 0.115% of the ordinary budget for primary education (33,730,000,000 Tk). Accordingly, cost is not thought to represent a problem in implementation of the Project. Moreover, the School Management Committees (SMCs) can afford to pay 225,000 Tk not including personnel expenses.

Table 2-26 Annual Facilities Operation and Maintenance Cost

Item	Contents	Rough Cost (1000 Tk/year)
Personnel expenses	Teachers' salaries	38,400
Building maintenance cost	Repainting, roof and finishing repairs, replacement of metal fittings	200
Furniture maintenance cost	Replacement of damaged members, repainting, hardware strengthening	20
Well maintenance cost	Bucket and hardware repairs	5
Total		38,625

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

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PROJECT EVALUATION AND RECOMMENDATIONS

3-1 Project Effect

The implementation of the Project is expected to achieve the various effects described below.

Table 3-1 Project Effects

Current Situation and Problems	Remedial Measures under the Project	Direct Effects and Extent of Improvement	Indirect Effect and Extent of Improvement
The target areas that suffer from major cyclone damage have a shortage of cyclone shelters for evacuation. This heightens the risk of damage in the event where cyclones strike.	Construction of cyclone shelters cum primary schools	Increase in the cyclone shelter evacuation population With the construction of 38 shelters under the Project, some 62,200 people living in target areas will be able to evacuate, and they will be able to lead their lives with peace of mind.	Improvement in the education environment Classrooms that ensure safety in the event of disasters will be secured for 6,470 schoolchildren (7,870 children if pre-school children are included) attending 38 primary schools in the target areas. The number of children per classroom, including pre-school children, will be reduced from 57.5 to 33.1, thereby leading to improvement in the education environment.

3-2 Recommendations

In order to actualize and sustain the Project effects, the Bangladeshi side needs to tackle the following issues.

To ensure that lessons are appropriately carried out after the Project facilities have been handed over to the local side, it is necessary to promptly secure and appropriately assign the required numbers of teaching staff. Also, it will be necessary to immediately get the SMC maintenance setups functioning.