

Ministry of Education
The Kingdom of Bhutan

OUTLINE DESIGN STUDY REPORT
ON
THE PROJECT FOR
CONSTRUCTION OF EDUCATIONAL FACILITIES
IN
THE KINGDOM OF BHUTAN

March 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

MATSUDA CONSULTANTS INTERNATIONAL CO., LTD.

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PREFACE

In response to a request from the Royal Government of Bhutan, the Government of Japan decided to conduct an outline design study on the Project for Construction of Educational Facilities and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bhutan a study team from August 27 to September 21, 2007.

The team held discussions with the officials concerned of the Government of Bhutan, 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 Bhutan in order to discuss a draft outline design, and as this result, the present report was finalized.

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

I wish to express my sincere appreciation to the officials concerned of the Royal Government of Bhutan for their close cooperation extended to the teams.

March, 2008

Masafumi Kuroki
Vice-President
Japan International Cooperation Agency

March, 2008

Letter of Transmittal

We are pleased to submit to you the outline design study report on the Project for Construction of Educational Facilities in the Kingdom of Bhutan.

This study was conducted by Matsuda Consultants International Co., Ltd., under a contract to JICA, during the period from August, 2007 to March, 2008. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Bhutan and formulated the most appropriate outline design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Tomohiro Osawa

Project manager,
Outline design study team on the Project for
Construction of Educational Facilities
in the Kingdom of Bhutan
Matsuda Consultants International Co., Ltd.

Summary

1. Overview of the Country

The Kingdom of Bhutan is a small inland country located in the eastern part of the Himalayas. It is surrounded by China in the north and India in the south. The national land area is 46500 km² (about 1.1 times as large as the area of Kyushu) and the national population is 672,000 (2005 census, including floating population). Most of the national land is occupied by steep mountainous areas ranging from 160 m to 7,500 m in elevation, and 72.5% of the land is covered with forests. The country is in the tropical monsoon region. While the climate of Bhutan has a rainy season (from June to September) and a dry season (from October to May), weather conditions vary dramatically depending on elevation, and the country is broadly divided into the hot and humid southern region, the temperate and dry valley region, the cold and dry northern region, and the extremely cold Himalayan highlands. Reflecting the diversity in terrains and climate, the country's rich biological diversity is outstanding in the world.

Due to the geographical conditions, the economy of Bhutan has long been regionally self-sufficient centered on agriculture and forestry. In and after the 1960s, government-led socioeconomic development based on Five Year Plans has been realizing rapid economical growth through such measures as the development of power resources utilizing abundant water resources. The annual GDP growth rate in the period from 2001 to 2006 was 7.7% in average, and the per-capita GNI in 2006 was US\$1,410, vastly surpassing the South Asian average of US\$767 (The World Bank). The distribution of GDP among industries is 25% in the primary industries, 38% in the secondary industries, and 37% in the tertiary industries (2005, The World Bank). In addition to the agriculture sector employing about 80% of the workforce population, the electric power sector is a key industry representing 11.4% of GDP and 30% of exportation. In economic relationship with other countries, the connection with India is overwhelmingly strong. The trade with India represents 88% of exportation and 75% of importation (2005, Statistics Bureau). The financial contribution from India is also large. In the fiscal year 2005/06, 25% of the national revenue was supported by the assistance from India.

2. Background and Outline of the Requested Project

With the goal of building a society supporting national happiness, the Government of Bhutan has been promoting unique policies that balance both economic development as well as conservation of environment and traditional culture. In this framework, education is positioned as the most prioritized area holding "the key to the achievement of national goals." The basic education course has been extended to 11 years including middle secondary level (10th grade), and the Government has been making intensive investment in education through successive Five Year Plans, aiming to achieve "full enrolment of basic education by 2012." As a result, school enrolment has been improving year by year, and the gross enrolment rate reached 105.7% for primary education and

87.8% for basic education as a whole in 2007. In particular, the spread of primary education has caused a rapid increase in the number of students entering secondary schools at a rate of over 7% a year, and there is an urgent need for the improvement of the access to secondary education through provision of adequate facilities. In this situation, the Government of Bhutan intends to improve secondary education facilities at 173 schools in the ongoing Ninth Five Year Plan. Regarding the large-scale secondary education facilities for which Bhutan has difficulty in obtaining funds on its own, the Government of Bhutan requested the World Bank to assist in 29 schools and India to assist in 10 schools. Likewise, the Government requested Japan to assist in the improvement of secondary education facilities at 15 schools.

In response to the request, the Government of Japan commissioned Japan International Cooperation Agency (JICA) to conduct the "Preparatory Study on the Project for the Improvement of Social Infrastructure" from January to February 2003 and the "Preparatory Study on the Project for the Construction of Fifteen Schools" from November to December 2003 for the purpose of grasping the present state of the education sector and confirming the appropriateness as a grant aid project. Based on the result of the preparatory studies, the "Basic Design Study on the Project for Construction of Educational Facilities" was conducted from October to November 2004 and the "Basic Design for the Project for Construction of Educational Facilities" was compiled. Although the project was scheduled to implement the improvement of 5 secondary schools in 4 phases and the Phase 1 Project (Chukha Higher Secondary School in Chukha Dzongkhag and Kanglung Middle Secondary School in Tashigang Dzongkhag) in the fiscal year 2005, the tendering for the construction works in the Phase 2 Project ended in a failure in the fiscal year 2006. Because this caused a great difficulty in the scheduling of works, the implementation of the Phase 2 Project was cancelled.

After this circumstance, it was decided that the Phase 2 and later projects should be implemented in the scheme of Grant Aid for Community Empowerment, pursuing cost reduction through the maximal use of local standard specifications and local contractors, and the "Preliminary Study on the Project for Construction of Educational Facilities" was conducted from May to June 2007. The result of this preliminary study showed that there had been no significant changes in the background of request, the situation of education, the demand for facilities, the educational policies of the Government, etc. since the time of the Basic Design Study, and the necessity and appropriateness of the Phase 2 and later projects were reconfirmed. In addition, the study confirmed the feasibility of the project in Grant Aid for Community Empowerment and the possibility of cost reduction in this scheme. In addition to the 3 schools included in the Basic Design, the preliminary study identified 5 more schools as the secondary education facilities requiring urgent need for improvement, and these were added to the request. As a result, the request was made covering the construction of facilities and the provision of furniture at 8 schools in total.

3. Summary of Study Results and Contents of the Project

On the basis of the above request and the result of the preliminary study, the Government of Japan decided to conduct the Outline Design Study, and JICA sent the Outline Design Study Team to Bhutan from August 27 to September 21, 2007. Thereafter, analyses based on the result of field surveys were conducted in Japan. JICA compiled the Outline Design covering 4 middle secondary schools out of the 8 schools in the request, provided explanation of the Draft Outline Design Study Report from December 22 to 28, 2007 in Bhutan, and finalized this Outline Design Study Report.

This Project is implemented using the fund of the Grant Aid for Community Empowerment. It intends to achieve cost reduction and efficiency improvement as compared with Grant Aid for General Project through various means such as the use of local standard specifications and designs and the use of local contractors, materials, and equipment, as well as the promotion of competitive processes. The outline of this Project, determined through the discussion with the recipient side, is as follows.

1) Target Schools and Components

As a result of the analysis of the data collected during site surveys covering all the 8 schools in the request, 5 sites providing secondary education were identified as the schools prioritized for improvement according to the selection criteria, which had been agreed on during discussion. These were the sites presenting no obstacles to the implementation of the Project in terms of vehicle access and the configuration of the premises, and were expected to have sufficient demand for school education. Of these schools, the 4 sites that had been given higher priority by the Bhutanese side were selected as the targets of assistance. Three of these sites were the schools at which improvement had been planned in the discontinued General Grant Aid Project.

With regard to project components, the highest priority was given to classrooms, administration rooms, hostels, and other facilities that are necessary and indispensable for school operation. The scope of assistance is the provision of standard facilities and furniture for secondary schools specified by the Ministry of Education. Considering the situation and usage at existing schools, multi-purpose halls are provided only in boarding schools, where the halls will be used as dining rooms. The size of classrooms and hostels was determined after evaluation of the requested size based on the number of needed rooms calculated from the estimated schooling demand (number of commuting students/number of boarders) at the time of project completion in the catchment area (the area including neighboring gewogs in the case of boarding schools) and the standard number of students in a classroom as specified by the Ministry of Education (36 students in a classroom and 16 students in a hostel room). The size of assistance was limited to the requested size, and if the needed number of rooms was smaller than the requested number, the calculated necessary number of rooms was set to be the size of assistance. As a result, the size of assistance was determined to be 72 classrooms (accommodating 2,592 students) and 8 hostel blocks (accommodating 640 students) in the total of 4 schools. With respect to furniture, this Project provides educational and hostel furniture needed for school operation based on the standard furniture list of the Ministry of Education. Because this Project is implemented in the Grant Aid

for Community Empowerment scheme, the final scope of assistance will be determined in the stage of project implementation. The target schools of assistance, the target components of assistance, and the size of facilities are shown in the following Table.

Target Schools and Contents of Facilities

	School	Dzongkhag	Priority	Educational					Residential						Floor Area m ²	
				4 Classroom block	8 Classroom block	Admi. & Library block	Laboratory block	Toilet block	64-bedded hostel	96-bedded hostel	Kitchen & store block	Warden's/Matron's qtr.	Principal's quarter	Staff quarters		Multi purpose hall
1	Kabjisa MSS	Punakha	1	1	2	1	1	2					1	1		2,769.52
2	Pakshikha MSS	Chukha	1	2	1	1	1	2		4	1	2	1	1	1	6,136.69
3	Phobjikha MSS	Wangdue	2-a	1	2	1	1	2	4		1		1			5,675.01
			2-b									2		1	1	
4	Darla MSS	Chukha	3-a	2	1											1,474.24
			3-b				1									
Total				6	6	3	4	6	4	4	2	4	3	3	2	16,055.46

List of Furniture

Classroom	Desks (2-person) and chairs/stools for students, desks and chairs for teachers, green boards, notice boards
Staff room, meeting room, Principal's office, Vice-principal's office, general office, librarian's office	Office desks and chairs, work station tables and chairs, meeting tables and chairs, wooden racks, green boards
Library	Wooden racks, periodical stands, book trolleys, counter table, reading tables and chairs
Laboratories and preparation rooms	Laboratory tables and chairs/stools, desks and chairs for teachers, green boards, notice boards, wooden racks, laboratory cupboards
Multi-purpose hall	Dining tables (6-person), benches (3-person)
Hostel, Warden/Matron's quarter (sickroom)	Bunk beds, hostel lockers

2) Outline Design of Facilities

Based upon the principle of Grant Aid for Community Empowerment to make the best use of local standard designs and specifications and of local contractors, materials, and equipment, the plans, room configuration and area, and specifications for each facility were determined basically according to the local specifications following the standard designs of the Ministry of Education. However, minimal necessary improvements will be incorporated considering the improvements

made in the General Grant Aid Project (structural framework, plans of some buildings, specifications for openings, etc.) and the problems identified in similar facilities, based on the comparison of different designs from the standpoints of durability, comfort, work efficiency, and cost reduction.

Because all target sites are located on sloped lands in mountainous areas, appropriate site development and construction of exterior facilities are needed for the sake of safety. For this reason, the minimal items of site development works will be conducted in conjunction with the construction of the facility. The site development and building layout plans have been determined so that existing topographical conditions may be utilized as much as possible, aiming at optimization of the balance between earth cutting and filling and minimization of the amount of work.

3) Implementation System

This Project is implemented in the Grant Aid for Community Empowerment scheme. Based on the Agreed Minutes on Procedural Details (A/M) attached to the Exchange of Notes (E/N) between the Government of Japan and the Government of Bhutan, the Government of Bhutan and the procurement management agent will enter into an agent agreement. The two countries will establish the Consultative Committee for the purpose of discussion and coordination regarding the targets of assistance and the contents of the Project. The chair of the Consultative Committee will be the representative from the Government of Bhutan. From the Japanese side, the representative from the Japanese Embassy in India will be a member of the Committee, and the representatives from JICA and the procurement management agent will participate as advisors if necessary. The Committee members from the Bhutanese side will include the representative from the Ministry of Education, which is the responsible and implementing organization for this Project, as well as the representative from National Planning Commission.

The procurement management agent will assign a Japanese engineer in charge of construction in its organization, and conclude contracts with a design and supervision consultant, contractors, and a furniture supplier for the implementation of the Project. On the Bhutanese side, the Secretary of the Ministry of Education and the Department of School Education will take care of the project implementation process in cooperation with the procurement management agent. In addition, the School Planning and Building Division will provide necessary support to the procurement management agent regarding the technical issues related to selection of consultant/contractors and construction.

4. Term of Work and Estimated Project Cost

The term of work needed for the implementation of this Project is about 33.5 months, considering the scale of work and the local construction situation. The period from the signing of E/N to the conclusion of the agent agreement and to the selection of the detailed design and supervision

consultant is planned to be 3.0 months. Thereafter, the process will proceed to detailed design, the preparation of bid documents, and to the selection of contractors. While the overall period of detailed design is planned to be 4.5 months, the site development work at Kabjisa MSS, where construction work will start before other sites, will be started ahead of time as a separate lot for the purpose of shortening the overall term of work. The construction of facilities at the 4 sites will be divided into 7 lots, about 3,000 m² each, and contractors will be selected sequentially according to the order of priority. However, the orders concerning the final lot (Darla MSS) will be placed after the completion of site development and foundation works in preceding lots because of the need for fund adjustment in the later half of the Project. The period needed for placing orders concerning each lot is expected to be 2.5 – 3.0 months. The period needed for the process from site development to facility construction is expected to be 14.5 – 21.5 months.

The estimated project cost needed for this Project is expected to be 1.080 billion yen (1.070 billion yen borne by the Government of Japan and 0.010 billion yen borne by the Government of Bhutan).

5. Verification of the Appropriateness of the Project

The implementation of this Project is expected to have the following direct beneficial effects:

- The 3 target dzongkhags will have additional 2 schools providing lower secondary education and 3 schools providing middle secondary education, with additional classrooms for 2,592 students in total. This will alleviate the shortage of capacity at secondary education facilities in the region, and improve the access to secondary education.
- The 4 target schools will have 72 new classrooms with standard size and environment. The learning environment of 2,128 students, who has been forced to study in inappropriate environment, will be improved.
- In the areas lacking schools with permanent boarding facilities, hostels accommodating 640 students will be constructed at 2 schools. The absolute shortage of boarding facilities at the secondary education level will be alleviated.
- Laboratories and libraries needed for the execution of secondary education curriculums will be constructed at the 4 target schools, making it possible to provide education according to formal curriculums.

In addition, the improvement of the access to education is expected to enhance the enrolment rate at the secondary education level. The provision of appropriate learning and living environment is expected to improve the effectiveness of learning. Furthermore, the improvement of the work environment of teachers through the provision of staff rooms and staff quarters is expected to facilitate the recruiting and deployment of high-quality teachers, leading to the improvement of the quality of education provided.

In addition to these beneficial effects, this Project directly supports the attainment of the goal of

"full enrolment of basic education," which Bhutan is pursuing as the most prioritized issue in education, through the expansion of the capacity of educational facilities. At the same time, this Project will contribute to the improvement of basic living conditions of inhabitants in general. Therefore, it is sufficiently appropriate to implement the Project using the grant aid assistance of Japan.

With respect to the operation and maintenance after the implementation of the Project, the maintenance of the facilities constructed in this Project will not require special skills, and can be managed adequately by the manpower and skills in Bhutan. The cost that will become necessary is estimated to be 2.8 million Nu (about 8.2 million yen), including the increase in personnel expenses for the additional employment of supporting personnel. Because this amount corresponds to about 1.7% of the budget for secondary school operation in target dzongkhags, the country will be able to provide this fund on a permanent basis.

However, the effectiveness of this Project will essentially require that each school will have teachers with appropriate qualifications and capabilities according to the level of education and subjects. For this sake, the Ministry of Education and the target dzongkhags must cooperate to achieve better coordination, and the abilities of existing teachers must be further improved through various measures such as re-training.

The effects of this Project will be greater and more sustainable, if the current efforts to strengthen the operation and maintenance capabilities at the school level are continued using various means, such as the allocation of multi-skilled instructors and the promotion of school improvement through co-curricular activities.

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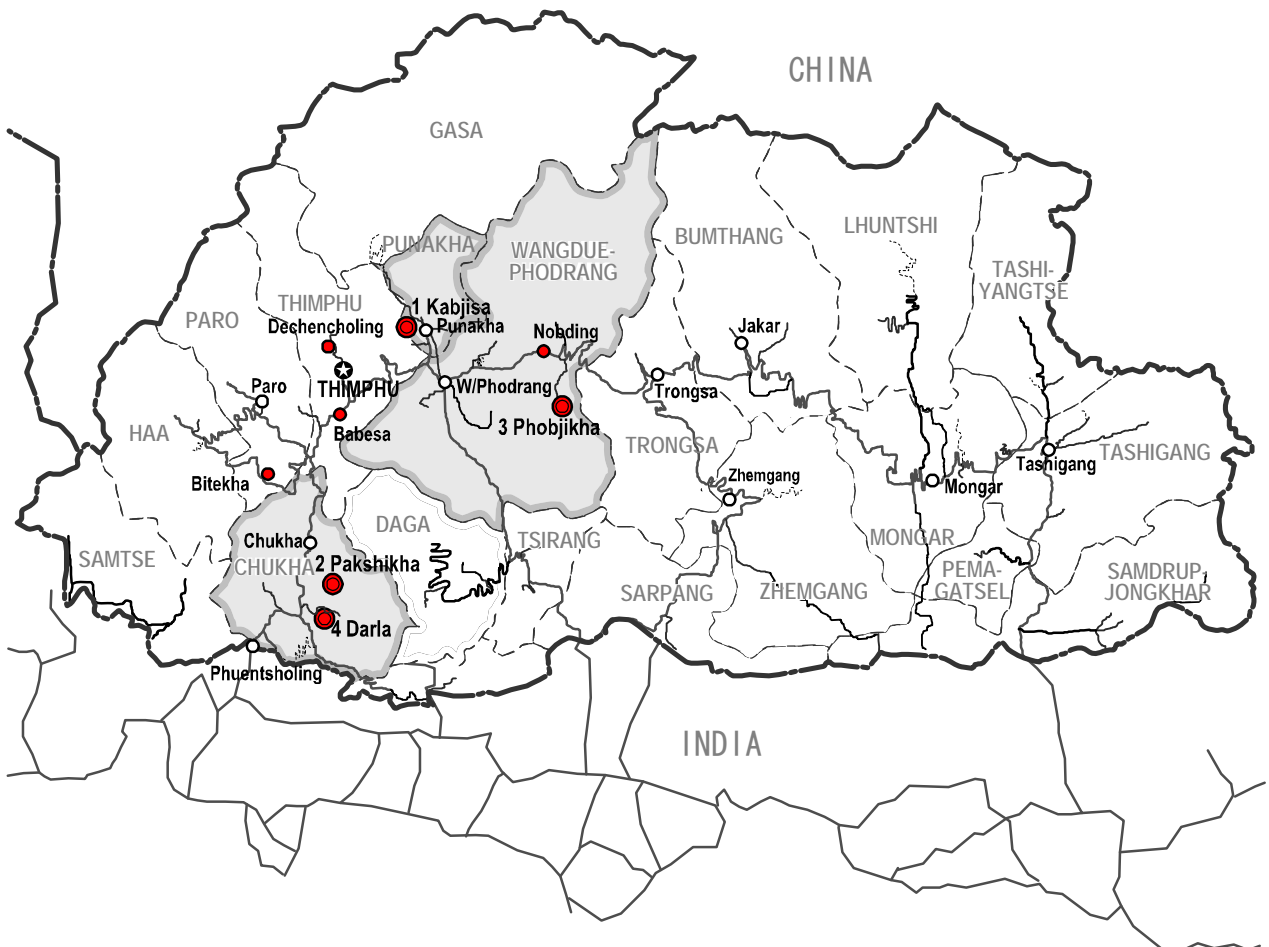
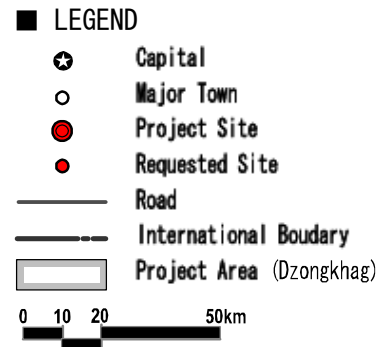
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Perspective



**PROEJCT FOR CONSTRUCTION OF EDUCATIONAL FACILITIES
PAKSHIKHA MSS, CHUKHA DZONGKHAG**

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Abbreviations

ADEO	Assistant Dzongkhag Education Officer
A/M	Agreed Minutes of Procedural Details
B.Ed	Bachelor of Education
BHN	Basic Human Needs
BQ	Bill of Quantities
CDB	Construction Development Board
CIDA	Canadian International Development Agency
CPS	Community Primary School
DANIDA	Danish International Development Assistance
DEO	Dzongkhag Education Officer
DSE	Department of School Education
E/N	Exchange of Notes
GDP	Gross Domestic Product
GNH	Gross National Happiness
GNI	Gross National Income
HSS	Higher Secondary School
ICT	Information and Communication Technology
IS	Indian Standards
JICA	Japan International Cooperation Agency
LGSF	Light Gauge Steel Frame
LPG	Liquefied Petroleum Gas
LSS	Lower Secondary School
M/D	Minutes of Discussions
MSI	Multi Skilled Instructor
MSS	Middle Secondary School
NEI	National Institute of Education
NGO	Non Governmental Organization
PGCE	Post Graduate Certificate in Education
PP	Pre-Primary Class
PPD	Policy and Planning Division
PS	Primary School
PTC	Primary Teacher Certificate
RC	Reinforced Concrete
SDC	Swiss Agency for Development and Cooperation
SDF	School Development Fund
SMB	School Management Board
SPBD	School Planning and Building Division
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
ZTC	Zhungkha Teacher Certificate

Chapter 1. Background of the Project

Chapter 1 Background of the Project

1-1 Background and Outline of the Request

Placing education as one of the most important area of national development, the Government of Bhutan has extended the basic education course to 11 years including middle secondary level (10th grade), and has been making intensive investment in education through successive Five Year Plans, aiming to achieve "full enrolment of basic education by 2012." As a result, school enrolment has been improving year by year, and the gross enrolment rate reached 105.7% for primary education and 87.8% for basic education as a whole in 2007. In particular, the spread of primary education has caused a rapid increase in the number of students entering secondary schools at a rate of over 7% a year, and there is an urgent need for the improvement of the access to secondary education through provision of adequate facilities. In this situation, the Government of Bhutan intends to improve secondary education facilities at 173 schools in the ongoing Ninth Five Year Plan. Regarding the large-scale secondary education facilities for which Bhutan has difficulty in obtaining funds on its own, the Government of Bhutan requested the World Bank to assist in 29 schools and India to assist in 10 schools. Likewise, the Government requested Japan to assist in the improvement of secondary education facilities at 15 schools.

In response to the request from Bhutan, the Government of Japan commissioned Japan International Cooperation Agency (JICA) to conduct the "Preparatory Study on the Project for the Improvement of Social Infrastructure" from January to February 2003 and the "Preparatory Study on the Project for the Construction of Fifteen Schools" from November to December 2003 for the purpose of grasping the present state of the education sector and confirming the appropriateness as a grant aid project. Based on the result of the preparatory studies, the "Basic Design Study on the Project for Construction of Educational Facilities" was conducted from October to November 2004 and the "Basic Design for the Project for Construction of Educational Facilities" was compiled. Although the project was scheduled to implement the improvement of 5 secondary schools in 4 phases and the Phase 1 Project (Chukha Higher Secondary School in Chukha Dzongkhag and Kanglung Middle Secondary School in Tashigang Dzongkhag) in the fiscal year 2005, the tendering for the construction works in the Phase 2 Project ended in a failure in the fiscal year 2006. Because this caused a great difficulty in the scheduling of works, the implementation of the Phase 2 Project was cancelled.

After this circumstance, it was decided that the Phase 2 and later projects should be implemented in the scheme of Grant Aid for Community Empowerment, pursuing cost reduction through the maximal use of local standard specifications and local contractors, and the "Preliminary Study on the Project for Construction of Educational Facilities" was conducted from May to June 2007. The result of this preliminary study showed that there had been no significant changes in the background of request, the situation of education, the demand for facilities, the educational policies of the Government, etc. since the time of the Basic Design Study, and the necessity and appropriateness of the Phase 2 and later projects were reconfirmed. In addition, the study confirmed the feasibility of the project in Grant Aid

for Community Empowerment and the possibility of cost reduction in this scheme. In addition to the 3 schools included in the Basic Design, the preliminary study identified 5 more schools as the secondary education facilities requiring urgent need for improvement, and these were added to the request. As a result, the request was made covering the construction of facilities and the provision of furniture at 8 schools in total. The contents of the request finally confirmed through discussions are as follows.

Table 1-1 Outline of the Request (According to Table 2-2)

Priority · School Name	Dzongkhag	Requested Components
First Priority Group		
1. Kabjisa MSS	Punakha	Construction of classroom block (20 classrooms), administration & library block, laboratory block, toilet block (men/women), Principal's quarter, and staff quarters; provision of furniture
2. Pakshikha MSS	Chukha	Construction of classroom block (16 classrooms), administration & library block, laboratory block, toilet block (men/women), Principal's quarter, staff quarters, hostel (4 blocks for 96 students each), Warden's/Matron's quarter (2 blocks), multi-purpose hall, and kitchen & store; provision of furniture
3. Phobjikha MSS	Wangdue	Construction of classroom block (20 classrooms), administration & library block, laboratory block, toilet block (men/women), Principal's quarter, staff quarters, Warden's/Matron's quarter (2 blocks), hostel 4 blocks for 64 students each), multi-purpose hall, and kitchen & store; provision of furniture
Second Priority Group		
1. Darla MSS	Chukha	Construction of classroom block (24 classrooms), laboratory block, toilet block (men/women), and multi-purpose hall; provision of furniture
2. Bitekha MSS	Paro	Construction of classroom block (12 classrooms), administration & library block, laboratory block, toilet block (men/women), hostel (2 blocks for 64 students each), and Warden's/Matron's quarter (2 blocks); provision of furniture
3. Dechencholing MSS	Thimphu	Construction of laboratory block and multi-purpose hall; provision of furniture
4. Baebssa PS	Thimphu	Construction of classroom block (6 classrooms), administration block, toilet block (men/women), Principal's quarter, and multi-purpose hall; provision of furniture
5. Nobdign LSS	Wangdue	Construction of toilet block (men/women), hostel (for 64 students), Warden's/Matron's quarter, and multi-purpose hall; provision of furniture

1-2 Natural Conditions

(1) Topography and Geology

For the purpose of grasping detailed topographical conditions in the premises to develop the most appropriate design, detailed topographic surveys were conducted in the 5 sites of the prioritized schools. The conditions of the premises in the project sites observed in the surveys were as shown in Table 1-2.

Table 1-2 Results of the Surveys on Site Conditions

Kabjisa MSS (Surveyed area: The area to the northeast of existing buildings)	
Topography	The land after the demolition of existing buildings forms 3 tiers of flat areas, and the level differences have been worked into natural slopes of about 48 degrees. The entire area is sloped at about 16 degrees from NW to SE. The overall level difference is about 50 m. There is a gully at the center.
Present state	Most of the area is grassland with some bush. There are some trees between this area and the existing buildings in the SW part of the area.
Conditions around the site	There are private lands across the paths to the south and north of the site. The eastern end of the site is connected to the access road.
Soil & ground	The prepared ground is stable. Soil is mostly cohesive soil mixed with gravel.
Remarks	Buried water pipes, utility poles, septic tanks, etc. remain in the area.
Pakshikha MSS (Surveyed area: Entire premises)	
Topography	The land has a ridge at the center with an elliptical sloped area. There is an area with relatively gentle slope to the NE across the saddle and the in-premise road. The other parts are steep slopes up to 50 degrees.
Present state	The site is entirely covered with bush, with scattered outcrops of rock (soft rock).
Conditions around the site	The SE end of the site is surrounded by a road, and the area around the site is unused. There is a community public facility below the slope to the north.
Soil & ground	Cohesive soil mixed with sand, containing relatively large rocks in some parts.
Remarks	The road (unpaved) has been constructed as far as the saddle area, routed around the back of the site.
Phobjikha MSS (Surveyed area: Northeastern part of the premises)	
Topography	The entire site is a gentle slope uniformly descending from SW to NW at 9 degrees. There are several shallow furrows where rainwater flows.
Present state	The site is grassland with scattered outcrops of rock.
Conditions around the site	The NW end is lined with a small stream, and is flanked with the access road across the stream. The eastern end is facing with a settlement across wooden fences.
Soil & ground	Cohesive soil mixed with sand, containing a lot of rocks ranging from fist size to 30-40 cm.
Remarks	There is a cistern with buried pipes supplying water to neighboring settlement.
Darla MSS (Surveyed area: The area around existing buildings)	
Topography	The site is sloped downward to the east. The area containing existing buildings is flat land and gentle slopes prepared in terraces. There is a flat swamp area to the south of the school entrance. The area to the north of existing buildings across a small stream is unused land with relatively gentle slope.
Present state	Existing buildings are located on a terraced slope. Unused areas are grassland with few trees.
Conditions around the site	There are private houses and other buildings between the site and the access road to the west. The school premises continue to the east.
Soil & ground	Cohesive soil mixed with gravel. Ground condition is good.
Remarks	There is plenty of spring water. Several streams flow down via the draining ditch in the premises.
Bitekha MSS (Surveyed area: The area to the north of existing buildings and schoolyard)	
Topography	The area is sloped with the level difference of about 25 m and the overall inclination of 16 – 22 degrees. There are cliffs in some places. The NE part contains an area with relatively gentle slope. There are outcrops of rock all over the site.
Present state	Two classroom blocks have been constructed newly behind the main school building. There are few vegetation except for partial coverage with bush.
Conditions around the site	The site is facing with a road to the south and private land to the NE. The area between the site and the private land is the school's vegetable garden.
Soil & ground	Cohesive soil mixed with sand, containing a lot of relatively large rocks.
Remarks	The borderline of the expanded NE area is unclear.

(2) Climate Conditions

Bhutan is located in the tropical monsoon region, and the country has a rainy season (from June to September) and a dry season (from October to May). The climate varies widely depending of altitude and topography. The prioritized schools in this Project are all located in the mountainous areas in the central western part of Bhutan. The 3 schools in Kabjisa, Pakshikha, and Darla are about 1,500 m above sea level, while the schools in Phobjikha and Bitekha are over 2,500 m above sea level. The 2 sites at high altitudes record the minimum temperature below the freezing point in winter and have snowfall several times in a year. In contrast, the other 3 sites have relatively temperate climate; the minimum temperature in winter is about 5°C and the temperature in summer exceeds 25°C. Annual rainfall reaches about 3,000 mm in Darla and Bitekha exposed to the effect of the monsoon from the south. In particular, Darla in the southern part has the record of a monthly rainfall exceeding 1,000 mm. The Ministry of Education has divided the country into tropical and temperate regions, and determined standard specifications corresponding to the weather conditions in each of these regions. The schools in Phobjikha and Bitekha are in the temperate region, and the other schools are in the tropical region.

(3) Natural Disasters

As an instance of natural disaster that caused damage in the project sites, there is a record that strong wind damaged the roofs of some old buildings of Darla and Bitekha schools in the areas affected by the monsoon. Floods and landslides frequently occur in Bhutan, mostly in the rainy season, reflecting the severe topographical conditions in this country. Although there is no record of damage in the project sites, these may often cause disruption of main roads. The impact on construction works is expected to be small, because restoration works are conducted promptly. However, the possibility of such disasters should be taken into consideration in work scheduling. Damage from earthquakes has not been recorded in the areas around the project sites, but the country has experienced earthquakes of magnitude 5 in the past, and the whole country is designated as the area prone to earthquakes. Building regulations require earthquake resistant designs according to the Indian standards.

1-3 Environmental and Social Considerations

1) The Impacts of the Project on Natural and Social Environment

This Project involves the construction of school facilities including site development on the existing school and newly acquired sites. While partial alteration of natural environment in the sites is expected to occur from site development, logging, construction activities, installation of wastewater treatment facilities, etc., this Project will be executed in compliance with environmental and other standards in Bhutan and will consider the following to avoid adverse impacts on environment as much as possible.

- Site development should be limited to the areas needed for the construction of facilities. The

balance between earth cutting and filling should be optimized so that the amount of earth moved out of the sites may be minimized.

- Facility layout should be designed to utilize existing topographical conditions as much as possible. Avoiding the use of retaining walls whenever possible, level differences should be treated using natural slopes with planting to enhance the harmony with surrounding natural environment.
- Rainwater drainage in the sites should be planned using continuous gutters leading to an appropriate discharge destination such as a river so that rainwater would not cause topsoil runoff or land erosion.
- Wastewater should be treated within the sites so that there would be no impacts on the areas outside the sites. Septic tanks should be upgraded to 2 compartment systems to improve the water quality after treatment and to prevent pollution of underground water.
- Facilities should be positioned avoiding existing trees and water veins as much as possible, considering the conservation of natural environment and protection of ecosystems within and around the sites.

Since the construction sites are located in existing school compounds or unused land, this Project will not cause relocation of inhabitants or alteration of living environment of inhabitants in the vicinities, and no negative impacts on the living of local inhabitants are expected. This Project pertains to the construction of school facilities, which basically benefits local inhabitants, and therefore leads to the improvement of social environment in local communities.

Based on the above view, this Project is considered to be "a project with minimal or no adverse impacts on the environment and society."

2) Environmental Impact Assessment and Other Procedures

The laws and regulations of Bhutan define the procedures for environmental assessment. Construction activities require prior procedures as stipulated by the Environmental Assessment Act of 2000 and Regulation for the Environmental Clearance of Projects. In the case of this Project, the application will be submitted to the Environmental Committee of relevant Dzongkhag, whereby the Environmental Clearance will be issued within a maximum of about 2 weeks unless special problems are involved. The Environmental Clearance may be accompanied by incidental conditions. The Project needs to be executed in compliance with these conditions as well as relevant environmental regulations concerning deforestation and waste treatment, etc.

In this Project, Phobjikha MSS will be relocated to a new site for the purpose of habitat protection, because the school is currently located in the midst of a marshland which overlaps with the stopover sites for black-necked cranes, an endangered species. A part of the Phobjikha Valley is designated as a biological corridor, and is controlled under regulations similar to those for a nature preserve. The new site is outside the boundaries of this area, and permission has been granted for the construction of school facilities. The permission requires the conformance to the specifications for fences (not barbed

wire but wood fences or hedges) and the treatment of waste in compliance with regulations. For the other sites, the Bhutanese side needs to go through necessary procedures and obtain permission prior to the execution of the Project.

Chapter 2. Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goals and Project Objectives

With the goal of building a society supporting national happiness, the Government of the Kingdom of Bhutan has been promoting unique policies that balance both economic development as well as conservation of environment and traditional culture. "Bhutan 2020: A Vision for Peace, Prosperity and Happiness" has been the long-term development principle in this endeavor. In this framework, education is declared as "the inalienable right of all Bhutanese," and is positioned as the most prioritized area holding "the key to most of the nation's ambitions." Basic education was extended to middle secondary level (10th grade) in 2000, and "the Education Sector Strategy" was formulated in 2003. In addition to full enrolment in primary education, the Government aims to achieve "full enrolment of basic education by 2012," and has been making intensive investment in education through successive Five Year Plans.

An issue requiring urgent attention in this situation is the improvement of the access to secondary education, which needs to accommodate the rapidly increasing number of students after the extension of basic education, as well as to provide education to children in remote areas. The ongoing 9th Five Year Plan addresses these needs for improvement through the action plans including facility improvement at 173 secondary schools (establishment, expansion, and upgrade from primary schools). The 10th Five Year Plan, currently under development, also assigns high priority to "facility improvement to cope with the increasing demand for school education particularly at the secondary level." Expecting a 32% increase in the number of students in secondary education, the Ministry of Education is developing concrete plans to deal with the projected shortage of educational facilities.

Based on the Government of Bhutan's superordinate plan for full enrolment in basic education, the purpose of the Project is to expand the access to basic education and improve educational environment through the provision of facilities for primary and secondary education at schools requiring urgent actions in the 3 target Dzongkhags.

2-1-2 Outline of the Project

Within the educational facility improvement program promoted by the Government of Bhutan to achieve the above goals, this Project will, according to Bhutan's standards, construct school facilities (classrooms, laboratories, libraries, administration rooms, toilets, principal/staff quarters, and hostels) and provide necessary furniture at 4 secondary schools to be improved under the 9th and 10th Five Year Plans. This Project is expected to expand the capacity of secondary-level educational facilities in the target areas, raising the school attendance rate in basic education as a whole, and providing facilities needed for the implementation of secondary education, leading to the provision of high-quality education.

The schools covered by this Project include the 3 schools for which the facility improvement in a prior Japan's General Grant Aid Project was not implemented due to a unsuccessful tender.

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

This Project will be executed using the funds of Japan's Grant Aid for Community Empowerment. Compared with Japan's Grant Aid for General Project, this scheme aims to achieve substantial cost reduction and efficiency improvement through works based on local specifications and design, as well as the use of local contractors, materials, and equipment, enhancement of competitiveness, etc. The target sites and components are subject to changes according to the result of detailed design.

(1) Basic Concept

The target sites and components of the Project will be selected according to the list of the prioritized schools prepared in the outline design. This list will be prepared based on the priority list regarding requested schools and components submitted by the Bhutanese side, following the analysis of the data from site surveys to confirm the urgency and appropriateness of requests regarding each school, and the verification of the optimal size of facilities covered by the Project. The urgency and appropriateness will be confirmed according to the following criteria for the list of prioritized schools.

Table 2-1 Criteria for the List of Prioritized Schools

<ol style="list-style-type: none">1) Facility improvement of the school is identified as necessary in the national/regional plan and master plan for the school development has been worked out,2) Secondary education is currently provided, or upgrading plan to a secondary school has been authorized,3) Land ownership or proper land use right for school construction is secured with written evidence,4) No other plan exists for current/ongoing facility improvement by the Bhutanese Government, other donors, NGOs, etc.,5) Topographically /environmentally safe and appropriately sized land for construction is secured,6) Access roads for construction vehicles are properly provided, and7) Present and future demand can be quantitatively estimated by a set of data such as numbers of school-aged children within the catchment area.

The size of facilities will be verified according to the following standards. The estimated demand for school education in 2011, the year of the Project completion, will be used for determining the size of necessary facilities.

- Classroom: Assuming full-time operation, the standard capacity will be 36 students per classroom (the standard of the Ministry of Education) .

- Hostel: Assuming the accommodation of secondary level students, hostels are designed so that each room accommodates 16 students (the standard of the Ministry of Education) .
- If the required size is larger than the requested size, the size of the target facilities will be determined within the limit of the requested size.

Basic facilities to satisfy the minimal need for school operation and implementation of secondary education curriculums (classrooms, laboratories, libraries, administration rooms, toilets, and principal's quarters) will be assigned the highest priority as the target facilities. In the case of a boarding school, additional facilities will be provided, assigning priority by site. These are hostels, a kitchen, warden's/matron's quarters, and a multi-purpose hall (used as a dining room). Each facility will be provided with furniture to satisfy the minimal need for the use of the facility, such as desks, chairs, and green boards.

(2) Design Policy on Natural Conditions

1) Response to Weather Conditions

The climate of Bhutan generally has a dry season (from November to June) and a rainy season (from May to October). Weather conditions such as temperature, precipitation, humidity, and wind direction vary greatly depending on the difference in elevation. Accordingly, the Ministry of Education has classified all areas of the country into tropical and temperate zones, and determined standard facility specifications responding to weather conditions in these zones. In this Project, facility plans will be developed based on the standard specifications of the Ministry of Education and the following is taken into account. Hence the facilities will be appropriate to weather conditions in each site.

- In the temperate zone at elevations exceeding 2,500 m, there is snowfall (from several cm to 25 cm) for several days each year, and the lowest temperature in winter dropping below the freezing point. According to the local standard specifications, floors and ceilings should have two-layered constructions to ensure heat insulation and openings should be designed to ensure air tightness. Residential facilities should be planned according to the standard design which considers the use of room heating.
- The target sites in the southern area (Chukha DZ) have an annual rainfall exceeding 2,500 mm. Drainage gutters should be provided and appropriate rainwater treatment should be ensured to avoid earth erosion due to rainwater.
- Although there are no past records of severe earthquake disasters in Bhutan, the whole country is seismic (Zone V according to IS), and the use of earthquake-resistant design is mandatory. The seismic load, calculated from the applicable earthquake resistance standards (IS), slightly exceeds that of the Japanese standards, and this Project will use earthquake-resistant design conforming to the applicable standards.

2) Response to Topographical Conditions

Most of the national land of Bhutan contains mountainous areas with steep slopes. All target sites are located on sloped lands, and construction will require extensive site development and the erection of retaining walls. In this Project, as an indispensable component to ensure building safety, the parts of site development and exterior works that are inseparable from the facility will be conducted in conjunction with the construction of the facility. In planning, the existing topographical conditions should be utilized as much as possible, so that the site development work can be minimized and environmental conservation can be maximized.

(3) Design Policy on Socio-economic Conditions

It is a national policy of Bhutan to protect traditional culture. In architectural design, the Guidelines for Traditional Architecture demand the incorporation of traditional architectural elements defined according to the purpose of buildings. These traditional elements are included in all buildings, serving as an important factor in comprising the landscape in Bhutan. In this Project, basic ornamental elements such as the shape of roofs, eaves ornamentation, style of fixture, ornamental frames, and traditional painting (Bhutanese Paints) will be incorporated according to the standard design of the Ministry of Education, ensuring the facility design rooted in local traditional culture.

(4) Policy on Local Condition on Construction

1) Permission, Building Codes, Etc.

The Bhutan Building Rules and the Building Permit System are enforced in "declared urban areas" governed by city corporations. The Bhutan Building Rules are not applied to local areas, where the target sites of this Project are located, and the only procedures needed before construction are the notification to relevant Dzongkhag administrations. However, the design in this Project will comply with the Bhutan Building Rules regarding the provisions for safety, stair width, and other basic performance of buildings. The earthquake resistance standards, material standards, and other technical standards used widely in Bhutan are those of the Indian Standards (IS) , and this Project will also be conducted in compliance with IS.

2) Construction and Procurement Condition

Except for aggregates, cement, and timber, most of the construction materials and equipment used in Bhutan are made in India. Imported goods used in common local construction can be easily procured through suppliers in the country. Construction materials distributed in the country are controlled under quality certification system of Standards & Quality Control Authority, Ministry of Works and Human Settlements. Basically, only certified products are used in public construction works. On the other hand, special items such as fabricated steels are imported directly from India, and as such require careful management of procurement including quality control and transportation. In this Project, local products or general imported goods will be used as much as possible to ensure stable material procurement.

(5) Policy on Use of Detailed Design and Work Supervision Consultants

In Bhutan, there are multiple offices performing architectural design as the main business, including the consultant firms (7 firms as of 2007) registered at Construction Development Board (CDB) of the Ministry of Works and Human Settlements. A few firms has experience in educational projects by the Ministry of Education, and these firms have the ability to conduct the detailed design of an entire project with the size comparable to this Project. However, these are comparatively small firms employing a dozen or so engineers at the most. Therefore, work supervision needs to be conducted in cooperation with a civil engineering consultant or by a project-wide employment of engineers.

Since this Project is conducted using the local standard design and the number of target sites is small, it is desirable that the entire process from detailed design to work supervision is commissioned to one firm. This will help enhance the consistency and uniformity of design and work supervision, and also improve the efficiency of the selection process conducted by the procurement management agent. Therefore, this Project will count on the commissioning to one firm, while allowing reinforcement from a consortium and other firms.

(6) Policy on Use of Local Contractors

In Bhutan, there are many contractors mainly in the capital Thimphu and in Phuentsholing on the Indian border. The contractors in Bhutan are registered at Construction Development Board (CDB) of the Ministry of Works and Human Settlements with ranks according to the amount of contracts they can accept. The Contractors that can undertake works as large as this Project are limited to A-rank civil engineering and construction companies (45 companies as of July 2007) . More than 90% of the school construction projects commissioned by the Ministry of Education have been executed by A-rank companies. The ability of A-rank companies in quality control and work management, as judged from our observation during site visits of similar projects, is relatively high in this area, and is considered sufficient for use in this Project. However, many companies have limitations to their financial ability and the number of construction machines and engineers. Therefore, works should be commissioned in sufficiently small lot sizes, and the work execution ability of companies should be fully examined during qualification evaluation at the time of tendering.

(7) Policy on Use of Specialized Furniture Suppliers

The procurement of school furniture in Bhutan is conducted using specialized furniture suppliers. Major furniture suppliers are concentrated in Phuentsholing near the Indian border. There are several furniture suppliers equipped with both steel and wood furniture production lines. These major suppliers produce furniture in factories equipped with timber seasoning and steel baking finish facilities, and also deal in the importation of various finished furniture. Judging from production ability and technical level, any of these major suppliers is capable of undertaking procurement of all furniture in this Project. One company should be selected, and production, transportation, and installation should be planned systematically staggering the timing from site to site.

(8) Policy on Operation and Maintenance

Reflecting decentralization, the operation and maintenance of primary and secondary schools in Bhutan are managed by each school under the supervision and guidance of Dzongkhag's Education Office. The deployment of teachers to schools and the allocation of budgets for school operation are also managed at the Dzongkhag level. For secondary schools, the budget for school operation is given to each school, and these schools operate with a certain degree of independence. In the target Dzongkhags, the average operation budget given to each secondary school is 570,000 Nu (approx. 1.66 million yen) . Although 100,000 Nu is expended for utility cost and 200,000 Nu for facility and equipment maintenance from this sum, the fund for the maintenance of existing facilities tends to be insufficient, and many schools make up for this deficit using a part of School Development Fund collected from students. In this Project, construction methods and materials that are common in the country should be used and structures should be designed to be durable and maintained without special techniques, so that the burden borne by each school can be minimized as much as possible.

(9) Policy on Quality Requirements for Facilities and Equipment

The grade of facilities and furniture should be determined according to the grade specified in the standard design of the School Planning and Building Division (SPBD) with additional improvement from the standpoints of earthquake resistance, ease of work, and convenience in maintenance and use. With respect to work quality, large-scale projects executed by high rank contractors have shown a satisfactory level in terms of the accuracy of the work and basic quality of buildings such as the strength of the building framework. The policy of this Project is to ensure the same quality as other large-scale school construction projects executed according to SPBD's standard design. However, for work supervision commonly practiced in Bhutan, most of the supervising work focuses on the assessment of the amount of work done related to payment, making it difficult to allocate sufficient time and personnel to quality control. In this Project, engineers focused mainly on conducting quality control will be sent to construction sites within the framework of work supervision conducted by a local consultant. Only one company will be selected to work as the consultant and a controlling engineer will be assigned to ensure consistent work quality throughout the entire project.

(10) Policy on Construction Period

Although this Project involves only a small number of target sites, the works in each site are large-scale construction and site development of multiple multi-purpose buildings. Breaking down each site project into appropriate work lots and observing the condition of overall fund management, the Project should be planned so that main work lots start as early as possible and that various work lots can progress in parallel. The schedule for each work lot should be developed considering local conditions such as the frequent road closure due to landslides during the rainy season and the temperature drop below the freezing point during the coldest period in some areas.

2-2-2 Basic Plan

Prior to the basic plan for facilities, the list of prioritized schools will be prepared. This list will be prepared considering the requested size and priorities submitted by the Ministry of Education and based on the presumed appropriate size for each site in the request, which are calculated from the data for site conditions, school operation statuses, etc. acquired during our surveys.

The basic plan for facilities will basically comply with the standard design and specifications of the Ministry of Education. However, necessary improvements will be added with respect to structural frameworks and floor plan configuration affecting strength and durability, based on the comparison with the facility plan and specifications used in the previous grant aid project and will avoid unnecessary over-specification.

2-2-2-1 Determination of Proposed Target Schools and the Contents and Size of Assistance

The appropriateness of the requested 8 sites will be examined based on the result of evaluation of: 1) the contents of request (priorities, appropriateness of request, position in superordinate plans) , 2) site conditions (access, land use right, configuration of sites, condition of existing facilities) , and 3) facility demand (number of classrooms and number of hostel rooms required) according to the data acquired during site surveys. At this stage, the schools that do not meet the selection criteria for the list of prioritized schools will be deleted from the list and excluded from the targets of the Project. However, a lack of the documents demonstrating proper land use right will not be the cause of deletion at the stage of outline design, as the final confirmation of the presence of such documents will be taken place at the time of the beginning of detailed design.

(1) Evaluation based on the Contents of Request and Site Conditions

The contents of request and priorities indicated from the Bhutanese side, through discussion, can be organized as shown in the next Table.

Table 2-2 Contents of Request and Priorities

Priority · School Name	Dzongkhag	Contents of the Requested Facilities
First Priority Group		(The notation a-c indicates the priority of each component.)
1. Kabjisa MSS	Punakha	a: Classroom block, Laboratory block, Administration & Library block, Toilet block, Principal's Quarter, Staff Quarters
2. Pakshikha MSS	Chukha	a: Classroom block, Laboratory block, Administration & Library block, Toilet block, Principal's Quarter, Staff Quarters, Hostel, Warden's/Matron's Quarter, Kitchen & Store, Multi-purpose hall
3. Phobjikha MSS	Wangdue	a: Classroom block, Laboratory block, Administration & Library block, Toilet block, Principal's Quarter, Hostel, Kitchen & Store b: Staff Quarters, Warden's/Matron's Quarter, Multi-purpose hall
Second Priority Group		
1. Darla MSS	Chukha	a: Classroom block, Toilet block; b: Laboratory block; c: Multi-purpose hall
2. Bitekha MSS	Paro	a: Classroom block, Administration & Library block, Toilet block; b: Laboratory block, Hostel, Warden's/Matron's Quarter
3. Dechencholing MSS	Thimphu	a: Laboratory block; c: Multi-purpose hall
4. Baebssa PS	Thimphu	a: Classroom block, Administration block, Toilet block; b: Principal's Quarter; c: Multi-purpose hall
5. Nobdign LSS	Wangdue	a: Toilet block; b: Hostel, Warden's/Matron's Quarter; c: Multi-purpose hall

* Although the Bitekha school was listed as an LSS in the request, the site survey has confirmed that it is scheduled for upgrade to MSS in 2008. Therefore, this school is treated as an MSS in this Project.

Of these schools, the following sites do not meet the selection criteria for the list of prioritized schools shown in Table 2-1.

- Nobdign LSS: The document demonstrating land use right has not been confirmed. If this school is to be a target of the Project, final confirmation must be done before the beginning of detailed design.
- Bitekha MSS: The procedures for the transfer of title of the land acquired for the expansion of school compound is in progress. If this school is to be a target, final confirmation must be done before the beginning of detailed design.
- Baebssa PS: Improvement of primary school facilities has been requested. At the time of survey, the upgrade to the secondary level was not confirmed officially. This school is excluded because it does not meet the purpose of this Project.
- Dechencholing MSS: The request included only incidental facilities (laboratory block and multi-purpose hall) . The existing laboratory (1 room) is usable, and other existing facilities are durable and mostly in good conditions. Therefore, the urgency and necessity of improvement are low. This school is excluded considering the purpose of this Project.

(2) Verification of Facility Demand and Size of Assistance

Excluding the 2 schools based on the above evaluation, for the 6 remaining sites, we will gather data and estimate the demand for school education in 2011, when the Project is expected be complete. The

size of facilities (number of classrooms and number of hostel rooms) that need to be newly constructed is then calculated, and the appropriateness of the size of facilities in the request is examined. If the needed size of facilities exceeds the requested size of facilities, the size of the Project will be set according to the requested size of facilities. If it is found to be smaller than the requested size, the size of the Project will be revised based on the result of calculation.

Projection of Demand for School Education

The projected demand for school education in 2011 is calculated using the following 2 methods: 1) the projection of future enrolment based on the current enrolment at the target school and existing schools in the surrounding areas expected to supply potential students, and 2) the projection based on the projected school-age population in the catchment area and the surrounding areas expected to supply potential students. The larger of the results is used in the verification of size.

1) Projection Based on Current Enrolment

- The expected enrolment in 2011 was calculated based on the current enrolment in primary education (average in each grade, 2007) and assuming 100% advancement to secondary education and 1.3% annual increase rate (annual mean population growth at the time of the census).
- The number of boarders (secondary level) was calculated in the same manner based on the current enrolment in primary schools (average in each grade, 2007) in adjacent areas.
- For the newly created Pakshikha MSS, the number of students in the catchment area was assumed to be 200, based on the interview with the Gewog Head (GUP).

2) Projection Based on the School-Age Population in the Catchment Area

- School-age population was estimated based on the census population in the catchment area (2005, gewogs, 5-14 years old), and the expected enrolment in 2011 was calculated assuming the target school attendance rate of 94.2% (excluding 5.8% in monastery education) and 1.3% annual increase rate (annual mean population growth at the time of the census).
- For the number of students in day schooling, population in the catchment area was estimated by proportional division of the total area of the gewog on the assumption that students living within 5 kilometers radius attend school on foot. However, in the case of Kabjisa Gewog, the entire gewog was regarded as the catchment area, because the population is concentrated in the area within a walking distance from school.
- For the number of boarders, the target school-age population in 2007 was calculated, and the current number of boarders in the area (2007) was deducted to determine the school-age population covered by the target schools.

The results of calculation were as shown in Table 2-3.

Table 2-3 Projection of Demand for School Education in the Year or Project Completion (2011)

1) Projection based on current enrolment

School	Dzongkhag	Type	Current Class	Enrolment (2007)				Adjusted enrolment for projection				Projected Enrolment (2011)	
				PS	LS	MS	Total	PS	LS	MS	Total		
Kabjisa MSS	Punakha	Day	PP-8	515	106		621	515	147	147	809	809	852
Pakshikha MSS	Chukha	Boarding	-	New				200	57	57	314	1096	1154
Projected advancement from feeder schools (as boarders)									391	391	782		(823)
	Alaykha CPS		PP-3	107			107		54	54			↑
	Meretsemo CPS		PP-6	98			98		28	28			boarders
	Ketokha CPS		PP-6	86			86		25	25			
	Bongo CPS		PP-6	93			93		27	27			
	Arekha CPS		PP-6	315			315		90	90			
	Baikunza CPS		PP-6	127			127		36	36			
	Sinchula CPS		PP-6	328			328		94	94			
	Getana CPS		PP-6	128			128		37	37			
Pobjikha MSS	Wangdue	Boarding	PP-6	381			381	381	109	109	599	1157	1218
Projected advancement from feeder schools (as boarders)									246	312	558		(588)
	Rameychen CPS		PP-6	192			192		55	55			↑
	Bayta CPS		PP-4	139			139		56	56			boarders
	Athang CPS		PP-6	141			141		40	40			
	Bjena CPS		PP-3	75			75		38	38			
	Khotokha CPS		PP-6	199			199		57	57			
	Nobding LSS		PP-8	231	168		399			66			
Darla MSS	Chukha	Day	PP-10	747	208	171	1126	747	213	213	1173	1173	1235
Bitekha MSS	Paro	Boarding	PP-8	282	104		386	282	81	81	444	625	658
Projected advancement from feeder schools (as boarders)									10	171	181		(191)
	Wanakha LSS		PP-8	286	32		318			82			↑
	Nabesa CPS		PP-5	29			29		10	10			boarders
	Dawakha LSS		PP-8	277	126		403			79			
Nobding LSS	Wangdue	Boarding	PP-8	231	168		399	231	66	66	363	485	511
Projected advancement from feeder schools (as boarders)									122	0	122		(128)
	Dangchu CPS		PP-6	107			107		31				↑
	Rukubji CPS		PP-6	203			203		58				boarders
	Sephu CPS		PP-6	114			114		33				

2) Projection based on school-age population in the catchment area

School	Dzongkhag	Type	Catchment Area (Gewogs)	2005 Census Population				Projected school-age population at 2007 [excluding existing boarders]					Projected enrolment (2011)	
				School-age population				PS	LS	MS	Total	Total		
				5-14	PS	LS	MS							
Kabjisa MSS	Punakha	Day	Kabjisa	627	439	125	125	689	450	128	128	706	706	700
Pakshikha MSS	Chukha	Day	Bongo Rural	273	191	55	55	301	196	56	56	308	1034	1026
Potential students from surrounding areas		Boarder				402	402	804		313	413	726		(720)
			Bongo Rural	1105		221	221	442		227	227	454		↑
			Getena	903		181	181	362		186	186	372		boarders
Existing boarders		Chungkha LSS								-100		-100		
Pobjikha MSS	Wangdue	Day	Phobji	307	215	61	61	337	221	63	63	347	861	854
Potential students from surrounding areas		Boarder				251	251	502		257	257	514		(510)
			Phobji	234		47	47	94		48	48	96		↑
			Athang	195		39	39	78		40	40	80		boarders
			Bjena	434		87	87	174		89	89	178		
			Gangtey	389		78	78	156		80	80	160		
Darla MSS	Chukha	Day	Dala	1129	790	226	226	1242	811	232	232	1275	1275	1265
Bitekha MSS	Paro	Day	Naja	393	275	79	79	433	282	81	81	444	678	673
Potential students from surrounding areas		Boarder				191	191	382		38	196	234		(232)
			Naja	366		73	73	146		75	75	150		↑
			Doga	589		118	118	236		121	121	242		boarders
Existing boarders		Dawakha LSS Wanakha LSS								-126 -32		-126 -32		
Nobding LSS	Wangdue	Day	Dangchu	242	169	48	48	265	242	69	69	380	534	530
Potential students from surrounding areas		Boarder				151	151	302		154	0	154		(153)
			Dangchu	285		57	57	114		58		58		↑
			Sephu	472		94	94	188		96		96		boarders

Calculation of the Size of Necessary Facilities and Planned Facilities

Using the number of students calculated as above, the size of necessary facilities (number of classrooms and number of hostel rooms) is calculated according to the standard of the Ministry of Education (36 students per classroom, hostel room capacity of 16 students) . The capacity of existing facilities that are considered usable is deducted to determine the size of facilities in shortage.

Table 2-4 Calculation of the Size of Planned Facilities

School	Type	2007 Enrolment	Projected enrolment (2011) A		Necessary facilities B		Usable existing facilities C		Shortage of facilities B-C		Requested facilities		Planned facilities	
			Based on school-age population	Based on current enrolment	Class- rooms A/36	Hostel room A/16	Class- rooms A/36	Hostel room A/16	Class- rooms A/36	Hostel room A/16	Class- rooms A/36	Hostel room A/16	Class- rooms A/36	Hostel room A/16
Kabjisa MSS	Day	621	700	852	24		0	0	24	0	20		20	
Pakshikha MSS	Total	0	1026	1154	32	51	0	0	32	51	16	24	16	24
	Day	0	306	331										
	Boarder	0	720	823		51								
Pobjikha MSS	Total	381	854	1218	34	37	0	0	34	37	20	16	20	16
	Day	381	344	630										
	Boarder	0	510	588		37								
Darla MSS	Day	1126	1265	1235	35		20	0	15	0	24		16	0
Bithekha MSS	Total	386	673	658	19	15	14	0	5	15	12	8	4	8
	Day	329	441	467										
	Boarder	57	232	191		15								
Nobding LSS	Total	399	530	511	15	10	6	6	9	4	0	6	-	-
	Day	247	377	383										
	Boarder	152	153	128		10								

From the result of calculation, the 3 schools in the first priority group in the request (Kabjisa, Pakshikha, and Phobjikha) were considered to have sufficient demand justifying the requested size of facilities. The appropriateness of the requested size of facilities was therefore confirmed. On the other hand, the request regarding the 3 schools in the second priority group was in excess of the calculated shortage of facilities. Of these schools, Darla MSS and Bitekha MSS are revised so that the difference from the shortage would be minimized using standard facility components, as follows:

- Darla MSS: While 15 classrooms are needed (24 were requested), 16 are planned.
- Bitekha MSS: While 5 classrooms are needed (12 were requested), 4 are planned.

Nobding LSS is excluded from the targets of the Project, because the recipient side indicated low priority both regarding the site and the main components, and the result of calculation did not demonstrate sufficient demand for school education for full use of the requested facilities (hostel and multi-purpose hall).

(3) List of Prioritized Schools and Table of Planned Facilities

Table 2-5 shows the list of prioritized schools and the table of planned facilities prepared based on the above examination.

Table 2-5 List of Prioritized Schools and Planned Facilities

	School	Dzongkha	Type	Priority	Educational					Residential					Multi purpose hall	Floor Area m ²	Total Floor Area of the Project Schools m ²	
					4-Classroom block	8-Classroom block	Admin. & Library block	Laboratory block	Toilet block	64-bedded hostel	96-bedded hostel	Kitchen & store block	Warden's/matron's quarter	Principal's quarter				Staff quarters
1st priority group	Kabjisa MSS	Punakha	Day Existing	1	1	2	1	1	2					1	1	2,769.52	16,055.46	
	Pakshikha MSS	Chukha	Boarding New	1	2	1	1	1	2		4	1	2	1	1	6,136.69		
	Phobjikha MSS	Wangdue	Boarding Relocation	2-a	1	2	1	1	2	4		1		1		4,315.66		
2-b												2		1	1	1,359.35		
2nd priority group	Darla MSS	Chukha	Day Existing	3-a	2	1										1,010.56		
				3-b				1										463.68
				3-c					2						1			842.13
	Bitekha MSS	Paro	Boarding Existing	4-a	1		1										704.40	
				4-b				1		2			2				1,585.48	
4-c								2								86.26		

The priority of sites and components is assigned as follows:

- The 3 schools in the first priority group in the request were included in the previous Japan's Grant Aid Project, and some procedures and preparatory works for construction have already been executed. The above examination shows that the facility demand is high and the necessity for improvement is great. This school is included in the list of prioritized schools, as indicated by the recipient side.
- Because all 3 schools in the first priority group lack usable existing facilities, the provision of all components is equally prioritized. However, for Phobjikha School, 3rd place in site priority, level a priority is assigned to the components that are necessary for the minimal functioning of the school and level b priority is assigned to other components (multi-purpose hall and staff/warden's/matron's quarters) . Should the fund procurement at the project implementation stage not cover all components assigned with level a priority, the target of the project will be changed to another school.
- For the 2 schools in the second priority group in the request, the school in want of the larger number of classrooms is prioritized. As for facilities, classrooms and administration rooms that are necessary for school operation are prioritized (priority level a) , and incidental facilities (multi-purpose hall in the case of day schools) are assigned priority level c.
- For the second priority group, priority a/b components are prioritized, and priority c components are excluded from assistance as a rule.

(4) Determination of the Scope of Assistance

Since this Project is implemented as Japan's Grant Aid for Community Empowerment, the final

decision on the scope of assistance will be made at the stage of project implementation according to the list of prioritized schools. In this Outline Design, considering the restriction of budget on the Japanese side, the scope of assistance is defined as the priority a/b components at the top 4 schools in the list of prioritized schools (white area in Table 2-5).

2-2-2-2 Local Specifications and Proposed Improvement

Specifications are basically determined according to local specifications in the standard design of the Ministry of Education (conventional construction methods). The improvement proposed in Japan's General Grant Aid Project for the purpose of improving structural strength, durability, and comfort or reducing cost will be considered in comparison with local specifications, and appropriate improvement will be incorporated in this Project.

1) Improvement Concerning Structure

Structural framework:

Local specifications call for stone masonry for foundations and superstructures (reinforced concrete for 1st story floor and floor beams). While maintenance-free and durable, stone masonry has drawbacks of difficulty in numerical analysis of structural strength and poor earthquake resistance. In addition, it requires a long construction period because of poor work efficiency. To minimize these drawbacks, reinforced concrete framework was employed in the General Grant Aid Project. This method is commonly used in Bhutan, and has been incorporated into the standard design of the Ministry of Education for some buildings (multi-purpose hall, 12-classroom block, and MSS laboratory and library block). There are no problems in the design and construction using this method. In this Project, the structural framework will be reinforced concrete, and the following specifications will be employed:

- The RCC roof slab proposed in the General Grant Aid Project will not be used. Instead, a structure with wooden roof trusses supported by RCC beams will be used following the standard local style.
- To improve work efficiency and the convenience, the thickness of columns and beams in the parts attached to walls will be 200 millimeters, and the dimensions of members will be determined so that the shafts are contained within the thickness of walls. This will require the additional columns in the middle of the main span to limit the depth of beam. On the other hand, this makes it possible to use lightweight foundations and foundation beams, enabling the streamlining of the structure as a whole.

Non-bearing Walls:

Walls in concrete framework are generally constructed using stone or brick masonry in Bhutan. Both of these methods require much labor in construction, and bricks, in particular, are imported from India, raising transportation cost and risks in procurement. In contrast, while hollow concrete blocks used in

the General Grant Aid Project are not common in Bhutan, they can be procured from factories in the country and they can save labor. In this Project, 200-millemeter thick hollow concrete blocks conforming to the Indian Standards will be used for walling.

Roof Structure:

Established standard design and construction methods for wooden trusses have no problems in strength under ordinary conditions. Roof structures will be designed following local specifications rather than steel trusses or purlins used in the General Grant Aid Project.

2) Improvement Concerning Comfort and Convenience

Specifications for Openings:

Openings (windows) in the standard design are basically wooden windows that open inward allowing the installation of ornamental frames on the outer face. In contrast, aluminum sliding windows were used in the General Grant Aid Project for the purpose of increasing air-tightness to improve interior environment and effective space use. Aluminum windows are all imported and not commonly used in Bhutan. These need to be installed under the guidance of foreign skilled workers. However, aluminum windows are employed in school building using light-gauge steel frame (LGSF) construction by the Ministry of Education. These are superior to wooden windows in terms of durability and weather resistance, with small cost difference. For these reasons, aluminum sliding windows will be used in this Project. To ensure the area of opening in the standard design, triple windows will be designed to have 3 sliding sashes.

Security Lights:

In the standard design, exterior lighting is provided only in some parts of external corridors and building entrances, and illumination is not sufficient for the use of facilities and maintenance of security after sunset. At least 2 bracket lights will be installed on the outer wall of each building so that night lighting will be available to satisfy the minimal need for security around the building and the passage from building to building.

Ventilation of Toilet Block:

In the standard design, the inner wall of each booth is raised to the ridge level so that they support a rafter roof, and this structure does not provide sufficient ventilation in the booth. In this Project, the roof will be constructed with wooden trusses supported by the RCC beams on the outer wall, keeping a space between the inner wall of each booth left open. This improvement will ensure sufficient ventilation in the building.

3) Other Improvements

Type of Septic Tanks:

The standard design of the Ministry of Education uses 1-compartment septic tanks with separators for scum removal. In the General Grant Aid Project, this was improved to a 2-compartment system

achieving better treatment. Because the buildings in this Project are located on sloped lands, it is desirable to minimize the impact of infiltration of treated water on underground water veins, paying sufficient attention to the protection of downstream environment. As an example of local standards, the standard specifications of Ministry of Works and Human Settlement have defined a 2-compartment standard type. This Project will comply with these standards.

Specifications for Eaves Ceiling:

The standard design of the Ministry of Education specifies eaves ceiling faced with wooden open slats for tropical areas or those faced with slats and equipped with mesh ventilation openings (wooden frames, 800 x 800 mm x 2 places) for temperate areas. In the case of the General Grant Aid Project and LGSF construction, similar ventilation openings are used in the ceiling finished with cement boards. The parts with such ventilation openings are likely to encounter problems due to the deterioration of metal mesh and breakage of frames. If left without repair, such openings may allow the entry of birds and bats into the attic, causing ensuing damage to the major elements of the building. Such cases were observed during our field survey. In this Project, the use of such openings will be avoided, and the ceiling faced with slats according to the standard design will be used in all areas. In tropical areas, the entire surface will be faced with open slats. In temperate areas, slits with a width of about 15 mm will be made only in the parts needed to provide necessary attic ventilation.

2-2-2-3 Layout Plan

Since the target sites of this Project are all located on sloped lands in mountainous areas, site development conforming to building layout occupies a large part of construction work. Thus, we developed a layout plan and a site development plan in the Outline Design Study. The plans were developed according to the following principles.

- Based on the results of detailed topographic surveys, plans should be developed to minimize the amount of earth moving and the quantity of retaining walls, making the best use of existing topographical conditions.
- Site development should be planned to balance the amount of earth cutting and filling, and the movement of surplus soil to outside locations should be avoided as a rule. The surface of filled areas should be utilized effectively as a schoolyard or for other purposes.
- Buildings should be located on the face of cut earth as much as possible to simplify foundation structures and avoid special land-forming work.
- The layout should be divided into educational, residential, and multi-purpose zones and be arranged considering the connections among different functions. The multi-purpose zone should be located in the middle, considering the use from both educational and residential zones, and be provided with automobile access for the transportation of foods and other goods.

- An open space that can be used for morning assembly and various meetings should be provided near the administration block.
- The hostel should be designed so that the boys' and girls' quarters are separated clearly from each other at an appropriate distance with the warden's/matron's quarter located in the middle.

(1) Site Development and Building Layout Plan

The outline of the layout plan for each site based on the above principles is as follows:

- Kabjisa: Utilizing the 3 tiers of flat areas after the demolition of existing buildings, new buildings will be arranged into 3 rows, facing the valley side. The top tier will be the residential zone including principal's/staff quarters. The middle and the lowest tiers will be the educational zone. The slope between the lowest tier and the middle tier will be treated by a combination of retaining walls and natural slopes to reduce the quantity of retaining walls. The lowest tier will be filled with the soil obtained from the earth cutting, so that there will be a flat area that is wide enough for use as the schoolyard and for other purposes.
- Pakshikha: Utilizing the existing road for construction, the upper tier will be used as the residential zone and the lower tier as the educational zone. The multi-purpose hall and the kitchen will be located in the middle. Because most of the sites are on steep slopes and areas suitable for construction are limited, buildings should be located close to each other as possible, separated from one another by minimum space required for the functioning of buildings and execution of construction works. While extensive earth moving will be required, ground levels and the position of retaining walls should be determined carefully to balance the amount of earth cutting and filling. The filled areas should be utilized as the schoolyard and for other purposes.
- Phobjikha: Keeping a certain distance from the existing settlement (assumed to be used as the space for the schoolyard), buildings will be located in the lower half of the school compound. Across a gully at the center, the access side will be the educational zone, and the rear side will be the residential zone. The multi-purpose hall and the kitchen will be located on the top tier near the midpoint between the 2 zones. Because the inclination of the site is mostly 20% or less, level differences will be treated by natural methods and protective planting, avoiding the use of retaining walls.
- Darla: Buildings will be constructed after the demolition of some existing buildings according to the master plan. To maintain the unity with existing facilities, the laboratory block and the 8-classroom block will be located at the places surrounding the schoolyard, and two 4-classroom blocks will be located in the area across the gully to the north of the existing building, which is an area with relatively gentle slope. Although construction of retaining walls will be needed in some parts to preserve land after the demolition of existing classrooms, treatment with natural slopes is possible for the most part.

(2) Exterior Plan

1) Retaining Walls and Slope Treatment

- Retaining Walls: Instead of stone gravity retaining walls specified in local standards, stone leaning-type retaining walls according to the standards of Japan's Ministry of Land, Infrastructure and Transport will be used. Although this method requires a larger footprint area than the gravity method, cost can be reduced with less use of materials. Considering the fact that local workers will execute construction, the thickness of stone masonry will be increased from that in the Japanese standards and concrete back-filling will be used.
- Slope Treatment: So long as there is sufficient space and safety can be ensured, level differences will be treated by natural methods, avoiding the construction of retaining walls as much as possible. The inclination of the face of slopes will be generally 30 degrees or less. Edges will be retained with curbstone and slope planting (at the expense of the Bhutanese side) will be done for surface soil protection.

2) Exterior Facilities

The following exterior facilities are planned. These are the minimal facilities needed for school operation. In addition, it is more effective and efficient to construct these in combination with building facilities. The scope of assistance regarding exterior facilities will be ultimately determined at the time of detailed design according to priority levels.

- Rainwater Drainage (priority level 1) : Rainwater gutters collecting the water from slopes will be constructed at the foot of retaining walls. Combined with gutters around buildings, these will be connected via rainwater gutters to appropriate terminals such as an existing natural drainage.
- On-site Access Roads and Parking Lots (priority level 2) : The plan will include the on-site roads for automobile access that connect from the external access road (constructed by the Bhutanese side) to the educational zone (near administration/library block) and the multi-purpose zone (near kitchen/store block) , as well as parking spaces.
- Passages Connecting Buildings and Footpaths (priority level 2) : Because unpaved passages may become muddy and impassable during the rainy season, the minimal passages from building to building will be planned using gravel or stone paved footpaths and stairs.
- Exterior Lighting and Water Supply Facilities (priority level 3) : For boarding schools, the plan will include exterior lights needed at night and outdoor hand-washing facility.
- Open Space for Meetings (priority level 3) : This is needed as the place for morning assembly and various meetings. The plan will include pavement with cement pavers.

2-2-2-4 Architectural Plan

(1) Floor Plan

The floor plan of each facility will be developed according to the Table 2-6, comparing the standard design of School Planning & Building Division (SPBD) of Ministry of Education and the design used in the Japan's General Grant Aid Project which includes improvement of the standard design. The SPBD standard design specifies 3 types of classroom blocks: 4-classroom, 6-classroom, and 12-classroom blocks. On the other hand, the Japan's General Grant Aid Project used 2 types: 4-classroom and 8-classroom blocks. Considering the contents of request and facility plan for each site, this Project will use 2 types of classroom blocks: 4-classroom and 8-classroom blocks.

Table 2-6 Types of Facility Plan Configuration

Facility	Stories	Reference Plan Type	Reason for Use
4-Classroom block	2 stories	Japan's Grant Aid Type (RC)	The same plan as SPBD standard design (masonry) .
8-Classroom block	2 stories	Modified SPBD standard design (RC 3-storied 12-classroom block)	Japan's Grant Aid Project used a plan of interconnected 4-classroom blocks. Stairs are located only in 1 place for cost reduction.
Administration/library block	2 stories	Japan's Grant Aid Type (RC)	Each is divided into 2 blocks in local standards. Cost reduction through consolidation of buildings.
Laboratory block	2 stories		
Toilet block	1 story	Japan's Grant Aid Type (RC)	The same plan configuration as SPBD standard design (masonry) .
Kitchen/store block	1 story		
Principal's quarter	1 story		
Staff quarters	2 stories		
Warden's/matron's quarter	1 story		
64-bedded hostel	2 stories	New type	A linear plan will be used for adaptation to sloped land and cost reduction.
96-bedded hostel	2 stories		
Multi-purpose hall	2 stories	SPBD standard design (RC)	The same plan (RC) was used in Japan's Grant Aid

The floor plan for each facility will be as follows.

1) Classroom Block (4-classroom and 8-classroom)

Both 4-classroom and 8-classroom blocks will have a plan with an indoor staircase at the center. In the 8-classroom block, the 2 classrooms at the center will be arranged in a staggered configuration, and there will be an outdoor corridor on one side. Compared with a plan of interconnected 4-classroom blocks (Japan's Grant Aid type), the plan with only one entrance will achieve better convenience and security, as well as cost reduction.

- Classroom: The SPBD standards specify the capacity of 36 (standard) to 40 (maximum) students per classroom, the classroom size of about 7 m x 7 m (varying depending on type), and the area of 47.6 – 53.2 m² (center line of wall). These specifications are followed in this Project. Based on a

standard area of 49 m², each classroom will have a square/rectangular plan measuring 7 m x 7 m in a 4-classroom block and 6.8 x 7.2 m in an 8-classroom block.

- Stairs: In the Japan's General Grant Aid Project, the external stairs in local standard design was changed to internal stairs, and the width of staircase was set to 1.5 m, as required by Bhutan's building codes, to minimize the parts exposed to weather conditions and improve durability. These changes also provided better user protection in winter and diminished traditional ornamentation on staircase and external corridors. For these reasons, the same style will be used in this Project.

2) Administration and Library Block

The administration block and the library block, specified as separate blocks in the SPBD standards, will be consolidated into one block for cost reduction. Similar to the classroom block, the plan will have an internal staircase with the width of 1.5 m located at the center, providing entry into each room.

- Administration Section: The 1st floor will have a principal's office, vice-principal's office, general office, meeting room, and staff room, and the ground floor will have staff toilets, kitchenette, and store (for teaching material and stationeries). The principal's and vice-principal's office will have an area of about 15 m², and the general office, which includes a waiting area, will have an area of about 25 m². The staff room and the meeting room will have the size specified in the SPBD standards (6.9 x 7 m x 3 rooms = 145 m²). While the kitchenette is not included in the SPBD standard design, these have been used as intended in the schools completed in the Japan's General Grant Aid Project. Kitchenette is serving essential functions in existing schools.
- Library: The library will have the size specified in the SPBD standards for the library for middle secondary schools (a single-purpose block having an effective area of 155 m²). The library will be divided into the reading area and the storage area, with a librarian's room at the center.

3) Laboratory Block

Because all laboratory blocks in this Project are for MSS, each will have 4 laboratories (physics, chemistry, biology, and computers) according to the curriculum. The functions that are divided into 2 separate blocks in the SPBD standard design will be consolidated into one block for cost reduction. The external staircase will be replaced with an internal staircase with the width of 1.5 m at the center, providing entry into each room. Each laboratory will accommodate a class of 36 students after installation of furniture, using a plan according to the SPBD standards (7.2 m x 10.8 m = 77.8 m²) and be accompanied by a preparation room also serving as instrument store.

- Chemistry and Biology Laboratories: These will be located on the ground floor, because these are equipped with built-in sinks and tables with sinks, which require water supply and drainage.
- Physics Laboratory and Computer Room: These will be located on the 1st floor. The computer room will be equipped with cable pits.

4) Toilet Block

The plan will be the same as that in the SPBD standard design (7 booths + urinals only for males), constructed with reinforced concrete instead of masonry.

5) Kitchen and Store Block

The plan will be the same as that in the SPBD standard design, constructed with reinforced concrete instead of masonry. With the office at the center, the kitchen will be located on one side and the food storage on the other. The food storage will be divided into two areas for dry foods and wet foods.

6) Principal's Quarter

The plan will be the same as that in the SPBD standard design, constructed with reinforced concrete instead of masonry. The residential unit will comprise a 3-bedroom unit, living room, kitchen, WC/shower room, and a veranda. The area of the residential unit will be 96.9 m².

7) Staff Quarters

The plan will be the same as that in the SPBD standard design, constructed with reinforced concrete instead of masonry. The ground floor and the 1st floor will each have 2 residential units facing the staircase at the center. Each residential unit will comprise a 2-bedroom unit, living room, kitchen/store, WC/shower room, and veranda. The area of each residential unit will be 83.3 m²/unit.

8) Warden's/Matron's Quarter

The plan will be the same as that in the SPBD standard design, constructed with reinforced concrete instead of masonry. The residential unit will have a 2-bedroom unit, living room, kitchen, WC/shower room, and veranda. A sickroom accepting sick students (up to 6 students) will be attached to the quarter. The area of the residential unit will be 77.5 m².

9) Hostels (64- and 96-student blocks)

While the SPBD standard design places WC/shower rooms in a separate building, the Japan's General Grant Aid Project improved the design by incorporating these rooms into the hostel building and moved the staircase from exterior to interior –to improve convenience, safety in winter, and living environment–, employing L-shaped (64 students) and square-shaped (96 students) plan configurations. Retaining this improvement, this Project will use a linear configuration with small front-to-back depth, so that the facility can be constructed with minimal site development works on the sloped site.

- Boarding Room: According to the standard design, each boarding room will accommodate 16 students in the size of about 61 m² (7.8 m x 7.8 m, 8.2 m x 7.4 m). The rooms will be arranged in a row, and the rooms in intermediate positions will be set back by 2 m to allow for the provision of an exterior corridor.
- Stairs: An internal staircase with the width of 1.5 m will be located between the boarding rooms and the WC/shower room so that it can work as a buffer against odor and other problems.

- WC/Shower Room: This will be located opposite to boarding rooms across the staircase. The number of booths (toilets and showers) will be identified on 1 booth for 13 to 15 students basis, according to the typical number in the SPBD standard design.
- Study Space: Semi-indoor study spaces will be located above the WC/shower room. In the Japan's General Grant Aid Project, the corresponding spaces are designed as service balconies, which are open spaces with frames, but students are actively using these spaces for reading and other activities. In this Project, these spaces will be equipped with lighting fixtures and simple screens, so that they can be used more effectively at night and when it is raining.

10) Multi-purpose Hall

The SPBD standard design constructed in reinforced concrete will be used. The brick walls specified in the standard design would require importation of bricks and incur large procurement and transportation costs. Therefore, they are changed to walls made of hollow concrete blocks in this Project. The ground floor will comprise of a hall with a stage, toilets and a waiting space, a pantry used for dining, and a store. A gallery will be located on the 1st floor.

Table 2-7 shows the rooms and floor areas in each block.

Table 2-7 Table of Rooms and Floor Areas

Block	Story	Rooms	No.	Floor Area	Remarks
4-CL	G/1F	Classroom	4	196.00m ²	49m ² /CL
		Stairs/Corridor	1	47.60m ²	
	Total Floor Area			243.60m ²	
8-CL	G/1F	Classroom	8	391.68m ²	49m ² /CL
		Stairs/Corridor	1	131.68m ²	
	Total Floor Area			523.36m ²	
Laboratory	G/1F	Laboratory	4	311.04m ²	77.76m ² /R
		Preparation	4	103.68m ²	25.92m ² /R
		Stairs/Corridor	1	48.96m ²	
Total Floor Area			463.68m ²		
Admin. & Library	GF	Library	1	148.32m ²	incl. office
		Stationery Store	1	25.60m ²	
		WC/Kitchenette	3	23.65m ²	
	1F	Principal's office	1	15.68m ²	
		Vice-principal's	1	15.68m ²	
		General office	1	26.25m ²	
		Meeting room	1	25.12m ²	
	G/1F	Staff room	1	115.20m ²	
Stairs/Corridor		1	65.30m ²		
Total Floor Area			460.80m ²		
Multi purpose hall	GF	Entrance	5	87.89m ²	incl. stairs
		Hall	1	302.40m ²	
		Pantry	1	19.44m ²	
		Toilet	3	28.14m ²	
		Store	1	10.98m ²	
		Stage	1	79.68m ²	
		1F	Control room	2	8.28m ²
	Store		1	29.42m ²	
	Gallery		1	189.64m ²	incl. Stairs
	Total Floor Area			755.87m ²	excl porch
Toilet	GF	Toilet	1	43.13m ²	
		Total Floor Area			43.13m ²
Kitchen & Store	GF	Kitchen	1	57.40m ²	
		Food Storage	1	57.40m ²	
		Preparation	1	11.55m ²	
		Office	1	11.55m ²	
Total Floor Area			137.90m ²	excl. porch	
64- Hostel	G/1F	Boarding room	4	243.04m ²	60.76m ² /R
		Study space	1	47.56m ²	
		WC/Shower room	1	47.56m ²	
		Stairs/Corridor	1	106.80m ²	
Total Floor Area			444.96m ²		
96- Hostel	G/1F	Boarding room	6	364.72m ²	60.79m ² /R
		Study space	1	60.68m ²	
		WC/Shower room	1	60.68m ²	
		Stairs/Corridor	1	144.24m ²	
Total Floor Area			630.32m ²		
Principal's Qtr.	GF	3-Bedroom Unit	1	96.86m ²	
		Total Floor Area			96.86m ²
Staff Qtrs.	G/1F	2-Bedroom Unit	4	333.52m ²	83.38m ² /Unit
		Stairs	1	29.68m ²	
	GF	Porch	2	8.40m ²	
Total Floor Area			371.60m ²	excl. balconies	
Warden's Matron's Qtr.	GF	2-Bedroom Unit	1	77.54m ²	
		Sick room	1	38.40m ²	
Total Floor Area			115.94m ²	excl. porch	

(2) Cross-section and Elevation Plan

The cross-section and elevation plan of facilities will basically follow the SPBD standard design. Considering the ceiling height, lighting, ventilation, and other space conditions required for the uses of facilities, as well as cost-effectiveness, the plans are developed as follows.

- **Story Height:** Following the SPBD standard design, the story height of buildings other than the multi-purpose hall and the toilet block will be 3.2 m. Main rooms will have a ceiling height of 3 m or more and a floor-to-beam clearance of 2.6 m or more.
- **Floor Level:** Following the SPBD standard design, the ground floor level will be set at 400 mm from the ground level. This will improve work efficiency, cost-performance, and durability, because excavation works can be limited to the areas of foundations (GL-700) and foundation beams (GL-260), the back-filling beneath concrete floor can be minimized in areas other than the vicinity of foundations, and concrete floor can be placed directly on the filled ground (GL) prepared using cut earth. While the Japan's General Grant Aid Project used a floor level of 500 mm to avoid flooding during local severe rain, the risk of flooding can be addressed sufficiently with appropriate provision of rainwater gutters around buildings.
- **Openings:** The Japan's General Grant Aid Project used ribbon windows in classrooms and laboratories so that larger opening widths would be obtained. However, this Project will use single windows according to the SPBD standard design, because a column is placed at the center of the span for the purpose of rationalizing the structural members. The wooden inward-opening windows in the local standards will be replaced with aluminum sliding windows employed in the General Grant Aid Project, considering the improvement of durability and the effective use of the space in the room. In addition, because the use of traditional architectural elements around openings is mandatory, ornamental frames following the standard design will be added.
- **Roof Shape:** Half-hipped, pitched roofs according to the SPBD standard design will be used. (The toilet block will have a gable roof.) The inclination of the roof will be 1/4. To prevent the entry of wind-driven rain, the standard for eave projection will be 1850 mm from the center of external wall.

(3) Structural Plan

1) Type of Structural Design

- **Structural framework:** This Project will use cast-in-situ reinforced concrete structural frameworks, consisting of columns and beams, which are superior to the standard design (stone masonry) in earthquake resistance and is used commonly in Bhutan. The structural cross-section of main columns and beams will be dimensioned being equal to the thickness of hollow concrete block walls (200 mm). Thus columns and beams would not protrude from the wall surface for simplifying following works and enabling effective use of space.

3) Structural Materials

Structural materials are planned as follows, according to the specifications for materials in the local standards.

- Concrete: Cast-in-situ normal concrete (as per Standard Specifications of Ministry of Works and Human Settlement)
 - Foundations, columns, beams, and other major structural parts: M20 ($F_{c28} = 20 \text{ Mpa}$)
 - Lintels, windowsills, plinths, and unreinforced concrete: M15 ($F_{c28} = 15 \text{ Mpa}$)
- Steel bars: Imported (made in India) or domestic round steel bars, deformed bars (as per IS-1786)
 - M6: $F_e = 250 \text{ MPa}$
 - M8-M20: $F_e = 415 \text{ MPa}$

(4) Building Equipment Plan

Basically following the SPBD standard design, the following equipment will be planned:

1) Electrical Installations

- Main circuits: Assuming low-voltage initial power receiving (incoming capacity 300kW or less), downstream equipment after the leading-in pole will be covered by this Project. From the leading-in pole, the 3-phase 4-wire 440/220V power will be supplied via buried cables to the main switchboard (with integrated individual meters) in each building. The circuits within buildings will be 2-phase 3-wire 220V.
- Lightings and outlets: Depending on the function of each room, lighting fixtures, outlets, and switches according to the SPBD standard design will be provided. For walking at night and security, exterior lighting using bracket type fixtures will be installed outside of buildings.
- Kitchen appliances: Electric cooking appliances will be installed and necessary power sources will be provided.
- Telecommunication facilities: Telephone and other telecommunication facilities will be provided by the Bhutanese side and out of scope for this Project.
- Ceiling fans and ventilation facilities: The rooms for human occupancy in tropical zones will be equipped with ceiling fans. In addition, the food storage in the kitchen/store block, each room in the laboratory block, and the kitchen in the principal's quarter will be equipped with wall-mounted ventilators according to the standard design.

2) Water Supply, Drainage, and Sanitary Equipment

- Water supply and drainage: The WC/shower room and the locations of sinks (kitchen, kitchenette, pantry, laboratories) in each building will be equipped with water supply and drainage facilities.

For the water supply, the connection from the water source to the reservoir tank in the sites will be provided by the Bhutanese side. The installation of the tank and the on-site piping downstream of the tank will be covered by this Project. The method of water supply will be gravitational. In boarding schools, hand-washing stands (outdoor type) according to the SPBD standard design will be installed near the multi-purpose hall, which will be used as dining room.

- Hot water supply: The kitchenette in the administration/library block and the shower rooms in the principal's/staff/warden's/matron's quarters (including sick rooms) will be equipped with geysers (electric water heaters) for local hot water supply.
- Sanitary equipment: Sanitary fixtures will be in accordance with the SPBD standard design. Those for staff and guests will be of the Western style and those in personnel quarters will be of the Western and the Asian style, while others will be of the Asian style. The toilets for students will be equipped so that a water tap at the side of the toilet is operated manually for flushing. Other toilets will be equipped with low tank units.
- Drainage treatment facilities: The wastewater from toilets will be treated in a septic tank installed for each building and the treated water will be disposed of using ground infiltration via an percolation pit. Septic tanks and infiltration systems will be in accordance with the SPBD standard design. The wastewater from showers and sinks will be connected directly to the percolation pit via a separate drainage system. The floor of the kitchen will have floor drainage gutters, which will be connected to the percolation pit via a trap basin.
- Gas facilities: It is assumed that electricity or small LPG cylinders will be used for cooking in the kitchen of each quarter building. The installation of appliances will be conducted by the Bhutanese side. The chemistry laboratory will be equipped with gas (LPG) piping according to the SPBD standard design.

2-2-2-5 Furniture Plan

Basically according to the contents of the Japan's General Grant Aid Project, the furniture for educational and boarding purposes satisfying the minimal need for school operation will be provided in this Project. The furniture for the principal's/staff/warden's/matron's quarters is expected to be supplied by residents, and will not be provided in this Project. The specifications for furniture will be in accordance with the SPBD standard design. The details and quantities of furniture in each facility will be as follows.

1) Classroom Block

- Each classroom assumes a capacity of 36 students, according to the standards of the Ministry of Education. A set of teacher's desk and chair, a green board, a bulletin board, and 18 two-person desks and 36 stools or chairs for students will be provided. The desks and stools for students will

be provided in 4 different types (for PP-II grades, for III-IV grades, for V-VI grades, and for VII-X grades) according to the standard design. The number of each type of classroom furniture will be allocated to each site adjusting with different grade levels which will be determined.

2) Administration and Library Block

- Staff Room: In addition to 24 sets of desks and chairs for teachers, 12 sets of workstation desks and chairs will be provided following the new standard design of the Ministry of Education. Wooden racks (low) for document storage and a green board will also be installed.
- Meeting Room: Conforming to the room capacity, 6 conference tables, 14 chairs, and a green board will be provided.
- Principal's Office, Vice-Principal's Office, General Office, and Librarian's Office: In accordance with the room capacity, sets of desks and chairs, chairs for guests (2 in each room), and wooden racks will be provided.
- Store: 8 wooden racks will be provided in the store.
- Library: Furniture for 36 persons (9 reading tables and 36 chairs), wooden racks (high and low), periodicals stands, a card cabinet, a counter table, and book trolleys will be provided.

3) Laboratory Block

- Physics and Biology Laboratories: A set of green board and bulletin board, a set of teacher desk and chair, 8 laboratory tables (physics/biology), and 36 stools will be provided in each laboratory.
- Chemistry Laboratory: The same furniture as the physics and biology laboratories will be provided, but the laboratory tables will be fixed to the building (included in construction works).
- Computer Room: A set of green board and bulletin board, a set of teacher desk and chair, computer tables for 36 students, and 36 chairs will be provided.
- Preparation Rooms: A set of teacher desk and chair, 2 chairs for guests, 2 laboratory cupboards, and 3 wooden racks will be provided in each preparation room.

4) Multi-purpose Hall

- Expecting the use as dining room, sets of 3-person benches and 6-person tables to accommodate 360 persons will be provided.

5) Hostel

- In accordance with the capacity of each room (16 students), 2-tier bunk beds and 2-tier hostel lockers will be provided.

6) Warden's/Matron's Quarter

- Three 2-tier bunk beds and 2-tier cabinets for use by sick students will be provided in the sick room.

2-2-2-6 Issues Requiring Special Attention in Detailed Design

(1) Confirmation of Soil Conditions

The outline design study did not include the detailed confirmation of soil conditions in each site. Surveys in all sites must be conducted at the beginning of the detailed design. If it is suspected that the bearing capacity of the bearing ground surface in a site may fall short of the specified value (150 kN/m²), the bearing capacity must be confirmed using plate loading test, standard penetration test, or other methods, and the design of foundations must be re-examined.

(2) Coordination with the Works Conducted by the Bhutanese Side

The works to be conducted by the Bhutanese side as the prerequisites for the implementation of this Project (construction of access roads, provision of electricity and water supply to sites, and demolishing and relocation of existing structures) have not been planned in concrete terms at the time of the outline design study. During the site survey at the beginning of the detailed design, sufficient coordination is required through discussion with relevant authorities regarding the following issues, to confirm concrete conditions for detailed design.

- Phobjikha: The location of the connection to the access road, the route for re-routing existing water supply pipes, and the location of electricity receiving point.
- Darla: The scope of demolition of existing buildings and structures, the ground level after demolition, use of existing school buildings during construction work, and the method used for the branching of water supply and electricity.
- Kabjisa and Pakshikha: Location of electricity and water supply receiving points.

(3) Discussion with School Planning & Building Division (SPBD)

The facility design in this Project is developed in conformity with the standard design for school facilities defined by School Planning & Building Division (SPBD) of Ministry of Education. The products of detailed design compiled in this Project are expected to be used for future school construction as a new set of standard design for school facilities using reinforced concrete structure. In the compilation of the detailed design, a deep discussion with SPBD based on the full understanding of the contents of the outline design is needed to determine detail specifications, to prepare drawings, etc. with an eye to expanding their use to other projects.

(4) Ensuring the Unity of Design among Different Components

Since the SPBD standard design for school facilities has been added and revised as needs arose, there are some inconsistencies in the details of design among components. In this Project, some of the facilities are planned using the building types that were employed in the Japan's General Grant Aid Project. It will be necessary to standardize detail specifications and ensure the unity of design as much

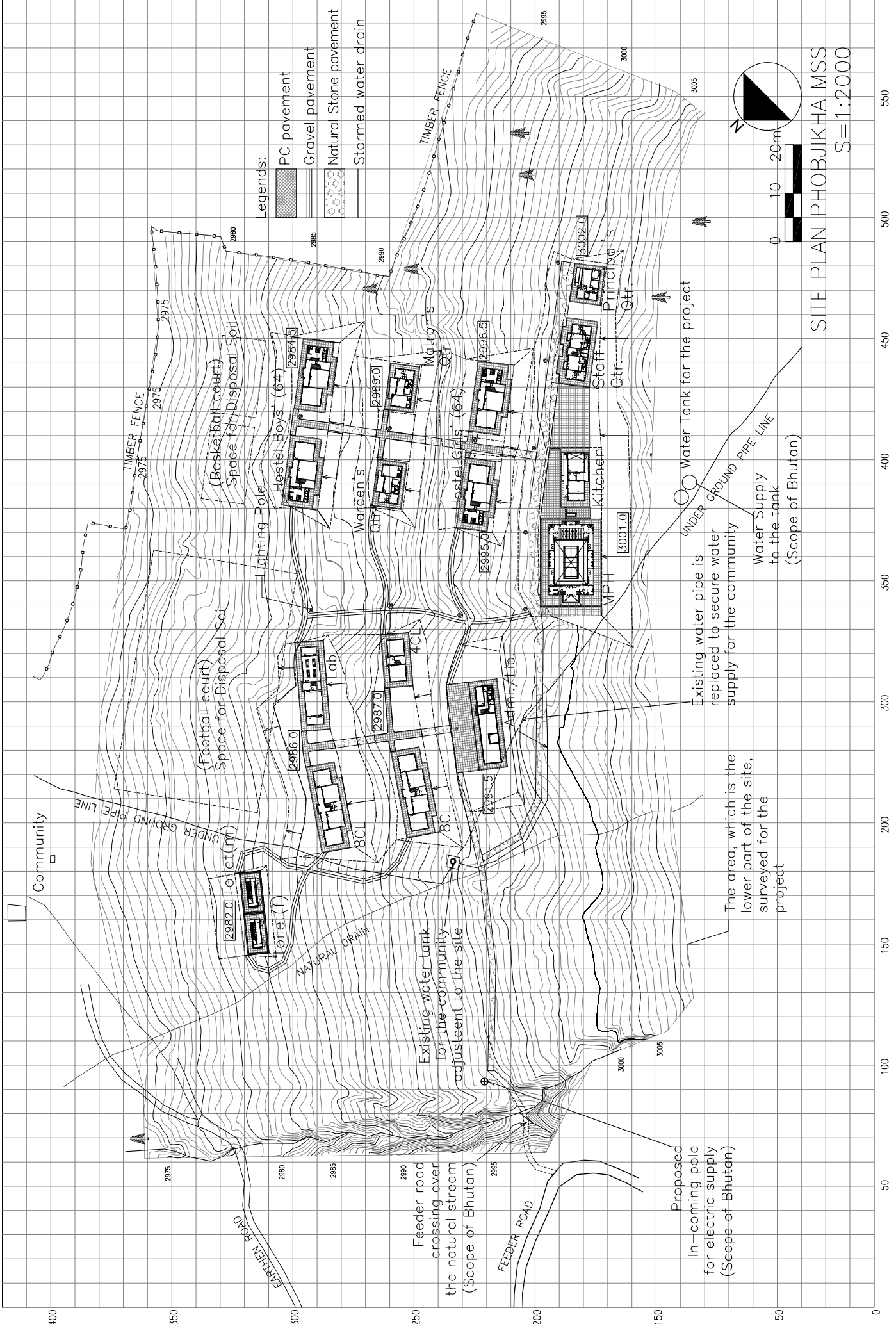
as possible at the time of detailed design. The unification and standardization of detail specifications are important not only for labor saving in designing but also for prevention of confusion at the stage of construction works. Examination at the stage of detailed design will be conducted paying attention to the following.

- Dimension of eave projection: In the current standards, different types of buildings have different dimensions of eave projection. In this project, this will be standardized to 1850 mm.
- Pitch of roof: There are roofs with the pitch ranging from 1/4 to 1/3.5. In this Project, this will be standardized to 1/4 as much as possible.
- Arrangement of ceiling-mounted equipment: Because the style of ceiling differs between the Japan's General Grant Aid Project and the local standard design, there are differences in the arrangement of lighting fixtures and ceiling fans. In this Project, the equipment will be coordinated based on the design in the Japan's General Grant Aid Project, which produces more efficient arrangement.

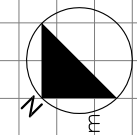
2-2-3 Outline Design Drawings

(1) Layout Plans

- 1) Kabjisa MSS
- 2) Pakshikha MSS
- 3) Phobjikha MSS
- 4) Darla MSS



SITE PLAN PHOBJIKHA MSS
S=1:2000



Existing water pipe is replaced to secure water supply for the community

Water Tank for the project

Water Supply to the tank (Scope of Bhutan)

The area, which is the lower part of the site, surveyed for the project

Existing water tank for the community adjacent to the site

Feeder road crossing over the natural stream (Scope of Bhutan)

Proposed In-coming pole for electric supply (Scope of Bhutan)

Community

Lighting Pole

(Basketball-court) Space for Disposal Soil

(Football-court) Space for Disposal Soil

Hostel Boys (64)

Weiden's Qtr.

Hostel Girls (64)

Matron's Qtr.

MPH

Kitchen

Staff Qtr.

Principals Qtr.

Lab

4C

Adm. / Lib.

Toilet (f)

Toilet (m)

Community

Feeder road crossing over the natural stream (Scope of Bhutan)

Feeder Road

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Water Tank for the project

Water Supply to the tank (Scope of Bhutan)

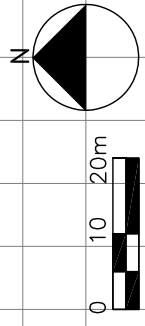
Existing water pipe is replaced to secure water supply for the community

(Football-court) Space for Disposal Soil

(Basketball-court) Space for Disposal Soil



- Legends:
- PC pavement
 - Gravel pavement
 - Natural stone pavement
 - Stormed water drain
 - Existing facilities
 - Existing electric pole



SITE PLAN DALA MSS
S=1:1200