

## List of Tables and Figures

Table 2-1 Average Increase Rate of Enrollments by Education Level .....	2-1
Table 2-2 List of Schools to be Surveyed .....	2-9
Table 2-3 Number of Necessary Classrooms .....	2-15
Table 2-4 List of Project Schools .....	2-17
Table 2-5 Priorities of Requested Components .....	2-18
Table 2-6 Planned Number of Students and Boarders.....	2-19
Table 2-7 List of Project Components for Each Project School.....	2-21
Table 2-8 Specifications to be Adopted and Reasons .....	2-33
Table 2-9 List of Educational Furniture at Each Project School.....	2-36/37
Table 2-10 Project Schools and Classrooms in Each Construction Stage .....	2-57
Table 2-11 Major Quality Control Items during Structural Work.....	2-61
Table 2-12 List of Construction Materials & Educational Equipment .....	2-62
Table 2-13 List of Works to be Done by the Bhutanese Side .....	2-67
Table 2-14 Required Number of Teachers after the Completion of the Project....	2-68
Table 2-15 Proportion of Budgets for Daily Maintenance and Major Repair .....	2-69
Table 2-16 Estimated Electricity Consumption by Each Facility .....	2-73
Table 2-17 Number of Additional Teachers and Staffs.....	2-74
Table 2-18 Additional Annual Operation and Maintenance Cost.....	2-75
Figure 2-1 Organization Chart for Construction Supervision for the Project.....	2-60
Figure 2-2 Construction Schedule .....	2-64

## Abbreviation

BHN	Basic Human Needs
CPS	Community Primary School
DEO	Dzongkhag Education Officer
GNH	Gross National Happiness
HSS	Higher Secondary School
LGSF	Light Gauge Steel Framework
LSS	Lower Secondary School
MOE	Ministry of Education
MPH	Multipurpose Hall
MSS	Middle Secondary School
PPD	Policy and Planning Division
PS	Primary School
SDF	School Development Fund
SMB	School Management Board
SPBD	School Planning and Building Division

## Summary

Since the foundation for the modern country was laid by the first monarch, King Ugyen Wangchuck in 1907, the Kingdom of Bhutan (hereinafter referred to as Bhutan) has been promoting modernization while trying to achieve socio-economic development based on the national development plan prepared every five years since 1961. Under the leadership of the fourth monarch, King Jigme Singye Wangchuck, who acceded to the throne in 1974, Bhutan is currently implementing “the 9<sup>th</sup> Five-Year Plan (2002-2007)”, adopting a slogan of the Gross National Happiness (hereinafter referred to as GNH) so as to realize a balance in national development between material and non-material well-being including such concepts as spiritual, cultural and social needs. In “Bhutan 2020: A Vision for Peace, Prosperity and Happiness” as a long-term national development plan made in 1999, the importance of education for “maximizing the happiness of all Bhutanese and enabling them to achieve their full potential as human beings” is clearly mentioned and “access to basic education” and “improvement in the quality of basic education” are regarded as main areas to be improved.

In Bhutan, although the gross enrolment rate at primary education level has been improved and stands at 84.2% as of 2004, the potential demand for primary schooling still remains high. In addition, since the basic education was extended up to Middle Secondary School (MSS) from Lower Secondary School (LSS) in 2000, the demand for secondary education has rapidly increased. In “the 9<sup>th</sup> Five-Year Plan (2002-2007)”, the improvement of primary and secondary educational facilities is regarded as an important strategy. In “the implementation plan of the 9<sup>th</sup> Five-Year Plan”, it is concretely planned to expand and develop both 135 new and 227 existing Primary Schools (PS) and Community Primary Schools (CPS) and 173 secondary schools. However, while primary educational facilities have been developed through the efforts of the mobilized community, it is difficult for the government of Bhutan only through its own efforts to secure all the necessary budgets and technical experts for constructing secondary educational facilities including several kinds of facility components such as student hostels. Taking this situation into consideration, the government of Bhutan requested the World Bank and the government of India to construct 29 and 10 secondary schools respectively. Also, the government of Bhutan similarly requested the government of Japan to construct 15 secondary schools (including 10 schools which cover both primary and secondary levels).

In response to this request, the government of Japan, through Japan International Cooperation Agency (JICA), dispatched the Preparatory Study Team on “the Project for the Improvement of Social Infrastructure” from January 12, 2003 to February 5, 2003 and the Preparatory Study Team on “the Project for the Construction of Fifteen Schools in the Kingdom of Bhutan” from November 18, 2003 to December 12, 2003 for understanding the situation in the education sector especially at primary and secondary education levels and examining the validity of the Grant Aid cooperation. Following those preparatory studies, JICA dispatched the Basic Design Study Team from October 5, 2004 to November 13, 2004. The Team discussed with representatives of the Ministry of Education as a responsible agency on the contents of the Project as well as conducted a site survey at each of the requested schools so as to obtain necessary documents and information. After the Team came back to Japan, the relevance of the Project, school management and maintenance systems, and effects of the Project were analysed based on the results of the study. Then the Japanese side set the appropriate facility components and the scale of the Project, selected materials, and calculated a rough cost estimate for implementation for the Project. In order to explain those outlines of basic design of the Project to the Bhutanese side, the Draft Report Explanation Team was dispatched from February 22, 2005 to March 3, 2005.

Among the 15 schools requested by the government of Bhutan, 5 schools were selected based on the following criteria agreed between the countries of Bhutan and Japan with considering budgetary restriction of the Japanese side.

1. Highly prioritised by the Bhutanese side.
2. Access roads for the construction vehicles are properly provided.
3. Present and future demand can be quantitatively estimated by a set of data such as the number of school-age children, the rates of population growth, etc.
4. Sufficient teachers, budget allocation, and necessary cooperation from concerned people for the proper operation and maintenance of the facilities are assured.
5. No other program or plan exists for current/ongoing classroom construction by the MOE, local government, other donors, NGOs and so forth.
6. Topographically safe and appropriately sized land for construction is secured.
7. Ownership of land for construction is legally secured. And the demonstrative evidence of land ownership is provided to the Japanese side.

The Project components include ordinary classrooms, laboratories, a library, administrative offices, a multipurpose hall, a kitchen and store, students' hostels, a principal's quarter, staff quarters, warden's and matron's quarters and toilets. They are the minimum necessary as boarding educational facilities required under the unique topographical and social conditions in Bhutan as a mountainous country. The Project facility components for each Project school are shown in Table 1. As for the size of the Project, the calculation of the necessary number of classrooms is based on the projected number of students in 2009 when the Project will be completed. The number of students per classroom is set at 36 persons according to the standard of Bhutan.

Table 1: List of Project Components for Each Project Schools

No	School	Academic						Multi-Purpose		Residential					Total Floor Area (m <sup>2</sup> )
		4 CR Type	8 CR Type	10 CY Type	Administration & Library Blk.	Laboratory Blk.	Toilet	Multipurpose Hall	Kitchen & Store	Hostel (96 Beds)	Hostel (64 Beds)	Principal's Quarter	Staff Quarters	Warden's & Matron's Quarters	
1	Phobjikha MSS	0	0	2	1	1	2	1	1	0	4	1	1	2	5,771.02
3	Kabjisa MSS	1	2	0	1	1	2	0	0	0	0	1	1	0	2,763.45
5	Pakshikha MSS	2	1	0	1	1	2	1	1	4	0	1	1	2	6,133.29
9	Kanglung MSS	1	1	0	0	0	2	0	0	0	0	1	1	0	1,336.40
13	Chukha HSS	2	0	0	1	0	2	1	1	0	4	1	0	1	3,867.62
合計		6	4	2	4	3	10	3	3	4	8	5	4	5	19,871.78

\* MSS = Middle Secondary School、HSS=Higher Secondary School

Table 2 shows the educational furniture necessary for school operation provided by the Project.

Table 2: List of Furniture

Facility	Furniture
Classroom	Students' Desk(Large, Medium, Small), Students' Chair (Large, Medium Small), Teachers' Desk, Teachers' Chair, Blackboard, Bulletin Board
Staff Room, Meeting Room, Principal's Room, Office, Librarian's Room	Teachers' Desk, Teachers' Chair, Wooden Cabinet, Blackboard
Library	Library Desk, Library Chair, Magazine Shelf, Steel Shelf, Wooden Cabinet, Cabinet for Library Cards, Check-Out Desk
Laboratory	Laboratory Desk, Stool, Teachers' Desk, Teachers' Chair, Wooden Cabinet, Blackboard, Bulletin Board
Multipurpose Hall	Table (for 6 persons), Chair (for 3 persons)
Students Hostel	Double Bunk Bed, Cabinet (for 2 persons)
Warden's and Matron's Quarters	Double Bunk Bed

The estimated Project cost is 1,808 million Japanese Yen (1,782.6 million Japanese Yen for the Japanese side work and 25.8 million Japanese Yen for the Bhutanese side). The whole implementation schedule (including the period of Detailed Design work) requires approximately 82 months.

The following effects can be expected upon implementation of the Project.

**【Direct Effects】**

1) Increasing capacity of educational facilities in Bhutan

By constructing 76 classrooms at 5 Project schools, the capacity of educational facilities can be expanded to accommodate an additional 2,736 students in Bhutan<sup>1</sup>. As a result, the severe shortage of educational facilities will be alleviated in the country.

2) Improving the learning and teaching environment in the Project schools that the covered education level will not be changed

By constructing 20 classrooms at 2 existing schools (No.9 Kanglung MSS, No.13 Chukha HSS) in the Project, the total number of usable classrooms will increase from 18 to 38 and the number of students per classroom will be reduced from 158 to 75 students in 2009 when the Project will be completed<sup>2</sup>. As a result of Project

<sup>1</sup> Based on the presumption that the number of students per classroom is 36, it is calculated as 76 classrooms (to be newly constructed in the Project) × 36 students per classroom=2,736.

<sup>2</sup> The number of students per classroom = Expected number of students as of 2009 / the number of usable classrooms

implementation, congestion in the classrooms will be alleviated without using old and dilapidated classrooms, which are regarded as unusable. Thus, a more desirable learning and teaching environment for class operations will be realized at those Project schools.

3) Improving access to schools in the Project schools which will be newly constructed and that the covered education level will be expanded

Through the Project implementation, by expanding the education level from PS or LSS to MSS at existing No.1 Phobjikha MSS and No.3 Kabjisa MSS, access to education of children who have had to go to schools in other Dzongkhag as boarders will be improved. Also, by constructing No.5 Pakshikha MSS (a new school) in an area where there have been no schools so far, access to education for the children living in the surrounding areas who have never attended school including at least 250 primary students and 143 secondary students will be given.

4) Improving the living environment in the Project schools with student hostels

By constructing an appropriate number of student hostels at 3 existing boarding schools (No.1 Phobjikha MSS, No.5 Pakshika MSS and No.13 Chukha HSS) according to the number of classrooms, the absolute shortage of boarding facilities at secondary education level will be alleviated and the living environment for the boarders will be improved. Especially, in No.13 Chukha HSS in which car garages have been used as student hostels for girls, living conditions of girls who are forced to live a life under such a terrible situation will be improved. In addition, being separated from the residence areas in the standard design of the MOE, the toilet facilities of student hostels, in the Project, will be located near the residence areas in the hostels so that it will be possible especially for girls to go to toilets in the night time without going outside and feeling any fear.

#### **【Indirect Effects】**

1) Efficient use of time by shortening the commuting time to school

Through the Project implementation, commuting time to and from school, which has been spent by children out of the residential areas, will be shortened. As a result, time before going to and after coming back from school will be able to be used efficiently for things which have been difficult to find time for such as studying at home and helping parents to do farmwork and/or housework and so on.

## 2) Improving educational standard in Bhutan

Through the Project implementation, the number of schools covering PS level will nationally be increased from 90 to 93, from 77 to 81 at LSS level, from 29 to 34 at MSS level and from 16 to 17 at HSS level. As a result, training and development of human resource in the country will be promoted, which will contribute to realize the “9<sup>th</sup> Five-Year Plan (2002-2007)”.

The Project will help to realize the many benefits mentioned above, and in a broader sense, contribute to the improvement of BHN (Basic Human Needs) of local communities. Thus, the implementation of the Project through the Japanese Grant Aid scheme deemed worthy and meaningful. TO this end, the following issues are expected to be taken up and improved for the realization of the larger benefit.

### 1) Technical support and monitoring of school facility maintenance by the government

In the Project, it is expected that proper school facility maintenance will be regularly and continuously implemented at each Project school. In the site survey; however, it was found that maintenance activities for existing facilities were not properly done in spite of the serious condition of damaged or old facilities and toilet facilities were not kept clean at most of the existing schools. Taking those situations into consideration, in order that both newly constructed and existing facilities are well maintained, it is required to allocate a necessary amount of budgets not only for highly prioritized major repair but also for daily maintenance as well. Furthermore, it is also indispensable that the government officials (especially DEO) periodically visit schools, monitor the maintenance activities, and provide necessary managerial and technical support to the schools.

### 2) Establishment, reorganization and capacity building of the School Management Board (SMB) as a main actor in school management and maintenance

As for the School Management Board (SMB) as a main actor in school management and maintenance, although its formation depends on the size of the school and whether the school is a boarding school or not, it is indispensable to establish the SMB in order to maintain the newly constructed facilities properly. Both establishing the SMB at No.5 Pakshikha MSS (a new school) and reorganization and capacity building of the SMB at No.1 Phobjikha MSS and No.3 Kabjisa MSS in which the education level being covered will be expanded because of the implementation of the Project are required.



### 3) Support for opening new school

In No.5 Pakshikha MSS which will be newly opened in the Project, the preparation activities such as appointment of a new head teacher and other teachers, recruitment of school staff, the above-mentioned establishment of the SMB are expected to be done without delay.

# CONTENTS

Preface	
Letter of Transmittal	
Location Map / Perspective	
List of Figures and Tables	
Abbreviations	
Summary	
<b>Chapter 1 Background of the Project</b>	<b>1-1</b>
<b>Chapter 2 Contents of the Project</b>	
2-1 Basic Concept of the Project	2-1
2-1-1 Overall Goal and Objective of the Project	2-1
2-1-2 Outline of the Project	2-2
2-2 Basic Design of the Project	2-3
2-2-1 Basic Design Policy	2-3
2-2-1-1 Principles of the Project	2-3
2-2-1-2 Policies Regarding Natural Conditions	2-3
2-2-1-3 Policies Regarding Social Conditions	2-4
2-2-1-4 Policies Regarding Construction Conditions	2-5
2-2-1-5 Policies Regarding the Use of Local Contractors and Materials	2-6
2-2-1-6 Policies Regarding Maintenance Capabilities of the Project	
Implementing Agency	2-7
2-2-1-7 Policies Regarding the Grade of Facilities and Equipment	2-7
2-2-1-8 Policies Regarding Construction Schedules	2-7
2-2-2 Basic Plan	2-9
2-2-2-1 Selecting Project Schools, Contents & Size of Project Components	2-9
2-2-2-2 Site and Layout Plan	2-21
2-2-2-3 Architectural Plan	2-23
2-2-2-4 Furniture Plan	2-34
2-2-3 Basic Design Drawing	2-37
2-2-4 Implementation Plan	2-55
2-2-4-1 Implementation Policy	2-55
2-2-4-2 Implementation Conditions	2-56
2-2-4-3 Scope of Works	2-58

2-2-4-4 Consultant Supervision .....	2-59
2-2-4-5 Quality Control Plan .....	2-60
2-2-4-6 Procurement Plan .....	2-61
2-2-4-7 Implementation Schedule .....	2-63
2-3 Obligations of Recipient Country .....	2-65
2-4 Project Operation Plan .....	2-68
2-4-1 Operation Plan .....	2-68
2-4-2 Maintenance Plan .....	2-69
2-5 Project Cost Estimation .....	2-71
2-5-1 Project Cost .....	2-71
2-5-2 Operation and Maintenance Cost .....	2-73
2-5-2-1 Operation Cost .....	2-73
2-5-2-2 Maintenance Cost .....	2-74
2-5-2-3 Total Operation and Maintenance Cost .....	2-75

### **Chapter 3 Project Evaluation and Recommendations**

3-1 Effects of the Project .....	3-1
3-2 Recommendations .....	3-2

### Appendices

1. List of Team Members
2. Study Schedule
3. List of Concerned Parties in the Recipient Country
4. Minutes of Discussions
5. Cost Estimate for the Works Borne by the Bhutanese Side
6. Reference
7. Estimation of the Number of Students in the Requested Schools (2009)

## Chapter 1 Background of the Project

## Chapter 1 Background of the Project

In the Kingdom of Bhutan (hereinafter referred to as Bhutan), although the gross enrolment rate at primary education level has been improved and stands at 84.2% as of 2004, the potential demand for primary schooling still remains high. In addition, since the basic education was extended up to Middle Secondary School (hereinafter referred to as MSS) from Lower Secondary School (hereinafter referred to as LSS) in 2000, the demand for secondary education has rapidly increased. In “the 9<sup>th</sup> Five-Year Plan (2002-2007)”, the improvement of primary and secondary educational facilities is regarded as an important strategy. In “the implementation plan of the 9<sup>th</sup> Five-Year Plan”, it is concretely planned to expand and develop both 135 new and 227 existing Primary Schools (hereinafter referred to as PS) and Community Primary Schools (hereinafter referred to as CPS) and 173 secondary schools. However, while primary educational facilities have been developed through the efforts of the mobilized community, it is difficult for the government of Bhutan only through its own efforts to secure all the necessary budgets and technical experts for constructing secondary educational facilities including several kinds of facility components such as student hostels. Taking this situation into consideration, the government of Bhutan requested the World Bank and the government of India to construct 29 and 10 secondary schools respectively. Also, the government of Bhutan similarly requested the government of Japan to construct 15 secondary schools (including 10 schools which cover both primary and secondary levels).

In response to this request, the government of Japan dispatched the Preparatory Study Team on “the Project for Improvement of Social Infrastructure” from January 12, 2003 to February 5, 2003 and the Preparatory Study Team on “the Project for Construction of Fifteen Schools in the Kingdom of Bhutan” from November 18, 2003 to December 12, 2003 for understanding the situation in the education sector especially at primary and secondary education levels and examining the validity of the Grant Aid cooperation. Following those preparatory studies, the government of Japan dispatched the Basic Design Study Team from October 5, 2004 to November 13, 2004 and the Draft Report Explanation Team from February 22, 2005 to March 3, 2005.

## Chapter 2 Contents of the Project

## Chapter 2 Contents of the Project

### 2-1 Basic Concept of the Project

#### 2-1-1 Overall Goal and Objective of the Project

In Bhutan, there are 292 primary schools (PS and CPS) and 122 secondary schools as of 2004. Under the unique topographic condition that villages are dotted throughout mountainous areas, there are no day schools within walking distance from children's houses and admission to boarding schools is limited because of congestion. Due to this situation, many children are not able to go to school. In reality, it is estimated that there are about 18,000 out-of-school children at primary level and about 7,000-8,000 at LSS and MSS levels respectively<sup>1</sup>. It can be assumed that a cause of such non-enrolment of children is the shortage of educational facilities. The shortage of educational facilities is remarkable especially at secondary level. For example, there are no MSS in 5 districts and no HSS in 7 out of 20 districts.

Since being constructed between the 1960s and the 1980s except those constructed by the World Bank and the Government of India after 1988, most of the existing school facilities in Bhutan are seriously damaged or dilapidated after the long-term use. Besides, inadequate sizes of the classrooms are not complying with the standard design of the country. Thus, major rehabilitation and reconstruction of school facilities are highly required and the improvement of school facilities is in substantial need.

In addition, as for the future demand for educational facilities, although the primary enrolment rate has increased up to 84.2% by 2004, the demand for schooling is still high. Also, the extension of the basic education system from LSS (class 7 and 8) to MSS (class 9 and 10) starting in 2000, the number of secondary enrolments has increased rapidly. (see Table 2-1) It is expected that the enrolments at primary and secondary levels in Bhutan will be increased from now on. Under such a situation, it is urgently required in Bhutan to develop and improve primary and secondary educational facilities to accommodate all enrolments which are expected to increase in the future.

**Table 2-1: Average Increase Rate of Enrolments by Education Level (2000-2004)**

PS	LSS	MSS	HSS
3.8%	5.3%	16.3%	37.5%

Source: General Statistics 2004

---

<sup>1</sup> Calculated based on "General Statistics 2004" and data provided from MOE

In the national development plan, “Bhutan 2020: A Vision for Peace, Prosperity and Happiness” prepared in 1999, full enrolment at lower and middle secondary levels as well as at primary level is expected to be achieved by 2007 and 2012 respectively. Moreover, in “the Education Sector Strategy, Realizing Vision 2020: Policy and Strategy”, two strategies are clearly mentioned: “to provide primary education with expansion of access to children within one hour’s walking distance of their homes” and “to expand secondary education places based on a proper study of the catchment area”. However, there is an acute shortage of existing education facilities especially at secondary education level rather than at primary education level. In addition, due to the large number of potential secondary enrolments in the country being estimated from the current enrolment rates of LSS and MSS level as 76% and 66% respectively, more secondary education facilities to accommodate them will clearly be required. Taking all these situations into consideration, the overall goal of the Project is to improve the basic education environment in Bhutan and the objective of the Project is to improve the basic educational environment and expand access to basic education in Project areas.

## 2-1-2 Outline of the Project

In order to achieve the above-mentioned objectives, in the Project, ordinary classrooms, laboratories, a library, administrative offices, a multipurpose hall, a kitchen and store, students’ hostels, a principal’s quarter, staff quarters, warden’s and matron’s quarters and toilets will be constructed and educational furniture will be provided for each of the 5 schools selected out of the original 15 schools requested by the Government of Bhutan.



## 2-2 Basic Design of the Project

### 2-2-1 Basic Design Policy

#### 2-2-1-1 Principles of the Project

The 5 Project schools have been selected from 15 schools for which the Bhutanese side originally requested aid. They are the most highly prioritized among the requested schools having no obstacles for implementation of construction. Also, the 5 Project schools are deemed to have insufficient classrooms to accommodate all their students when operating under the single shift system at 36 students per classroom. The number of additional classroom needed is calculated based on the projected number of students in 2009.

The facility component for the Project is based on the “minimum necessary” required for school operation: ordinary classrooms, laboratories, a library, administrative offices, a multipurpose hall, a kitchen and store, students’ hostels, a principal’s quarter, staff quarters, warden’s and matron’s quarters and toilets. As furniture, desks, chairs, blackboards, and cupboards are provided for classrooms, and desks, chairs, cabinets for the administrative offices. In addition, beds and cabinets are provided for hostels, and beds for sick rooms in warden’s and matron’s quarters.

#### 2-2-1-2 Policies Regarding Natural Conditions

##### 1) Geographic Features

Bhutan is located in the eastern Himalayan Mountains. Most of the country’s lands are in the mountainous areas with precipitous slopes. Therefore, all the project sites need site development prior to the building construction except for the cases of reconstruction of the existing school buildings. Some project sites require large-scale site development because there are many facilities to be constructed. It is therefore necessary to reduce the total amount of costs for site development, shorten the construction period, and conserve the landscape by reducing fills and cuts as much as possible when planning the layout of facilities on the Master Plan. Also, the scale of each school building should be minimized in order to avoid any inordinate burden on site development.

##### 2) Climate Conditions

In Bhutan buildings on the slope generally face the valley side. Several reasons are given for this, as follows: (1) to command an extensive view; (2) to secure the maximum possible hours of sunlight, which tends to be eclipsed by the surrounding mountains;

and (3) to take wind off the valley into the building as needed. Sufficient natural lighting by appropriate layout and wide opening of the buildings is effective to decrease running costs making it possible to reduce the use of artificial lighting. Also, for the purpose of effective acquisition of heat from daylight during wintertime, the buildings are constructed facing south as much as possible after considering the direction of the slope. With its characteristics of changeable weather and widely fluctuating temperature due to regions and seasons, some project sites are expected to be below zero in wintertime. Consequently the Project provides concrete slab on the top of the building and aluminum sash in order to enhance air tightness and insulation performance without depending on mechanical equipment. Concrete slabs on the top of the buildings should be cast before the rainy season since they improve working efficiency downstairs and contribute to facilitating the construction and reducing the cost by simplifying the steel structure supporting the roof. As for flooring materials, terrazzo is used for the project sites in the tropical regions since it has resistance to termite damage and low cost, while wooden flooring material is adopted at the project sites in the temperate areas considering their cold climates during wintertime.

### 3) Earthquakes

According to the earthquake resistant design code, IS Code, Bhutan belongs to Zone V of earthquake-resistant division. Therefore, seismic designs are also included in the building construction design.

## 2-2-1-3 Policies Regarding Social Conditions

### 1) Traditional Architectural Decoration

It is a longstanding convention to add traditional decoration influenced by Tibetan architecture to all the buildings in Bhutan. The same decoration style is applied to not only religious facilities, government offices and other public buildings but also buildings in town and private residences. It is not easy to decide uses of the building from appearance. Even though it is simplified, traditional decoration is applied to window frames of the buildings by the standard design of the Ministry of Education (hereinafter referred to as MOE). Therefore, the school buildings of the Project include traditional decoration based on the standard design of the MOE in order to respect the Bhutanese traditional culture as well as for the purpose of permit acquisition. However, for the purpose of cost reduction and shortening of the construction period, traditional decoration is applied to only exterior cladding and omitted for the interior. Multi-color painting as exterior decoration is limited to the administrative and Library blocks, and a multipurpose hall. As for other facilities, the exterior is finished in one color.

## 2) Environmental Policy

The government of Bhutan conducts an environment preservation policy based on the Environment Assessment Act. In accordance with this policy, changes in the figure of the land and disruption of the ecosystem such as cutting trees should be minimized when implementing the site development and the construction in the Project.

In Bhutan, cutting trees for timber is controlled to a certain extent and strictly managed after the tendering. Therefore, alternative materials are used in the Project as much as possible in order to minimize the amount of timber.

### 2-2-1-4 Policies Regarding Construction Conditions

#### 1) Transportation

Because of its location in the mountainous area, road conditions in Bhutan are extremely severe. Although most of the highways stretching east to west are already paved, other roads are still narrow and tortuous. Especially in the rainy season from June to September, traffic is often disrupted for several months because of fallen rocks and landslides. The domestic transportation is consequently in an unstable circumstance. Considering the construction work under such difficult transportation conditions, the selection of construction materials and equipment, as well as the construction method, are carefully made in order to procure them near each Project site. In the case that the construction materials and equipment from a distant place, such as near the Indian border, need to be used, raw materials should be transported to a maximum extent. The transportation plan is made after consideration of appropriate procurement timing under the difficult situation in transportation. In addition, the construction materials and equipment should be carried to the Project sites and kept in the storage facilities prepared in advance.

#### 2) Construction in Bhutan

Even though the concrete mixer has a concrete bucket with a lift and a hopper, mixed concrete is generally packed in jute or plastic bags by humans and carried by them to the height of 2<sup>nd</sup> or 3<sup>rd</sup> floor instead of using the lift, and workers cast the concrete by hand. The reason is that a failure-prone lift often disrupts the concrete casting because it requires substantial time to repair. Also, the concrete casting by humans is more effective and flexible because the number of local workers can be increased or reduced when needed. Therefore, humans cast the concrete in the Project.

According to the site survey, most of the local contractors have never implemented a compression test of cast concrete, nor investigated whether the strength of concrete is sufficiently secured. In order to procure high quality concrete for the Project, the local

engineers are posted to the concrete mixer at each Project site, and expected to control the quality under the guidance of the Japanese contractor. Also, compression-testing machines are distributed for each Project site, and a compression test for quality control is implemented using test pieces based on the design specification because unlike in the capital city, Thimphu, there are no public organizations for compression testing of cast concrete in the countryside.

## 2-2-1-5 Policies Regarding the Use of Local Contractors and Materials

### 1) Local Contractors

As previously mentioned, there are many A-class constructors, which have undertaken large-scale school construction works by the MOE in Bhutan. It seems that technical construction capabilities reach a certain level according to the past construction works, and no problems can be foreseen to take charge of the construction under guideline of the Japanese contractor. However, since many buildings are constructed and total floor area is also large at each school site, it is necessary to put several local contractors into one Project site considering the scale of the local contractor and the number of locally held construction machines. This is also an effective way in terms of securing of a labor force, which is relatively difficult in Bhutan. The layout of school buildings in each school site is divided into several zones in which classrooms, hostels, and so forth are centered. Therefore, even if several local contractors participate, construction work is not affected because it is possible to keep enough distance between each construction area. This is also effective way in terms of securing of labor force, which is relatively difficult in Bhutan.

### 2) Locally Available Construction Materials and Equipment

In order to make maintenance easier after the completion of construction, the locally available construction materials and equipment should be procured. While basic construction materials such as aggregate, cement, and timber used for formwork, flooring, fittings, and furniture are produced in Bhutan, reinforcing steel, galvanized iron sheet, glass, paint, and other materials are imported from India. These imported materials are always distributed commercially along with domestic products. Therefore, it is more effective to procure the locally available construction materials and equipment in terms of easy maintenance and cost reduction.

## 2-2-1-6 Policies Regarding Maintenance Capabilities of the Project Implementing Agency

In Bhutan, the budget for school facility maintenance is not sufficient because most of the budget allocated for school facilities from the national budget for education is used for school construction. Although some schools implement maintenance activities with contribution of labor force from the community people, in the site survey it seemed that most of the existing school buildings were found poorly maintained. Therefore, durable and locally available construction materials and equipment shall be used as much as possible in order to avoid any undue future economic burden on the school.

## 2-2-1-7 Policies Regarding the Grade of Facilities and Equipment

The grade of the Project facilities and equipment shall be of minimum quality, and shall be decided by taking the school facilities constructed according to the Standard design by the MOE into consideration in the light of cost reduction, as long as they satisfy the above-mentioned natural and socio-economic conditions. However, it is necessary to keep in mind that trying to alleviate maintenance cost is often in conflict with reduction of the initial construction cost. In general, cheap materials require frequent maintenance activities, and maintenance cost tends to increase. The selection of materials and equipment shall thus be made based on an integrated judgment balancing the need for durability and the desire to reduce cost.

## 2-2-1-8 Policies Regarding Construction Schedules

Because of the precipitous slopes in Bhutan, the expected amount of work and time required for construction in this Project cannot be compared to those in other countries. Especially, construction of temporary roads within the sites, site development, and other related additional works need to be done prior to the school building construction, and they often require much time. These outdoor construction works and mainframe constructions of building should be finished before the long rainy season comes. Besides, it is necessary to consider that work efficiency is generally decreased in the rainy season from June to September and wintertime with temperatures of below zero. Therefore, it is important to set an appropriate timing to start the construction.

In the case that a Japanese contractor undertakes construction, it is expected to take about 14-16 months including the preparation period before construction and 3 months for site development. In Bhutan, it is prerequisite to secure an adequate preparation period because it takes a long time to receive work permit for foreign workers.

Considering the scale of facilities and the geographical relationship between each Project site, it is appropriate that the Project be divided into 4 stages with range to 14-16 months (1 stage on a single-year basis each), in which construction starts in November and is completed in January-March the second year hence.

## 2-2-2 Basic Plan

### 2-2-2-1 Selecting Project Schools, Contents & Size of Project Components

#### (1) Selection Process of Candidate Schools

Based on discussions with the MOE, 2 schools out of the 15 requested schools are changed as below. Each new requested school was selected from the same Dzongkhag (district) of each original requested school. It was explained that both of these schools hold a high priority in terms of school construction.

Dzongkhag (District)	No.	Before Changed	After changed	Reasons
Chukha	5	Dala MSS	Pakshikha MSS	Additional classrooms shall be constructed by self-help since classroom shortage in Dala is extremely serious.
Lhuentse	10	Thimyong MSS	Minjey LSS	No access roads were improved to Thimyong site

Based on the above changes, 15 requested schools were chosen as schools to be surveyed for the Project. Table 2-2 shows the list of those schools.

**Table 2-2: List of Schools to be Surveyed**

No.	School	Dzongkhag (District)	Currently Covered Educational Level	Planned Educational Level	Priority by the Bhutanese Side
1	Phobjikha	Wangdue Podrang	PS	PS, LSS, MSS	1
2	Genekha	Thimphu	PS, LSS	PS, LSS, MSS	2
3	Kabjisa	Punakha	PS, LSS	PS, LSS, MSS	1
4	Bitekha	Paro	PS, LSS	PS, LSS, MSS	2
5	Pakshikha	Chukha	-	PS, LSS, MSS	1
6	Tangsibji	Trongsa	-	LSS, MSS	1
7	Bartsham	Trashigang	PS, LSS	PS, LSS, MSS	2
8	Lango	Paro	PS, LSS	PS, LSS, MSS	1
9	Kanglung	Trashigang	LSS	LSS, MSS	1
10	Minjey	Lhuentse	PS	PS, LSS	2
11	Buli	Zhemgang	PS	PS, LSS, MSS	1
12	Tsirang	Tsirang	-	LSS, MSS, HSS	3
13	Chukha	Chukha	MSS, HSS	MSS, HSS	1
14	Gyelposhing	Mongar	LSS, MSS, HSS	LSS, MSS, HSS	3
15	Autsho	Lhuentse	CPS	PS, LSS, MSS	1

## (2) Selection of Project Schools

In the discussions with the MOE, the priority both on a school basis and a component basis was shown on the chart, which was attached on the Minutes. Considering the priority, Project schools were selected according to the selection criteria outlined below.

### The Selection Criteria for Project Schools

1. Highly prioritised by the Bhutanese side
2. Access roads for the construction vehicles are properly provided.
3. Present and future demand can be quantitatively estimated by a set of data such as the number of school-age children, the rates of population growth, etc.
4. Sufficient teachers, budget allocation, and necessary cooperation from concerned people for the proper operation and maintenance of the facilities are assured.
5. No other program or plan exists for current/ongoing classroom construction by the MOE, local government, other donors, NGOs and so forth.
6. Topographically safe and appropriately sized land for construction is secured.
7. Ownership of land for construction is legally secured, and the demonstrative evidence of land ownership is provided to the Japanese side.
8. School selection considering budgetary restriction of the Japanese side

1. Highly prioritised by the Bhutanese side

9 schools out of 15 requested schools hold 1st priority and were nominated as candidate schools as below:

No.1 Phobjikha MSS, No.3 Kabjisa MSS, No.5 Pakshikha MSS, No.6 Tangsibji MSS, No.8 Lango MSS, No. 9 Kanglung MSS, No.11 Buli MSS, No.13 Chukha HSS, No.15 Autsho MSS

2. Access roads for the construction vehicles are properly provided

In regard to access roads, the following problem was noted in No.11 Buli MSS one of 9 schools with 1<sup>st</sup> priority. The access road to Buli village, to which No.11 Buli MSS belongs, is unpaved road newly constructed in 2003, and it takes 1 hour and 50 minutes (approximately 57 km) from the nearest highway. Besides, there are approximately 100 impassable stretches caused by landslides on the road. According to the community in Buli village, the access road was blocked six times since its opening, and it took around one week for repair each time. In addition, the Project site of No.11 Buli MSS is located on a mountain and is 20 minutes on foot from the village. In order to make it possible to access to the site by car, it is necessary to construct a road after corses around the site are cut for approximately 1.5km. However, no such specific road construction plan has



yet emerged. Based on the above-mentioned situation, No.11 Buli MSS has been excluded from the Project schools because it would be difficult to secure a safe access road to the Project site in such a limited period of time.

3. Present and future demand can be quantitatively estimated by a set of data such as the number of school-age children, or the rates of population growth.

1) Analysis of Demand for the Facilities

In regard to 8 candidate schools, which are selected according to the selection criteria 1 and 2, are analysed as following:

No.1 Phobjikha MSS (Wangdue Podrang)

The existing buildings of existing PS were constructed by the community. The existing site is located in a marsh area surrounded by the Phobjikha valley. Especially in the rainy season, the marshy ground often makes it difficult for school people to enter the school compound. These existing buildings become remarkably old. Moreover, the Project site is expected to move to another place because the site is located in a conservation area for cranes flying from the Himalayas during the wintertime. Considering this situation, the MOE decided upon a new construction site several km from the existing site yet within the same Gewog (sub-district). In this school, the average number of students per classroom is more than 42. As for students in Class VI, 2 sections share one classroom because of a severe classroom shortage. After completion of primary education, students of this school are obliged to go to Nobding LSS or Samtengan LSS as boarding students, though these schools are about 25km and more than 55 km from No.1 Phobjikha MSS respectively. Compared to other Gewog, people in this community have lower income earning and cannot afford to send their children to schools in such remote locations. Therefore, they demand to send their children to a school within the same Gewog until at least Class VIII (LSS). At the present, there are only 1 MSS and 1 HSS in Wangdue Podrang.

No.3 Kabjisa MSS (Punakha)

The existing school was opened as a PS in 1966, and then upgraded to a LSS in 2003. The additional necessary classrooms were established with labor contributed by the community as the number of students increased because the school had no access roads until recently thus preventing sufficient support from the government. However, the existing buildings are remarkably old, and the average number of students per 1 classroom is more than 43 persons. At the present, there is only 1 HSS and no MSS in the Punakha Dzongkhag.

#### No.5 Pakshikha MSS (Chukha)

No.5 Pakshikha MSS was requested as a new school in the Project. There are neither Primary nor Secondary educational facilities in the surrounding Gewog (seven villages centered on Pakshikha village). Therefore, there is significant number of out-of-school children and dropout children from Gedu MSS (approximately 35 students every year). Even though 1 CPS is under construction within commuting distance of three villages out of seven at the present, other villages have no PS within walking distance. Secondary educational facilities are also much in demand in the whole region including 2 villages on the further side of the river. Educational facilities with hostels are especially required because colonies are scattered all over the Gewog. Although Chukha has the second-highest population of school-age children, the school enrollment rate is 85% for PS level, 65% for LSS level, and 54% for MSS level respectively, all of which are below the national average (91% for PS level, 76% for LSS level, and 65% for MSS level respectively). These low figures are considered linked to the acute shortage of secondary educational facilities.

#### No.6 Tangsibji MSS (Trongsa)

No.6 Tangsibji MSS was requested as a new school in the Project. Since there were no secondary educational facilities in the surrounding region, Tshangkha PS established in 1993 was temporarily upgraded to LSS status in 2000. However, Tshangkha PS hopes to abolish secondary education and just focus on primary education after the secondary educational facilities with a laboratory and so forth are constructed within the Gewog because the school was not originally constructed as a secondary school. In Trongsa Dzongkhag, there are 3 LSS including Tshangkha LSS and 2 MSS. Secondary educational facilities are in especially great demand. As for secondary education, students from the whole Dzongkhag are to be accepted.

#### No.8 Lango MSS (Paro)

The existing school was opened as a PS in 1983, and then upgraded to a LSS status in 2000. As the surrounding region is near the center of town, the number of school-age children significantly increased, and the average number of students per 1 classroom is more than 50 persons in some classes. Also, the existing classrooms are so old that only 6 classrooms out of total 19 classrooms are available for use. There are no MSS or HSS in the surrounding Gewog, so that after completion of LSS, students commute to Drukgyel HSS approximately 5-6 km from the existing school. Besides, there are only 2 MSS and 1 HSS in the Paro Dzongkhag. Therefore, secondary educational facilities including MSS are much in demand not only within the Gewog but also in the whole

Dzongkhag. Considering the above-mentioned situation, it is prerequisite to mitigate overcrowded classrooms especially at the MSS level and contribute to enrolling more students at HSS level in Drukgyel HSS which is the only school providing higher secondary education in Paro Dzongkhag by upgrading Lango LSS to MSS.

#### No.9 Kanglung MSS (Trashigang)

Since there are no secondary educational facilities in the surrounding Gewog, Kanglung CPS, established in 1974, was temporarily upgraded to a LSS in 1999. This school will be upgraded to MSS status in 2005, but only LSS will be separated and moved to other site. Besides, separated LSS will be re-designated as PS. Although a part of the construction work has already been implemented, expansion of the facilities is required because not all the components are equipped due to insufficiency of funds. Additional construction is expected to contribute not only to mitigating long-distance commuting to other schools such as Yonphula LSS approximately 10 km from the existing school due to overcrowding in Kanglung LSS, but also to expansion of access to education at the LSS level for students in other Gewog. Besides, since there are only 3 MSS in Trashigang Dzongkhag in spite of the fact that the population of school-age children is the highest in the country, secondary educational facilities are highly in demand.

#### No.13 Chukha HSS (Chukha)

The existing school was established in 1978 as a MSS, and then upgraded to a HSS in 1998. There are only 2 HSS in Chukha Dzongkhag both of which accept students from not only from neighboring Dzongkhags such as Paro and Haa but also from Samtse where there is no HSS in the Dzongkhag. No.13 Chukha HSS is especially high demand since it is the only school in 4 Dzongkhags that provides courses of a major in Arts as well as hostels. With its poor living conditions, the girls' hostels also require reconstruction, as the buildings were partly rebuilt from a garage constructed for a hydroelectric project.

#### No.15 Autsho MSS (Lhuentse)

The existing school was opened in 1991, and then became a CPS in 2001. With its poor learning environment, the existing buildings require reconstruction. Autsho MSS is expected to accept students from the surrounding 14 villages for primary education, as well as from 3 Gewogs with no secondary educational facilities out of 5 Gewogs and partly from neighboring Mongar Dzongkhag for secondary education. Hostels are much in demand at both the primary and secondary educational levels because there are no schools within the area in spite of the fact that 4 villages are outside the reasonable commuting distance.

## 2) Validity of the Requested Number of Classrooms

As for the 8 candidate schools, the number of deficient classrooms required is calculated by the following criteria. Based on the results, validity of the requested number of classrooms is examined.

- ① The calculations of this Project are all based on a single-shift class system being used in the schools. The number of students per 1 classroom is set at 36 persons based on the architectural standards for educational facilities in Bhutan. The enrollment rate is assumed to be 100% both for primary and secondary education.
- ② According to Education Sector Strategy: Realizing the Vision 2020, “Primary education will be expanded to provide access to children within one hour’s walking distance of their homes” (Ministry of Health and Education, 2003, p14). Taking into account the above-mentioned premise, all the students at primary level are expected to be day boarders. Therefore, only the neighboring areas within a commuting distance are regarded as school zones.
- ③ As for secondary education, setting schools zones depends on the availability of hostel services in each Project school. The Project schools without hostels regard the neighboring areas within a walking distance as school zones as in the case of primary education in ②.
- ④ Considering the segregation of the students at CPS (both existing and planned ones) within the same school zone, the number of students at primary level is calculated.
- ⑤ The year for calculating the projected number of students is set as 2009.
- ⑥ As for the schools with no hostel, the projected number of students after expansion of target classes is calculated based on the present number of students, regarding the neighboring areas within a walking distance as school zones at both primary and secondary levels. The projected number of students in the 2 new schools is calculated based on information obtained from the stakeholder meetings.
- ⑦ As for the boarding schools, the number of primary students is calculated in the above-mentioned way in ⑥. The number of secondary students is calculated as the sum of the present number of students and all the out-of-school children at secondary level in the Dzongkhag where the school is located, as they would enter into the school. In Chukha Dzongkhag, since No.13 Chukha HSS and No.5 Pakshikha MSS are proposed in the Project, the calculation is made based on the presumption that the half number of out-of-school children in the Dzongkhag will go to each school respectively.

**Table 2-3: Number of Necessary Classrooms (See Appendix 7)**

No.	School	No. of existing student	Projected No. of student in 2009	(A) Necessary No. of classrooms	(B) Available existing classrooms	(A) – (B) No. of insufficient classroom	Requested No. of classroom
1	Phobjikha MSS	550	2,253	63	0	63	20
3	Kabjisa MSS	568	837	24	0	24	20
5	Pakshikha MSS	0	2,859	80	0	80	16
6	Tangsibji MSS	0	1,043	29	0	29	14
8	Lango MSS	766	1,418	40	6	34	18
9	Kanglung MSS	146	728	21	8	13	12
13	Chukha HSS	555	2,113	59	10	49	8
15	Autsho MSS	162	1,676	47	0	47	14

As mentioned in 1) and 2), the construction of school buildings in the 8 candidate schools is in high potential demand. Also, the number of necessary classrooms in each Project school is more than the requested number of classroom by the Bhutanese side. However, the Japanese side regards the requested numbers of classrooms as number of classrooms to be constructed, while the excess number of insufficient classrooms over the requested ones is entrusted to the Bhutanese side.

4. Sufficient teachers, budget allocation, and necessary cooperation from concerned people for the proper operation and maintenance of the facilities are secured.

Based on the field study results attained during the Basic Design Study period, no problems were found in each Project school in terms of the number of teachers, budget, cooperation from concerned people, and maintenance system of the facilities after the completion of construction.

5. No other program or plan exists for new/ongoing classroom construction by the MOE, local government, other donors, NGOs and so forth.

The existing buildings of No.15 Autsho MSS were roofed with new roof materials (CGI sheet) in 2003 as one of the Project schools in CPS support program by UNICEF. However, the structure of the existing buildings is so old that it is unfit for continued use according to the field survey results attained by the Basic Design Study period.

Therefore, it is concluded that if No.15 Autsho MSS is selected as a Project school in this Project, the existing buildings need to be reconstructed. With regard to this, the MOE showed its intention to utilize roof materials of the existing building for other schools within the Dzongkhag, and UNICEF accepted the offer. Also, it is confirmed that the list of Project schools of the program by UNICEF can be updated without any delay because when the construction materials and equipment provided by UNICEF is transferred from original Project school to another school, Dzongkhag Educational Officers (DEO) are obliged to report it to UNICEF each time. For these reasons, there is no overlap with other program or plan for new/ongoing classroom construction by other donors in No.15 Autsho MSS.

6. Topographically safe and appropriate-sized land for construction is secured.

All the 8 candidate school sites are far from ideal for the school construction work because of the characteristic location on slopes. Most of the construction works in Bhutan are, however, generally implemented together with site development. Rather, construction works on the flat sites are exceptions. Also, each Project site is relatively flat, and there are no alternatives near the sites.

Even though access roads to all the Project sites have the potential of being blocked because of landslides during the rainy season, the construction schedule with sufficient leeway can avoid crucial delay in construction works since the roads are usually repaired in one or two weeks. Besides, no Project sites are located in the southern border area where foreigners cannot enter because of the disorder. Therefore, no schools are excluded from the Project due to failure to meet the criteria.

7. Ownership of land for construction is legally secured, and the demonstrable evidence of land ownership will be provided to the Japanese side.

There is a land registration system in Bhutan and sites for schools generally belong to each Dzongkhag. Certificate of title to the land is called “Deed”, which is kept in each Dzongkhag office. The department of Measurement in the Ministry of Agriculture decides the shape, area, and lot number of the land. Rental sites from landowners are not used as sites for schools in Bhutan.

However, it was only No.9 Kanglung MSS that handed in the deed during the field survey of the Basic Design Study. After that, the Bhutanese side informed in the beginning of February that No. 6 Tangsibji MSS was renounced since the procuring of site was not approved by the Ministry of Agriculture. On the other hand, No.13 Chukha HSS and No.5 Pakshikha MSS submitted the deeds during the Draft Report

Explanation of the Basic Design Study. As for other Project schools, the Minutes of Discussions on the Draft Report Explanation describes that the deeds are promised to be submitted according to their construction schedules.

8. School selection considering budgetary restriction of the Japanese side

As above-mentioned results, 7 requested schools out of 15 were selected as the Project schools. However, considering the budgetary restriction, the Japanese side proposed during the Draft Report Explanation that 2 schools in the eastern regions (No.9 Kanglung MSS and No.15 Autsho MSS) should be excluded because of the higher construction cost caused by their long distance of transportation of construction materials and equipment. In response, the Bhutanese side insisted that No.9 Kanglung MSS should be selected as the Project school and No.8 Lango MSS should be excluded instead because of the two reasons: (1) urgent need of No.9 Kanglung MSS; and (2) the balanced distribution of the Project schools all over the country. Consequently, the following 5 schools were selected as the Project schools.

**Table 2-4: List of Project Schools**

No.	School Name	Dzongkhag
1	Phobjikha MSS	Wangdue Podrang
3	Kabjisa MSS	Punakha
5	Pakshikha MSS	Chukha
9	Kanglung MSS	Trasigang
13	Chukha HSS	Chukha

**(3) Setting Project Components**

1) Requested Components

Based on discussions with the MOE, priorities by requested components are shown as the following Table.

**Table 2-5: Priorities of Requested Components**

Component	Priority	Notes
Classrooms	1	
Toilet	1	
Laboratory and Library	1	
Hostels (including toilet)	1	
Kitchen and Store (with hostels)	1	
Kitchen and Store (with no hostels)	-	Unnecessary for schools with no hostels
Principal's quarters	1	
Warden's and matron's quarters	1	
Administrative offices	1	Unnecessary for No.9 Kanglung MSS due to the existing Administrative offices
Multipurpose Hall (for schools with hostels)	1	
Multipurpose Hall (for schools with no hostels)	3	
Staff quarters	1-3	Depends on each school's situation
Football field	1	3 <sup>rd</sup> priority only to No.14 Gyelposhing HSS
Basketball court	1	2 basketball courts requested in each school
Laboratory equipment	3	
Office equipment	3	
Computers and peripherals	3	
School Bus	3	

## 2) Necessity of Components

The 2<sup>nd</sup> and 3<sup>rd</sup> prioritised requested components are excluded from the Project because their necessity is low or the Bhutanese side explained that it is possible to procure these components independently. The necessity of the 1<sup>st</sup> prioritised requested components are examined in the following section.

### ① Classrooms

Classrooms are indispensable component of the Project.

### ② Administrative offices

Administrative offices contain the indispensable functions for school operation such as staff rooms, principal's rooms, meeting rooms, offices, staff toilets and so on. 14 schools, except No.9 Kanglung MSS which already has a newly constructed administrative block, which requested Administrative offices, consist of the following;

3 new schools;

2 transferred schools;

2 schools to be divided into 2 management systems;

3 schools with administrative offices transferred from other facilities;

4 schools with decrepit administrative offices

In any schools, administrative offices are much in demand.



③ Laboratories, Libraries and Computer rooms

They are indispensable components for curriculum of secondary education.

④ Toilet

It is prerequisite to provide toilet facilities from a hygiene viewpoint. Since all the Project schools have rich water sources within 5 km, no technical problems are foreseen for installation of toilets.

⑤ Multipurpose hall

The multipurpose hall is used for many purposes such as stage plays, music, ceremonies, meetings, sports, etc. Especially for the schools with hostels, besides the above-mentioned purposes, the multipurpose hall is much in demand for the reason of its use as the dining hall and so on. On the other hand, the priority of the multipurpose hall is low in the schools with no hostels.

⑥ Kitchen and store

Schools provide meals for boarders three times a day. Therefore the kitchen and store is much in demand for the school with hostels, while not for the schools with no hostels.

⑦ Hostels

In the criteria of the MOE, students with a commute distance over 5 km or more than one hour deserve to be boarders. Considering the fact that a significant number of students satisfy the criteria, hostels are greatly needed. With the exception of the day schools, it is impossible to plan the hostels and classrooms separately since the necessary number of classrooms depends on the number of boarders. The planned number of students and boarders at 3 schools out of 5 Project schools where the hostels will be constructed in the Project is shown in Table 2-6.

**Table 2-6: Planned Number of Students and Boarders**

School	Planned Number of Students	Planned Number of Boarders
No.1 Phobjikha MSS	720	256
No.5 Pakshikha MSS	576	384
No.13 Chukha HSS	648	512

⑧ Principal's quarters

Different from other school staff, the principal is obliged to reside within the school compound and play an important role in keeping the peace in the whole school compound night and day. Therefore, the principal's quarters are required in the school with no existing principal's quarters.

#### ⑨ Staff quarters

The priority of staff quarters differs from school to school. Unlike the principal, warden and matron, the staffs are not required to reside within the school compound. In many cases, they stay in lodgings in the neighboring villages. However, some schools require only one staff quarters with first priority in spite of the fact that several ones are requested because of an insufficient number of staff quarters within a commuting distance. Considering this situation, the staff quarters are also much in demand.

#### ⑩ Warden's and matron's quarters

Warden and matron are school staff who take care of students 24 hours a day. The warden's and matron's quarters need to be constructed near the boys' and girls' hostels respectively.

#### ⑪ Basketball court

With its frequency of use, basketball courts are much in demand especially for boarders. In a master plan, a basketball court is located close to the hostel. Basketball courts are excluded from the Project components because it is possible to construct a basketball court by the Bhutanese side independently.

#### ⑫ Football field

Even though the Bhutanese side strongly requests football fields, some Project sites have insufficient space for standardized field. Also, even if possible, site development on the slopes entails a great deal of costs. Besides, in the case that relatively flat land within the site is used for football field, other facilities have to be moved to the slope, which requires huge costs for site development in turn. As stated above, even though a football field appears on the master plan, its realization is entrusted to self-help of the Bhutanese side.

### 3) Components in the Projected Schools

Based on the above-mentioned results of the study, excepting a basketball court and a football field, first-prioritised facilities by the Bhutanese side are included in the Project components. The list of Project components for each Project school is shown in Table 2-7.

**Table 2-7: List of Project Components for Each Project School**

No.	School	Academic Zone						Multi-Purpose Zone		Residential Zone					Total Floor Area (m <sup>2</sup> )
		4 CR Type	8 CR Type	10 CY Type	Administration & Library Blk.	Laboratory Blk.	Toilet	Multipurpose Hall	Kitchen & Store	Hostel (96 Beds)	Hostel (64 Beds)	Principal's Quarter	Staff Quarters	Warden's & Matron's Quarters	
1	Phobjikha MSS	0	0	2	1	1	2	1	1	0	4	1	1	2	5,771.02
3	Kabjisa MSS	1	2	0	1	1	2	0	0	0	0	1	1	0	2,763.45
5	Pakshikha MSS	2	1	0	1	1	2	1	1	4	0	1	1	2	6,133.29
9	Kanglung MSS	1	1	0	0	0	2	0	0	0	0	1	1	0	1,336.40
13	Chukha HSS	2	0	0	1	0	2	1	1	0	4	1	0	1	3,867.62
Total		6	4	2	4	3	10	3	3	4	8	5	4	5	19,871.78

### 2-2-2-2 Site and Layout Plan

The Project facilities requested from the Bhutanese side have a huge variety ranging from ordinary classrooms and laboratories to multipurpose halls, hostels, and principal's quarters. Moreover, because of the geographical characteristics of precipitous slopes in Bhutan, it is prerequisite to develop a master plan for each project site as the whole facility layout plan. Based on a due consideration of many factors such as geographical formation of the site, functional requirements, and these priority sequences, the whole facility layout should be determined. The main policies regarding a master plan are as below:

- (1) The facility layout shall be divided into several zones: academic zone (classroom block, laboratory building, administrative and library building, toilet); multipurpose zone (multipurpose hall, kitchen and store, parking lot); students' residential zone (boys' hostel, girls' hostel, warden and matron's quarters); staffs' residential zone (staffs' quarters, principal's quarters); sports zone (football field, basketball court).

The basic notions are as follows:

- a. The multipurpose zone shall be located between the academic zone and the students' residential zone because it is used as the students' dining room as well as utilized for educational purposes.
- b. The sports zone should be located in an area distant from the academic zone because of expected noise. In addition, it is preferable to set the sports zone near the hostel so that boarding students can utilize it for leisure activities.
- c. The students' residential zone shall be located in the appropriate area where

students can reach the multipurpose zone and the sports zone without passing the academic zone.

- d. The staffs' residential zone shall not be located near the students' residential zone so as not to interrupt students after school.
  - e. The academic zone shall be located in the appropriate area as much as possible so that its component buildings can form the courtyard for the school assembly. Toilet shall be located at the area distant from other buildings to enhance hygiene.
  - f. The multipurpose hall shall be located near the kitchen and store for smooth serving of meals. Besides, the parking lot shall be adjacent to the kitchen and store for easy delivery of cooking ingredients.
  - g. The boys' hostel and girls' hostel in the students' residential zone should be sufficiently separated. The warden's quarters shall be adjacent to the boys' hostel and the matron's quarters to the girls' hostel.
  - h. The principal's quarters are not necessarily located near the staff quarters. Rather, it should be located in an area convenient for management of the entire school after a due consideration in each school.
  - i. The football field requires a large-scale site development on the Project sites, which have few gentle slopes. Therefore, its position and distance is not necessarily prioritised in planning the facility layout.
- (2) From the perspectives of environmental conservation and economic efficiency of the Project, the facilities shall be located in the flat areas or on gentle slopes. Moreover, major axes of buildings shall be parallel to contour and minimize the cutting in order to maintain the existing geographical formations as much as possible.
  - (3) Although for convenience the facilities shall be located considering their position relative to access roads to the site and to the existing buildings, newly developed sites' spoiling of the existing scenery should be avoided.
  - (4) The orientation of the facilities is decided based on the Bhutanese approach that the face of the building on the slope is generally located on the valley side. Moreover, it is necessary to consider other factors such as convenience of circulation within the site, frontality to the courtyard, sunshine and direction of the wind caused by regional characteristics of climates.
  - (5) Preparing for expansion of the facilities in the future, buildings in each zone and zones themselves should allow sufficient space.
  - (6) The natural environment such as forests and streams and religious buildings should be conserved in the case that the community people agree on the necessity of conservation.

## 2-2-2-3 Architectural Plan

### (1) Floor Plans

Although basically floor plans of each facility are based on the standard design of the MOE, the following changes are made to the classroom block, the laboratory block, the administration and library block, the kitchen and store, and the hostels for the purpose of improvements in functionality and efficiency, and cost reduction.

#### ➤ Classroom Block

At the beginning, 4-Classroom Type blocks and 6-Classroom Type blocks of the standard design were requested for the Project. As a result of master plans, however, it turned out that most of the Project schools hold two 4-Classroom Type blocks or a combination of 4-Classroom Type block and 6-Classroom Type block. Therefore, 8-Classroom Type blocks and 10-Classroom Type blocks were newly prepared for the purpose of cost reduction, and unnecessary 6-Classroom Type blocks were excluded.

As for the staircases, wooden stairs up to the first floor are built on the frontage of the school buildings in the standard design. However, in this Project, reinforced concrete stairs are built inside the school buildings in order to enhance their durability.

#### ➤ Laboratory Block

3 laboratories and 1 computer room, which are separated into two buildings in the standard design, are provided in one laboratory block for the purpose of cost reduction. A staircase is installed between 2 rooms of every floor inside the laboratory block.

#### ➤ Administration and Library Block

In the standard design, an administration office is located on the first floor, while 2 classrooms on the ground floor. However, a library is provided on the ground floor instead of 2 classrooms in order to secure independence of classroom as a place for study.

#### ➤ Kitchen and Store

The store is divided into 2 parts in order to stock dried foods and wet foods separately.

#### ➤ Hostel

Considering the fact that toilets are complete with communal showers, toilets are attached to the ground floor of the hostels for convenience in the severe cold of wintertime and for night time safety.

The basic floor plan concept is as follows:

1) Academic zone

① Classroom Block

3 types of classroom blocks are provided (4-Classroom type, 8-Classroom type, and 10-Classroom type). As for a 4-Classroom type, the floor plan of 2-storied school buildings of stone masonry with a staircase in the standard design are directly adopted for school buildings with a reinforced concrete structure in this Project. Each Classroom with a capacity of 36 students shall be a square of 7 m on each side, with a staircase installed between 2 classrooms of each floor. Natural lighting is taken into classrooms from two directions, namely, the front part facing the courtyard and the opposite direction, and a sufficiently wide opening of the building is secured on bays. The width of the stairs shall be 1.5 m according to the Building Code of Bhutan.

The floor plan of an 8-Classroom type block shall be that of an integrated combination of two 4-Classroom type blocks from side to side. As for a 10-Classroom type block, the floor plan shall be that of a 2-storied balcony type. 5 Classrooms with 7m squares on every floor are connected by a 1.5 m-wide corridor on one side, and staircases of the same width are provided at the both ends.

② Laboratory Block

A room with dimensions of 7.2 m by 10.8 m is provided at each side of 1.5 m-wide staircase of every floor, which is located on the center of the 2-storied school building. 3 rooms out of these 4 are laboratories to be used for classes of physics, chemistry and biology. 2 laboratories for chemistry and biology are located on the ground floor as students frequently deal with liquids like water, while 1 laboratory for physics is located on the first floor together with a computer room. Considering the use as a space for teachers in charge, 4 preparatory rooms for 3 laboratories and a computer room respectively are placed on each end of the building, which is the furthest away from the staircases. Natural lighting is taken into each room from two directions like ordinary classrooms, namely, from the front part facing the courtyard and the opposite direction.

③ Administrative and Library Block

The first floor of 2-storied building is more convenient and suitable in terms of student management. Besides, in Bhutan, the positions of the rooms are closely related to the social status of those who use them, which means a person with a higher social status usually uses the upper floor. Therefore, the administrative offices are provided on the first floor of 2-storied building such as principal's rooms, offices, waiting rooms, staff rooms, meeting rooms, and print rooms based on the standard design. On the other

hand, a store frequently used for holding educational equipment and tools, toilets, a kitchenette, and a library is provided on the ground floor. Considering the convenience for teachers, a library should be integrated with the administrative block and needs to be located on the ground floor for students' access. The librarian's office is provided on the center of the library.

#### ④ Toilet

In 1-storied toilet buildings, 7 stalls are aligned on one side based on the standard design. As for boys' toilets, the ditch type of urinals is provided on the other side. 1 doorway is set on each side of the building and faucets for washing hands are provided on the end of one side.

### 2) Multipurpose Zone

#### ① Multipurpose Hall (MPH)

The multipurpose hall is a large-scale 2-storied building complete with a stage and a main hall used not only for assemblies but also for as a dining room for the boarding school. The high open ceiling is secured on the main hall and the stage. The hall itself can accommodate 360 students as a dining room. Adjunct facilities are provided such as the store and toilets around the main hall, one dressing room for boys on one side of the stage and another for girls on the other side, and a gallery on the first floor.

#### ② The Kitchen and Store

According to the standard design, the offices are located at the center of the 1-storied building, with the kitchen on one side and the store on the other side. High ceiling with louver windows is secured above the cooking stoves for the purpose of efficient ventilation in the kitchen. The store is divided into 2 parts in order to stock dried foods (ex. rice) and wet foods (ex. vegetables) separately. Also, a large-sized door is installed in the store for easy delivery of cooking ingredients directly from a car.

### 3) Students' Residential Zone

#### ① Boys' and Girls' Hostels

Each unit with a capacity of 16 students is a square of 7.8 m on each side. A 2-storied hostel for 96 students consists of 4 units on each floor. Each unit should be sufficiently separated in order to secure natural lighting and improve ventilation. 3 units out of 4 on each floor are used as housing units. The remaining unit is used for toilets complete with communal shower facilities on the ground floor and a service balcony on the first floor. Stairs and corridors are efficiently provided in the empty spaces between the units in order to secure smooth circulation within the building such as connection between a

students' room and a toilet.

As for a hostel for 64 students, the number of housing units is reduced to 2 on each floor and the unit size for a toilet is smaller. Boys' and girls' hostels are basically the same size except for the layout of toilets.

#### ② Warden's and Matron's Quarters

Warden's and matron's quarters are 1-storied residential buildings built near the boys' and girls' hostels respectively for the purpose of hostel management. Each quarters consists of two bedrooms, a living room, a kitchen, a toilet, and a porch. Besides, a sick room for emergency cases is attached to each warden's and matron's quarters respectively.

#### 4) Staff residential Zone

##### ① Principal's quarters

Principal's quarters are 1-storied residential buildings for principals, as they are the chiefly responsible for the management of school facilities and students for 24 hours a day. Each principal's quarters consists of three bedrooms, a living room, a kitchen, a bathroom and a porch.

##### ② Staff Quarters

Staff quarters are 2-storied buildings with 4 housing units each on both sides of the staircase. Each unit consists of two bedrooms, a living room, a kitchen, a toilet, and a porch.

#### (2) Sectional Plans

##### 1) Story Height and Ceiling Height

Based on the standard design, all the story heights and the ceiling heights shall be 3.2 m and approximately 3 m respectively except the heights of the multipurpose hall and toilets.

The story heights and the ceiling heights are 3.45 m and 8.2 m respectively for the multipurpose hall, and 2.65 m is the story heights with no ceiling for toilets.

Also, considering the fact that school facilities are generally located on precipitous slopes, the finished floor level on the ground floor shall be set 500mm higher than the ground level in order to avoid submergence from severe rain and flash floods during the rainy season.



## 2) Walls and Openings

Walls are composed of reinforced concrete frames of columns and beams and concrete blocks with 200 mm thickness.

Instead of traditional wooden windows, double-sliding aluminum sashes are used for the openings of walls for reasons of their air tightness and durability. Traditionally decorated wooden frames are fixed to the outside of the windows. Steel lattices are provided for only the ground floor.

The opening is located directly below the beams, and sill heights are set low in order to secure a large-scale day lighting area. Taking advantage of the structure of reinforced concrete frame, the opening width of the classroom blocks and the laboratory blocks are increased by replacing bay windows with band windows in order to improve the learning environment of poorly-lighted and humid rooms caused by insufficient ventilation in the existing buildings.

## 3) Roofs

According to the standard design, roof styles are basically gambrel roofs except the toilets with gable roofs. The hostels, however, adopt a pyramidal roof style for the 96-bed type and hipped roof style for the 64-bed type, both of which have a one in four pitched slope. The depth of eaves shall be 1.85 m for the classroom blocks, the hostels and so on, 3 m for the multipurpose halls, and 0.95 m for the toilets respectively. Rainwater is drained out into open ditches on the ground level without installing any eaves gutters.

Except the multipurpose halls with steel truss roof and the toilets with no ceilings, concrete roof slabs are provided for as roofs for 1-storied and 2-storied buildings instead of false ceilings. The reasons for this are as follows: (1) to shorten the construction period and improve the construction quality and the safety by adopting roof frames of post and beam structure instead of large-scale roof truss structure in the standard design; (2) to enhance insulation efficiency of the school facilities with no heating equipment in spite of subzero winters; (3) to reduce the noise of the rain which interrupts class sessions; (4) to reduce maintenance costs by eliminating the use of suspended ceiling materials with low durability; (5) to prevent small wild animals from entering the kitchen and the store.

### (3) Elevation Plans

It is a longstanding convention to add traditional decoration influenced by Tibetan architecture to all the buildings in Bhutan. Even though it is simplified, traditional decoration is applied to all the school buildings except toilets by the standard design of the MOE.

Although this Project also basically follows the standard design, the following changes are made for the purpose of cost reduction and shortening of the construction period:

- ① Traditional decoration such as three-dimensional decoration for window frames are applied only to exterior cladding, while the modern architectural design is applied to interior decoration.
- ② Multi-color painting as exterior decoration is limited to the Administrative and library blocks, which play a leading role among the school buildings and the multipurpose halls. As for other facilities, the exterior is finished in one color, which the Bhutanese side will be painted in multi-color according to need.

### (4) Structural Plans

#### 1) Structure Type

For the selection of structure type in this Project, the following are comparative reviews of structure types of school buildings in the existing schools such as the Light Gauge Steel Framework (hereinafter referred to as LGSF) method, natural stone masonry, and reinforced concrete structure, which has become rapidly become common in ordinary construction mainly in urban areas. Mud wall structure is excluded from a comparative review because of problems with its durability.

#### ① LGSF method

SPBD has adopted the LGSF method in school construction funded by the World Bank, and plans to spread it across the whole country in the future. The method is excellent in terms of efficiency of material handling, a reduction of the amount of construction work at the sites, and the shortening of the construction period. In order to reduce the amount of construction work, however, it is prerequisite to secure skilled labor. Also, there are concerns that lightweight steel frames, which are customized in Calcutta, could cause a delay in the whole construction schedule since the delivery of materials becomes frequently bogged down at schools being constructed by the LGSF method. Besides, even though joints of cement boards used for exterior walls are painted after putting on a cloth layer, it seems more likely that joints will be cracked soon, so that glass wool used as a thermal insulating materials will deteriorate because of the rainwater penetrating through the walls.

School buildings built using the LGSF method are vulnerable to wind pressures because of their lightweight materials, so winds off the valley peculiar to Bhutan are expected to shake the buildings. Even though the construction cost under the LGSF method is equivalent to that for natural stone masonry in the standard design according to SPBD, it is not constant since the LGSF method is still in the experimental stage in that construction period management and material supply are unstable.

As mentioned above, considering the fact that there is a shortage of skilled labor, an unstable material supply, and concurrent construction with the project funded by the World Bank, it is risky to adopt the LGSF method for this Project since there is a need to maintain construction quality as well as to manage the construction period.

### ② Natural Stone Masonry

Except for the multipurpose halls, the school facilities by the standard design of the MOE are also designed using locally produced natural stone masonry. Only beams and floors are made of reinforced concrete. At the present, some of the school facilities newly constructed by the MOE adopt the natural stone masonry, which requires little maintenance, and has a massive appearance that is attractive. It is not easy to procure natural stones in some regions since this masonry method requires natural stones of high quality and appropriate shape. Also, its worst weakness is its low efficiency in constructions. It is time-consuming to trim natural stones and build them into a wall with 40 cm in width, so that shortening of the construction period becomes difficult. Besides, considering its inferiority in earthquake protection and impossibility of structural numerical analysis, the natural stone masonry is not suitable for this Project.

### ③ Reinforced Concrete Structure

The reinforced concrete structure is composed with frames of reinforced concrete columns and beams and walls of concrete blocks or bricks. No problems can be seen in terms of the securing of skilled workers since most of the local contractors are familiar with this method. Although both concrete blocks and bricks are distributed in the market in Bhutan, the former is used in this Project for the reason of cost reduction. Concrete blocks do not need to be of a high quality since they are not used as structural materials. Also, it is possible to produce them by setting simplified production machines within the sites. Therefore, transportation costs and the breakage rate can be reduced more effectively compared to bricks which need to be transported as finished products over a long distance from a border towns because they can be produced only in India. For the same reason, reinforced concrete itself

also gives a great advantage for reducing transport costs because raw materials such as sand, cement, and reinforcements can be transported without any concerns about breakage. Besides, the frame structure of reinforced concrete is attractive in that it can provide larger openings compared to that of LGSF method and natural stone masonry both of which often provide buildings with insufficient lighting and ventilation in Bhutan.

As a result of the above-mentioned comparative reviews, the frame structure of reinforced concrete is adopted for the school buildings in this Project. Taking advantage of generally good soil conditions, an individual footing is adopted in order to enhance economical efficiency by reducing the amount of concrete. The design bearing capacity shall be 180 kN/m<sup>2</sup> (18 ton/m<sup>2</sup>), while rubble concrete foundation work is also implemented in the case that the bearing stratum levels are different.

Besides, except for the multipurpose halls and toilets, gambrel roofs, hipped roofs, and pyramidal roofs are provided by the steel structure on the top of the reinforced concrete floor slabs in order to reduce the loads and enhance their durability. With its long span structure, the multipurpose halls shall adopt steel trusses, which should be designed taking into account their rigidity and deformation.

## 2) Design Load and External Forces

The load conditions and external forces adopted in the structural design are based on the Buildings Code of Bhutan, and seismic force is based on the Indian standard.

① Live Load	Classroom, Corridor, Stairs	3000 N/m <sup>2</sup>
	Roof	750 N/m <sup>2</sup>
	Room	2000 N/m <sup>2</sup>
② Seismic Forces	Zoning factor	Zone V 0.36
	Importance factor	1 1.5
	Response factor	R 3.0
	Sa/g	2.5 (Ordinary soil character)
	Natural period	Ta=0.075 · h <sup>0.75</sup> = 0.320
③ Snow Load	Seismic factor	Ah=Z · I · Sa/2 · R · g= 0.225
	Altitude 2000-3000m	1200 N/m <sup>2</sup>
	Roof incline coefficient	0.8
	Snow Load	S=960 N/m <sup>2</sup>
	④ Wind Load	Standard wind speed
Pz=0.6 · Vz <sup>2</sup> = 1.16 kN/m <sup>2</sup>		
• Augmented coefficient of wind speed by height		
h Additional velocity Additional pressure		
10 1.00 1.0		
15 1.05 1.1		
20 1.07 1.14		

### 3) Structural Materials

The strength of the structural materials are described as follows:

① Concrete	Fc20 N/mm <sup>2</sup> (Grade M20 in the Bhutanese standard)	
② Reinforcement	D8-D20	254 N/mm <sup>2</sup>
	D25-D40	235 N/mm <sup>2</sup>
	D40>	235 N/mm <sup>2</sup>
③ Steel frame	F = 235 N/mm <sup>2</sup>	

### (5) Facility Services Plans

#### 1) Electrical Systems

Electrical systems are installed in 4 Project schools in regions where electricity is already sufficiently supplied. As well as the 4 schools above, No.1 Phobjikha MSS that belongs in a non-electrified area will be provided with electrical systems because the Ministry of Education as an implementing agency promised during the Draft Report Explanation to negotiate with Department of Energy, the Ministry of Trade and Industry aiming at including this area in the electrification project under “the 10<sup>th</sup> five year national plan” or to install power generators even if the electrification is not achieved.

Electricity mains are drawn to the first pole near the boundary of the site, and electricity of 3 phases 4 wires with 380/220 voltages is distributed to each facility through overhead supply wires from the first pole.

Based on the standard design of the MOE, distribution board facilities and other equipment such as lighting fixtures with illuminance of 100 luxes, outlets, and switches are provided for all the school facilities. Besides, the ceiling fans are provided for the facilities except the multipurpose halls and toilets of No.3 Kabjisa MSS, No.5 Pakshikha MSS and No.13 Chukha HSS in the tropical areas of Bhutan considering their climate of high temperature and high humidity during the summertime.

Taking into account the fact that electricity expense is cheaper than the cost of wood in Bhutan, the Project schools will be equipped with electric cooking devices.

#### 2) Water Supply Systems

Water sources from spring water and streams are secured in each Project school. The water tank is located above the level of planned school buildings, so that water can be supplied to the kitchen, toilets, and faucets for washing hands by gravity. The size of the water tank is basically designed to receive enough water to use the showers and toilets at the same time for two hours.

### 3) Hot Water Supply Systems

It is prerequisite from a hygiene standpoint to provide bathing facilities for the Project schools since residential facilities are included as the Project components. However, the water temperature in the wintertime is extremely low in Bhutan because of its water sources are from spring water and streams. Therefore, the electrical hot water heaters, which require inexpensive maintenance and simplified operation, are provided for hostels, principal's quarters, staff quarters, and warden's and matron's quarters as hot water supply systems for showers.

### 4) Sewage Systems

For those Project schools in Bhutan with insufficient public sewage systems, sewage disposal is achieved through sewage systems of septic tanks and infiltration pipes for environmental consideration based on the standard design. Since the school facilities in the Project are located on the slopes, to assemble septic tanks extends the plumbing distance of pipes, which leads to blockages in those pipes. Therefore, a septic tank and infiltration pipes are to be installed near each facility. Miscellaneous drainage is drained out from infiltration pipes after meeting sewage from a septic tank. Rainwater infiltrates naturally into the ground.

### 5) Sanitary Facilities

According to the standard design, the Project adopts squat-type (Asian type) toilet bowls for students, and continuous ditch-type urinals for boys. As for toilets for staff, western-type toilet bowls are provided for both men and women.

The number of toilet bowls, urinals, and faucets for washing hands in toilets, the multipurpose halls, and the quarters are based on the standard design, while the number of those facilities in the hostels integrated with toilets is calculated based on the number of boarders and the frequency and hour of use.

## (6) Plans Regarding Construction Materials

As previously mentioned, the Project adopts reinforced concrete structure for all the school facilities. Based on the standard design of the MOE that takes into account future maintenance, readily available construction materials in the local market should be selected.

As for floor finishes in the classrooms, the standard design provides roughly two different types for schools in temperate areas and those in tropical areas respectively.

The following is a categorization of the Project schools.

- ① Temperate areas  
No.1 Phobjikha, No.9 Kanglung
- ② Tropical areas  
No.3 Kabjisa, No.5 Pakshikha, No.13 Chukha

**Table 2-8: Specifications to be Adopted and Reasons**

Parts	The Standard Design (Natural stone masonry)	Adopted in this Project	Reasons for Adoption	
<b>Main Structure</b>				
Foundation	Natural stones	Reinforced concrete	Better earthquake resistance	
Column and Beam	Reinforced concrete (Beams)	Reinforced concrete	Better earthquake resistance	
Wall	Natural stones	Concrete block	Better economical efficiency	
Roof	Wooden truss	Steel	Better durability	
<b>Exterior</b>				
Roof	Corrugated galvanized steel sheet	Same as at left	To follow the standard design	
Exterior Wall	Natural stones	Paint finish on mortar	Easier construction	
Window	Paint finish on wood sash and decorated frame	Aluminum sash and paint finish on wood decorated frame	Better air tightness, sound insulation and durability	
Door	Paint finish on wood	Same as at left	To follow the standard design	
Corridor floor	Cast-in-place terrazzo	Same as at left	To follow the standard design, better durability and easier maintenance	
<b>Interior</b>				
Floor	CR (Temperate areas) and General room	Wood flooring	Same as at left	Better heat insulation in the wintertime
	CR (Tropical areas), chemistry room, toilet, kitchen, MPH, etc	Cast-in-place terrazzo	Same as at left	Better durability and easier maintenance
Interior wall	Paint finish on mortar	Same as at left	To follow the standard design	
Ceiling	Paint finish on perforated particleboard	Paint finish on mortar	Better durability and easier maintenance	

## 2-2-2-4 Furniture Plan

### (1) Basic Plan

The minimum necessary educational furniture required for school operation is provided in the Project. Although educational furniture belonging to academic zone and multipurpose zone is basically provided, beds for students in hostels are included in the Project as a special case.

### (2) Furniture in Each Component

#### 1) Classroom Blocks

##### ① Classrooms

18 desks (2 students per desk) and 36 chairs (a student per chair) are provided for each classroom in 3 different sizes: small for PP and Class 1-2, medium for Classes 3-6, and large for Classes 7-12. The particular ratio of those sizes depends on each school.

1 set of a desk and chair for the teacher, 1 blackboard, and 1 bulletin board are provided for each classroom.

#### 2) Administration and Library Blocks

##### ① Staff rooms

32 sets of a desk and chair for teachers, 29 wooden cabinets (low), and 1 blackboard are provided.

##### ② Meeting rooms

6 desks and 8 chairs for teachers, and 1 blackboard are provided.

##### ③ Principal's offices

1 set of a desk and chair for the principal, 2 wooden cabinets (low), and 2 wooden cabinets (high) are provided.

##### ④ Offices

2 sets of a desk and chair for teachers and 4 cabinets (low) are provided.

##### ⑤ Libraries

9 library desks and 18 library chairs, 3 magazine shelves, 25 steel bookshelves, 11 wooden cabinets (low), 4 wooden cabinets (high), 2 cabinets for library cards, and 1 checkout desk are provided.

##### ⑥ Librarian's offices

1 set of a desk and chair for teacher and 5 wooden cabinets (low) are provided.



### 3) Laboratory Blocks

#### ① Physics rooms and preparatory rooms

36 stools, 2 sets of a desk and chair for teachers, 3 wooden cabinets (high), 1 blackboard, and 1 bulletin board are provided. The experiment tables are installed as a part of the architectural work.

#### ② Chemistry rooms and preparatory rooms

36 stools, 2 sets of a desk and chair for teachers, 3 wooden cabinets (high), 1 blackboard, and 1 bulletin board are provided. The experiment tables are installed as a part of the architectural work.

#### ③ Biology rooms and preparatory rooms

36 stools, 2 sets of a desk and chair for teachers, 3 wooden cabinets (high), 1 blackboard, and 1 bulletin board are provided. The experiment tables are installed as a part of the architectural work.

#### ④ Computer rooms and preparatory rooms

12 computer desks (2 students per desk) and 24 large chairs for students, 2 sets of a desk and chair for teachers, 3 wooden cabinets (high), 1 blackboard, and 1 bulletin board are provided.

### 4) Multipurpose Halls (MPH)

60 tables (6 students per table) and 120 chairs (3 students per chair) are provided.

### 5) Hostels

The number of double bunk beds and cabinets for two persons is a half of the number of total boarders.

### 6) Warden's and Matron's Quarters

8 double bunk beds are provided per sick room.

The educational furniture to be provided in the Project is listed in Table 2-9.

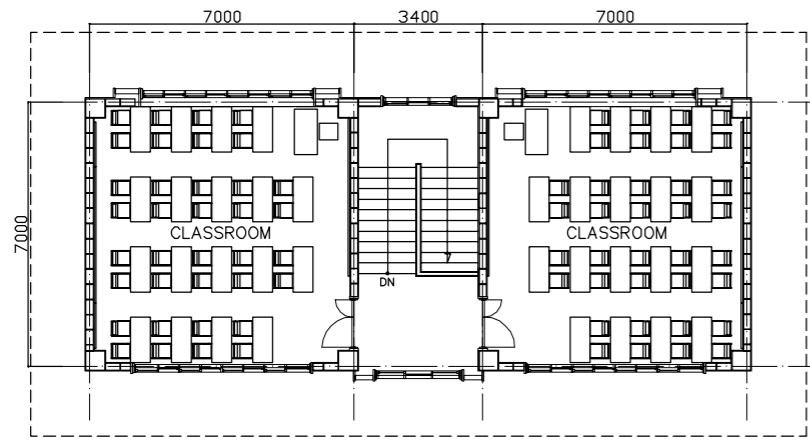
**Table 2-9: List of Educational Furniture at Each Project School**

		School	No.1 Phobjikha	No.3 Kabjisa	No.5 Pakshikha	No.9 Kanglung	No. 13 Chukha	Total
		Classroom	20	20	16	12	8	82
Classroom Block	Classroom	Teachers' Desk	20	20	16	12	8	76
		Teachers' Chair	20	20	16	12	8	76
		Students' Desk (For 2, Large)	108	108	72	216	144	648
		Students' Chair (For 1, Large)	216	216	144	432	288	1296
		Students' Desk (For 2, Medium)	144	144	108	0	0	396
		Students' Chair (For 1, Medium)	288	288	216	0	0	792
		Students' Desk (For 2, Small)	108	108	108	0	0	324
		Students' Chair (For 1, Small)	216	216	216	0	0	648
		Blackboard	20	20	16	12	8	76
		Bulletin board	20	20	16	12	8	76
Administrative and Library Block	Staff room	Teachers' Desk	32	32	32	-	32	128
		Teachers' Chair	32	32	32	-	32	128
		Wooden cabinet (Low)	29	29	29	-	29	116
		Blackboard	1	1	1	-	1	4
	Meeting room	Teachers' Desk	6	6	6	-	6	24
		Teachers' Chair	8	8	8	-	8	32
		Blackboard	1	1	1	-	1	4
	Principal's Office	Principal's Desk	1	1	1	-	1	4
		Teachers' Chair	1	1	1	-	1	4
		Wooden cabinet (High)	2	2	2	-	2	8
		Wooden cabinet (Low)	2	2	2	-	2	8
	Office	Teachers' Desk	2	2	2	-	2	8
		Teachers' Chair	2	2	2	-	2	8
		Wooden cabinet (Low)	4	4	4	-	4	16
	Library	Library Desk	9	9	9	-	9	36
		Library Chair	36	36	36	-	36	144
		Magazine shelf	3	3	3	-	3	12
		Steel shelf	25	25	25	-	25	100
		Wooden cabinet (High)	4	4	4	-	4	16
		Wooden cabinet (Low)	11	11	11	-	11	44
		Cabinet for library cards	2	2	2	-	2	8
	Librarian's room	Check-out desk	1	1	1	-	1	4
		Teachers' Desk	1	1	1	-	1	4
		Teachers' Chair	1	1	1	-	1	4
			5	5	5	-	5	20

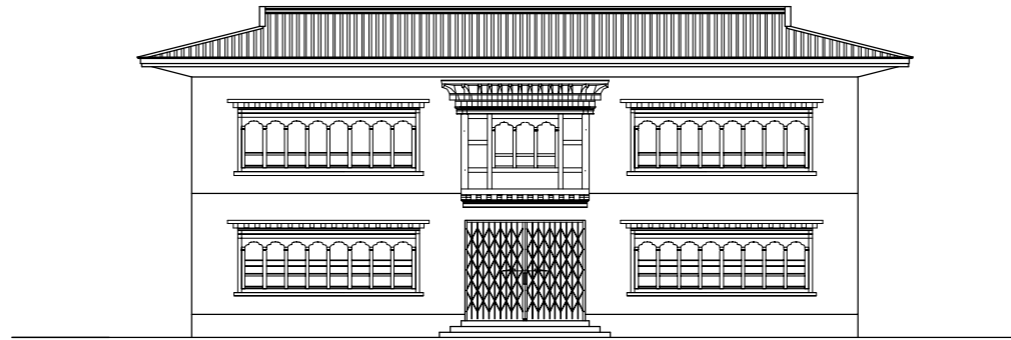
Laboratory Block	Physics room	Laboratory desk (without sink)	4	4	4	-	-	12
		Stool	36	36	36	-	-	108
		Teachers' Desk	2	2	2	-	-	6
		Teachers' Chair	2	2	2	-	-	6
		Wooden cabinet (High)	3	3	3	-	-	9
		Blackboard	1	1	1	-	-	3
		Bulletin board	1	1	1	-	-	3
	Chemistry room	Laboratory desk (with sink)	4	4	4	-	-	12
		Stool	36	36	36	-	-	108
		Teachers' Desk	2	2	2	-	-	6
		Teachers' Chair	2	2	2	-	-	6
		Wooden cabinet (High)	3	3	3	-	-	9
		Blackboard	1	1	1	-	-	3
		Bulletin board	1	1	1	-	-	3
	Biology room	Laboratory desk (with sink)	4	4	4	-	-	12
		Stool	36	36	36	-	-	108
		Teachers' Desk	2	2	2	-	-	6
		Teachers' Chair	2	2	2	-	-	6
		Wooden cabinet (High)	3	3	3	-	-	9
		Blackboard	1	1	1	-	-	3
		Bulletin board	1	1	1	-	-	3
	Computer room	Computer desk	12	12	12	-	-	36
		Students' Chair (Large)	24	24	24	-	-	72
		Teachers' Desk	2	2	2	-	-	6
		Teachers' Chair	2	2	2	-	-	6
		Wooden cabinet (High)	3	3	3	-	-	9
		Blackboard	1	1	1	-	-	3
		Bulletin board	1	1	1	-	-	3
MPH	Table for 6	60	-	60	-	60	180	
	Chair for 3	120	-	120	-	120	360	
Hostel	Double bunk bed	128	-	192	-	128	448	
	Cabinet (For 2)	128	-	192	-	128	448	
Warden's and Matron's Quarters	Double bunk bed	8		8		8	24	

## 2-2-3 Basic Design Drawing

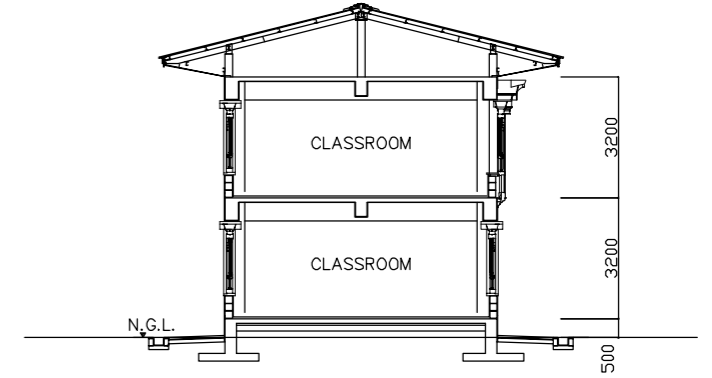
The basic design drawings prepared for the Project are as attached hereafter.



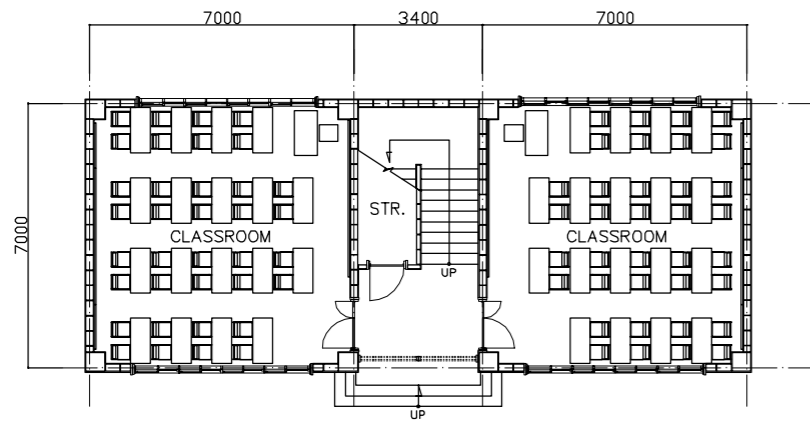
FIRST FLOOR PLAN



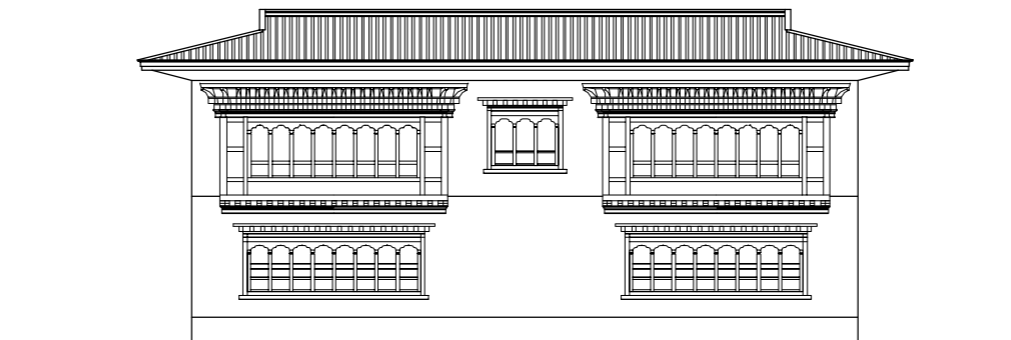
FRONT ELEVATION



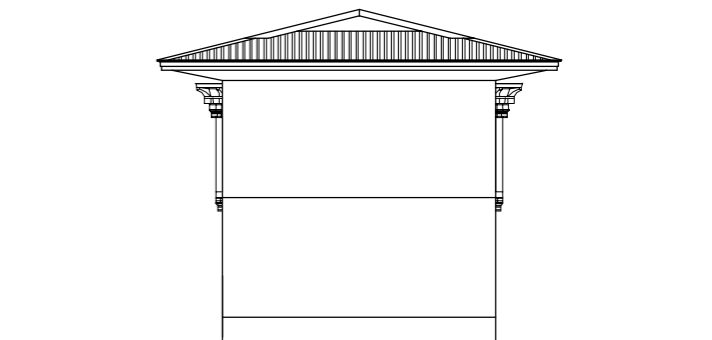
SECTION



GROUND FLOOR PLAN

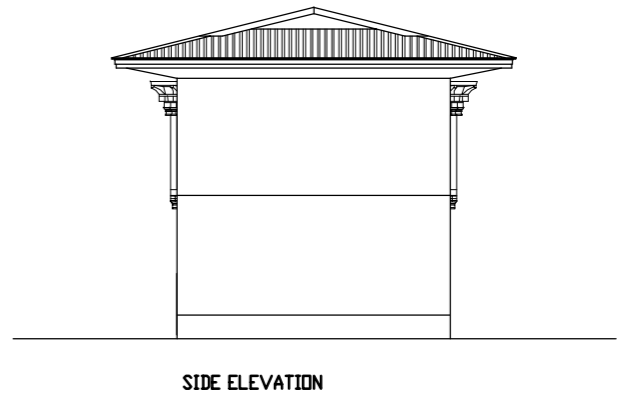
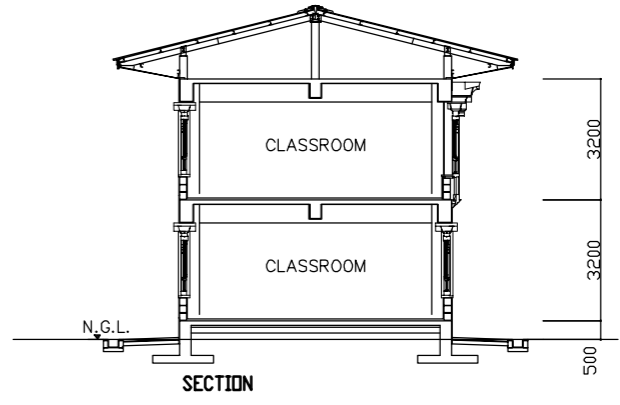
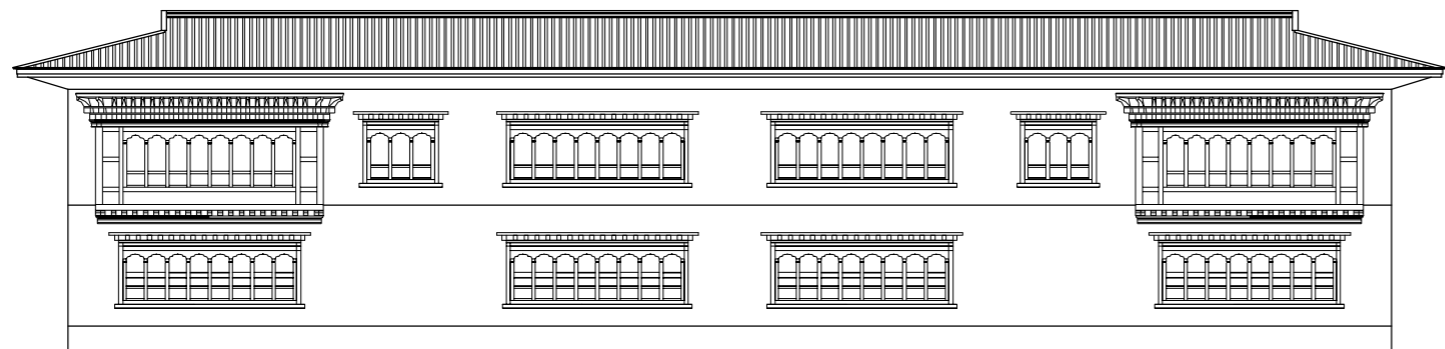
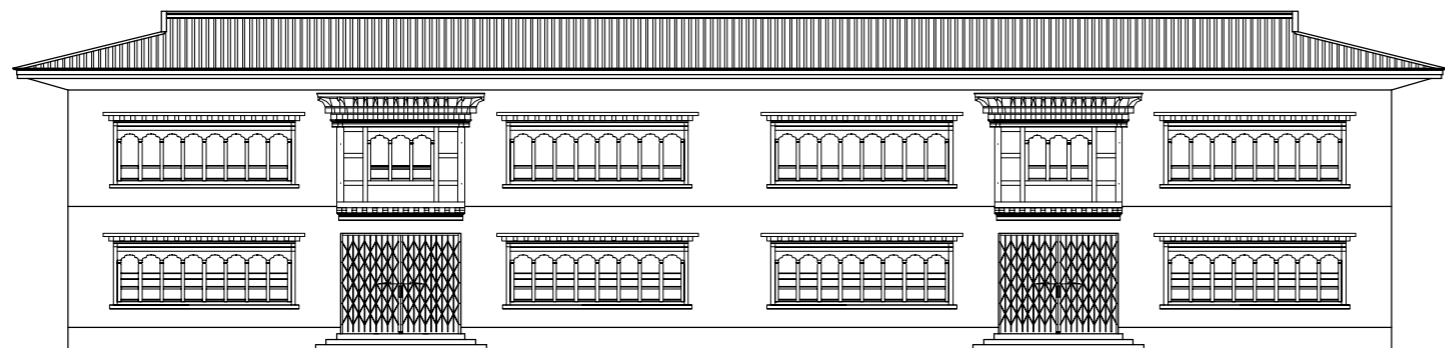
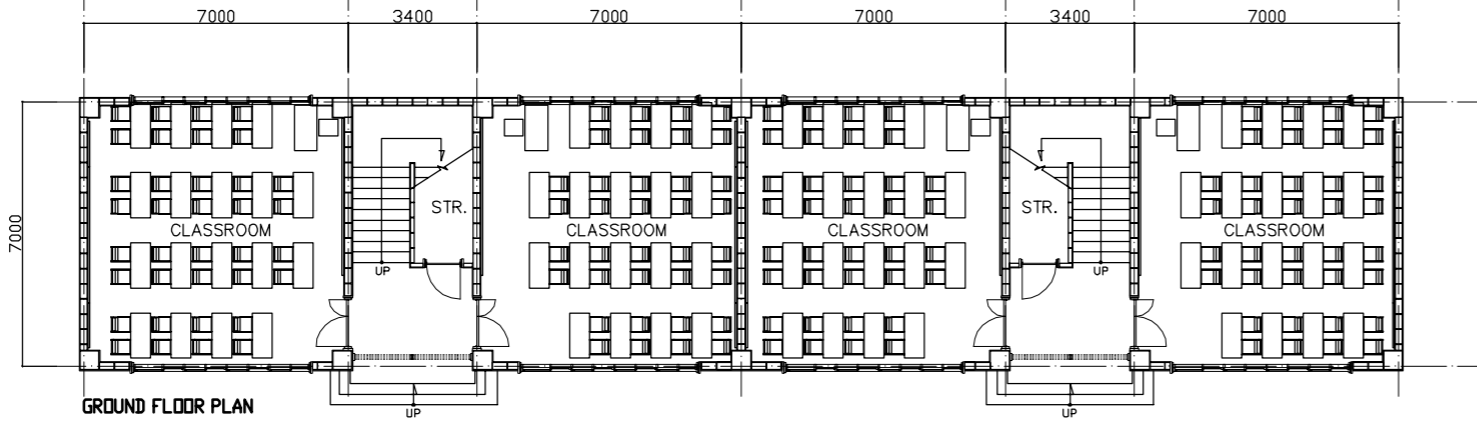
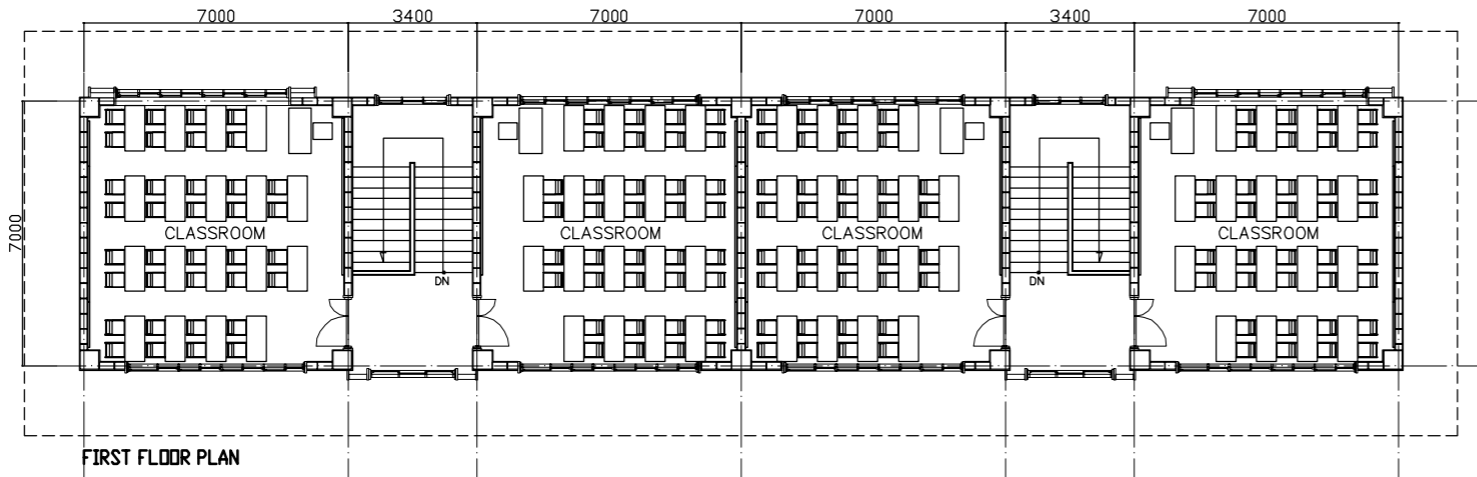


REAR ELEVATION

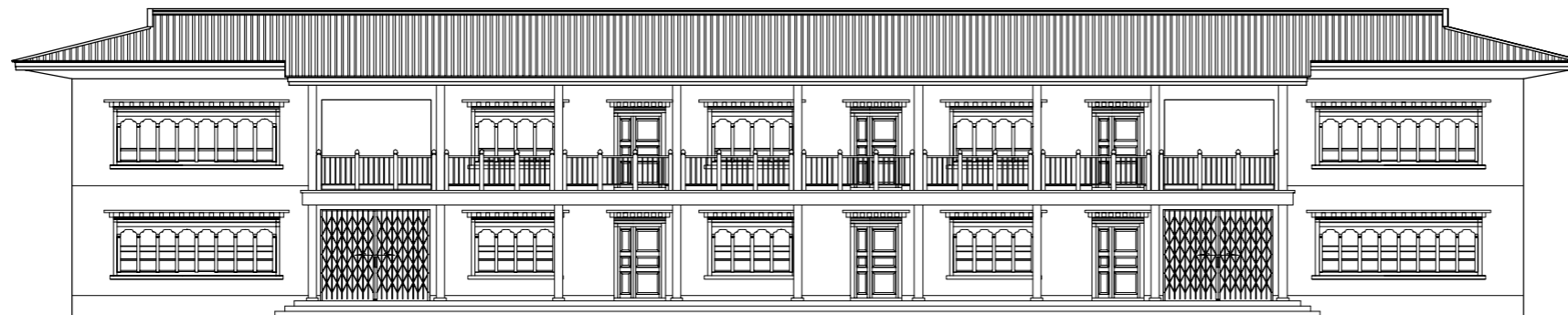
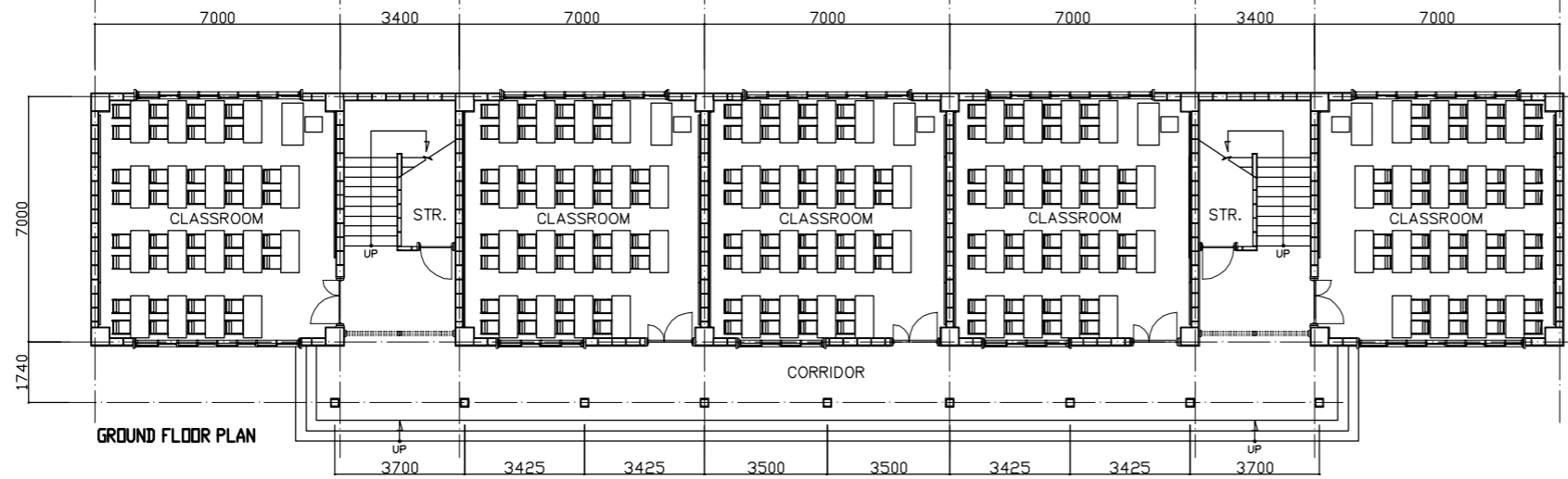
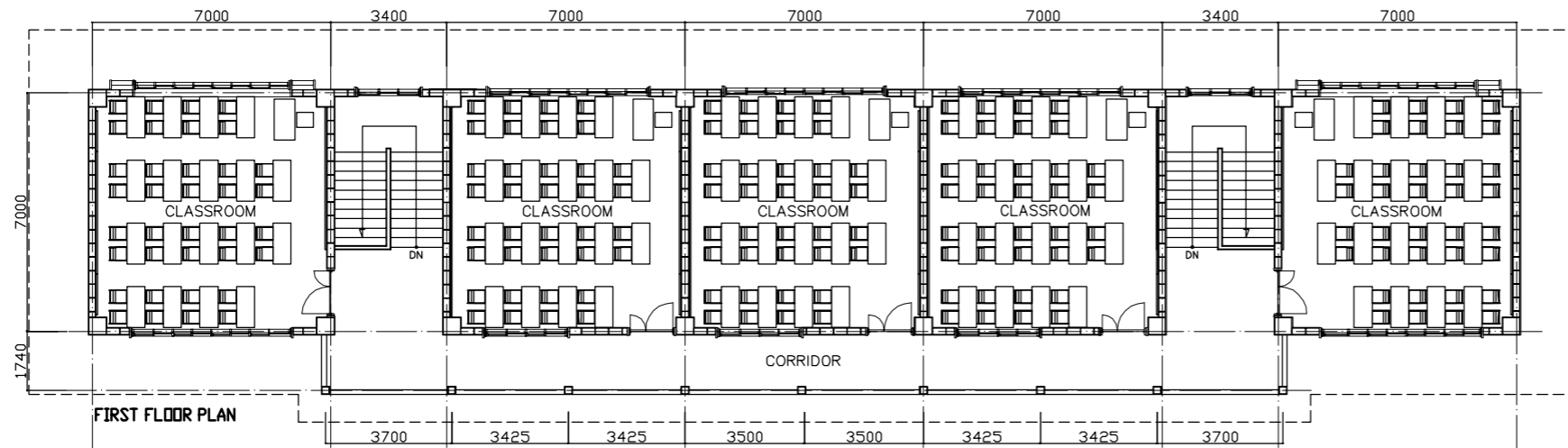


SIDE ELEVATION

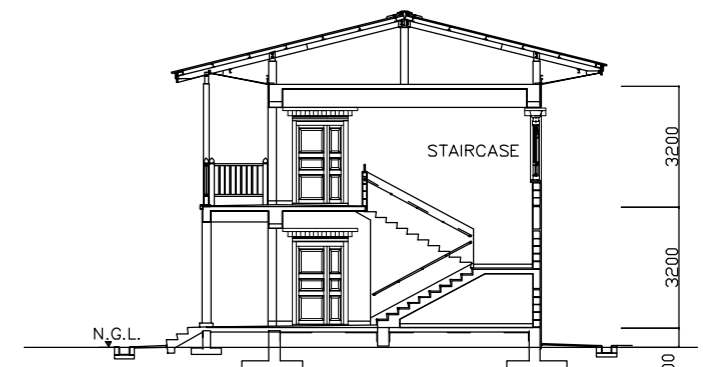
DRAWING TITLE <b>4-CLASSROOM TYPE BLOCK &lt;4CR&gt;</b> <b>FLOOR PLANS, ELEVATIONS, SECTION</b>	SCALE <b>1/200</b>	<b>2-38</b>
---	-----------------------	-------------



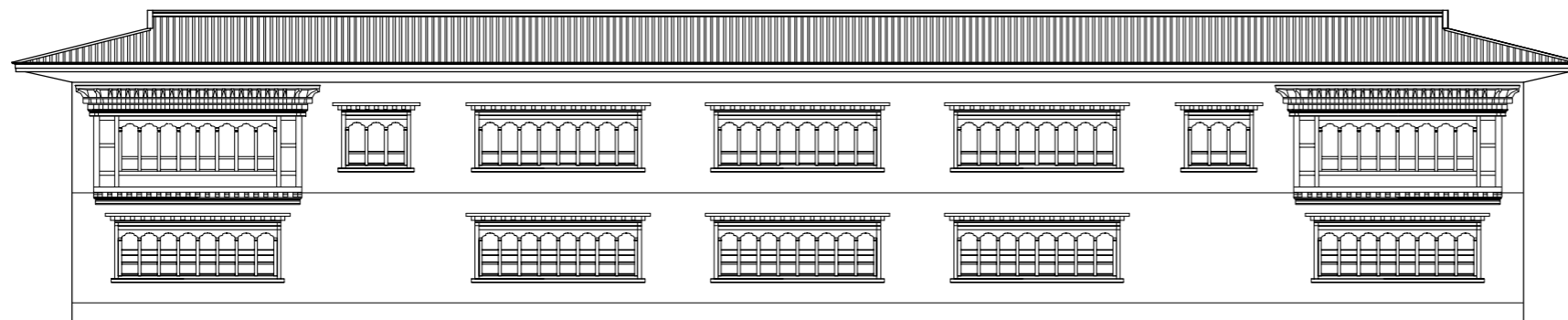
DRAWING TITLE <b>8-CLASSROOM TYPE BLOCK &lt;8CR&gt;</b> <b>FLOOR PLANS, ELEVATIONS, SECTION</b>	SCALE <b>1/200</b>	<b>2-39</b>
---	-----------------------	-------------



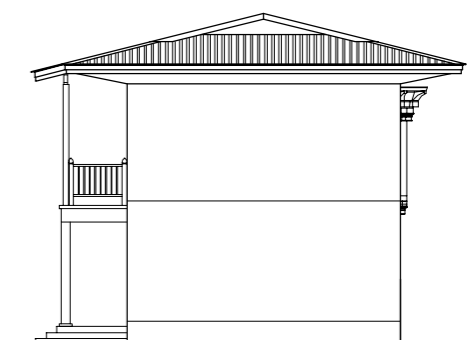
FRONT ELEVATION



SECTION

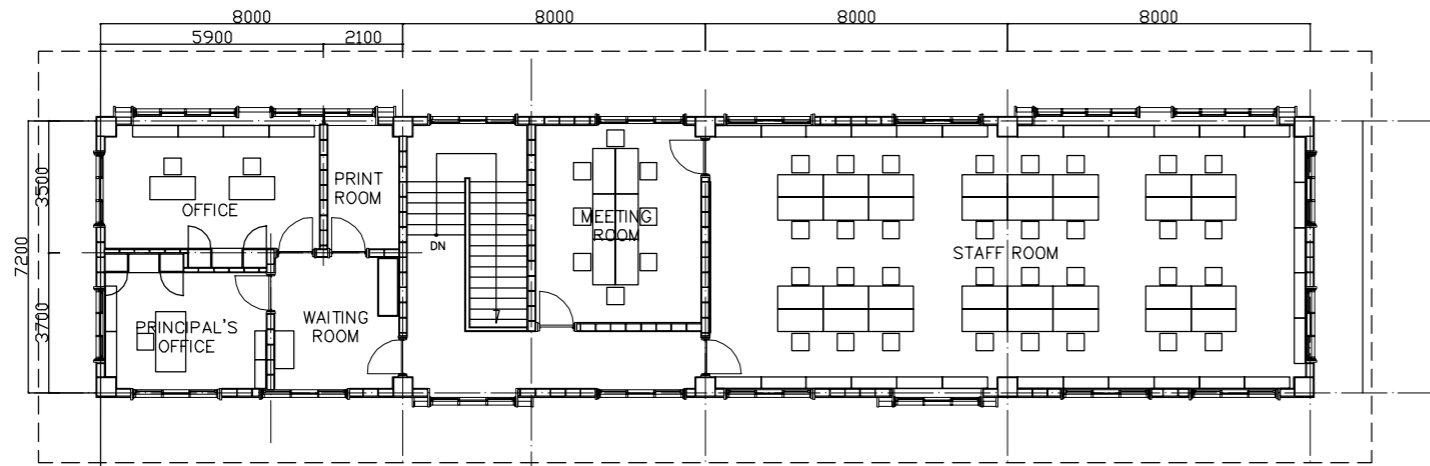


REAR ELEVATION

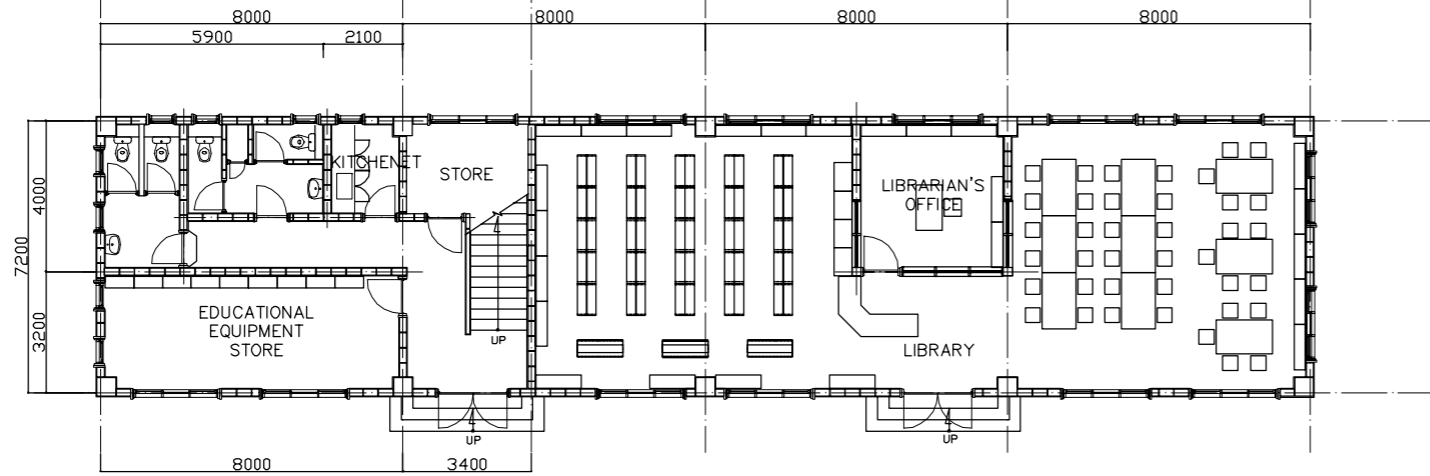


SIDE ELEVATION

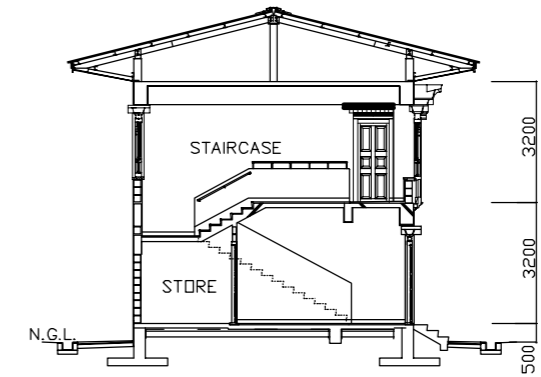
DRAWING TITLE	SCALE	
10-CLASSROOM TYPE BLOCK <10CR> FLOOR PLANS, ELEVATIONS, SECTION	1/200	2-40



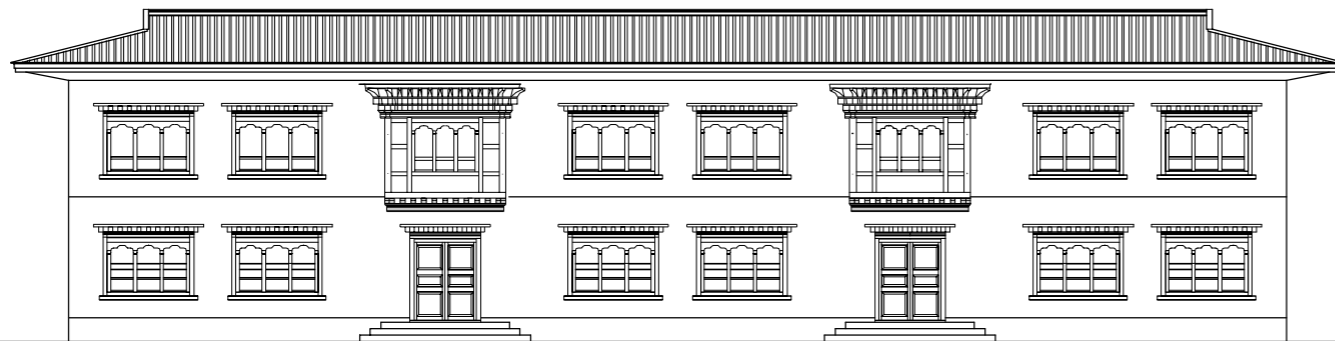
FIRST FLOOR PLAN



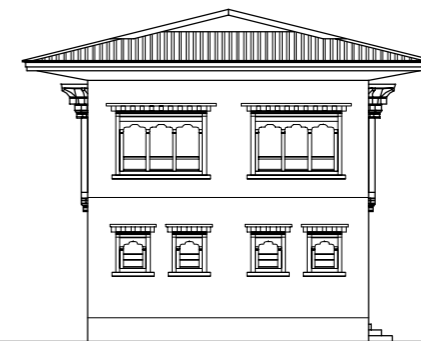
GROUND FLOOR PLAN



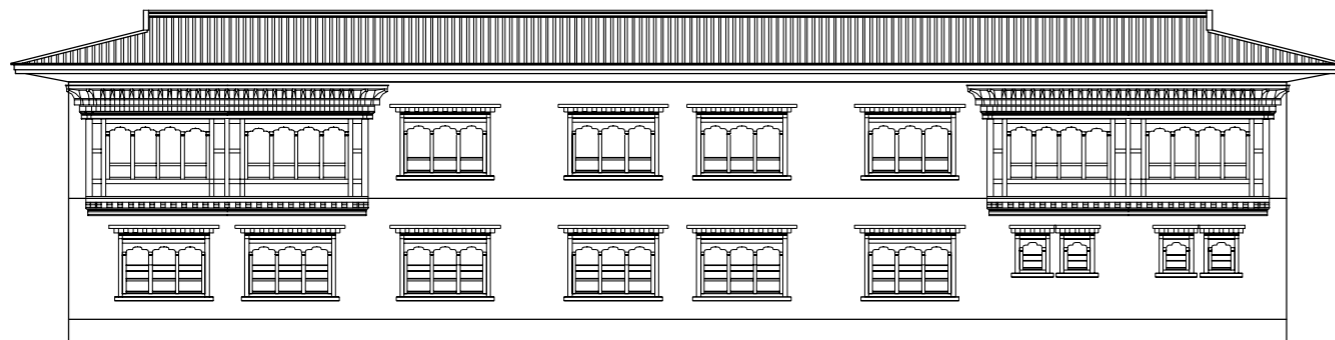
SECTION



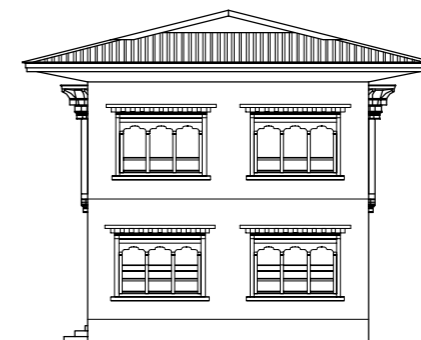
FRONT ELEVATION



SIDE ELEVATION

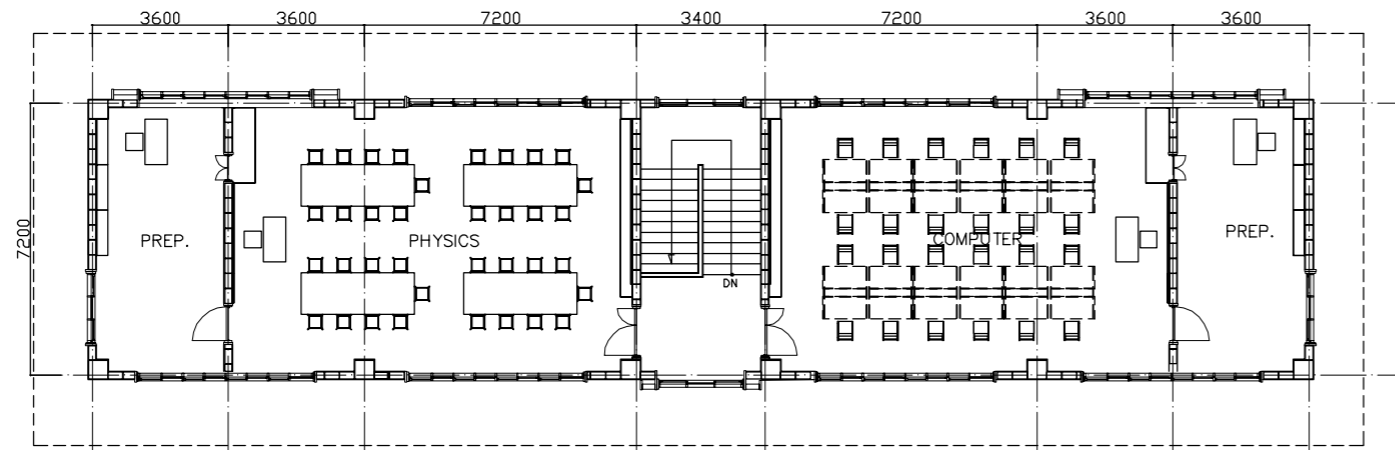


REAR ELEVATION

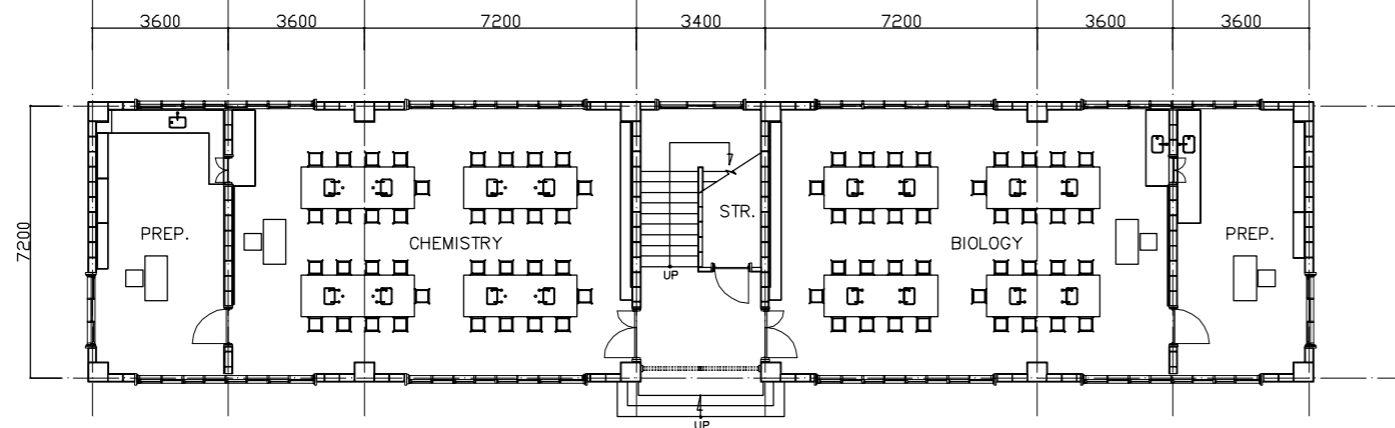


SIDE ELEVATION

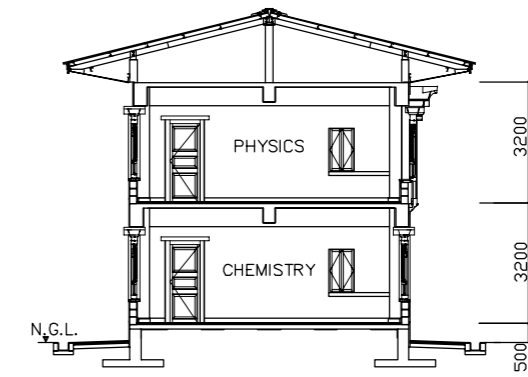
DRAWING TITLE <b>ADMINISTRATIVE AND LIBRARY BLOCK &lt;ADM&gt;</b> <b>FLOOR PLANS, ELEVATIONS, SECTION</b>	SCALE <b>1/200</b>	<b>2-41</b>
---	-----------------------	-------------



FIRST FLOOR PLAN



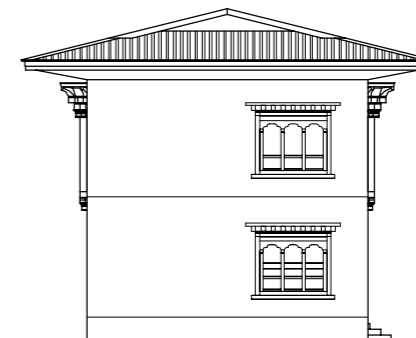
GROUND FLOOR PLAN



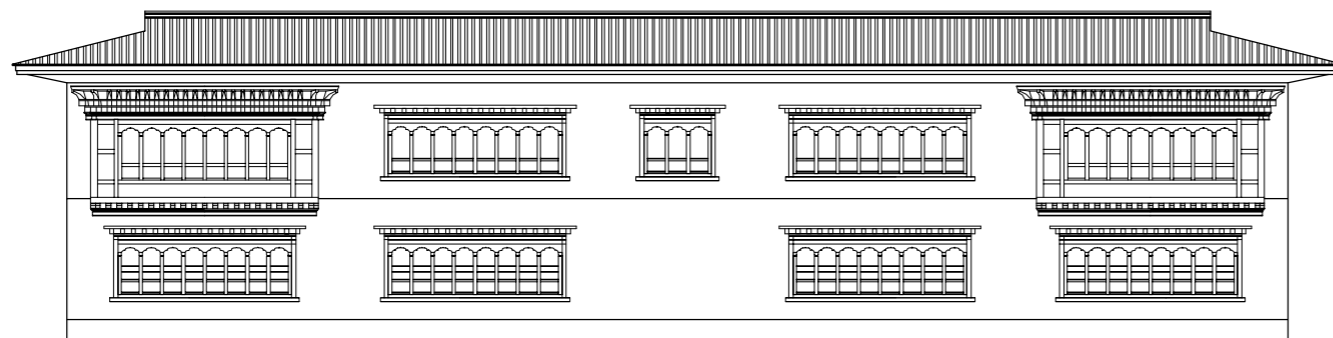
SECTION



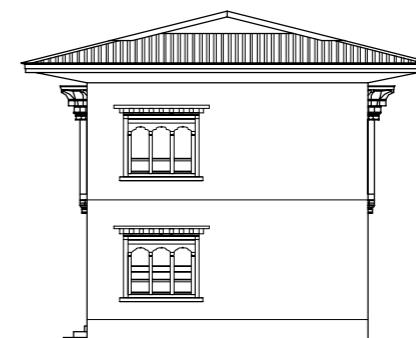
FRONT ELEVATION



SIDE ELEVATION



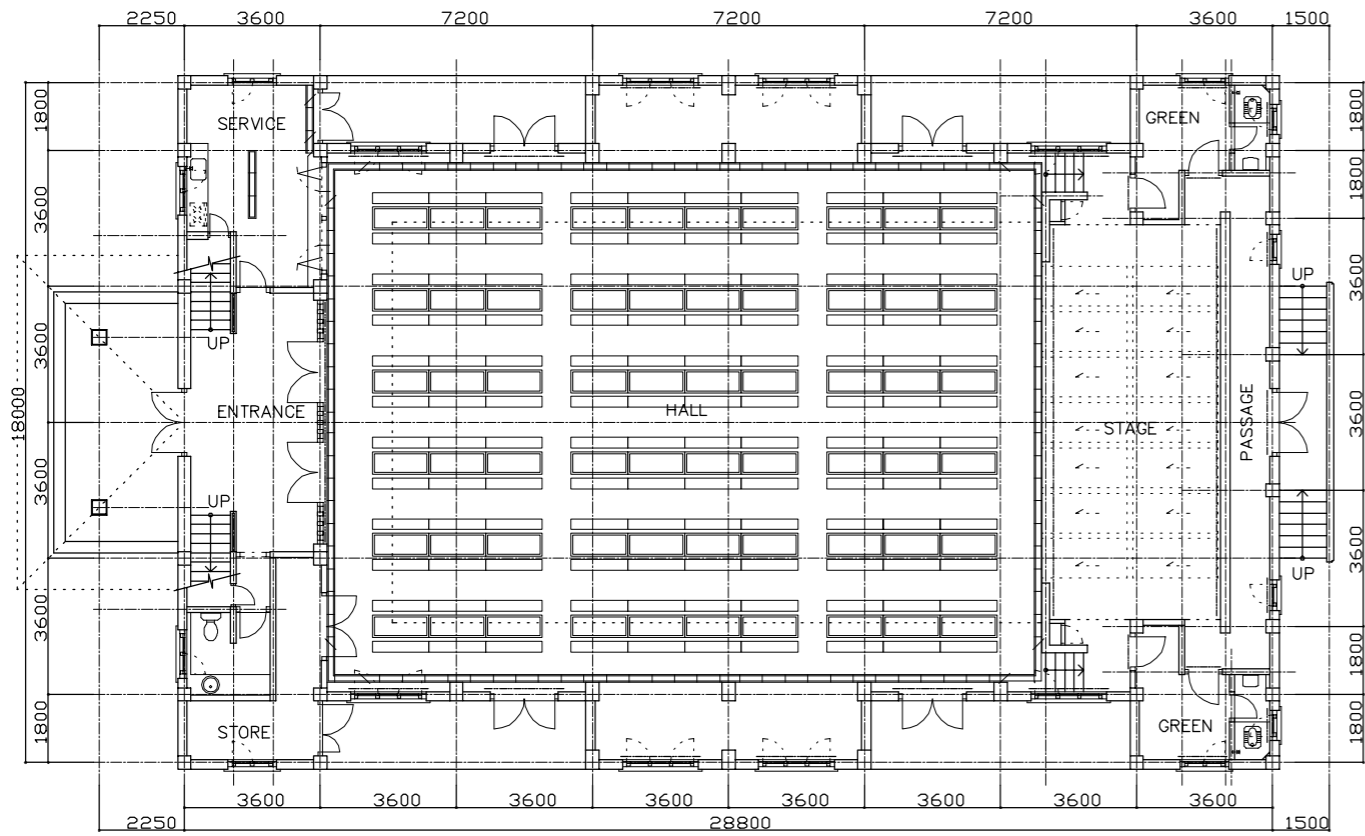
REAR ELEVATION



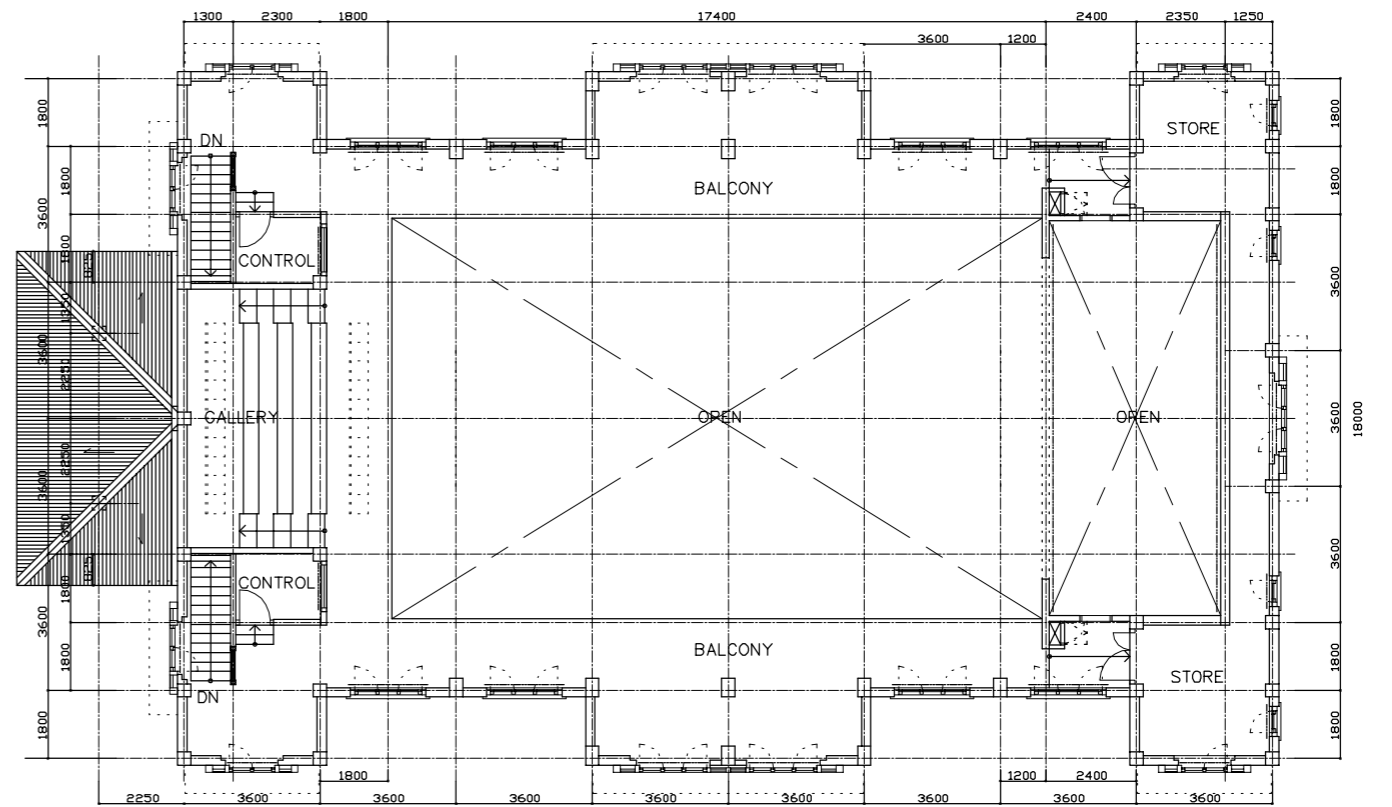
SIDE ELEVATION

DRAWING TITLE <b>LABORATORY BLOCK &lt;LAB&gt;</b> <b>FLOOR PLANS, ELEVATIONS, SECTION</b>	SCALE 1/200	2-42
---	----------------	------

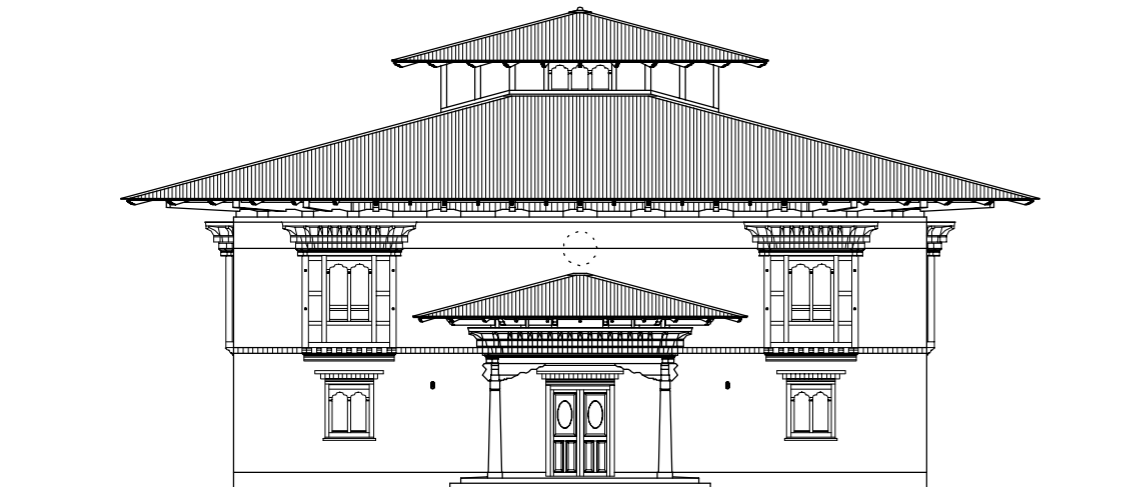




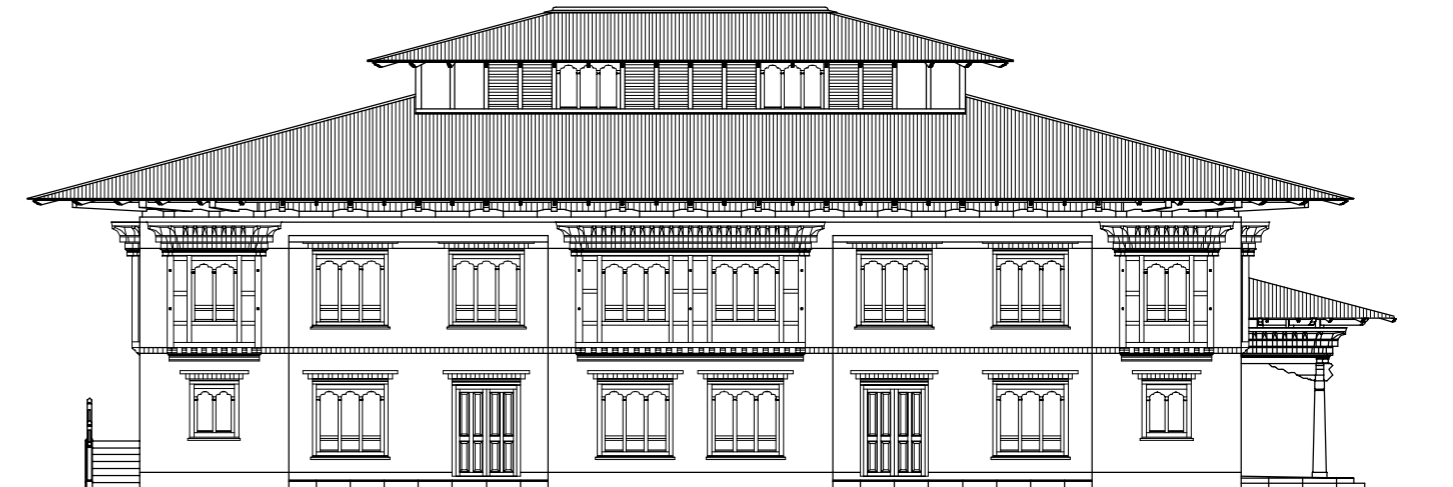
GROUND FLOOR PLAN



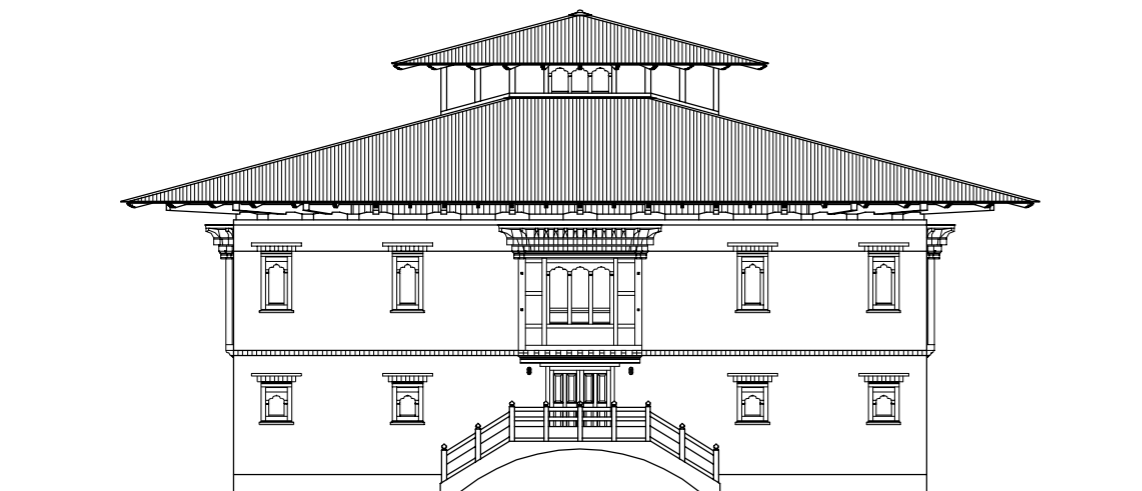
FIRST FLOOR PLAN



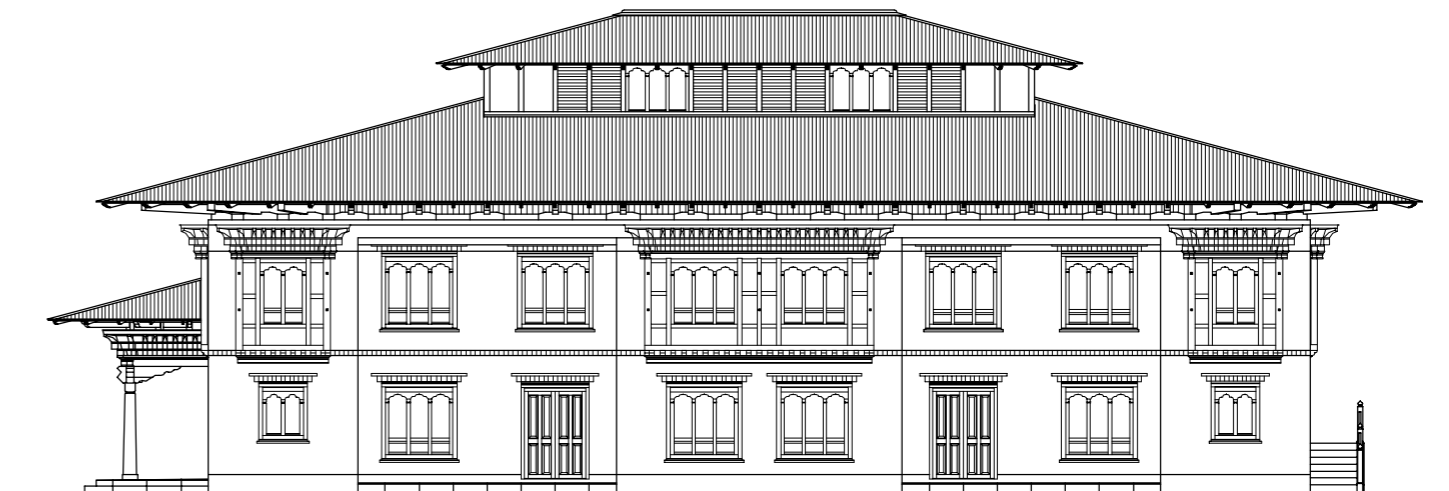
FRONT ELEVATION



SIDE ELEVATION

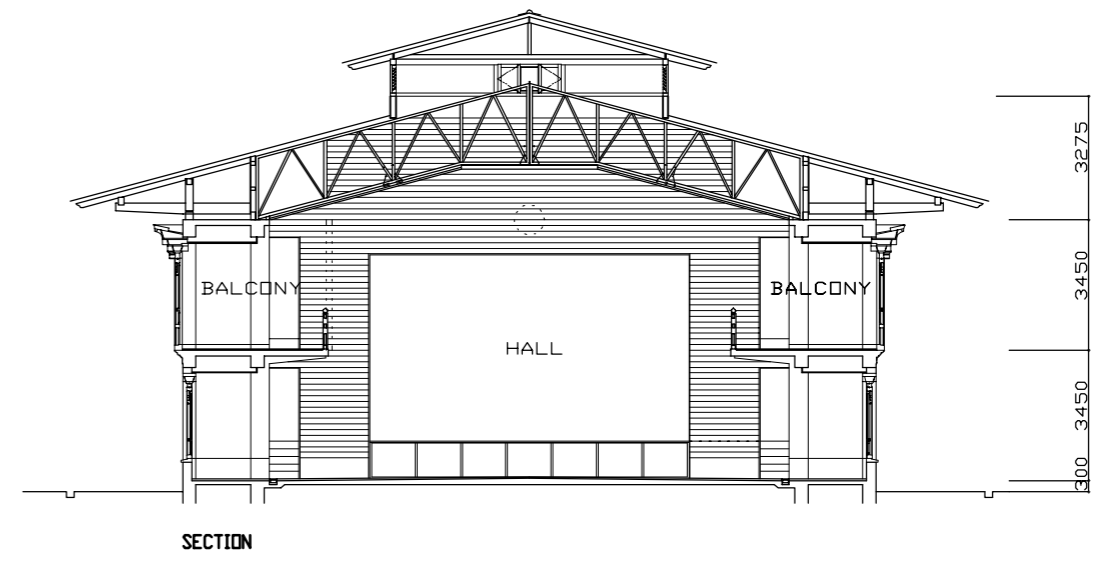
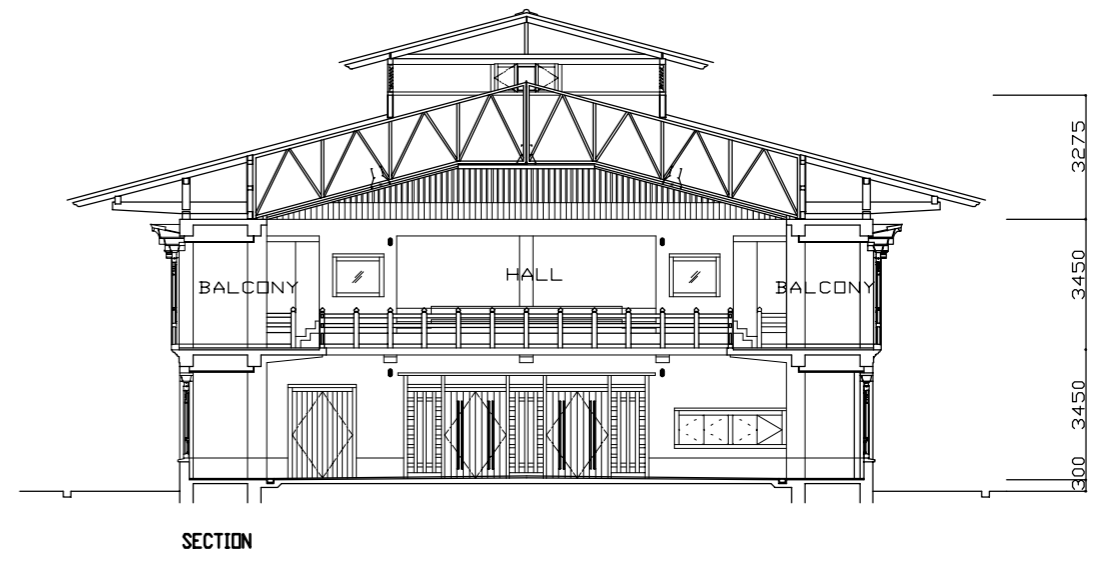
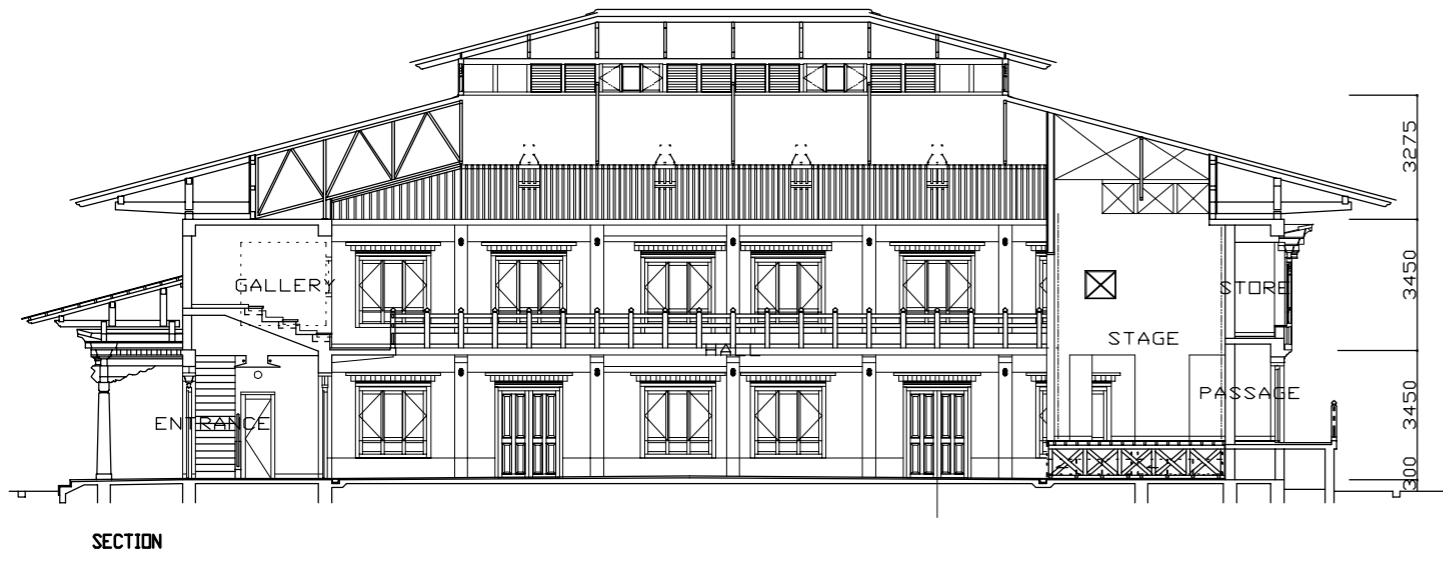


REAR ELEVATION

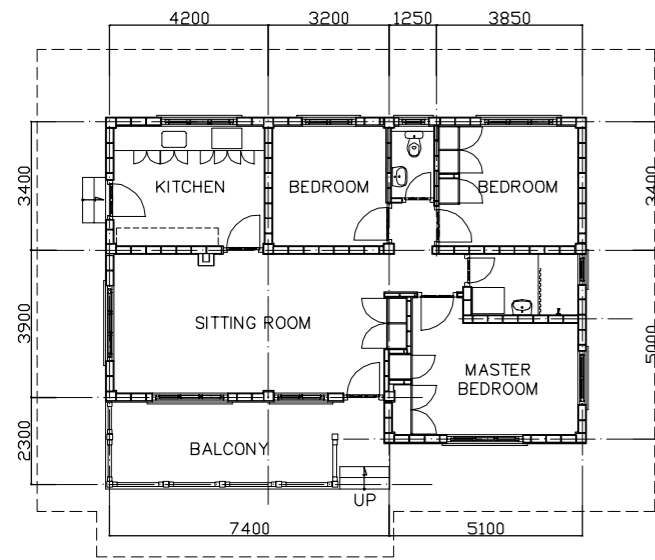


SIDE ELEVATION

DRAWING TITLE	SCALE	
MULTIPURPOSE HALL BLOCK <MPH> FLOOR PLANS, ELEVATIONS	1/200	2-43



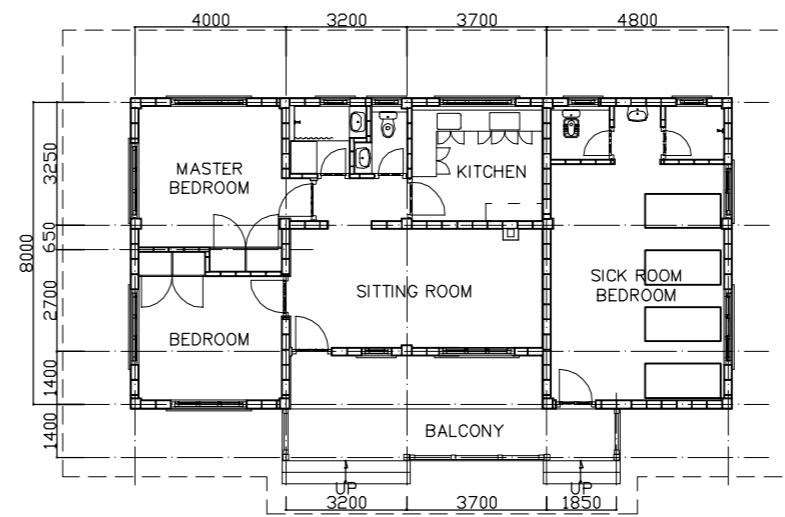
DRAWING TITLE <b>MULTIPURPOSE HALL BLOCK &lt;MPH&gt;</b> <b>SECTIONS</b>	SCALE <b>1/200</b>	<b>2-44</b>
--	-----------------------	-------------



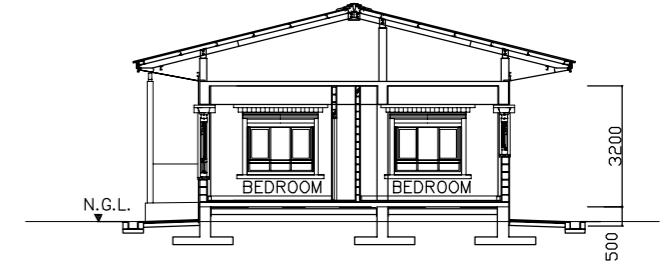
PRINCIPAL'S QUARTERS GROUND FLOOR PLAN



PRINCIPAL'S QUARTERS SECTION



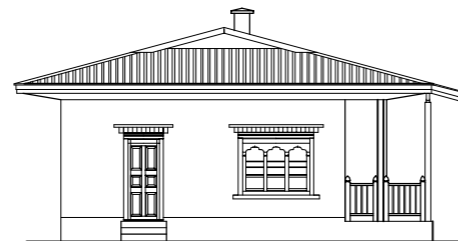
WARDEN'S AND MATRON'S QUARTERS GROUND FLOOR PLAN



WARDEN'S AND MATRON'S QUARTERS SECTION



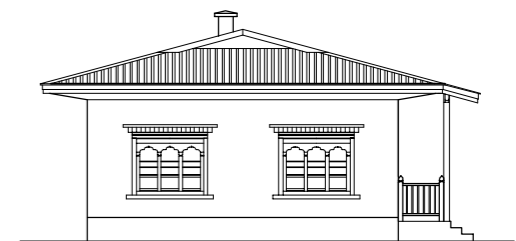
PRINCIPAL'S QUARTERS FRONT ELEVATION



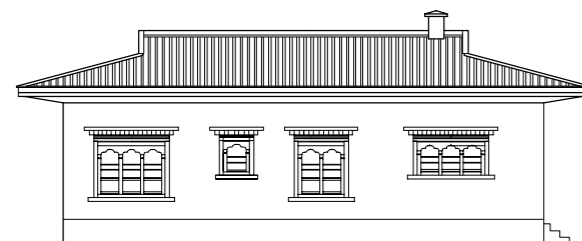
PRINCIPAL'S QUARTERS SIDE ELEVATION



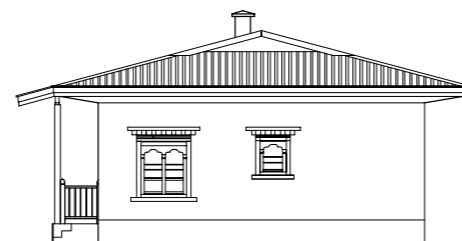
WARDEN'S AND MATRON'S QUARTERS FRONT ELEVATION



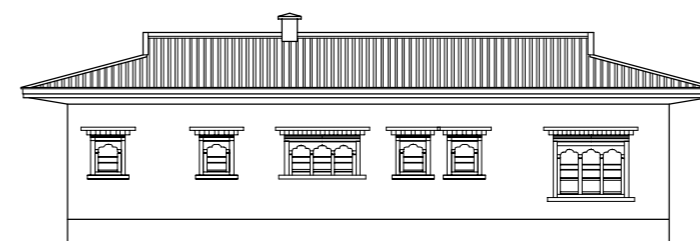
WARDEN'S AND MATRON'S QUARTERS SIDE ELEVATION



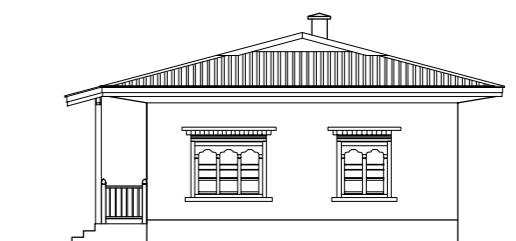
PRINCIPAL'S QUARTERS REAR ELEVATION



PRINCIPAL'S QUARTERS SIDE ELEVATION

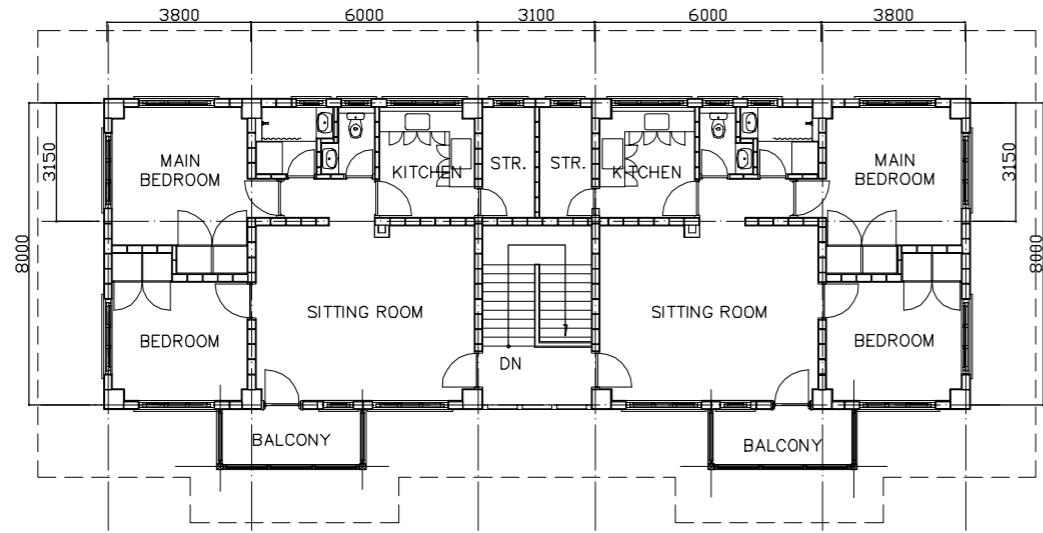


WARDEN'S AND MATRON'S QUARTERS REAR ELEVATION

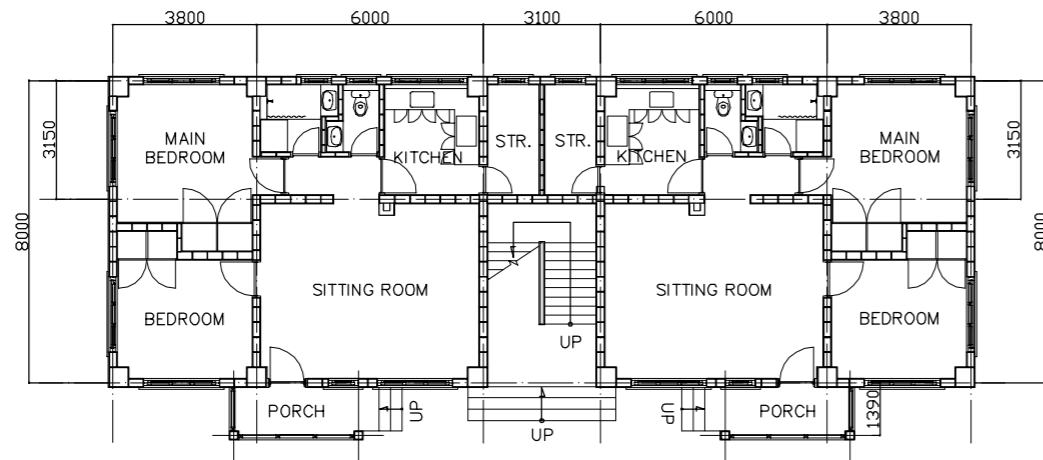


WARDEN'S AND MATRON'S QUARTERS SIDE ELEVATION

<p>DRAWING TITLE  <b>PRINCIPAL'S QUARTERS BLOCK&lt;PQ&gt;, WARDEN'S AND MATRON'S QUARTERS BLOCK&lt;WQ, MQ&gt; FLOOR PLANS, ELEVATIONS, SECTIONS</b></p>	<p>SCALE  <b>1/200</b></p>	<p><b>2-45</b></p>
---	--------------------------------	--------------------



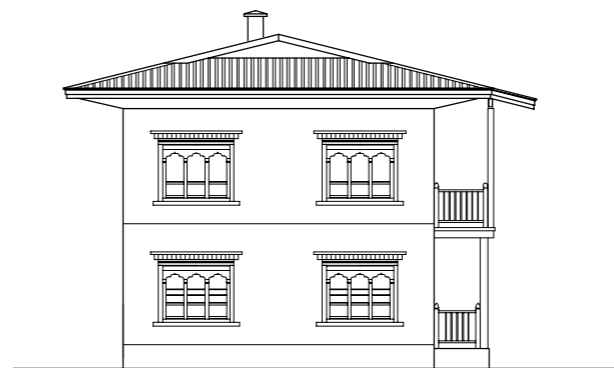
FIRST FLOOR PLAN



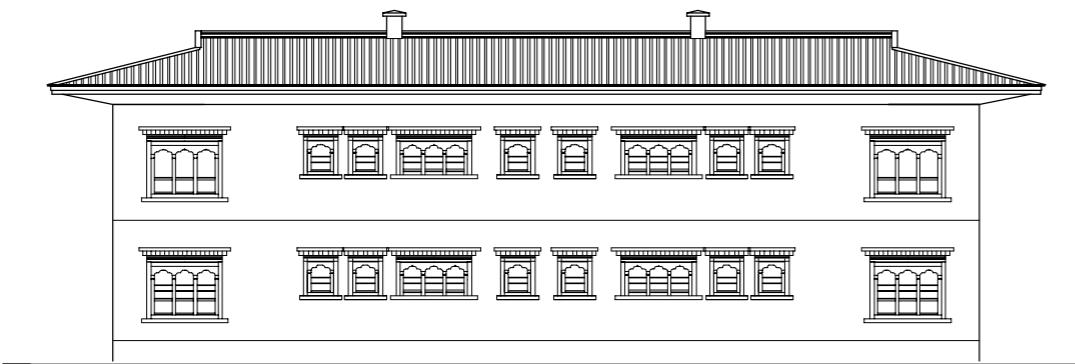
GROUND FLOOR PLAN



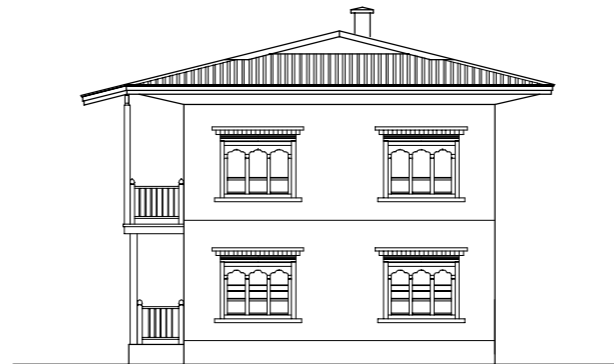
FRONT ELEVATION



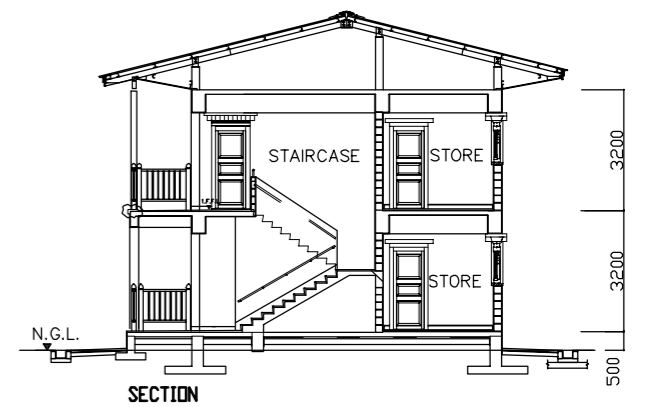
SIDE ELEVATION



REAR ELEVATION



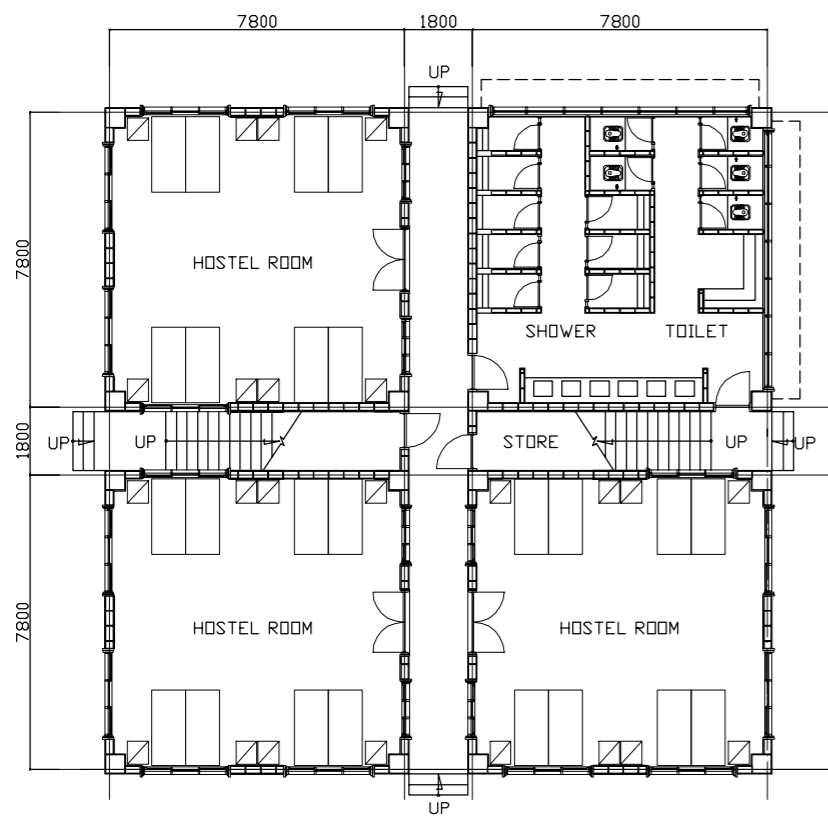
SIDE ELEVATION



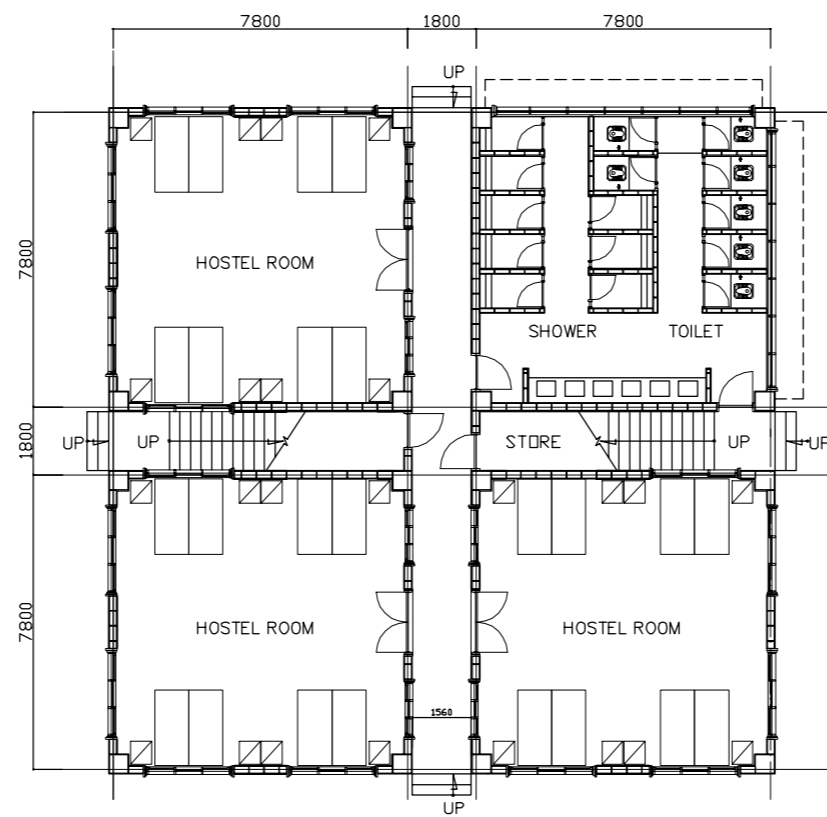
SECTION

DRAWING TITLE  
**STAFF QUARTERS BLOCK <SQ>**  
**FLOOR PLANS, ELEVATIONS, SECTION**

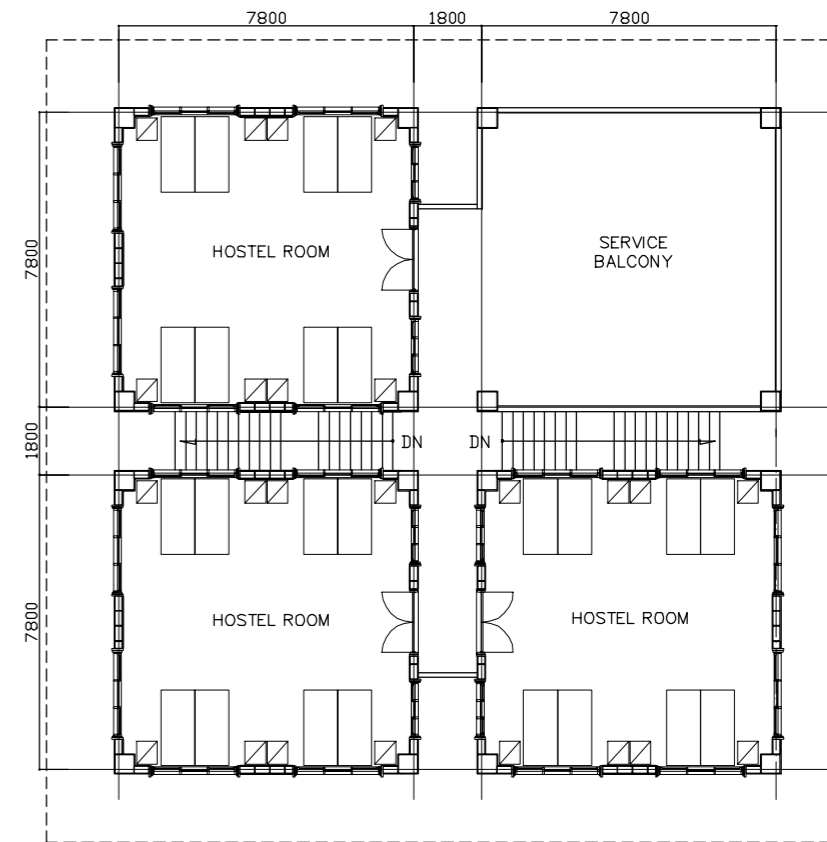
SCALE  
**1/200**



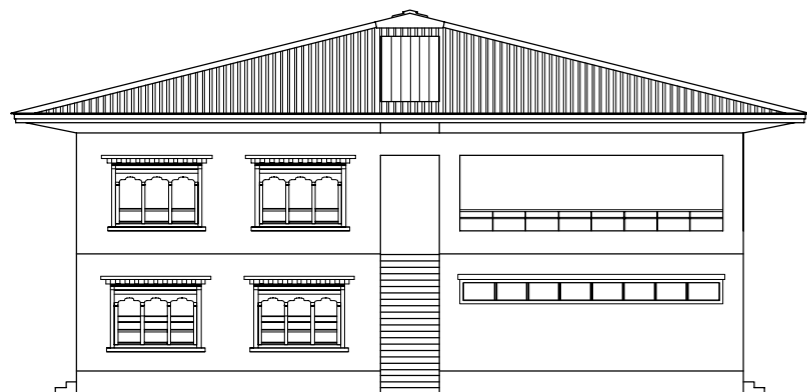
BOY'S HOSTEL GROUND FLOOR PLAN



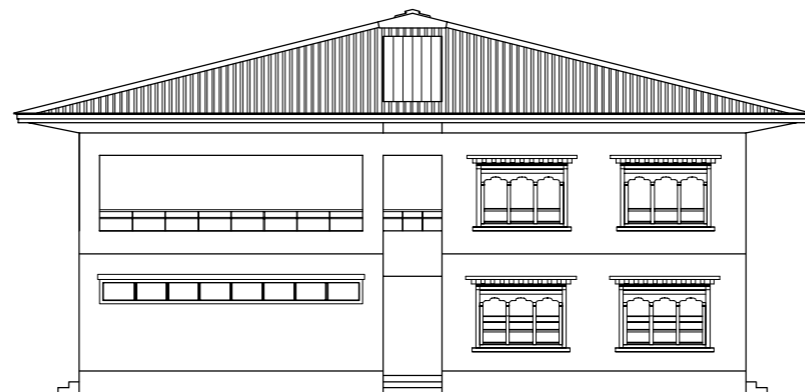
GIRL'S HOSTEL GROUND FLOOR PLAN



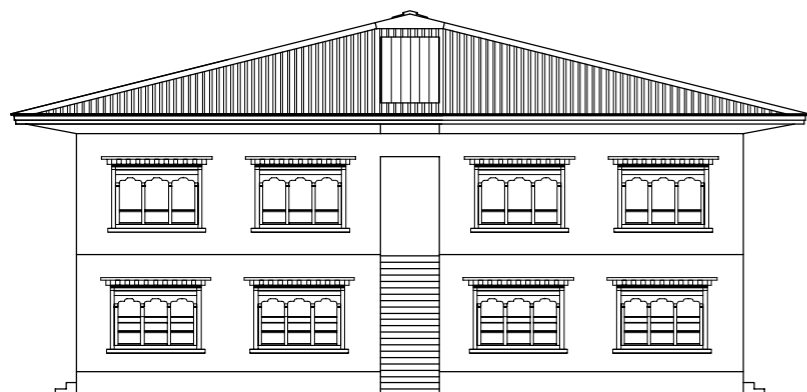
BOY'S AND GIRL'S HOSTEL FIRST FLOOR PLAN



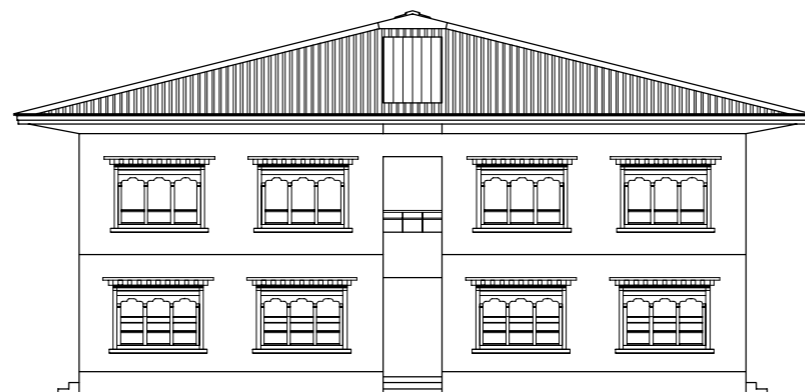
BOY'S AND GIRL'S HOSTEL FRONT ELEVATION



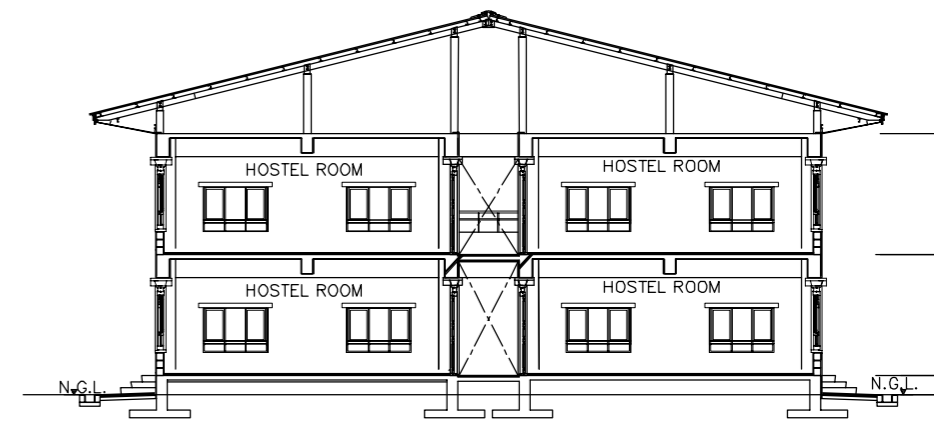
BOY'S AND GIRL'S HOSTEL SIDE ELEVATION



BOY'S AND GIRL'S HOSTEL REAR ELEVATION

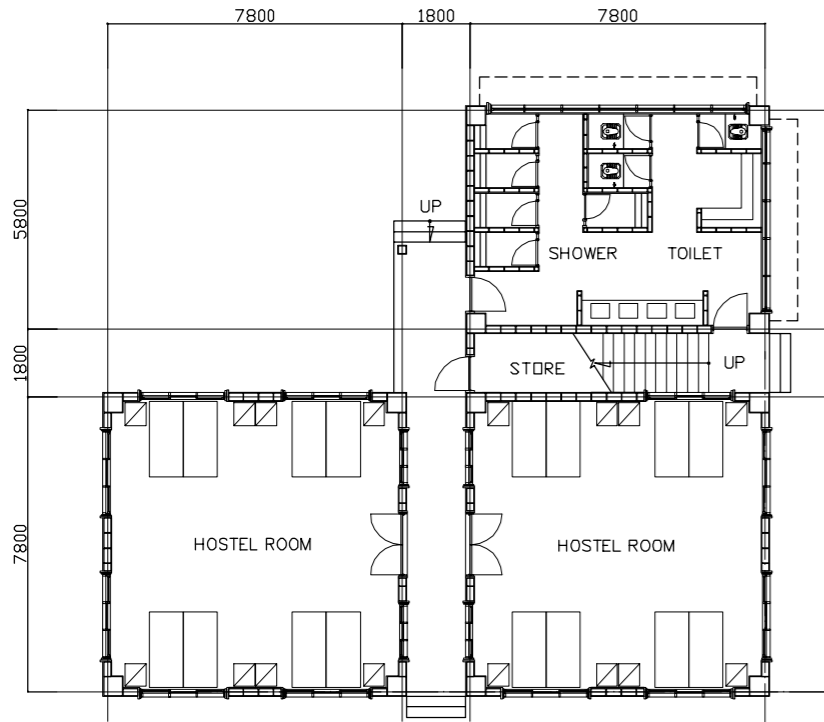


BOY'S AND GIRL'S HOSTEL SIDE ELEVATION

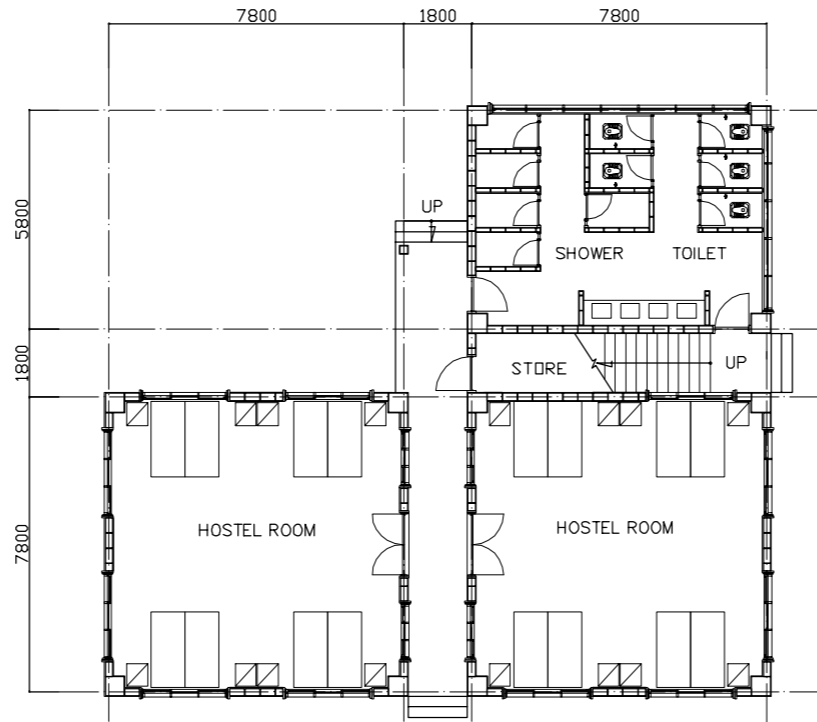


BOY'S AND GIRL'S HOSTEL SECTION

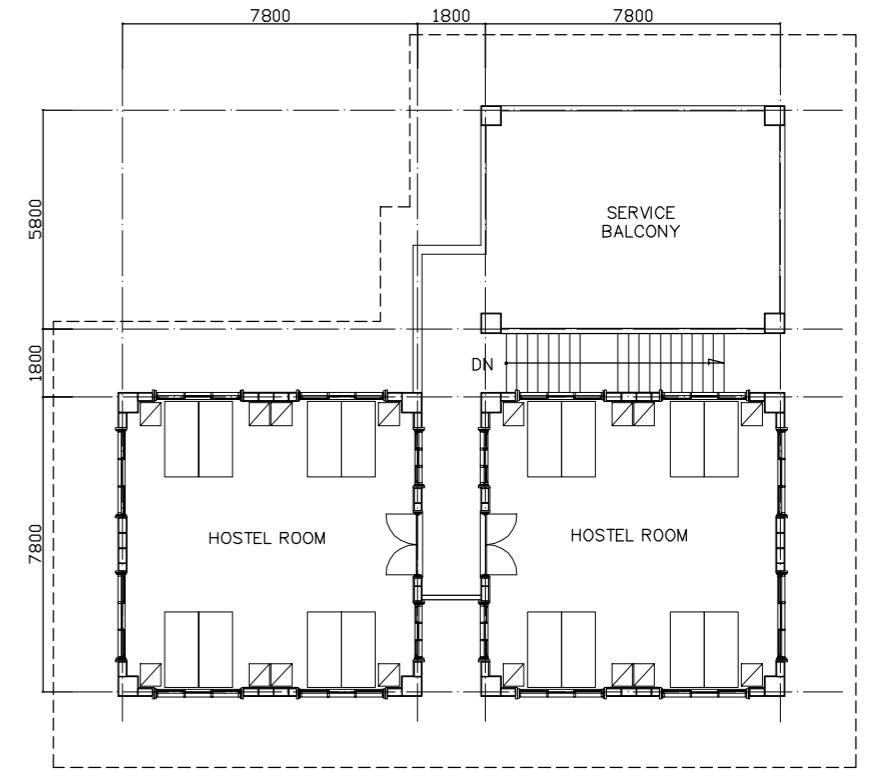
DRAWING TITLE <b>BOY'S AND GIRL'S HOSTEL BLOCK (96 BEDS) &lt;96HOST-B &amp; 96HOST-G&gt;</b> FLOOR PLANS, ELEVATIONS, SECTION	SCALE <b>1/200</b>	<b>2-47</b>
---	-----------------------	-------------



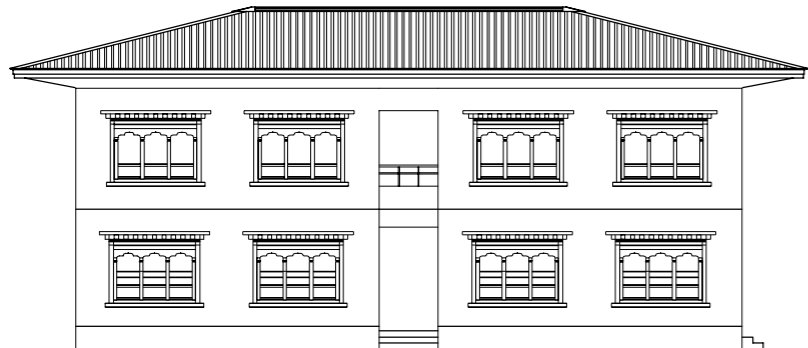
BOY'S HOSTEL GROUND FLOOR PLAN



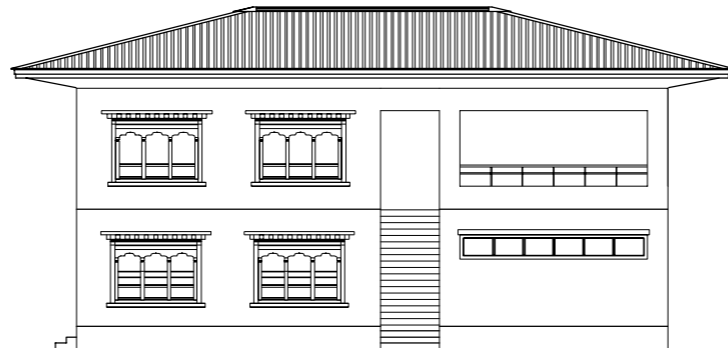
GIRL'S HOSTEL GROUND FLOOR PLAN



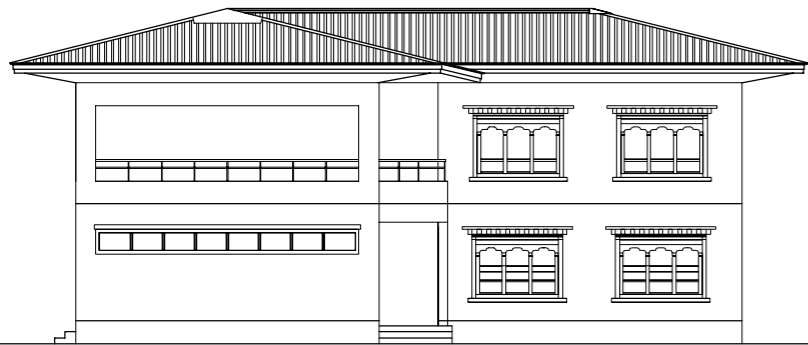
BOY'S AND GIRL'S HOSTEL FIRST FLOOR PLAN



BOY'S AND GIRL'S HOSTEL FRONT ELEVATION



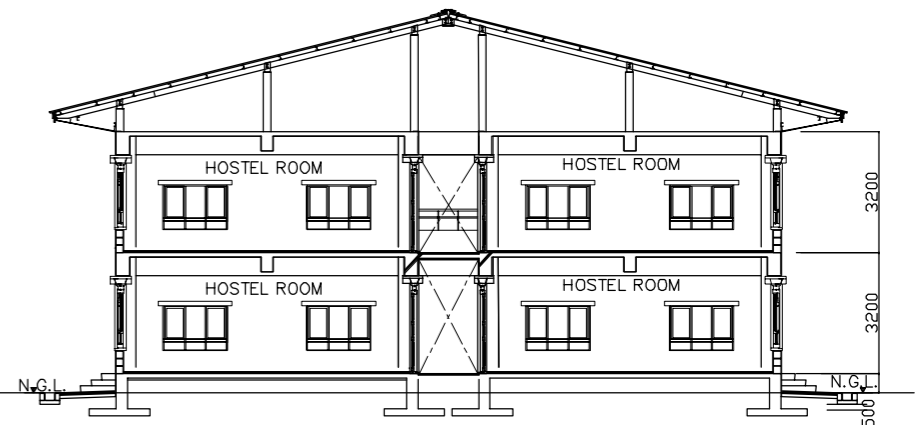
BOY'S AND GIRL'S HOSTEL SIDE ELEVATION



BOY'S AND GIRL'S HOSTEL REAR ELEVATION

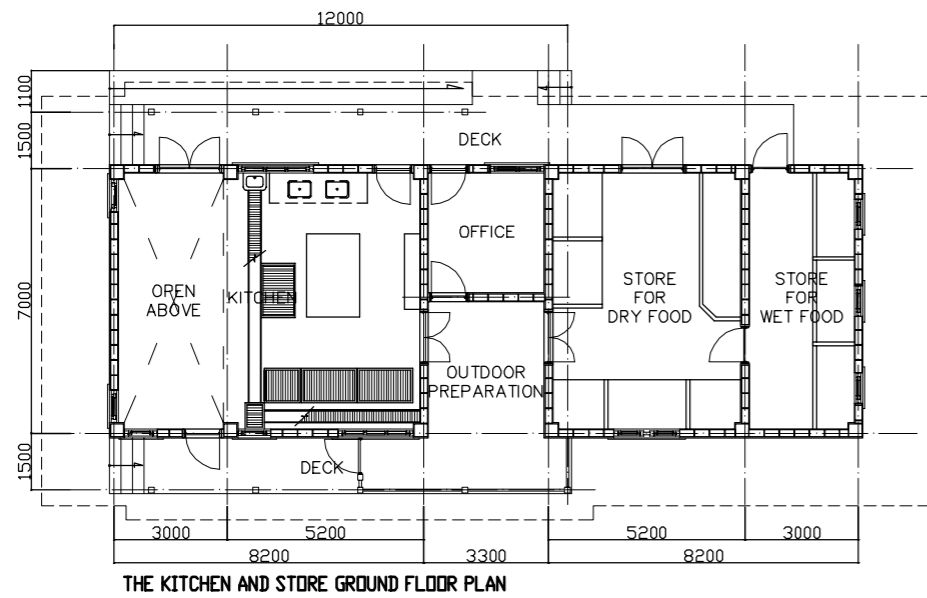


BOY'S AND GIRL'S HOSTEL SIDE ELEVATION

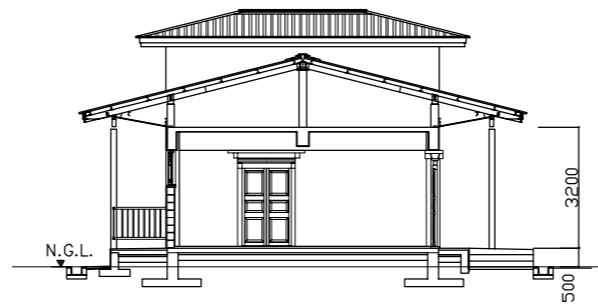


BOY'S AND GIRL'S HOSTEL SECTION

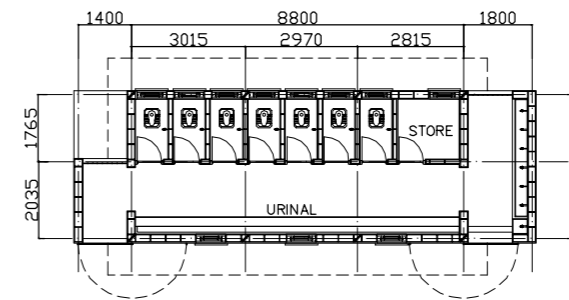
DRAWING TITLE	SCALE	
BOY'S AND GIRL'S HOSTEL BLOCK (64 BEDS) <64HOST-B & 64HOST-G> FLOOR PLANS, ELEVATIONS, SECTION	1/200	2-48



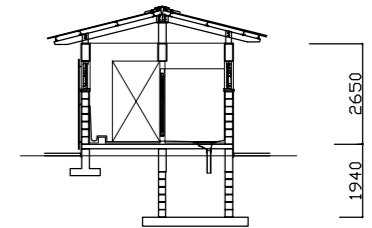
THE KITCHEN AND STORE GROUND FLOOR PLAN



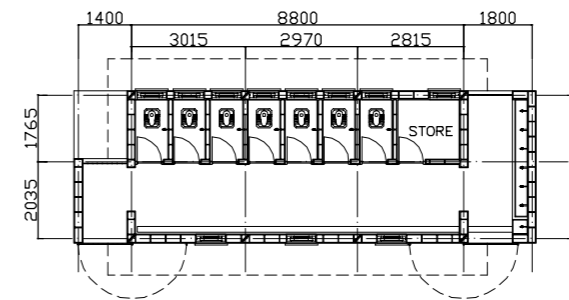
THE KITCHEN AND STORE SECTION



BOY'S TOILET GROUND FLOOR PLAN



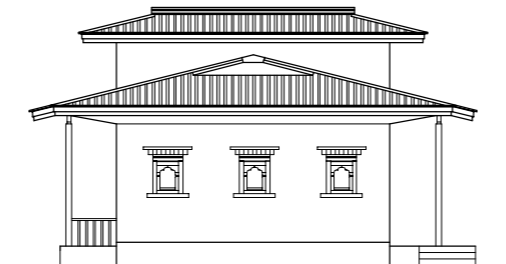
BOY'S TOILET SECTION



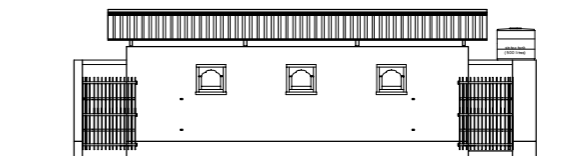
GIRL'S TOILET GROUND FLOOR PLAN



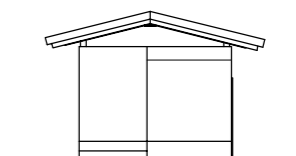
THE KITCHEN AND STORE FRONT ELEVATION



THE KITCHEN AND STORE SIDE ELEVATION



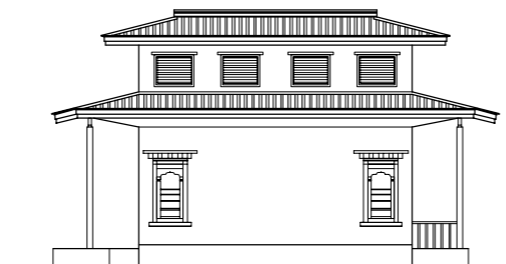
BOY'S AND GIRL'S FRONT ELEVATION



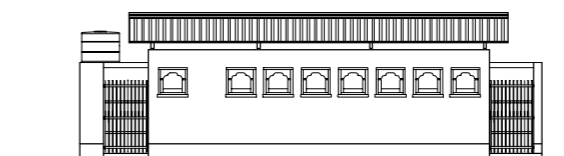
BOY'S AND GIRL'S SIDE ELEVATION



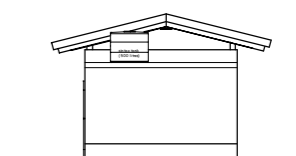
THE KITCHEN AND STORE REAR ELEVATION



THE KITCHEN AND STORE SIDE ELEVATION



BOY'S AND GIRL'S TOILET REAR ELEVATION



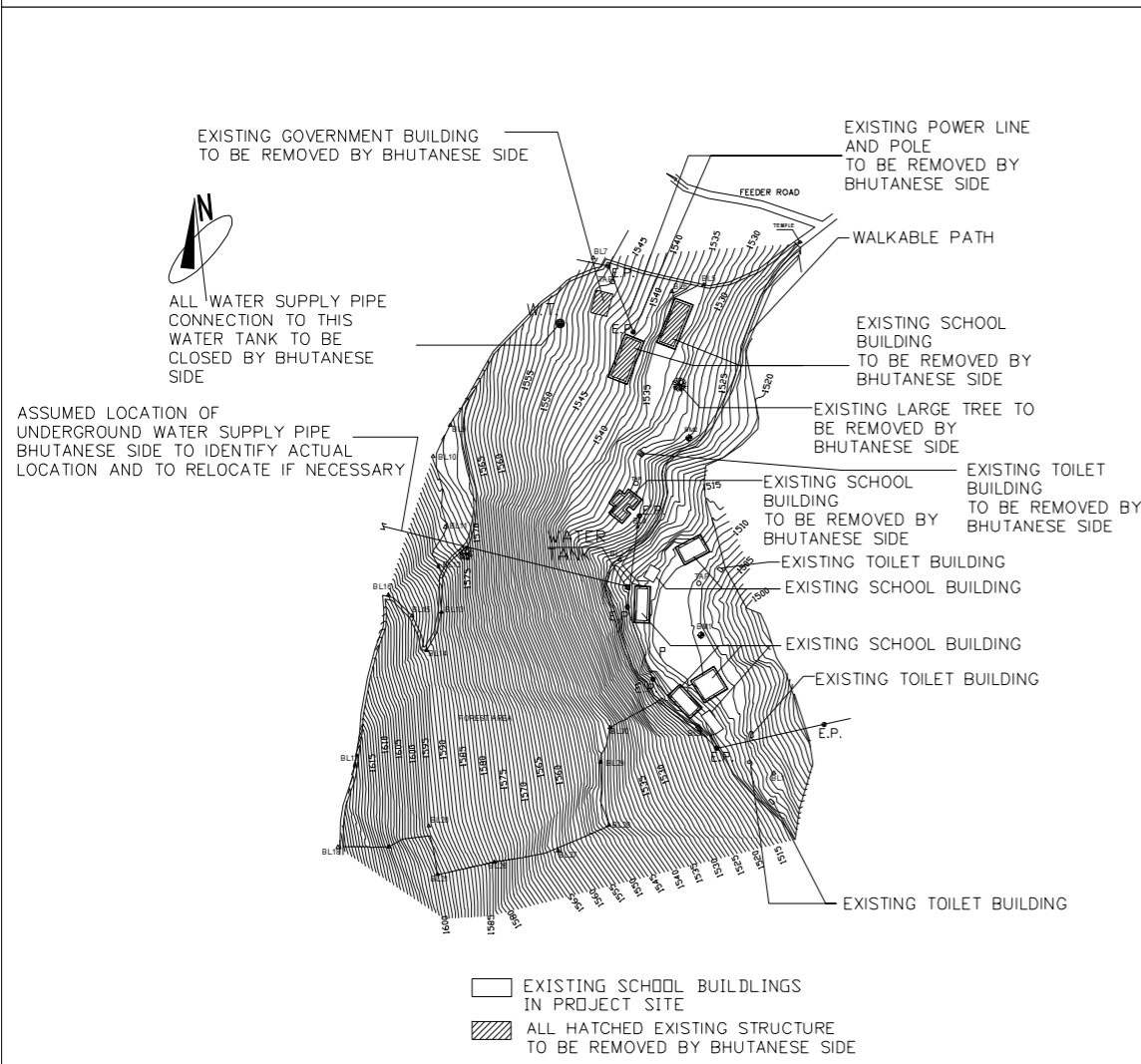
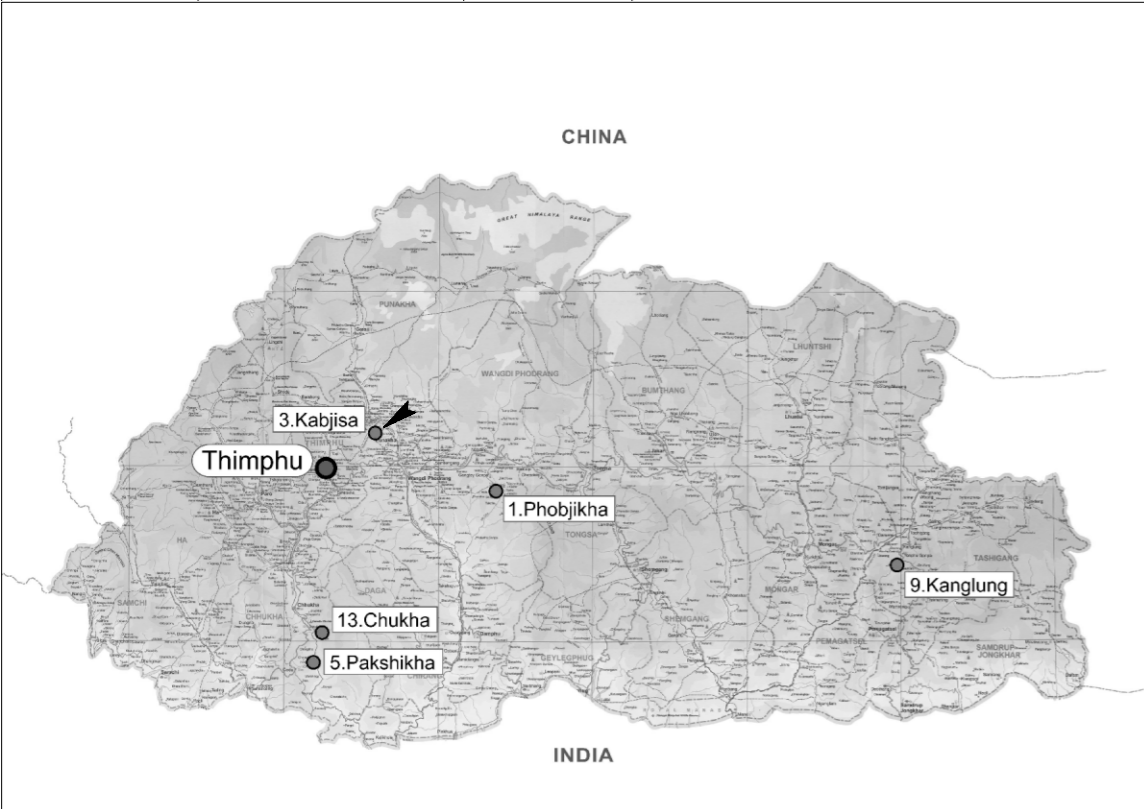
BOY'S AND GIRL'S SIDE ELEVATION

DRAWING TITLE	SCALE	
THE KITCHEN AND STORE BLOCK <KTN>, BOY'S AND GIRL'S TOILET BLOCK <TB & TG> FLOOR PLANS, ELEVATIONS, SECTIONS	1/200	2-49

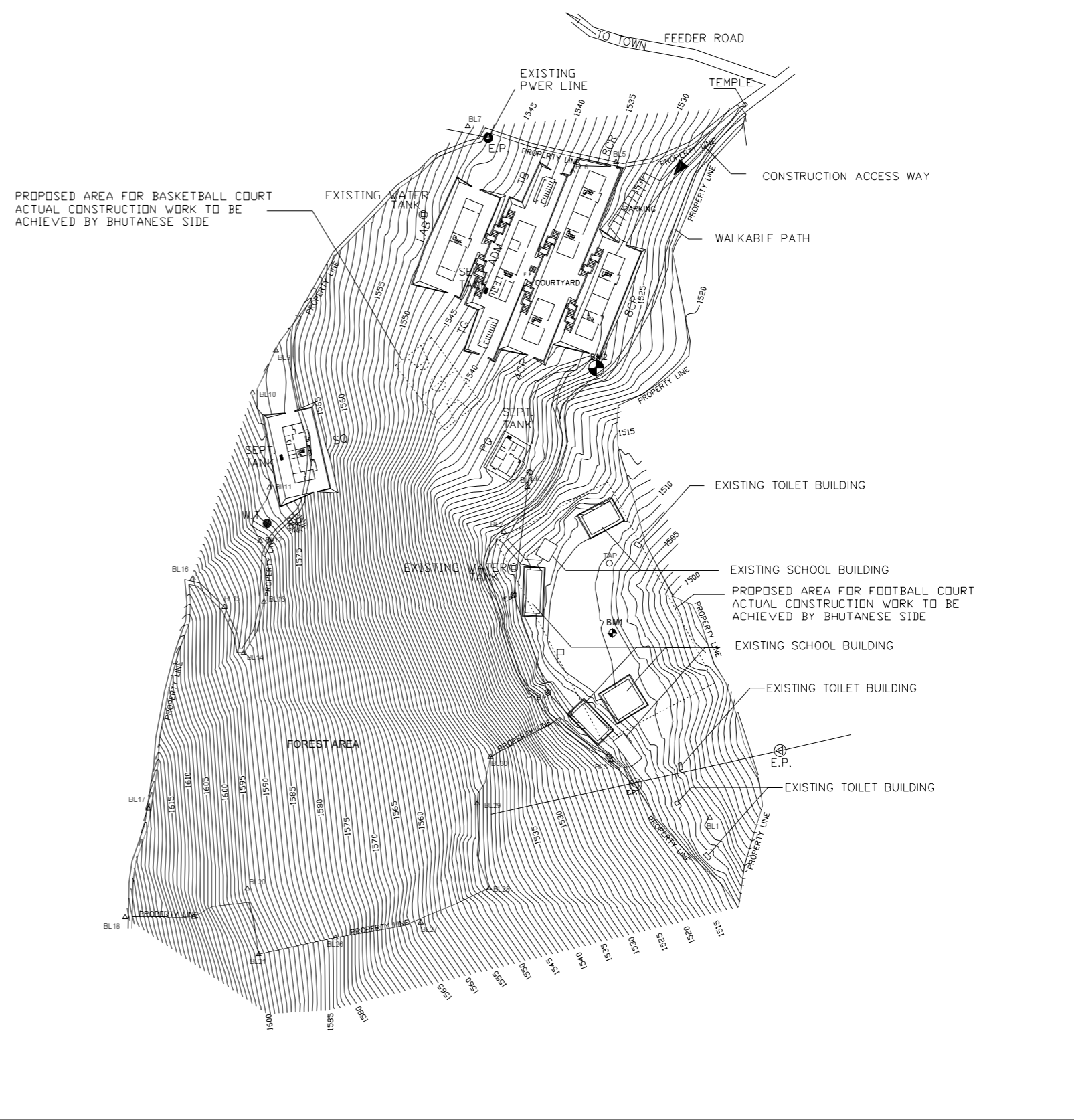




SCHOOL NAME	KABJISA	CLIMATE ZONE	TROPICAL	GENUS	MODEL
		CLIMATE ZONE	TROPICAL		

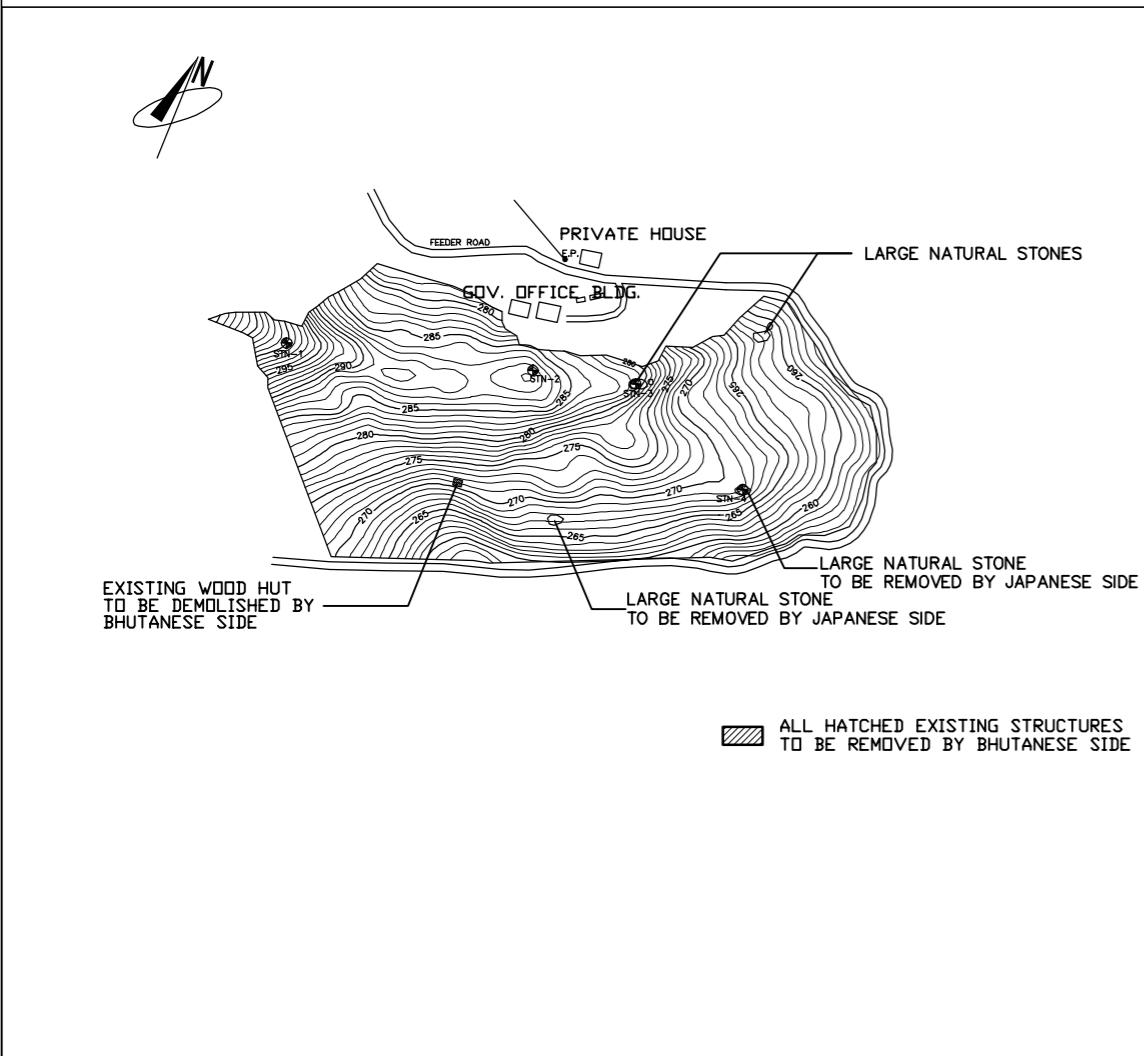
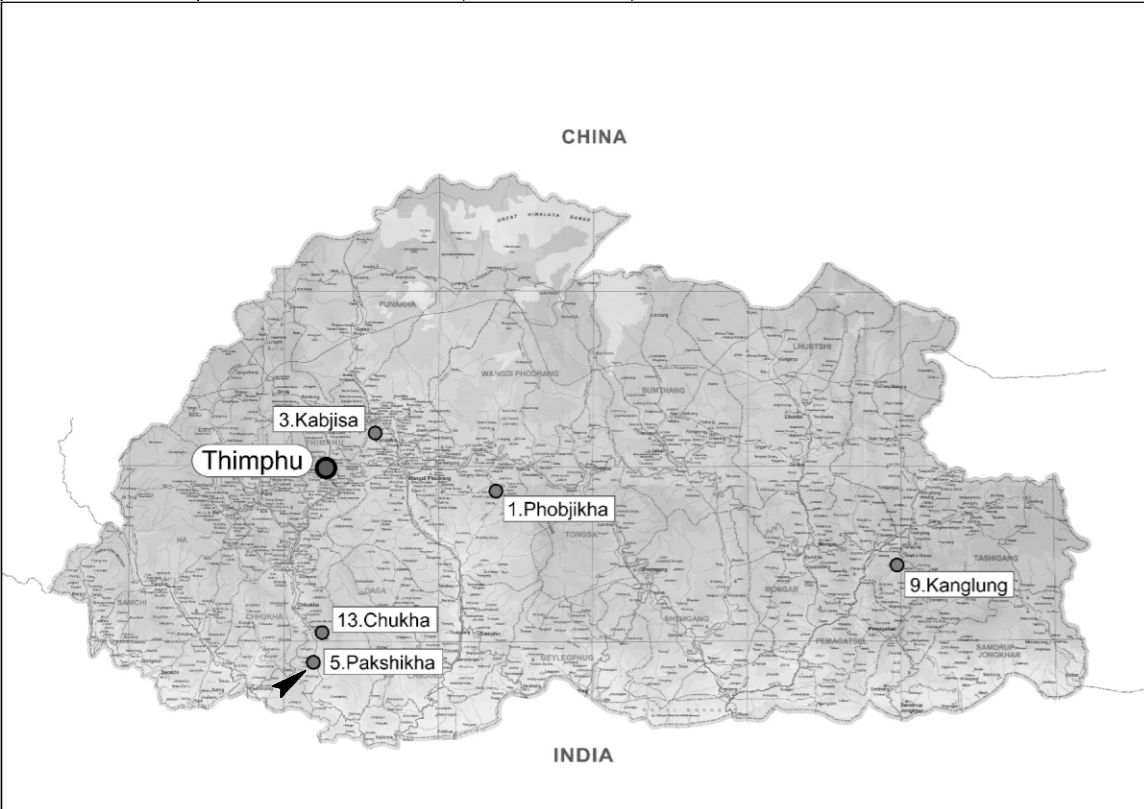


EXISTING SITE PLAN  
SCALE: 1:4000

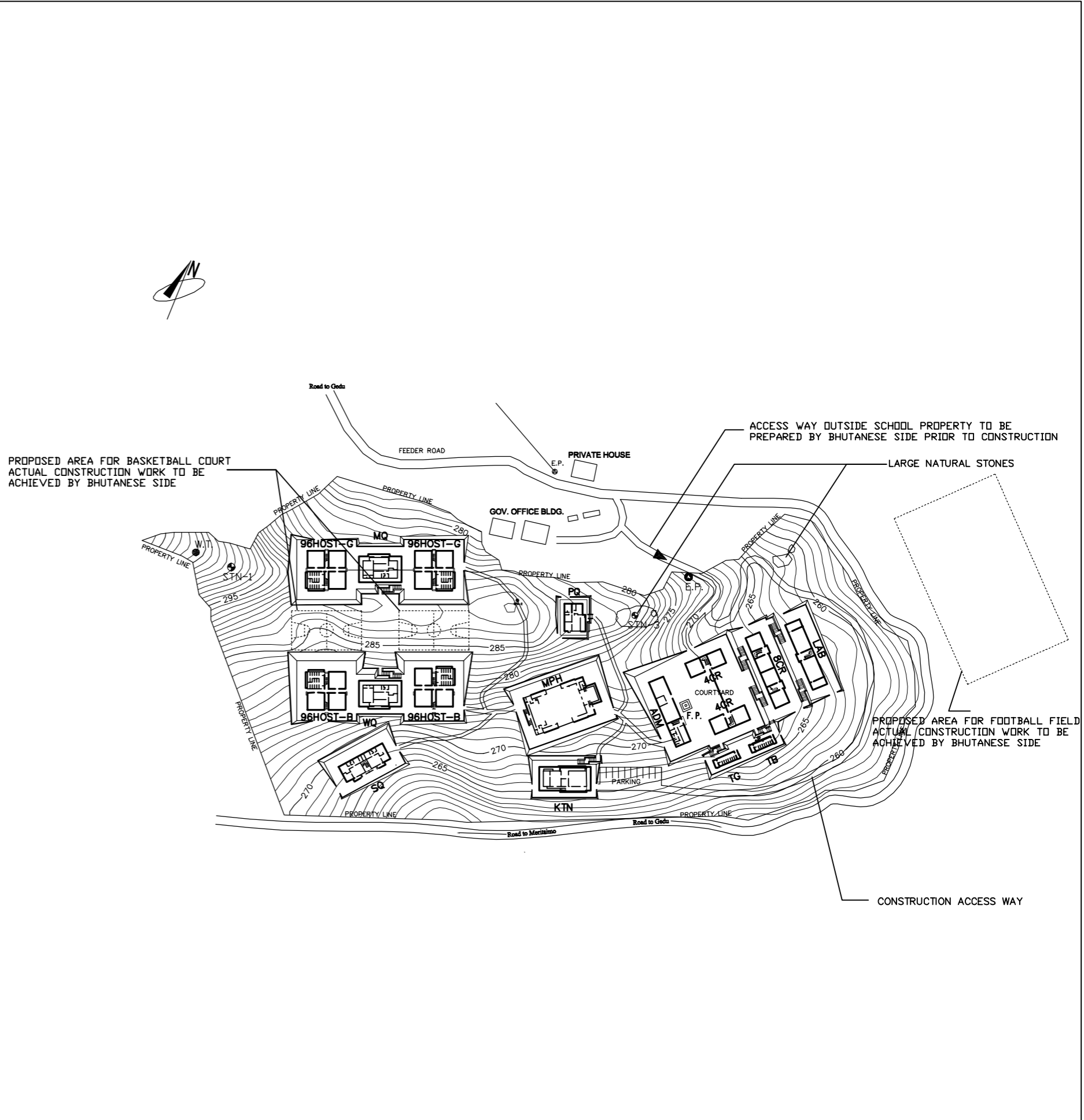


PROPOSED MASTER PLAN  
SCALE: 1:2000

SCHOOL NAME	PAKSHIKHA	GEOMETRY	CLIMATE	UTM	UTM
		CLIMATE ZONE	TROPICAL		



EXISTING SITE PLAN  
SCALE: 1:4000



LEGEND  
 ● E. P. PROPOSED LOCATION OF PROJECT FIRST ELECTRICAL POLE FOR BHUTANESE SIDE TO INSTALL W/H METER AND CONNECT POWER LINE  
 ● W. T. PROPOSED LOCATION OF PROJECT WATER TANK FOR BHUTANESE SIDE TO CONNECT LOCAL WATER SUPPLY LINE

⊙ F. P. PROPOSED LOCATION OF FLAG POLE  
 ▼ PROPOSED LOCATION OF SCHOOL ENTRANCE

PROPOSED MASTER PLAN  
SCALE: 1:2000