LOCAL GOVERNMENT ENGINEERING DEPARTMENT,
MINISTRY OF LOCAL GOVERNMENT , RURAL
DEVELOPMENT AND COOPERATIVES
THE PEOPLE'S REPUBLIC OF BANGLADESH

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (Ⅳ)
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

MARCH, 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
JAPAN ENGINEERING CONSULTANTS CO., LTD

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PREFACE

In response to a request from the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a basic design study on the Project for the Construction of Multipurpose Cyclone Shelters (IV) in the People's Republic of Bangladesh and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh a study team from October 9 to November 22, 1998.

The team held discussions with the officials concerned of the Government of Bangladesh, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Bangladesh in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the Project (IV) and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the People's Republic of Bangladesh for their close cooperation extended to the teams.

March, 1999

Kimio Fujita
President
Japan International Cooperation Agency

March, 1999

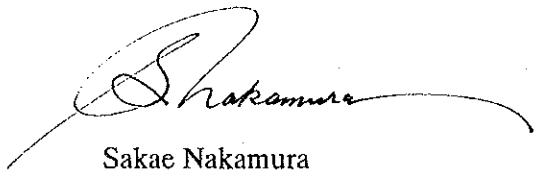
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for the Construction of Multipurpose Cyclone Shelters (Ⅳ) in the People's Republic of Bangladesh.

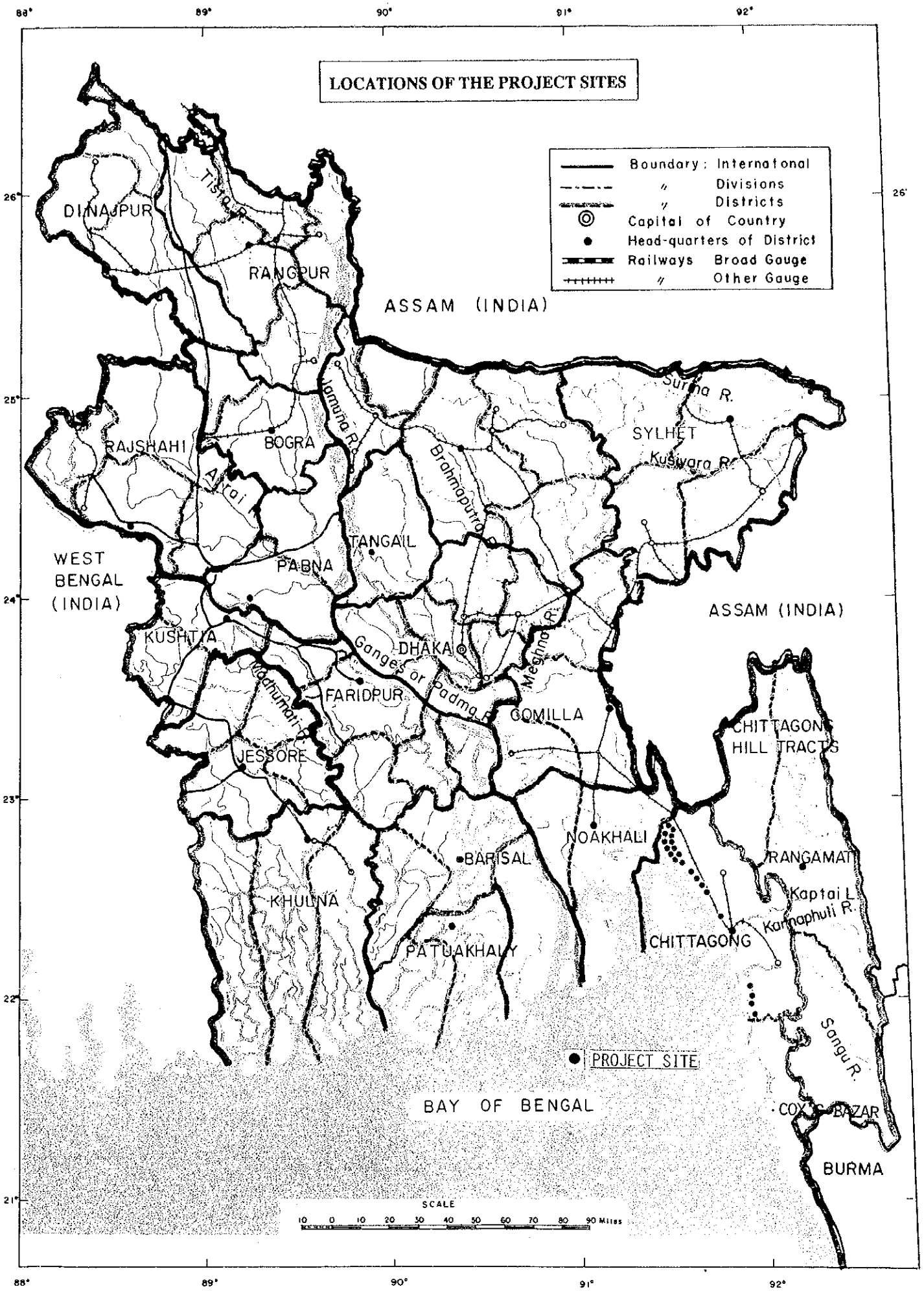
This study was conducted by Japan Engineering Consultants Co., Ltd., under a contract to JICA, during the period from September 28, 1998 to March 12, 1999. In conducting the study, we have examined the feasibility and rationale of the Project (Ⅳ) with due consideration to the present situation of Bangladesh and formulated the most appropriate basic design for the Project (Ⅳ) under Japan's grant aid scheme.

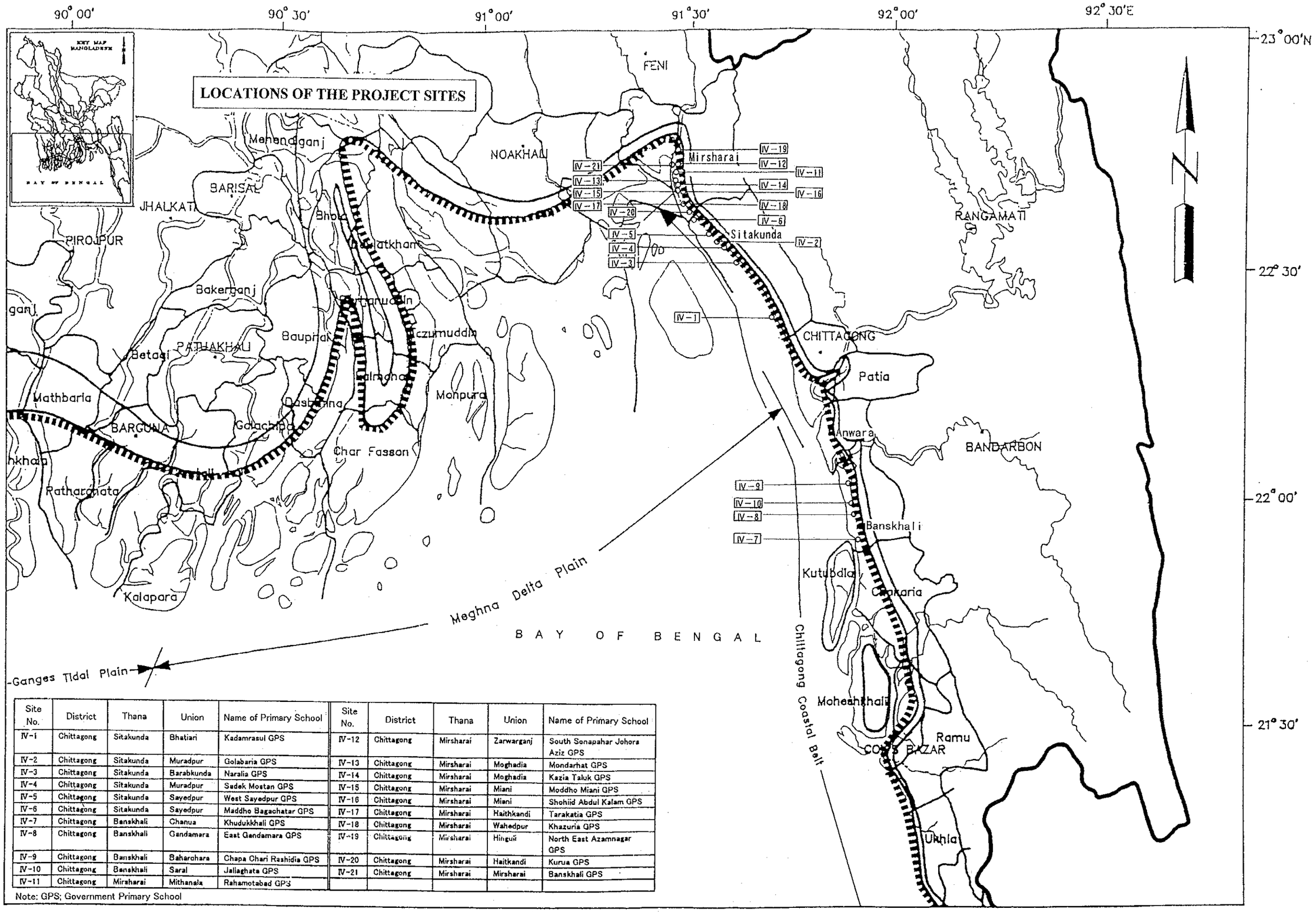
Finally, we hope that this report will contribute to further promotion of the Project (Ⅳ).

Very truly yours,



Sakae Nakamura
Project Manager
Basic Design Study Team on the Project for the Construction of Multipurpose Cyclone Shelters (Ⅳ)
Japan Engineering Consultants Co., Ltd.


LOCATIONS OF THE PROJECT SITES
Boundary : International
Divisions
Districts
Capital of Country
Head-quarters of District
Railways Broad Gauge
Other Gauge
DINAJPUR
Tista R.
RANGPUR
ASSAM (INDIA)
Jamuna R.
Surma R.
SYLHET
Kushiara R.
RAJSHAHI
BOGRA
Atrai
Brahmaputra
TANGAIL
PABNA
WEST BENGAL (INDIA)
ASSAM (INDIA)
KUSHTIA
DHAKA
Meghna R.
Ganges or Padma R.
Madhumati
FARIDPUR
COMILLA
CHITTAGONG HILL TRACTS
JESSORE
NOAKHALI
BARISAL
RANGAMATI
Kaptai L.
Karnaphuli R.
KHULNA
CHITTAGONG
PATUAKHALY
Sangu R.
PROJECT SITE
BAY OF BENGAL
COX'S BAZAR
BURMA
SCALE
10 0 10 20 30 40 50 60 70 80 90 Miles
88°
89°
90°
91°
92°
26°
25°
24°
23°
22°
21°

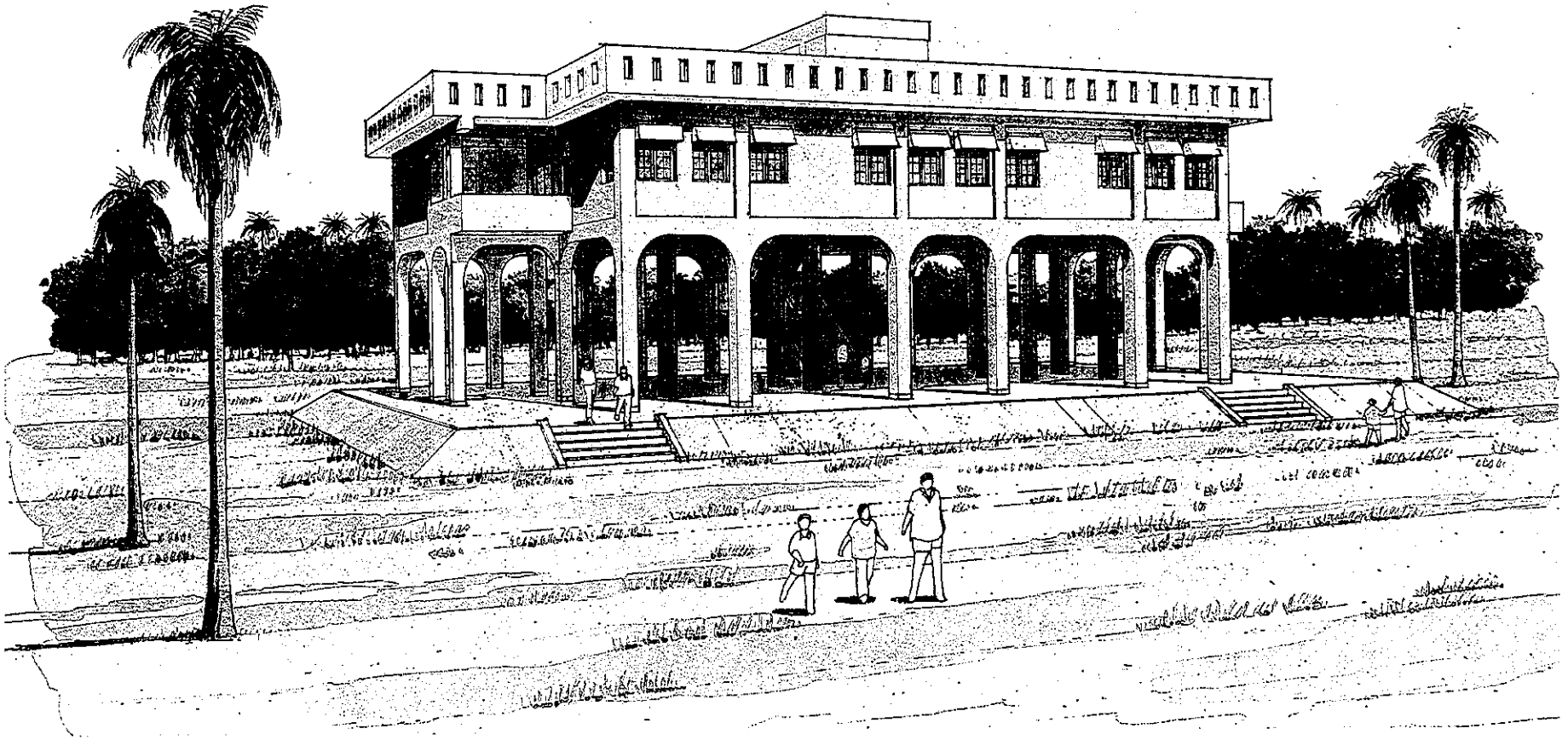


Site No.	District	Thana	Union	Name of Primary School
IV-1	Chittagong	Sitakunda	Bhatiari	Kadamrasul GPS
IV-2	Chittagong	Sitakunda	Muradpur	Golabaria GPS
IV-3	Chittagong	Sitakunda	Barabkunda	Naralia GPS
IV-4	Chittagong	Sitakunda	Muradpur	Sudek Mostan GPS
IV-5	Chittagong	Sitakunda	Sayedpur	West Sayedpur GPS
IV-6	Chittagong	Sitakunda	Sayedpur	Maddho Bagachatar GPS
IV-7	Chittagong	Banskhali	Chanua	Khudukkhali GPS
IV-8	Chittagong	Banskhali	Gandamara	East Gandamara GPS
IV-9	Chittagong	Banskhali	Baharchara	Chapa Chari Rashidia GPS
IV-10	Chittagong	Banskhali	Saral	Jallaghata GPS
IV-11	Chittagong	Mirsharai	Mithanala	Rahamotabad GPS

Site No.	District	Thana	Union	Name of Primary School
IV-12	Chittagong	Mirsharai	Zarwarganj	South Sonapahar Johora Aziz GPS
IV-13	Chittagong	Mirsharai	Moghadia	Mondarhat GPS
IV-14	Chittagong	Mirsharai	Moghadia	Kazia Taluk GPS
IV-15	Chittagong	Mirsharai	Miani	Moddho Miani GPS
IV-16	Chittagong	Mirsharai	Miani	Shohiid Abdul Kalam GPS
IV-17	Chittagong	Mirsharai	Haithkandi	Tarakatia GPS
IV-18	Chittagong	Mirsharai	Wahedpur	Khazuria GPS
IV-19	Chittagong	Mirsharai	Hinguli	North East Azamnagar GPS
IV-20	Chittagong	Mirsharai	Haitkandi	Kurua GPS
IV-21	Chittagong	Mirsharai	Mirsharai	Banskhali GPS

Note: GPS; Government Primary School

PERSPECTIVE



ABBREVIATIONS

ATEO	:	Assistant Thana Education Officer
BDRCS	:	Bangladesh Red Crescent Society
BNBC	:	Bangladesh National Building Code
CPP	:	Cyclone Preparedness Programme
DEO	:	District Education Officer
DPE	:	Directorate of Primary Education
ECNEC	:	Executive Committee for the National Economic Council
E/N	:	Exchange of Notes
ERD	:	Economic Relations Division
EU	:	European Union
HRA	:	High Risk Area
IDNDR	:	International Decade for Natural Disaster Reduction
IFAD	:	International Fund for Agricultural Development
JICA	:	Japan International Cooperation Agency
LGED	:	Local Government Engineering Department
M/LGRD&C	:	Ministry of Local Government, Rural Development & Cooperatives
NGO	:	Non-Government Organization
PCP	:	Project Concept Paper
PMED	:	Primary and Mass Education Division
SMC	:	School Management Committee
TEO	:	Thana Education Officer
UNDP	:	United Nations Development Programme

CONTENTS

CHAPTER 1

BACKGROUND OF THE PROJECT (IV)

CHAPTER 1 BACKGROUND OF THE PROJECT (IV)

The People's Republic of Bangladesh (Bangladesh) has the world's largest delta formed by the Ganges, Brahmaputra and Meghna Rivers and covering as much as 90% of the total national land area. Because of the delta's topographical conditions with an elevation of less than 10 m above sea level in most places, the natural disasters which cause the most devastating damage are flooding and cyclones.

The primary characteristic of cyclones in Bangladesh is storm surge caused by strong winds which is even more devastating than the overpowering force of the winds themselves (60 m/s). The water level along the sea coast is often raised by as much as 1 m or more above the normal level due to winds from the Bay of Bengal. Together with the high tide between 3 - 5 m above the normal tide level, storm surge along the coastal area can be as high as 5 - 9 m, inundating upto 5 - 8 km inland and causing great loss of human life and livestock.

Some 6.15 million people currently live in Bangladesh's High Risk Area (HRA) which is prone to cyclone damage and two-thirds of these people are without proper emergency shelters. There have been particularly many cyclone disasters in recent years and the maximum wind velocity appears to be increasing. The recent death toll includes 300,000 people in 1970, 11,000 in 1985, 2,000 in 1988 and 140,000 in 1991.

The construction of cyclone shelters as a measure against cyclone damage commenced in the 1960's and, following the great disaster in 1991, there was an increase of aid from international agencies and donors (bilateral assistance), resulting in the construction of some 830 shelters over a period of approximately seven years. Under its grant aid scheme, the Government of Japan has selected sites in the HRA which are particularly prone to disaster damage and has constructed multipurpose cyclone shelters which can be used as schools during normal times, excavated deep wells and installed septic tanks for toilet facilities. A total of 40 shelters have so far been constructed under the Project (I) - (III): 10 shelters were constructed in the Chittagong, Cox's Bazar and Noakhali Districts under the Project (I) in fiscal 1993; 15 shelters were constructed in the Chittagong and Cox's Bazar Districts under the Project (II) in fiscal 1994 and 15 further shelters were constructed in the Chittagong, Laxmipur and Noakhali Districts under the Project (III) in fiscal 1995. In the case of the cyclone which occurred in May, 1997, causing some 115 deaths and 9,600 injuries and affecting a total of 2,830,000 people, it is believed that these shelters saved many lives and were highly appreciated locally.

However, according to the Master Plan for the Project for Multipurpose Cyclone Shelters which was prepared by the Government of Bangladesh in cooperation with the World Bank and UNDP in July, 1993, the construction of some 1,560 shelters (as of the end of 1998) to protect the HRA population in 2002 is required and further assistance is hoped for.

Against this background, the Government of Bangladesh made a request to the Government of Japan to provide grant aid for the construction of 31 cyclone shelters which can also be used as primary schools under the Project (IV) in the HRA in the Chittagong District with the Local Government Engineering Department (LGED) of the Ministry of Local Government, Rural Development and Cooperatives (M/LGRD & C) acting as the project implementation body.

In regard to the contents of the request, appropriate project sites will be selected from the 31 candidate sites of the Bangladesh side (see Table 1-1-1) and existing primary schools which have suffered or may suffer damage caused by cyclones will be rebuilt as cyclone shelters-cum-primary schools.

The contents and size of the facilities requested by the Bangladesh side are shown below and the composition of each cyclone shelter will be as follows.

- Necessary number of classrooms
  - The area per room will be 37.15 m^2
  - The following equipment will be provided for each classroom

    Desks and chairs for 50 pupils

    One teacher's desk and chair

    One blackboard

- Teachers' room : one
- Storage : one
- Toilets : two (one for boys and one for girls)
- Water supply facilities (deep well and hand pump)
- Other necessary facilities

Table 1-1-1 Requested Project Sites (31 Sites)

	District	Thana	Union	Name of Primary School
1	Chittagong	Sitakunda	Sonaichari	Sitalpur GPS
2	Chittagong	Sitakunda	Barobkunda	Mandaritola GPS
3	Chittagong	Sitakunda	Bhatiari	Kadamrasul GPS
4	Chittagong	Sitakunda	Muradpur	Golabaria GPS
5	Chittagong	Sitakunda	Barabkunda	Naralia GPS
6	Chittagong	Sitakunda	Bhatiari	Bhatiari GPS
7	Chittagong	Sitakunda	Banshbaria	Banshbaria GPS
8	Chittagong	Sitakunda	Muradpur	Sadek Mostan GPS
9	Chittagong	Sitakunda	Sayedpur	West Sayedpur GPS
10	Chittagong	Sitakunda	Sayedpur	Maddho Bagachatar GPS
11	Chittagong	Anowara	Battali	East Baria GPS
12	Chittagong	Banskhali	Chanua	Khukukkhali GPS
13	Chittagong	Banskhali	Gandamara	East Gandamara GPS
14	Chittagong	Banskhali	Baharchara	Chapa Chari Rashidia GPS
15	Chittagong	Banskhali	Saral	Jaliaghata GPS
16	Chittagong	Mirsharai	Mithanala	Rahamotabad GPS
17	Chittagong	Mirsharai	Zarwarganj	South Sonapahar Johora Aziz GPS
18	Chittagong	Mirsharai	Durgapur	Gopalpur GPS
19	Chittagong	Mirsharai	Mithanala	Banatoli Sobhania RNGPS
20	Chittagong	Mirsharai	Moghadia	Mondarhat GPS
21	Chittagong	Mirsharai	Moghadia	Kazia Taluk GPS
22	Chittagong	Mirsharai	Miani	Moddho Miani GPS
23	Chittagong	Mirsharai	Miani	Shohid Abdul Kalam GPS
24	Chittagong	Mirsharai	Haithkandi	Tarakatia GPS
25	Chittagong	Mirsharai	Wahedpur	Khazuria GPS
26	Chittagong	Mirsharai	Saherkhali	East Saherkhali GPS
27	Chittagong	Mirsharai	Saherkhali	South Moghadia GPS
28	Chittagong	Mirsharai	Hinguli	North East Azamnagar GPS
29	Chittagong	Mirsharai	Haitkandi	Kurua GPS
30	Chittagong	Mirsharai	Katachara	West Katachara GPS
31	Chittagong	Mirsharai	Osmanpur	Banskhali GPS

Note GPS: Government Primary School RNGPS: Registered Non-Government Primary School

CHAPTER 2

SELECTION OF PROJECT SITES

CHAPTER 2 SELECTION OF PROJECT SITES

2.1 Selection of Study Sites

For the Project (IV), the Government of Bangladesh proposed 31 candidate sites (Table 1-1-1) and this proposal was examined and discussed by the Japanese government organizations involved in the Project (IV). Coupled with reconfirmation of the requested project sites with the Government of Bangladesh during the field survey, it was decided to select the 31 sites in the Mirsharai, Sitakunda, Anowara and Banskhali Thanas in the Chittagong District, all of which are located in the High Risk Area (HRA).

In short, it was decided to conduct a general survey at all of the 31 requested sites, followed by a detailed site survey on promising sites selected on the basis of the findings of the general survey. The final project sites would be decided based on the findings of the detailed site survey.

2.2 Finalisation of Project Sites

2.2.1 Site Selection Criteria

As the primary objective of the Project (IV) is the construction of cyclone shelters, in regard to the selection of the project sites, a general site survey and a detailed site survey were conducted based, in principle, on the following criteria.

1) The subject site shall be the site of a government primary school which is managed by the central government.
2) The subject site shall be located in the HRA designated by the Multipurpose Cyclone Shelter Master Plan.
3) In principle, the subject site shall not have any solid building or hill of sufficient height to provide a reliable evacuation site vis-a-vis storm surge caused by a cyclone within a 1.5 km radius.
4) The subject site shall have sufficient land area for the construction of a multi-purpose cyclone shelter and shall have secure land ownership. Even if the area of the subject site is inadequate, the site may be approved as an exception provided that sufficient land is made available by the removal of a facility (or facilities) which are judged unfit for use or additional land can be acquired adjacent to the

site with the assurance that the necessary removal work or land acquisition will be conducted by the Bangladesh side.

5) The subject site shall not have an adjacent large pond which cannot be filled in on three sides.
6) The subject site shall allow access by vehicle for the transportation of construction materials to the site.
7) The subject site shall not be associated with a similar project or plan of the Government of Bangladesh, a foreign aid association or a donor country to construct a cyclone shelter.
8) The subject site shall already have a primary school with teachers and pupils. In addition, it is judged that the new facilities will be fully used as a primary school during normal times.
9) A school management committee which will be responsible for the maintenance of the new facilities and equipment already exists and is judged to be willing to conduct the required work.
10) The subject site shall have a killa for the evacuation of animals within a radius of 0.3 km of the site or a feasible site for the construction of a killa within the same radius of the site with the firm assurance of its construction by the Bangladesh side.

2.2.2 General Site Survey

A general survey was conducted at the 31 requested sites. As this survey was regarded as a preliminary survey for the subsequent detailed site survey, the following factors were confirmed.

1) Degree of perceived disaster risk of the site in view of the spirit of the Multipurpose Cyclone Shelter Master Plan (The site should be located in HRA)
2) Method of access to the site
3) Land size, shape, and layout of the existing buildings and draft layout of the new facilities on the site
4) Land ownership of the site
5) Topographical features of the site

The survey findings at each site are compiled in Table 2-2-1. Based on the selection procedure in accordance with the site selection criteria to described above in 2.2.1, 21 sites were selected for the detailed site survey.

2.2.3 Detailed Site Survey

A detailed site survey was conducted at the 21 sites selected on the basis of the general survey findings. As this survey intended the selection of the final project sites, detailed confirmation of the following factors was conducted.

1) Degree of perceived disaster risk of the site in view of the spirit of the Multipurpose Cyclone Shelter Master Plan
2) Method of access to the site
3) Land size, shape, layout of the existing buildings and draft layout of the new facilities on the site
4) Land ownership of the site
5) Topographical features of the site
6) Population of the catchment area, population of school age children, their distribution and school enrollment ratio
7) Current conditions of the facilities and operation of the existing primary school
8) Operation and management system after the completion of the new facilities (Existing of SMC)
9) Participation of local people in the operation and management of the new facilities (Provision of labour for filling, fencing and cleaning, etc. at the site)
10) Past results and/or present state of projects involving similar facilities (primary school buildings and/or cyclone shelters) by other donors (including NGOs) in areas around the proposed sites. The existence of similar requests submitted to other donors and duplication of projects.
11) Water supply and sewerage systems and proper use of toilets, etc. at the site
12) Condition of water intake (depth, quality, etc) of groundwater in and around the site
13) Fact-finding on auxiliary facilities (principal's office, warehouse and toilets) of the existing primary school at the site
14) Approaching cyclone warning system at the site
15) General conditions of the evacuation zone for the site (houses, farmland, roads, rivers, public facilities and other main buildings/civil engineering structures)
16) Technical standard, manpower and work capacity of sub-contractors near the site
17) Feasibility of procuring the required equipment and materials near the site

The findings of the detailed site survey, based on the criteria for the selection of project sites, are compiled in Table 2-2-2.

Table 2-2-1 Results of General Site Survey

	Site. No. / Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Remarks
As a Cyclone Shelter	In or Outside the HRA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Inside HRA ×: Outside HRA
	Max. Surge Height of Cyclone in the past (m)	2.1	2.8	4.6	4.9	5.0	2.1	1.8	3.0	3.0	3.5	1.8	5.0	3.0	6.0	4.0	5.0	3.0	1.8	2.4	3.0	3.0	2.1	3.0	3.5	3.0	3.0	3.0	3.0	3.5	1.8	3.0	Interview with Headmaster, SMC Representative, UP Chairman
	Distance to the Nearest Cyclone Shelter (Km)	○	○	○	○	○	× (※4)	×	○	○	○	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	△	△	○	○	×	○	○: 1.5km or more ×: Less than 1.5km
	Population within a 1.5Km Radius	7,000	7,000	15,000	6,000	8,000	7,000	10,000	7,000	4,000	5,000	4,500	7,000	4,000	5,000	5,000	10,000	5,000	5,000	8,000	5,000	5,000	7,000	5,000	6,000	8,000	10,000	8,000	6,000	10,000	8,000	5,000	
	Hilly Area within a 1.5 Km Radius	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Non-existing ※7 ×: Existing ※8
	Public Building (2-story) within a 1.5Km radius	○	○	○	○	○	○	×	○	○	○	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Non-existing ×: Existing
	Max. No. of Casualties by Cyclone in the Past	200	250	200	500	670	150	300	250	700	1,000	50	1,500	1,000	500	2,000	500	1,000	200	100	1,000	800	200	250	200	300	200	250	300	400	100	2,000	
	Existing Killa	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○: Existing ×: Non-existing
	Access Conditions to the Site	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×	○	○	○	○	○: Good (Possible 4WD) ×: Bad
As a School building	Type of School	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×	○	○	○	○	○	○	○	○	○	○	○	○	○: GPS ×: RNGPS
	Total No. of pupils	760	838	497	456	359	1,092	519	621	281	178	601	165	219	411	440	376	471	400	239	187	189	205	122	168	193	450	200	101	302	350	307	
	School Site Area (m2)	3,000	1,460	728	1,300	810	1,080	2,810	1,307	675	475	802	1,415	1,445	1,604	1,407	1,110	1,281	1,001	1,024	1,401	1,102	1,018	1,748	876	1,435	1,465	510	1,213	1,023	536	916	
	Ownership of the Site	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×	○	○	○	○	○	○	○	○	○	○	○	○	○: Government-owned ×: SMC-owned
	Site & Site Surrounding Conditions	○	× (※1)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	× (※2)	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Good ×: Bad ※9
	Size of the Site	○	× (※2)	△ (※3) (150)	○	△ (※3) (150)	△ (※5)	○	○	△ (※3) (200)	△ (※3) (1250)	×	○	○	△ (※3,6) (350)	○	△ (※3) (80)	○	○	△ (※3) (260)	○	○	○	○	△ (※3) (120)	○	○	△ (※3) (420)	○	○	○	△ (※3) (250)	○: Sufficient △: Sufficient on condition ×: Insufficient
	Total Evaluation	×	×	△	○	△	×	×	○	△	△	×	○	○	△	○	△	○	×	×	○	○	○	○	△	○	×	×	○	○	×	△	○: Appropriate △: Appropriate on condition ×: Inappropriate

Notes

(※1):Large ponds esist around the site in three directions.
(※2):Additional land acquisition is impossible because large ponds exits around the site in three directions and the site is closed in by a mosque and houses.
(※3):Number in the brackets shows the rough necessary land acquisition area (sq m). Detailed land acquisition area will be fixed on the results of detailed site survey and the natural conditions survey.
(※4):Saudi Cyclone Shelter exists 1 km away from the site and a small school-cum-shelter is being constructed at the site.
(※5):Removal of the above shelter under construction and the deteriorated coastal community center(CCC) at the site are necessary.
(※6):Removal of the deteriorated CCC at the site is necessary.
(※7):During the past evacuations to standing trees, house roofs and faraway shelters.
(※8):Same as above
(※9):In the past evacuations, there have been large ponds inand around the site in three directions and therefore a potential danger of falling in and drowing, while evacuating.

Table 2-2-2 Results of Detailed Site Survey

Item	Site No.	3	4	5	8	9	10	12	13	14	15	16	17	20	21	22	23	24	25	28	29	31	Remarks
As a Cyclone Shelter	Maximum Surge Height of Cyclone in the past (m)	4.6 ◎	4.9 ◎	5.0 ◎	3.0 ◎	3.0 ◎	3.5 ◎	5.0 ◎	3.0 ◎	5.0 ◎	4.0 ◎	5.0 ◎	3.0 ◎	3.0 ◎	3.0 ◎	2.1 ○	3.0 ◎	3.5 ◎	3.0 ◎	3.0 ◎	3.5 ◎	3.0 ◎	◎: 3m or more ○: 1m or more to less than 3m △: Less than 1m
	Distance to the Nearest Cyclone Shelter (km)	2 ○	3 ○	2 ○	2 ○	1.5 ○	1.5 ○	1.5 ○	2 ○	3 ○	3 ○	5 ○	15 ○	2 ○	2 ○	1.5 ○	3 ○	4 ○	3 ○	4 ○	2 ○	4 ○	○: 1.5km or more ×: Less than 1.5km
	Population within a 1.5km Radius	15,000	6,000	8,000	7,000	4,000	5,000	7,000	4,000	5,000	5,000	10,000	5,000	5,000	5,000	7,000	5,000	6,000	8,000	6,000	10,000	5,000	
	Hilly Area within a 1.5km Radius	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Non-existing ×: Existing
	Public Building (2-story) within a 1.5km Radius	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Non-existing ×: Existing
	Maximum No. of Casualties by Cyclone in the past	200 1991	500 1960	670 1960	250 1963	700 1963	1,000 1960	1,500 1991	1,000 1991	500 1960	2,000 1991	500 1991	1,000 1963	1,000 1962	800 1962	200 1991	250 1963	200 1963	300 1962	300 1962	400 1962	2,000 1960	※1
	Existing Kills	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○: Existing ×: Non-existing
	Land for Kills Construction	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Existing ※2 ×: Non-existing
As a School building	Type of School	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: GPS △: Registered NGPS
	No. of Classrooms	3	3	3	4	3	4	3	3	2	3	3	4	3	3	3	3	3	3	1	4	5	
	Total No. of Shishu	84	0	125	46	45	0	70	50	82	80	150	0	42	35	43	29	35	43	35	54	70	
	Total No. of Pupils (Class1-5)	487	456	359	621	281	178	165	219	411	440	376	471	187	189	205	122	168	193	101	302	307	
	No. of Pupils in Morning Class	191	216	170	212	144	73	88	99	230	250	168	245	74	83	85	54	92	74	48	119	128	Class 1 + Class 2
	Pupils in Morning Session / Classroom	64	72	57	53	48	18	29	33	115	83	56	61	25	28	28	18	31	25	48	30	26	
	No. of Pupils in Afternoon Class	306	240	189	409	137	105	77	120	181	190	208	226	113	106	120	68	76	119	55	183	179	Class 3 + Class 4 + Class 5
	Pupils in Afternoon Session/ Classroom	102	80	63	102	46	26	26	40	91	63	69	57	38	35	40	23	25	40	55	46	36	
	No. of Teachers	5	5	4	6	4	3	3	3	4	4	4	5	4	5	5	3	4	3	3	5	4	
	Pupils / Teachers Ratio	93	91	90	104	70	59	55	73	103	110	94	94	47	38	41	41	42	64	34	60	77	
	Existence of SMC	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Existing △: Nonexisting
	Local Community Organization for Maintenance	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: SMC(School Management Committee) ※3 △: Other
	School Building Conditions	△	○	△	△	×	×	×	×	×	△	○	×	×	×	×	×	△	△	×	△	×	○: Good (Well-maintained) △: No so bad (Deteriorated) ×: Bad (Seriously deteriorated)
	Area Size of the School Buildings (m2)	166	210	121	174	132	211	150	146	64	192	120	115	128	145	180	116	110	153	102	129	63	
Means of Accessibility		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: 4WD ×: Pushcart, Foot
Site & Site Surrounding Conditions		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Good ×: Bad
Ownership of the Site		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Government-owned △: SMC-owned
Area Size of the Site (m2)			1,300 ○		1,307 ○			1,415 ○	1,445 ○		1,407 ○		1,281 ○	1,401 ○	1,102 ○	1,018 ○	1,748 ○		1,435 ○	1,213 ○	1,923 ○		○: Enough △: Not enough
Minimum additional Land Area for Acquisition (m2)		160	-	180	-	244	1,275	-	-	280	-	84	-	-	-	-	-	125	-	-	-	270	○: Enough △: Not enough
Removal of Existing Facilities			○		○		○	○			○	○		○	○						○		○: Not necessary △: Necessary
Water Quality in/and around the Site (As)		○	○	○		○	○	○	○	○	○	○	○			○	○	○			○		○: Drinkable ×: Non-Drinkable in Shallow Well
Total Evaluation		△ A,B	○	△ A,B	△ C	△ A,B	△ A	○	△ B	△ A,B	○	△ A	○ B	△ C	△ C	○ B	○ B	△ A,B,D	△ B,C	○	△ B,C	△ A,B,C	○: Appropriate A:A.L.A. B:R.E.F. △: Appropriate on Condition C:As D:Others ×: Inappropriate

(※1): Interview with Headmaster, SMC Representative, UP Chairman, etc.
(※2): Guarantee of kills construction obtained from LGED
(※3): Provision of labour services such as filling, fencing, cleaning, etc.

[Notes] A.L.A.: Additional Land Acquisition, R.E.F.: Removal Existing Facilities

Table 2-2-2 Results of Detailed Site Survey

	Item \ Site No.	3	4	7	8	9	10	12	13	14	15	16	17	20	21	22	23	24	25	28	29	31	Remarks
As a Cyclone Shelter	Maximum Surge Height of Cyclone in the past (m)	4.6 ◎	4.9 ◎	5.0 ◎	3.0 ◎	3.0 ◎	3.5 ◎	5.0 ◎	3.0 ◎	6.0 ◎	4.0 ◎	5.0 ◎	3.0 ◎	3.0 ◎	3.0 ◎	2.1 ○	3.0 ◎	3.5 ◎	3.0 ◎	3.0 ◎	3.5 ◎	3.0 ◎	◎ 3m or more ○ 1m or more to less than 3m △ Less than 1m
	Distance to the Nearest Cyclone Shelter (km)	2 ○	3 ○	2 ○	2 ○	1.5 ○	1.5 ○	1.5 ○	2 ○	3 ○	3 ○	5 ○	1.5 ○	2 ○	2 ○	1.5 ○	3 ○	4 ○	3 ○	4 ○	2 ○	4 ○	○ 1.5km or more × Less than 1.5km
	Population within a 1.5km Radius	15,000	6,000	8,000	7,000	4,000	5,000	7,000	4,000	5,000	5,000	10,000	5,000	5,000	5,000	7,000	5,000	6,000	8,000	6,000	10,000	5,000	
	Hilly Area within a 1.5km Radius	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○ Non-existing × Existing
	Public Building (2-story) within a 1.5km Radius	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○ Non-existing × Existing
	Maximum No. of Casualties by Cyclone in the past	200 1991	500 1960	570 1960	250 1963	700 1963	1,000 1960	1,500 1991	1,000 1991	500 1950	2,000 1991	500 1991	1,000 1963	1,000 1967	800 1957	700 1991	250 1963	200 1963	300 1962	300 1962	400 1962	2,000 1960	※1
	Existing Killa	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○ Existing × Non-existing
	Land for Killa Construction	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○ Existing ※2 × Non-existing
As a School building	Type of School	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○ GPS △ Registered NGPS
	No. of Classrooms	3	3	3	4	3	4	3	3	2	3	3	4	3	3	3	3	3	3	1	4	5	
	Total No. of Shishu	84	0	125	46	45	0	70	50	82	60	150	0	42	35	43	29	35	43	35	54	70	
	Total No. of Pupils (Class 1-5)	497	456	359	621	281	178	165	219	411	440	376	471	187	189	205	122	168	193	101	302	307	
	No. of Pupils in Morning Class	191	216	170	212	144	73	88	99	230	250	168	245	74	83	85	54	92	74	46	119	128	Class 1 + Class 2
	Pupils in Morning Session / Classroom	64	72	57	53	48	18	29	33	115	83	56	61	25	28	28	18	31	25	46	30	26	
	No. of Pupils in Afternoon Class	306	240	189	409	137	105	77	120	181	190	208	226	113	106	120	68	76	119	55	183	179	Class 3 + Class 4 + Class 5
	Pupils in Afternoon Session / Classroom	102	80	63	102	46	26	26	40	91	63	69	57	38	35	40	23	25	40	55	46	36	
	No. of Teachers	5	5	4	6	4	3	3	3	4	4	4	5	4	5	5	3	4	3	3	5	4	
	Pupils / Teachers Ratio	99	91	90	104	70	59	55	73	103	110	94	94	47	38	41	41	42	64	34	60	77	
	Existence of SMC	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○ Existing △ Non-existing
	Local Community Organization for Maintenance	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○ SMC(School Management Committee) ※3 △ Other
	School Building Conditions	△	○	△	△	×	×	×	×	×	△	○	×	×	×	×	×	△	△	×	△	×	○ Good (Well maintained) △ Not so bad (Deteriorated) × Bad (Seriously deteriorated)
	Area Size of the School Buildings (m2)	166	212	121	174	132	211	150	145	54	192	120	115	128	145	180	116	110	153	102	125	63	
Means of Accessibility		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○ 4WD × Pushcart, Foot
Site & Site Surrounding Conditions		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○ Good × Bad
Ownership of the Site		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○ Government owned △ SMC owned
Area Size of the Site (m2)		728 △	1,300 ○	810 △	1,207 ○	575 △	475 △	1,415 ○	1,445 ○	1,604 △	1,407 ○	1,110 △	1,281 ○	1,401 ○	1,102 ○	1,018 ○	1,748 ○	876 △	1,455 ○	1,213 ○	1,223 ○	816 △	○ Enough △ Not enough
Minimum additional Land Area for Acquisition (m2)		158	-	180	-	744	1,275			260	-	84	-	-	-	-	-	125	-	-	-	270	○ Enough △ Not enough
Removal of Existing Facilities		△	○	△	○	△	○	○	△	△	○	○	△	○	○	△	△	△	△	○	△	△	○ Not necessary △ Necessary
Water Quality in and around the Site (As)		○	○	○	×	○	○	○	○	○	○	○	○	×	×	○	○	○	×	○	×	×	○ Drinkable × Not Drinkable or Shallow Well
Total Evaluation		△ A B	○	△ A B	△ C	△ A B	△ A	○	△ B	△ A B	○	△ A	○ B	△ C	△ C	○ B	○ B	△ A B C	△ B C	○	△ B C	△ A B C	○ Appropriate △ Appropriate on Condition × Inappropriate

※1 Interview with Headmaster, SMC Representative, UP Chairman, etc.
※2 Guarantee of killa construction obtained from LGED
※3 Provision of labour services such as filling, fencing, cleaning, etc.

(Notes) A: Additional Land Acquisition B: Removal of Existing Facilities C: [illegible]

2.2.4 Finalisation of Project Sites

A total of 21 sites, i.e. Site Nos. 3, 4, 5, 8, 9, 10, 12, 13, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 28, 29 and 31, were selected as suitable project sites for cyclone shelter construction as shown in Table 2-2-2 based on the findings of the detailed survey and selection criteria described above.

To be more precise, Site Nos. 4, 12, 15 and 28 were selected as suitable sites without any attached conditions while the remaining sites (Site Nos. 3, 5, 8, 9, 10, 13, 14, 16, 17, 20, 21, 22, 23, 24, 25, 29 and 31) were selected as suitable sites with attached conditions.

2.2.5 Location of Project Sites

The project sites are 21 government primary schools located in the Mirsharai, Sitakunda and Banskhali Thanas in the Chittagong District. The locations of these sites are shown on the Project Site Location Map at the beginning of this report. These sites are given new site numbers as shown in Table 2-2-3 to avoid confusion with sites where cyclone shelters have been constructed in the previous three phases.

Table 2-2-3 Location of Project Sites

Old Site No.	New Site No.	District	Thana	Union	School
3	IV-1	Chittagong	Sitakunda	Bhatiari	Kadamrasul GPS
4	IV-2	Chittagong	Sitakunda	Muradpur	Golabaria GPS
5	IV-3	Chittagong	Sitakunda	Barabkunda	Naralia GPS
8	IV-4	Chittagong	Sitakunda	Muradpur	Sadek Mostan GPS
9	IV-5	Chittagong	Sitakunda	Sayedpur	West Sayedpur GPS
10	IV-6	Chittagong	Sitakunda	Sayedpur	Maddho Bagachatar GPS
12	IV-7	Chittagong	Banskhali	Chanua	Khudukkhali GPS
13	IV-8	Chittagong	Banskhali	Gandamara	East Gandamara GPS
14	IV-9	Chittagong	Banskhali	Baharchara	Chapa Chari Rashidia GPS
15	IV-10	Chittagong	Banskhali	Saral	Jaliaghata GPS
16	IV-11	Chittagong	Mirsharai	Mithanala	Rahamotabad GPS
17	IV-12	Chittagong	Mirsharai	Zarwarganj	South Sonapahar Johora Aziz GPS
20	IV-13	Chittagong	Mirsharai	Moghadia	Mondarhat GPS
21	IV-14	Chittagong	Mirsharai	Moghadia	Kazia Taluk GPS
22	IV-15	Chittagong	Mirsharai	Miani	Moddho Miani GPS
23	IV-16	Chittagong	Mirsharai	Miani	Shohid Abdul Kalam GPS
24	IV-17	Chittagong	Mirsharai	Haithkandi	Tarakatia GPS
25	IV-18	Chittagong	Mirsharai	Wahedpur	Khazuria GPS
28	IV-19	Chittagong	Mirsharai	Hinguli	North East Azamnagar GPS
29	IV-20	Chittagong	Mirsharai	Haitkandi	Kurua GPS
31	IV-21	Chittagong	Mirsharai	Osmanpur	Banskhali GPS

Note: GPS = Government Primary School

CHAPTER 3

CONTENTS OF THE PROJECT (IV)

CHAPTER 3 CONTENTS OF THE PROJECT (IV)

3.1 Objectives of the Project (IV)

As Bangladesh faces natural conditions which are beyond its control and which cause chronic natural disasters, endangering many lives, it has been earnestly implementing various disaster prevention measures with international aid. Among the measures to prevent damage by cyclones, the construction of cyclone shelters is believed to be the most feasible and quickly achievable measure from both the technical and financial viewpoints. As such, the government is aiming at the urgent construction of the required number of cyclone shelters to at least protect human lives and livestock.

A request was made by the Government of Bangladesh to the Government of Japan through the LEGD for the construction of cyclone shelters at 40 sites and these were completed under the Project (I) (10 shelters in fiscal 1993), the Project (II) (15 shelters in fiscal 1994) and the Project (III) (15 shelters in fiscal 1995).

During the Basic Design Study period of the Project (I), both governments agreed that the use of the cyclone shelters as primary school buildings during normal times was desirable in view of the better maintenance of the shelters. Based on this agreement, the Government of Bangladesh made a renewed request to the Government of Japan for assistance to rebuild 30 existing primary schools which were either damaged or likely to be damaged by cyclones. These 30 shelters (primary schools) were completed under the Project (II)~(III). The Government of Bangladesh then made a request for the construction of 31 new cyclone shelters under the Project (IV) from those sites selected as suitable sites for new cyclone shelter-cum-school buildings in the Project (IV) following a similar arrangement for the Project (II)~(III).

The objectives of the Project (IV) are, therefore, to construct cyclone shelters designed to protect human lives during cyclones and also to act as educational facilities during normal weather conditions. The Project (IV) also intends the establishment of a reliable maintenance system for the long-term upkeep of these new cyclone shelters.

3.2 Basic Concept of the Project (IV)

According to the Master Plan prepared by the Government of Bangladesh with the assistance by the World Bank and UNDP, areas subject to storm surge of up to 1m are designated as the HRA (high risk area) and the construction of some 1,560 more shelters

is called for to protect the lives of people living in the HRA in 2002. The Project (IV) aims at rebuilding the existing primary schools in the HRA in Sitakunda, Mirsharai and Banskhali in the Chittagong District to be cyclone shelter-cum-primary school buildings as part of the efforts to achieve this target number of cyclone shelters.

(1) Number of Cyclone Shelters to be Constructed

The Master Plan predicts that the total population of 5.2 million people in the HRA in 1992 will increase to 6.4 million in 10 years which is also the target population of the Master Plan in the year 2002.

The total accommodation capacity of all cyclone shelters (including those currently under construction or planned) and secure public and private buildings (including those planned) is calculated to be 2.16 million, leaving 4.25 million people unprotected. Assuming a capacity of some 1,750 people/shelter, the further construction of some 2,500 shelters is called for by the Master Plan.

Table 3-2-1 Required Number of Cyclone Shelters in Project Area

District	Thana	Shelters Planned by the Master Plan	Shelters Planned Under the Project
Chittagong	Mirsharai	28	11
	Sitakunda	72	6
	Banskhali	99	4
Total		199	21

The required number of new cyclone shelters in the three Thanas is 199 and the planned number of 21 shelters under the Project (IV) accounts for some 10.5% of the total shelters required.

As described in 2.1 and 2.2, the general site survey selected 21 sites from among the 31 candidate sites and the detailed survey conducted at these 21 sites concluded that these 21 sites are suitable for the construction of a cyclone shelter under the Project (IV). Accordingly, these 21 sites are now designated the Project Sites.

(2) Cyclone Shelter Accommodation Capacity

The cyclone shelter design size depends on the envisaged cyclone shelter accommodation capacity. At present, there is no uniform standard for the capacity

or design of shelters constructed by various international aid organizations and NGOs.

The cyclone shelters to be constructed under the Project (IV) will have a minimum accommodation capacity of 1,650 people each which is not far below the figure recommended by the Master Plan and which also takes the Primary School Standard Design Criteria established by the PMED into consideration.

(3) Use and Maintenance of Cyclone Shelters During Normal Weather Conditions

The Basic Design Study of Project (I) found that the cyclone shelters are difficult to maintain without regular use during normal weather conditions. The detailed site survey conducted as part of the present Study found that other than primary schools, the preferred use of cyclone shelters for adult literacy education and clinics was expressed at 10 sites and seven sites respectively, illustrating the local need for these facilities. However, such facilities are currently only observed in limited areas (for example, adult education in Banskhali) and the feasibility of the new cyclone shelters being used for such purposes is not clearly established. Moreover, the PMED has already expressed its view that the design criteria for school facilities should be uniform regardless of cyclone shelters being used for primary school purposes or not and is less than enthusiastic in regard to the regular use of educational facilities for purposes other than education because of the difficulty of identifying the body responsible for maintenance. Therefore, it appears difficult for the facility plan for the Project (IV) to incorporate the use of the cyclone shelter-cum-primary school buildings for purposes other than education.

(4) Size of Each Cyclone Shelter

Examination of the requested facilities found that the shelter size has a minimum accommodation capacity of 1,650 persons; however, the Master Plan failed to provide information on the maximum number of classrooms per shift at each site. As the Project intends the rebuilding of primary school buildings damaged by cyclones, the maximum number of classrooms is calculated for each site in the following manner to finalise the shelter size at each site.

[Calculation of Required Number of Classrooms per Shift]

All classes employ the two shift system due to the classroom shortage. The number of pupils of the first shift or the second shift (Table 3-2-2), which is attended by more pupils, is the basis for calculating the required number of

classrooms per shift. This number, divided by the standard class size of 50 pupils results in the maximum number of classrooms per shift for each site, as shown in Table 3-2-3. Taking the above calculation results into consideration, facility size can be classified into three categories, i.e. 3-classroom type, 4-classroom type and 5-classroom type.

In the case of Site Nos. IV-1 and IV-4, there will be a shortage of one classroom and three classrooms respectively which should be compensated for by the use of the existing classrooms. As all of the existing classrooms require demolition at Site No. IV-1, the piloti section on the ground floor will be used to provide an extra classroom to meet the shortage.

Although the maximum number of classrooms was originally two at Site Nos. IV-6, IV-7, IV-8, IV-13, IV-14, IV-15, IV-17 and IV-18 and one at Site Nos. IV-16 and IV-19, these have been changed to three classrooms because of the minimum shelter accommodation capacity of 1,650 persons.

Table 3-2-2 Number of Pupils in Existing Schools by Project Site

Site No.	Total No. of Pupils	Shift 1 (a.m.)		Shift 2 (p.m.)			No. of Shifts
		Class 1	Class 2	Class 3	Class 4	Class 5	
IV-1	497	89	102	116	84	106	2
		191		306			
IV-2	456	136	80	93	81	66	2
		216		240			
IV-3	359	85	85	94	50	45	2
		170		189			
IV-4	621	110	102	180	110	119	2
		212		409			
IV-5	281	76	68	61	33	43	2
		144		137			
IV-6	178	35	38	39	32	34	2
		73		105			
IV-7	165	50	38	32	25	20	2
		88		77			
IV-8	219	60	39	57	37	26	2
		99		120			
IV-9	411	120	110	83	61	37	2
		230		181			
IV-10	440	150	100	90	60	40	2
		250		190			
IV-11	376	97	71	76	64	68	2
		168		208			
IV-12	471	150	95	91	75	60	2
		245		226			
IV-13	187	40	34	46	35	32	2
		74		113			
IV-14	189	41	42	45	30	31	2
		83		106			
IV-15	205	41	44	46	38	36	2
		85		120			
IV-16	122	29	25	22	23	23	2
		54		68			
IV-17	168	50	42	30	24	22	2
		92		76			
IV-18	193	39	35	45	39	35	2
		74		119			
IV-19	101	30	16	21	17	17	2
		46		55			
IV-20	302	64	55	63	64	56	2
		119		183			
IV-21	307	65	62	70	54	55	2
		128		179			

Note: The shaded areas show the maximum number of pupils under two shifts.

Table 3-2-3 Maximum Number of Classrooms per Shift, Teacher Shortage and Types of Schools

Site No.	Maximum No. of Pupils with Two Shifts	No. of Existing Teachers	Maximum No. of Classrooms per Shift	Teacher Shortage Vis-a-Vis Maximum No. of Classrooms	School Type Under the Project
IV-1	306	5	6	1	5-classroom type
IV-2	240	5	5	—	5-classroom type
IV-3	189	4	4	—	4-classroom type
IV-4	409	6	8	2	5-classroom type
IV-5	144	4	3	—	3-classroom type
IV-6	105	3	2*3	—	3-classroom type
IV-7	88	3	2*3	—	3-classroom type
IV-8	120	3	2*3	—	3-classroom type
IV-9	230	4	5	1	5-classroom type
IV-10	250	4	5	1	5-classroom type
IV-11	208	4	4	—	4-classroom type
IV-12	245	5	5	—	5-classroom type
IV-13	113	4	2*3	—	3-classroom type
IV-14	106	5	2*3	—	3-classroom type
IV-15	120	5	2*3	—	3-classroom type
IV-16	68	3	1*3	—	3-classroom type
IV-17	92	4	2*3	—	3-classroom type
IV-18	119	3	2*3	—	3-classroom type
IV-19	55	3	1*3	—	3-classroom type
IV-20	183	5	4	—	4-classroom type
IV-21	179	4	4	—	4-classroom type

* Minimum number of classrooms to take account of the expected building use as a cyclone shelter.

(5) Killa Size

The main function of a cyclone shelter is to facilitate the swift and smooth evacuation of local inhabitants at the time of an approaching cyclone and it is also essential that the killas located near shelters have sufficient capacity to accommodate the livestock and household goods belonging to the evacuees. The

different sizes of the planned killas at each site are given in Table 3-2-4. This size was determined based on the number of animal heads/person, the shelter accommodation capacity, etc. (see Appendix 7 for details).

Table 3-2-4 Required Size of Killa at Each Site

Site No.	Killa Size (m)
IV-1	44 x 66 x 5.0
IV-2	44 x 66 x 5.0
IV-3	42 x 63 x 6.0
IV-4	42 x 64 x 4.5
IV-5	40 x 81 x 5.0
IV-6	38 x 59 x 4.5
IV-7	52 x 77 x 6.0
IV-8	48 x 73 x 5.0
IV-9	52 x 77 x 6.0
IV-10	48 x 73 x 5.0
IV-11	50 x 76 x 5.0
IV-12	48 x 78 x 4.5
IV-13	44 x 70 x 4.5
IV-14	44 x 70 x 4.5
IV-15	44 x 70 x 4.5
IV-16	44 x 70 x 4.5
IV-17	44 x 70 x 4.5
IV-18	44 x 70 x 4.5
IV-19	50 x 76 x 5.0
IV-20	44 x 70 x 4.5
IV-21	46 x 72 x 5.0

Note: Bottom Width x Bottom Length x Height
Slope Gradient of 1:2.0

(6) Outline of Planned Facilities

Based on the thorough examination results of the request made by the Government of Bangladesh, the following items are deemed appropriate as facilities to be constructed in the case of the Government of Japan's provision of grant aid.

1) Cyclone Shelters

The PMED has established the standard type of primary school facilities which consists of three classrooms, one teachers' room and one storage room and the shelters to be constructed under the Project (IV) will have these facilities. The

actual number of classrooms at each project site is calculated on the basis of the present number of pupils.

The following facilities will be provided in view of the use of the cyclone shelters as primary school buildings during normal times.

a) Classrooms: number of required classrooms with a minimum floor area of 37.15 m^2 per classroom together with the following furniture

   - one teacher's desk and chair set
   - desks and chairs for 50 pupils
   - one blackboard

b) Teachers' Room: one desk and chair for each teacher
   one blackboard

c) Storage: one storage room

No special need for other educational equipment is recognised.

Table 3-2-5 List of Facilities at Each Site

Site No.	No. of Classrooms	Capacity of Teachers' Room (No. of Teachers)	Storage	Toilets
IV-1	5	6	1	separate toilets for boys and girls
IV-2	5	6	1	
IV-3	4	5	1	
IV-4	5	6	1	
IV-5	3	4	1	
IV-6	3	4	1	
IV-7	3	4	1	
IV-8	3	4	1	
IV-9	5	6	1	
IV-10	5	6	1	
IV-11	4	5	1	
IV-12	5	6	1	
IV-13	3	4	1	
IV-14	3	4	1	
IV-15	3	4	1	
IV-16	3	4	1	
IV-17	3	4	1	
IV-18	3	4	1	
IV-19	3	4	1	
IV-20	4	5	1	
IV-21	4	5	1	

Note: A classroom is designed to accommodate upto 50 pupils.

- Structure
  - Main Body (pillars, beams and floors) : reinforced concrete
  - Walls (interior and exterior) : brick masonry
  - Number of Storys : two
- School Furniture : see Table 3-2-6

Table 3-2-6 School Furniture by School Type

Item	3-Classroom School	4-Classroom School	5-Classroom School
Pupil's Desk (three seater) and Bench	51 sets	68 sets	85 sets
Teacher's Desk and Chair	7 sets	9 sets	11 sets
Blackboard	4	5	6

2) Auxiliary Facilities

Water supply facilities (deep well and hand pump), sewerage facilities (septic tank and seepage pit) and water storage facilities (rainwater tank) for toilet cleaning will be introduced as auxiliary facilities for the cyclone shelter-cum-primary school buildings.

- Deep Well

Based on the water quality analysis results in/around each project site as shown in Appendix 9, the water quality of deep wells generally clears the Bangladesh's provisional standards. Meanwhile, the high level of Cl in water from dug wells (shallow wells) suggests a strong likelihood of salt water incursion. In addition, the detection of NH_4 indicates a strong likelihood of the infiltration of sewage from the ground surface.

Consequently, it has been decided to use a deep well as the water supply source at each project site and the deep well depth is provisionally set at an average of 300 m based on the deep well data obtained by the above-mentioned water quality analysis. The optimal deep well depth, however, will be decided for each site by drilling a test hole in each Thana during the detailed design period to obtain more detailed data on local aquifers.

- Hand Pump

As a deep well will be used as the water supply source as described above together with the requirement for the installation of a pump on the first floor to supply safe and hygienic water to evacuees at the time of storm surge caused by a cyclone, the planned pump for the Project (IV) will be a Tara pump which is made in Bangladesh and widely used as a high head pump.

- Septic Tank and Seepage Pit for First Floor Toilets

A septic tank will be installed for the biological decomposition and purification of sewage from the first floor toilets together with a seepage pit to discharge the purified water into the ground.

- Rainwater Tank for First Floor Toilets

A rainwater tank will be installed on top of the roof so that rainwater can be used for flushing the first floor toilets.

3.3 Basic Design

3.3.1 Design Concept

(1) Natural Conditions

The design concept of the Project (IV) vis-a-vis the relevant natural conditions is discussed here.

1) Wind Velocity

Based on the analysis results of cyclone wind velocities recorded in the past and wind velocities with various return periods, the wind velocity with a 50 year return period of 260 km/hr (72.0 m/sec) used as the standard design wind velocity in the Master Plan is also used in this report.

2) Earthquakes

Bangladesh divides the country into three zones and gives each zone a separate standard earthquake factor as listed below.

Zone 1 (North)	:	K = 0.08
Zone 2 (Central and East)	:	K = 0.05
Zone 3 (Central and South)	:	K = 0.04

The cyclone shelters constructed with Japanese aid in the past are located in Zone 2 (Central and East) with an earthquake factor of 0.05. With the introduction of the Bangladesh National Building Code (BNBC), however, stricter earthquake factors have been introduced, i.e. 0.2 for Zone 1, 0.15 for Zone 2 and 0.1 for Zone 3. An earthquake factor of 0.15 is, therefore, used for the Project in accordance with the BNBC.

3) Tide Level

The wave force associated with high tide is not considered here because it has little impact on cyclone shelters on stilts. In comparison, however, the tide level is important to determine the required floor height of these shelters. The method used for the preparation of the Master Plan (based on a tide level with a 50 year return period) is also used here for the analysis of storm surge. The following equation is used to calculate the storm surge (see Appendix 6.) height at the cyclone shelter sites.

$H_1 = h_{50}(X - 1) K + h_w$

h_{50} : Design surge height with a 50 year return period (m)

X : Distance of shelter from the beach (km)

K : Rate of decrease of surge height (m/km)

h_w : Amplitude of local wave in meters from mean water level

h_w : $[h_{50} - (X - 1) K]$ 1/4 $h_w = 1$ if $h_w < 1$

4) Temperature and Lighting

While the maximum temperature exceeds 35°C at all the sites, no air-conditioning, mechanical or otherwise, or ventilation system will be provided. No lighting system will be installed because the present maintenance requirement conditions of the facilities are insufficient and because there are no requests for installation by PMED. Therefore, as many windows as possible will be designed for ventilation and lighting purposes.

5) Geology

The type of foundations will be decided based on the boring survey and laboratory soil test results. If pile foundations are used, it will be necessary for the supporting ground to have a N value of at least 20 for clayey soil or 30 for sandy soil with a layer thickness of at least 2 - 3 m. The pile supporting strength will be the sum of the point-bearing strength and friction-bearing strength. Spread foundations will be used when the N value at the foundation bottom is 3 or more.

(2) Social Conditions

The Project (IV) intends the rebuilding of existing primary schools in the HRA to improve the quality of educational facilities as well as to use the new facilities as cyclone shelters. Therefore, the new facilities meet basic human and social needs and are suitable for all types of lifestyle and cultural traditions. As the facilities primarily aim at serving as cyclone shelters, the buildings must have a strong RC structure with a high floor.

(3) Construction Industry

1) Building Construction Method

In general, low buildings in Bangladesh are brick masonry buildings while larger/taller buildings are rigid frame, reinforced concrete buildings with

brick masonry external walls. The popularity of these methods can be justified mainly by the general availability of the requirement materials, equipment and skills locally.

The present Study has confirmed that all cyclone shelters constructed or proposed by aid organizations or the Government of Bangladesh have or will have a reinforced concrete structure. As such a structure was adopted for the previous projects, all cyclone shelters to be constructed under the Project (IV) will have a reinforced concrete structure.

2) Project Authorisation System

No specific approval or authorisation is required for the implementation of a project of this type in Bangladesh.

3) Relevant Laws and Standards

The general design standards for the present design purposes are those adopted by the Master Plan. In the case of structural planning, the RC structure computation standards and building foundation design standards in Japan and those adopted by the Master Plan are principally referred to except for the pile foundation yield strength and floor load set where the application of the BNBC introduction in 1995 is appropriate for the present project purposes.

4) Technical Level of Local Construction Companies

The technical level of local construction companies in such large cities as Dhaka and Chittagong has been rapidly improving to the point where these companies are capable of constructing multi-story buildings without outside assistance. A large quantity of materials for temporary structures is imported with a significant improvement of the safety aspect. The number of companies with experience of building construction for aid projects of Japan and others is steadily increasing. In short, the local technical level today is sufficient for the implementation of the Project (IV).

5) Quality and Quantity of Local Labour

As described in 4) above, the technical level of workers in Bangladesh has been rapidly improving, largely because of their involvement in construction

work abroad as well as the transfer of technology through foreign aid projects.

As the Project (IV) does not involve any special construction method or skills, it can be sufficiently implemented using local labour in Bangladesh. While skilled workers will be recruited from such large cities as Dhaka and Chittagong, ordinary workers will be recruited near the project sites. There is an inevitable decline of the available labour during the rice harvesting season (December to January) and Ramadan.

(4) Use of Local Construction Companies and Local Equipment/Materials

1) Local Construction Companies

Although the general contractor for the Project (IV) is a Japanese construction company, the use of local construction companies in Bangladesh is essential because of the vast differences between the two countries in terms of the social conditions, construction industry conditions, customs and religion, etc. As already described earlier, some local construction companies have a high technical level. Others have experience of construction work involving Japanese aid. Consequently, it is assumed that local construction companies will be actively used for the Project (IV).

2) Local Equipment and Materials

In principle, the construction equipment and materials required for the Project (IV) will be procured in Bangladesh. In the case of reinforcing bars, as their import from Japan or the third country would considerably reduce the cost compared to local procurement, their partial import from Japan or the third country may be considered. The main materials and planned procurement locations are listed below.

Material Place of Procurement

Cement	Chittagong
Sand	Sylhet
Pit Sand	Sylhet
Cobble Stones	Sylhet
Reinforcing Bars	Chittagong / Japan / the third country
Bricks	Chittagong
Wooden Forms	Chittagong

Paint	Chittagong
Fittings	Chittagong
Pumps	Chittagong
Furnishings	Chittagong

(5) Scope and Quality Level of Cyclone Shelters

1) Scope

The scope of the buildings to be constructed under the Project (IV) has been determined as follows.

a) The size of the new buildings (number of classrooms) will depend on the number of pupils at each school.

b) As a cyclone shelter, each building will have a minimum accommodation capacity of 1,650 people.

c) Each building will be provided with school furniture (desks, chairs and blackboards) in view of its use as a primary school building.

d) Each building will be provided with a water supply system using a deep well and rainwater tank for the first floor toilets.

e) Each building will be provided with first floor toilet facilities and a septic tank which can be used at the time of a disaster.

2) Quality

In principle, the construction materials and equipment to be used for the Project (IV) will be procured locally as stated earlier and the building structure will be a reinforced concrete structure which is common in Bangladesh. The quality of the structure and finishing work, etc. will be equivalent to that of other cyclone shelters constructed by the Government of Bangladesh and aid organizations. No special materials will be used in regard to the finishing and other aspects to keep the maintenance cost low.

(6) Construction Schedule

The construction schedule for the Project (IV) must be decided taking the social conditions, customs and religion, conditions of the construction industry, labour and supply of construction materials and the climatic conditions into consideration.

The climatic conditions in particular greatly affect the construction cost and schedule. From the religious point of view, the work efficiency declines by 50% during the some one month period of Ramadam, demanding careful planning of the construction schedule.

The foundation and earth work to be conducted at the early stage of construction is extremely difficult in the rainy season. This work should, therefore, be conducted during the dry season to avoid any delay of the subsequent work and a eight month period between October and May as dry season should be selected for this work. Finishing work, particularly painting work and external work, at the final stage should be conducted during the dry season.

Considering these requirements, the necessary work duration is estimated to be 12 months.

3.3.2 Basic Design

(1) Site Plan

As the Project (IV) intends the rebuilding of existing primary school buildings in the HRA as cyclone shelter-cum-primary school buildings, the existing school premises can be used. In conjunction with this rebuilding of existing school buildings, temporary classrooms should be constructed or rented to ensure the continuation of school activities. Given the difficulty of finding alternative buildings, it has been decided that new buildings will be constructed on empty space on the existing premises while school activities will continue at the existing buildings. Those buildings which are been already damaged and/or the use of which is dangerous will be demolished and new buildings will be constructed on the same site. At sites with insufficient land, additional land will be acquired. The construction or renting of a temporary school building following the demolition of damaged or unusable buildings and the acquisition of additional land will be the responsibility of the Government of Bangladesh.

(2) Architectural Design

The architectural design of the planned facilities is based on the Master Plan, agreed details between the Government of Bangladesh and Japan, findings of the survey on the project contents and conditions of use of existing cyclone shelters, and the standards and criteria set by the PMED and LGED, etc.

1) Facilities

The facilities at each site consist of the following.

- The ground floor is designed to be piloti (open space) throughout.
- Classrooms : 3 - 5 (50 pupils each)
  - Number of Pupils : 50
  - Floor Area/Pupil : 8 ft^2 (approximately 0.74 m^2)
  - Floor Area : approximately 37 m^2 (0.74 x 50)
- Teachers' Room : one (4 - 6 teachers)
  - Number of Teachers: number of classrooms plus one
  - Floor Area/Teacher : 50 ft^2 (approximately 4.6 m^2)
- Toilets : As there are no specific design standards for school toilets in Bangladesh, the school facilities constructed by the LGED are referred to in order to determine the size of toilets. The LGED provides two cubicles each for boys and girls for a school with three classrooms. In the case of the Project (IV), three, three or four cubicles each for boys and girls will be provided for a school with three, four or five classrooms respectively. In addition, a hand washing area for common use will be provided.
- Storage Room : one
- Common Use Areas : corridor, staircase and verandah

2) Floor Plan

The building will have a simple rectangular shape with a central corridor for the efficient use of space. The staircase will be located at the centre to minimise the counterflow volume of pupils in the corridor. A high head hand pump will be installed on the first floor verandah to ensure the supply of clean water when hit by cyclone storm. Toilet cubicles will be provided based on approximately three cubicles per 100 persons. The building will have two storys and the ground floor will be piloti (open space) to be used for various activities.

- Classrooms
  - 3 - 4 Classroom School : 37.6 m^2
  - 5 Classroom School : 37.8 m^2

- Teachers' Room	4 - 5 Teachers	:	18.8 m^2
	6 Teachers	:	28.4 m^2
- Toilets	3 - 4 Classroom School	:	18.8 m^2
	5 Classroom School	:	26.3 m^2

Table 3-3-1 Floor Area by School Type

School Type	First Floor (m^2)	Roof Top (m^2)	Total (m^2)
3 Classrooms	261.9	21.9	283.8
4 Classrooms	288.0	29.2	317.2
5 Classrooms	337.4	31.5	368.9

3) Cross-Sectional View

The height of the first floor must be high enough so as not to be inundated by storm surges caused by cyclones. The tide level calculated for each site based on the principles vis-a-vis the natural conditions described in 3.3.1-(1) is given in Appendix 6 of this report. Taking the flood level during the rainy season into consideration, however, it has been found necessary to raise the ground floor height by 1 m above the existing ground floor surface. In addition, at least 3.5 m is required between the ground floor level and first floor level for convenience of using the building. The resulting design height of the first floor at each site is shown in Table 3-3-2.

While a first floor ceiling height of 4.0 m was originally planned for good natural ventilation and the slow transfer of heat, the survey on existing shelters found that this height lengthened the reverberation time in the room, making the sound less clear. As a result, it has been revised to 3.3 m.

Table 3-3-2 Design Floor Height at Each Site

(Unit: mm)

Site No.	District	Thana	Final Design Floor Height (GL+)	Tentative Design Floor Height (GL+)
IV-1	Chittagong	Sitakunda	5.0	5.0
IV-2	Chittagong	Sitakunda	5.0	5.0
IV-3	Chittagong	Sitakunda	6.0	6.0
IV-4	Chittagong	Sitakunda	4.5	3.5
IV-5	Chittagong	Sitakunda	5.0	5.0
IV-6	Chittagong	Sitakunda	4.5	3.5
IV-7	Chittagong	Banskhali	6.0	6.0
IV-8	Chittagong	Banskhali	5.0	5.0
IV-9	Chittagong	Banskhali	6.0	6.0
IV-10	Chittagong	Banskhali	5.0	5.0
IV-11	Chittagong	Mirsharai	5.0	5.0
IV-12	Chittagong	Mirsharai	4.5	3.5
IV-13	Chittagong	Mirsharai	4.5	3.5
IV-14	Chittagong	Mirsharai	4.5	3.5
IV-15	Chittagong	Mirsharai	4.5	3.5
IV-16	Chittagong	Mirsharai	4.5	3.5
IV-17	Chittagong	Mirsharai	4.5	3.5
IV-18	Chittagong	Mirsharai	4.5	3.5
IV-19	Chittagong	Mirsharai	5.0	5.0
IV-20	Chittagong	Mirsharai	4.5	3.5
IV-21	Chittagong	Mirsharai	5.0	5.0

4) Shelter and School Capacity

The shelter and school capacity of each planned building of the sizes described above is given in Table 3-3-3.

Required Sheltering Area/Person

- Indoor : $2ft^2$ ($0.185m^2$)
- Roof Top : $8ft^2$ ($0.74m^2$)

Table 3-3-3 Shelter and School Capacity

School Type	Shelter Capacity Area/Building		Shelter Capacity (persons)/ Building	School Capacity (persons)/ Building	No. of Building	Total Shelter Capacity (persons)	Total School Capacity (persons)
	Indoor (m^2)	Roof Top (m^2)					
3 Classrooms	232	298	1,656	300	11	18,216	3,300
4 Classrooms	270.2	334.8	1,912	400	4	7,648	1,600
5 Classrooms	312.2	392.7	2,217	500	6	13,302	3,000
Total					21	39,166	7,900

5) Design Strength

- Floor Live Load : 300 kg/m^2 for long-term, 480 kg/m^2 for short-term
- Wind Load : mean wind velocity of 72 m/sec (50 year return period)
- Horizontal Seismic Factor : 0.15
- Design Concrete Strength : 210 kg/cm^2
- Tensile Strength of Reinforcing Bars : 2,100 kg/cm^2

6) Natural Lighting Plan

Similar facilities in the past used sheet iron for the windows and had the shortcoming of preventing the entry of natural light when closed. Windows with strong plastic glass are planned under the Project (IV) to improve the natural lighting.

(3) Structural Plan

1) Foundations

For the design of the foundations, the appropriate foundations will be selected based on geological data obtained by the relevant survey.

a) Spread Foundations

[Bearing Strength]

The load (dead load plus live load) of the buildings to be constructed under the Project (IV) is roughly estimated below.

Superstructure load		:	4.0 tons/m^2
Dead load of foundations	GL -1.0 m	:	2.0 tons/m^2
Total load	GL - 1.0 m	:	6.0 tons/m^2

A minimum bearing strength of 6 tons/m^2 for GL -1.0 m is, therefore, required. Sites with a N value of 3 or more, i.e. N$\geqq$3 for the lower layer, will be subject to spread foundations. To be more precise, these total 12 sites: Site Nos. IV-1, IV-3, IV-4, IV-5, IV-6, IV-11, IV-12, IV-13, IV-15, IV-17, IV-18 and IV-20. At Site Nos. IV-1, IV-4, IV-11 and IV-15, the supporting layer to support the piles is situated at a relatively shallow depth, making pile foundations less expensive than spread foundations. At Site Nos. IV-13 and IV-20, as the consolidation

settlement exceeds the allowable amount (15 cm), pile foundations will be used. Consequently, spread foundations will be employed at six sites, i.e. Site Nos. IV-3, IV-5, IV-6, IV-12, IV-17 and IV-18.

[Consolidation Settlement]

If thick and very compactable clayey soil is distributed at the bottom of spread foundations or below the supporting layer of piles, consolidation settlement may occur over a long period of time because of the height of the structure and banked soil. The amount of subsidence will vary in accordance with changes of the ground, causing uneven settlement of the structure. When the amount of such uneven settlement is larger than the strength of the structural body, cracks will occur, damaging the structure.

Although it is difficult to accurately estimate the amount of uneven settlement, it generally increases in line with the increased amount of total settlement.

There are several proposals to estimate the amount of total settlement based on the consolidation characteristics of the soil. Of these, the method using the consolidation coefficient (Cc) has a relatively good correlation with the liquid limit (W_L) even though it tends to slightly exaggerate the amount of consolidation. Therefore, it is often used for soil formations for which a consolidation test is not conducted.

$$Sc = \frac{Cc}{1+e_o} \cdot H \cdot \log \frac{P_Z + \Delta P}{P_Z} \quad \text{..... Equation 3-3-1}$$

Where,

- Sc : amount of consolidation settlement
- e_o : initial void ratio of original ground
- H : consolidation layer thickness
- Cc : consolidation coefficient
- P_Z : effective soil cover pressure of original ground
- ΔP : incremental vertical stress

The results of the consolidation test conducted for the Project (IV) suggest the following correlation between Cc and W_L as shown in Fig. 3-3-1 as well as the following equation.

$$\frac{Cc}{1+e_o} = -0.076 + 0.0049W_L \quad \text{..... Equation 3-3-2}$$

Table 3-3-4 gives the assumed consolidation settlement results breed on the soil characteristics, including the value of W_L obtained by soil test conducted at each site and on the above 2 equations.

Fig. 3-3-1 Correlation Between Cc and W_L

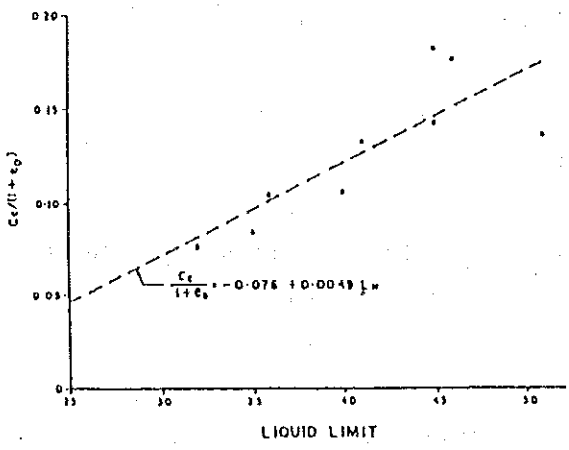


Table 3-3-4 Results of Assumed Consolidation Settlement

Site No.	Supporting Layer	Thickness of Supporting Layer (m)	Amount of Consolidation Settlement (cm)
IV-3	Clayey Soil	2.0	12.3
IV-5	Clayey Soil	2.8	8.0
IV-6	Clayey Soil	4.5	14.0
IV-12	Clayey Soil	2.5	8.0
IV-13	Clayey Soil	5.5	17.0
IV-17	Clayey Soil	0	0
IV-18	Clayey Soil	2.5	8.0
IV-20	Clayey Soil	6.3	19.0

[Allowable Amount of Consolidation Settlement]

The Structural Calculation Rules for Building Foundations are used for the allowable amount of consolidation settlement.

Spread Foundations : 15 cm

b) Pile Foundations

Given a N value of less than 3, pile foundations will be employed at nine sites, i.e. Site Nos. IV-2, IV-7, IV-8, IV-9, IV-10, IV-14, IV-16, IV-19 and IV-21. Pile foundations will also be employed at Site Nos. IV-1, IV-4, IV-11, IV-13, IV-15 and IV-20 in view of economy or the allowable amount of consolidation settlement as discussed in the previous section.

c) Type of Foundations by Site

The type of foundations to be employed at each site based on the analysis results described in a) and b) above is shown in Table 3-3-5.

Table 3-3-5 Type of Foundations by Site

Site No.	District	Thana	Type of Foundations	Pile Length (m)
IV-1	Chittagong	Sitakunda	pile foundations	13
IV-2	Chittagong	Sitakunda	pile foundations	16
IV-3	Chittagong	Sitakunda	spread foundations	—
IV-4	Chittagong	Sitakunda	pile foundations	10
IV-5	Chittagong	Sitakunda	spread foundations	—
IV-6	Chittagong	Sitakunda	spread foundations	—
IV-7	Chittagong	Banskhali	pile foundations	11
IV-8	Chittagong	Banskhali	pile foundations	30
IV-9	Chittagong	Banskhali	pile foundations	30
IV-10	Chittagong	Banskhali	pile foundations	30
IV-11	Chittagong	Mirsharai	pile foundations	11
IV-12	Chittagong	Mirsharai	spread foundations	—
IV-13	Chittagong	Mirsharai	pile foundations	17
IV-14	Chittagong	Mirsharai	pile foundations	16
IV-15	Chittagong	Mirsharai	pile foundations	10
IV-16	Chittagong	Mirsharai	pile foundations	16
IV-17	Chittagong	Mirsharai	spread foundations	—
IV-18	Chittagong	Mirsharai	spread foundations	—
IV-19	Chittagong	Mirsharai	pile foundations	17
IV-20	Chittagong	Mirsharai	pile foundations	20
IV-21	Chittagong	Mirsharai	pile foundations	19

2) Superstructure

a) Live Load

	Normal (Long-Term Load) (P_L)	Abnormal (Short-Term Load) (P_S)
Floor	300	480
Framework	200	320
Seismic	100	160

The figure for the floor load set by the BNBC for schools is used for the normal load while the figure used by the Master Plan is used for the abnormal floor load.

b) Seismic Factor (K)

The BNBC Standards set the horizontal seismic factor (K) for the Project Area at 0.15 and this value is used for the Project (IV).

c) Wind Load

The wind load of 72 m/sec with a 50 year return period adopted by the Master Plan is used.

d) Load

Long-Term	$G + P_L$	G: dead load
Short-Term	$G + P_L + K$	P_L: constant live load
	$G + P_L + W$	P_S: emergency live load
	$G + P_S + W$	K: seismic load
		W: wind load

Among the above combinations, that with the largest load is used.

(4) Auxiliary Facilities

The following water supply and drainage facilities are planned for each site.

1) Water Supply

Groundwater from a deep well will be used.

Depth : maximum of 300 m

Pump : high head Tara hand pump (made in Bangladesh)
This hand pump will be installed on the first floor verandah to ensure the supply of clean water when hit by cyclone storm.

2) Waste Water

Waste water will mainly consist of sewage which will be discharged to a septic tank for subsequent infiltration of the treated water into the ground via a seepage pit.

3) Rainwater

A rainwater tank will be installed on the roof and the first floor toilets will be plumbed so that water can be used for flushing and cleaning during the rainy season and at the time of a cyclone.

4) Ventilation

Natural ventilation will be employed. In the past, natural ventilation consisted of the opening and closing of windows. However, fixed louvres (made of bricks) will be introduced under the Project (IV) so that the rooms can be ventilated when the windows are closed.

(5) School Furniture

The following school furniture will be provided.

[For Each Classroom]

- Desks and three-seater benches for pupils : 17 sets
- Desk and chair for teacher : 1 set
- Blackboard : 1

[Teachers' Room]

- Desks and chairs for teachers : 1 set/teacher
- Blackboard : 1

The above furniture is shown in Table 3-3-6.

Table 3-3-6 List of Furniture

Site No.	Classroom			Teacher's Room	
	Desks & 3-Seater Bench for Pupils	Desks & Chairs for Teachers	Blackboard	Desks & Chairs for Teachers	Blackboard
IV-1	85 sets	5 sets	5	6 sets	1
IV-2	85 sets	5 sets	5	6 sets	1
IV-3	68 sets	4 sets	4	5 sets	1
IV-4	85 sets	5 sets	5	6 sets	1
IV-5	51 sets	3 sets	3	4 sets	1
IV-6	51 sets	3 sets	3	4 sets	1
IV-7	51 sets	3 sets	3	4 sets	1
IV-8	51 sets	3 sets	3	4 sets	1
IV-9	85 sets	5 sets	5	6 sets	1
IV-10	85 sets	5 sets	5	6 sets	1
IV-11	68 sets	4 sets	4	5 sets	1
IV-12	85 sets	5 sets	5	6 sets	1
IV-13	51 sets	3 sets	3	4 sets	1
IV-14	51 sets	3 sets	3	4 sets	1
IV-15	51 sets	3 sets	3	4 sets	1
IV-16	51 sets	3 sets	3	4 sets	1
IV-17	51 sets	3 sets	3	4 sets	1
IV-18	51 sets	3 sets	3	4 sets	1
IV-19	51 sets	3 sets	3	4 sets	1
IV-20	68 sets	4 sets	4	5 sets	1
IV-21	68 sets	4 sets	4	5 sets	1
Total	1,343 sets	79 sets	79	100 sets	21

(6) Basic Design Drawings

The basic design drawings (plans, elevations and sections of shelters-cum-schools as well as section of hand pump and deep well) are given in Figs.3-3-2～3-3-6, while the site plans are shown in Appendix 8.

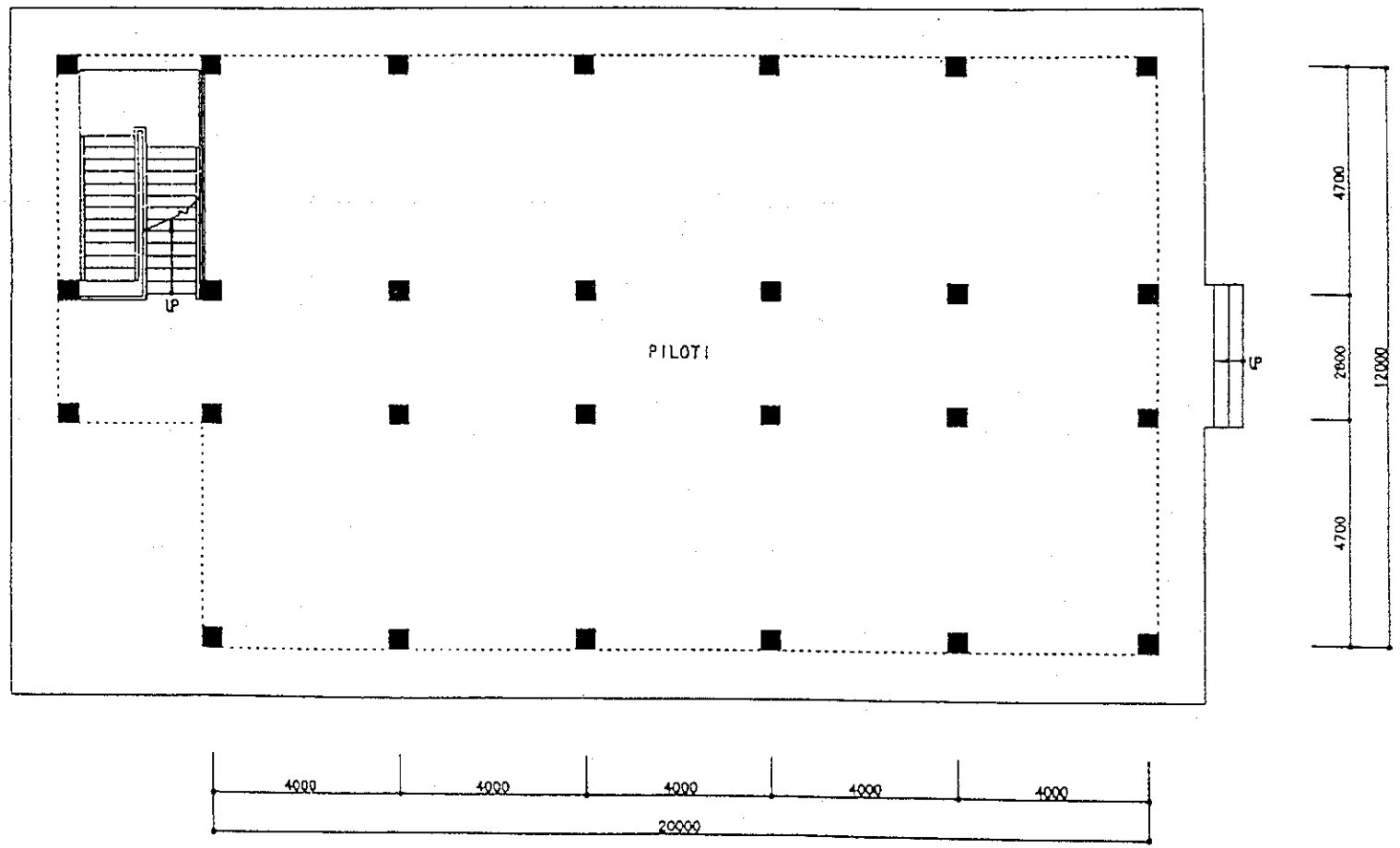


Fig. 3-3-2(1) GROUND FLOOR PLAN (3-CLASROOM TYPE)

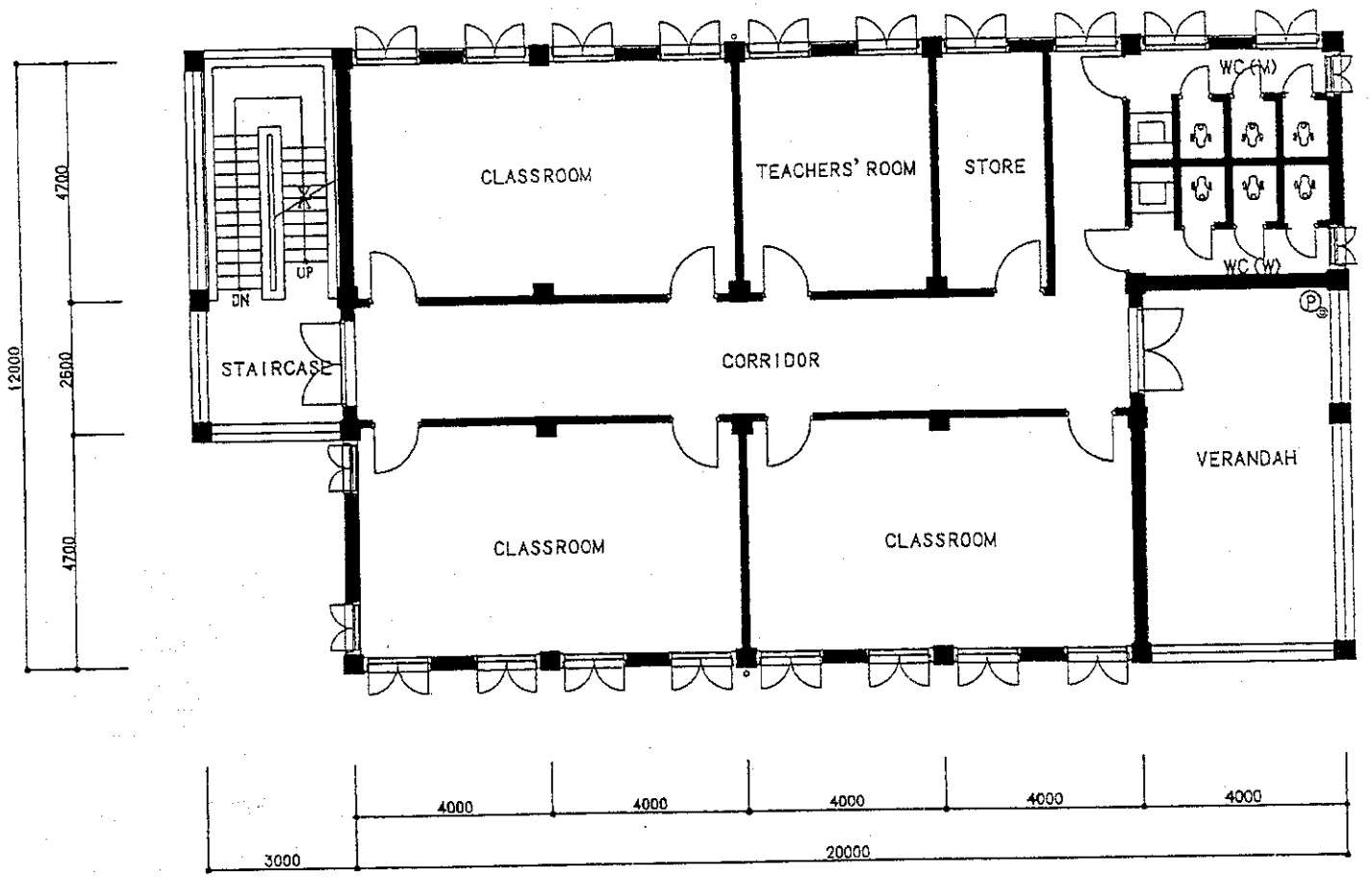


Fig. 3-3-2(2) FIRST FLOOR PLAN (3-CLASROOM TYPE)

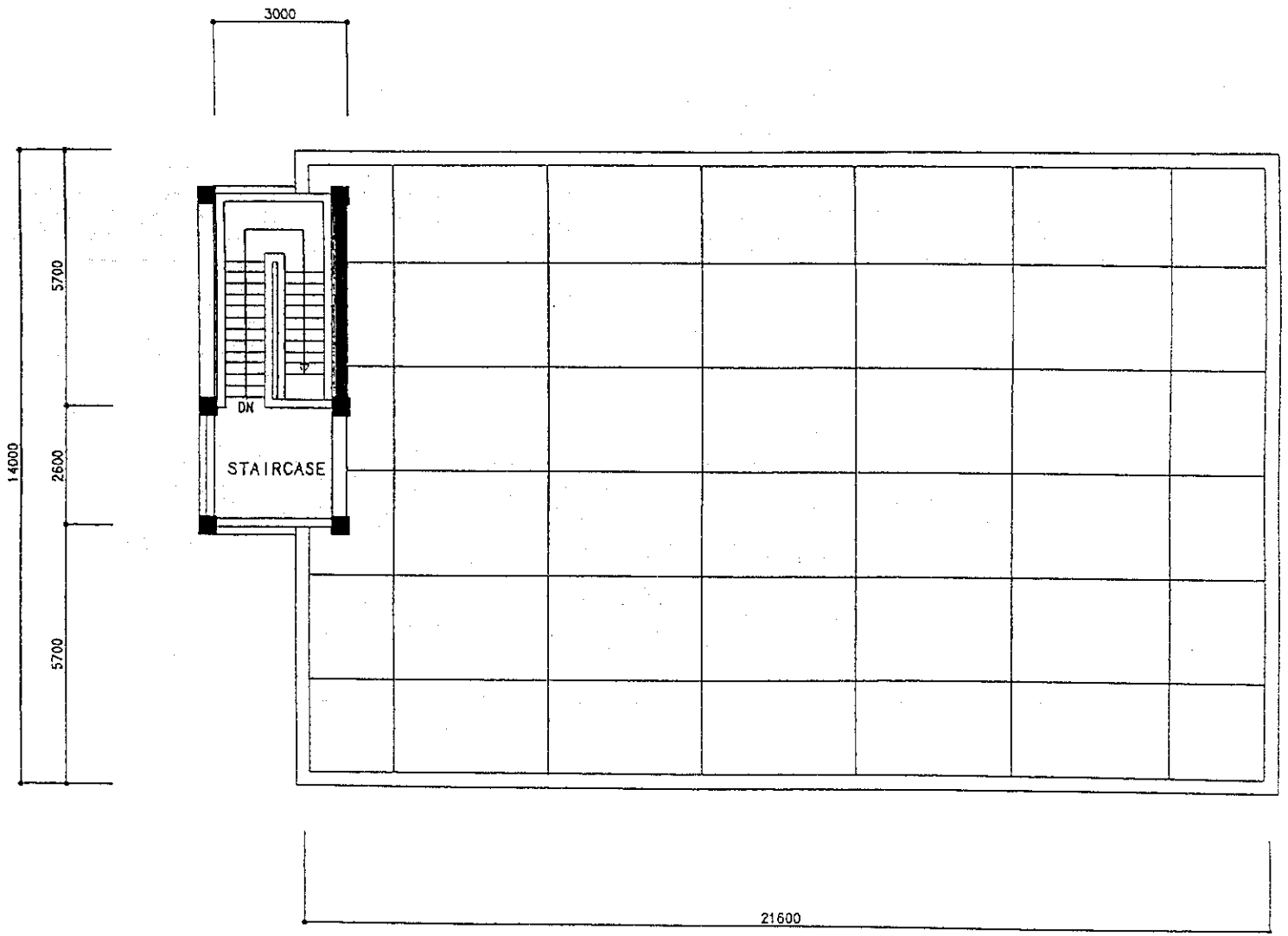


Fig. 3-3-2(3) ROOF FLOOR PLAN (3-CLASROOM TYPE)

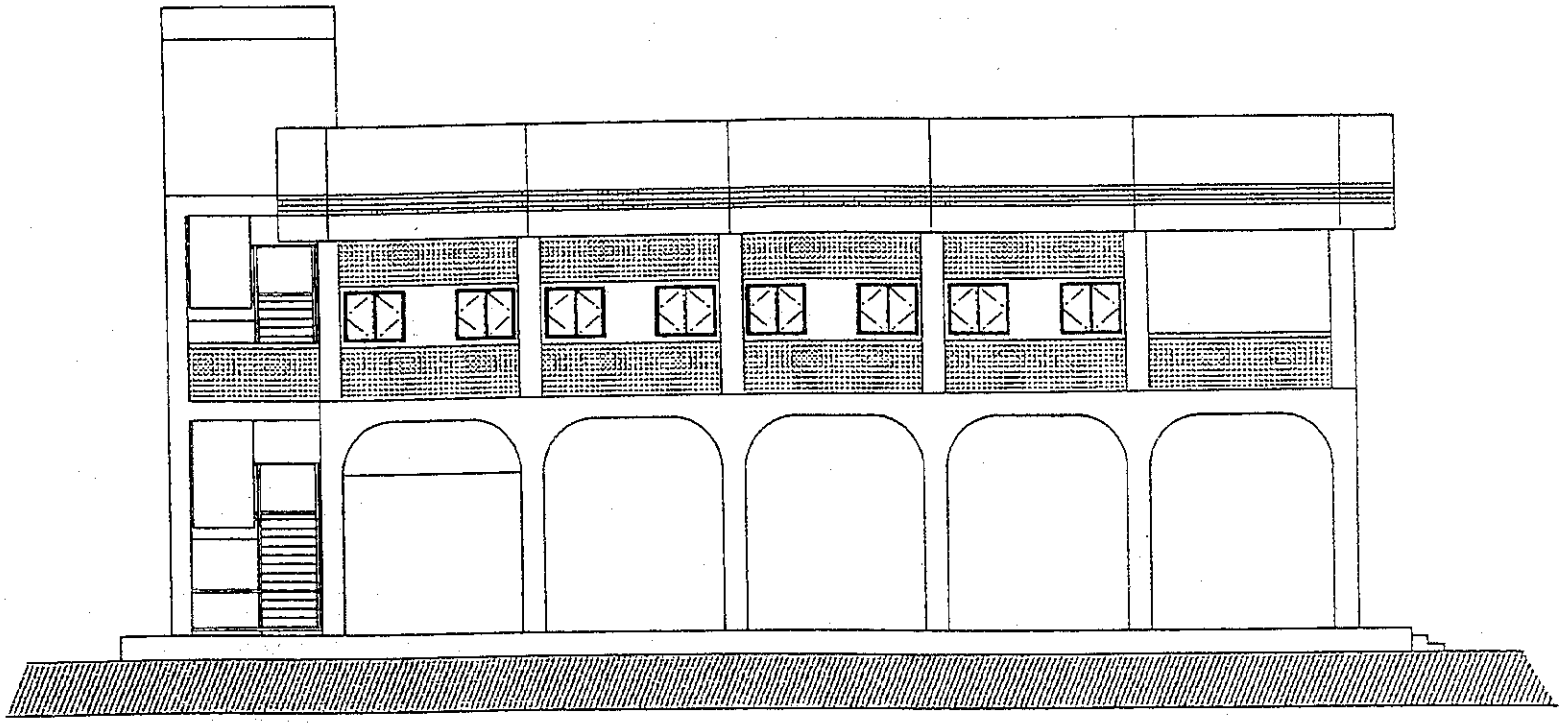


Fig. 3-3-2(4) ELEVATION (3-CLASROOM TYPE)

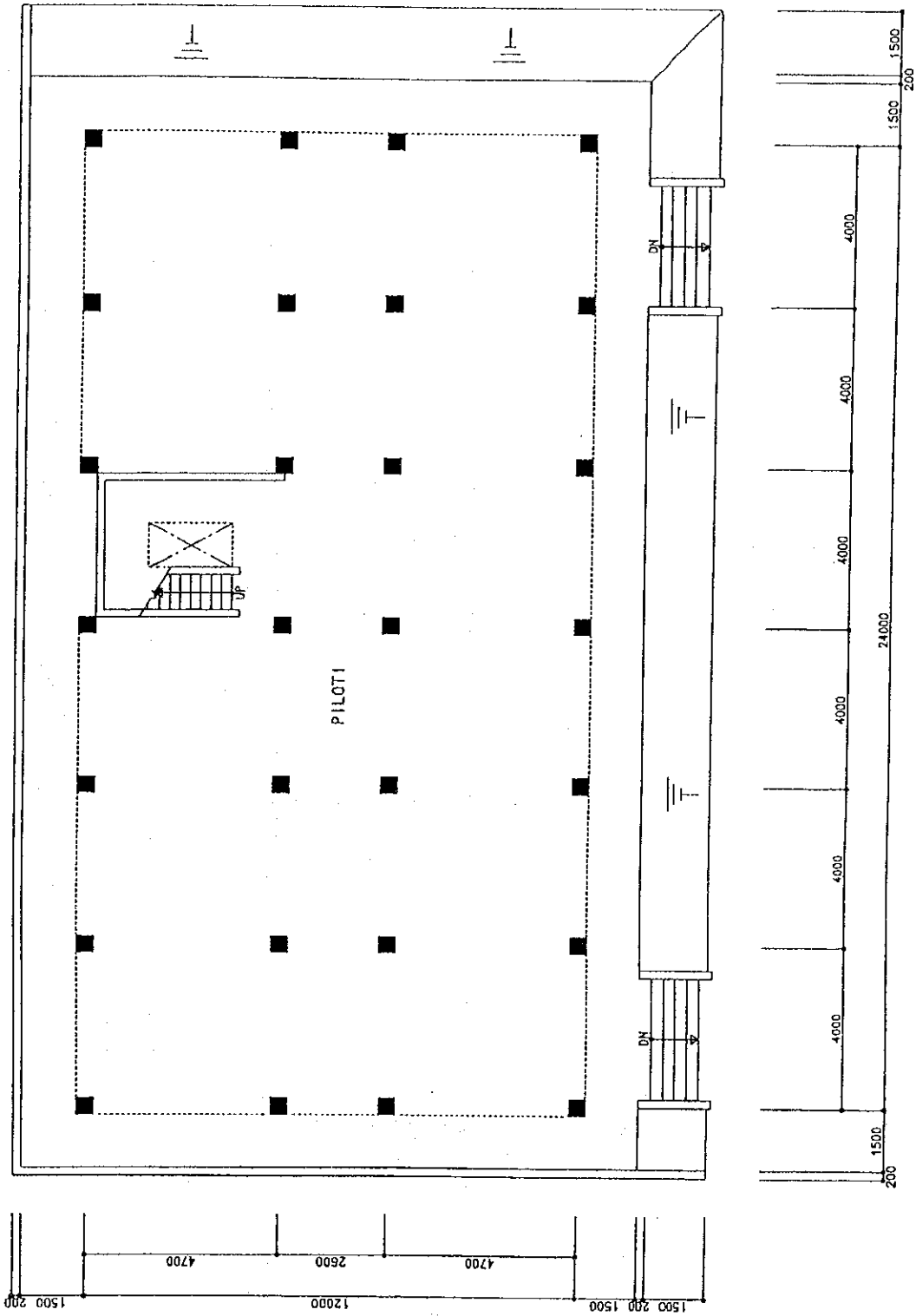


Fig. 3-3-3(1) GROUND FLOOR PLAN (4-CLASROOM TYPE)

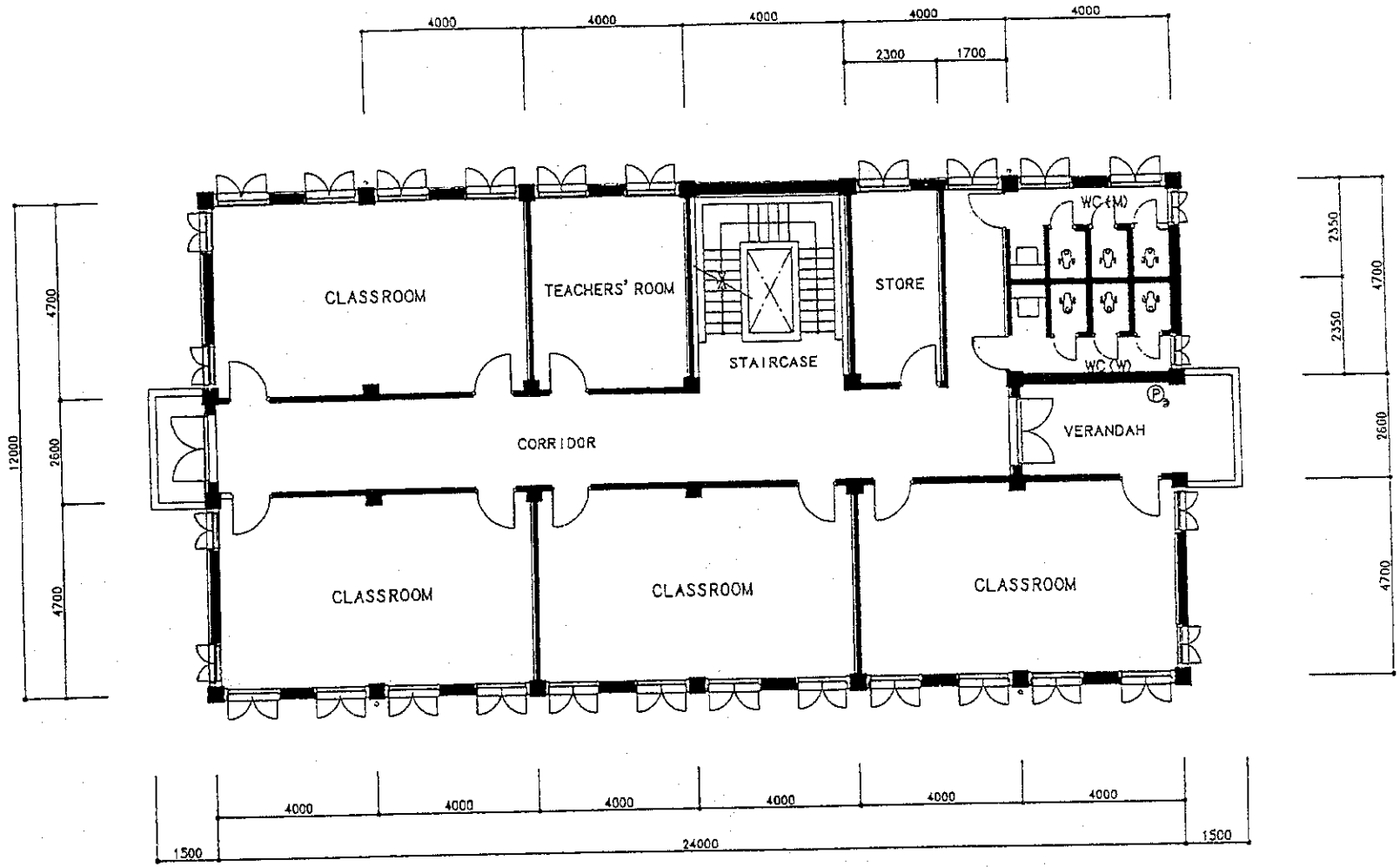


Fig. 3-3-3(2) FIRST FLOOR PLAN (4-CLASROOM TYPE)

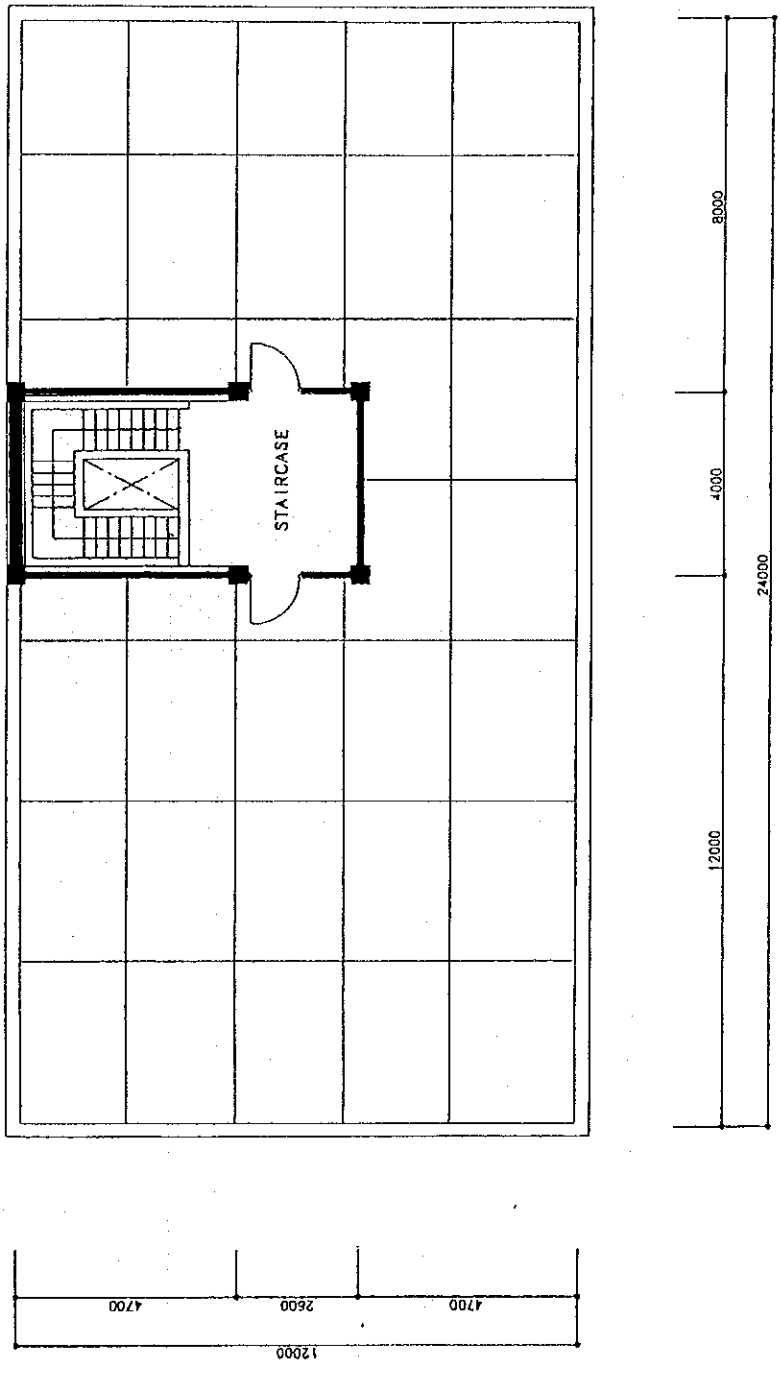


Fig. 3-3-3(3) ROOF FLOOR PLAN (4-CLASROOM TYPE)

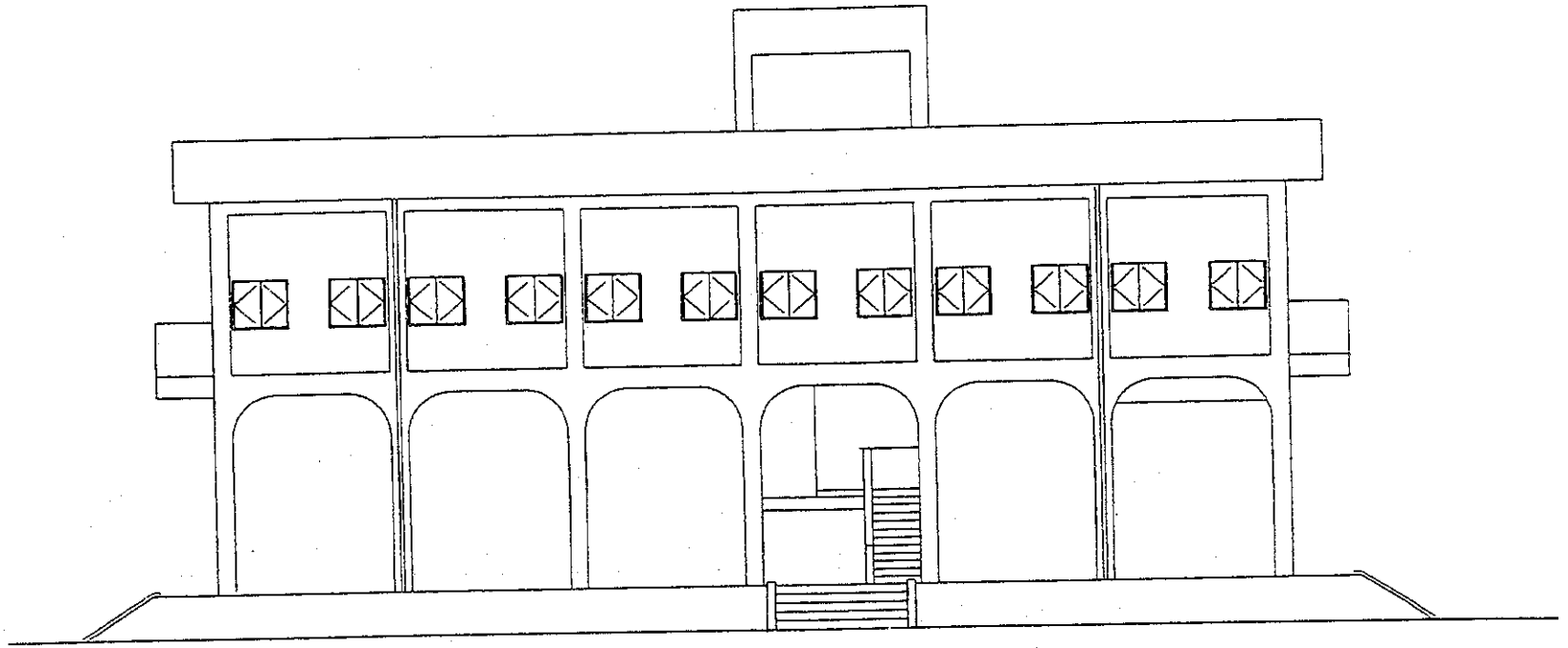


Fig. 3-3-3(4) ELEVATION (4-CLASROOM TYPE)

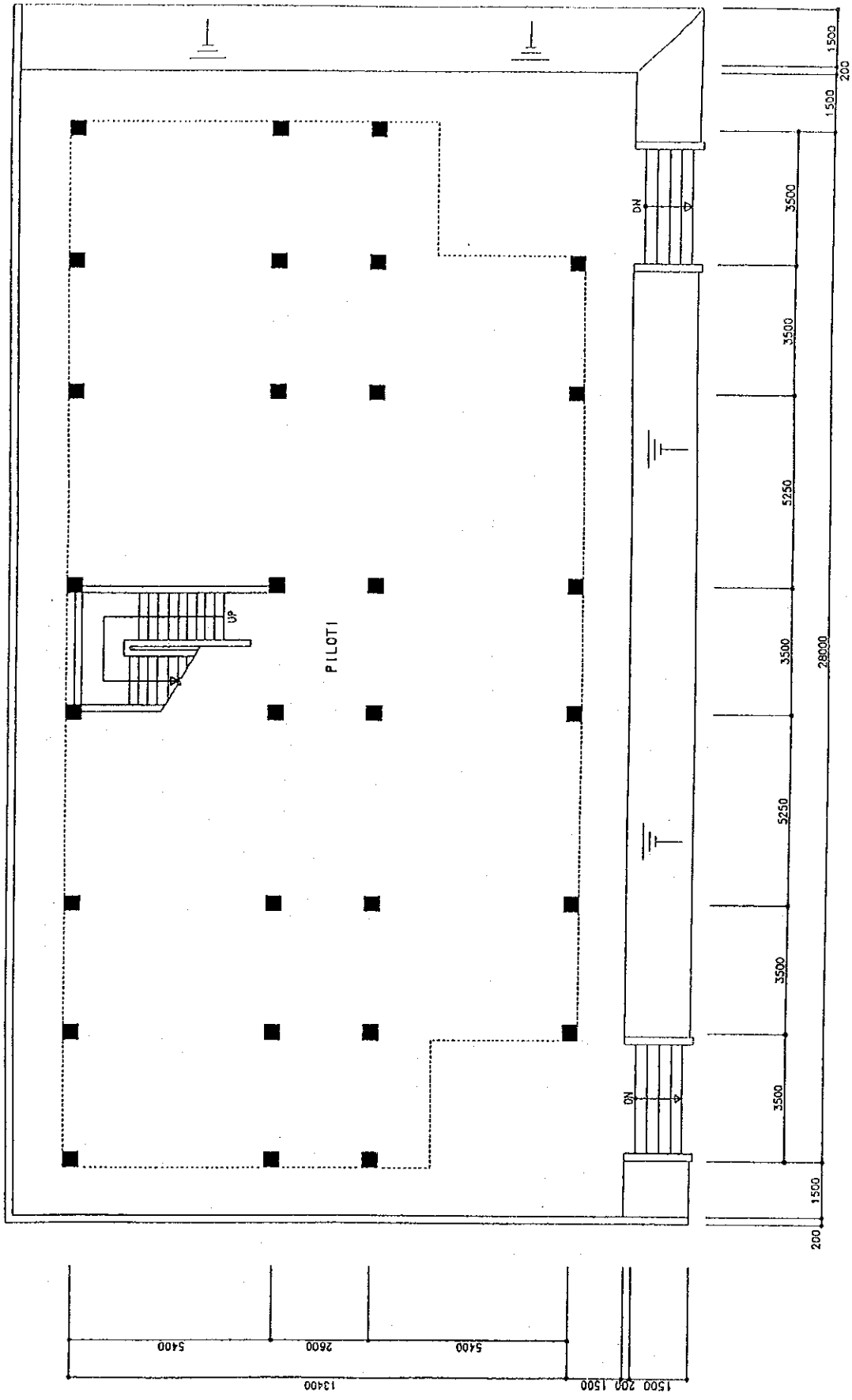


Fig. 3-3-4(1) GROUND FLOOR PLAN (5-CLASROOM TYPE)

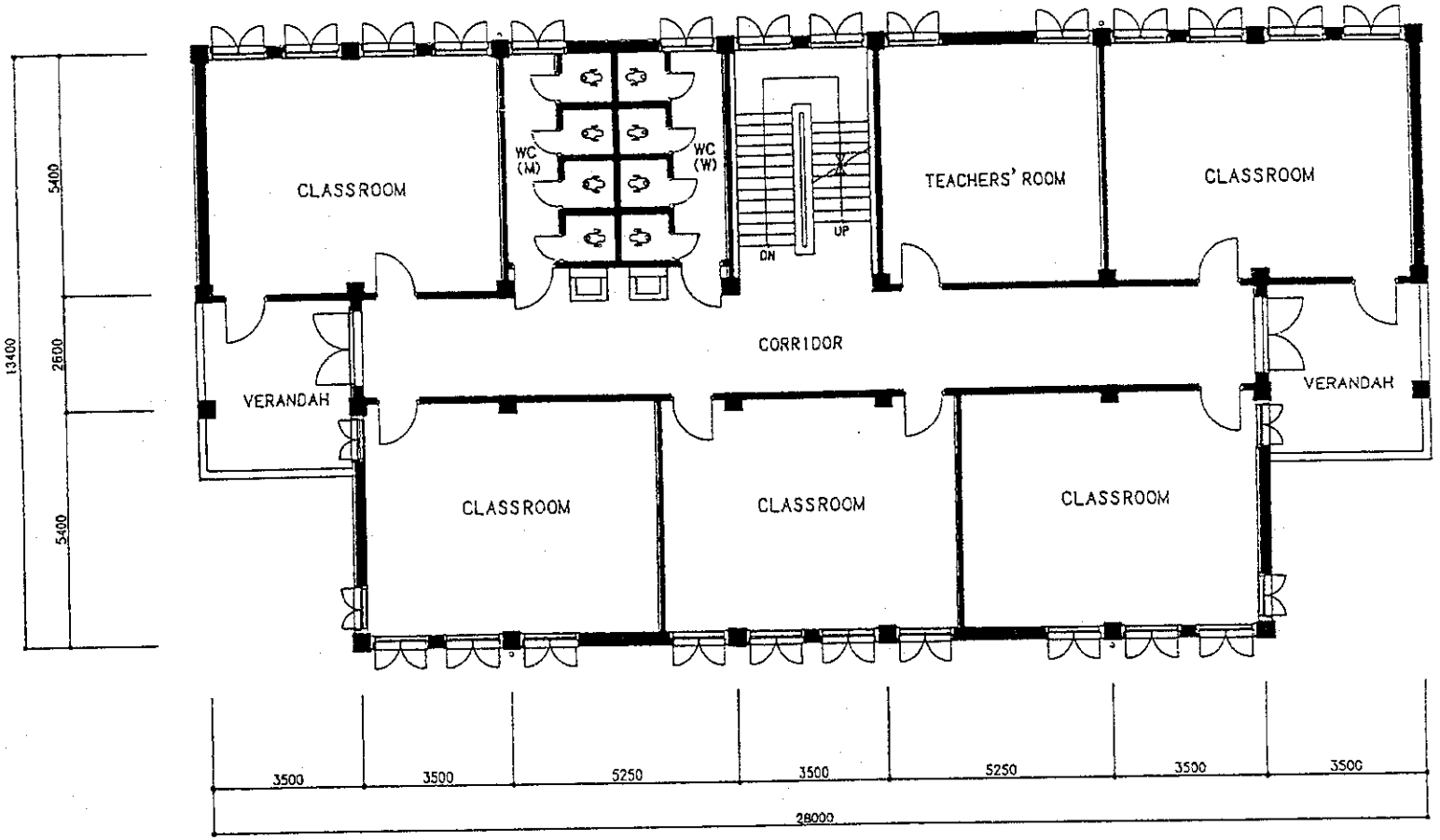


Fig. 3-3-4(2) FIRST FLOOR PLAN (5-CLASROOM TYPE)

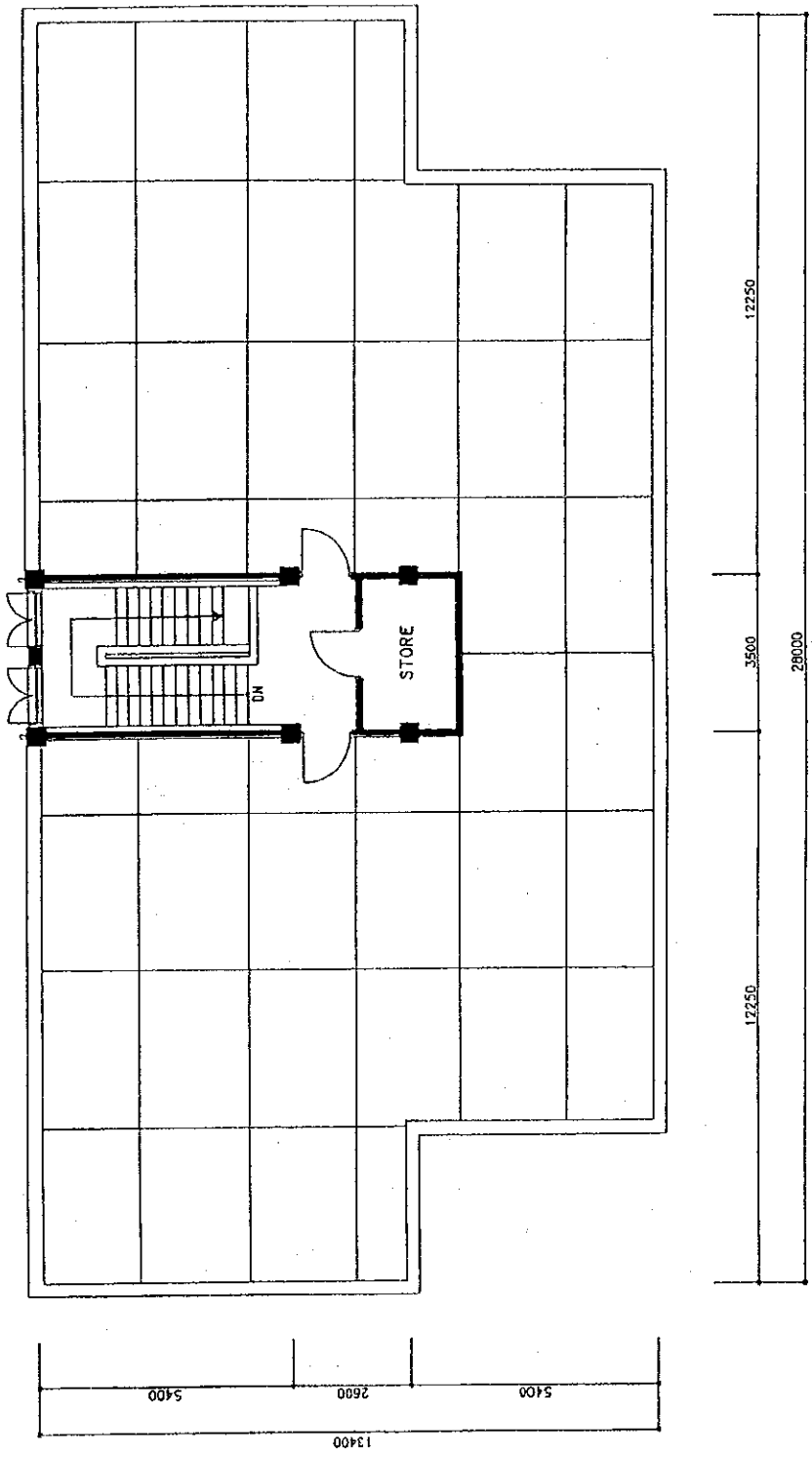


Fig. 3-3-4(3) ROOF FLOOR PLAN (5-CLASROOM TYPE)

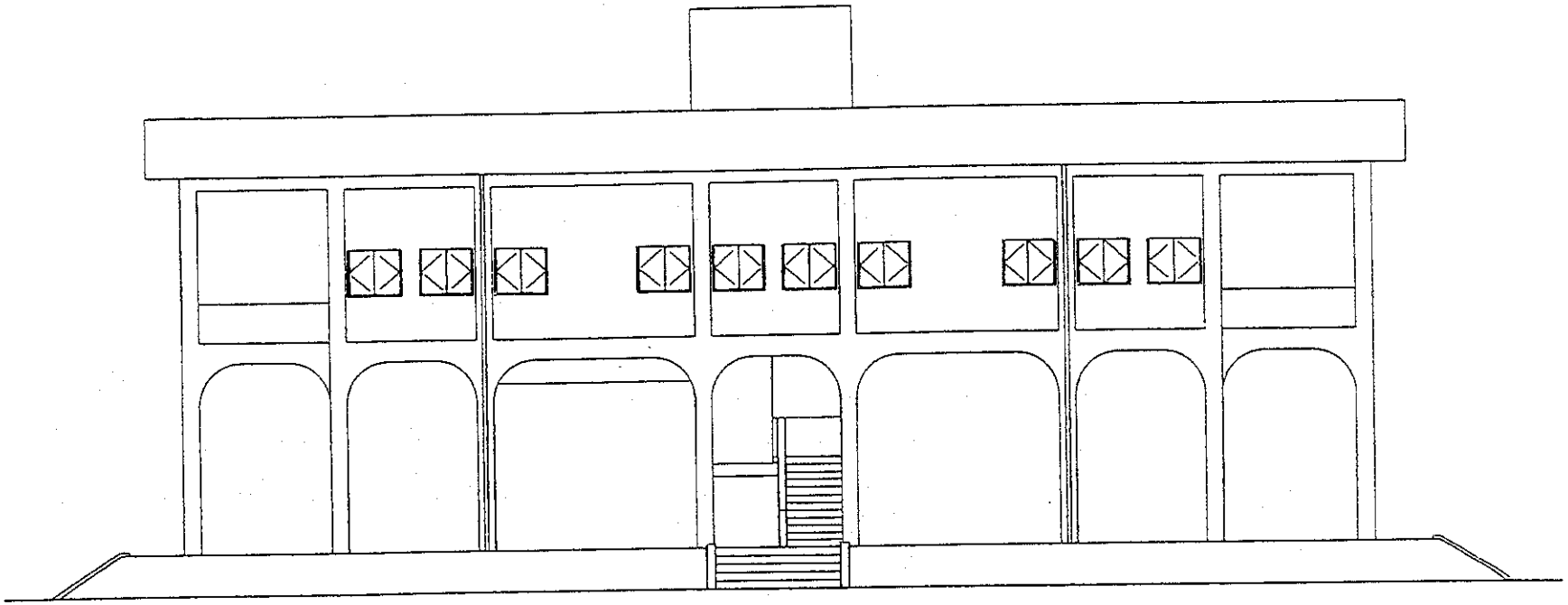


Fig. 3-3-4(4) ELEVATION (5-CLASROOM TYPE)

Site No.	L	H
IV-1	5.4	4.0
IV-2	5.4	4.0
IV-3	4.7	5.0
IV-4	5.4	3.5
IV-5	4.7	4.0
IV-6	4.7	3.5
IV-7	4.7	5.0
IV-8	4.7	4.0
IV-9	5.4	5.0
IV-10	5.4	4.0
IV-11	4.7	4.0
IV-12	5.4	3.5
IV-13	4.7	3.5
IV-14	4.7	3.5
IV-15	4.7	3.5
IV-16	4.7	3.5
IV-17	4.7	3.5
IV-18	4.7	3.5
IV-19	4.7	4.0
IV-20	4.7	3.5
IV-21	4.7	4.0

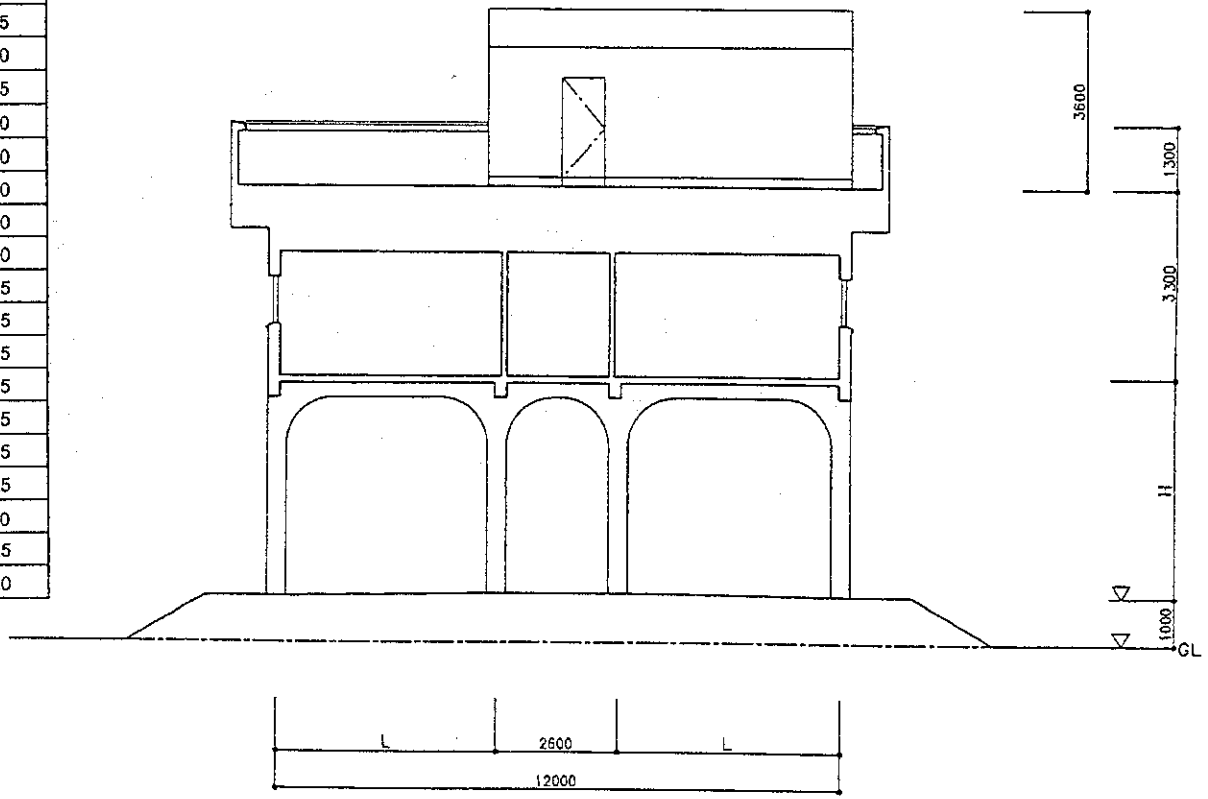
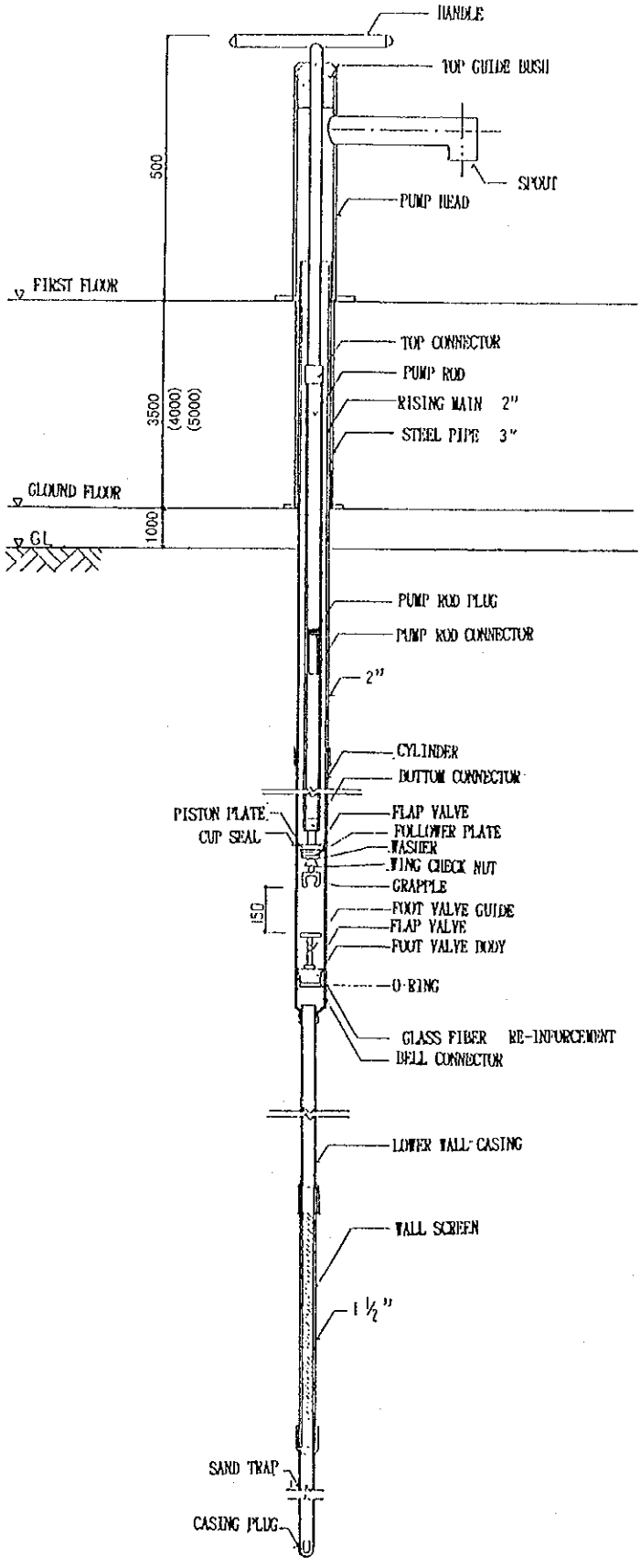


Fig. 3-3-5 SECTION (COMMON TO EACH CLASSROOM TYPE)

Fig. 3-3-6 SECTION OF HAND PUMP AND DEEP WELL



CHAPTER 4

IMPLEMENTATION PLAN

CHAPTER 4 IMPLEMENTATION PLAN

4.1 Implementation Plan

4.1.1 Implementation Concept

The responsible ministry for the Project (IV) is the M/LGRD & C and the implementation agency is the LGED of the M/LGRD & C. Therefore, the local counterparts for the Detailed Design Study are staff members of the LGED who will also be responsible for supervision of the construction work representing the Bangladesh side. Contracts with the consultant and contractor for the Project (IV) will also be made by the LGED.

Following the signing of the E/N relating to grant aid for the Project (IV), the LGED will conclude a consultancy contract with a Japanese consultant. The Japanese consultant will be assigned the preparation of the detailed design (preparation of detailed design documents and drawings and supervision of the tender procedure in support of the Government of Bangladesh) and supervision of the construction work. The actual construction work will be conducted by a Japanese contractor selected by the LGED in accordance with the tender procedure supervised by the consultant.

4.1.2 Implementation Conditions

As described earlier, local materials and local construction methods will, in principle, be used for the construction of the planned facilities. As these facilities are classified as simple structures, conventional construction methods in Bangladesh will be sufficient. However, careful consideration of the following points will be required.

1) Construction Schedule

The construction schedule must take the decline of the work efficiency during the rainy season (June to October) and the month of Ramadan into consideration.

2) Types of Work to be Avoided During Rainy Season

As foundation work, earth work and painting work are unsuitable during the rainy season, these will have a major influence on the planning of the construction schedule.

3) Delivery of Construction Equipment and Materials

The conditions of road access to each site are very poor and access by vehicle is impossible during the rainy season (and after rain which lasts a day or more). This demands careful planning of the delivery of equipment and materials.

4) Cyclone Seasons

April and November constitute the peak cyclone seasons in Bangladesh. As all of the sites are located near the coast in the HRA, special attention must be paid to the weather forecast. If evacuation is deemed necessary, all persons at the sites should be evacuated sooner rather than later.

4.1.3 Scope of Works

The scope of work for the Government of Japan and the Government of Bangladesh is listed below.

Government of Japan

1) Construction of 21 cyclone shelter-cum-primary school buildings
2) Provision of school furniture
3) Provision of a hand pump at each site
4) Construction of deep wells (GL -300 m)
5) Construction of septic tank and seepage pit for first floor toilets
6) Provision of rainwater tank for first floor toilets
7) Provision of consultancy services

Government of Bangladesh

1) Additional land acquisition and ground preparation (including the removal of dilapidated existing facilities) prior to commencement of construction work
2) Construction of a kill at each site
3) Improvement of access road to each site

4.1.4 Consultant Supervision

Following the signing of the E/N, the consultant which has secured the consultancy contract will prepare the detailed design and tender documents, provide support in the

tender process on behalf of the Government of Bangladesh and supervise the work to be conducted by the contractor who submits the successful bid.

(1) Preparation of Detailed Design and Tender Documents

The detailed design documents will be prepared by the consultant based on the survey maps prepared for the Basic Design, the boring survey results for the Basic Design and the findings of further field surveys for the Detailed Design. The consultant will also prepare the tender documents for approval by the Government of Bangladesh.

(2) Tender

The consultant will provide support in the tender announcement, acceptance of tender applications, explanatory meeting on the tender process, distribution of tender documents, acceptance of bids and evaluation of bids on behalf of the Government of Bangladesh. The consultant will advise on negotiations between the Government of Bangladesh and the successful bidder and supervise the conclusion of the construction contract.

(3) Work Supervision

Following the conclusion of the construction contract, the work supervision stage will commence. In Japan, the consultant will check and approve the documents presented by the contractor. At the actual construction sites, the consultant will supervise the contractor (including sub-contractors) on all aspects of the construction work, including the transportation of materials and equipment, process control, quality control (including quality tests conducted by the contractor at an authorized laboratory in Bangladesh) and materials control, in support of the Government of Bangladesh.

(4) Personnel Plan

The experts to be assigned at the detailed design stage will be the Project Manager who will be responsible for overall project implementation and engineers specializing in architectural design, structural design, estimation and tender document preparation, etc., all of whom will be controlled by the Project Manager. For on-site management and supervision, the full-time Supervisor will be dispatched to Bangladesh and the Project Manager and Architectural Designer will also be dispatched for spot supervision.

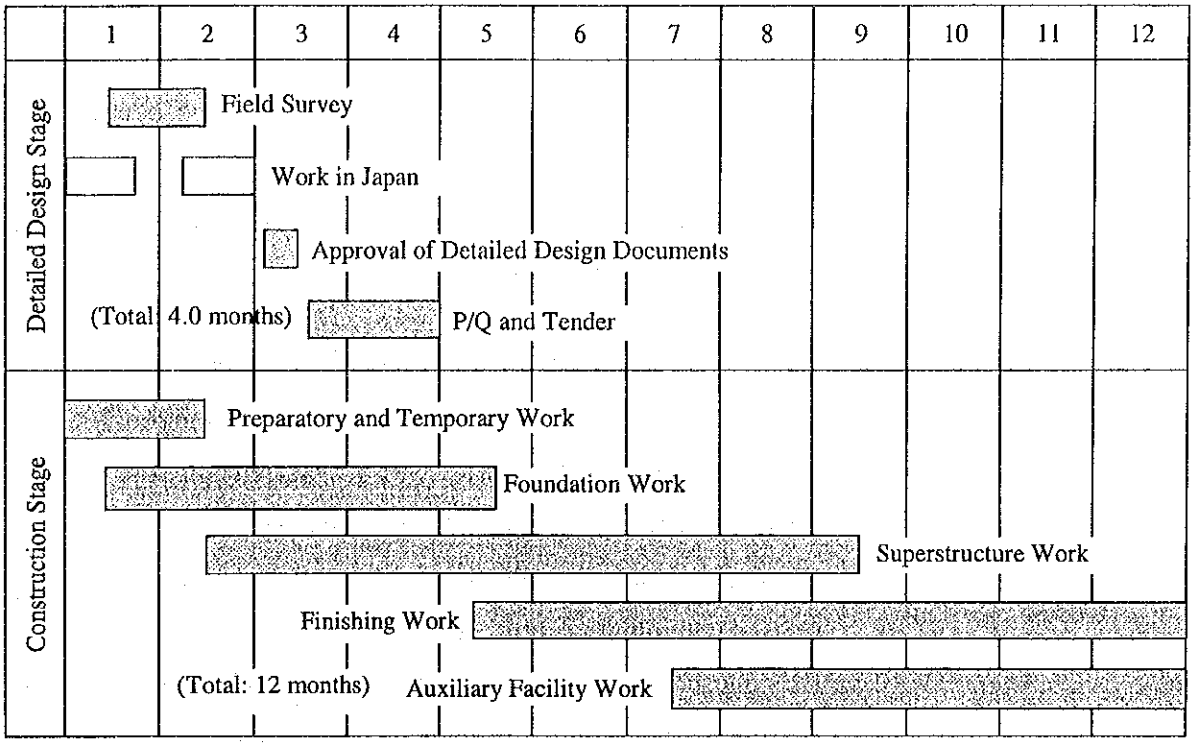
4.1.5 Procurement Plan

The procurement of the required equipment and materials for the construction of the facilities under the Project (IV) is planned to be conducted in Chittagong, the second largest city in Bangladesh and located near the project sites. In the case of reinforcing bars, their import will be more cost effective and the total construction cost will be cheaper. However, the transportation of these bars to the project sites will take a total of some three months, making the completion of the Project (IV) in accordance with the schedule shown in Table 4-1-1 difficult to achieve. Accordingly, it will be necessary to procure the reinforcing bars for piles and foundations and some part of the superstructure locally and to procure the remaining by import. On this basis, the ratio of imported reinforcing bars is estimated to be approximately 55% of the total.

4.1.6 Implementation Schedule

The adoption of the following project implementation schedule after the signing of the E/N by both governments is desirable. Following the signing of the E/N, the Government of Bangladesh (LGED) will then immediate conclude the consultancy contract to proceed with the detailed design. A period of some two months will be required for the detailed design which will be followed by the tender procedure to select the contractor for a total of approximately four months. This tender procedure will be conducted by the consultant on behalf of the LGED and the contract will be made through negotiations between the LGED and successful bidder. The construction period for the Project (IV) is, in principle, estimated to be 12 months. The prospective project implementation schedule taking the conditions described the above into consideration is shown in Table 4-1-1.

Table 4-1-1 Project Implementation Schedule



4.1.7 Obligations of Recipient Country

For the implementation of the Project (IV), the Government of Bangladesh will be required to conduct the following.

(1) Additional land acquisition for the project sites

The additional land will be required at the following 8 sites because of the insufficient size of the existing site to accommodate the planned facilities.

Site No.	Area of Existing Site	Minimum Additional Land Acquisition
IV-1	728 m^2	168 m^2
IV-3	810 m^2	180 m^2
IV-5	675 m^2	244 m^2
IV-6	475 m^2	1,275 m^2
IV-9	1,604 m^2	260 m^2
IV-11	1,100 m^2	84 m^2
IV-17	876 m^2	125 m^2
IV-21	916 m^2	270 m^2

(2) If necessary, levelling of the ground at each project site prior to the commencement of the construction work

(3) Removal of existing facilities prior to the commencement of the construction work

The existing school buildings are dilapidated at the following 12 sites, requiring removal for the construction of the planned facilities.

Site No.	Details of Facilities to be Removed
IV-1	Existing school building (brick with galvanized zinc roof)
IV-3	Existing school building (brick with galvanized zinc roof)
IV-5	Existing school building (brick with galvanized zinc roof)
IV-8	Existing school building (brick with galvanized zinc roof)
IV-9	Coastal community centre (brick)
IV-12	Existing school building (brick with galvanized zinc roof)
IV-15	Existing school building (brick with galvanized zinc roof)
IV-16	Existing school building (wooden with galvanized zinc roof)
IV-17	Existing school building (brick with galvanized zinc roof)
IV-18	Existing school building (brick with galvanized zinc roof)
IV-20	Existing school building (brick with galvanized zinc roof)
IV-21	Existing school building (wooden with galvanized zinc roof)

(4) Provision of water quality analysis data on arsenic, taken from areas in the vicinity of each project site, and strict guidance to school staff not to use groundwater for drinking purposes if a higher level of arsenic than the relevant provisional standards in Bangladesh is detected after deep well completion.

(5) Construction of a killa near each project site

(6) Improvement of access road to each site

(7) Allocation of an appropriate number of teachers to run the primary school at each project site after the completion of the Project (IV)

Based on the number of existing teachers and the maximum number of teachers per shift, an increase of one teacher will be required at Site Nos. IV-1, IV-9 and

IV-10 and an increase of two teachers will be required at Site. No. IV-4 for the sound management of teaching staff. The Education Office at the Division, District or Thana level does not have the authority to increase the number of teaching positions. On its part, the PMED places emphasis on qualitative improvement rather than a quantitative increase of teachers, making the appointment of an additional teacher(s) difficult. However, the Thana Education Office can redistribute teachers between schools depending on the actual needs of the schools in the Thana and it is possible to move a surplus teacher(s) from one school to a school with a teacher shortage.

(8) Payment to the commissions to a Japanese bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commissions.

(9) Ensuring prompt unloading and customs clearance at ports of disembarkation in Bangladesh and internal transportation therein of the products purchased for the Project (IV).

(10) 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 under the verified contracts;

(11) According Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into the Bangladesh and stay therein for the performance of their work;

(12) Obtaining the necessary permits for the implementation of the Project (IV)

(13) Maintenance and effective use of the facilities and equipment provided with Japanese grant aid

(14) Payment of all expenses which are not covered by the Japanese grant aid

4.2 Operation and Maintenance Plan

(1) Operation Plan

As the planned cyclone shelter-cum-primary school buildings will be used as government primary schools after their completion, the PMED will ultimately be responsible for these facilities with the DPE of the PMED assuming the practical responsibility.

These cyclone shelter-cum-primary school buildings will be managed by the Deputy Director in Division, and the District and Thana Education Offices to which the DEO and TEO will be assigned. At the Thana level, one ATEO supervises some 15 - 20 schools to ensure the smooth running of primary schools.

Moreover, a primary education committee is established at the Thana level with a view to receiving budgetary requests for maintenance, assisting the management of the primary schools in the Thana and providing a place to solve the financial and educational problems faced by schools.

Each primary school has a school management committee (SMC) which is responsible for the supervision of teachers and the maintenance of school facilities.

The total number of teachers required at the 21 project sites is 83 as shown in Table 3-2-3.

(2) Maintenance Plan

In addition to materials control and quality control during the construction period, regular maintenance after the completion of the cyclone shelters is essential to maintain these structures in good condition over a long period of time. The expected life of the cyclone shelters could be reduced if damage is left unrepaired for too long. Many badly damaged existing cyclone shelters were observed during the field survey, damage probably resulting from the lack of proper maintenance. If these shelters are left unrepaired, they will soon become incapable of fulfilling their declared purpose. The underlying reason for the poor state of maintenance could be a lack of sufficient maintenance funds on the part of the central government or particular local circumstances.

The adoption of a construction method and materials which will not involve an excessive maintenance cost in the future is, therefore, extremely important for the Project (IV). In regard to the maintenance of the planned shelters, minor work

costing as little as some TK5,000 is usually conducted by teachers with a donation from the SMC or within the school budget. Meanwhile, small-scale maintenance work costing up to TK20,000 per school within the budget of the PMED is conducted by the SMC under the supervision of the Thana's technical engineer. Much larger maintenance work costing more than TK20,000 (repair or rebuilding of the school building or the construction of an additional classroom) is conducted by the LGED.

[Maintenance Work]

The types of required maintenance work and the maintenance intervals for the planned facilities are as follows.

- Repainting of exterior walls : every 10 years or less
- Repainting of interior walls : every 10 years or less
- Repair of damaged mortar finish of pillars, beams and walls : as and when discovered
- Inspection of deep well and pump : monthly
- Repair of damaged desks and chairs : as and when discovered

(3) Maintenance Cost

The annual operation and maintenance cost of the planned 21 shelters will consist of the personnel cost, stationary cost and maintenance cost as shown below. Although the maintenance (repair) cost does not arise every year, the average annual figure is estimated here for convenience.

1) Personnel cost
(wages for 83 teachers) ※1 : TK3,280,000 (approx. ¥8,659,000)/year
2) Stationary cost
(chalk, attendance book and others) : TK50,400 (approx. ¥133,000)/year
3) Maintenance cost : TK666,300 (approx. ¥1,759,000)/year
   - Repainting of external walls : TK276,000 (approx. ¥729,000)/year
   - Repainting of internal walls : TK357,500 (approx. ¥944,000)/year
   - Repair of damaged mortar finish of and walls : TK32,800 (approx. ¥86,000)/year

Total : approx. TK3,996,700 (approx. ¥10,551,000)/year

※1 However, TK3,090,000 (approx. ¥8,158,000) accounting for the wages for existing teachers (78) already in their posts, is already secured and therefore does not count for additional costs.

CHAPTER 5

PROJECT EVALUATION AND RECOMMENDATION

CHAPTER 5 PROJECT EVALUATION AND RECOMMENDATION

5.1 Project Effect

In July, 1993, the Government of Bangladesh compiled a master plan calling for the construction of 2,500 new cyclone shelters as an emergency measure to protect people living in the coastal HRA from storm surge caused by cyclones. The Government of Bangladesh has since requested the assistance of donor countries, international aid organizations and NGOs, etc. for the construction of cyclone shelters and the coordination of assistance is currently in progress by Japan and other donors.

The Project (IV) is considered to be a significant international cooperation project, playing an important role in the completion of the Master Plan.

According to the Master Plan, some 3,400 cyclone shelters will be required by the year 2002 to protect the inhabitants of the HRA and approximately 1,840 shelters have so far been constructed or finalised for construction. In regard to the construction of the 2,500 shelters called for by the Master Plan, the construction of some 1,560 shelters is necessary in the coming years. For the three Thanas in the project area, 199 shelters still require construction, including the 21 shelters to be constructed under the Project (IV).

The implementation of the Project (IV) will enable approximately 39,000 people living in the coastal HRA to find safe shelter at times of emergency when there is storm surge due to cyclones. The shelters will also contribute to the promotion of education as they will be used as safe and pleasant primary school buildings for some 7,900 pupils during normal times. Moreover, the new sense of security given by the shelters will facilitate the settlement of people in the target areas.

From an international point of view, the Project (IV) perfectly matches the objectives of the International Decade for Natural Disaster Reduction (IDNDR) and it may well be argued that Japan has an obligation to actively implement the Project (IV) as part of the international community's assistance for the Master Plan.

5.2 Recommendation

As the Project (IV) can be expected to have the major effects described above and as the implementation arrangements on the Bangladesh side are considered to be sufficiently

established, the implementation of the Project (IV) under the grant aid scheme of the Government of Japan is deemed to be viable.

The Project (IV), the fourth of its kind following the three previous phases (40 sites in total), intends the construction of 21 cyclone shelters. Based on the objectives and conclusion of the Project (IV), its necessity and viability are justified and further study is desirable with a view to constructing more cyclone shelters in the future.

The following measures are required in order to ensure the smooth and effective implementation of the Project (IV).

1) Additional Land Acquisition at Target Sites

There is not enough land available for the construction of shelters at Site Nos. IV-1, IV-3, IV-5, IV-6, IV-9, IV-11, IV-17 and IV-21. It is, therefore, essential that the Bangladesh acquires additional land at these sites as soon as possible.

2) Removal of Existing Deteriorated Facilities

As the existing school buildings, etc. are deteriorated and constitute an obstruction to construction work at Site Nos. IV-1, IV-3, IV-5, IV-8, IV-9, IV-12, IV-15, IV-16, IV-17, IV-18, IV-20 and IV-21, the removal of these buildings is required. Moreover, in the period between the removal of the existing school buildings and the completion of the shelters, it will be necessary for the Bangladesh side to secure alternative facilities at different sites for the continuous running of the primary schools.

3) Assignment of Teachers

As the construction of cyclone shelters under the Project (IV) also entails the replacement of existing primary school buildings, the existing number of teachers will be inadequate at some sites vis-a-vis the calculated maximum number of classrooms. In order to ensure the sound management of education, it will be necessary to increase the number of teachers by one teacher at Site Nos. IV-1, IV-9 and IV-10 and by two teachers at Site No. IV-4. Alternatively, it will be necessary for the Bangladesh side to conduct the appropriate reassignment of teachers from nearby schools.

4) Well Water Quality (Arsenic)

An arsenic level in excess of the provisional standards in Bangladesh has been detected at shallow wells located in or around Site Nos. IV-4, IV-13, IV-14, IV-18, IV-20 and IV-21 although such a level has not been detected in the case of deep wells. By the detailed design stage, it will be necessary to obtain further water quality data from other nearby water sources and to establish a proper understanding of the conditions of pollution.

A hand pump will be installed at each facility under the Project (IV) so that water can be obtained from deep wells. If an arsenic level in excess of the above standard are still found following the completion of the said wells, it will be necessary to make it absolutely clear to the schools that well water must not be used for drinking purposes.

5) Improvement of Site Access Roads

At present, the access roads to each site are mainly earth roads which become muddy during the rainy season and cyclone attacks. This makes site access difficult and, therefore, the improvement of access roads is essential.

6) Necessary Procedures

It will be necessary for the Government of Bangladesh to promote the smooth progress of the necessary procedures involving related ministries and agencies to ensure that the Project (IV) is implemented on schedule within the framework of Japan's grant aid system. The PCP responsible for the Project (IV) has already received the authorisation of the ECNEC ensuring that the necessary funding will be secured in the government budget.

Furthermore, in order to ensure that the shelters are effectively utilised following completion, it is hoped that the Bangladesh side will take the following steps.

1) Construction of Killas

The construction of killas together with the new shelters is essential to protect the livestock owned by people who are evacuated to the shelters. It is necessary for the Bangladesh side to construct killas which match the accommodation capacity of each shelter.

2) Strengthening of Operation and Maintenance System

As the new cyclone shelters will normally be used as primary school buildings, the jurisdiction for the 21 shelters will be transferred from the LGED to the PMED. Accordingly, it is essential that the PMED consolidates the existing operation and maintenance system during the construction period in order to firmly establish a system which is capable of handling the new facilities.

The operation and maintenance of the facilities is conducted by means of government budget allocation and contributions made by local inhabitants. However, the government budget is limited. For example, the small-scale operation and maintenance budget is TK2,000,000 for 1998 - 1999. Assuming that TK20,000 is allocated to each school, only 10,000 of the some 60,000 primary schools (one-sixth) receive an allocation. Accordingly, it is necessary for the Bangladesh side to secure a larger operation and maintenance budget and to find a way for the beneficiaries to meet some of the burden via the SMC.

The SMC and teachers are responsible for conducting daily maintenance which has a great impact on the service life of the facilities. The SMC is composed of local leaders and their chiefs are often the providers or land or influential persons. Therefore, in areas where the SMC has a strong interest in education, the good communication with teachers enables any problems to be quickly dealt with and it is easy to obtain the financial support of local inhabitants. Conversely, in areas where the SMC shows little interest in education or where the management capability of the schools is weak, it is difficult to raise local interest in schools and to obtain public support for school maintenance regardless of how passionate the teachers are. Accordingly, in the event of the implementation of the Project (IV), it will be necessary to further strengthen the organization of the bodies responsible for maintenance.

As a way of strengthening the maintenance arrangements, it is believed that that most effective method will be an approach to each school by the Thana Education Committee (members of which include the Thana Engineer and Thana Education Officer) in view of the composition of its members and its relationship with schools. Possible methods to raise the participation awareness of the SMC are the introduction of case studies relating to facility maintenance (case studies of income creation and technical maintenance matters, etc.) and the promotion of ownership by inhabitants through the pooling of a set amount from the maintenance budget (approximately TK10,000 - 20,000) and the provision of funds matching the cost

borne by inhabitants. Moreover, the seeking of the labour of local inhabitants to conduct incidental work (fencing and nearby road repair, etc.) during the implementation stage of the shelter construction work should prove an effective means of encouraging ownership by local inhabitants. Through the strengthening of the SMC, it will not only be possible to improve the facility maintenance and school education but secondary effects will be achieved in that it will be possible to secure autonomous development under future projects by selecting sites where local inhabitants are actively involved in maintenance and school activities. In view of this, it is hoped that the Bangladesh side will take a more positive approach in terms of soft issues.

3) Links with Disaster Prevention NGOs

It is necessary to inform the local Cyclone Preparedness Programme (CPP) units of the shelter construction schedules via the Thana and Union level disaster management committees to establish firm links with the said units from the construction stage and to ensure that the facilities are immediately incorporated into the CPP system following completion.