

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR CONSTRUCTION OF
PRIMARY SCHOOLS IN PHNOM PENH, PHASE III
IN
THE KINGDOM OF CAMBODIA

MARCH 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

MOHRI, ARCHITECT&ASSOCIATES, INC

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PREFACE

In response to a request from the Government of Kingdom of Cambodia, the Government of Japan decided to conduct a basic design study on the Project for Construction of Primary Schools in Phnom Penh, Phase III and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Cambodia a study teams from September 21 to October 30, 2008.

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

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

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

March, 2009

Eiji Hashimoto
Vice-President
Japan International Cooperation Agency

March, 2009

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Construction of Primary Schools in Phnom Penh, Phase III.

This study was conducted by Mohri, Architect & Associates, Inc., under a contract to JICA, during the period from September, 2008 to March, 2009. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Cambodia and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

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

Very Truly Yours,

Akira Yokoyama
Project Manager,
Basic design study team on
the Project for Construction of
Primary Schools in Phnom Penh, Phase III
Mohri, Architect & Associates, Inc.

SUMMARY

1. Overview of the Country

The Kingdom of Cambodia (hereinafter referred to as “Cambodia”) is situated in the center of the Indochina Peninsula, and has an area of 181 thousand sq.km, which is half that of Japan. The country is a plain surrounded by low mountains of 400 m- 1,500m high and shares its borders with Vietnam in the East, Thailand in the Northwest, and Laos in the Northeast. The country also faces the Gulf of Thailand in the Southwest. Dominant features are the large, almost centrally located, Tonle Sap, and the Mekong River, which traverses the country from North to South. The climate is monsoonal and has marked rainy (June – October) and dry seasons (November – May). The hottest time of a year is between March and May and the temperature reaches about 40 °C in daytime. The annual precipitation is over 1,200 mm in Phnom Penh.

The 1991 Paris Peace Accord brought the prolonged internal war to an end. Since then, the politics has been stabilized and the economy has been recovering. Among the major industries, namely, agriculture, manufacturing, forestry, mining, and hydroelectric power, agriculture is the biggest industry and involves about 70 % of the working population to produce about a third of GDP. In addition, tourism and garment and shoemaking industries are growing areas.

Major exports are garments, textiles, natural gum, and rubber products, while major imports are cloth, petroleum products, home appliances, and automobile parts. The ratio of each industry to GDP is 30.1% for the first industry, 26.2% for the second and, 43.7% for the third (2006: World Bank). GDP per capita is US\$594 (2007: The Government of Cambodia). On the diplomatic front, Cambodia joined ASEAN and the WTO in 1999 and 2004 respectively.

2. Background of the Request

Cambodia has recorded stable economic growth since the 1991 Paris Peace Accord that ended the long civil war from the 1970s. The government of Cambodia planned a holistic development strategy called “Rectangular Strategy” in 2006 focusing on the improvement of governance to achieve further stability and growth of the state. Of many Cambodian development issues, because of the huge loss in human resource owing to the war, the development of human resource has been regarded as a core issue to be addressed. Therefore, other than the “Rectangular Strategy,” the Government of Cambodia elaborated “an action plan for Education for All” in 2003, “Education Strategic Plan 2006-2010: ESP” in 2005, and “Education Sector Support Program 2006-2010: ESSP” to secure equal educational opportunity for all and to improve the quality of education.

The enrolment rate at primary level (6 years) has risen since the 1990s in Cambodia. While the recent population growth rate is 1.5% on the one hand, the Net Enrolment Rate jumped up

from 69% in 1991 to 91 % in 2005 on the other. Consequently, the school facilities are in serious shortage. Especially in Phnom Penh, the student-classroom ratio is 63.9, surpassing the standard of 50 determined by the Ministry of Education, Youth and Sport (hereinafter referred to as “MoEYS”), and therefore, most of the schools end up operating under the double or the triple shifts to meet the standard. Moreover, some of the existing classrooms are dilapidated, which negatively impacts the improvement of quality education in Phnom Penh.

Against this backdrop, the Government of Japan assisted in two primary school construction projects in Phnom Penh using the Project Grant Aid scheme and 224 classrooms at 11 schools were constructed. These facilities have been effectively used and well maintained, and thereby, are contributing to the improvement of the school environment in the Municipality. However, the demand for school facility construction is still high in Phnom Penh due to the rising primary school enrolment rate and dilapidation of school facilities. Therefore, in August 2007, the Government of Cambodia requested the Government of Japan an additional Grant Aid assistance to replace old buildings with new ones and to expand school facilities at 7 schools in Phnom Penh.

3. Brief Outline of the Field Survey and the Contents of the Project

Based upon the aforementioned request, the Government of Japan sent a Basic Design Survey Team to Cambodia from September 21 to October 31, 2008. The team held discussions with the government officials of Cambodia, confirmed the requests, developed the basic plan of the school facilities, and scrutinized the background of the Project. In addition, the team examined the necessity and the relevance of the cooperation during the field survey. The team conducted further analysis in Japan to put together a Draft Report of the Basic Design Study and presented it in Cambodia from February 9 to February 18, 2009. Incorporating updated information, this Basic Design Study Report was finalized.

The Project sets as its objective “improvement of the primary education quality in Phnom Penh,” the city which constantly replaces old school buildings with new ones and builds additional buildings as it is afflicted with dilapidated school buildings and classroom shortage.

The Project provides 7 requested schools with facilities consisting of classrooms and toilets and furniture consisting of student desks/chairs, teacher desks/chairs and whiteboards.

The Project identified all seven of the requested schools as the Project schools, since it has been confirmed that:

- ① all of them fulfill the school selection criteria listed as below;
 - To clarify documents confirming land ownership or land-use rights.
 - To prepare the construction lot by leveling and/or reclamation, and clear any obstacles on the lot.

- To be responsible for removing the existing buildings marked for demolition by the Japanese side in the case of rebuilding on the same lot.
 - To provide substitute classrooms during the construction work in the case of replacing the existing buildings.
 - To have a lot of sufficient size for the classroom building construction.
 - To be free from security problems.
 - To have an access road for the construction vehicles.
 - To have sufficient teachers, budget allocation and necessary cooperation from concerned people for the proper operation and maintenance of the facilities.
- ② all of them need additional classrooms to accommodate students residing in their school catchment areas at the time of 2007/8 on condition that every classroom has 48 students and the schools operate under the double-shift;
 - ③ all of them need a higher than 3-story building based upon the calculated classroom shortage and owing to the site conditions; and,
 - ④ no difficulties are expected in implementing the Project.

Since the soil foundation is weak, 3-story or 4-story classroom buildings above the ground level shall be of reinforced concrete and built upon piles. In accordance with the standard primary school floor plan by the MoEYS, in the Project schools, aligned classrooms face a side corridor and staircases are attached to the corridor at both ends. Each classroom shall be 7m x 8m (floor area 56 sqm) in size, the most common module in Cambodia. However, this module does not apply to one school featuring an extremely small construction site, and its classroom size shall be 7 m x 7 m (floor area 49 sqm).

Only one entrance to each classroom is planned. Classroom windows shall be louver type, since it provides the most comfort in the tropical climate. The classroom windows shall be as wide as the length between the columns to secure adequate natural lighting, while on the corridor side, single-open type windows will be installed so that the windows do not become an obstacle to corridor traffic even when they are open.

Toilet buildings shall be of hollow brick masonry, having 4 toilet booths (2 booths each for boys and girls) for students and a large and multipurpose booth for teachers and handicapped students. In addition, a small toilet tank is provided in each booth for flushing.

As to the arrangement plan, in order to avoid the strong sunlight during the morning and evening times, the axis of all the classroom buildings shall be east-west. By constructing the medium-rise classroom buildings along the site boundary, the central part of the sites can be left as the schoolyard. The toilet building of each site shall be constructed in such a spot that students' entry and exit are not visible.

The overall architectural plan aims to cut back the construction costs without

downgrading the facility functions or durability by lowering the story height of the classroom buildings, reducing the number of columns and piles, getting rid of a hanging wall and an eave above handrails, simplifying the floor finishing, and reducing the provision criterion of toilet booths.

The contents and size of the facilities are shown in the tables below.

(1) Facilities

No.	School Name	Structural Details	No.of Classrooms	No. of Toilet Booths (+Multipurpose Booths)	Floor Area (sqm)
1	Chak Ang Re Phum 2	4-story, RC	20	4+1	1,708.97
2	Kork Banchorn	3-story, RC	15	4+1	1,294.97
3	Toul Sangke	3-story, RC	15	4+1	1,294.97
4	Wat Neak Voan	4-story, RC	12	4+1	1,132.97
5	Wathanak Vichea	3-story, RC raised floor	12	4	1,224.00
6	Sothearos	3-story, RC	12	4+1	1,078.97
7	Sante Pheap	2-story, RC, raised floor	10	0	1,242.00
Total			96	24+5	8,976.85

RC stands for reinforced concrete.

(2) Furniture

Based upon the classroom capacity of 48 students, each classroom is provided with 24 sets of bench-tables for two students each, 1 chair and 1 desk for a teacher and 2 whiteboards.

No.	School Name	Bench-Table for Two (for students)	Chair and Desk (for teacher)	Whiteboards
1	Chak Ang Re Phum 2	480	20 each	40
2	Kork Banchorn	360	15 each	30
3	Toul Sangke	360	15 each	30
4	Wat Neak Voan	288	12 each	24
5	Wathanak Vichea	288	12 each	24
6	Sothearos	288	12 each	24
7	Sante Pheap	240	10 each	20
Total		2,304	96 each	192

4. Implementation Period of the Project

The detailed design and tender period, and the whole construction period are estimated to be 5 months and 13 months respectively. The detailed schedule is shown in the following table.

	1	2	3	4	5	6	7	8	9	10	11	12	13
Detailed Design /Tender	Work in Cambodia			Work in Cambodia									
	Design work in Japan												
				Tendering work in Japan									
Construction/Procurement	Preparation work												
	Earth&foundation work												
	Structural Work												
							Mechanical/electrical, interior/exterior finishing work						
											External work		
												Inspection/Handover	

5. Relevance of the Project

The Project is expected to bring about the following effects.

- (1) By constructing 96 classrooms at the 7 Project schools, the school environment for about 12,000 students residing in the Project school catchment areas will be improved.
- (2) By constructing 96 classrooms at the 7 Project schools, about 3,500 students currently studying at schools outside of their school catchment areas owing to the triple-shift and serious dilapidation of school building, can be enrolled in the schools of their catchment areas.
- (3) 3 of the 7 Project schools operate under the triple-shift due to classroom shortage, and consequently are unable to fulfill the standard class hours. By newly constructing 40 classrooms at the 3 schools, the number of schools which operate under the triple-shift will be decreased.

- (4) By constructing new school facilities, the Project will contribute to better school management and facility maintenance activities by SSC and community residents.
- (5) By constructing new toilets, the Project will contribute to better school hygiene.

The following issues must be addressed by the Cambodian side in order that the facilities constructed by the Project will be used continuously and effectively.

- (1) Staff the appropriate number of teachers and staff in the Project schools.
- (2) Allocate the necessary operation and maintenance costs to the Project schools.

As stated, since the Project is expected to produce many important effects, and at the same time widely contributes to Basic Human Needs of community residents, it is confirmed appropriate to assist in a part of the Project using Japan's Grant Aid. In addition, it is confirmed that the Cambodian side has sufficient manpower and finance to operate and maintain the Project facilities, and therefore, no problems are anticipated. Hence, the Project is expected to be implemented smoothly and efficiently.

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Abbreviations

DEP	Department of Education, Youth and Sport, Phnom Penh Municipality
EFA	Education for All
E/N	Exchange of Notes
ESP	Education Strategic Plan
ESSP	Education Sector Support Program
G/A	Grant Agreement
MoEYS	Ministry of Education, Youth and Sport
PB	Program Budget
PQ	Pre-qualification
SSC	School Supporting Committee

Chapter 1 Background of the Project

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1-1 Background of the Request

The Kingdom of Cambodia has recorded stable economic growth since the 1991 Paris Peace Accord that ended the long civil war from the 1970s. The Government of Cambodia planned a holistic development strategy called “Rectangular Strategy” in 2006 focusing on the improvement of governance to achieve further stability and growth of the state. Of many Cambodian development issues, because of the huge loss in human resource owing to the war, the development of human resource has been regarded as a core issue to be addressed. Therefore, other than the “Rectangular Strategy,” the Government of Cambodia elaborated “an action plan for Education for All” in 2003, “Education Strategic Plan 2006-2010: ESP” in 2005, and “Education Sector Support Program 2006-2010: ESSP” to secure equal educational opportunity for all and to improve the quality of education.

The enrolment rate at primary level (6 years) has risen since the 1990s in Cambodia. While the recent population growth rate is 1.5% on the one hand, the Net Enrolment Rate jumped up from 69% in 1991 to 91 % in 2005 on the other. Consequently, the school facilities are in serious shortage. Especially in Phnom Penh, the student-classroom ratio is 63.9, surpassing the standard of 50 determined by the Ministry of Education, Youth and Sport (hereinafter referred to as “MoEYS”), and therefore, most of the schools end up operating under the double or the triple shifts to meet the standard. Moreover, some of the existing classrooms are dilapidated, which negatively impacts the improvement of quality education in Phnom Penh.

Against this backdrop, the Government of Japan assisted in two primary school construction projects in Phnom Penh using the Project Grant Aid scheme and 224 classrooms at 11 schools were constructed. These facilities have been effectively used and well maintained, and thereby, are contributing to the improvement of the school environment in the Municipality. However, the demand for school facilities is still high in Phnom Penh due to the rising primary school enrolment rate and dilapidation of school facilities. Therefore, the Government of Cambodia requested the Government of Japan an additional Grant Aid assistance to replace old buildings with new ones and to expand school facilities at 7 schools in Phnom Penh.

Based upon the aforementioned request, the Government of Japan sent a Basic Design Survey Team to Cambodia from September 21 to October 31, 2008. The team held discussions with the government officials of Cambodia, confirmed the requests, developed the basic plan of the school facilities, and scrutinized the background of the Project. In addition, the team examined the necessity and the relevance of the cooperation during the field survey. The team

conducted further analysis in Japan to put together a Draft Report of the Basic Design Study and presented it in Cambodia from February 9 to February 18, 2009. Incorporating updated information, this Basic Design Study Report was finalized.

1-2 Natural Conditions

1-2-1 Location and Size

Cambodia is situated in the center of the Indochina Peninsula, and has an area of 181 thousand sq.km, which is about half that of Japan. The country is a plain surrounded by low mountains of 400 m- 1,500m high and shares its borders with Vietnam in the East, Thailand in the Northwest, and Laos in the Northeast. The country also faces the Gulf of Thailand in the Southwest.

1-2-2 Topography and Soil Condition

Cambodia features Tonle Sap, the largest lake in East Asia, and the Mekong River. The former is located in the northwestern part of the central plain, while the latter runs from the North to South in the center of the country.

The Mekong River and Tonle Sap are the dominant features of Cambodian geography, providing abundant water not only to lakes, bogs, and mangroves, but to the entire country.

The Cambodian soil consists of three different sediments. In the East, the sedimentary rocks from the early Jurassic period (195,000 million – 135,000 million years ago) outstretch, while the terrestrial rocks from Jurassic period – Cretaceous (140,000 million – 65 million years ago) period form highlands in the West. In addition, the sediments of the Quaternary era (240 million years ago – present) lie throughout the central plain.

The surface sediments of the central plain, consisting of sand, silt and clay, stretch over the banks of the Mekong River and Tonle Sap.

1-2-3 Climate

Cambodia lies in the Monsoonal area and has two seasons, namely, the rainy season (June-October) and the dry season (November-May). Rain in the rainy season is mostly squalls, and its precipitation varies depending on area and month. Moreover, as the downstream area of the Mekong River belongs to the Pacific typhoon area, from time to time, a typhoon triggers floods in the Mekong, though its intensity is weakened by the time it hits the area.

The average monthly temperature does not vary very much throughout the year. Rather, the temperature fluctuates widely within a day. For example, during the dry season, the daily temperature fluctuation is more than 10 °C.

Table1-1 Precipitation and Temperatures in Phnom Penh (2004)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Precipitation (mm)	0.4	0.0	0.0	94.8	160.6	164.2	142.7	101.1	237.2	202.1	118.8	0.0
High temp (°C)	34.0	35.1	39.5	39.0	37.8	35.8	36.2	35.2	34.5	32.1	33.5	32.7
Low temp (°C)	19.0	19.0	23.3	22.5	22.9	22.8	23.5	23.5	22.5	22.5	21.5	18.5

(From Statistical Yearbook 2006)

1-2 Environmental and Social Considerations

The Project constructs school facilities to replace the dilapidated buildings and to expand the facilities at the existing schools. Though one of the 7 Project schools landfills a lotus pond, no large scale land development is necessary. Hence, the Project does not negatively affect the surrounding ecosystem. Furthermore, as the Project includes no forced transfer of the residents, there are no negative social impacts.

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 the Project Objective

Cambodia has recorded stable economic growth since the 1991 Paris Peace Accord that ended the long civil war from the 1970s. The Government of Cambodia planned a holistic development strategy called “Rectangular Strategy” in 2006 focusing on the improvement of governance to achieve further stability and growth of the state. Of many Cambodian development issues, because of the huge loss in human resource owing to the war, the development of human resource has been regarded as a core issue to be addressed. Therefore, other than the “Rectangular Strategy,” the Government of Cambodia elaborated “an action plan for Education for All” in 2003, “Education Strategic Plan 2006-2010: ESP” in 2005, and “Education Sector Support Program 2006-2010: ESSP” to secure equal educational opportunity for all and to improve the quality of education.

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Against this backdrop, the Government of Japan assisted in two primary school construction projects in Phnom Penh using the Project Grant Aid scheme and 224 classrooms at 11 schools were constructed. These facilities have been effectively used and well maintained, and thereby, are contributing to the improvement of the school environment in the Municipality. However, the demand for school facilities is still high in Phnom Penh due to the rising primary school enrolment rate and dilapidation of school facilities. Therefore, the Government of Cambodia requested the Government of Japan an additional Grant Aid assistance to replace old buildings with new ones and to expand school facilities at 7 schools in Phnom Penh.

Under these circumstances, the Project sets as its objective “improvement of the primary school environment in the school catchment areas of the Project schools,” having “improvement of the primary school environment in Phnom Penh” as its overall goal.

2-1-2 Outline of the Project

The Project provides 7 requested schools with facilities consisting of classrooms and toilets and furniture to achieve the above-mentioned objective.

2-2 Basic Design of the Project

2-2-1 Design Policy

2-2-1-1 Basic Policy

The Project identified all the seven requested schools as the Project schools, since it has been confirmed that:

- (1) all of them fulfill the school selection criteria (refer to 2-2-2-1 (1) Criteria to Select the Project Schools);
- (2) all of them need additional classrooms to accommodate students residing in their school catchment areas at the time of 2007/8 on condition that every classroom has 48 students and the schools operate under the double-shift;
- (3) all of them need a higher than 3-story building based upon the calculated classroom shortage and owing to the site conditions; and,
- (4) no difficulties are expected in implementing the Project.

The facility components of the Project are classrooms and toilets. For classrooms, student desks/chairs, teacher's desks/chairs, and whiteboards will be provided.

Table 2-1 List of the Requested Schools

No.	School Name
1	Chak Ang Re Phum 2
2	Kork Banchorn
3	Toul Sangke
4	Wat Neak Voan
5	Wathanak Vichea
6	Sothearos
7	Sante Pheap

2-2-1-2 Policy for Natural Conditions

(1) Monsoonal Climate

Due to Phnom Penh's geographical proximity to the Equator, the sunlight is very intense

there. Especially, in the morning and evening times, as the incidence is low, the glare is unbearable. Hence, school buildings shall have their building axis east-west with their windows facing either north or south as far as possible.

To secure enough ventilation to lower students' perceived temperature and to allow enough natural lighting on desks, classroom windows shall be as large as possible. On the other hand, when a squall hits in the rainy season or the sunlight is too intense, classroom windows must be shut. Considering these points, classroom windows shall be of louver type, as a louver window secures good ventilation while it is shut and allows adjustment of the amount of sunlight coming into classrooms. Furthermore, eaves shall be installed outside of louver windows so that they can be left open for comfort even during the rain.

As to roofs, considering the heavy rain during the rainy season, roofs shall be appropriately sloped. Also, in order to cool down the temperature of classrooms right underneath the roof, the space under the roof on the uppermost floor classrooms shall be used as an insulator. In addition, tanks will be installed to collect rainwater from the rooftops for toilet use so that the Project schools can reduce their running cost.

(2) Soil Conditions

The overall soil conditions of Phnom Penh are not very good for building foundations, since the land is made up of the soils carried by the Mekong River. Hence, the Project schools must be designed to reduce the overall weight of the buildings and an optimal foundation structure shall be calculated based on the soil tests. Furthermore, the number of columns above the ground level shall be reduced thereby reducing the number of piles that convey the entire buildings weight to the bearing foundation at the deepest level.

2-2-1-3 Policy for Socio-Economic Conditions

(1) Small Construction Land

The Project school buildings will not be of low-rise, but of medium-rise to save building areas thereby taking a full advantage of limited space due to many existing buildings and by reducing preparatory works such as landfill, the cost of which is born by the Cambodian side.

(2) City Infrastructure

The drainage of city roads in Phnom Penh is not sufficient yet and some schoolyards get completely submerged when a squall hits during the rainy season. Considering this point, the floor of the ground level shall be set higher than the maximum submerge point throughout a year.

(3) Forest Protection Policy

The Cambodian government controls logging under its forest protection policy. Consequently, the domestic lumber production has decreased and the lumber price has increased. Hence, substitution materials such as steel shall be used as much as possible for structural and finishing materials.

(4) Barrier-Free

A ramp shall be installed from the schoolyard to the ground floor level for wheelchair-access. In addition, a multipurpose toilet where a wheelchair-student can use shall be installed.

(5) Security

To prevent furniture and equipment in classrooms from being stolen during the nighttime and vacations, classroom windows and doors shall be of steel and the ground floor door of the staircase shall be also of lattice steel.

2-2-1-4 Policy for Procurement of Construction

(1) Construction Materials and Machinery

There are many traders who import to sell construction materials in Phnom Penh and a large amount of imported materials from neighboring Asian states is available in the domestic market. In addition, as concrete aggregate, cement, and lumber are domestically produced, they are easily available. As to steel products such as steel bars, it is easy to procure products of a sufficient quality level from Vietnam, a country which acquired technology from Japan and/or Europe.

On the other hand, construction machinery is available by lease; however, contractors of medium size and bigger have their own machinery. Therefore, in principle, the Project designs school buildings that can be constructed using locally procurable construction materials and machinery.

(2) Construction Workers

In general, in Phnom Penh, Cambodian construction workers are hired in construction projects except for few cases where Chinese are hired in Chinese capital projects and Vietnamese are engaged in civil related works.

Contractors above a certain level have their own engineers and skilled workers. The wage for such engineers and skilled workers has been on the rise, since high-rise complex building constructions by foreign-capitalized firms have been started in the central Phnom Penh, and small-size apartment building constructions have been on-going for a few years in

the suburbs of Phnom Penh. Therefore, the Project school facility design shall be of a level which can be constructed by general workers.

(3) Building Codes and Permits

In Cambodia, as construction laws and regulations equivalent to the building code in Japan have yet to be established, it is allowed to apply a foreign standard such as a Japanese or British one to design structures in a construction project.

Thus, the Project discusses the standard and size, such as the size of classrooms, width of stairs and corridors, specified in the standard design of MoEYS, with Department of Education, Youth and Sport, Phnom Penh Municipality (DEP) and follows the Japanese structural design code.

The building permit of the Project will be submitted from the DEP to the Department of Construction and cadastral within the Phnom Penh Municipality Office.

2-2-1-5 Policy for Use of Local Contractors and Consultants

(1) Local Contractors

674 contractors are currently registered with the Cambodian government (542 - Cambodian contractors 132 -Foreign based contractors). They are classified into three classes based upon the number of architects and engineers, their years of experience, size, and capital. Most of the contractors fall into the small size category, while 5% of the contractors are categorized as large size and 10% of them are categorized as medium size. Contractors bigger than the medium size have their own construction machinery and undertake construction works using their own experts in electricity and plumbing.

The Project shall select several large-size contractors that have the ability to control construction quality under a Japanese contractor's supervision and have their own construction machinery, following examples of the past school construction projects under Japan's General Project Grant Aid scheme.

(2) Local Consultant

There are more than 70 architectural consultants in Phnom Penh, most of whom have experience in construction projects by donors including ones under Japan's General Project Grant Aid scheme. They have sufficient ability to support Japan-funded projects.

Therefore, the Project shall use local consultants such as civil engineers at the stage of detailed design and construction supervision to support a Japanese consultant.

2-2-1-6 Policy for Operation and Maintenance

At Cambodian schools, small-scale maintenance such as repair of furniture and windows

are taken care of by teachers and students. However, engineers and workers must be called for large-scale maintenance. Each school is responsible for maintaining its school facilities using a Program based Budget (PB) provided by the MoEYS. When the PB is in shortage, each school uses other sources such as parking space income and vendors' monthly rent and/or asks local communities for donations through a School Supporting Committee (SSC). The Project schools collect about US\$ 400-3,000 per year depending on school sizes. The cost for basic school operation and maintenance is covered by PB, other sources and donations. Therefore, there is no problem to implement the Project. In the case that unexpected expense becomes necessary, schools revise their operation and maintenance plan to manage it.

However, it is difficult for schools in Cambodia to handle large-scale maintenance. Therefore, the Project shall use durable materials which are locally available for finishing materials in order to minimize the operation and maintenance costs.

2-2-1-7 Policy for Setting Grade of Facilities

The Project, in principle, shall follow examples of general primary school facilities funded by other donors and the 2nd phase of the Project in setting the grade of facility designs. However, the Project modifies the grade set by the 2nd phase of the Project on the following points in order to further reduce the cost.

- (1) To get rid of medium columns in the direction of a classroom beam and to use a cantilever for corridors, thereby reducing the number of piles.
- (2) To lower the story height from 3.6 m, the height adopted in the 2nd phase of the Project, to 3.4m, and to lower the story height of the uppermost floor from 3.2m, the height adopted in the 2nd phase of the Project, to 3.0 m.
- (3) To get rid of a hanging wall and an eave above the handrail in the corridors.
- (4) To use louver windows and doors made of steel instead of wooden ones so that theft-proof steel lattices can be omitted.
- (5) To finish classrooms, corridors and stairs with mortar instead of cement tiles.
- (6) To forego installation of wooden bulletin boards in classrooms.
- (7) To change the criterion of provision of toilet booths from 1 booth per 2 classrooms, the criterion adopted in the 2nd phase of the Project, to 1 booth per 4 classrooms. In addition, the Project counts in the number of usable existing toilet booths to reduce the total number of toilet booths to be provided.
- (8) To change the criterion of provision of multipurpose toilets, i.e. wheelchair accessible toilet, from 2 booths per school, the criterion adopted in the 2nd phase of the Project, to 1 booth per school.
- (9) To reduce the number of ramps connecting the schoolyard to the ground floor level from 2 to 1.

2-2-1-8 Policy for Construction Method

As it is difficult to secure a sufficient number of skilled workers, the Project schools' building structure shall be of reinforced concrete, because it is common and can be constructed with only general workers. Regarding the selection of exterior and interior finishes, the Project shall select one which can be undertaken by general workers. In addition, for piling work, a less-noisy method that does not disturb the neighborhood shall be selected.

2-2-2 Basic Plan

2-2-2-1 Setting Contents and Size of the Project

(1) Criteria to Select the Project Schools

The following criteria to select schools for the Project were agreed upon in the Minutes of Discussions. And, all the seven requested schools fulfill all the criteria.

<Criteria to Select Schools for the Project>

- ① To clarify documents confirming land ownership or land-use rights.
- ② To prepare the construction lot by leveling and/or reclamation, and clear any obstacles on the lot.
- ③ To be responsible for removing the existing buildings marked for demolition by the Japanese side in the case of rebuilding on the same lot.
- ④ To provide substitute classrooms during the construction work in the case of replacing the existing buildings.
- ⑤ To have a lot of sufficient size for the classroom building construction.
- ⑥ To be free from security problems.
- ⑦ To have an access road for the construction vehicles.
- ⑧ To have sufficient teachers, budget allocation and necessary cooperation from concerned people for the proper operation and maintenance of the facilities.

(2) The Number of Classrooms to be Constructed

The primary-school-age population in Phnom Penh was slightly in decline before 2008, however, from 2008 to 2010, it levels off, and it is expected to increase drastically from 2011 onward, a few years after the construction of the Project is completed. In other words, at this moment the primary-school-age population is at a turning point, and hence, the calculation to determine the number of classrooms in shortage and setting the number of classrooms to be constructed are based upon the current number of primary school students residing in each Project school catchment area.

① Calculation of the number of classrooms in shortage:

<Preconditions>

- *The number of students at each requested schools:*
The current number of students residing in the catchment area of each requested school is used for the calculation.
- *The number of students per classroom:*
While the MoEYS sets 50 students per class as its standard, the Project sets its classroom capacity at 48 students per classroom. This is because the standard student furniture of MoEYS is a bench-table for two and 24 sets of the bench-table are best laid out in a classroom.
- *The number of shifts:*
The double-shift
- *The number of usable classrooms:*
The number of dilapidated classrooms and rented-classrooms from secondary schools are subtracted from the number of existing classrooms.

<Equation>

The number of classrooms in shortage =

$$\frac{\text{The number of students currently residing in each requested school catchment area}}{48 \text{ (students)} \times 2 \text{ (shifts)}} - \text{the number of usable classrooms}$$

<Results>

The number of classrooms in shortage at each requested school was calculated as the table below shows.

Table 2-2 The number of classrooms in shortage

School No.	No. of Requested Classrooms	No. of Students Residing in the Catchment Area (A)	No. of Classrooms in necessity (B) = (A)/48/2	No. of Usable Classrooms (C)	No. of Classrooms in Shortage (B) – (C)
No.1	24	1,814	19	0	19
No.2	15	1,851	20	0	20
No.3	20	2,228	24	9	15
No.4	16	1,437	15	3	12
No.5	12	961	11	0	11
No.6	12	1,522	16	5	11
No.7	10	2,298	24	12	12
Total	109	12,111	129	29	100

② Setting the Number of Classrooms to be Constructed

<Preconditions>

- *The maximum number of classrooms to be constructed:*
The number of classrooms to be constructed shall not exceed the number of requested classrooms.
- *Architectural design rationality in relation to the number of classrooms:*
In planning classroom buildings, unifying the number of classrooms on each floor level is the most rational from the architectural design viewpoint. Hence, the number of classrooms to be constructed shall be a multiple number of the classrooms on each floor level, which is determined by the size and positional relationship with existing buildings.
- *The maximum number of floor levels: 4*

<Results>

Based on the number of classrooms in shortage drawn in ①, the number of classrooms to be constructed at each school is shown in the following table. The result is summarized in Table 2-3.

School No.	Process of Setting the No. of Classrooms to be Constructed
No.1	As each floor shall have 5 classrooms, 1 more classroom is added to 19, the number of classrooms in shortage, and thereby, 20 classrooms in total will be constructed.
No.2	As each floor shall have 5 classrooms, the requested and maximum number of classrooms, 15, shall be constructed.
No.3	As each floor shall have 5 classrooms, the number of classrooms in shortage, 15, shall be constructed.
No.4	As each floor shall have 3 classrooms, the number of classrooms in shortage, 12, shall be constructed.
No.5	As each floor shall have 4 classrooms, 1 more classroom is added to 11, the number of classrooms in shortage, and thus, 12 classrooms in total will be constructed.
No.6	As each floor shall have 4 classrooms, 1 more classroom is added to 11, the number of classrooms in shortage, and thus, 12 classrooms in total will be constructed.
No.7	As each floor shall have 5 classrooms, the requested and maximum number of classrooms, 10, shall be constructed.

Table 2-3 The number of classrooms to be constructed

School No.	No. of Requested Classrooms	No. of Classrooms in Shortage	No. of Classrooms per floor x No. of Floors	No. of Classrooms to be Constructed.
No.1	24	19	5 x 4	20
No.2	15	20	5 x 3	15
No.3	20	15	5 x 3	15
No.4	16	12	3 x 4	12
No.5	12	11	4 x 3	12
No.6	12	11	4 x 3	12
No.7	10	12	5 x 2	10
Total	109	100	-	96

(3) The Number of Toilet Booths to be Constructed

The number of toilet booths to be constructed is determined by the criterion of 1 booth per 4 classrooms. The calculated number of toilet booths is split into two for boys' and girls' use. Besides, a large and multipurpose toilet booth for teachers and the handicapped shall be provided for each Project school. However, since the school No.5, Watanak Vichea, does not have enough space, no multipurpose toilet booth shall be installed. In addition, as the school No.7, Sante Pheap does have enough functioning toilets, no new toilet booth shall be provided for the school.

Considering the architectural design rationality, the 6 Project schools except for No.7 Sante Pheap, 4 booths (2 booths for boys and girls respectively) will be provided for each school. Hence, 24 toilet booths (12 booths for boys and girls respectively) and 5 multipurpose toilets shall be provided in total.

(4) Furniture and Equipment to be Provided

As each classroom accommodates 48 students, each classroom shall be provided with 24 sets of bench-tables for two students each, a teacher's desk, a teacher's chair, and 2 whiteboards.

(5) Contents and the Size of the Cooperation

Table 2-4 Contents and the size of the cooperation

No.	School Name	No. of Classrooms to be Constructed	No. of Toilet Booths to be Constructed (+Multipurpose booth)	Furniture and Equipment		
				Bench-table for Students	Desks and Chairs for Teachers	Whiteboard
1	Chak Ang Re Phum 2	20	4+1	480	20 each	40
2	Kork Banchorn	15	4+1	360	15 each	30
3	Toul Sangke	15	4+1	360	15 each	30
4	Wat Neak Voan	12	4+1	288	12 each	24
5	Wathanak Vichea	12	4	288	12 each	24
6	Sothearos	12	4+1	288	12 each	24
7	Sante Pheap	10	0	240	10 each	20
Total		96	24+5	2,304	96 each	192

2-2-2-2 Facility Arrangement Plan

The school facility arrangement plan and its justification at each Project school are summarized below.

(1) No.1 Chak Ang Re Phum 2

A 4-story-building with 20 classrooms shall be built rather closer to the existing primary school classrooms than to the secondary school building on the same site. In order to avoid the strong sunlight during the morning and evening times, the axis of the building shall be east-west. By constructing the medium-rise classroom building along the site boundary, the central part of the site can be left as the schoolyard. A toilet building shall be constructed between the classroom building and the secondary school building in such a spot that students' entry and exit are not visible.

(2) No.2 Kork Banchorn

A lotus pond will be land-filled for the construction of a 3-story-building with 15 classrooms in order to separate the Project school from the abutting secondary school. The classroom building will be built along the southern site boundary line, having the axis of the building east-west. By laying out the building as far from the secondary school as possible, the Project school can be prepared for a possible building expansion plan in the future. A toilet building shall be constructed in an obscure spot of a corner of the site abutting to the classroom building.

(3) No.3 Toul Sangke

A 3-story-building with 15 classrooms shall be built on the spot where there was an old classroom building. By constructing the building with its axis of building east-west and along the northern site boundary line, the Project shall keep the schoolyard area as large as possible in the center of the site. A toilet building shall be built in an obscure spot of a corner of the site abutting to the classroom building.

(4) No.4 Wat Neak Voan

Since an old administration building was demolished, a 4-story building with 12 classrooms shall be laid out on the spot, and along the southern site boundary line, with its axis of the building east-west. To keep smooth entry and exit between the existing school gate and the building, the building shall be located close to the western site boundary line. In addition, a toilet building shall be located to the north of the building across the corridor.

(5) No.5 Wathanak Vichea

The site is very small to plan a building with 12 classrooms. Taking this constraint into account, the classroom building shall be of a 4-story type with a raised floor, leaving the ground floor level for a piloti where students can play and get together. Since the site is east-west long, the axis of the building shall be naturally east-west. So as to prevent students from straying out into the street in the north when they are playing in the schoolyard, and to protect the living conditions of the neighborhood in the three directions except for the north, the classroom building shall be situated along the northern site boundary line. As the site is small, the toilet shall not be an independent building, but shall be located underneath the stairs of the classroom building.

(6) No.6 Sothearos

Provided that the old wooden classroom building is demolished, a 3-story building with 12 classrooms shall be built along the northern site boundary line and a little westward, as the largest possible vacant space can be secured there on this site crowded with existing classroom buildings. The classroom building shall have its building axis in an east-west direction. A toilet building shall abut the west side of the classroom building and its entrance shall be on the lateral side.

(7) No.7 Sante Pheap

To compensate for the small schoolyard, a building with 10 classrooms shall be of a 3-story type with a raised floor, leaving the ground floor level for a piloti. Furthermore, in

order to keep the schoolyard as large as possible between the new and existing classroom buildings, the classroom building shall be laid out along the northern site boundary line having its building axis almost east-west. No new toilet building is planned, as there are functioning toilets on the west side within the site.

2-2-2-3 Architectural Plan

(1) Floor Plan for Classroom Buildings

Based upon the standard primary school floor plan by the MoEYS, in the Project schools, aligned classrooms face a side corridor and staircases are attached to the corridor at both ends. Each classroom shall be 7m x 8m (floor area 56sqm) in size, the most common module in Cambodia. The width, in the direction of the beams, is 7m and the depth, the side tangent to the corridor and windows, is 8m. The width of the corridor is 2 m, while that of the staircase is 3 m. However, regarding No.5 Wathanak Vichea, its classroom size shall be 7 m x 7 m (floor area 49 sqm), smaller than that of other schools, since the construction site is extremely small.

Only one entrance to each classroom is planned and the classroom door shall be of a double-swinging type. Classroom windows shall be as wide as the length between the columns to secure adequate natural lighting, while on the corridor side, single-open type windows will be installed, between which shall be a wall so the windows do not become an obstacle to corridor traffic even when they are open.

At each Project school, two abutting classrooms located at either end of the building on the lowermost level will be parted by movable partitions so that the classrooms can be combined as one room for student or community meetings when necessary.

A podium and a whiteboard will be installed either on the west or east side of each classroom so that the light shines on students' desks from the left side. However, regarding one of the two classrooms parted by movable partitions, as a whiteboard cannot be installed on the partitions, a podium and a whiteboard shall be set on the side opposite the partitions.

(2) Sectional Plan for Classroom Buildings

1) Floor and Roof

The roof is tiled, and its underside is to be layered with sheathing and asphalt membrane waterproof sheet over the steel purlin/rafter. As the asphalt membrane waterproof sheet enhances the waterproof function, the roof pitch shall be no more than 4-in-10. The floor of each level shall be of reinforced concrete slab to insulate acoustically between the consecutive floor levels. However, the upside of classrooms on the uppermost level shall not have slab in the attic for the sake of cost reduction.

2) Ground Floor Level

As the water drainage system is not yet complete in Phnom Penh, from time to time, rainwater submerges structures from 20-40cm above the ground level in the rainy season depending on sites. When rainwater completely covers the ground floor level, the schools close. Therefore, the ground floor level shall be set 50 cm higher than the schoolyard ground level.

3) Story and Ceiling Height

The story height adopted by other donors' primary school construction projects is 3.8m-4.0m. Considering conflicting purposes, namely, the provision of a comfortable learning environment in the humid weather on the one hand and cost reduction on the other, the story height of the Project schools shall be 3.4m, 0.2m lower than the height adopted in the 2nd phase of the Project. Likewise, the story height of the uppermost floor shall be 3.0m, 0.2m lower than the height adopted during the 2nd phase of the Project.

4) Walls

Walls shall be made of reinforced concrete frames consisting of columns and beams, and masonry structure bricks. For the masonry structure, the most commonly used and inexpensive hollow brick shall be used. The exterior wall shall be of a double-layer structure, while parting walls inside shall be of single-layer structure.

5) Openings

Classroom windows shall be of a louver type commonly used in Cambodia, since it allows ventilation when shut, is durable and easy to use. Though in Cambodia, wooden type louver windows are common, in the Project, steel type windows shall be used, as they are cheaper. Since steel louver windows are strong and theft-proof, there will be no need to install a theft-proof steel lattice, which would be imperative for a wooden louver window. Nonetheless, steel lattice shall be installed over all the windows facing outside on the first floor and higher so that students shall not fall.

Moreover, the height of windows shall be up to that of beams so that the skeleton work can be omitted, the construction efficiency can be improved, and adequate natural lighting can be secured. Above the windows, eaves shall be installed to prevent the direct sunlight from coming into the classrooms and to allow the natural ventilation while the windows are shut in the rain.

Classroom doors shall be wide and double-swing, as in Cambodia, classroom doors are usually left open regardless of whether lessons are going on or not for the sake of easier entry and exit and for better natural ventilation. The material of classroom doors shall be steel, the same as windows, because such doors are stronger and cheaper than wooden ones.

(3) Toilet Buildings

5 out of the 7 Project schools will be provided with an independent toilet building consisting of 4 toilet booths (2 booths for boys and girls respectively) for students and a large and multipurpose booth for teachers and handicapped students. The boys' and girls' booths are separated by a wall and an uncovered ditch functioning as a tank. Since the uncovered ditch, located between the boys' and girls' booth, is connected to a small toilet tank provided in each booth, the water level of the tanks and the ditch will remain the same. To add, the toilet building shall be covered with tiled gable roof. The space under the roof shall be used for securing sunlight and ventilation. Moreover, at each site, a handicapped access ramp connecting to the schoolyard shall be built between the classroom building and the toilet building.

(4) Structural Plan

1) Design Policy

The structure of classroom buildings shall be of reinforced concrete frame. The buildings shall be 3 or 4 stories high. Toilet buildings shall be one story of hollow brick masonry. Since the soil of construction sites is weak, concrete piles shall be driven for the classroom buildings.

2) Design Load

① Live Load	Roof	0N/m ²
	Classroom Floor	2900N/m ² (Floors and beams) 2100N/m ² (Frames)
	Stairs/Corridor Floor	3500N/m ² (Floors and beams) 3200N/m ² (Frames)
② Seismic Load	Not considered	
③ Wind Load	The following equation is applied to calculate wind load. W=C x q x A	
		C: Wind pressure coefficient Q: Velocity pressure (25kg/m ²) A: Area (m ²)

3) Structural Materials and Strength

The structural materials and their strength for the structural design are as follows.

- ① Concrete FC24N/m²
- ② Reinforcing bars Deformed steel bar: SD390 Round steel bar: SR235 or equivalent

(5) Facility Service Plan

1) Water Supply System

As to the water supply for toilet buildings, city water supplied to the site or well water within the site will be used in principle. In addition, the Project will have collected rainwater available for toilet use.

2) Drainage System

The main drainage connected to each site is not connected to the final sewage treatment system but to a pond. Therefore, in the Project, sewage water shall be treated in a septic tank and then flow into the main drainage. However, in the event that there is no sufficient angle to connect a septic tank to the existing main drainage, an infiltration pipe shall be additionally installed for connection.

3) Electrical System

Classrooms and toilets shall be equipped with lighting fixtures, considering that it is not very bright during the daytime in the rainy season, and that the schools operate under the double-shift system. In addition, each classroom shall be equipped with outlets.

(6) Construction Material Plan

The following table summarizes major construction materials for the Project and their justifications.

Table 2-5 Construction Materials for the Project and Justifications

Parts	Local Standard Materials	Material adopted for the Project	Justification
Main Structures			
Foundation	Reinforced concrete	Same as left	Follow local standard
Column/Beam	Reinforced concrete	Same as left	Follow local standard
Wall	Hollow brick	Same as left	Follow local standard
Roof/Floor	Reinforced concrete	Same as left	Follow local standard
Exteriors			
Exterior wall	Paint on mortar	Same as left	Follow local standard
Opening	Wooden louver window	Steel louver window	Cost effectiveness and theft-proof
Roof	Ceramic roof tile	Colored cement roof tile	Durability
Interiors			
Classroom floor/Corridor floor	Cement tile, porcelain tile	Mortar	Cost effectiveness
Toilet floor	Porcelain tile	Same as left	Follow local standard

Parts	Local Standard Materials	Material adopted for the Project	Justification
Classroom wall	Paint on mortar	Same as left	Follow local standard
Toilet wall	Upper: paint on mortar Lower: porcelain tile	Same as left	Follow local standard
Ceiling	Paint on mortar	Paint on concrete	Cost Effectiveness
Classroom door	Wooden door	Steel door	Cost effectiveness and theft-proof

(7) Size of the Project School Facilities

Table 2-6 Size of the Project School Facilities

No.	School Name	No. of Classrooms to be Constructed	No. of Floor Levels	Floor Area of Classroom building (sqm)	Floor Area of Toilet Building (sqm)	Total Floor Area (sqm)
1	Chak Ang Re Phum 2	20	4	1,656.00	52.97	1,708.97
2	Kork Banchorn	15	3	1,242.00	52.97	1,294.97
3	Toul Sangke	15	3	1,242.00	52.97	1,294.97
4	Wat Neak Voan	12	4	1,080.00	52.97	1,132.97
5	Wathanak Vichea	12	4 (raised floor)	1,224.00	0.0	1,224.00
6	Sothearos	12	3	1,026.00	52.97	1,078.97
7	Sante Pheap	10	3 (raised floor)	1,242.00	0.0	1,242.00
Total		96	-	8,712.00	264.85	8,976.85

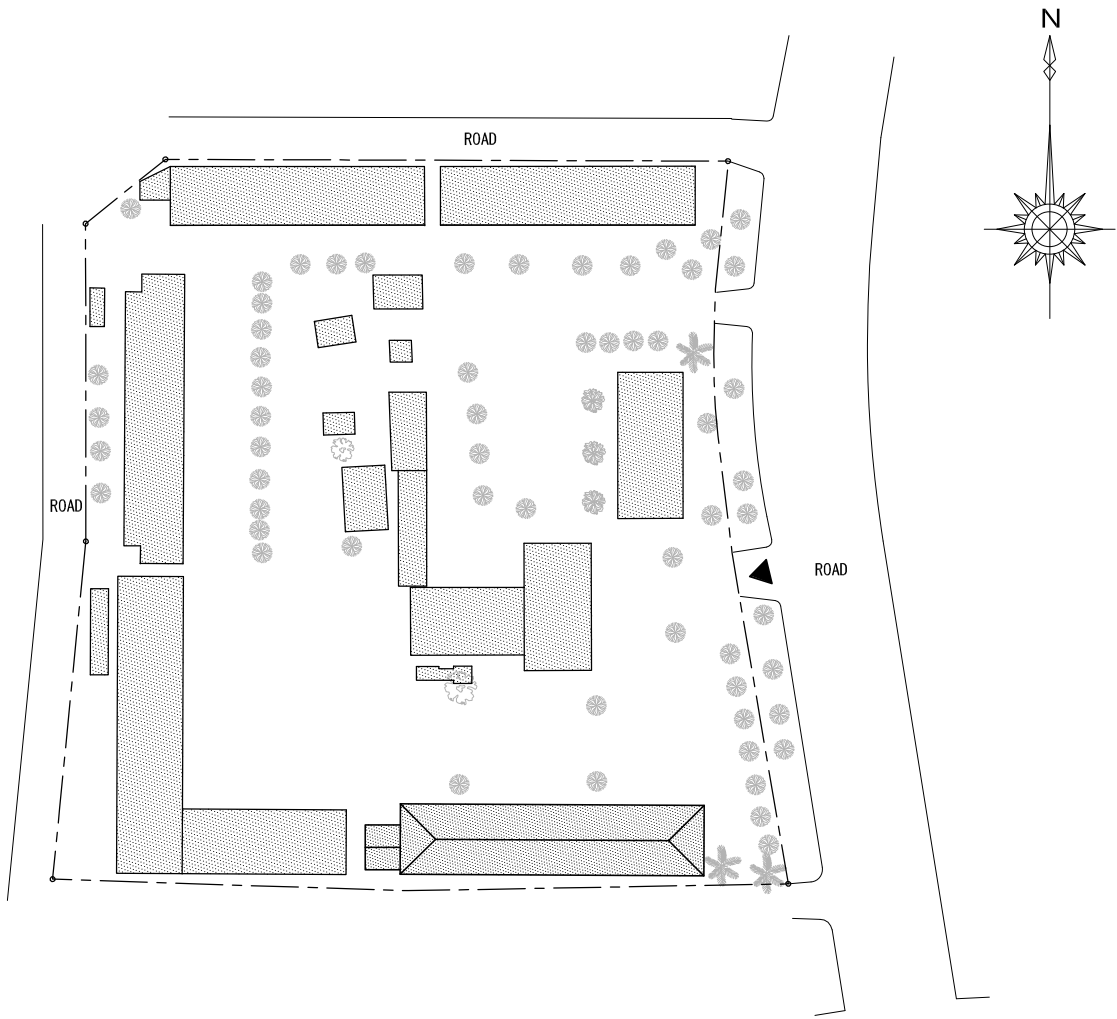
2-2-2-4 Furniture Plan

Student desks and chairs shall be of a bench-table type for two commonly used in Cambodian primary schools, as it is easy to organize classrooms. Alternatively, teacher desks and chairs are of a general separated type. Teacher desks and chairs are wooden, but the students' desks and chairs will be of steel, since wooden materials are pricy due to the recent forest protection policy and because steel materials are more durable.





Instead of a blackboard, a whiteboard of the type commonly used in schools in Phnom Penh, will be provided in each classroom. This is because concerns have been raised about the effects of chalk dust on students' health. To add, whiteboard markers shall be purchased by each school using funds provided by MoEYS.

2-2-3 Basic Design Drawings

Building site plans, floor plans, elevations, sections are shown in the following pages.



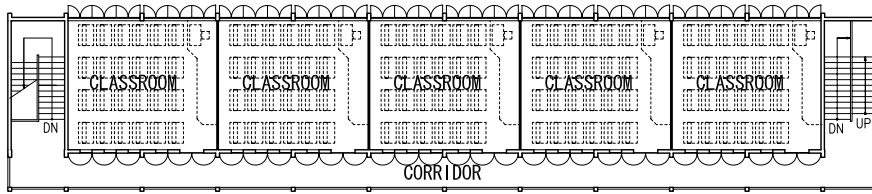
LEGEND

-  PROJECT BLDG.
-  EXISTING BLDG.
-  BOUNDARY LINE
-  MAIN GATE

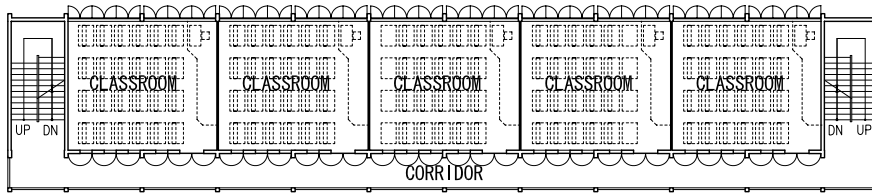
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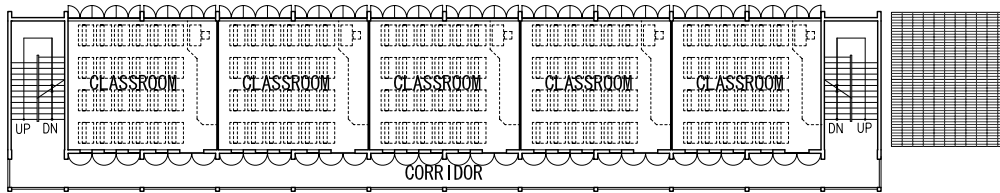
SITE PLAN



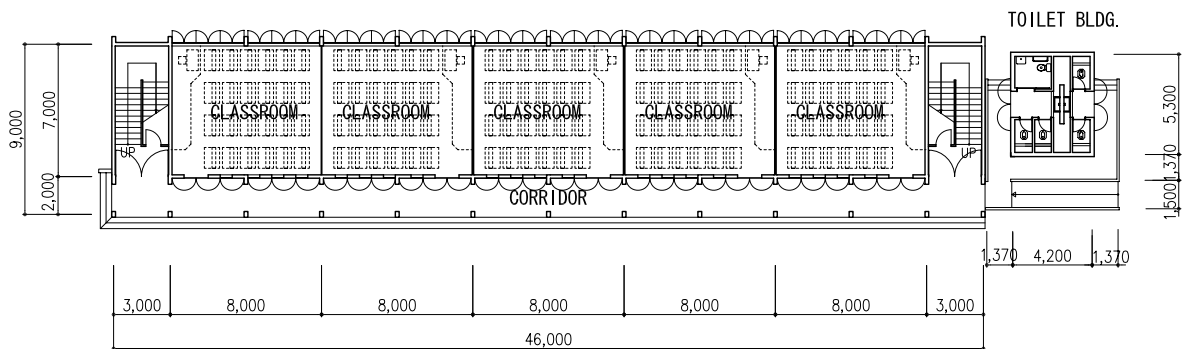
THIRD FLOOR



SECOND FLOOR



FIRST FLOOR

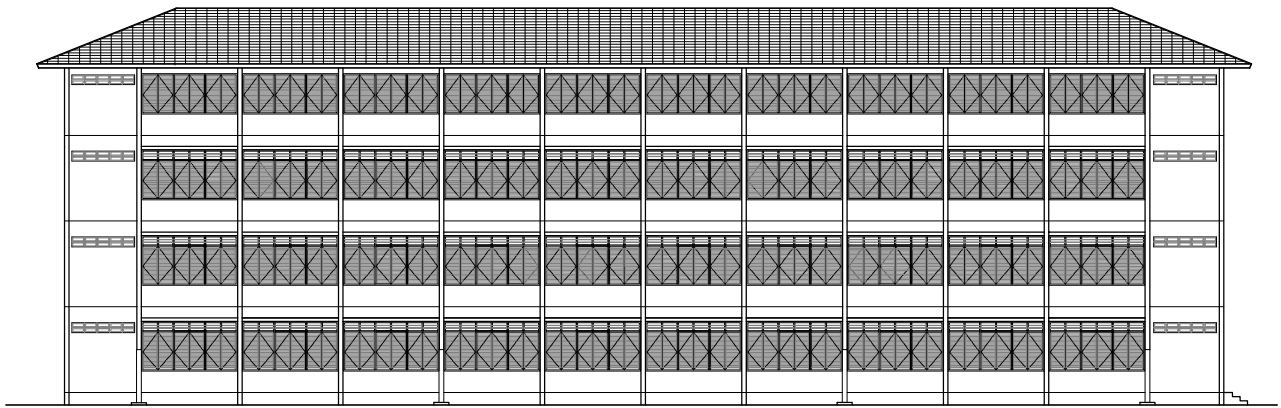


GROUND FLOOR

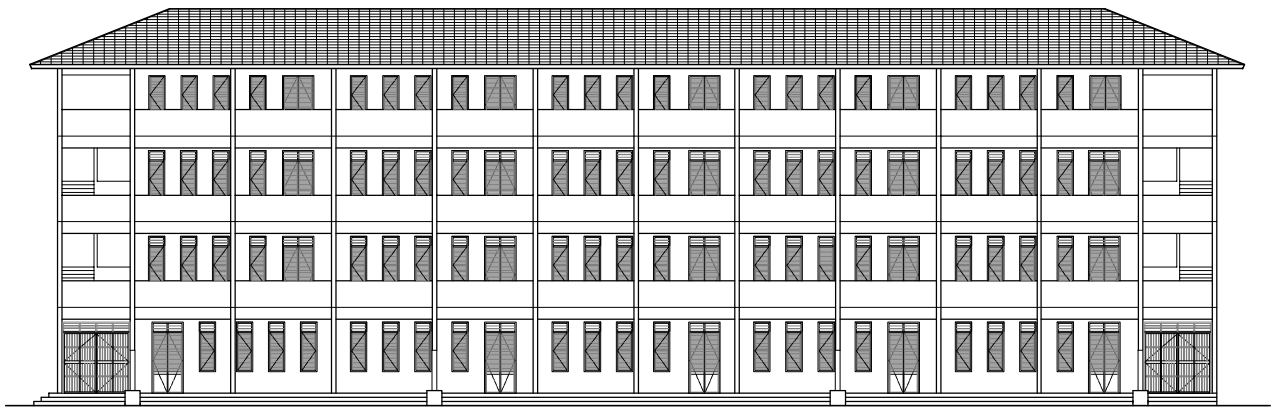
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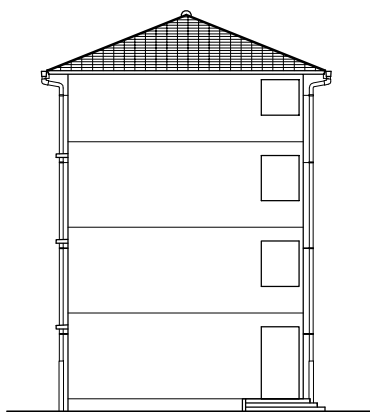
CLASSROOM BLDG.
FLOOR PLAN



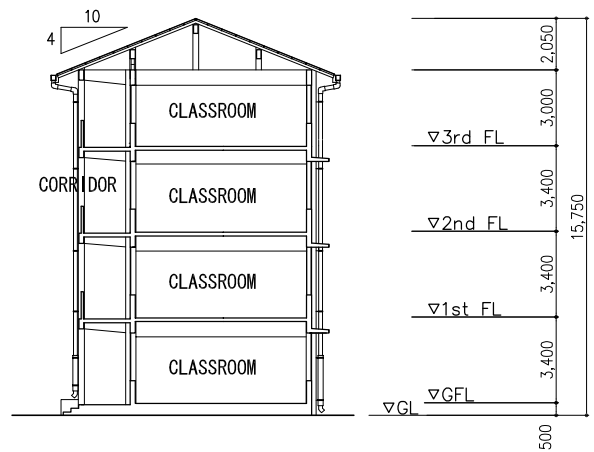
ELEVATION (CLASSROOM SIDE)



ELEVATION (CORRIDOR SIDE)



ELEVATION (GABLE SIDE)

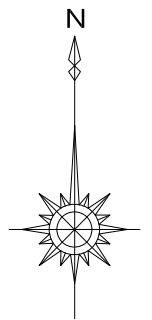
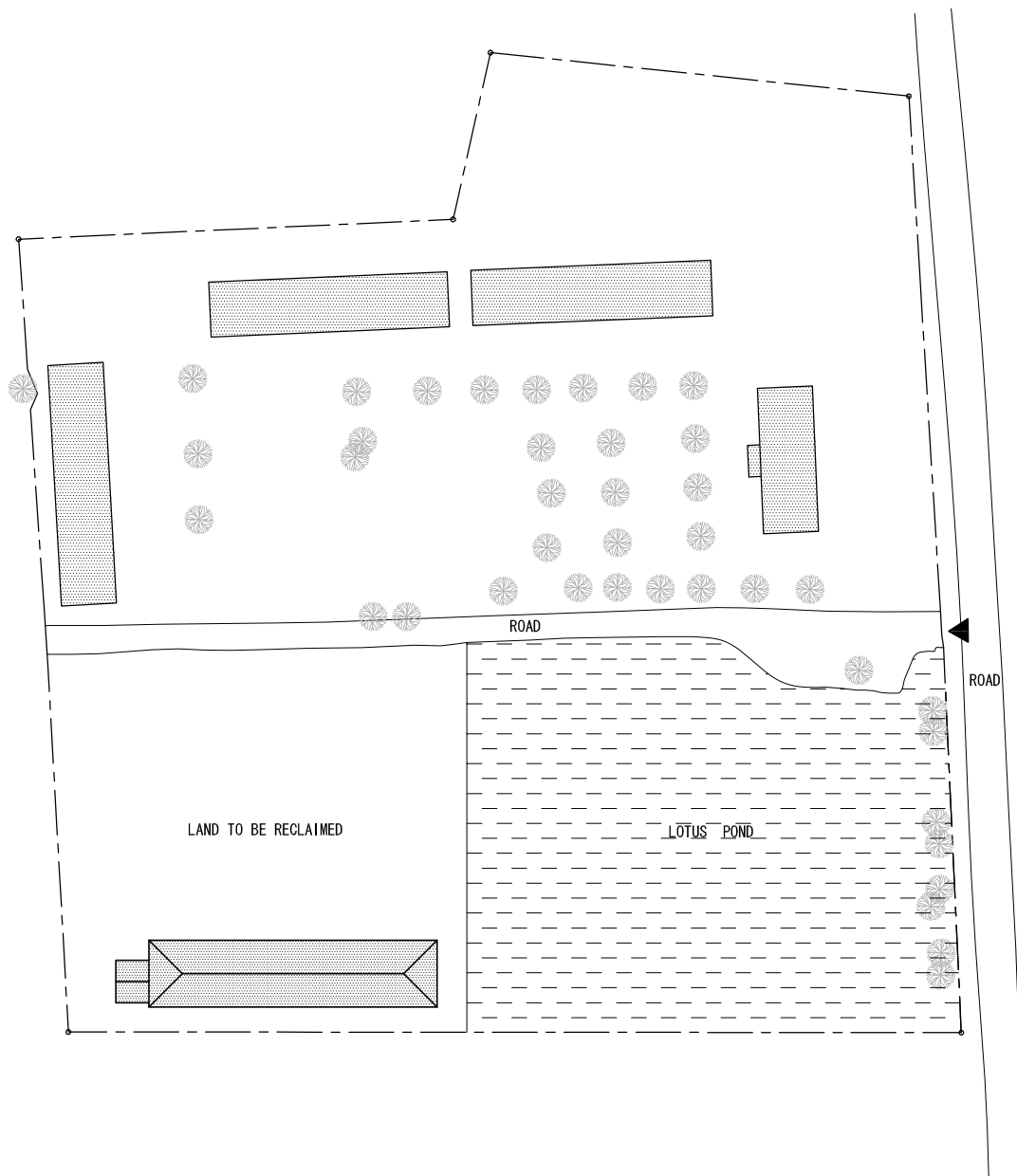


SECTION





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No. 1 Chak Ang Re Phum2

CLASSROOM BLDG.
ELEVATION-SECTION



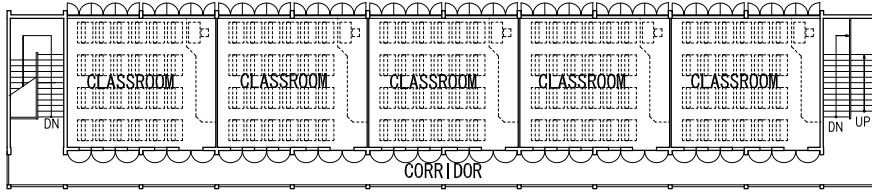
LEGEND

-  PROJECT BLDG.
-  EXISTING BLDG.
-  BOUNDARY LINE
-  MAIN GATE

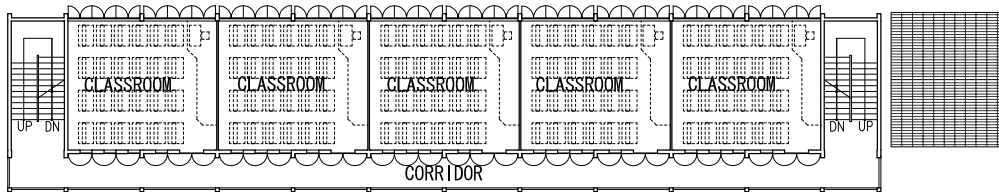
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No. 2 Kork Banchorn

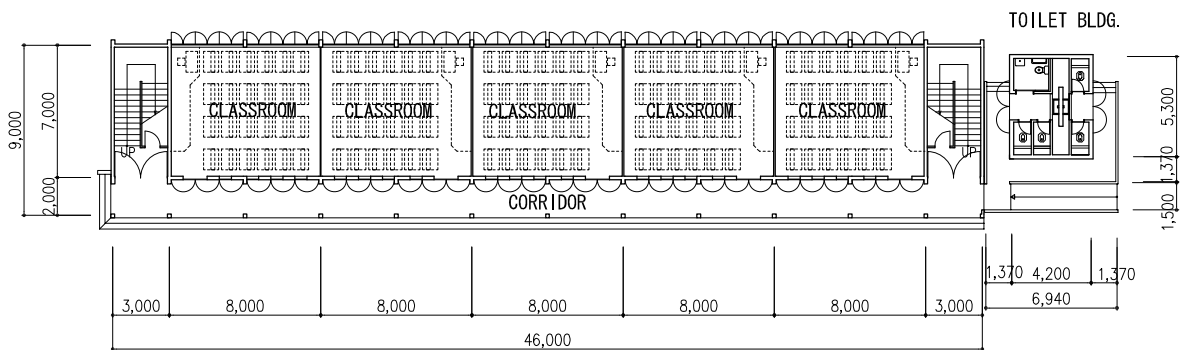
SITE PLAN



SECOND FLOOR



FIRST FLOOR

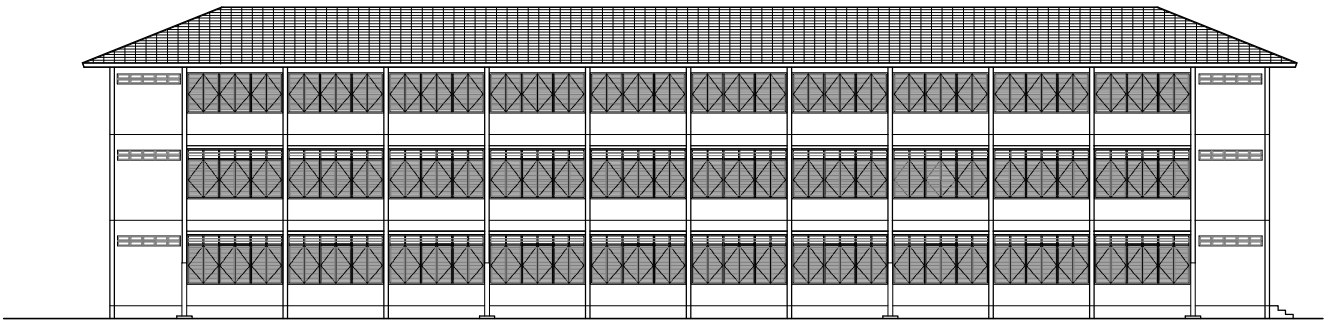


GROUND FLOOR

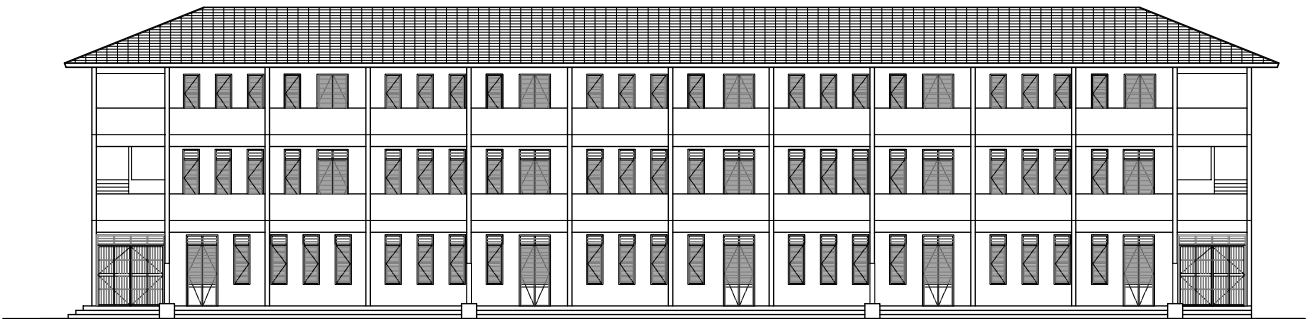
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No. 2 Kork Banchorn

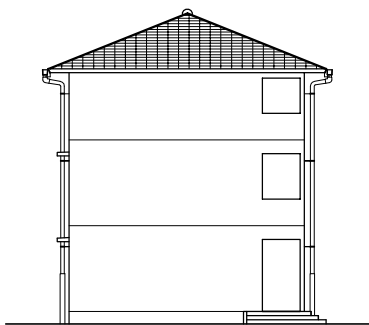
CLASSROOM BLDG.
FLOOR PLAN



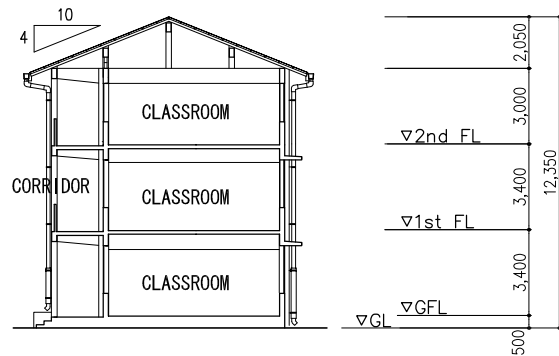
ELEVATION (CLASSROOM SIDE)



ELEVATION (CORRIDOR SIDE)



ELEVATION (GABLE SIDE)

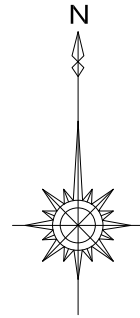
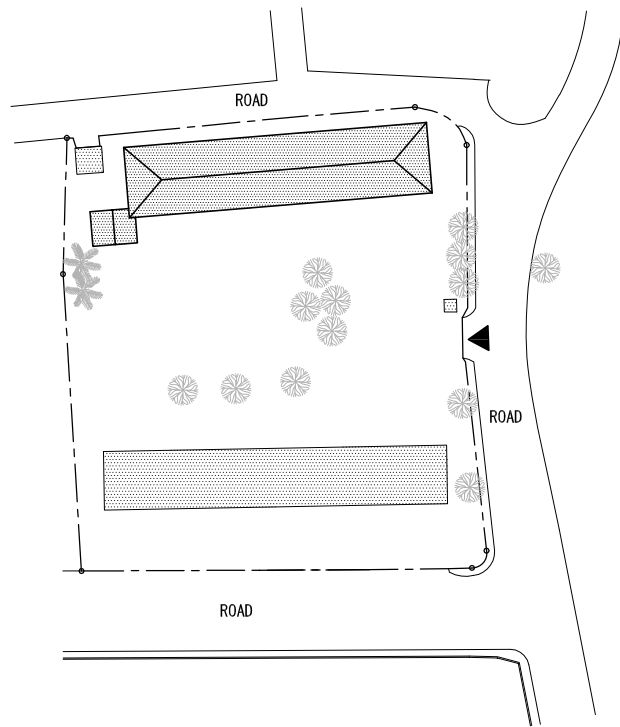


SECTION





S=1:300

No. 2 Kork Banchorn

CLASSROOM BLDG.
ELEVATION-SECTION



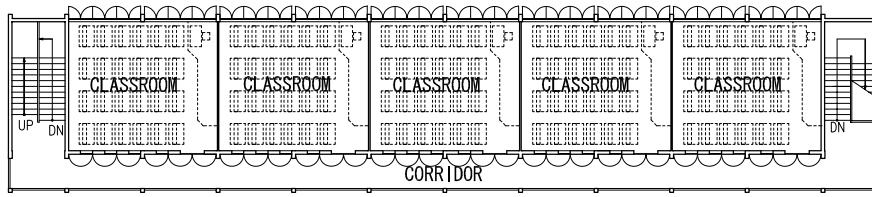
LEGEND

-  PROJECT BLDG.
-  EXISTING BLDG.
-  BOUNDARY LINE
-  MAIN GATE

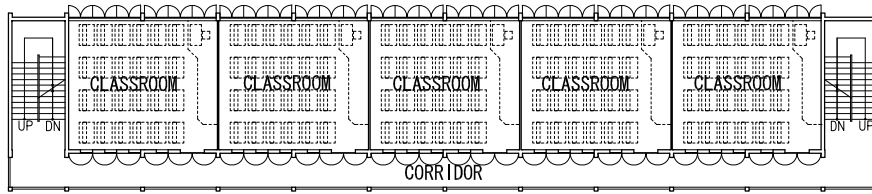
S=1:1200

SITE PLAN

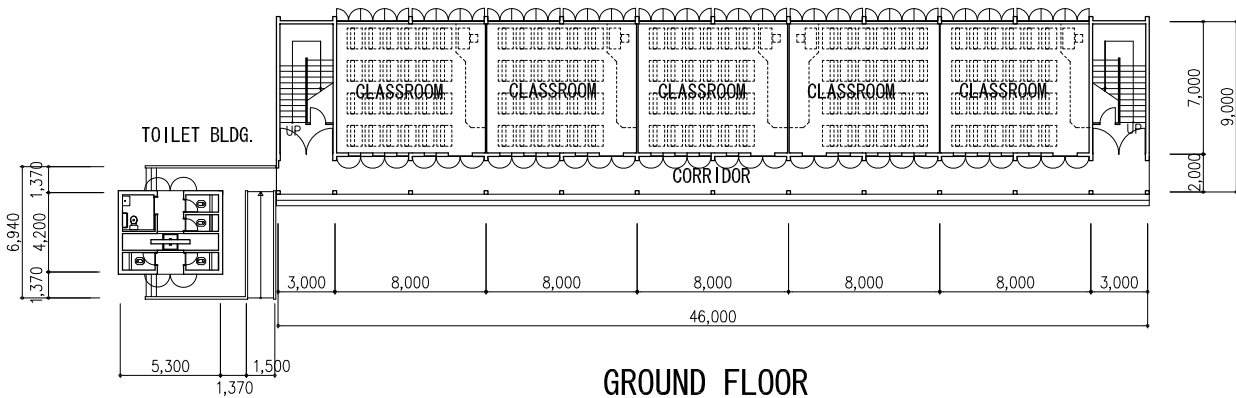
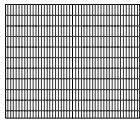
No. 3 Toul Sangke



SECOND FLOOR



FIRST FLOOR

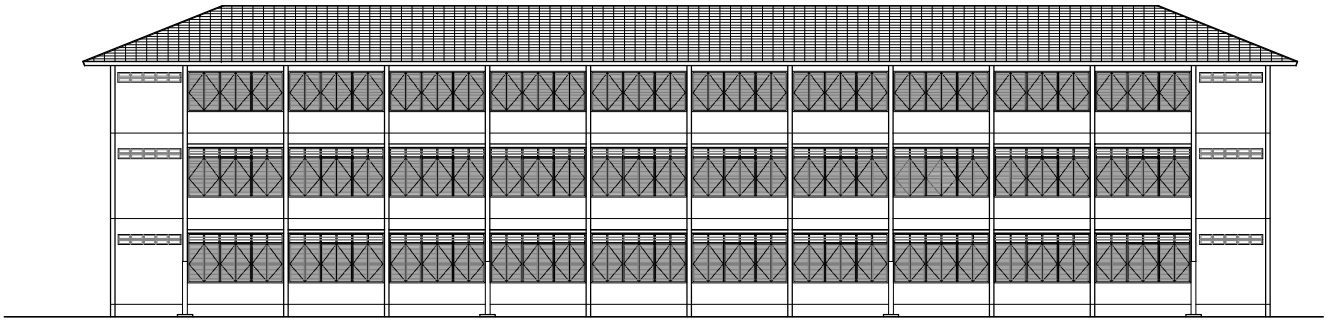


GROUND FLOOR

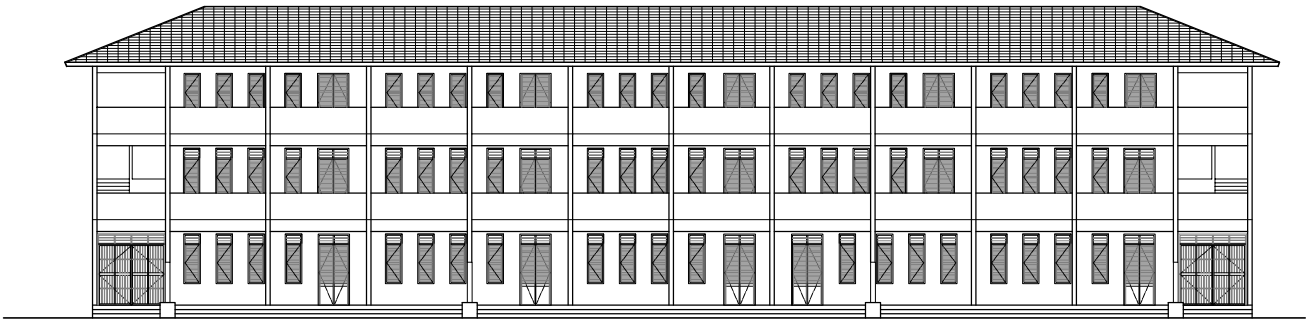
S=1:400

No. 3 Toul Sangke

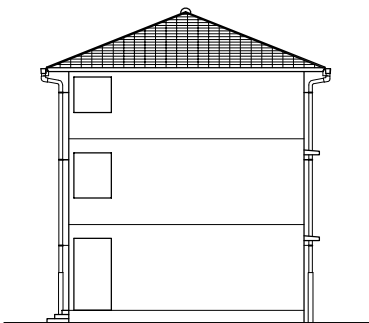
CLASSROOM BLDG.
FLOOR PLAN



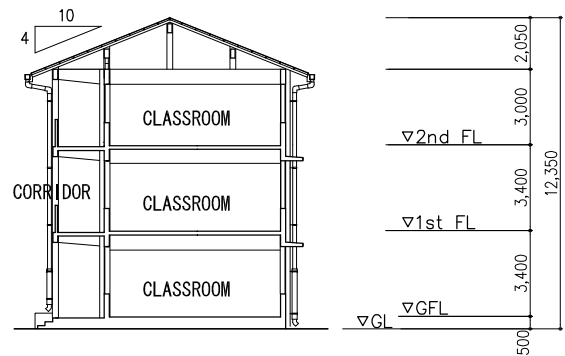
ELEVATION (CLASSROOM SIDE)



ELEVATION (CORRIDOR SIDE)



ELEVATION (GABLE SIDE)

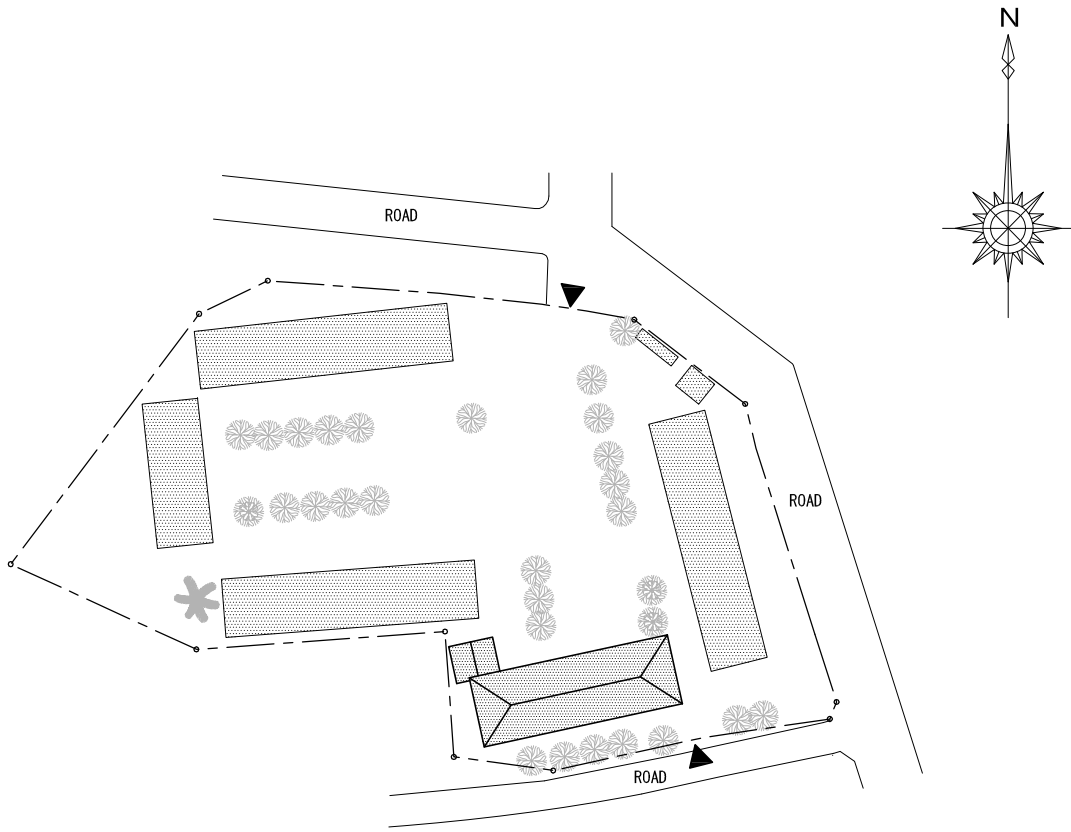


SECTION





S=1:300

No. 3 Toul Sangke

CLASSROOM BLDG.
ELEVATION-SECTION



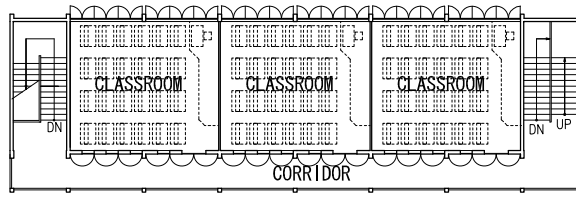
LEGEND

-  PROJECT BLDG.
-  EXISTING BLDG.
-  BOUNDARY LINE
-  MAIN GATE

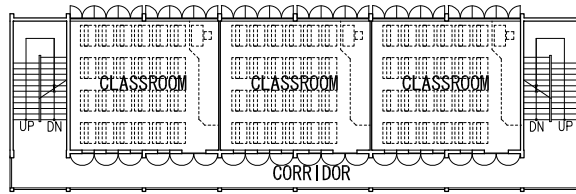
S=1:1200

No. 4 Wat Neak Voan

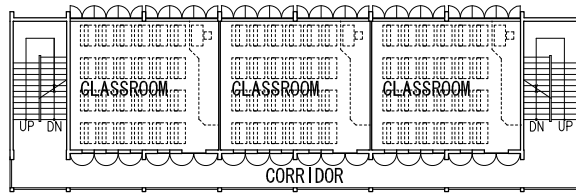
SITE PLAN



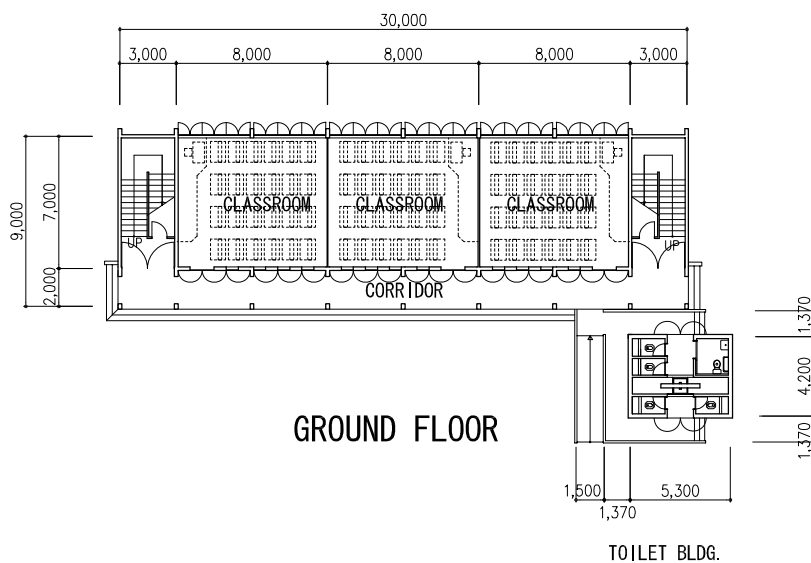
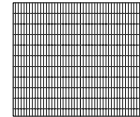
THIRD FLOOR



SECOND FLOOR



FIRST FLOOR



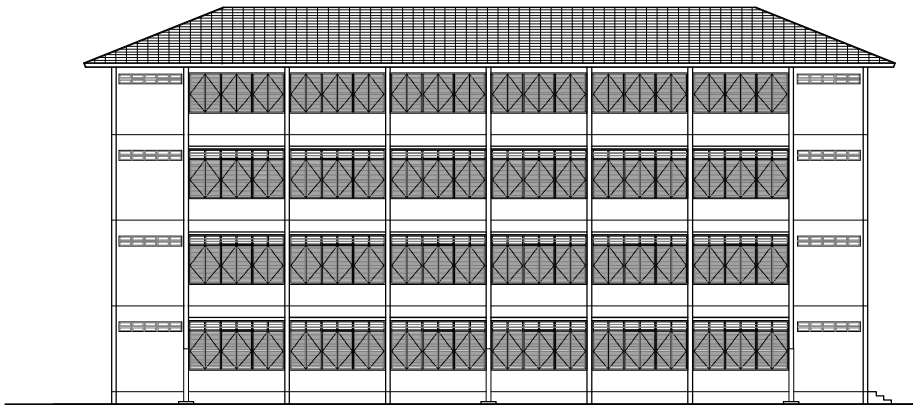
GROUND FLOOR

TOILET BLDG.

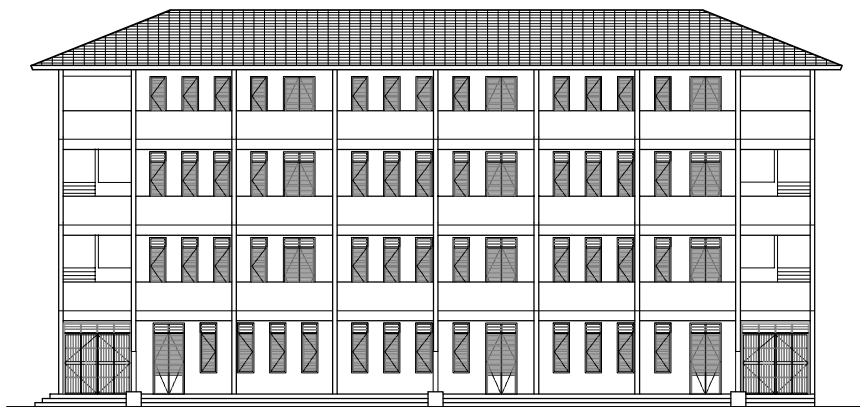
S=1:400

No. 4 Wat Neak Voan

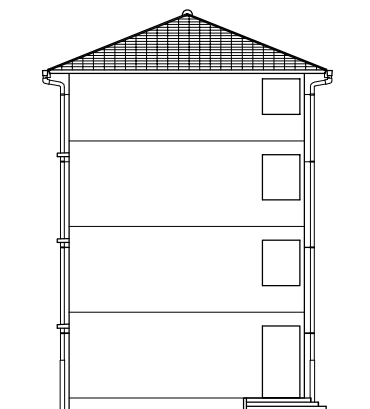
CLASSROOM BLDG.
FLOOR PLAN



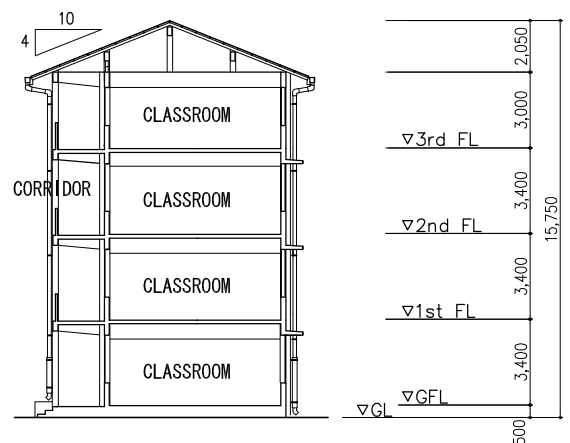
ELEVATION (CLASSROOM SIDE)



ELEVATION (CORRIDOR SIDE)



ELEVATION (GABLE SIDE)

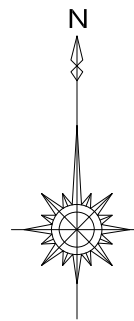
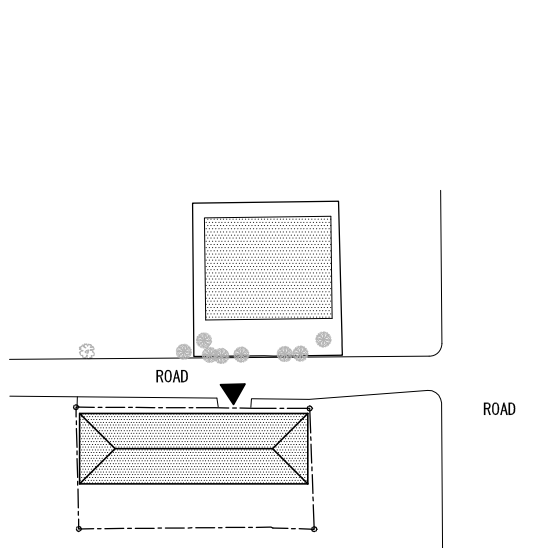


SECTION





S=1:300

No. 4 Wat Neak Voan

CLASSROOM BLDG.
ELEVATION-SECTION



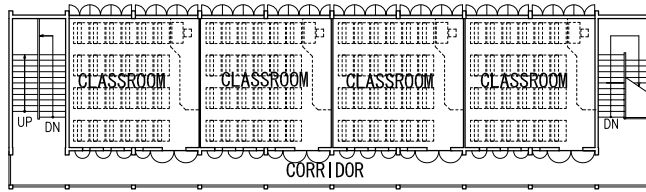
LEGEND

-  PROJECT BLDG.
-  EXISTING BLDG.
-  BOUNDARY LINE
-  MAIN GATE

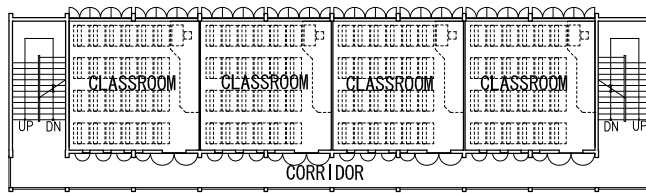
S=1 : 1200

No. 5 Wathanak Vichea

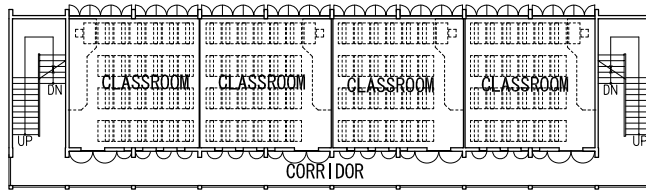
SITE PLAN



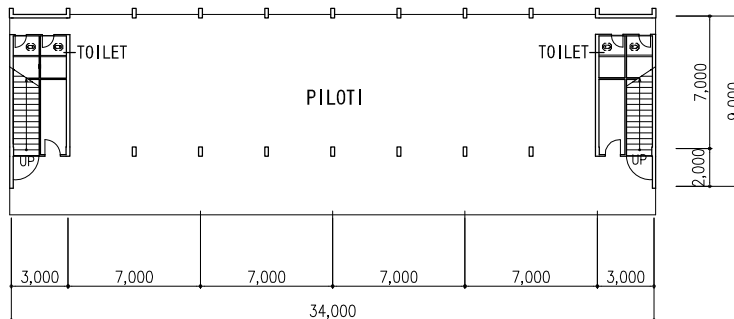
THIRD FLOOR



SECOND FLOOR



FIRST FLOOR

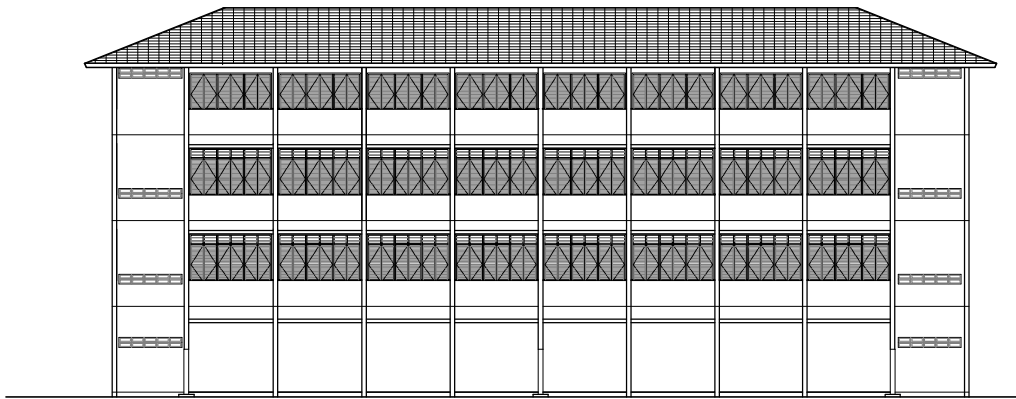


GROUND FLOOR

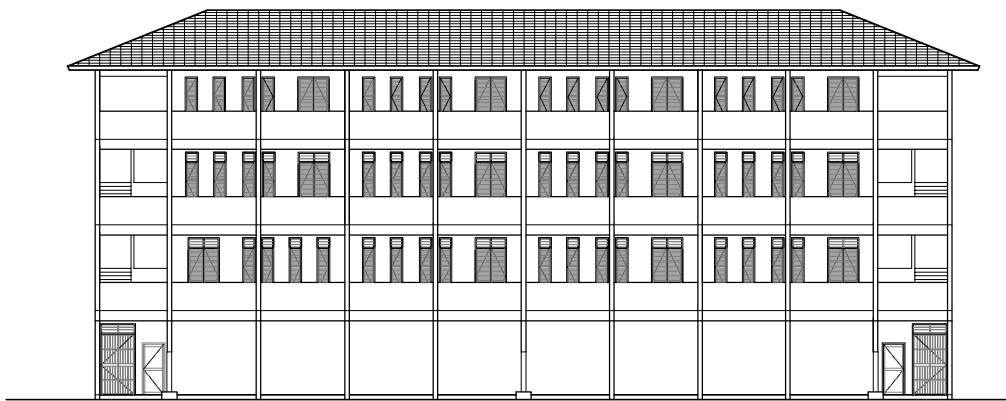
S=1:400

No. 5 Wathanak Vichea

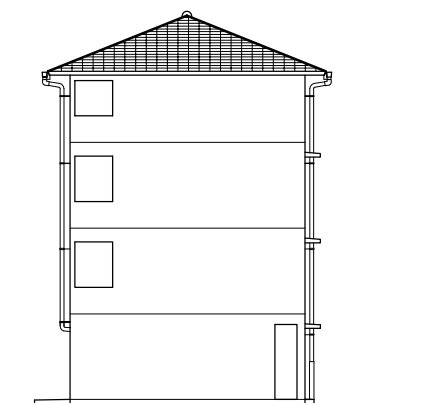
CLASSROOM BLDG.
FLOOR PLAN



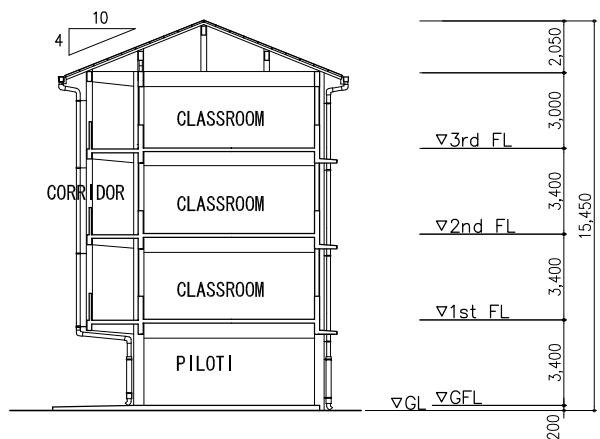
ELEVATION (CLASSROOM SIDE)



ELEVATION (CORRIDOR SIDE)



ELEVATION (GABLE SIDE)

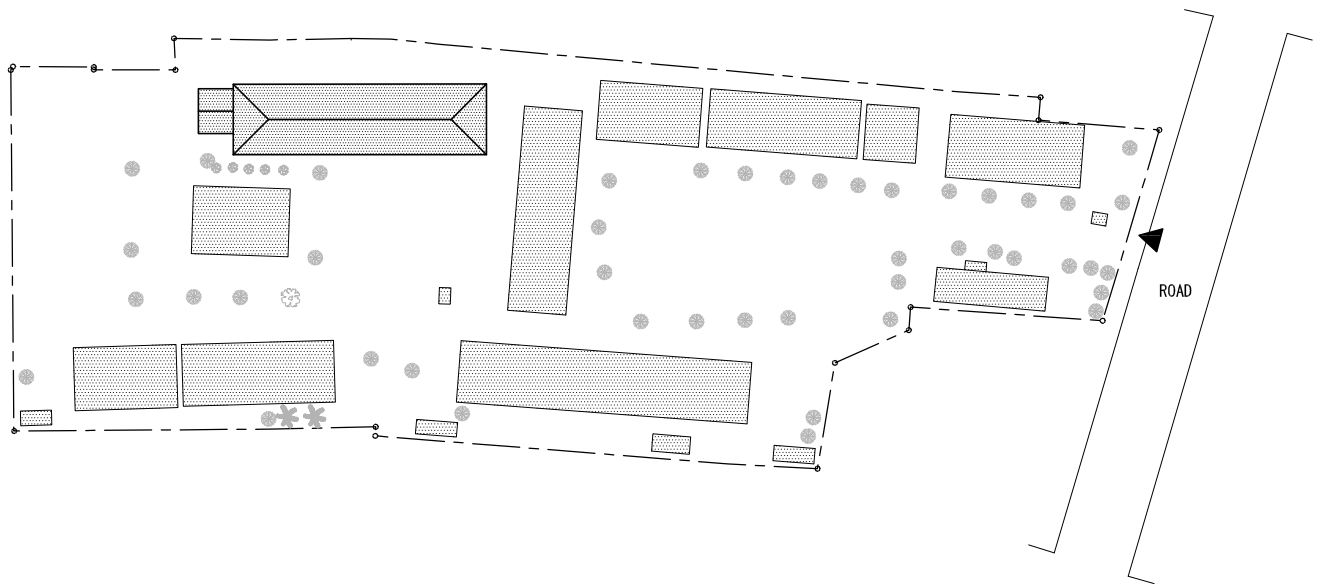
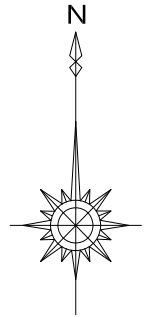


SECTION





S=1:300

No. 5 Wathanak Vichea

CLASSROOM BLDG.
ELEVATION-SECTION



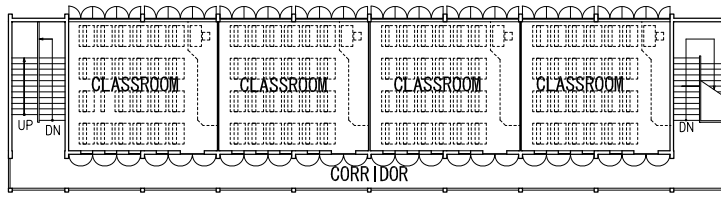
LEGEND

-  PROJECT BLDG.
-  EXISTING BLDG.
-  BOUNDARY LINE
-  MAIN GATE

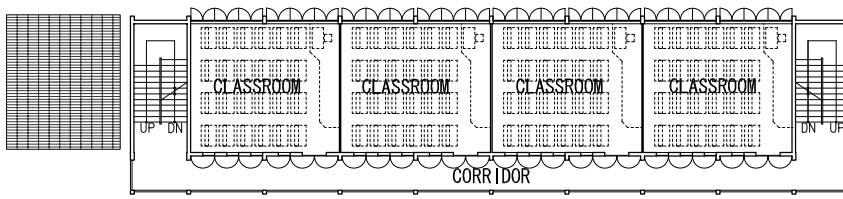
S=1:1200

No. 6 Sothearos

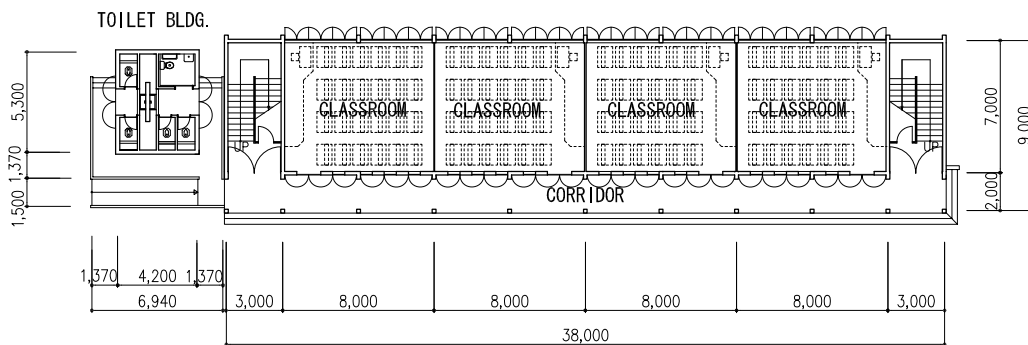
SITE PLAN



SECOND FLOOR



FIRST FLOOR

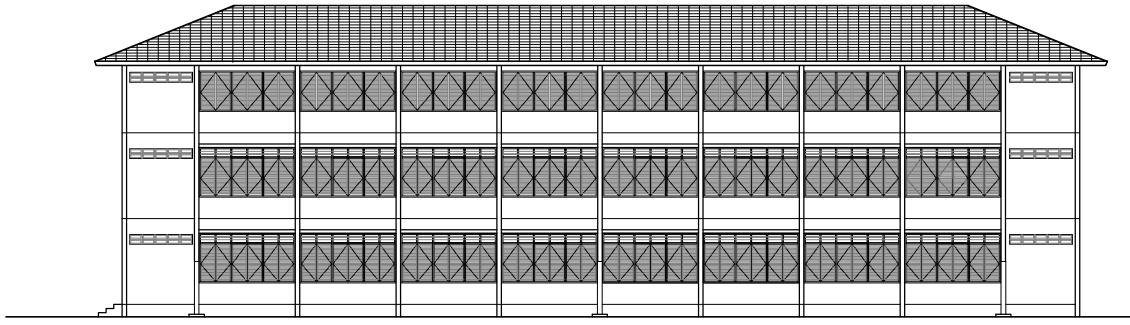


GROUND FLOOR

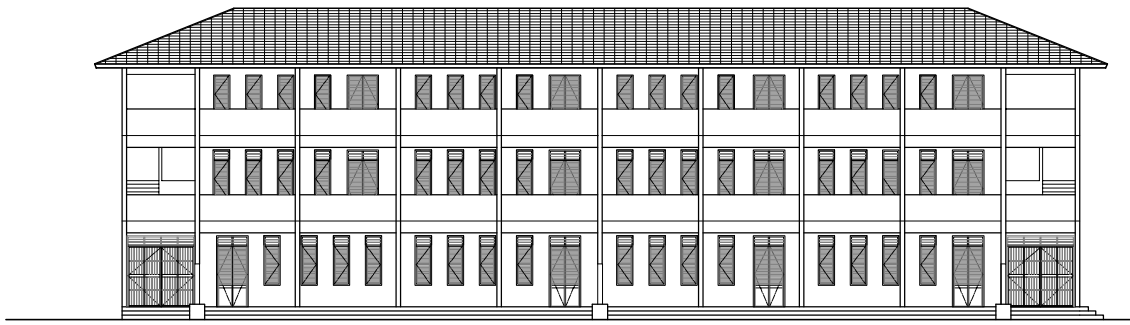
S=1:400

No. 6 Sothearos

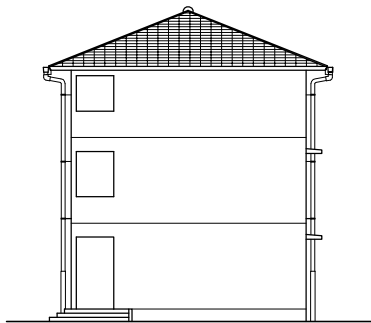
CLASSROOM BLDG.
FLOOR PLAN



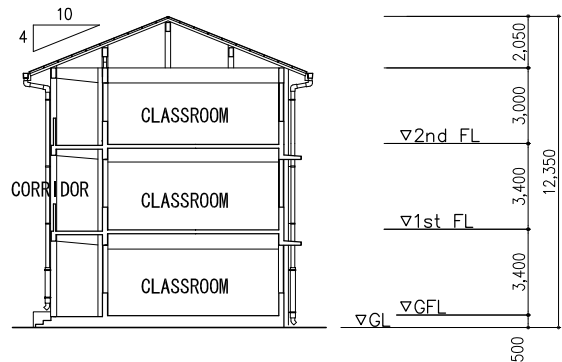
ELEVATION (CLASSROOM SIDE)



ELEVATION (CORRIDOR SIDE)



ELEVATION (GABLE SIDE)

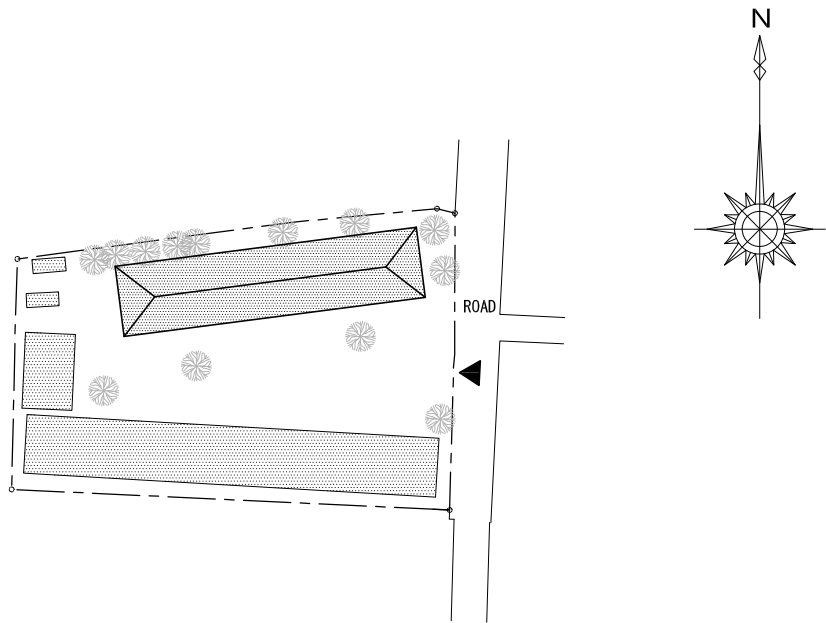


SECTION





S=1:300

No. 6 Sothearos

CLASSROOM BLDG.
ELEVATION-SECTION



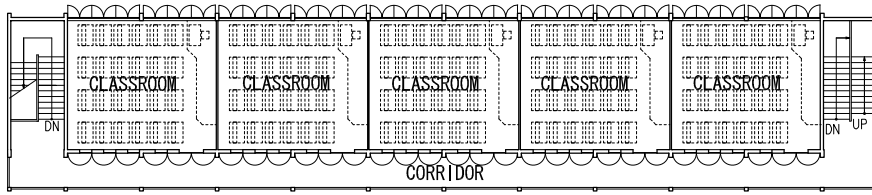
LEGEND

-  PROJECT BLDG.
-  EXISTING BLDG.
-  BOUNDARY LINE
-  MAIN GATE

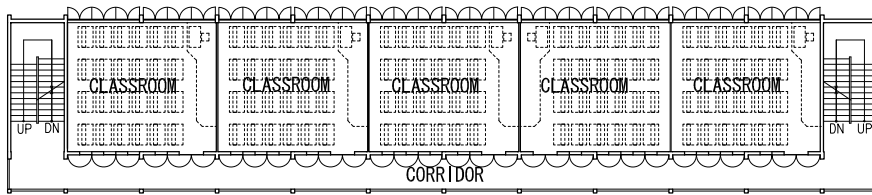
S=1:1200

No. 7 Sante Pheap

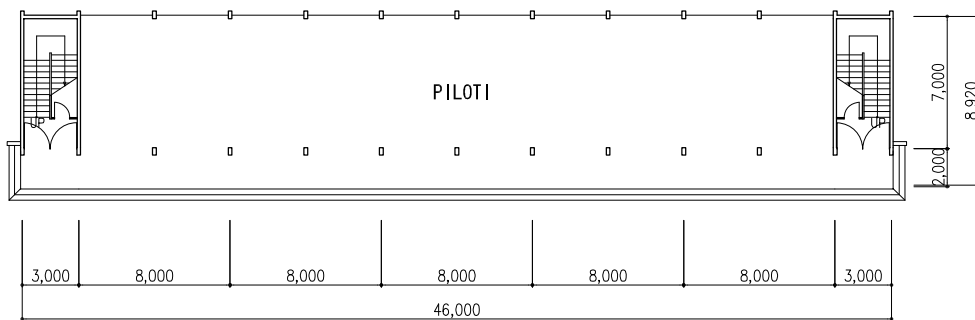
SITE PLAN



SECOND FLOOR



FIRST FLOOR

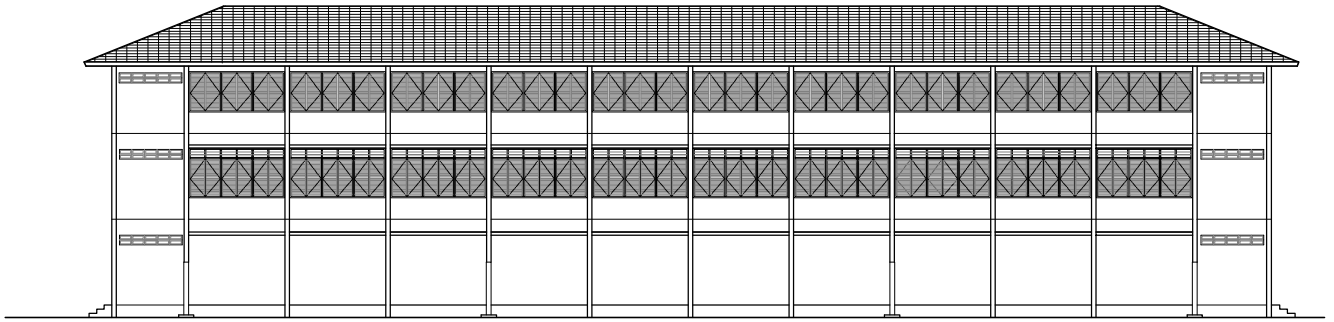


GROUND FLOOR

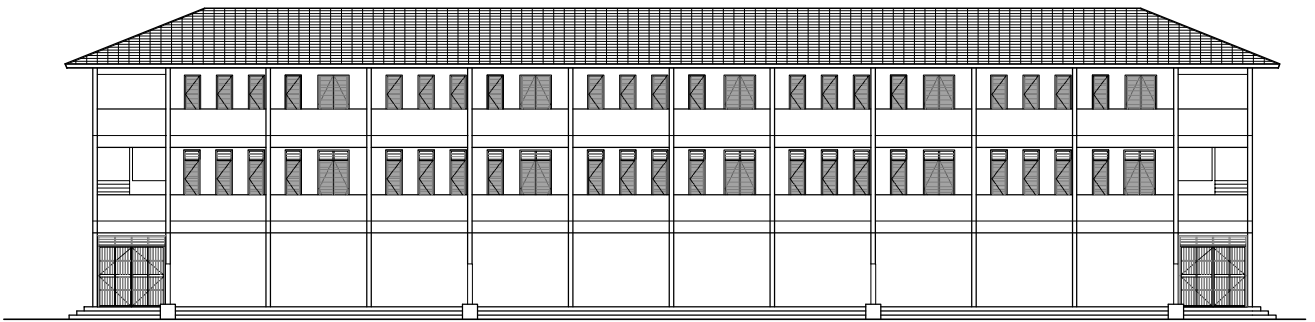
S=1:400

No. 7 Sante Pheap

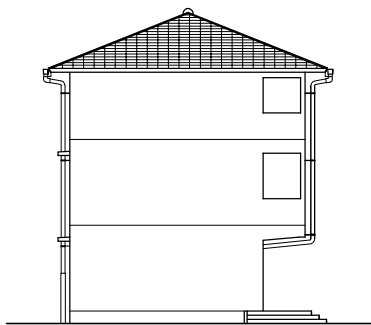
CLASSROOM BLDG.
FLOOR PLAN



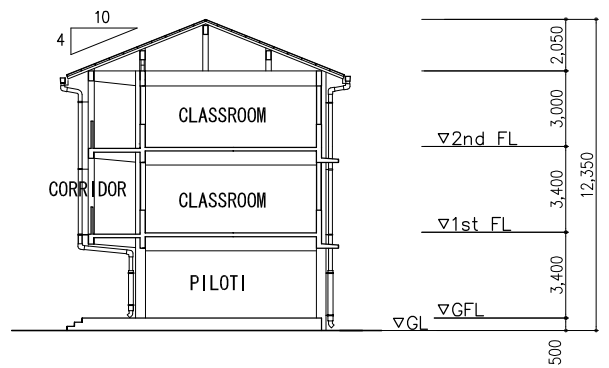
ELEVATION (CLASSROOM SIDE)



ELEVATION (CORRIDOR SIDE)



ELEVATION (GABLE SIDE)

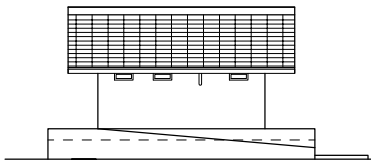
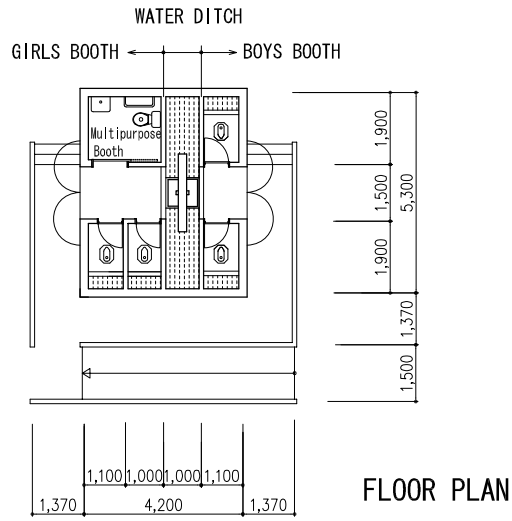


SECTION

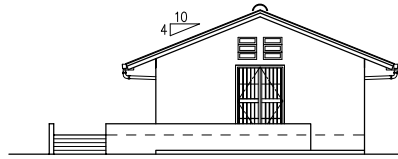
S=1:300

No. 7 Sante Pheap

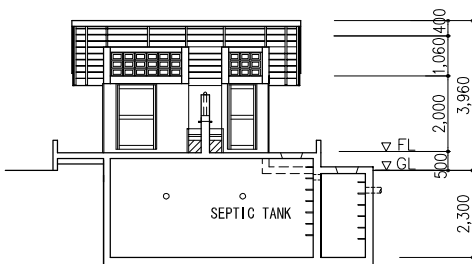
CLASSROOM BLDG.
ELEVATION-SECTION



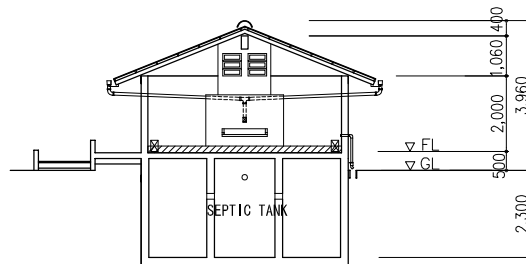
ELEVATION



ELEVATION



LONGITUDINAL SECTION



CROSS SECTION

S=1:200
TOILET BLDG.
FLOOR PLAN·ELEVATION·SECTION