

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

SEPTEMBER 2002

**JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
MOHRI, ARCHITECT & ASSOCIATES, INC.**

PREFACE

In response to a request from the Government of the 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 and entrusted the study to the Japan International Cooperation Agency (JICA).

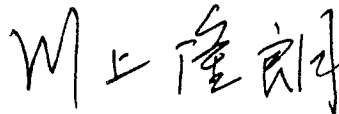
JICA sent to Cambodia a study team from March 17 to April 5, 2002.

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 the Kingdom of Cambodia for their close cooperation extended to the teams.

September, 2002



Takao Kawakami
President
Japan International Cooperation Agency

September, 2002

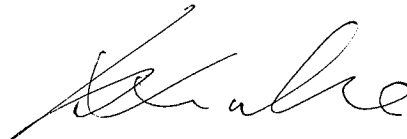
Letter of Transmittal

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

This study was conducted by Mohri, Architect & Associates Inc., under a contract to JICA, during the period from March, 2002 to September, 2002. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of the 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,



Shinichi Urabe
Project Manager
Basic design study team on
the Project for Construction of Primary
Schools in Phnom Penh
Mohri, Architect & Associates, Inc.

SITE LOCATION MAP





Perspective: San Thor Mok

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ABBREVIATION

A/P	Authorization to Pay
B/A	Bank Arrangement
BHN	Basic Human Needs
CREP	Construction et Rehabilitation des Ecoles Primaires
EFA	Education for All
ESP	Education Strategic Plan
ESSP	Education Sector Support Program
EU	European Commission
I-PRSP	Interim Poverty Reduction Strategy Paper
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
MoEYS	Ministry of Education, Youth and Sport
NPRD	National Programme to Rehabilitate and Develop Cambodia
PAP	Priority Action Program
P/Q	Pre-qualification
PRSP	Poverty Reduction Strategy Paper
SEDP	Socioeconomic Development Plan
SEDP-2	Second Socioeconomic Development Plan
SSC	School Supporting Committee
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Fund
USAID	United States Agency for International Development
WB	World Bank

Summary

In order to realize the overall goal of “universal primary education” in the education sector, the Government of Cambodia set up the “Education Strategic Plan (ESP)” and the “Education Sector Support Program (ESSP).” The ESP is a 5-year plan aiming at 1) assuring equitable access to education, 2) improved quality and efficiency of education services, and 3) sustainable institutional development and capacity building for decentralization. Especially for 1) above, in regards to assuring equitable access to education services and in order to improve classroom shortages, the ESP has set 2005 as the target year for complete provision of additional classrooms in all current as well as projected overcrowded schools in the near future.

The ESSP is a 5-year strategic action plan in conjunction with ESP. In order to expand access to a primary education, the "Education Facilities Development Program 2001 to 2005," which is included in ESSP, contains 3 components: 1) Villages Without Schools, which is to shorten the distance to schools (within 3 kilometers), 2) Easing Extreme Overcrowding, and 3) Incomplete Cycle Primary Schools.

However, the construction of school facilities cannot catch up with the drastic increase of the number of school aged children in the country. In general, facility shortages are serious in primary schools; in particular, they are extreme in the target area of this Project, Phnom Penh, due to the massive inflow of population from rural areas. In 2000, there was an average number of 96.3 students per classroom at the primary schools, and 95.2% of those schools have had to conduct either double-shift or triple-shift classes. Many of these schools have also been obliged to use temporary or badly deteriorated classrooms as well as adopt mobile classes.¹.

¹ In Cambodia, children go to school on Monday, Tuesday, Wednesday, Friday and Saturday, taking Sunday and Thursday off. But because of the classroom shortages, some Project schools adopt different "rotating" days off so that all the classrooms can be fully utilized. In addition to each classroom being a homeroom, mobile class homerooms also exist which use any open (not being used) classrooms during the week. In short, there is a rotation of classrooms and days off for the children, and students in the mobile classes do not have their own, regular home classroom..

To overcome these problems, the Phnom Penh Municipality has been constructing classrooms under the assistance of the donors. Even so, the classroom shortage situation has not been improved. In addition, under the limited budgetary funds allocated to the education sector, it is difficult for the government of Cambodia to implement any large-scale school facility construction project on its own.

In view of this situation, the Government of Cambodia requested grant-aid assistance in 1999 from the Government of Japan for the construction and reconstruction of school primary school buildings in Phnom Penh.

Following this request, a Basic Design Study was conducted from March 17 to April 6, 2002. The Basic Design Study Team (hereinafter referred to as the Team) had meetings with representatives of the Ministry of Education, Youth and Sports (hereafter referred to as MoEYS) and Phnom Penh Municipality, who are the agencies responsible for the Project, and the Department of Education of Phnom Penh Municipality who is the implementing agency, as well as other associated people to discuss Project feasibility and detailed plans while the Team conducted site surveys at each school and obtained other necessary information. After the Team came back to Japan, based on the results of the study, the relevance of the Project, maintenance and management systems, and effect of the Project were analyzed. Then, the Japanese side set the appropriate facility components and the scale of the Project, selected materials and equipment, and calculated a rough cost estimate for implementation of the Project. In order to explain these outlines of basic design of the Project to the Cambodian side, the Draft Report Explanation Team was dispatched from August 1 to August 10, 2002.

During the Basic Design study, an agreement between the Cambodian and the Japanese sides was reached to select the 6 Project schools originally requested from the Government of Cambodia based on the following criteria:

- ① School sites which cannot meet the demand for school facilities by their own efforts of the central and local governments and the communities, and support from other donors;
- ② School sites which can provide proof of land ownership of the sites;

- ③ School sites that all costs for necessary removal works of existing building(s) and grading work will be borne by the Cambodian side in case of reconstruction of existing building(s);
- ④ School sites which secure temporary classrooms for students during the construction period in case of reconstruction of existing building(s);
- ⑤ School sites which have sufficient land space for construction;
- ⑥ School sites which have no security problems;
- ⑦ School sites which have adequate road access for transporting materials and equipment for construction;
- ⑧ School sites where the geographical condition of the land must be free of obstacles that might pose a problem for construction;
- ⑨ School sites which can ensure necessary funds for teachers' salaries after implementation of the Project.

From the results of the site surveys, it was clear that all the 6 schools met the above criteria. Thus, it has been confirmed that the 6 schools are accepted as the Project schools.

As a basic principle, cost reduction will be given priority as much as possible in the design of the Project facilities while keeping a "minimum necessary quality," such as ease of maintenance, building safety and a comfortable learning environment for daily class activities. Also, in consideration of the low bearing capacity of the soil, the most suitable type of building foundation will be chosen after examining the results of the boring tests. In addition, considering the tropical monsoon climate conditions in Cambodia, the architectural plans should pay enough attention to ensure heat insulation and ventilation. The use of lumber is limited due to the Government of Cambodia's high priority on forest protection and prevention of possible termite damage to wood products. Further, in order to make all maintenance work easier and to keep maintenance costs down, the facilities are to be planned so that the Project buildings will be durable as well as easy to clean and maintain. For the easy use of facilities by the physically handicapped at the Project schools, necessary considerations to the Project facilities shall be taken such as sloped ramps for easy access to the building entrances and toilet facilities for their use, etc.

In considering teaching materials, other donors have previously provided basic

teaching materials (globes, scales etc.), and the teachers themselves are also making efforts to create them, and as there are no specific items mentioned in the request by the Government of Cambodia, such materials are not covered in the Project.

Ordinary classrooms and toilet facilities, which are considered the minimum necessary facilities for schools, are included in the Project components. Although the Cambodian side also requested to build a library, a meeting room and a workshop (for the making and storing of teaching materials) at 2 core schools, they are excluded from the component for the following reasons:

- ① Library - All the 6 Project schools already have a library;
- ② Meeting Room - After implementation of the Project, the reduction in classroom shortages will allow for a more flexible class schedule so that meetings can be held in existing classrooms. However, considering that meetings with a very large attendance would be impossible in one regular classroom, and that the Government of Cambodia did request the construction of a room at all the Project schools which can double as a classroom & meeting room, movable partitions will be put up between 3 connected ordinary classrooms at the 3 large-sized schools, and between 2 connected classrooms at the other schools;
- ③ Workshop – The 2 core schools already have a storage room for teaching materials.

As for the component of facilities, the target year for completion of construction is set for 2005. The calculation of the necessary number of classrooms is based on the projected number of students in 2005, with the assumption that the expected number of students per classroom will be 40 in accordance with Cambodian standards, and that all the Project schools will conduct classrooms in double shifts. Classroom shortages are calculated by subtracting the number of existing usable classrooms from the necessary number of classrooms. The calculation of the number of classrooms to be built in the Project is based on the number of classroom shortages. In order to completely reduce classroom shortages, not only 3 story but also 4 story buildings would need to be constructed at some schools, because each school in this Project has limited construction space. However, from comprehensive

perspectives such as the safety of students, harmonization with other school buildings at the Project sites and the low bearing capacity of the soil, all the Project buildings will be 3 stories and have a framed reinforced concrete structure and pile or a spread foundation following the local construction methods. In addition, for the sake of efficiency in this grant aid project, the number of classrooms to be constructed for the Project shall be adjusted to multiples of 3, rounding off fractions to the lowest whole number. Due to the limited space at the Back Touk School site, the maximum number of 27 classrooms will be constructed.

Classrooms to be Constructed at each Project School

Name of School	Estimated Number of Students in 2005-2006	Necessary Number of Classrooms	Number of Usable Classrooms	Classroom Shortages	Classrooms to be Constructed
1.Bak Touk	7,304	92	60	32	27
2.San Thor Mok	6,780	85	49	36	36
3.Toul Kok	6,645	84	63	21	21
4.Anu Wat Reach Theany	3,396	43	18	25	24
5.Boueng Salang	3,533	45	22	23	21
6.Phuom Russey	2,285	29	10	19	18
Total	29,943	378	222	156	147

As there are no strict guidelines or standards in Cambodia, the number of toilets for the Project is calculated as “1 toilet per 2 newly constructed classrooms (80 students)” In addition to the toilets for students, toilets for the physically handicapped, which can also be used by teachers, will be built in the Project.

As desks and chairs for students, and tables and chairs for teachers to use in the ordinary classrooms are considered as the minimum necessary for school operation, they are included in the Project components. As for classroom blackboards, whiteboards will be chosen as originally requested by the Government of Cambodia. Although the Cambodian side requested storage shelves in the classrooms, they are excluded from the Project component. Since each school uses shelves differently (one school uses shelves, while the other does not use them at all) at this moment, it is expected that the Cambodian side will make its own self-efforts to acquire them. The content of facilities and list of furniture are shown in the following tables.

Facility Component at Each Project School

Name of School	Classrooms to be Constructed	Toilet				Floor Area
		Female Toilet Bowl	Male Toilet Bowl	Male Urinal	Toilet Bowl for the Handicapped	
1.Bak Touk	27	7	3	8	2	2,258.20 m ²
2.San Thor Mok	36	9	4	8	2	2,915.99 m ²
3.Toul Kok	21	5	2	6	2	1,730.60 m ²
4.Anu Wat Reach Theany	24	6	3	6	2	2,031.58 m ²
5.Boueng Salang	21	5	2	6	2	1,896.38 m ²
6.Phuom Russey	18	5	2	6	2	1,514.60 m ²
Total	147	37	16	40	12	12,347.35 m ²

List of Furniture at Each Project School

Name of School	Classrooms to be Constructed	Student Desk / Chairs			Teacher's Desk/ Chair	White board
		L	S	Total		
1.Bak Touk	27	216	324	540	27	54
2.San Thor Mok	36	288	432	720	36	72
3.Toul Kok	21	168	252	420	21	42
4.Anu Wat Reach Theany	24	192	288	480	24	48
5.Boueng Salang	21	168	252	420	21	42
6.Phuom Russey	18	144	216	360	18	36
Total	147	1176	1764	2940	147	294

The following benefits are expected after Project implementation:

[Direct Effect]

1) Improvement of the Learning Environment

As a result of the completion of the Project's 147 classrooms (115 new and 32 reconstructed), the increased seating capacity will be able to accommodate the equivalent of an additional 9,200 students. Triple-shift classes and mobile classes may be eliminated. The average number of students per classroom at Project schools, 56.7 during the site survey period, will be reduced to 40.6 by 2005. The Project schools that have difficulties in conducting adequate classes will be able to satisfactorily conduct classes in accordance with the country's educational targets

and curriculum, and as a result, the learning environment would be greatly improved.

2) Improvement of Sanitary Conditions and Girls' Learning Environment

There is an extreme shortage of toilets as well as classrooms at the Project schools. The shortage is especially severe for females and has been one of the obstacles preventing girls from enrolling in schools. However, as the Project will construct an adequate number of toilets in proportion to the number of classrooms, toilet shortages at the Project schools will be alleviated and the sanitary conditions will be considerably improved. Thus, a positive learning environment for girls is expected to develop.

[Indirect Effect]

1) Promotion of Activities for Cluster-School Development

Classrooms, which can also be used as a meeting room through the use of movable partitions, will be constructed at all the Project schools. It is expected that these "dual use" rooms will be used not only for teachers' meetings but also for activities that include teachers from neighborhood schools to further promote cluster-school development. Therefore, installation of these rooms will contribute to the improvement of the quality of education.

2) Benefits to the Surrounding Communities

The school facilities constructed by the Project will be used not only for basic education purposes but also for other social educational as well as social activities, such as adult education and other non-educational community activities. Thus, it is expected that the Project will benefit the surrounding communities.

In conclusion, this Project can expect many benefits to be realized while also meeting the conditions necessary to receive Japan Grant Aid funds; thus, the implementation of this Project has a high value and is deemed worthy and meaningful. If the items mentioned below are improved, this project will be implemented more smoothly, and thus more effectively contribute to improving the

general educational environment.

(1) Conducting Appropriate Facility Maintenance

In order to obtain the maximum benefits from the Project, it is crucial for each Project school to continuously conduct appropriate maintenance work of the Project facilities as well as existing facilities and effectively use them.

During the site survey period, it was observed that facility management and maintenance conditions varied from school to school. Therefore, the preparation of a school facility operation and maintenance manual seems necessary. Furthermore, it is vital that the administrative side periodically monitors the facility operations and maintenance conditions, and then provides sufficient guidance and assistance to school principals and persons in charge, to sustain appropriate facility operation and maintenance activities.

Assistance from Japan and other donors is considered absolutely essential in order to acquire the knowledge and upgrading skills necessary to establish a comprehensive facility management and maintenance system at both the administrative and the school levels..

(2) Effective Use of Facilities

It is hoped and expected that the school facilities will be effectively used not only for school meetings but also for other non-formal education and area resident meetings or social activities, etc.

(3) Active Participation of the Community Residents

For the adequate, effective and continuous use of school facilities including the Project facilities, donations and contributions from the surrounding communities are indispensable.

To promote the giving of donations and contributions, it is very important for each school to have a clear objective and a plan for facility management and maintenance, with periodical disclosure on how the collected donations were used, as well as for the schools to express their views to the public. In addition, it is also important for the schools to reflect the opinions of surrounding communities into the process of decision making and evaluation so that a closer relationship between the schools

and communities can be established.

(4) Expanding of the Good Effects of the Project by Connecting to Other Schemes

The Government of Japan has contributed to the education sector in Cambodia through its “Study of Participatory School Construction in Cambodia”, “Secondary School Teacher Training Project in Science and Mathematics”, and a dispatch of experts and volunteers. By effectively connecting to these activities, it is expected that the Project will be able to contribute to improving the quality and efficiency of education throughout the entire country of Cambodia.

(5) Cooperation with Other Donors

Due to the differences in budgetary systems, the Project does not adhere to the same “sector-wide approach” scheme that has been adopted by other major donors in Cambodia. However, the objective of the Project – the improvement of educational facilities to alleviate serious facility shortages at Project schools – is consistent with the objective which aims to secure equal access to a primary education, as stated in the “Education Strategic Plan (ESP)” and the “Education Sector Support Program (ESSP)”, which are the national educational plans in Cambodia, on which the “sector-wide approach” is based. From this viewpoint, "project-based" assistance such as this Project is very effective when its objectives comply with national policies and priority programs, as long as cooperation among all donors is properly acknowledged, focusing on achieving greater efficiency as well as avoiding unnecessary overlapping of activities.

Thus, it is important to fully utilize all chances to meet with as many donor-related persons as possible, including NGOs and government agency personnel, to nurture a better understanding of the Project by explaining its contents and relevance to other donors, and to find a common ground for cooperation with each other through discussion and the sharing of various ideas.

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CHAPTER 1 BACKGROUND OF THE PROJECT

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In order to realize the overall goal of “universal primary education” in the education sector, the Government of Cambodia set up the “Education Strategic Plan (ESP)” and the “Education Sector Support Program (ESSP).” The ESP is a 5-year plan aiming at 1) assuring equitable access to education, 2) improved quality and efficiency of education services, and 3) sustainable institutional development and capacity building for decentralization. Especially for 1) above, in regards to assuring equitable access to education services and in order to improve classroom shortages, the ESP has set 2005 as the target year for complete provision of additional classrooms in all current as well as projected overcrowded schools in the near future. The ESSP is a 5-year strategic action plan in conjunction with ESP. In order to expand access to a primary education, the "Education Facilities Development Program 2001 to 2005," which is included in ESSP, contains 3 components: 1) Villages Without Schools, which is to shorten the distance to schools (within 3 kilometers), 2) Easing Extreme Overcrowding, and 3) Incomplete Cycle Primary Schools.

However, the construction of school facilities cannot catch up with the drastic increase of the number of school aged children in the country. In general, facility shortages are serious in primary schools; in particular, they are extreme in the target area of this Project, Phnom Penh, due to the massive inflow of population from rural areas. In 2000, there was an average number of 96.3 students per classroom at the primary schools, and 95.2% of those schools have had to conduct either double-shift or triple-shift classes. Many of these schools have also been obliged to use temporary or badly deteriorated classrooms as well as adopt mobile classes.¹.

To overcome these problems, the Phnom Penh Municipality has been constructing classrooms under the assistance of the donors. Even so, the classroom shortage

¹ In Cambodia, children go to school on Monday, Tuesday, Wednesday, Friday and Saturday, taking Sunday and Thursday off. But because of the classroom shortages, some Project schools adopt different "rotating" days off so that all the classrooms can be fully utilized. In addition to each classroom being a homeroom, mobile class homerooms also exist which use any open (not being used) classrooms during the week. In short, there is a rotation of classrooms and days off for the children, and students in the mobile classes do not have their own, regular home classroom.

situation has not been improved. In addition, under the limited budgetary funds allocated to the education sector, it is difficult for the government of Cambodia to implement any large-scale school facility construction project on its own.

In view of this situation, the Government of Cambodia requested grant-aid assistance in 1999 from the Government of Japan for the construction and reconstruction of school primary school buildings in Phnom Penh.

CHAPTER 2 CONTENTS OF THE PROJECT

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2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Purpose

The government of Cambodia has developed the “Education Strategic Plan (ESP)” and the “Education Sector Support Programme 2001-2005 (ESSP)”, in their effort to achieve an "Education for All (EFA)" that will improve the quality and efficiency of education, and provide everyone fair access to a basic education. However, under present conditions, it is difficult to construct enough primary educational facilities to cope with the problem of sharp increases in the number of students caused by the recent explosive growth in population.

Especially in the Phnom Penh primary schools, due to the movement of people from the rural areas, classroom shortages have become a serious problem because construction of school facilities cannot keep up with the pace of student increases. The schools manage to deal with this problem by holding classes in multiple shifts, increasing the number of students per classroom and through mobile classes¹; however, multiple shift classes and congested classrooms result in other problems such as a reduction in study hours and a lowered quality of education.

Considering the above-mentioned situation, the Project intends to reduce classroom shortages at the Project schools as the Project purpose, and to improve the learning environment (proper classroom shifts, adequate school hours and the appropriate number of students per classroom) as the overall goal of the Project.

¹ In Cambodia, children go to school on Monday, Tuesday, Wednesday, Friday and Saturday, taking Sunday and Thursday off. But because of the classroom shortages, some Project schools adopt different "rotating" days off so that all the classrooms can be fully utilized. In addition to each classroom being a homeroom, mobile class homerooms also exist which use any open (not being used) classrooms during the week. In short, there is a rotation of classrooms and days off for the children, and students in the mobile classes do not have their own, regular home classroom.

2-1-2 Outline of the Project

In order to reduce classroom shortages in Phnom Penh, the Project will construct 147 classrooms and toilet facilities at 6 schools as well as procuring educational furniture. Proper classroom shifts, adequate school hours and the appropriate number of students per classroom will be realized by the Project, which contributes to the improvement of the learning environment in the 6 Project schools.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Principles

(1) Selection of Project Schools

During the Basic Design study, an agreement between the Cambodian and the Japanese sides was reached to conduct site surveys at the 6 schools originally requested from the Government of Cambodia, and to select the 6 Project schools based on the following criteria:

- a) School sites which cannot meet the demand for school facilities by their own efforts of the central and local governments and the communities, and support from other donors;
- b) School sites which can provide proof of land ownership of the sites;
- c) School sites that all costs for necessary removal works of existing building(s) and grading work will be borne by the Cambodian side in case of reconstruction of existing building(s);
- d) School sites which secure temporary classrooms for students during the construction period in case of reconstruction of existing building(s);
- e) School sites which have sufficient land space for construction;
- f) School sites which have no security problems;
- g) School sites which have adequate road access for transporting materials and equipment for construction;
- h) School sites where the geographical condition of the land must be free of obstacles that might pose a problem for construction;
- i) School sites which can ensure necessary funds for teachers' salaries after implementation of the Project.

From the results of the site surveys, it was clear that all the 6 schools met the above criteria. Thus, it has been confirmed that the 6 schools are accepted for the Project. The list of the Project schools is shown in Table 2-1.

Table 2-1 List of Project Schools

	School Name	Khan (District)	Core / Satellite
1	Bak Touk	7 Makara	Core
2	San Thor Mok	Toul Kok	Satellite
3	Toul Kok	Toul Kok	Satellite
4	Anu Wat Reach Theany	Toul Kok	Satellite
5	Boeung Salang	Toul Kok	Core
6	Phuom Russey	Mean Chey	Satellite

(2) Project Component

Ordinary classrooms and toilet facilities, which are considered the minimum necessary facilities for schools, are included in the Project components. Although the Cambodian side also requested to build a library, a meeting room and a workshop (for the making and storing of teaching materials) at 2 core schools, they are excluded from the component for the following reasons:

- a) Library - All the 6 Project schools already have a library;
- b) Meeting Room - After implementation of the Project, the reduction in classroom shortages will allow for a more flexible class schedule so that meetings can be held in existing classrooms. However, considering that meetings with a very large attendance would be impossible in one regular classroom, and that the Government of Cambodia did request the construction of a room at all the Project schools which can double as a classroom & meeting room, movable partitions will be installed between 3 connected ordinary classrooms at the 3 large-sized schools, and between 2 connected classrooms at the other schools;
- c) Workshop – The 2 core schools already have a storage room for teaching materials.

(3) Calculation of the Number of Classrooms for Project Schools

1) Prerequisites

- a) The target year for completion of construction is set for 2005.
- b) The expected number of students per classroom is 40 in accordance with Cambodian standard.

- c) All the Project schools conduct classrooms in double shifts.
- d) In order to completely reduce classroom shortages, not only 3 story but also 4 story buildings would need to be constructed at some schools, because each school in this Project has limited construction space. However, all Project buildings will be 3 stories for the following reasons:
 - Costs are comparatively more expensive for the foundation and piling work needed to construct buildings greater than 3 stories;
 - Buildings higher than 3 stories have a greater possibility of ground settlement due to the low bearing capacity of the soil at the Project sites;
 - Buildings limited to 3 stories have better harmony with other single or 2 story buildings surrounding the Project sites;
 - The possibility of serious injury to children with play-fatigue who may fall off the buildings is less.

For the sake of efficiency in this grant aid project, the number of classrooms to be constructed for the Project shall be adjusted to multiples of 3, rounding off fractions to the lowest whole number.

2) Current Condition of the Existing Schools

The current operating condition of the 6 Project schools are shown in Table 2-2.

Table 2-2 Current Operating Condition of the 6 Project Schools

School Name	No. of Students in 2001-2002 (No. of Classes in the lower column)							Average No. of Students per Class	Class Shift	Mobile Classes	No of Classrooms in Use	Average No. of Students per Classroom
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Total					
1 Bak Touk	1,392	1,227	1,276	1,311	1,245	1,297	7,748	47.2	2	32	69	56.1
	28	28	28	28	26	26	164					
2 San Thor Mok	1,288	1,165	1,144	1,147	1,061	1,086	6,891	49.2	2	18	61	56.5
	25	25	26	22	22	20	140					
3 Toul Kok	1,219	1,377	1,303	1,140	1,003	912	6,954	40.4	2	28	68	51.1
	30	32	31	29	27	23	172					
4 Anu Wat Reach Theany	646	573	490	417	370	306	2,802	60.9	2	8	19	73.7
	12	10	8	6	5	5	46					
5 Boeung Salang	680	555	476	480	435	356	2,982	41.4	2	12	31	48.1
	16	14	13	11	10	8	72					
6 Phuum Russey	432	396	392	289	219	173	1,901	55.9	3	4	10	63.4
	8	7	7	5	4	3	34					
Total	5,657	5,293	5,081	4,784	4,333	4,130	29,278	46.6	-	102	258	56.7
	119	116	113	101	94	85	628					

<Source> Based on the results of site survey

Average number of students per class = Total number of students ÷ Number of class

Average number of students per classroom = Total number of students ÷ Class shift ÷ Number of classrooms in use

3) Estimated Number of Students in 2005 (see Table 2-3)

The expected number of students in 2005 is calculated based on the number of students in 2001-2002 and the following assumptions:

- The number of new entrants per year will not change;
- As for the promotion rate, ESP sets the targeted rate as 90%. However, as MoEYS is considering the introduction of automatic promotion, the promotion rate is assumed to be 95% in 2005 in this Project.

Table 2-3 Expected Number of Students between 2001 and 2005

School Name	Grade	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
1. Bak Touk	1	1,392	1,392	1,392	1,392	1,392
	2	1,227	1,323	1,323	1,323	1,323
	3	1,276	1,166	1,257	1,257	1,257
	4	1,311	1,213	1,108	1,195	1,195
	5	1,245	1,246	1,153	1,053	1,136
	6	1,297	1,183	1,184	1,096	1,001
	Total	7,748	7,523	7,417	7,316	7,304
2. San Thor Mok	1	1,288	1,288	1,288	1,288	1,288
	2	1,165	1,224	1,224	1,224	1,224
	3	1,144	1,107	1,163	1,163	1,163
	4	1,147	1,087	1,052	1,105	1,105
	5	1,061	1,090	1,033	1,000	1,050
	6	1,086	1,008	1,036	982	950
	Total	6,891	6,804	6,796	6,762	6,780
3. Tuol Kok	1	1,219	1,219	1,219	1,219	1,219
	2	1,377	1,159	1,159	1,159	1,159
	3	1,303	1,309	1,102	1,102	1,102
	4	1,140	1,238	1,244	1,047	1,047
	5	1,003	1,083	1,177	1,182	995
	6	912	953	1,029	1,119	1,123
	Total	6,954	6,961	6,930	6,828	6,645
4. Anu Wat Reach Theany	1	646	646	646	646	646
	2	573	614	614	614	614
	3	490	545	584	584	584
	4	417	466	518	555	555
	5	370	397	443	493	528
	6	306	352	378	421	469
	Total	2,802	3,020	3,183	3,313	3,396
5. Boueng Salang	1	680	680	680	680	680
	2	555	646	646	646	646
	3	476	528	614	614	614
	4	480	453	502	584	584
	5	435	456	431	477	555
	6	356	414	434	410	454
	Total	2,982	3,177	3,307	3,411	3,533
6. Phuum Russey	1	432	432	432	432	432
	2	396	411	411	411	411
	3	392	377	391	391	391
	4	289	373	359	372	372
	5	219	275	355	342	354
	6	173	209	262	338	325
	Total	1,901	2,077	2,210	2,286	2,285
Total		29,278	29,562	29,843	29,916	29,943

<Source> Based on the results of site survey

4) Number of Existing Classrooms

Temporary classrooms, old existing classrooms to be demolished and classrooms now being used for kindergarten are not to be counted as “existing” when calculating classroom shortages. In addition, since the administration buildings at the Bak Touk and the Boeung Salang Schools (roughly the same size as 3 classrooms each) need to be demolished, in order to make up for the space to be demolished, 3 classrooms are subtracted from the number of existing classrooms. The number of existing usable classrooms is listed in Table 2-4.

Table 2-4 Number of Existing Usable Classrooms

	School Name	No. of Classrooms in Use	No. of Temporary Classrooms	No. of Classrooms to be Demolished	No. of Kindergarten Classrooms	No. of Classrooms equivalent to Temporary Buildings to be demolished	No. of Existing Usable Classrooms
1	Bak Touk	69		5	1	3	60
2	San Thor Mok	61		12			49
3	Toul Kok	63		0			63
4	Anu Wat Reach Theany	19	1				18
5	Boeung Salang	31	1	4	1	3	22
6	Phuom Russey	10					10
	Total	253	2	21	2	6	222

<Source> Based on the results of site survey

5) Number of Classroom Shortages

The number of classroom shortages calculated at each Project site is as follows:

- Necessary Number of Classrooms

$$\frac{\text{(The number of student in 2005)}}{2 \text{ shifts} \div 40 \text{ students per classroom}}$$
- Classroom Shortages

$$\text{(Necessary Number of classrooms)} - \text{(Number of Existing Usable Classrooms)}$$

The Expected number of classroom shortages in 2005 is shown in Table 2-5.

Table 2-5 Classroom Shortages

	School Name	Estimated No. of Students in 2005-2006	Necessary No. of Classrooms	No. of Usable Classrooms	Classroom Shortages
1	Bak Touk	7,304	92	60	32
2	San Thor Mok	6,780	85	49	36
3	Toul Kok	6,645	84	63	21
4	Anu Wat Reach Theany	3,396	43	18	25
5	Boeung Salang	3,533	45	22	23
6	Phuom Russey	2,285	29	10	19
Total		29,943	378	222	156

<Source> Based on the results of site survey

6) Calculating the Number of Classrooms to Build

The calculation of the number of classrooms to be built in the Project is based on the number of classroom shortages. As mentioned earlier, all the Project buildings will be 3 stories with the number of classrooms adjusted to multiples of 3, rounding off any fractions so that the number of classrooms per floor is the same. Due to the limited space at the Back Touk School site, the maximum number of 27 classrooms will be constructed. The number of classrooms to be built in the Project is shown in Table 2-6.

Table 2-6 Number of Classrooms to be Built in the Project

	School Name	Number of Classroom Shortages	Number of Planned Classrooms	Total Number of Classroom after the Project	Average Number of Students per Classroom
1	Bak Touk	32	27	87	42.0
2	San Thor Mok	36	36	85	39.9
3	Toul Kok	21	21	84	39.6
4	Anu Wat Reach Theany	25	24	42	40.4
5	Boeung Salang	23	21	43	41.1
6	Phuom Russey	19	18	28	40.8
Total		156	147	369	40.6

<Source> Based on the results of site survey

At the 4 Project schools (Bak Touk, Anu Wat Reach Theany, Boeung Salang and Phuom Russey Schools), the number of classrooms to be constructed is less than the

number of classroom shortages. However, for those schools, the expected average number of students per classroom after Project implementation is 42 at the most. As this number is much less than the one existing at the time of the site survey (48.1 to 73.7), there shouldn't be any problems regarding class operations by taking necessary measures such as the placing of additional desks and chairs, etc.

(4) Calculation of the Number of Toilet Facilities

While the number of toilets at primary schools in Japan is calculated based on a standard of 20 students per toilet², there is no such rigid standard in Cambodia. Thus, in considering that students do not usually stay for long hours at school due to double shift classes, nor do they use the toilet facilities very frequently at school, the number of toilets for the Project is calculated as “1 toilet per 2 newly constructed classrooms (80 students)”.

In addition, a toilet booth for the physically handicapped, which can also be used by teachers, will be built for each male and female toilet in the Project.

(5) Furniture and Equipment Component

As desks and chairs for students, and tables and chairs for teachers to be used in the ordinary classrooms are considered as the minimum necessary furniture for school operation, they are included in the Project components. As for classroom blackboards, since there was concern about unhealthy chalk dust flying around, and the fact that whiteboards are actually used in many existing buildings at Project schools, whiteboards will be chosen as originally requested. Although the Cambodian side requested storage shelves in the classrooms, they are excluded from the Project component. Since each school uses shelves differently (one school uses shelves, while another does not use them at all) at this moment, it is expected that the Cambodian side will make its own self-efforts to acquire them.

In addition, considering that other donors have previously provided basic teaching materials (globes, scales etc.), and the teachers themselves are also making an effort to create them, such teaching materials are not covered in the Project.

² As a basic principle, 2 toilet bowls and 4 urinals are for 100 boys, and 5 toilet bowls for 100 girls.

(6) Facility Component

Water supply and drainage facilities including a water storage tank and a septic tank will be installed for the toilet facilities in the Project. For night use of classrooms, lighting equipment and wall outlets will be installed in some classrooms which are also used as meeting rooms. For safety purposes, lighting will also be installed in the corridors in front of those rooms.

2-2-1-2 Consideration for the Natural Environment

(1) Soil Condition

The nature of the soil in Phnom Penh is formed of accumulated sediment from the Mekong River located to the east of the city. It is covered by a silt and clay pile mix about 10 to 15 meters in depth and has a low bearing capacity of soil. At the depth of lower than 15 meters below grade, the soil is composed more of sandy clay bed or a sandy bed with gravel, where the sand density becomes higher and has a soil bearing capacity of around 10t per square meters. At the depth of 25-30 meters below grade, the soil bearing capacity of the foundation bed is 50t per square meters in some sites. Considering that the bearing capacity of soil differs in each site, most suitable types of building foundation, construction methods and construction schedules would be examined based on boring tests at each site.

(2) Climate

Considering the tropical monsoon climate conditions in Cambodia, the architectural plans are made based on the following principles.

- 1) To deal with the high temperatures, heat insulation should be ensured by examining either the materials or the section plan of roofs and exterior walls.
- 2) The size of windows must be large enough and the ceiling height should be high enough so as to keep a large air volume flow for adequate ventilation inside the rooms.
- 3) Considering the large amount of rain, waterproof performance of the buildings should be ensured by examining either the materials or the section plan of

roofs and exterior walls.

- 4) Considering the large amount of rain, a water storage tank is to be installed in order to store rainwater for toilet facility use.

(3) Earthquakes

According to the "Bridge Design Standards" published by the Ministry of Public Works and Transport, there have been no earthquakes over magnitude 6 since 1960 in the surrounding areas of Cambodia; and none over magnitude 5 since 1980. The closest focus of an earthquake outside the country was 300 km away from the border of Cambodia, and the closest earth plate is 650 km away from the boarder. There are no records regarding earthquakes for the last 30 years kept by Department of Meteorology, Ministry of Water Resources and Meteorology. As earthquakes have not been taken into account in other similar projects done in Cambodia, they will not be taken into consideration in the structure plan in this Project either.

(4) Termites

Considering frequent termite damage in Cambodia, the use of wood for the main parts of building structures should be avoided. It should also be avoided or kept to minimum use for the finishing work and furniture. The bottom of excavation and backfilled soil must be treated with anti-termite chemicals.

2-2-1-3 Consideration for the Social Conditions

For the easy use of the facilities by physically handicapped students at the Project schools, necessary considerations to the Project facilities shall be taken such as sloped ramps to erase the gap between outside and the floor on the first floor for easy access to the building entrances and toilet facilities accessible for the wheelchair etc.

2-2-1-4 Policy for the Construction Conditions

While 73.8% of the country was forest area in Cambodia in 1958, the percentage of forest area in the country had decreased to 62% in 1993 due to recent deforestation. Since the Government of Cambodia has intensively put priority on forest protection by making stricter rules and laws against cutting trees, the amount of domestic lumber in market trading has decreased.

As for the roof frames of the Project facilities, wooden trusses that are widely adopted in the country will not be used. Instead, steel frame trusses will be used to reduce the total amount of wood used in the Project. The use of the steel frame trusses will also be effective for preventing insect damage, such as termites.

For the same reasons, it would also be desirable to avoid wooden educational furniture for the students. However, by taking the following reasons into consideration, wooden educational furniture will be used for the Project upon the request from the Government of Cambodia.

1. Wooden furniture may be easily repaired.
2. As for termite damage, it is expected that each school will be able to take its own necessary preventive measures.
3. In Cambodia, the large amount of lumber that had been cut down, prior to putting the lumber regulations into effect, is now stockpiled. Thus, it is possible to procure the necessary amount of lumber for Project use.
4. In view of the contribution to the domestic industries in Cambodia, adoption of wooden furniture is desirable, since the steel furniture needs to be imported.
5. Cost of wooden furniture is low

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

(1) Local Consultants

In Phnom Penh there are several local consultant companies (architecture, structure, and facilities) which have worked with other donors and Japanese consultants before, and their technical level is fairly high. In this Project, designing work and supervision of construction will be carried out in cooperation

with such local consultants who are familiar with the local situation.

(2) Local Contractors and Labor

The total construction building capacity of local contractors in Phnom Penh for the year 2001 was 648,000 square meters, averaging about 54,000 square meters monthly. As the total floor area of the Project is 12,000 square meters, it is not difficult to complete the Project within a single year.

With the active participation of local contractors, the general construction methods commonly found in Cambodia shall be adopted in the Project.

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

According to the policies of the Government of Cambodia, the primary school itself and the community people living around the school are responsible for the facility maintenance activities including minor repairs. In each school, the School Supporting Committee (SSC: Parents, Teachers and the community people) takes the initiative to conduct the actual maintenance activities. However, there are disparities in facility operation and maintenance system among Project schools, and it is necessary for some schools to improve their institutional capacity and maintenance skills. Since the budget from the Government is not enough, each Committee also collects donation from various sources.

In order to make maintenance work easier and to try to keep costs low in the Project, which would contribute to the active participation in the maintenance activities by the SSC, the following will be taken into consideration:

1. Finishing materials shall be resistant to stain and easy to clean so that maintenance is easier.
2. Finishing materials shall be durable so that the Project buildings will have a long life and thus maintenance costs can be kept to a minimum.

2-2-1-7 Policy for the Grade of Facilities and Equipment, and for Cost Reduction

The present situation requires the more efficient and effective use of Japan Grant Aid funds and the need for cutting costs for the project implementation. Thus, in regards to the designing of Project facilities, cost reduction will be given as much priority as possible while still keeping a certain "minimum necessary quality" including building safety, the ease of building maintenance after construction and a comfortable learning environment for daily class activities. Details of the cost reductions are as follows:

(1) Construction Methods

The underside of roof sheathing is paint finished without ceiling. Building openings, such as doors and windows, will use wooden louvers that are cheaper instead of using glasses. The walls of buildings should be constructed with a single layer of hollow bricks reinforced with steel bars instead of double layer of hollow bricks.

(2) Finishing Work

In Cambodia, it is common to finish corridor floors with a cement tile. However, in this Project, corridor floors will be finished with mortar in order to reduce construction costs.

Toilet walls will be finished with smooth tiles till 2m above the floor. The toilet walls over the 2m shall be finished with mortar for cost reduction purpose.

(3) Structure

In the Project, several considerations should be taken such as using steel frames for the roofs, one layer of hollow bricks for building walls, and change of concrete slab on the first floor from structural type to slab on grade. Thus, the weight of the building sitting on soil with low bearing capacity can be reduced. As the result, the amount of materials necessary for foundations will be decreased, contributing to the cost reduction.

(4) Water Supply and Drainage Facilities

By arranging septic tanks directly under the toilets, the amount of work for excavation, structure construction, and facility and piping installation can be reduced.

Ditch-type urinals should be installed to reduce construction costs instead of urinals. By following the local customs, a Thai-style wash basin at each toilet booth will be installed, but independent basins shall not be installed by the Project, except in the toilets for the physically handicapped.

(5) Electrical Facilities

Installation of electrical facilities shall be limited to lighting for the handicapped toilets and the dual-use "meeting room-classrooms."

(6) Furniture

The steel furniture imported from the third countries is avoided and wooden furniture that is domestic and low cost would be installed.

2-2-1-8 Policy for Construction Method

The appropriate designs and finishing materials should be selected so as to make it possible for major finishing work like roofs, wall, and floor to be done without any special skills or the learning of new techniques, due to the shortage of skilled workers.

2-2-2 Basic Plan

2-2-2-1 Architectural Plan

(1) Architectural Plan

1) Site Plan

Building Site Plan is made taking the following issues into consideration:

- a) Because of the limited extent of school playgrounds, the buildings will be located parallel to the school property line so that the area for playgrounds can be as large as possible;
- b) The corridor in the building will be placed on the playground side in order to keep the noise away from the classrooms;
- c) The above-mentioned two issues should have a higher priority than the issue of classrooms facing to the south;
- d) As a basic principle, toilets for students shall be arranged near the Project buildings and the toilets for the physically handicapped shall be located near the teachers' offices.

2) Floor Plan

Floor plan is made by taking the following issues into consideration:

- a) As shown in Figure 2-1, the size of the classrooms is 7m × 8m (the average size in Cambodia) with a corridor, 2m in width;
- b) The Project will install wooden movable partitions in the classrooms on the ground floor of the new school building located near the school entrance at every Project school so that these rooms, by opening the partitions, can be converted into one large conference room for meetings. At each of the large schools – the Bak Touk, the San Thor Mok, and the Toul Kok Schools- 3 classrooms will be constructed with two movable partitions; and at all the other Project schools, 2 classrooms will be constructed with a movable partition. In addition, lighting fixture will be installed in those rooms for the night use.

Table 2-7 shows the floor area of the new buildings.

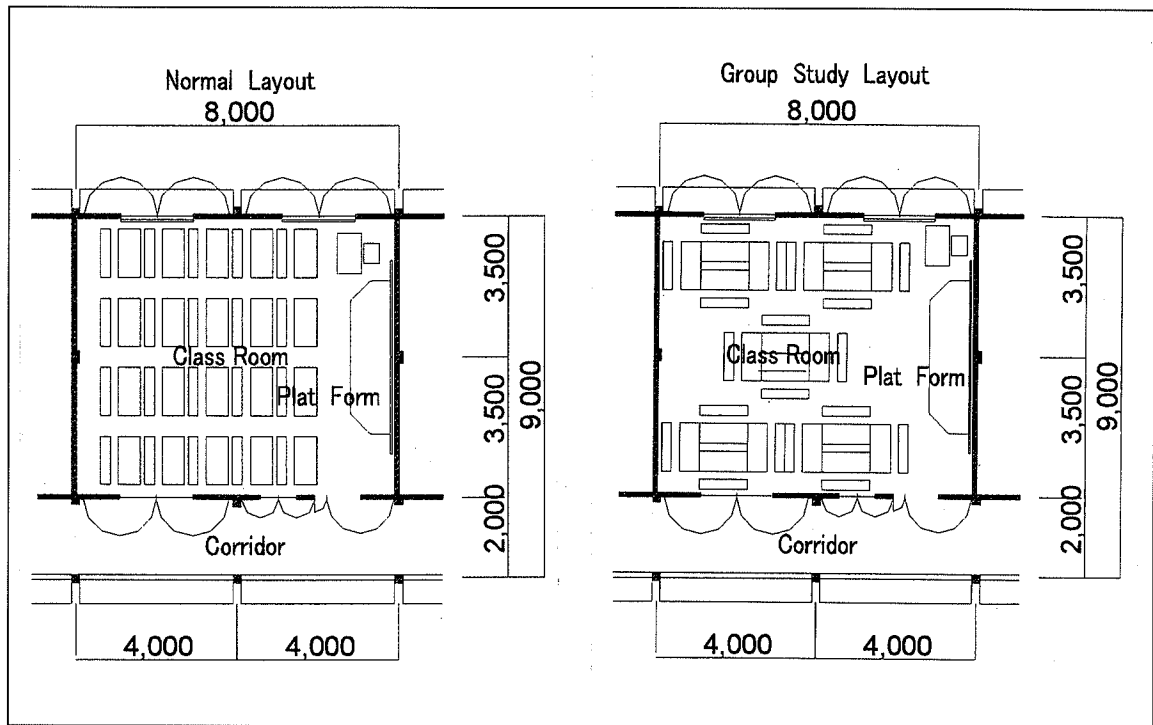


Figure 2-1 Floor Plan for Classroom

Table 2-7 List of Floor Area (sq. meter)

	Site Name	Site Area	No. of Classroom to be planned	Total Area of Classrooms	Total Area of Toilets	Total Floor Area
1	Bak Touk	11,166	27	2,192.67	65.53	2,258.20
2	San Thor Mok	14,258	36	2,852.6	63.32	2,915.99
3	Toul Kok	28,000	21	1,677.78	52.82	1,730.60
4	Anu Wat Reach Theany	7,291	24	1,976.67	54.91	2,031.58
5	Boeung Salang	12,100	21	1,843.56	52.82	1,896.38
6	Phuom Russey	8,870	18	1,461.78	52.82	1,514.60
Total			147	12,005.13	342.22	12,347.35

3) Section Plan

a) Roofs

A steel truss frame will be selected for the roof structure with roofboard, tile batten and roof tile. Since only the roof tile is waterproof, a 60% roof pitch will be used to avoid water leakage from roof tile joints. For preventing the roof tiles from falling off, roof tiles are tied to tile batten with copper wires.

b) Walls

Hollow bricks are most popular material in Cambodia with high thermal insulation and ease of maintenance, so the Project will use single layer of this material for wall construction. Fault joints will be installed in order to prevent wall cracks and leaking from wall cracks.

c) Floor Elevation on the Ground Floor

The floor height on the ground floor of all the Project buildings should be equal to the highest floor of the existing buildings, and should be in the range of 400mm to 500mm above ground level.

d) Window Openings

Wooden louvers, which can be locally produced, are cost effective and easy to maintain, will be installed for window openings in the Project. In order to avoid burglary and theft, steel grills for all the windows on the first floor and steel grill doors at the stairways from the first to the second floor will be installed. For the purposes of student safety, steel grills will be installed on all outside facing windows on floors higher than the second floor. All classrooms shall have a louver block opening installed above the windows for air ventilation.

e) Canopy

In order to prevent the exterior walls from exposure to the strong direct sunlight and rainwater, canopies will be installed outside the windows and corridors of the Project buildings.

(2) Structure Planning

1) School Building Structure

a) Soil Bearing Capacity and Foundation

As shown in Table 2-8, at the sites of the Toul Kok, the San Thor Mok, the Boeung Salang Schools, it is possible to construct new buildings on the existing foundation beds that have a soil bearing capacity of 7.5 - 10 t/ square meters by using independent footing and continuous footing for the foundation spread, since the weight of these buildings is fairly light. At the sites of the Bak Touk, the Anu Wat Reach Theany, and the Phum Russey Schools, pile driving is required because of a low soil bearing capacity of less than 5 t/ square meters within a shallow depth. Table 2-8 shows the soil bearing capacity and foundation type of each Project school.

Table 2-8 Soil Bearing Capacity and Foundation Type

		Soil Bearing Capacity (t / sq. meter)	Foundation Type
1	Bak Touk	5.0	Pile Foundation
2	San Thor Mok	7.5	Spread Foundation
3	Toul Kok	10.0	Spread Foundation
4	Anu Wat Reach Theany	5.0	Pile Foundation
5	Boeung Salang	10.0	Spread Foundation
6	Phum Russey	5.0	Pile Foundation

b) Main Structure Plan

Rigid framed reinforced concrete structure placed on a 8m × 7m grid will be used for all Project buildings.

c) Standards for Structural Planning

In Cambodia, as there are not any standards for structural design, the following Japanese building standards will be applied to the Project, in reference with the structural system and drawings used for designing similar buildings in Cambodia:

- Architectural Standards;
- AIJ Recommendation for the Design of Building Structures;

- AIJ Standard for Structural Calculations of Reinforced Concrete;
- Recommendations for the Design of Building Foundations.

d) Materials and the Strength

In the Project, concrete equivalent to the standards of JIS concrete FC21N, will be produced at the concrete batcher plants in Phnom Penh, and reinforced steels equivalent to JIS SR235 (T6-R10) or SD390 (D10-D25) will be used.

e) Load and External Forces

Considering the use of the Project buildings and taking the natural environment into account, the load and external forces used for structural calculation are as follows:

1. Dead Load	Roof:	85 kg/m ²
	Floor:	310 kg/m ²
	Wall:	160 kg/m ²
2. Live Load	Roof:	0 kg/m ²
	Classroom Floor	300 kg/m ² (floor, beam, calculated)
		230 kg/m ² (girder, column, calculated)
	Stairs, Corridor	360 kg/m ² (floor, beam, calculated)
	Floor	330 kg/m ² (girder, column, calculated)
3. Seismic Load	Not Applicable	
4. Wind Load	Calculated using the specifications below	
	$W = C \times q \times A$	C: wind power
		q: wind speed pressure (25 kg/m ²)
		A: area (sq meters)

(3) Facility Plan

1) Toilet Facilities and Sanitation

The calculation of the number of toilets to be built in the Project is based on the principle of “1 toilet for each 2 new classrooms” (see Table 2-9). First, the total number of toilet units is divided equally between males and females. A half of the

male toilet units will be toilet bowls, and double amount of another half will be urinals. The number of urinals will be used to calculate the actual length of straight urinal ditch, which will be installed by the Project instead of individual urinals. The number is rounded off to either lowest or highest whole numbers depending on the situation.

In addition, considering that there are few existing toilets with washing basins, the toilets will be constructed with a water tub in each toilet booth for washing and flushing, instead of installing washing basins.

Table 2-9 Number of Planned Toilet Bowls

	No. of New Classroom	No. of Female Toilet Bowl	No. of Male Toilet Bowl	No. of Male Urinal
1. Bak Touk	27	7	3	8
2. San Thor Mok	36	9	4	8
3. Toul Kok	21	5	2	6
4. Anu Wat Reach Theany	24	6	3	6
5. Boeung Salang	21	5	2	6
6. Phum Russey	18	5	2	6
Total	147	37	16	40

One male and one female toilet booth for the physically handicapped will also be installed at each Project school. These toilets should be provided with a western-style toilet bowl, a wash basin, a set of grab fixtures and a ramp for handicapped students, door opening fixtures, and an angled mirror.

2) Water Supply System

Existing water supply resources at each Project school is shown in Table 2-10.

- a) At Bak Touk and Toul Kok Schools, there is already an access to the city water supply and to a water well and pump system. Water will be collected from those sources and pumped into a cistern tank.
- b) At San Thor Mok School, which had failed to dig and strike water in the past, the existing city water system will be only used without another digging in the Project.
- c) Anu Wat Reach Theany School has no water well due to the lack of funds for

installation. The Cambodian side shall dig a well and install a pump and pipes inside the well so that Anu Wat Reach Theany School will have access to both water sources: the city water supply and well water.

- d) Phuom Russey School cannot use the city water because of no nearby water source pipe. In addition, due to the lack of funds, the water well has been left un-repaired. It should be shouldered by the Government of Cambodia to repair the existing pumping system and pipes so that water well can be reused.

With the installation of new toilets, a water supply system will also be installed in the Project (see Figure 2-2). At all Project sites, roofs of the newly constructed toilet facilities shall be designed to collect rainwater through the gutters, drain pipes, and funnel into the cistern tank for storage.

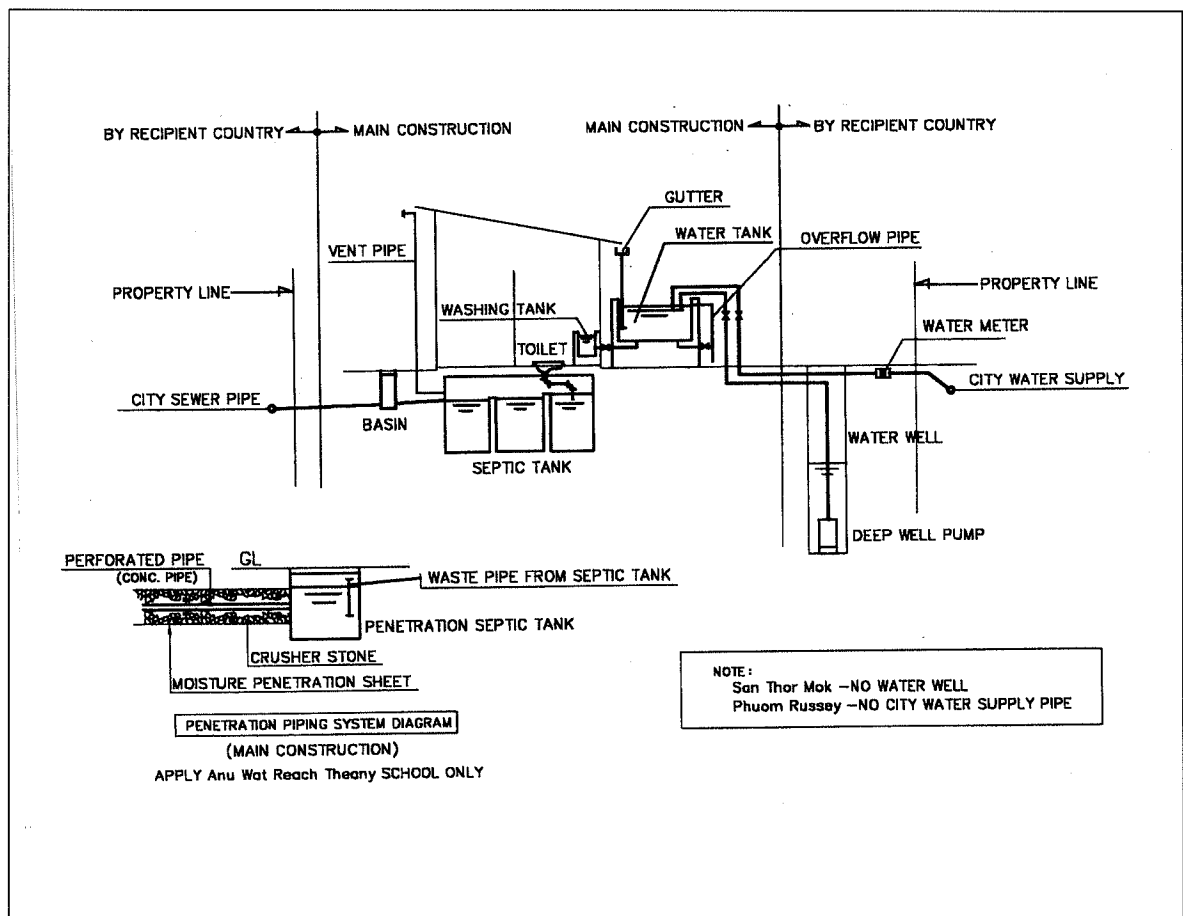


Figure 2-2 Water Supply and Sewerage System Diagram

Table 2-10 Existing Condition and Water Supply Plan

	Existing Water Supply Resource	Planned Supply Resource	Remarks
1. Bak Touk	Well · City Water	Well · City Water · Rain Water	
2. San Thor Mok	City Water	Well · Rain Water	No under ground creek exists.
3. Toul Kok	Well · City Water	Well · City Water · Rain Water	
4. Anu Wat Reach Theany	Adjacent Pond, City Water	Well · City Water · Rain Water	No well due to an insufficient amount of available funds. The digging well should be done by the Cambodian side.
5. Boeung Salang	Well · City Water	Well · City Water · Rain Water	
6. Phuum Russey	Well (Damaged and Unusable)	Well · Rain Water	No water supply pipe exists around the site. The existing well should be repaired by the Cambodian side.

<Source> Based on the results of site survey

3) Drainage Facilities

According to the regulations regarding drainage systems established in the Cambodian architectural standards, septic tanks shall be installed at all toilets. In the Project, sewage should be connected to the public drainage system through a septic tank and basin, which is done by the Cambodian side (see Figure 2-2).

Since there is no public drainage pipes nearby at the Anu Wat Reach Theany School, a penetration septic tank and perforated pipe shall be additionally installed so that sewage can soak into the ground (see Figure 2-2). During the rainy season, the water table goes up to the point where it might be impossible for the ground to absorb the sewage water, so an overflow pipe shall be installed to catch excess water and drain it into the pond used for waste water in the teachers' college next to the school.

4) Electrical Facilities

Each Project school shall have lighting fixtures installed in the 2 or 3 classrooms of the new building which are closest to the school entrance, as well as in the front corridors, as shown in Fig. 2-3 (3 classrooms at the large Project schools and 2 classrooms at the other Project schools). The Japanese side shall install the electrical supply facilities for both the new lighting fixtures and for the electric

pump for the water well (the pump and the well installed by the Cambodian side). The Japanese side will install a new main switchboard to supply electricity to both the existing distribution board and a new Project facility distribution board. From the new Project facility distribution board, electricity for the lighting fixtures and the water well pump will be supplied.

During the rainy season, the amount of power consumed throughout the entire Phnom Penh area increases, thereby causing voltage drops. Due to the voltage change, well pumps to be installed by the Cambodian side and the ballast of fluorescent lighting to be included in the Project may often be damaged. To prevent such damage, voltage regulators will be installed.

5) Fire Extinguishing System

In the Project buildings, some furniture and other fittings and fixtures are made of wood, which have a potential to catch fire. In the Project, fire extinguishers will be installed in the staircases on the second and third floor.

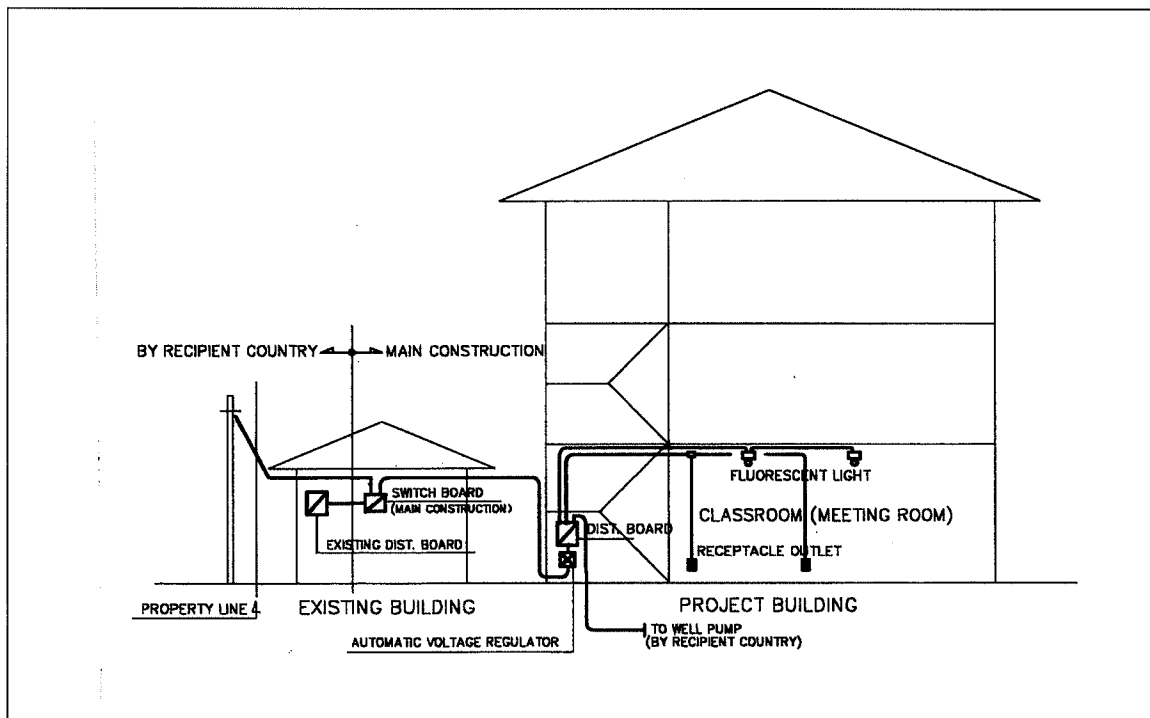


Figure 2-3 Electric Power Supply Diagram

(4) Building Material and Equipment Plan

1) Roofing

As shown in Table 2-11, all the following six considerations need to be taken in order to choose the material most suitable for the roof of the Project buildings;

a) Durability (material life and strength and resistance to damage)

Concrete tile and asphalt membrane are best in terms of durability;

b) Ease of Procurement in terms of Local Availability and Delivery

Corrugated steel sheet panel is not popular in Cambodia;

c) Waterproofing

The larger the size of the area of individual pieces of material, the less joint of parts needed and the less chance of leakage. Thus, steel sheeting and asphalt roofing materials are suitable because of the large size;

d) Insulation Quality

The insulating quality of materials is determined by the amount of the air volume in the material. As thin corrugated steel sheet panel and corrugated non-asbestos panel do not consist of air layers, thermal insulation performance of those materials cannot be expected;

e) Ease of Maintenance;

Since maintenance depends on ease of repair work and procurement, it is further acceptable to select the materials which can be widely used in the existing construction methods;

f) Cost Performance.

Comparing roof materials taking the above-mentioned six criteria into account, colored cement roof tile will be used as the most suitable material in this Project.

Table 2-11 Performance Comparison of Roof Materials

	Durability	Procurement	Water Proofing	Thermal Insulation	Maintenance	Cost Performance	Total Grading
Colored Cement Roof Tile	◎	○	○	△	◎	◎	◎
Ceramic Roof Tile	△	○	△	△	◎	○	○
Ceramic Tile	△	○	×	△	◎	◎	△
Corrugated Non-asbestos Panel	△	○	○	×	×	◎	△
Corrugated Steel Sheet Panel	○	△	◎	×	×	×	△
Asphalt Water Proofing	◎	○	◎	○	×	×	△

<Legend> ◎: Excellent ○: Good △: Standard ×: Inferior
 Comparison is based on the cost procured in Phnom Penh City

2) Ceilings

A roofboard will be used as the finishing material for the exposed ceiling on the top floor. For the ceilings on the middle floor, concrete slab with a plaster finish will be used.

3) Walls

To reduce costs, hollow bricks will be used as wall materials with mortar steel trowel and emulsion paint finish. Hollow bricks, which have a good insulation quality, are easy to maintain and popular in Cambodia. Fault joints will be installed in order to prevent water leakage from wall cracks.

4) Openings

For the purpose of student safety and security, steel grills shall be installed at all windows, and wood louver window shall be installed outside the grills. All wooden parts on both windows and doors shall be treated with anti-termite chemicals.

5) Flooring

Classroom floors shall be finished with cement panel, which is commonly used in Cambodia. Taking cost reduction into account, the finishing of the corridors and stairs will use the less costly mortar steel trowel finish.

6) Toilet Facilities

For ease of cleaning and to help prevent odor, the walls and floors of the toilet facilities shall have a tile finish. As mentioned earlier, the tile finish of the walls shall only go up 2 meters from the floor, and above that, be mortar and paint finish.

Table 2-12 shows the list of materials adopted in this Project.

Table 2-12 List of Selected Materials

Part	General Construction Method & Materials	Selected Method & Materials	Reason of Selection
Main Structure			
Roof Framing	Wood Truss	Steel Frame	Termite Resistible • Durability
Main Framing	Reinforced Concrete	Reinforced Concrete	Durability • Adopt Local Method
Wall	Hollow Brick	Hollow Brick	Inexpensive • Adopt Local Method
Floor	Upper Floor: Concrete Slab (Structural)	Upper Floor: Concrete Slab (Structural)	Inexpensive
	Ground Floor: Concrete Slab (Non-Structural)	Ground Floor: Concrete Slab (Non-Structural)	Adopt Local Method
Exterior Finish			
Roof	Ceramic Roof Tile Ceramic Tile	Colored Cement Roof Tile	Based on Total Performance Grading Shown Before
Exterior Wall	Paint Finish over Mortar System	Paint Finish over Mortar System	Inexpensive • Adopt Local Method Ease of Maintenance and Repair
Openings	Paint Finish over Wood Window Frames	Paint Finish over Wood Window Frames	Inexpensive • Adopt Local Method Ease of Maintenance and Repair
Interior Finish			
Ceiling	Top Floor	Exposed Ceiling	Paint Finish over Exposed Ceiling
	1 st , 2 nd Floor	Plaster System	Plaster System
Wall	Wood Panel Finish Over Mortar System	Paint Finish over Mortar System	Heat Insulation, Waterproof
Floor	Cement Panel Finish	Classroom : Cement Panel Finish	Inexpensive • Adopt Local Method Ease of Maintenance and Repair
		Corridor : Mortar Metal Trowel Finish	Economical Purpose
Restroom Wall	Paint Finish over Mortar System	Upper Wall : Paint Finish over Mortar System Lower Wall : Tile Finish	Ease of Maintenance and Repair • Odor Control
Restroom Floor	Mortar Metal Trowel Finish	Mosaic Tile Finish	Ease of Maintenance and Repair • Odor Control

2-2-2-2 Equipment Plan

Table 2-13 shows the placement standard for furniture at Project schools. Desks and chairs for students will have two sizes, for lower grades and for higher grades, and they will be placed in accordance with the current ratio of lower grades to higher grades.

Table 2-13 Placement List of Furniture

Furniture and Equipment	Placement Standard
Whiteboard 1200×2400	2 Boards per 1 New Classroom
Student Desk · Chair (Large : Grade 4 · 5 · 6, for 2 Students)	20 Desks/Chairs for 40%* of New Classrooms
Student Desk · Chair (Small : Grade 1 · 2 · 3, for 2 Students)	20 Desks/Chairs for 60%* of New Classrooms
Teacher's Desk	1 Desk per 1 New Classroom
Teacher's Chair	1 Chair per 1 New Classroom

* In primary school in Phnom Penh in 2000, the percentage of lower graders (grade 1-3) was 58.8% and upper graders (grade 4-6) 41.2%.

Table 2-14 shows a list of facilities and furniture at Project schools.

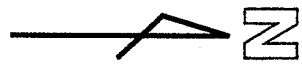
Table 2-14 List of Facilities and Furniture at Project Schools

Name of School	Facilities					Furniture				
	Classrooms to be Constructed	Toilet				Student Desk / Chairs			Teacher's Desk/ Chair	White board
		No. of Female Toilet Bowl	No. of Male Toilet Bowl	No. of Male Urinal	No. of Toilet for the Handicapped	L	S	Total		
1 Bak Touk	27	7	3	8	2	216	324	540	27	54
2 San Thor Mok	36	9	4	8	2	288	432	720	36	72
3 Toul Kok	21	5	2	6	2	168	252	420	21	42
4 Anu Wat Reach Theany	24	6	3	6	2	192	288	480	24	48
5 Boueng Salang	21	5	2	6	2	168	252	420	21	42
6 Phuum Russey	18	5	2	6	2	144	216	360	18	36
Total	147	37	16	40	12	1,176	1,764	2,940	147	294

2-2-3 Basic Design Drawing

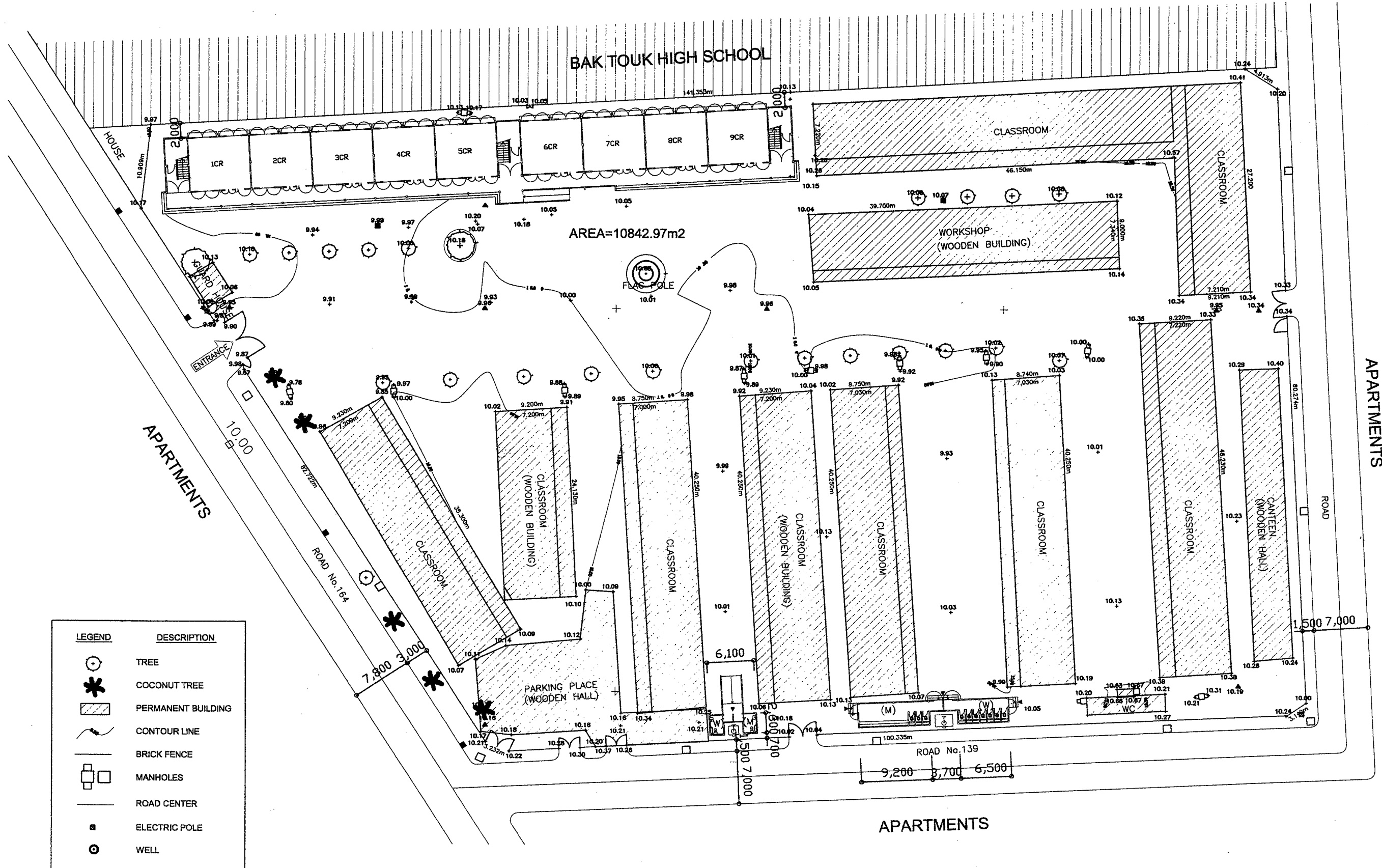
The Basic Design drawings are shown respectively.

- 01 Bak Touk : site plan
- 02 Bak Touk : floor plan
- 03 San Thor Mok : site plan
- 04 San Thor Mok : floor plan
- 05 Toul Kok : site plan
- 06 Toul Kok : floor plan
- 07 Anu Wat Reach Theany : site plan
- 08 Anu Wat Reach Theany : floor plan
- 09 Boueng Salang : site plan
- 10 Boueng Salang : floor plan
- 11 Phum Russey : site plan
- 12 Phum Russey : floor plan
- 13 Bak Touk : elevation & section plan
- 14 Bak Touk : Toilet
- 15 San Thor Mok : Toilet



BAK TOUK HIGH SCHOOL

AREA=10842.97m²



LEGEND	DESCRIPTION
	TREE
	COCONUT TREE
	PERMANENT BUILDING
	CONTOUR LINE
	BRICK FENCE
	MANHOLES
	ROAD CENTER
	ELECTRIC POLE
	WELL

THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

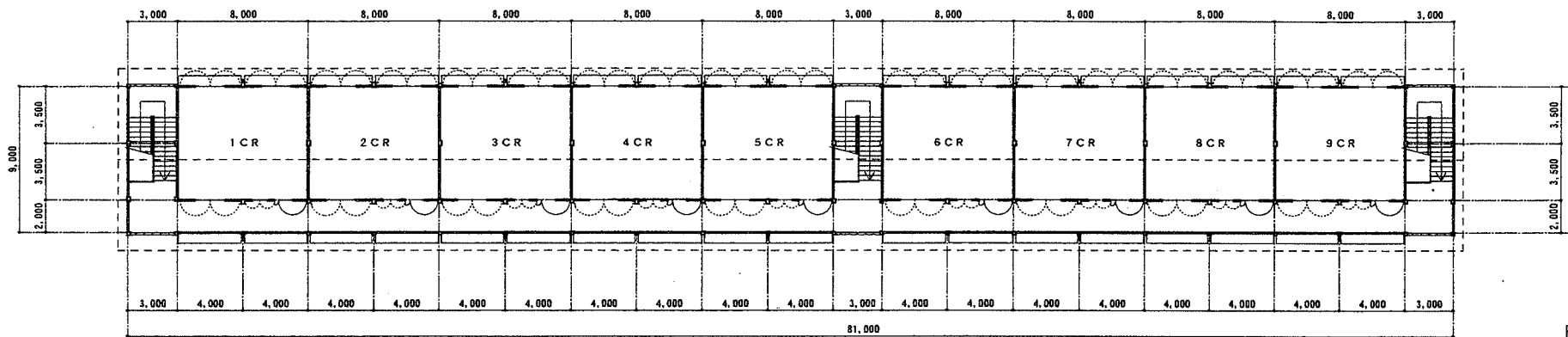
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BAK TOUK
SITE
PLAN

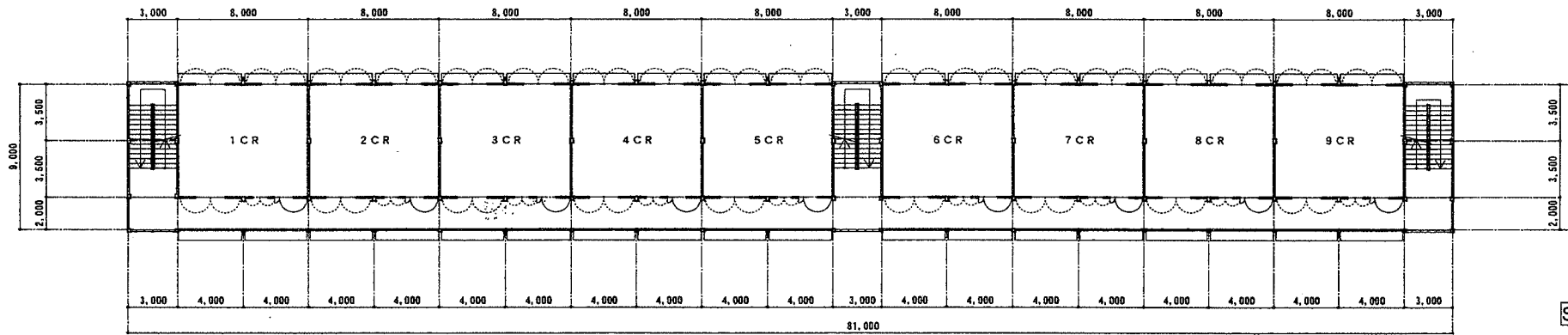
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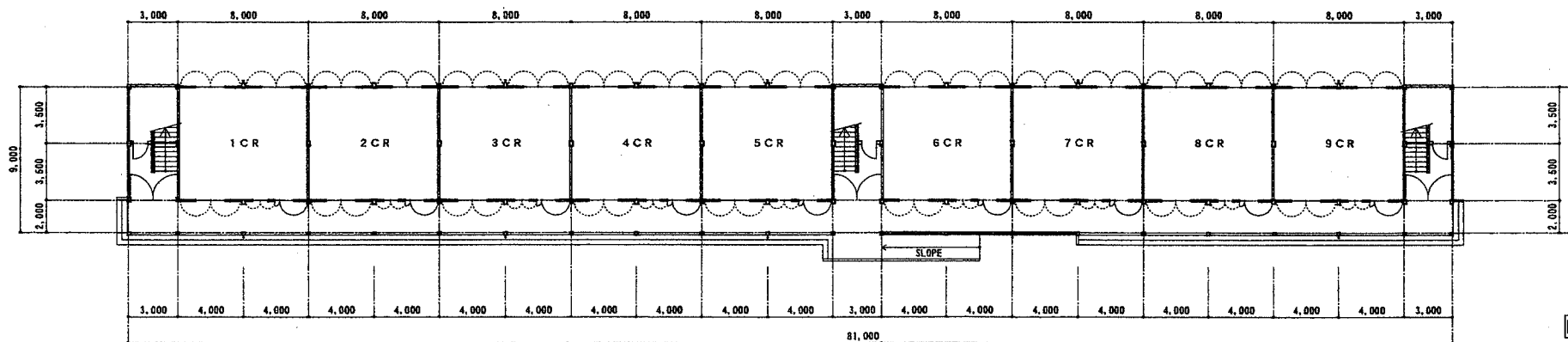
01



THIRD FLOOR



SECOND FLOOR



FIRST FLOOR

THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

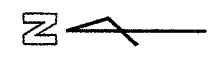
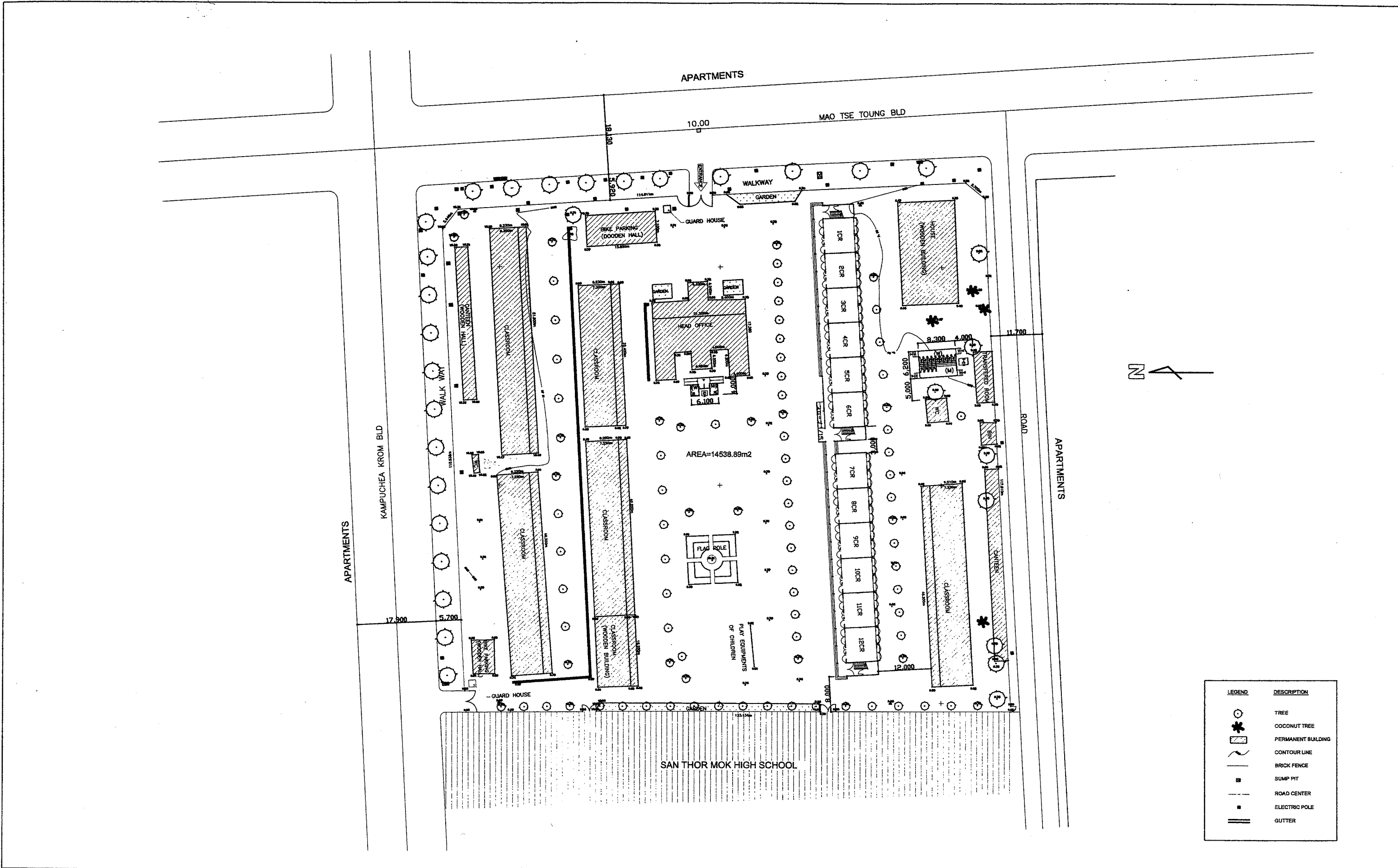
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BAK TOUK
CLASSROOM BUILDING
PLAN

SCALE

1/400

0 2



LEGEND	DESCRIPTION
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	PERMANENT BUILDING
	CONTOUR LINE
	BRICK FENCE
	SUMP PIT
	ROAD CENTER
	ELECTRIC POLE
	GUTTER

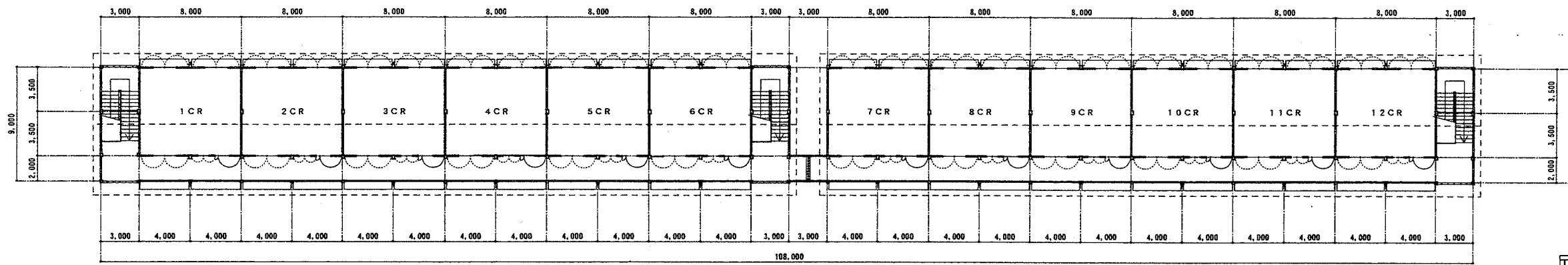
THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

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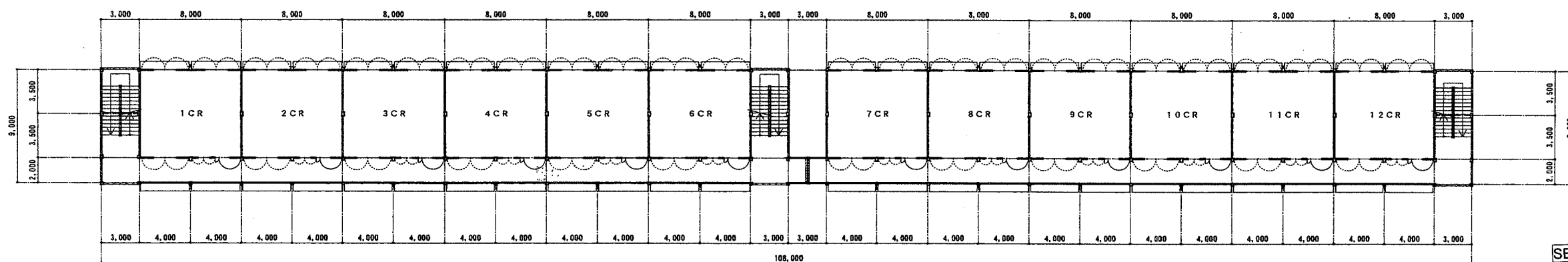
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SITE
PLAN

SCALE
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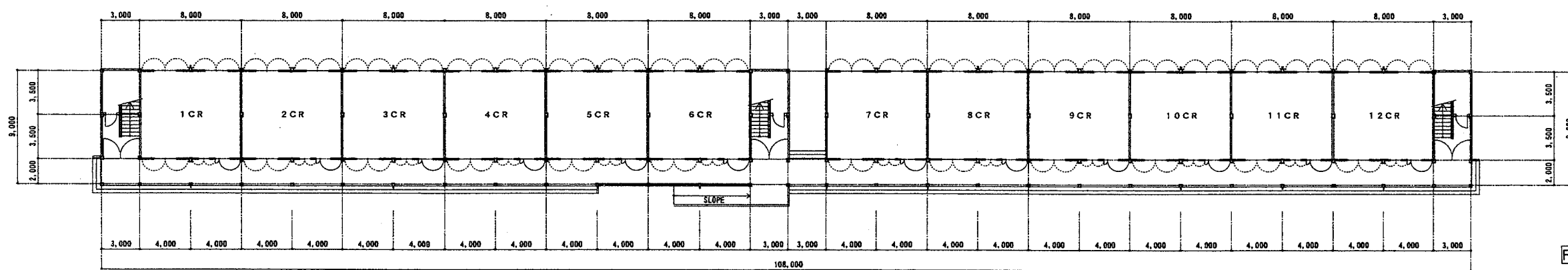
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THIRD FLOOR



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THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

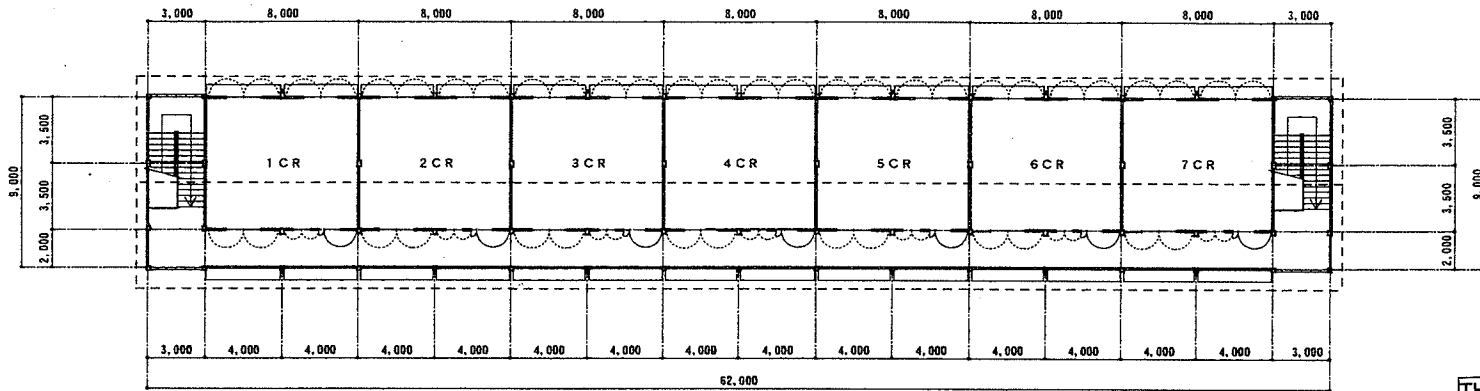
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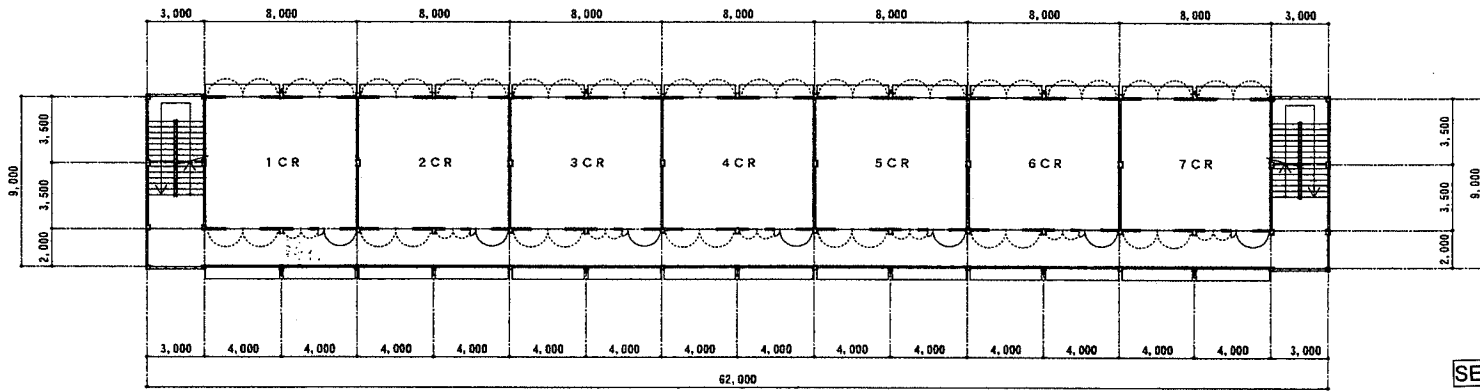
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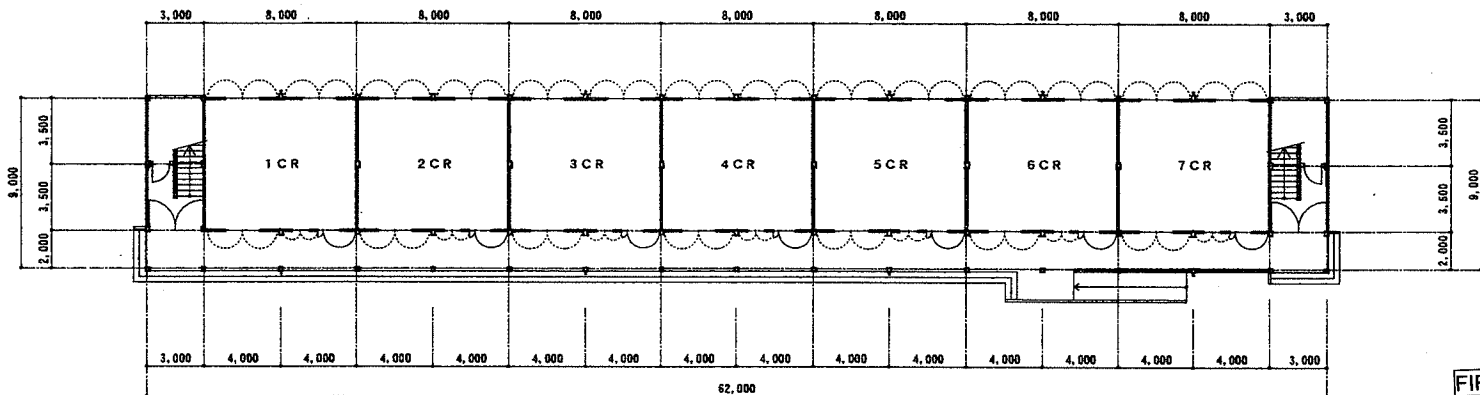
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THIRD FLOOR



SECOND FLOOR



FIRST FLOOR

THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

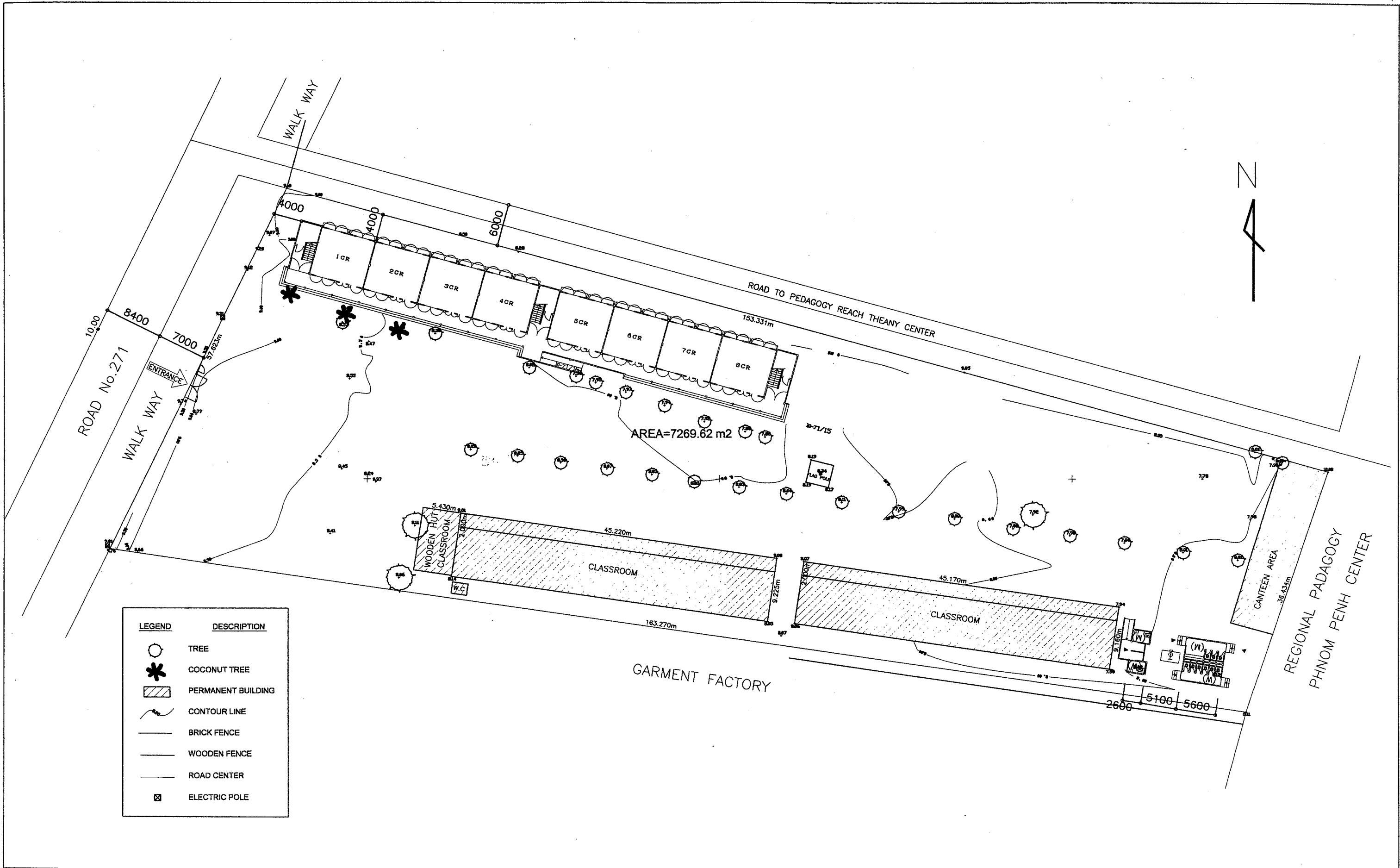
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TOUL KOK
CLASSROOM BUILDING
PLAN

SCALE

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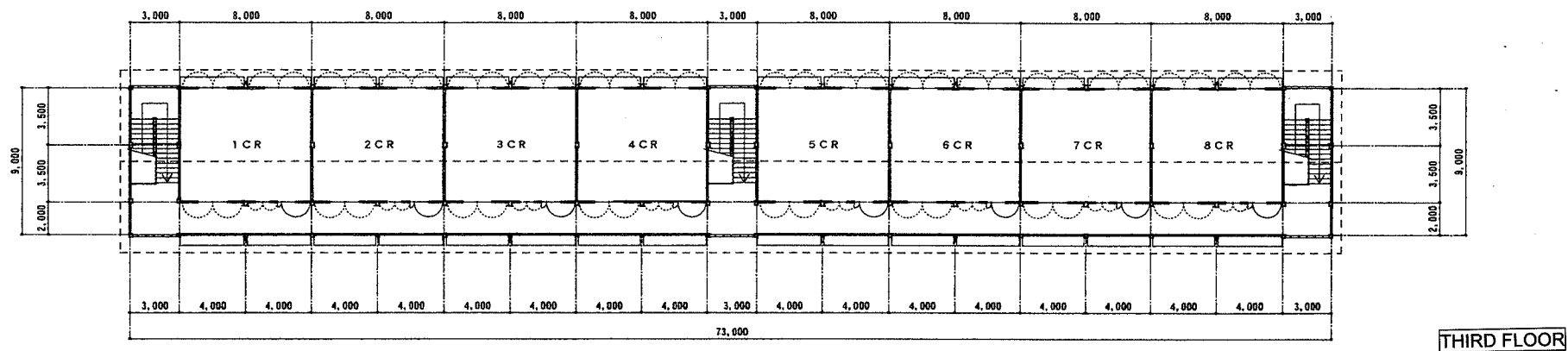
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	COCONUT TREE
	PERMANENT BUILDING
	CONTOUR LINE
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	WOODEN FENCE
	ROAD CENTER
	ELECTRIC POLE

THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

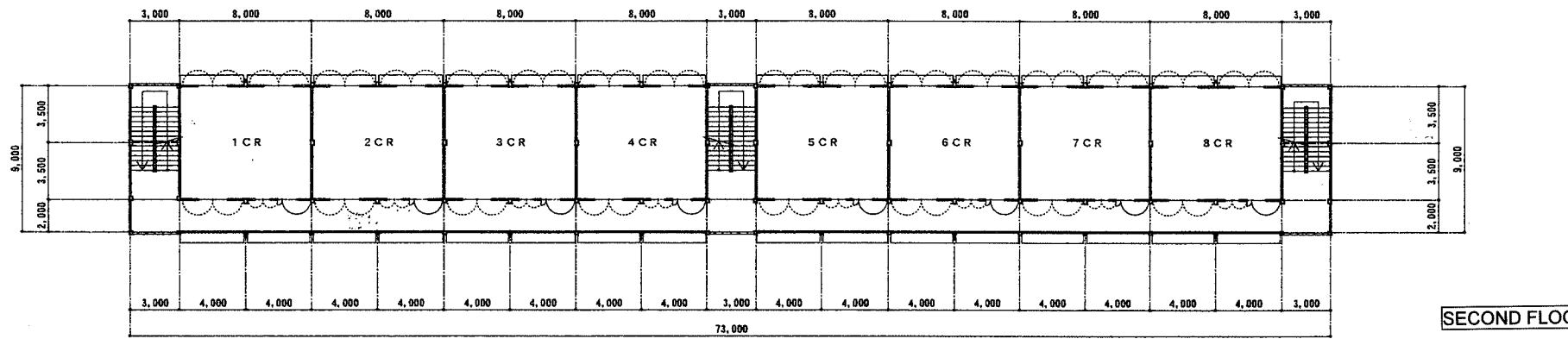
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 SITE
 PLAN

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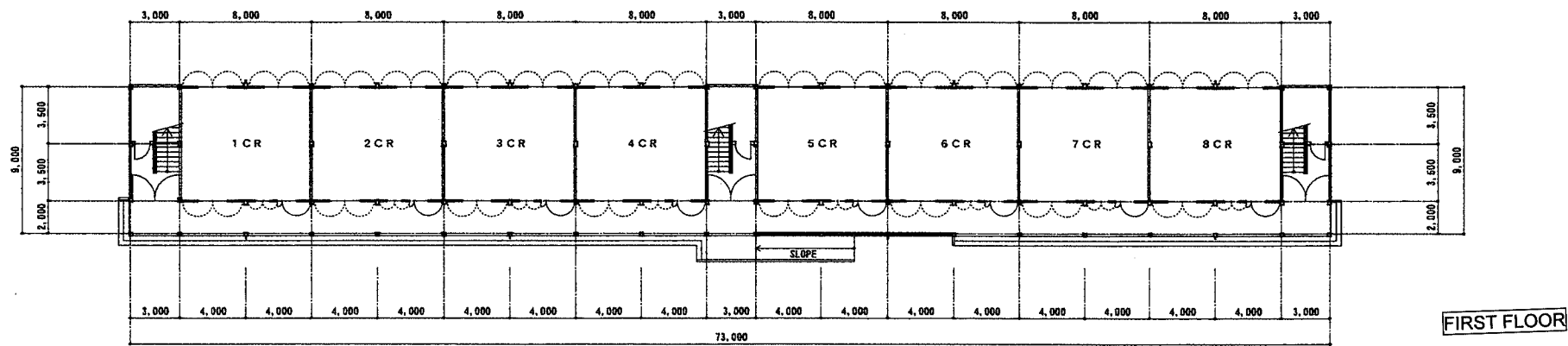
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THIRD FLOOR



SECOND FLOOR



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THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

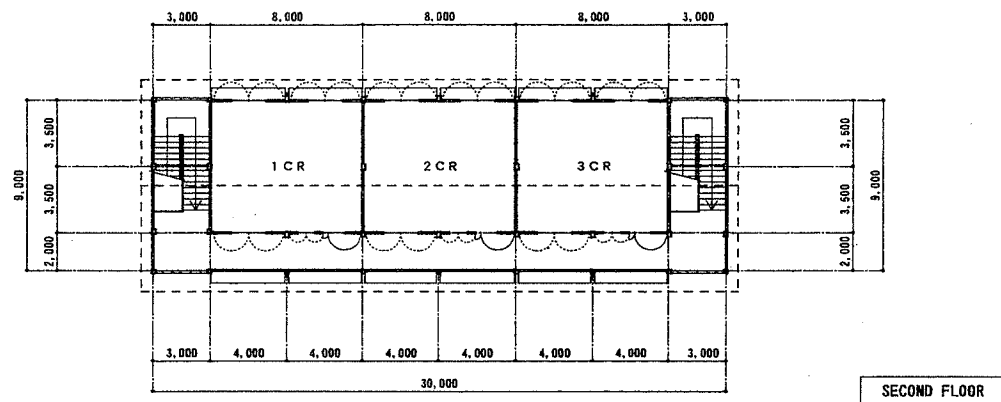
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CLASSROOM BUILDING
PLAN

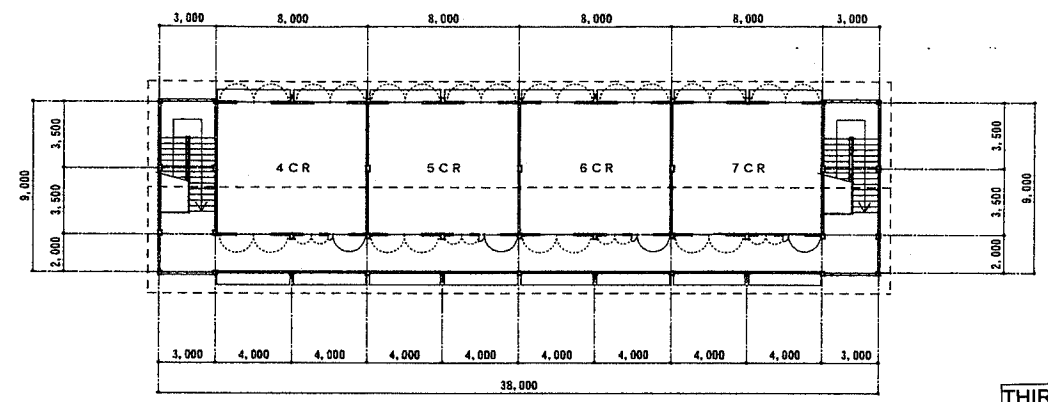
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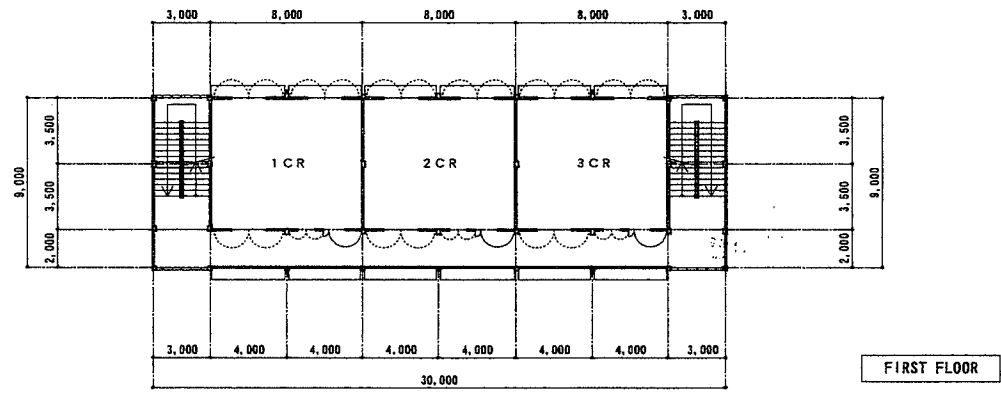
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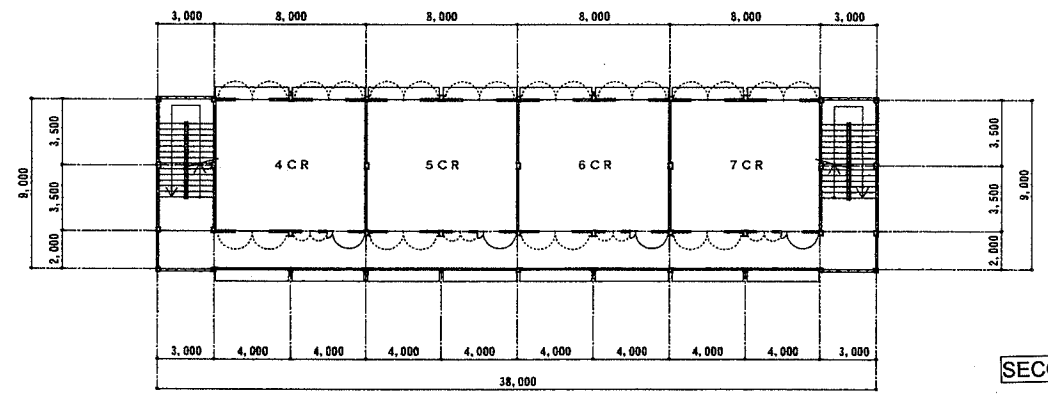
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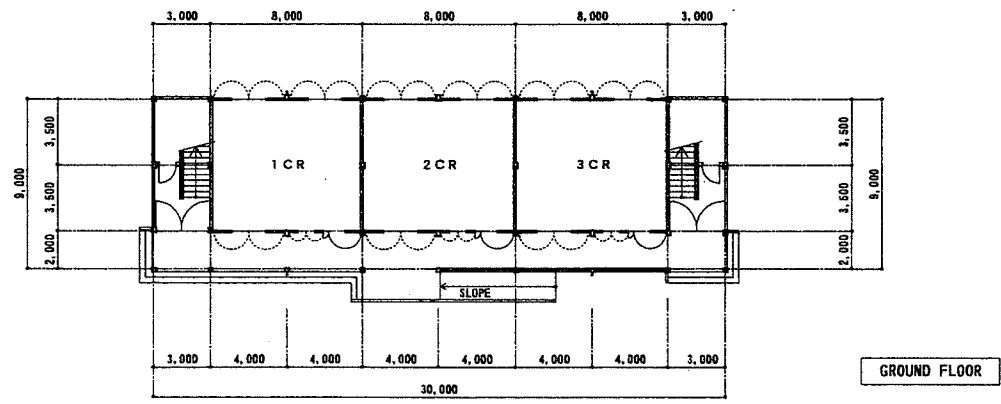
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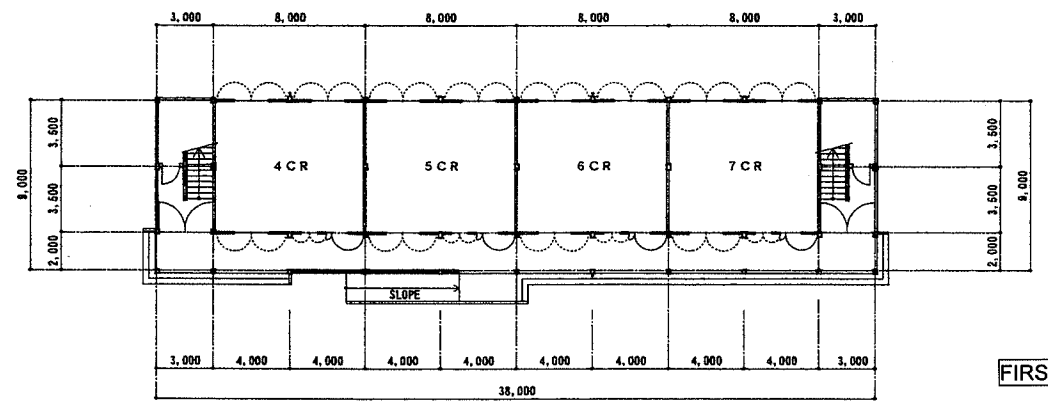
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SECOND FLOOR



GROUND FLOOR

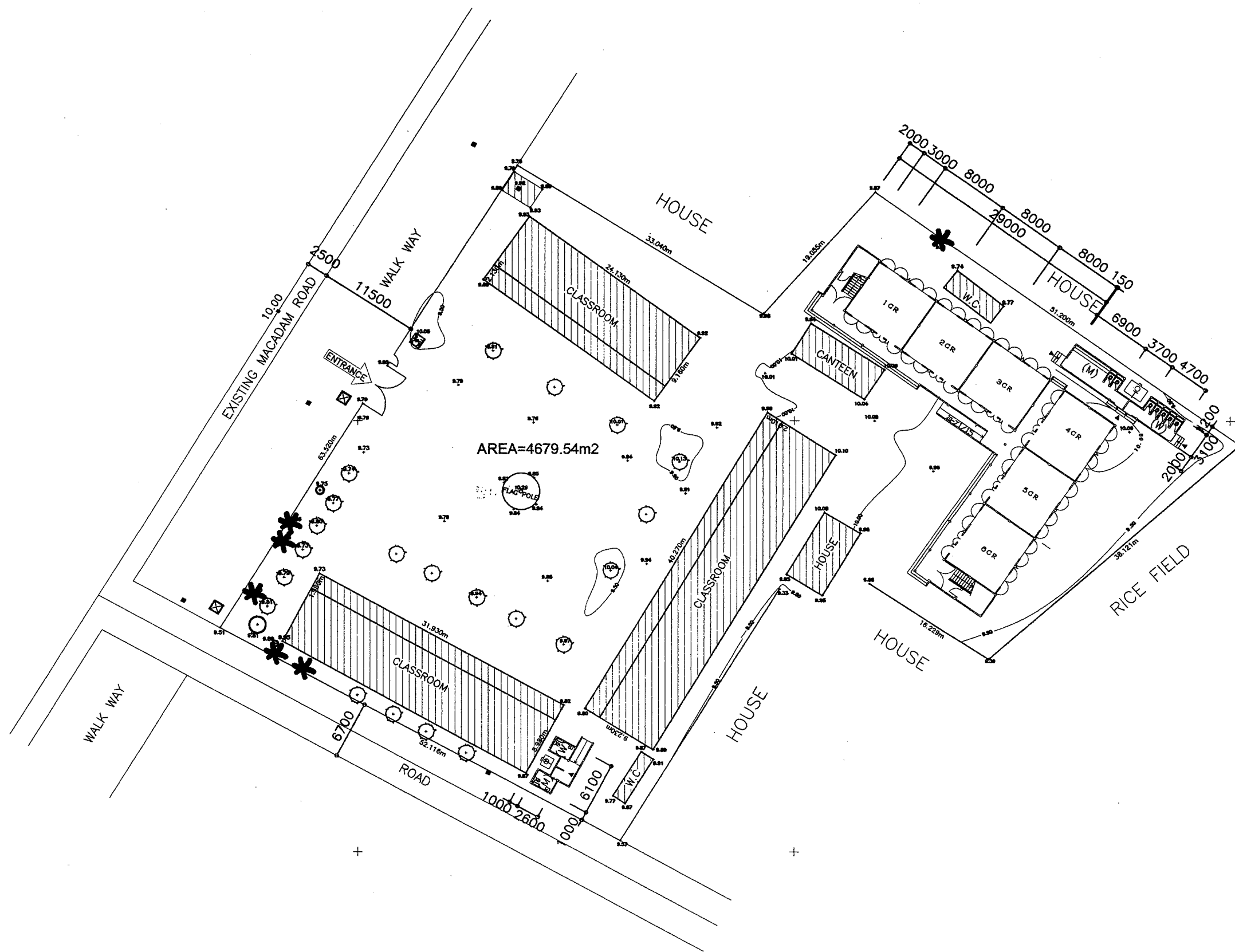


FIRST FLOOR

THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

DRAWN TITLE
 BOENG SALANG
 CLASSROOM BUILDING
 PLAN

SCALE
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 1 0



LEGEND	DESCRIPTION
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	COCONUT TREE
	PERMANENT BUILDING
	CONTOUR LINE
	BRICK FENCE
	WOODEN FENCE
	BARBED WIRE FENCE
	NO FENCE
	ROAD CENTER
	ELECTRIC POLE
	WELL
	SUMP PIT

THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

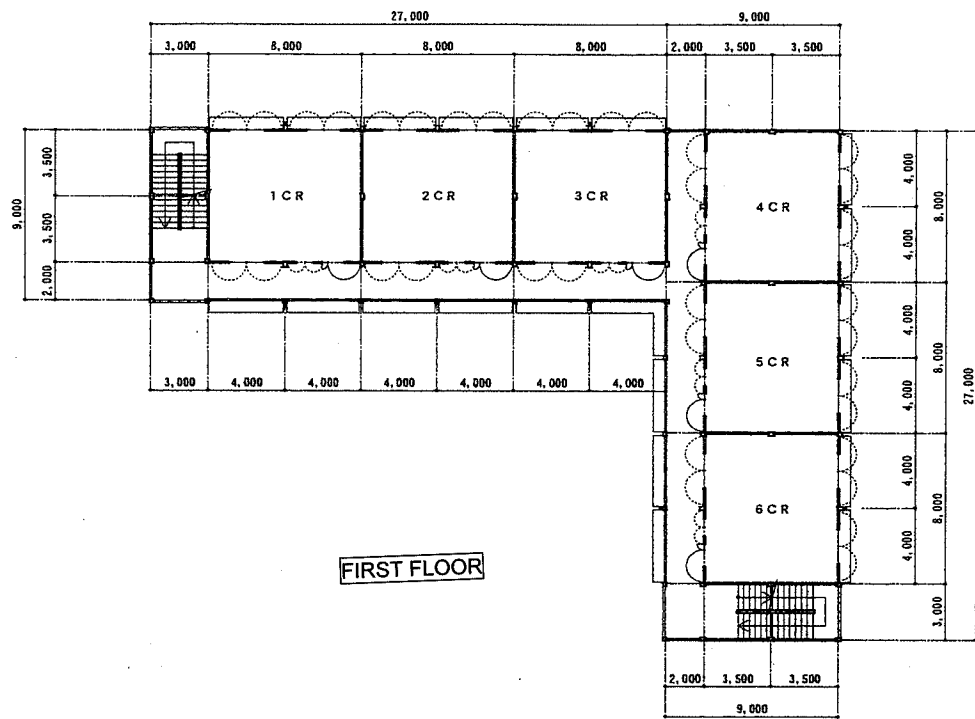
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PHUOM RUSSEY
SITE
PLAN

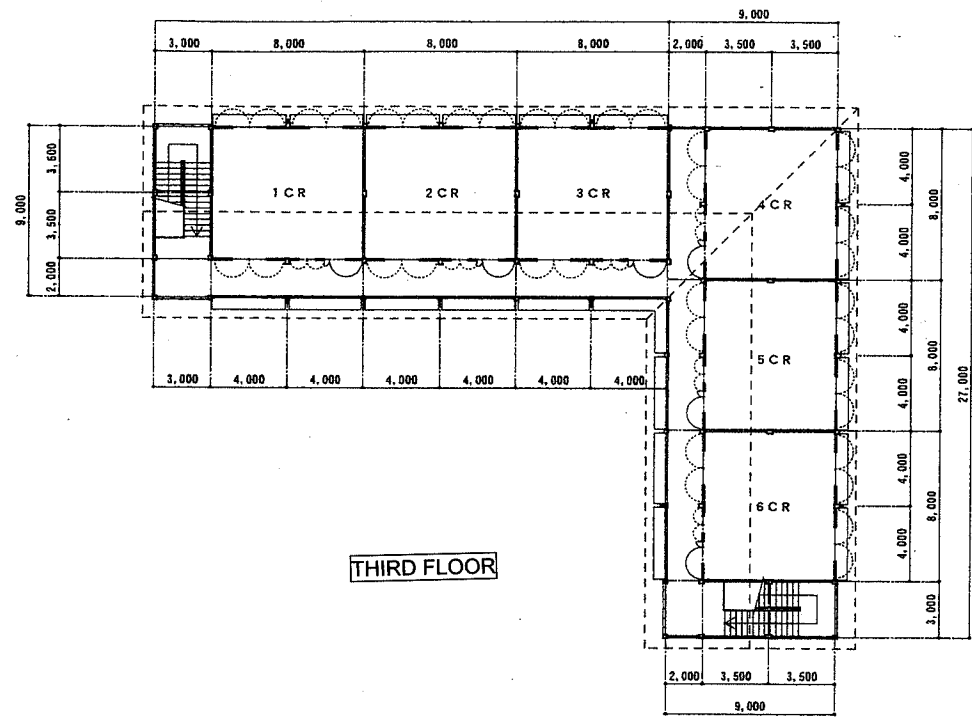
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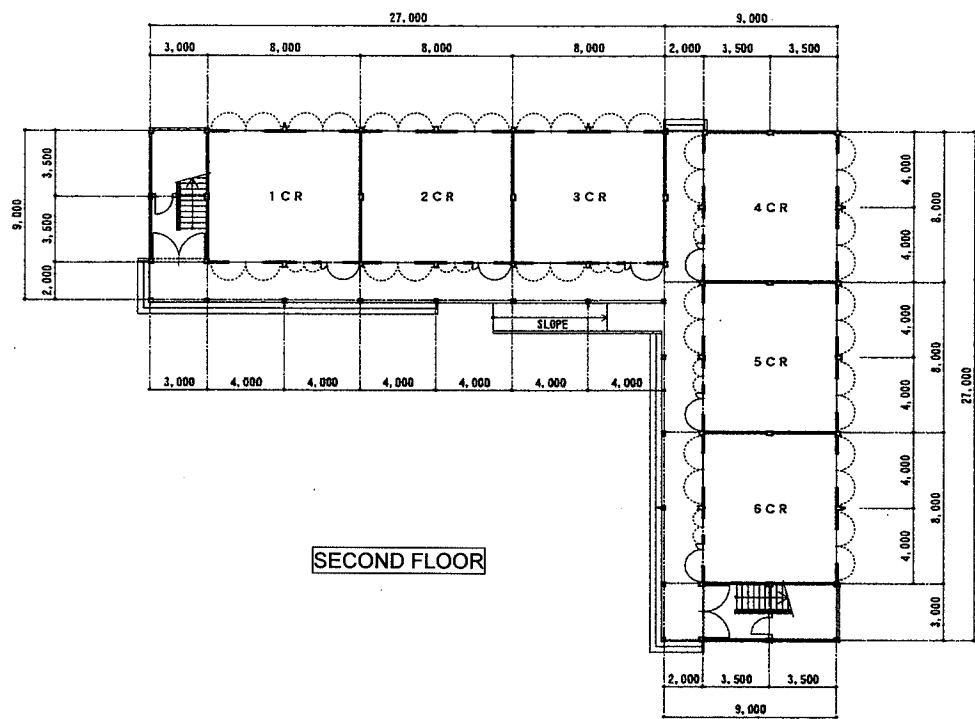
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FIRST FLOOR



THIRD FLOOR



SECOND FLOOR

THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

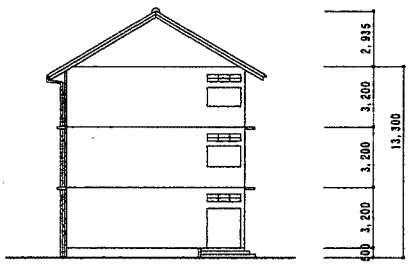
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PLAN

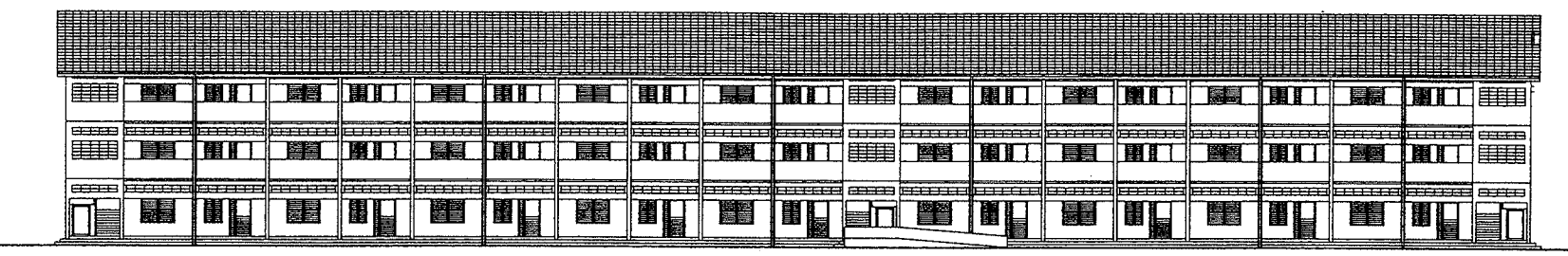
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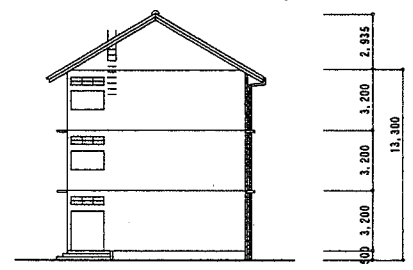
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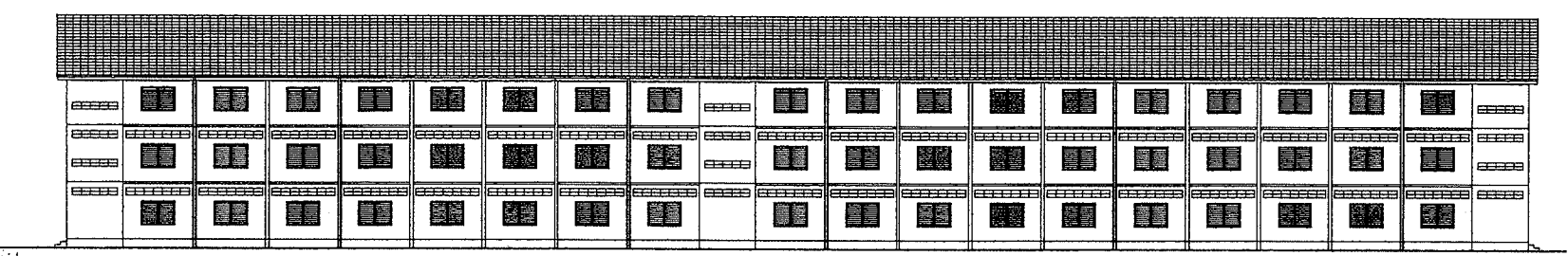
LEFT ELEVATION



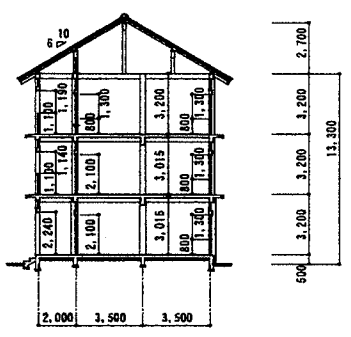
FRONT ELEVATION



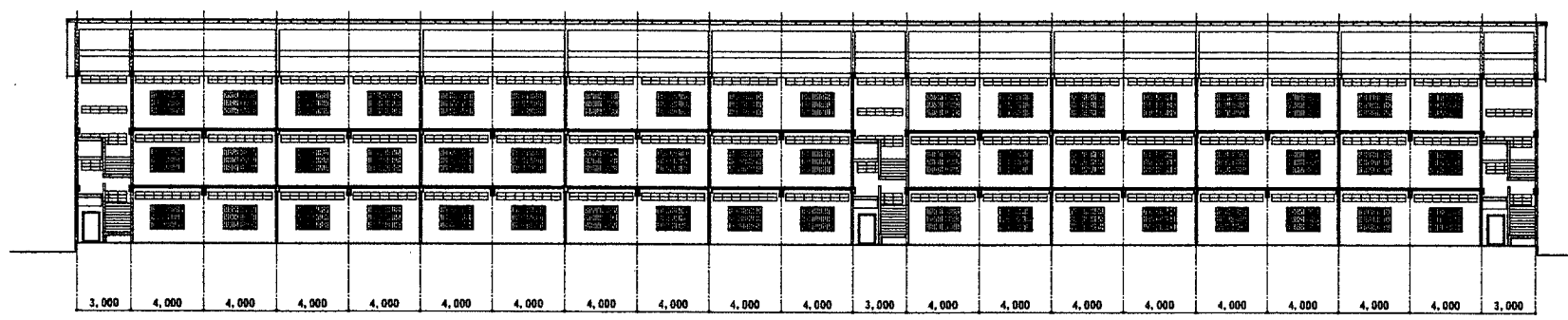
RIGHT ELEVATION



BACK ELEVATION



SECTION B-B



SECTION A-A

NO. 1 BAK TOUK ELEVATION - SECTION

THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

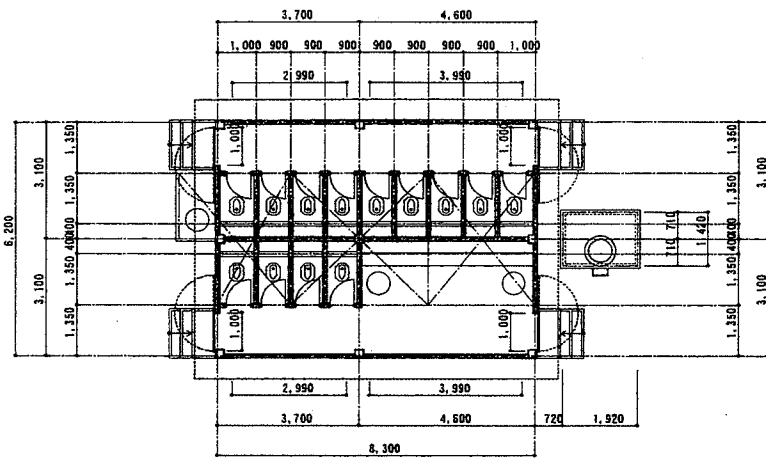
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BAK TOUK
CLASSROOM BUILDING
ELEVATION, SECTION

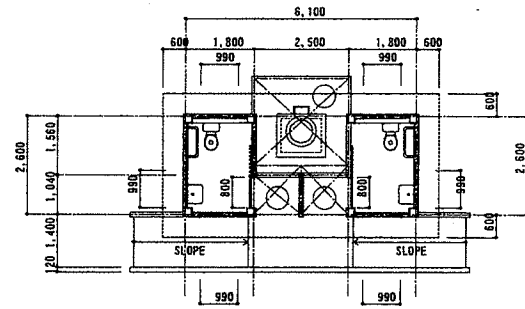
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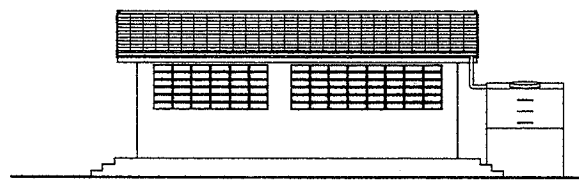
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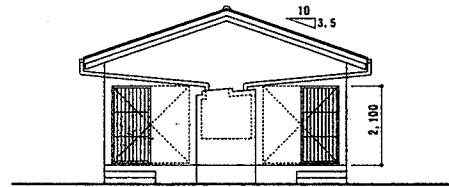
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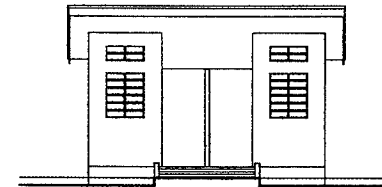
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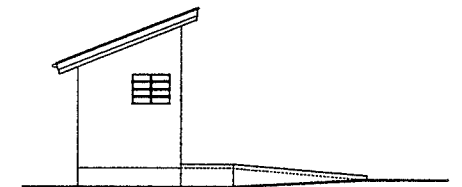
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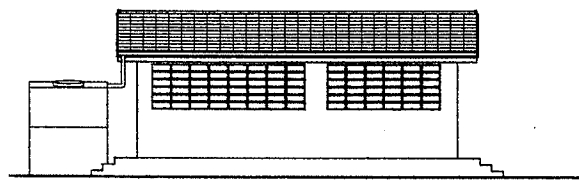
SIDE ELEVATION



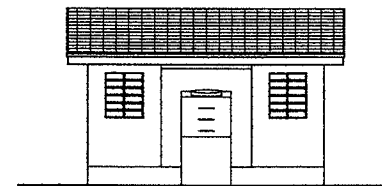
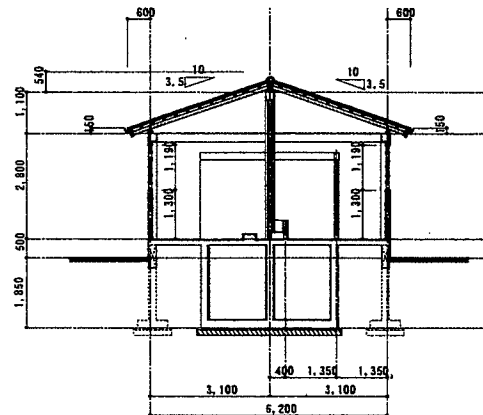
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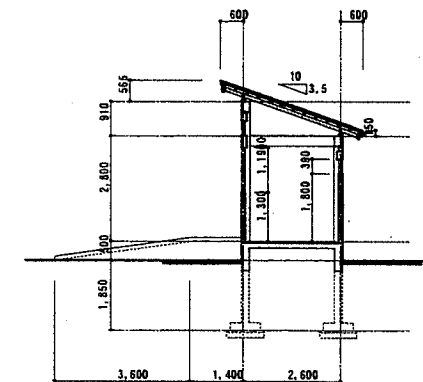
SIDE ELEVATION



FRONT ELEVATION



FRONT ELEVATION



THE PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH

DRAWN. TITLE

SAN THOR MOK
TOILET
PLAN

SCALE

1/200

1 5