

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

JULY 2005

**JAPAN INTERNATIONAL COOPERATION AGENCY
GRANT AID MANAGEMENT DEPARTMENT**

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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 (Phase II) in the Kingdom of Cambodia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Cambodia a study team from January 10, 2005 to February 4, 2005.

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.

July, 2005

Yoshihisa Ueda
Vice-President

Japan International Cooperation Agency

LETTER OF TRANSMITTAL

July, 2005

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

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from January, 2005 to July, 2005. 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,

Naoyuki Minami

Project Manager,

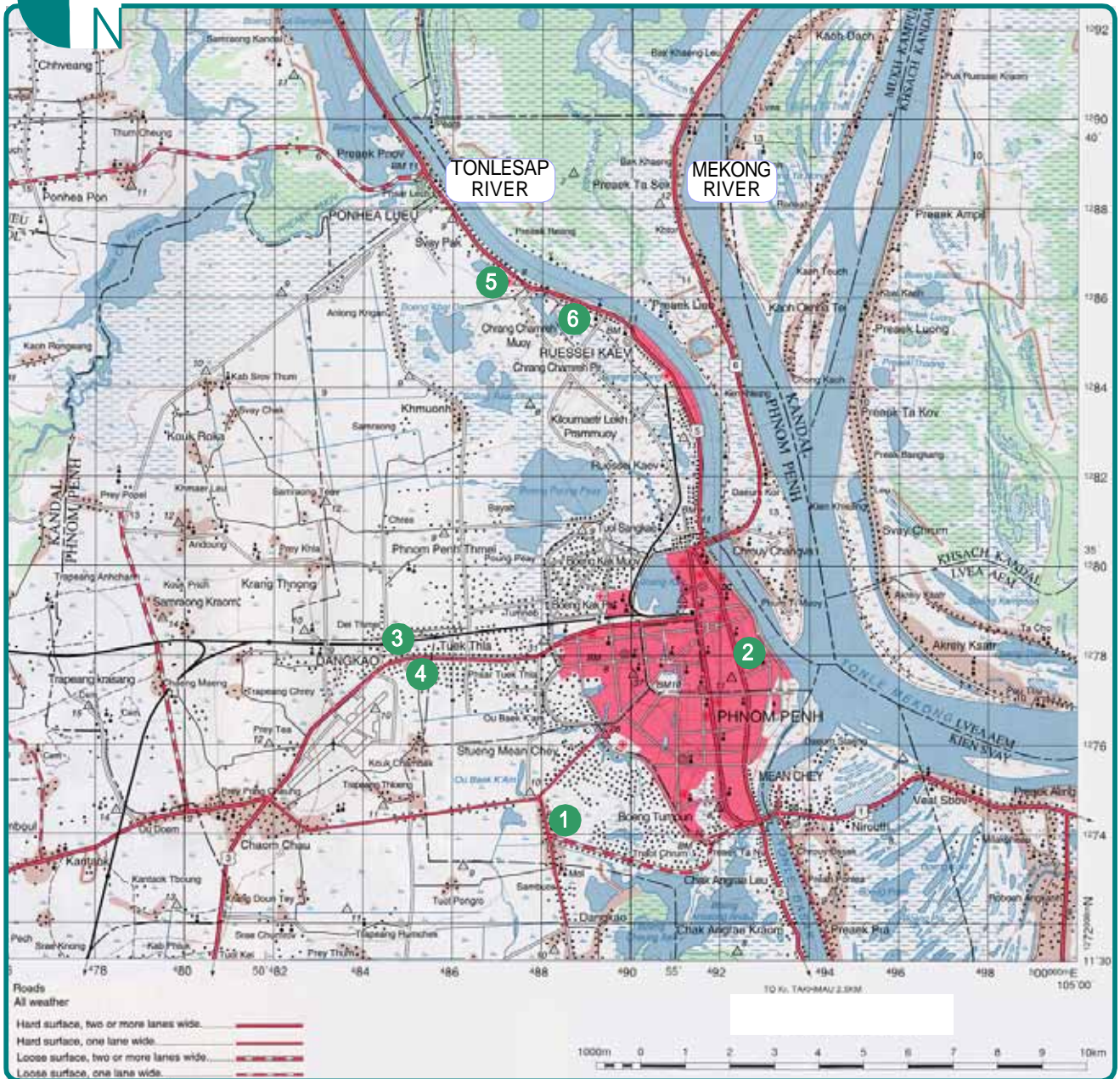
Basic design study team on the Project for

Construction of Primary Schools in

Phnom Penh (Phase II)

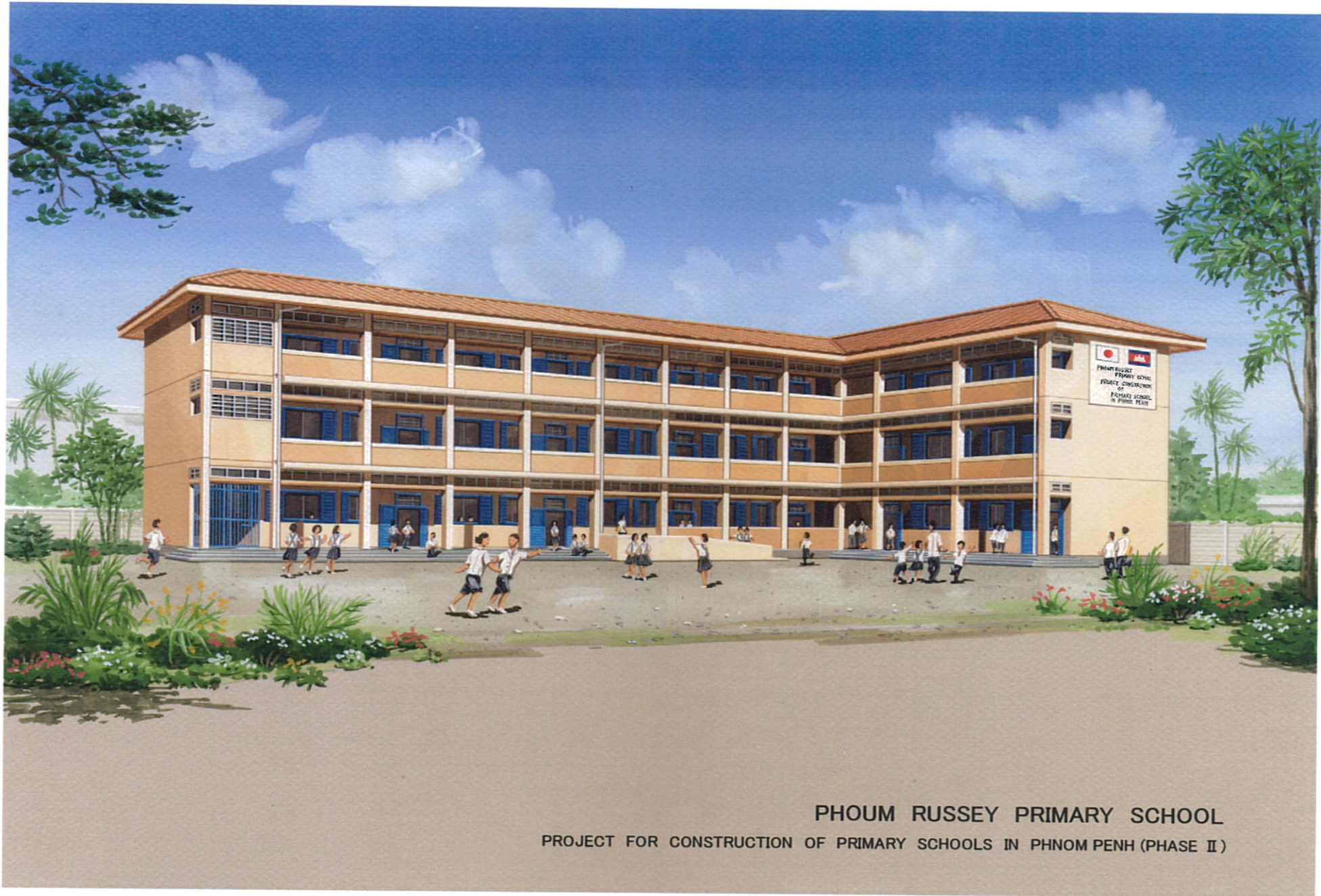
in the Kingdom of Cambodia

Yachiyo Engineering Co., Ltd.

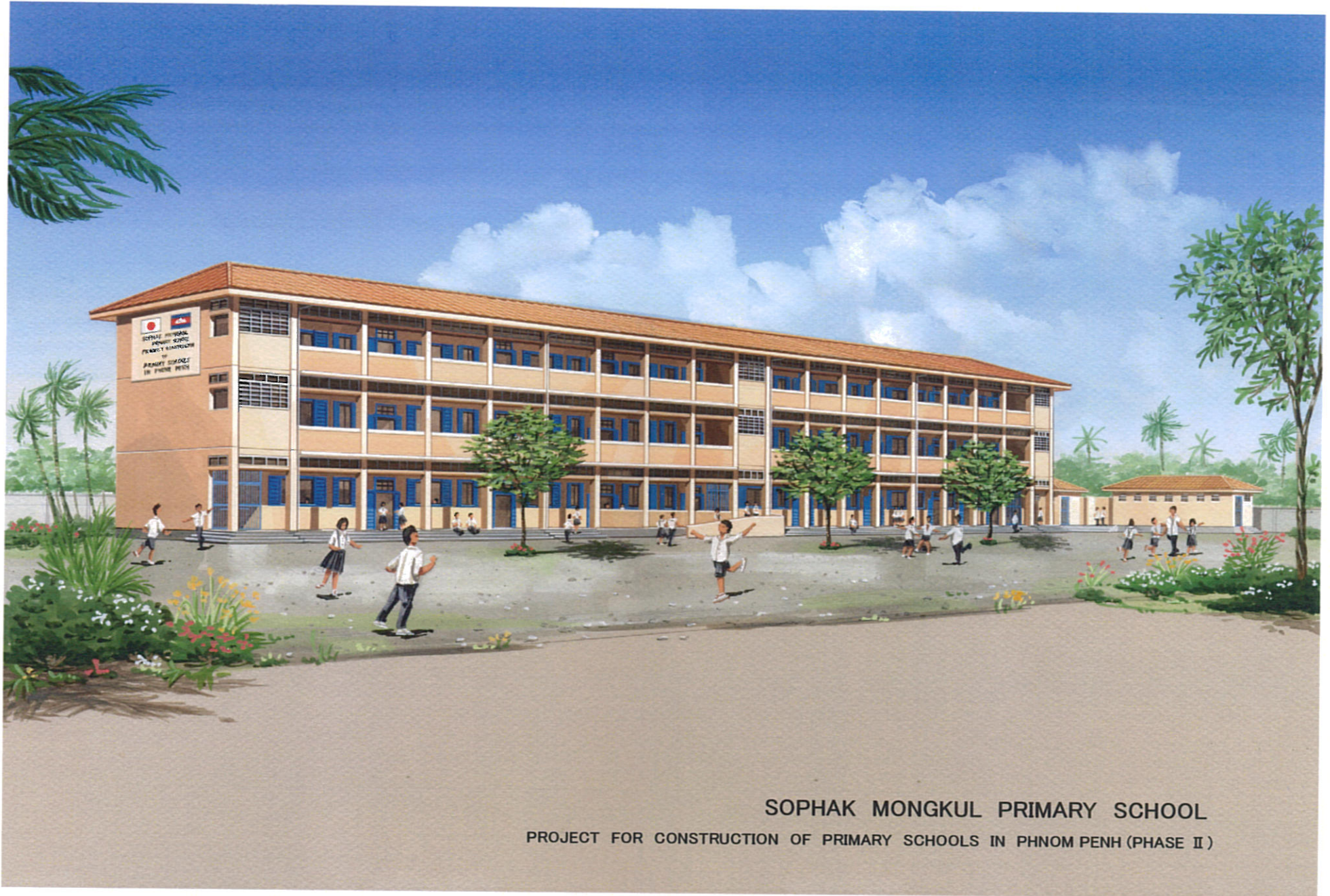


- Study Schools
- ① Phoum Russey
 - ② Chak Tomuk
 - ③ Sophak Mongkul
 - ④ Pochen Tong
 - ⑤ Chamreun Rath
 - ⑥ Chamreun Cheat

Location of Project Site

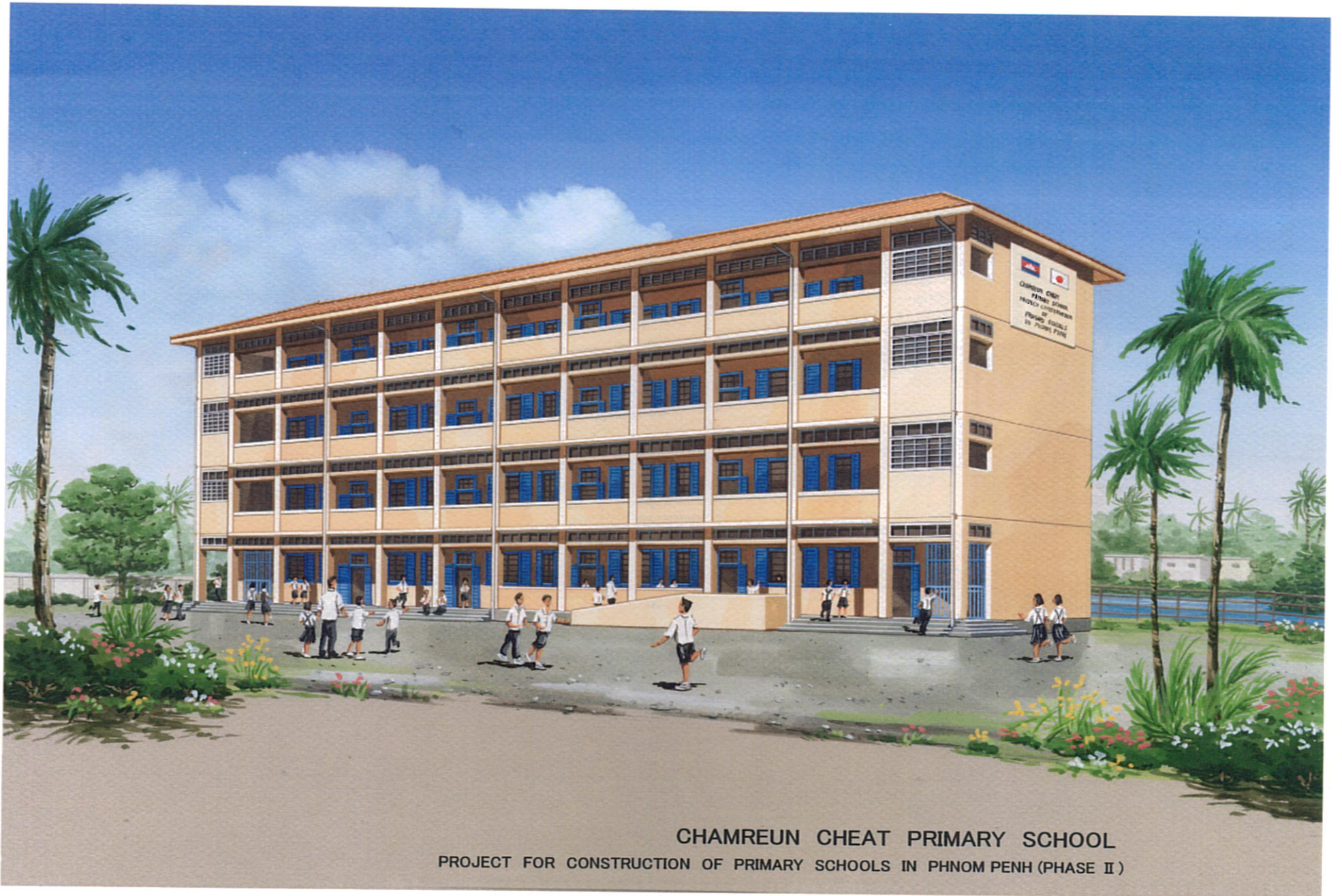


PHOUM RUSSEY PRIMARY SCHOOL
PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH (PHASE II)



SOPHAK MONGKUL PRIMARY SCHOOL

PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH (PHASE II)



CHAMREUN CHEAT PRIMARY SCHOOL
PROJECT FOR CONSTRUCTION OF PRIMARY SCHOOLS IN PHNOM PENH (PHASE II)

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ABBREVIATIONS

ADB	Asia Development Bank
CREP	Construction et Rehabilitation des Ecoles Primaries
DEP	Department of Education, Youth and Sports, Phnom Penh Municipality, MoEYS (= MEO: Municipal Education Office)
EC	European Commission
EDC	Electricite du Cambodge (Electricity of Cambodia)
EFA	Education for All
EMIS	Education Management Information System
ESD	Education Sector Development
ESP	Education Strategic Plan
ESSP	Education Sector Support Program
EU	European Union
JICA	Japan International Cooperation Agency
MoEYS	Ministry of Education, Youth and Sport
MTEP	Medium-Term Expenditure Program
NIE	National Institute of Education
NPRD	National Program to Rehabilitate and Develop Cambodia
PAP	Priority Action Program
PPM	Phnom Penh Municipality
P/Q	Pre-Qualification
PRSP	Poverty Reduction Strategy Paper
SEDP	Socio-Economic Development Plan
SEDP-II	Second Socio-Economic Development Plan
SSC	School Supporting Committee
TTC	Teacher Training Center
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations International Children's Fund
WB	World Bank

SUMMARY

Summary

Cambodia has been particularly emphasizing impartiality of access to primary education, improvement in the quality of education, and internal efficiency through the formulation of the “Education Strategic Plan 2004-2008 (ESP 2004-08)” and the “Education Sector Support Program 2004 -2008 (ESSP 2004-08 with the aim of achieving education for all (EFA). The additional construction of primary school classrooms cannot keep up with the rapid increase in forecasted number of school-aged children. In fact, most primary schools in Phnom Penh are compelled to adopt a two-shift or three-shift system, endure overcrowded classes¹, or implement a class rotation schedule (mobile classes²). In particular, schools implementing a three-shift system face such problems as being unable to secure sufficient lesson time. In addition, many of the existing primary and secondary school facilities have become so obsolete³ that the educational environment has deteriorated. According to a study conducted by the Ministry of Education, Youth and Sports, almost half the schools are in need of repair or reconstruction. Therefore, considering the need to secure buildings against flood damage more classrooms are urgently needed. More than 2,000 classrooms are needed to achieve a one-shift system for all classes by 2007.

Although the Phnom Penh Municipality has improved classrooms through the assistance of donors, etc. under the circumstances, the poor state of classrooms has still not been improved. In addition, it is difficult to achieve a large-scale classroom construction project through self-efforts due to the limited educational budget of the said nation. Consequently, in 1999 the Government of Cambodia requested to the Government of Japan grant aid for the reconstruction and extension of primary school buildings in Phnom Penh. In response to the request, the Government of Japan carried out a Basic Design Study (Phase 1) from March to September 2002 and tendering for the grant aid scheme between January and March 2003. Despite this, the tender has failed. Afterwards, a feasibility study (F/S) was implemented between February and July 2004 and a consultancy agreement was concluded in October of the said year.

In July 2002, the Government of Cambodia again made a request to the Government of Japan (Phase 2) for grant aid for the reconstruction and extension of 6 schools in the suburbs. A change was made to the list of target schools, and one school excluded in the above-mentioned Phase 1 in October 2004 was added. In response to this request, the Basic Design Study Team was dispatched from January 10 to February 5, 2005. The said study team held discussions with the parties concerned including the Ministry of Education, Youth and Sports (MoEYS), the Phnom Penh Municipality and the Department of Education, Youth and Sports. The Phnom Penh Municipality (DEP) which will be the implementing agency carried out a site survey of the target schools and obtained necessary data and information. After returning to Japan, the study team

¹ The number of pupils per classroom is 87.5.

² This is a system of rotating classes by staggering days-off each week for each class.

³ 15.1% of classrooms have damaged roofs.

calculated the estimated project cost by setting the optimum facility components and scale and by selecting equipment and materials after examining the appropriateness of the Project, an operation and maintenance scheme, and the effects of the aid in due consideration of the findings of the field survey. In order to explain the outline of the Basic Design, a study team was dispatched from May 26 to June 4, 2005 to explain the outline of the Basic Design.

As a result of a site survey of 6 schools as requested the examination in the Basic Design, since the following selection criteria are satisfied, all 6 schools will be subject to the Project.

As design policy for the Project, a facility plan should emphasize construction cost reduction while ensuring the minimal necessary quality to ensure building safety, easy maintenance and comfortable daily lessons. As for natural conditions, in addition to an appropriate foundation based on the findings of a geological survey of the fragile ground in the Mekong basin, special consideration should be given to securing heat insulation properties and the air permeability of buildings considering the tropical monsoon climate. Furthermore, utilization of timber will be restricted in due consideration of the forest conservation policy of the said country or damage from termites. At the same time, facilities will be designed for easy cleaning and repair with superior durability in order to reduce maintenance-related labor or expenses following their completion.

The components to be implemented under the Project will be ordinary classrooms and toilets which are minimum necessities for school operation. Although a request was made for the installation of a library, a meeting room and workshop for 2 core cluster schools, a new room will not be created by installing movable partition so that two rooms can be used as one. The minimum necessary equipment such as desks and chairs for pupils and teachers and white boards will be prepared.

The components of the Project are described below.

Project Components

No.	School	Facility				Furnishing			
		Planned No. of Classrooms	Total Floor Area of Classroom Buildings m ²	Total Floor Area of Toilet Buildings m ²	Total Floor Space m ²	Toilets Booth	Desks & Chairs for Pupils Set	Desks & Chairs for Teachers Set	White Boards Board
1	Phoum Russey	18	1,458	35	1,493	8	360	18	36
2	Chak Tomuk	12	1,026	28.5	1,054.5	6	240	12	24
3	Sophak Mougkul	24	1,971	47	2,018	12	480	24	48
4	Pochen Tong	15	1,242	28.5	1,270.5	6	300	15	30
5	Chamreum Rath	24	1,971	47	2,018	12	480	24	48
6	Chamreum Cheat	20	1,656	41	1,697	10	400	20	40
	Total	113	9,324	227	9,551	54	2,260	113	226

The necessary cost of the Project implemented through the grant aid scheme of the Government of Japan is estimated to be ¥521 million (¥519 million to be taken by the Japanese side and ¥2 million to be taken by the Cambodian side). In addition, the total construction period is expected to be approximately 16 months including the detailed design period.

Since Phnom Penh Municipality maintains 113 primary schools with 157,000 pupils, the municipality is judged to have sufficient organization and competency to maintain the target schools. Although the number of teachers associated with the implementation of the Project is estimated to be 113 persons, since teacher training in Phnom Penh has been suspended until 2009 there is a surplus of teachers. Therefore, since many qualified teachers are in waiting, there should be no problem securing teachers. Since the increase in salaries associated with an increase in teachers will be approximately Riel 200 million which is a small 0.1% of the teacher-related budget of the Ministry of Education, Youth and Sports (MoEYS), the said budget is growing 13% annually (2001 to 2005), so it should be able to handle the burden.

With respect to facility maintenance, etc., minor repairs are done through the Priority Action Program (PAP⁴); whereas, large-scale repair are done through donations from local communities or requests submitted to the DEP. There is a cleaning system in which pupils are on daily shifts. Although necessary maintenance in line with the implementation of the Project will include the painting inside and outside the buildings, and cleaning and maintenance of toilets and repairing of educational furniture, in the similar manner as before, joint implementation by the school, a school supporting committee (SSC⁵) and the local community is possible, so that a new organization or function is unnecessary. It should be possible to bear any increase in maintenance cost if increases in the PAP and assistance from the DEP are taken into account in keeping with the increase in number of pupils.

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

【Direct Effects】

Improvement in Learning Environment

Of the 13,000 pupils at the target schools, the current number of 128 persons per classroom will be improved to 80 persons. Since a 2-shift system and 40-person classes will be possible, education can be provided in safe, suitable classrooms at all target schools.

Improvement in the Sanitary Environment

Approximately 13,000 target pupils will utilize sanitary toilets.

⁴ Priority Action Program: A maintenance cost is paid per each school according to the number of pupils.

⁵ School Supporting Committee: A school supporting organization composed by teachers, parents and the influential in a local community.

【Indirect Effects】

Improvement in Learning Environment for Female Pupils, etc.

By improving toilets with large multi-purpose booths for men and women, reasons hindering girls from attending school will be reduced and the utilization of wheelchairs will be possible.

Encouragement for Cluster Activities

Since it will be possible to hold general meetings at core schools, it is expected to contribute to improving the quality of education through the encouragement of cluster activities.

Contribution to Local Communities

Since it will be possible to utilize classrooms as activities for social education such as adult education or community activities by installing lighting systems, it is expected to contribute to local communities.

As described above, sufficient beneficial effects under the Project can be expected and there are no problems with operation or maintenance. The implementation of Japan's grant aid scheme is therefore judged to be appropriate.

The Cambodian side should undertake the following to ensure the success and continuation of the Project effects.

- 1) To ensure that lessons at the target schools will be implemented appropriately after the handing over of facilities under the Project. Additional teaching staff should be secured and their proper arrangements made without delay.
- 2) To ensure suitable maintenance of the facilities to be improved under the Project, an appropriate operation and maintenance scheme should be enforced at SSC and at each school.

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Appendix 5 Cost Estimation Borne by the Recipient Country

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CHAPTER 1. BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

(1) Background and Process of the Request

The Kingdom of Cambodia (hereinafter referred to as “Cambodia”) has been emphasizing impartiality of access to primary education, improvement in the quality of education, and internal efficiency. However, most primary schools in Phnom Penh are compelled to adopt a two-shift or three-shift system, to tolerate overcrowded classes, or to implement a class rotation schedule (mobile classes) ¹⁾. However, schools implementing a three-shift system in particular face problems such as insufficient lesson time. In addition, many of the existing primary school facilities have become so obsolete that the educational environment has deteriorated. The rapid increase in school-aged children is also anticipated, renovation and additional construction are urgently needed.

In addition to school construction cooperation through Japanese Grass-Roots Grant Aid, the “Project for Construction of Primary School in Phnom Penh, Phase I” is now under construction. However, assistance through the donors is so limited that a shortage of classrooms has still not yet been solved. Due to stagnation in self-financed classroom construction, Cambodia made a request for Japanese grant aid for “Project for Construction of Primary School in Phnom Penh, Phase II” (hereinafter referred to as “Project”) with the aim of expansion of existing schools with the construction of additional classrooms in 6 primary schools in Phnom Penh which have significantly shortage.

(2) Outline of the Request

As shown in Table 2-1, Cambodia has requested for 147 classrooms in total at 6 schools in Phnom Penh, and multi-purpose rooms (libraries, teachers’ rooms and workshops) and furniture, etc.

1) By staggering days-off for each class, lessons for pupils in mobile classes utilize available classrooms on a daily basis. Pupils belonging to mobile classes therefore do not have their own exclusive classrooms.

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 Purpose

Cambodia has been emphasizing the needs of improvement of access to primary education, upgrading in the quality of education, and improvement internal efficiency through the formulation of the “Education Strategic Plan 2004-2008 (ESP 2004-2008)” and the “Education Sector Support Program 2004 -2008 (ESSP 2004-2008 with the aim of attaining Education for All (EFA). The construction of primary school classrooms cannot keep up with the rapid increase in forecasted number of school-aged children. In fact, most primary schools in Phnom Penh are compelled to adopt a two-shift or three-shift system, tolerate overcrowded classes, or implement a class rotation schedule (mobile classes). In particular, schools implementing a three-shift system face problems such as being unable to secure sufficient lesson time. In addition, many of the existing primary and secondary school facilities have become so obsolete that the educational environment has deteriorated. According to a study conducted by the Ministry of Education, Youth and Sports, almost half the schools are in need of repair or reconstruction. Therefore, considering the need to secure proper buildings and classrooms are urgently needed.

In response to these circumstances, the Project is designed for the purpose of the improvement of the educational environment at target schools (implementation of lessons through an appropriate shift system, securing appropriate lesson time and providing lessons with the appropriate number of pupils) by increasing the number of classrooms.

2.1.2 Outline of the Project

The aim of the Project is to increase the number of classrooms as a means of addressing the problem of a shortage in educational facilities in Phnom Penh by constructing 113 classrooms and toilets at six target primary schools and installing new furniture. Through this, the learning environment will be improved in the target schools to implement lessons through an appropriate shift system, lesson time and number of pupils.

2.2 Basic Design of Requested Japanese Assistance

2.2.1 Design Policy

2.2.1.1 Basic Policies

(1) Selection of Target Schools

The Cambodian and Japanese sides confirmed on the selection criteria of the schools outlined below.

Schools which cannot be satisfied with the facility demands by the Government of Cambodia, local governments or the self-efforts of local residents and assistance of other donors.

Schools which clarify documents to confirm land ownership or land use right.

In the case of rebuilding the existing school building, Cambodia will be responsible for removing the existing building and leveling the lot.

In the case of rebuilding the existing school building, Cambodia will provide substitute classrooms during the construction work.

School which a sufficient-sized lot for the classroom building construction.

Schools which are free from security problems.

Schools which have an access roads for the construction vehicles.

Schools of which location and surrounding topography will not hinder the construction work.

Schools which have sufficient teachers, budget allocation and necessary cooperation from concerned people for the proper operation and maintenance of the facilities are done.

As a result of the site survey and with reference to the above-mentioned criteria, all six schools are regarded as target schools. A list of target schools is shown in Table 2-1.

Table 2-1 List of Requested Schools and Target Schools

No.	Requested Schools	Number of Classrooms Required	Number of Classrooms Planned
1	Phoum Russey School	18	18
2	Chak Tomuk School	30	12
3	Sophak Mongkul School	27	24
4	Pochen Tong School (Core School)	27	15
5	Chamreun Rath School (Core School)	21	24
6	Chamreun Cheat School	24	20
Total		147	113

(2) Facility Components

The facility components of the Project will include classrooms and toilets as needed and the minimum facilities for school operation. Although the libraries, meeting rooms, workshops for preparing and storing teaching materials were requested for core schools in two clusters, it will not be included in the Project for the following reasons.

There are existing libraries and offices.

The aim of the Project is to alleviate the shortage of classrooms. Therefore, with careful scheduling ordinary classrooms can be used as meeting rooms. However, in the case of general meetings at core schools where a high attendance rate is expected, a movable partition will be installed between two classrooms which can be retracted to create one large room.

(3) Classroom Scale Setting

1) Basic conditions

The target year for completion is 2007.

The number of pupils per class will be 40/classroom which is the Cambodian standard.

A two-shift system will be adopted.

2) Current Situation at Existing Schools

The management conditions of the six study schools are shown in Table 2-3.

3) Forecast Number of Pupils

a) Trend in Number of Pupils in Cambodia

According to "Education for All (EFA)" the forecast number of pupils at Cambodian primary schools (age 6 to 11) fell until 2004 and began to increase in 2005. The population in 1998 by the national census showing a small population group age 0 to 4 years which has now reached the school age of primary education.

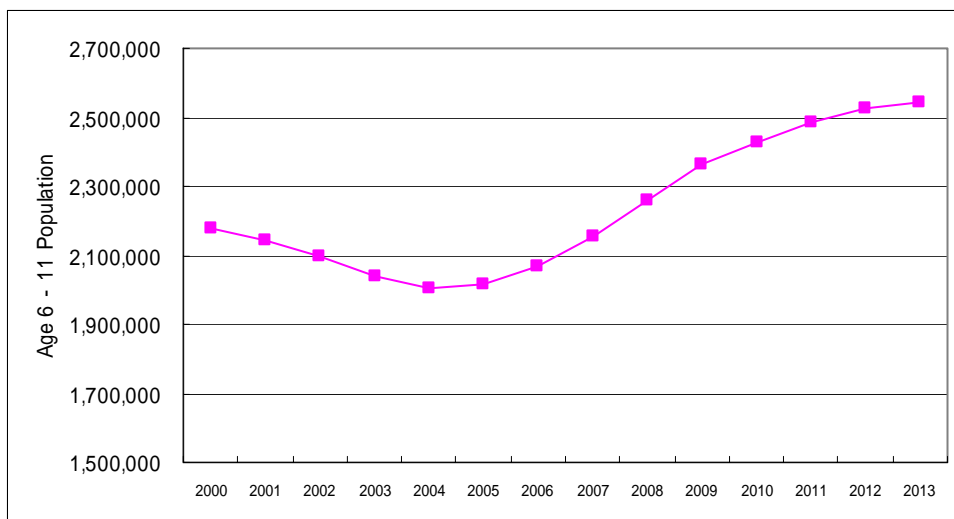


Figure 2-1 Forecast of Population Age 6 to 11
(Source: EFA National Plan)

Although the number of pupils in Phnom Penh has been decreasing since 2001, due to the above-mentioned impact, it is anticipated to increase more than the EFA forecast with the expected population inflow from rural areas. The rate of increase is expected to be higher in the suburbs than in the downtown area.

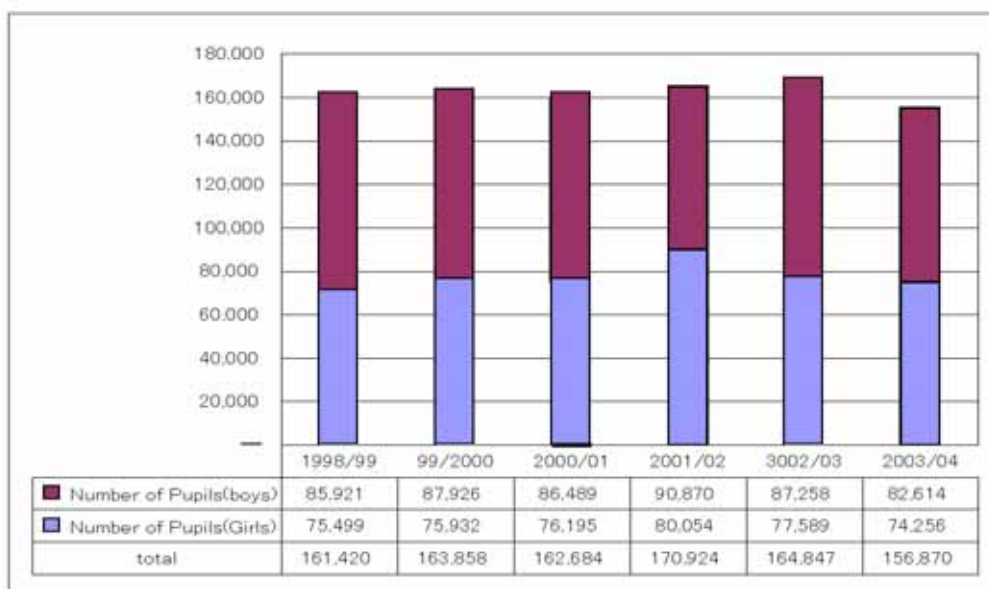


Figure 2-2 Number of Pupils at Primary Schools in Phnom Penh
(Source: EMIS)

The number of pupils by cluster and the number of pupils by classroom (overcrowding rate) in Phnom Penh are shown in the following table. The degree of congestion is high in clusters to

which target schools belong. If clusters to which target schools belong in Phase 1 of the Project are included, these account for the higher ranking. The classroom area per cluster at Stung Meanchey and Prea Norodom is very small at 0.5m² or less.

Table 2-2 Number of Pupils by Cluster and Classroom (2003/04)

Cluster Name	Classroom Area per Pupil (m ²)	No. of Pupils (persons)	No. of Pupils per Classroom (persons)
[Entire Phnom Penh]	0.71	156,870	87.5
Stung Meanchey	0.46	8,903	122.0
<i>Beung Salang</i>	<i>0.40</i>	<i>13,630</i>	<i>121.7</i>
Sansam Kosal	0.66	6,694	113.5
Pochentong	0.69	5,259	101.1
Chamreun Rath	0.70	6,460	99.4
Santepheap	0.58	7,551	96.8
Tuol Kauk	0.77	9,558	95.6
Chraing Chamres	0.67	10,957	94.5
Preah Norodom	0.49	9,458	93.6
Chbar Ampeuv 2	0.70	6,810	93.3
Prek Leap	0.83	4,631	92.6
Prek Pra Leu	0.72	4,813	90.8
Wat Tuol Tumpoung	0.67	12,501	86.2
<i>Bak Touk</i>	<i>0.73</i>	<i>9,297</i>	<i>84.5</i>
Chroy Changva	0.76	2,330	77.7
Chumpou Voan	0.95	6,051	76.6
Dangkor	0.80	3,653	76.1
Phnom Daun Penh	0.86	9,591	71.6
Prey Sar	0.85	2,962	70.5
Kraing Thnung	1.12	2,480	68.9
Tuol Sleng	1.10	8,543	58.5
Prateah Lang	1.18	2,259	53.8
Porng Teuk	1.39	2,479	51.6

[Bold-face and italic type indicate clusters at target schools and clusters at schools subject to Phase I of the Project respectively] (Source: EMIS)

b) Trend in the Number of Pupils at Each School

Although the number of pupils at each school was increasing until 2002, as observed in Figure 2-3 the number has leveled off. One reason for this is that school districts are not strictly determined so that movement of pupils between schools occurs depending on the school conditions. Another is that the inundated state of facilities limits the number of pupils that can be accepted.

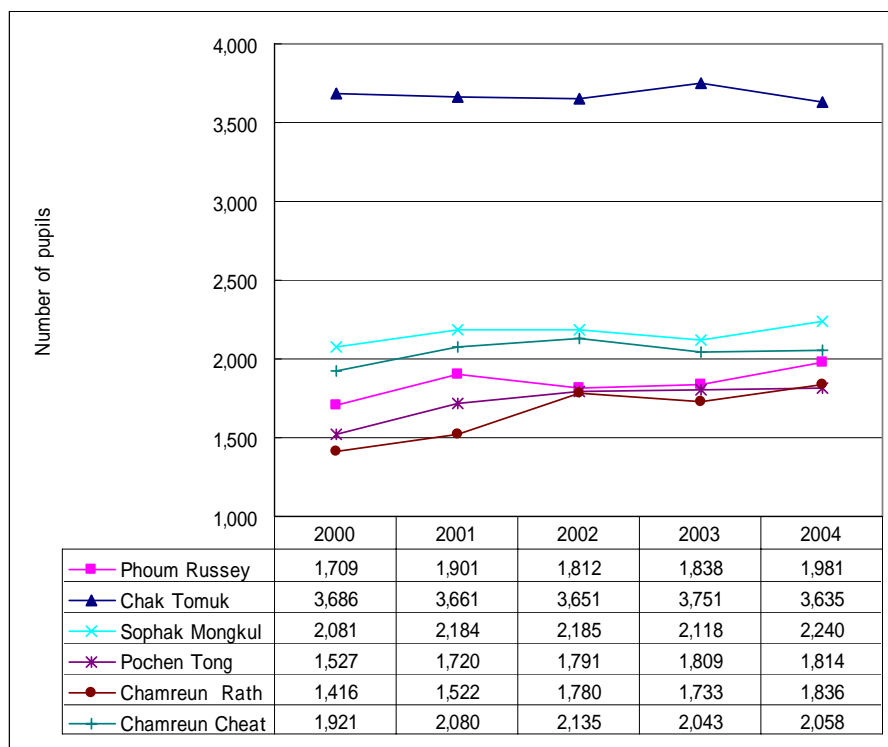


Figure 2-3 Trend in the Number of Pupils at Each School

(Source: Department of Education, Youth and Sports, Phnom Penh Municipality)

On the other hand, if we look at the trend in clusters to which target schools belong, the cluster of Chak Tomuk school (Prea Norodom cluster) tended to decrease between 2000 and 2004; whereas, other clusters tended to increase. This might be reflected in the actual demand of number of pupils. As described above, in the estimation of the number of pupils until 2007, the average growth rate between 2000 and 2004 of the clusters will be taken.

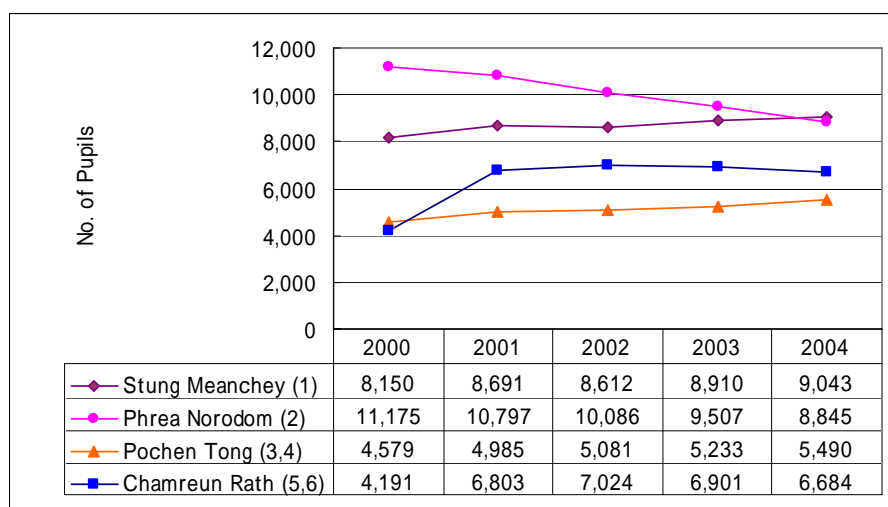


Figure 2-4 Trend in the Number of Pupils in Clusters to which Each School Belongs

(Source: Department of Education, Youth and Sports, Phnom Penh Municipality)

c) Degree of Congestion at Each School

The number of pupils per classroom exceeds one hundred (100) in all target schools, which is the highest degree of congestion and ranked highest overall in Phnom Penh. Taking the clusters²⁾ of study (target) schools in Phase 1 of the Project and assistance activities³⁾ into account, the selection of schools as requested by the Cambodian side is judged to be appropriate.

Table 2-3 Degree of Congestion at Each School

School	Cluster	No. of Classes	No. of Classrooms	No. of Pupils	Pupils/ Classroom	Pupils/ Class
Phoum Russey	STUNG MEANCHEY	37	12	1,838	153.2	49.7
Stung Meanchey	STUNG MEANCHEY	110	40	4,811	120.3	43.7
Sola	STUNG MEANCHEY	24	12	1,312	109.3	54.7
Chamreun Phal	STUNG MEANCHEY	22	9	942	104.7	42.8
Chak Tomuk	PREAH NORODOM	70	30	3,553	118.4	50.8
Preah Norodom	PREAH NORODOM	88	40	4,266	106.7	48.5
Sala Anouwat (Anuwatt)	PREAH NORODOM	21	11	701	63.7	33.4
Serei Pheap	PREAH NORODOM	26	14	563	40.2	21.7
Wat Botum Vadei	PREAH NORODOM	12	6	375	62.5	31.3
Sopheak Mongkol	POCHEN TONG	50	21	2,148	102.3	43.0
Pochen Tong	POCHEN TONG	37	16	1,809	113.1	48.9
Taing Kasang	POCHEN TONG	15	8	731	91.4	48.7
Tuol Sophea Khuon	POCHEN TONG	13	7	571	81.6	43.9
Chamreun Rath	CHAMREUN RATH	34	13	1,733	133.3	51.0
Chamreun Cheat	CHAMREUN RATH	43	15	2,043	136.2	47.5
Trapaing Raing	CHAMREUN RATH	12	7	551	78.7	45.9
Tuol Prasat Sen Sok	CHAMREUN RATH	43	30	2,133	71.1	49.6

(Source: EMIS, 2003/04, New grouping for Prea Norodom Cluster)

d) Calculation of Number of Planned Classrooms

Basic Conditions

The following matters were considered to be fundamental when calculating the facility scale.

- ◇ Eighty (80) pupils per classroom (two-shift system, 40 pupils per class)
- ◇ Target year: 2007 (facilities scheduled to be completed)
- ◇ Average growth rate in the number of pupils at schools belonging to relevant clusters between 2000 and 2004 will be used as growth rate.

In addition, since there are no regulations pertaining to the number of stories for primary schools, in order to maximize the number of classrooms per lot the number of stories should

2) Beung Salang Cluster (4 schools) and Bak Touk Cluster (1 school)

3) At the Stung Meanchey school a classroom building is being built through NGO assistance (Jan. 2005).

be increased and, as requested by the Cambodian side, one school will be a four-story building.

Calculation Method

The facility scale was calculated based on the following flowchart.

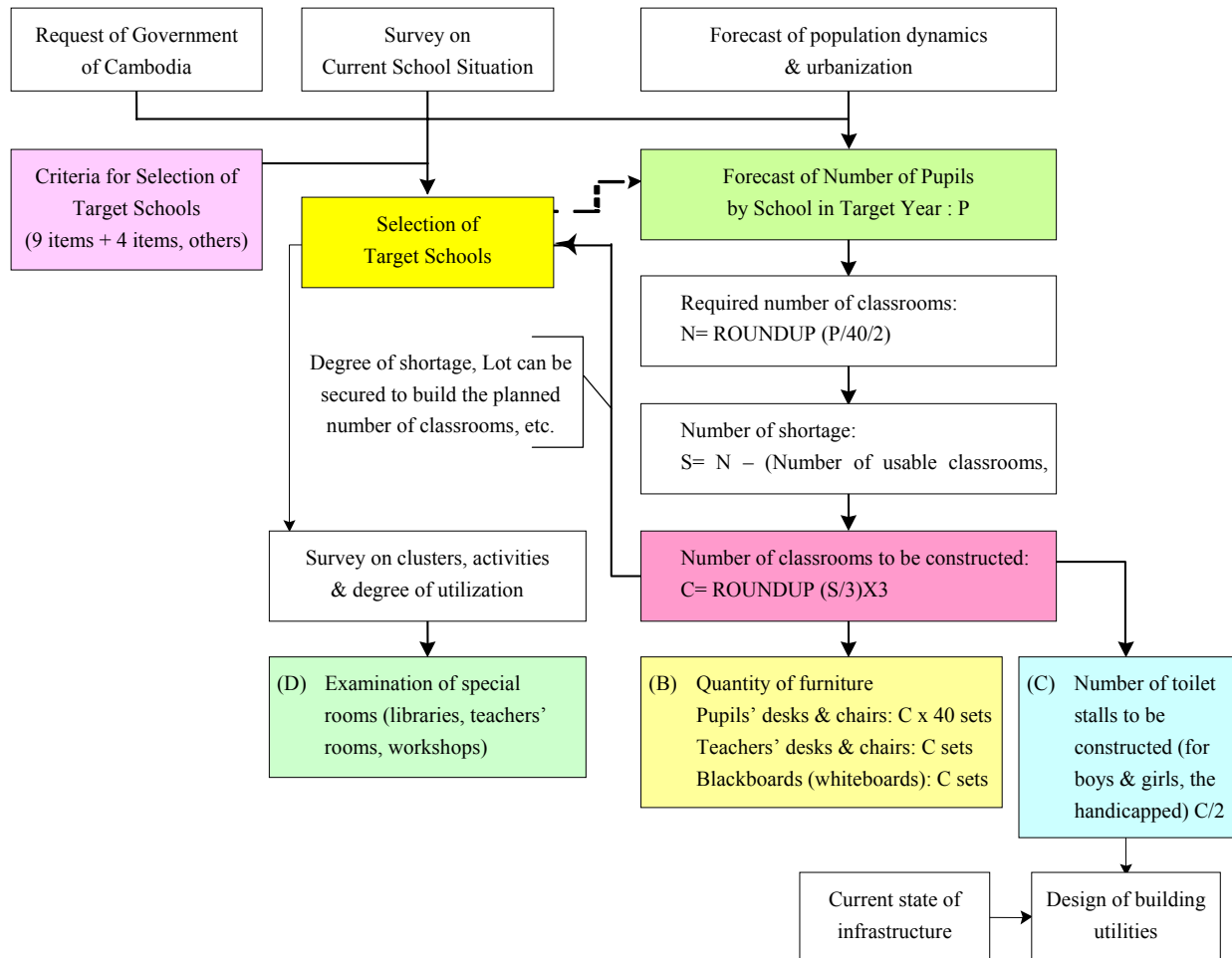


Figure 2-5 Calculation of Facility Scale Flowchart

Required number of classrooms = number of pupils for the target year ÷
2 (shift system) ÷ 40 (pupils/class)

Shortage of classrooms = (required number of classrooms) - (number of usable classrooms)

Planned number of classrooms : rounded up to a multiple of 3 in order to meet the EFT goal of implementing a one-shift system in 2007

The number of usable school buildings was based on the following criteria.

Structure Classification	Study Item	Study Contents
All Structures	Construction year Degree of secular change	Durable limit can be assumed according to construction year & degree of secular change.
Wooden Structures	Termite damage	By examining under floors or beams in the ceiling, etc., the degree of damage & structural impact is verified.
	Deformation in major members of framework	Deformations & cracks, etc. reduces member strength severely. If it occurs on a main member the impact is enormous.
	External walls & roofing materials	Damage on external walls or roof, such as looseness (lifting), gaps (slippage), cracks, peeling (separation) or deterioration of joints is a cause for leaking during rain thus hastening deterioration of the building frame.
Concrete Structures	Uneven settling	Whether or not cracks or breakage on both internal & external forms have arisen as a result of uneven settling is confirmed.
	Breaks, cracks & peeling (separation), etc.	Based on length, width, number & location of cracks, the degree of impact on strength is verified.

Calculation Results

The results of the above-mentioned calculation for one hundred thirteen (113) classrooms in total are shown in the following table.

Table 2-4 Calculation of Planned Number of Classrooms

		No.1	No.2	No.3	No.4	No.5	No.6	
		Phoum Russey	Chak Tomuk	Sophak Mongkul	Pochen Tong	Chamreun Rath	Chamreun Cheat	Total
a	Number of classrooms requested	18	30	27	27	21	24	147
b	Current number of pupils (2004/ 05) *	1,981	3,635	2,240	1,814	1,836	2,058	13,564
c	Number of classrooms	13	30	21	18	11	14	107
d	Of, number of usable classrooms in "c"	10	30	10	11	11	14	86
e	Required number of classrooms	25	46	28	23	23	26	171
f	Shortage of classrooms (number of more classrooms needed in "d") [40 pupils/class, 2-shift system]	15	16	18	12	12	12	85
g	Planned number of classrooms in accordance with the criteria of the Project in Phase 1 (rounded down to a multiple of 3)	15	15	18	12	12	12	84
h	Growth rate in the number of pupils at each school (2000-2004) *	3.8%	-0.3%	1.9%	4.4%	6.7%	1.7%	
i	Growth rate in the number of pupils by cluster (2000-2004) *	2.6%	-5.7%	4.6%	4.6%	12.4%	12.4%	
j	Estimated number of pupils in 2007 (depending on cluster growth rate in "g")	2,139	** 3,239	2,563	2,076	2,607	2,922	15,546
m	Number of classrooms short in 2007 [40 pupils/class, 2-shift system]	17	11	23	15	22	23	111
n	Planned number of classrooms	18	12	24	15	24	20	113
		3-story building	3-story building	3-story building	3-story building	3-story building	4-story building	

* Source: Department of Education, Youth and Sports, Phnom Penh Municipality

** Including acceptance of schools within the same cluster to be closed.

(4) Toilet Scale Setting

In principle, one toilet booth will be installed for two classrooms. As shown in Table 2-5, the total number of toilet booths will be divided equally between male and female. Except for the existing toilets at the Chak Tomuk school, instead of floor-length urinals for boys, flush toilets will also be utilized as a urinal for boys for convenience of cleaning. Hands will be washed in wash basins located in each booth and independent hand washing equipment will not be installed. One of the toilet booths will be large for a multi-purpose for wheelchairs etc. in order to prevent discrimination, and to improve convenience and frequency of usage, considering that ordinary pupils can also use them ⁴⁾. The basic plan is to integrate large toilet booths with the regular ones.

Table 2-5 Planned Number of Toilet Booths

No	School Name	No. of Classrooms to be Newly Constructed	No. of Toilet Booths for Girls	No. of Toilet Booths for Boys	Multi-purpose Large Toilet Booths (1 each for boys & girls)	Total No. of Toilet Booths
1	Phoum Russey	18	3	3	2	8
2	Chak Tomuk	12	2	2	2	6
3	Sophak Mongkul	24	5	5	2	12
4	Pochen Tong	15	2	2	2	6
5	Chamreun Rath	24	5	5	2	12
6	Chamreun Cheat	20	4	4	2	10
Total		113	21	21	12	54

(5) Furniture, Furnishings & Equipment

Furniture and other furnishings under the Project will be the minimum necessary components for school management of classrooms including cover chairs for pupils and teachers and desks for pupils and teachers as requested through the Japanese assistance. In addition, due to a general concern about the impact of chalk dust on health at the site area, since whiteboards have already been installed and are utilized effectively in existing buildings of the target schools, whiteboards will be installed in accordance with the request of the Cambodian side.

Teaching materials will not be included under the Project.

4) Utilization by pupils with leg injuries and pregnant teacher will be taken into consideration.

Table 2-6 Furniture, Furnishings & Other Equipment

No.	School	Chairs & Desks for Pupils (2-seat) *	Chairs & Desks for Teachers (within classrooms)	Whiteboards
		Sets	Sets	Boards
1	Phoum Russey	360	18	36
2	Chak Tomuk	240	12	24
3	Sophak Mongkul	480	24	48
4	Pochen Tong	300	15	30
5	Chamreun Rath	480	24	48
6	Chamreun Cheat	400	20	40
Total		2,260	113	226

* Of those, 40% small-size for lower grades and 40% large-size for upper grades.

(6) Utility Components

Water supply systems such as water storage and septic tanks will be installed for toilets to be constructed under the Project. Lighting equipment will be also installed in all classrooms.

2.2.1.2 Natural Conditions

(1) Geology

Phnom Penh is located where the Mekong River, an international river with its source far away in Tibet, and the Tonlesap River meet. The target site of the Project lies on alluvial deposits generally created by large rivers or lakes, in geological terms, clay mixed with sand stratum accumulated for more than twenty five meters underground. Although cohesive soil exists approximately three meters from ground level and slightly harder cohesive soil exists three to thirteen meters down, from about thirteen meters from the ground surface there are layers of fine gravel. Some schools do not have the favorable ground layer to support a three or four story building. Based on the findings of a boring survey implemented during this study at the planned construction site of each school, an appropriate and economic design and construction method will be selected.

(2) Weather

1) Wind Force

Although Cambodia experiences high humidity from the southwest monsoons, the climate is mild throughout the year. Due to a maximum wind velocity of 22.0m based on the meteorological data, a design reference wind speed of 25m/sec. will be adopted as a wind load to be applied to school building structure design.

2) Earthquakes

In the past thirty years there has been no record of any earthquake reported by the Meteorological Agency. Lateral force during an earthquake will therefore not be taken into account in structural designs under the Project.

2.2.1.3 Socio-economic Conditions

1) Measures for the Handicapped

There are many handicapped children not only in the Project target schools but also throughout Cambodia. Slopes for wheelchairs have not been installed at target schools so that pupils using wheelchairs do not attend school. Whereas, physically handicapped children such as children with disabilities of the hands, ears, mouth and eyes are registered in the schools. In view of the current state, toilets and slopes for the handicapped will be installed.

2) Noise and Vibration Control

Design and construction methods that take noise and vibration prevention during the school construction period will be selected. Although there is no legislation pertaining to piling construction especially within a municipality, people tend to refrain from huge noise and vibration created by diesel hammers. The Project will also adopt a low-vibration piling method in principle.

3) Multiple-storied Buildings

Since many schools and governmental buildings in Phnom Penh are multiple-storied buildings (three to five-stories), and since there is no legislation concerning the right for sunlight, etc., the construction of multiple-storied buildings appears to have no social impact. Under the Project, depending on lot conditions at the relevant school three or four story schools will be constructed in order to effectively utilize limited land space.

2.2.1.4 Construction Conditions

In Cambodia, forests which accounted for 73.8% of the national land in 1958, decreased to 62% in 1993 due to the influence of recent felling. Accordingly, the Government has enforced felling regulations with the aim of promoting forest conservation. As a consequence, domestically produced timber sold on the market have decreased and the volume of kiln-baked products utilizing timber as fuel, such as hollow bricks or tile roofing, has decreased while prices have increased. In addition, in recent years schools financed through cooperation aid from other countries have tended to utilize iron materials in place of roof trussing materials or rafters. In due consideration of Cambodian construction conditions, the Project will adopt iron products for rafters and roof trusses.

2.2.1.5 Effective Use of Local Companies

(1) Local Consultants

There are a few local consultant offices in Phnom Penh that have records engaged in not only Japanese grant aid projects but also the aid projects of other donors such as ADB and WB. Based on a background of acquired technical skills during the project process, they are therefore seemed to have technical competence to support the Project.

(2) Local Contractor

A construction boom is taking place in Phnom Penh so construction sites can be seen all over the city. In terms of schools, since a plan to build 534 schools nationwide to be completed in 2006 began in 2003 through ADB loans, most contractors in Cambodia have been involved. Therefore, the scale of construction work for the Project (6 schools and total area of approximately 9,572m²) in a single year should not pose a problem. However, the competency to carry out quality and schedule control during shop drawing procedures, the manufacturing of drawings and procurement plan, etc. appears to be inadequate. Therefore, for the Project local contractors will be employed under the supervision of a Japanese contractor.

2.2.1.6 Operation and Maintenance Capabilities of Implementation Agency

Due to the decentralization policy of the Government of Cambodia, maintenance activities such as simple repairs at primary schools are conducted by the schools themselves and by local residents. At each school level, the school and School Supporting Committee (SSC) take the initiative to formulate an annual school plan, or a Priority Action Program (PAP) committee utilizes a special budget allotment. Although some schools carry out repair activities with the collaboration of local residents, the majority use outsourcing. However, sufficient maintenance cannot be accomplished within the PAP budget. Therefore, at the present time large-scale repairs are made by utilizing donations through the SSC and local community or by requesting assistance from the Department of Education, Youth and Sports (DEP). For the purpose of promoting the implementation of independent and phased maintenance activities of the SSC and alleviating the maintenance-related financial burden, in the facility plan, especially for roof trusses or floor materials, highly durable construction materials that can be easily procured on the market and at reasonable cost will be selected.

2.2.1.7 Facility and Equipment Grade and Cost Reduction

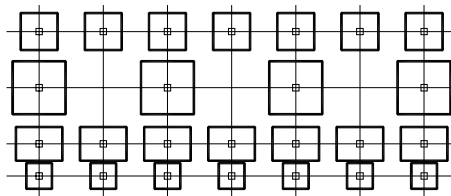
Building quality and safety and the creation of a comfortable educational environment and space will be the goals of the Japanese grant aid scheme, and a reduction in construction expenses will also be an important task. In addition to steps for reducing the direct construction cost, the indirect cost should be examined so

that construction materials and methods that are both effective and efficient can be selected. In addition, a reduction in overall construction cost should be taken into consideration not only by comparing and examining the performance or unit cost of each construction material, but by shortening the construction period or impact of individual construction materials on the structural frame.

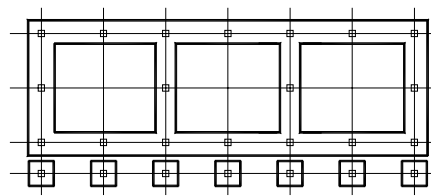
A concrete cost reduction is described below.

Foundation

Foundations are generally classified as piling foundations and spread foundations. In this study, a boring survey was conducted for the purpose of appropriately grasping the ground conditions at the construction sites. Ground conditions in the area surrounding Phnom Penh are generally not favorable, so that sufficient attention should be given to the selection of type of foundation. In examining the findings of the survey, an economic design will be taken from the viewpoints of construction cost and construction period.

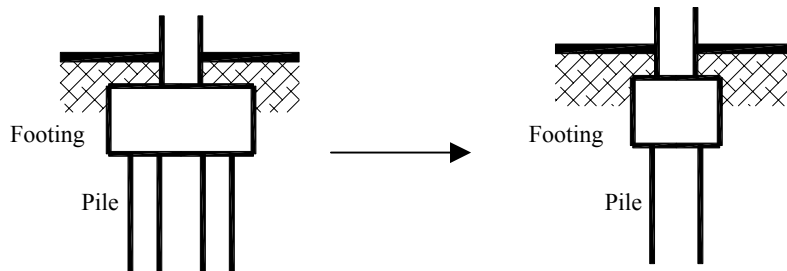


Floor Plan of Independent Footing



Floor Plan of Continuous Footing

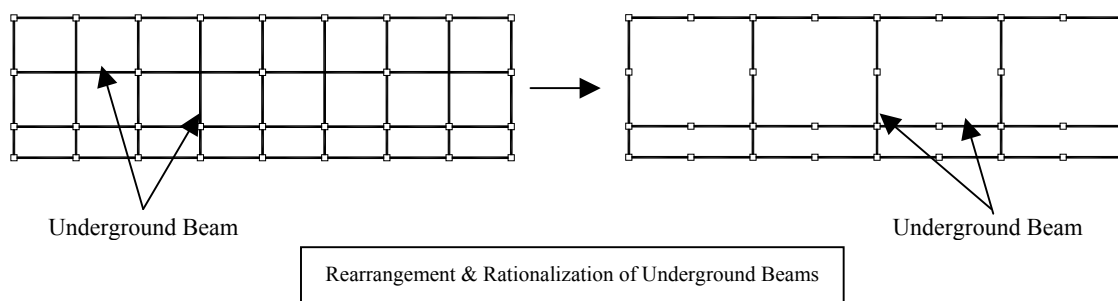
With independent footing, efficiency of operations will be promoted through a reduction in construction volume and simple form by adopting continuous footing as much as possible.



In the piling foundation, the design will include a reduction in the number of piles by increasing their diameter as much as possible.

Footing Beams

There have been no recorded earthquakes in Cambodia in the past thirty years. Therefore, considering that the only lateral force acting upon a building is wind load, in principle an economic design will be adopted by installing underground beams only in necessary places.



Structural Design

By applying standardized sections as much as possible, special consideration will be given to easy conversion of molded materials. In addition, a structural design that encourages a lower construction volume will generally be applied. The sizes of the columns are designed larger and the spans are longer with less number of columns.

Roof Pitch

The gradient of 31.0° is used in Cambodia because roofing tiles are laid directly onto roof frames without roof substrate. However, the Project will adopt gradient of 21.8° for water proofing by installing sheathing roof boards (roofers).

Toilets

Toilets for the handicapped treated as separate buildings in Phase 1 will be incorporated as one of a number of general toilets booths by establishing a large-sized multi-purpose booth accessible by wheelchair. Accordingly, lower facility volume (septic tanks, etc.) and construction cost should be promoted.

2.2.1.8 Construction Method

Due to the difficulty in hiring an adequate number of skilled workers in Cambodia, general concrete structures and rigid framed structure will be adopted for frame work and conventional construction methods familiar to ordinary workers will be also be applied to finishing work. In addition, a few local civil engineering companies have experience in piling work so pile driving using hammers, earth auger method or by intrusion is possible. However, after considering the construction environment or construction site conditions, the intrusion method was selected.

2.2.2 Basic Plan

2.2.2.1 Facility Plan

(1) Architectural Planning and Design

1) Layout Plan

No.1 Phoum Russey School

The site of new construction is currently vacant land projected to northeast from the existing school building area. Since the site is narrow, the school building was planned with L-shape.

No.2 Chak Tomuk School

Despite the large school yard, the secondary school buildings are located side by side and most of school lot is occupied by the secondary school facilities. Since there is little room for construction of new school buildings on the primary school land, in order to secure the required number of classrooms in the space between the existing school market and external wall, an appropriate layout was created.

No.3 Sophak Mongkul School

Despite the relatively simple rectangular shaped lot, due to poor water drainage during the rainy season, the wooden school buildings in the adjoining site of the neighboring temple become flooded. In addition, deterioration of the existing school buildings is getting worse. The wooden school building and the concrete building presently utilized will be demolished and removed, and construction will be carried out at the same location.

No.4 Pochen Tong School

In the relatively wide land area, the bicycle lot, power receiving facilities and teachers' lodgings are scattered all over the site. The new school building will be built parallel to the boundary on the north side. The bicycle lot and gate should be moved by the Cambodian side.

No.5 Chamreun Rath School

The planned site for the classroom building to be newly constructed is presently vacant land and no obstacles exist so lot area is sufficient. The planned layout will take into consideration the position of a new toilet building to be built and convenience with the existing school buildings.

No.6 Chamreun Cheat School

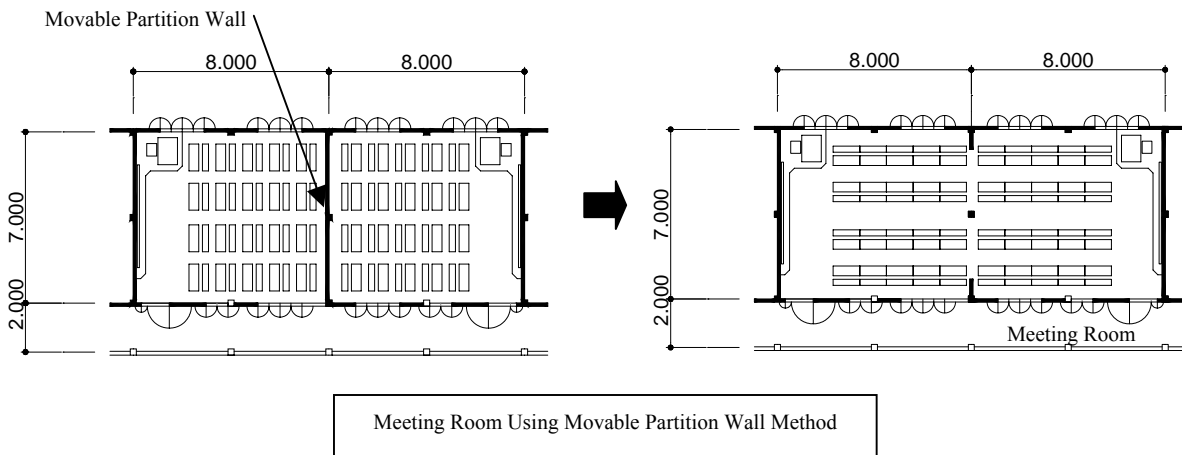
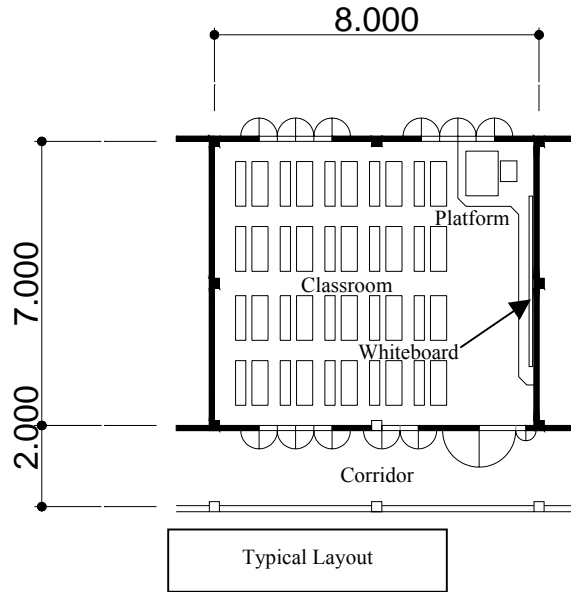
Although the location of the new school building to be constructed is vacant land at the present time, the school lot is narrow and limited due to a neighboring swamp. In order to satisfy the required number of classrooms obtained from the findings of the study, a four-story school building will be built for efficient use of land.

2) Planning and Design for Classroom Buildings

The standard Cambodian module measuring $7\text{m} \times 8\text{m}$ (56m^2) is to be the standard for classrooms. The width of the outside corridor will be 2m in width and floor height will be sufficient enough to ensure ventilation and natural illumination. Due to the limited lot space, three or four story school buildings are planned with the condition that the higher floors will be occupied by higher grades. Although a parallel layout is preferable as a floor design, L-shape floors will be arranged efficiently according to the shape of the lot. In addition, emergency stairways to be used during disasters such as a fire will be installed in two or more directions and slopes will be constructed on the first floor for wheelchairs.

The floor height in the plan for Phase 1 was 3.2m. There are generally no problems with this design and it has been approved by the MoEYS. However, the plan for Phase 2 will adopt 3.6m for the height of the floors for the following reasons. [Beam height of 3.2m will be applied to the highest floor (third or fourth floor) where the volume of the room is large enough by slanted roofing board without ceiling.]

- ◇ Large classrooms 55m^2 in area and 4m high are common in Cambodia due to the high temperatures and humidity. Low-cost classrooms financed by the UNICEF or NGOs also adopt a floor height of 4m to ensure ventilation up to the attic.
- ◇ Although the EU has built classrooms of approximately 45m^2 in area with a floor height of 3.2m in order to reduce the cost and planned to promote this as the standard, this design was unacceptable to Cambodia and became very unpopular because of the low ceiling height.
- ◇ The floor height of a three-story classroom building at Chak Tomuk school constructed through local donations is 3.8m. The floor height of a four-story classroom building at neighboring Prea Norodom school, which is a core school, is 3.6m. The Department of Education, Youth and Sport, Phnom Penh Municipality has also requested that the floor height be raised for better ventilation.
- ◇ Raising the floor height is no more expensive than widening the area.
- ◇ A favorable educational environment can be provided.



Although general cluster meetings are held several times a year, there are no meeting rooms to accommodate all attendants. In due consideration of the situation, adequate space for general cluster meetings and community gatherings should be provided in the core schools. With movable partition between two classrooms, an area the size of two-classrooms will be established for the large meetings.

3) Covered Area and Total Floor Area

The total floor area of planned buildings at each target school is shown in the following table.

Table 2-7 Table of the Total Planned Floor Area

Target School		Planned No. of Classrooms	Total Classroom Building Area (m ²)	Total Toilet Building Area (m ²)	Total Covered Area (m ²)
1	Phoum Russey School	18	1,458	35	1,493
2	Chak Tomuk School	12	1,026	28.5	1,054.5
3	Sophak Mongkul School	24	1,971	47	2,018
4	Pochen Tong School	15	1,242	28.5	1,270.5
5	Chamreun Rath School	24	1,971	47	2,018
7	Chamreun Cheat School	20	1,656	41	1,697
		113	9,324	227	9,551

4) Sectional Planning

Roof

Light-weight steel will be applied to the structure supporting the roof. On top of this, sheathing boards of 12mm in thickness and asphalt sheets will be laid. After installing glazing (sash) bars, it will be covered with roofing tiles. Since it will be covered with waterproof asphalt sheets, the gradient of 21.8° will be adopted as the roof pitch taking durability, weight, workability and easy repair into account.

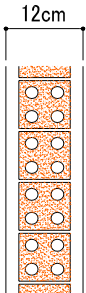
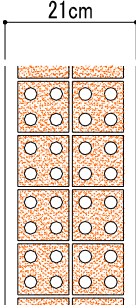
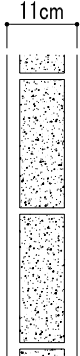
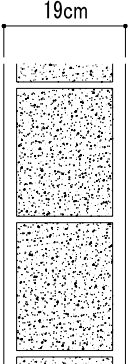
Floor Height

A drainage system has not yet developed in Phnom Penh so approximately 30 to 40cm of rainwater collects in the school yard during the rainy season hindering lessons. Under the Project, to address this problem, floor height on the first floor will be raised and footing beams will be installed along the perimeter of the school building up to 50cm from the school yard level and the perimeter will be protected with concrete walls.

Walls

Although hollow bricks are most commonly used for wall plates in Cambodia, concrete blocks are also manufactured to some degree. Light-weight and high general-purpose materials will be locally adopted. Two-row hollow brick masonry and one-row hollow brick masonry will be applied to the outside walls and inside walls respectively. However, considering indirect cost savings from higher speed, concrete block masonry is also justifiable from the viewpoint of reduction in overall construction expenses and environmental concerns.

Table 2-8 Comparison of Walls

Type	1-Row Hollow Brick Masonry	2-Row Hollow Brick Masonry	Concrete Block Masonry (Locally produced)	Concrete Block Masonry (Imported)
Section				
Popularity	Common method locally	Most common method locally	Applies to fences at local site; rarely adopted for building walls.	X Rarely applied at local site.
Weight	150kg/m ²	270kg/m ²	160kg/m ²	X 300kg/m ²
Unit Cost	Most cheap	expensive	Cheap	X Most expensive
Workability	Due thin wall, laying is difficult. If floor height is high, reinforced bars or lintels, etc. are required.	Although this is the most common local method, laying speed is relatively slow.	Although laying speed is fast, reinforced bars or lintels, etc. are required.	A laying speed is fast.
Aptitude	Although this can be applied to partition walls, cracks easily, so it is not suitable for outside wall faces.	Can be applied to both partition walls and outside wall faces.	Can be applied to both partition walls and outside wall faces.	Can be applied to both partition walls and outside wall faces.

5) Structural Design

Design Standard

Since there are no provisions on building structural design in Cambodia, designs under the Project will be made in accordance with the design criteria of the Architectural Institute of Japan (AIJ). However, if the Japanese Architectural Standard Specification (JASS) is applied to the operations the cost will tend to increase. Proper structural design will therefore be made with reference to ordinary construction techniques or structural forms in Cambodia.

Concrete Strength

Due to the availability of ready-mix concrete from a manufacturer in a suburb of Phnom Penh, concrete will be procured from the concrete manufacturer without field mixing. The design strength of concrete to be utilized for building frames will be equivalent to FC 21N/mm² of the Japan Industrial Standards (JIS).

Reinforcement Bar Standard

Reinforcement bars of consistent quality will be procured from neighboring countries and products equivalent to SR235 (round steel bars) and SD390 (deformed bars) of the JIS will be utilized.

Design Load

Since the buildings to be constructed under the Project will be utilized for elementary schools, the following loads will be applied by adopting load criteria of the AIJ.

◆ Live Load (L. L)

Place of Application	Calculation for Beams & Slabs	Calculation for Structural Frame & Foundation
Roof	0 kg/m ²	0
Classroom	230 kg/m ²	210 kg/m ²
Corridor & Stair Hall	360 kg/m ²	330 kg/m ²

◆ Wind Load (W.L)

Due to a maximum wind velocity of 22m/sec. based on the Cambodian meteorological data, 25m/sec. will be adopted as the design load.

◆ Seismic load (S. L)

Since there are no earthquakes in Cambodia, this will not be taken into account.

6) Draft for Building Equipment Plan

Water Supply System

Since most teachers and pupils at the target schools bring water bottles from home, the installation of a water supply system will be limited to the planned toilets. As shown in Table 2-9, although the Phoum Russey school uses the municipal water supply and a well presently out of service, under the Project water for the target toilet will continue to be supplied by a private water company instead of utilizing well water before connection to municipal water. A well is located in the yard of the Chak Tomuk school so municipal water is not utilized.

Although the Chamreun Rath and Chamreun Cheat schools currently purchase water from a private water supplier, a reduction in water charges will be promoted by switching to the municipal water system through the construction, which will be taken by the Cambodian side (since the charge for 1m³ of municipal water is Riel 1,030 compared with Riel 1,500 for private-sector water, approximately US\$300 is needed to change the contract to municipal water).

In addition, rainwater fed from gutters and fed to storage tanks on the roofs will be used as the water source for toilets at all target schools.

Table 2-9 Present and Planned Water Resources at Target Schools

No.	School Name	Present Water Source	Planned Water Source
1	Phoum Russey School	Private Water Supplier	Municipal Water, Rainwater
2	Chak Tomuk School	Well Water (42m)	Municipal Water, Rainwater
3	Sophak Mongkul School	Municipal Water	Municipal Water, Rainwater
4	Pochen Tong School	Well Water (5m)	Municipal Water, Rainwater
5	Chamreun Rath School	Private Water Supplier	Municipal Water, Rain Water
6	Chamreun Cheat School	Private Water Supplier, Rainwater	Municipal Water, Rainwater

Toilet and Sewage System

In principle, the Project will ensure one toilet booth for every two classrooms to be newly constructed. As shown in Table 2-5, half the total number of toilets will be divided between boys and girls. For wash basins, the water tanks of the flush toilets will be utilized so independent hand-washing equipment will not be installed. In addition, two multi-purpose type booths, one each for girls and boys, will be accessible by wheelchair. Flush toilet, wash bowl, inclined mirror and sliding door for the entrance will be installed in each booth. Although it was called a toilet for the handicapped in Phase 1 of the Project and was in a separate building, to prevent any discrimination and to improve convenience and usability, and considering that all pupils are able to utilize large toilets, large booths will be incorporated together with general booths. Many Moslem pupils attend the Chamreun Cheat and Chamreun Rath schools. Therefore, separate toilet buildings for boys and girls will be built.

With respect to the target toilets at the Phoum Russey school (sewerage pipes were improved in December 2003 through NGO assistance), Chak Tomuk and Pochen Tong schools where

the municipal sewerage pipes have been installed. Waste water from the planned toilets will be fed to a settling tank after treatment through a three-compartment septic tank and connected to the main municipal drainage pipes. Waste water from the septic tank in Sophak Mongkul school will be drained to the existing drainage pipe. Chamreun Rath and Chamreun Cheat schools where it is impossible to prepare drainage main pipes due to a difference in elevation will drained to the pond in each school after treatment. With both systems the school should periodically collect sludge using a collector as part of the obligations of Cambodia. However, each school may apply to the DEP for financial assistance as a matter of environmental consideration of the Priority Action Program (PAP) of the MoEYS. Collectors include the Phnom Penh Waste Management (PPWM) and private companies (Sarom Training Co., Ltd. and several others). The PPWM is usually responsible for the collection of general households and schools.

Table 2-10 Current and Planned Drainage Systems at Target Schools

No.	School Name	Present Drainage System	Planned Drainage System	Remarks
1	Phoum Russey	Connected to public drainage	Connected to public drainage	
2	Chak Tomuk	Connected to public drainage	Drained to public drainage	Connected to school drainage
3	Sophak Mongkul	Permeated to underground	Connected to existing drainage	Drained to lake after existing drainage
4	Pochen Tong	Connected to public drainage	Connected to public drainage	
5	Chamreun Rath	Permeated to underground	Drained to the pond in school after treatment	Impossible to connect to main drainage pipes due to difference in elevation
6	Chamreun Cheat	Permeated to underground	Drained to the pond in school after treatment	

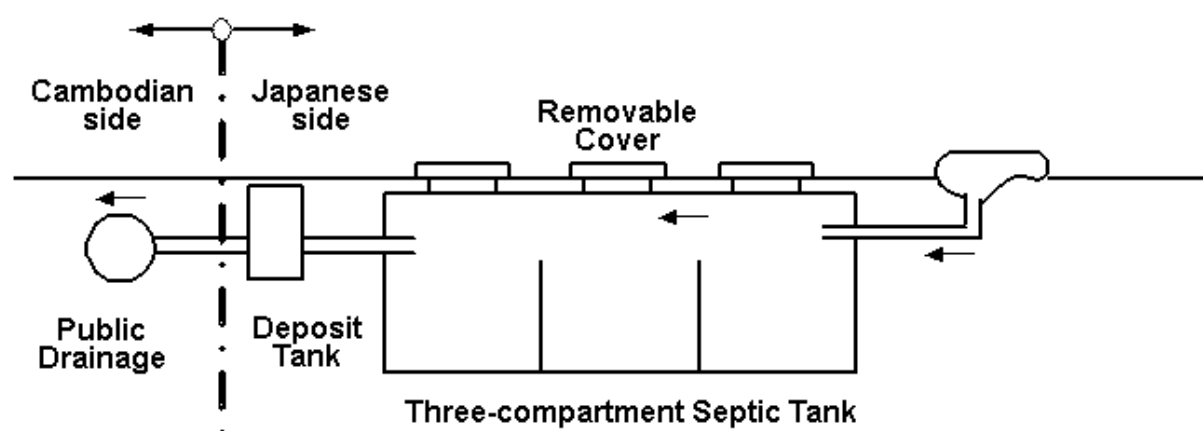


Figure 2-6 Toilet System Connected to Public Drainage

Electricity

In Phase I Project, electrical equipment was only provided for classrooms used concurrently as meeting rooms, corridor on ground floor, toilets for the handicapped and well power supplies. However, considering that (i) pupils eyes may deteriorate during the rainy season due to low illumination in classrooms without lighting, and (ii) classrooms can be utilized as multi-purpose rooms at night such as adult education for example, electrical equipment will be installed in all target classrooms. With respect to improved illumination in classrooms, 370 lx at the level of 0.8m from floor level which is the general standard in Cambodia should be ensured.

- a. Lighting equipment will be installed in all classrooms, corridors and toilets.
- b. In order to reduce electricity charges, fluorescent lamps instead of incandescent lamps will be adopted.
- c. Wall outlets will be installed in each classroom.
- d. In order to prevent breakdown of equipment resulting from a voltage drop, an automatic voltage regulator (AVR) will be installed at the primary side of the distribution board in school buildings to be newly constructed.

The following figure shows the distribution diagram of power supply and house wiring system and demarcation of construction work between Japan and Cambodia.

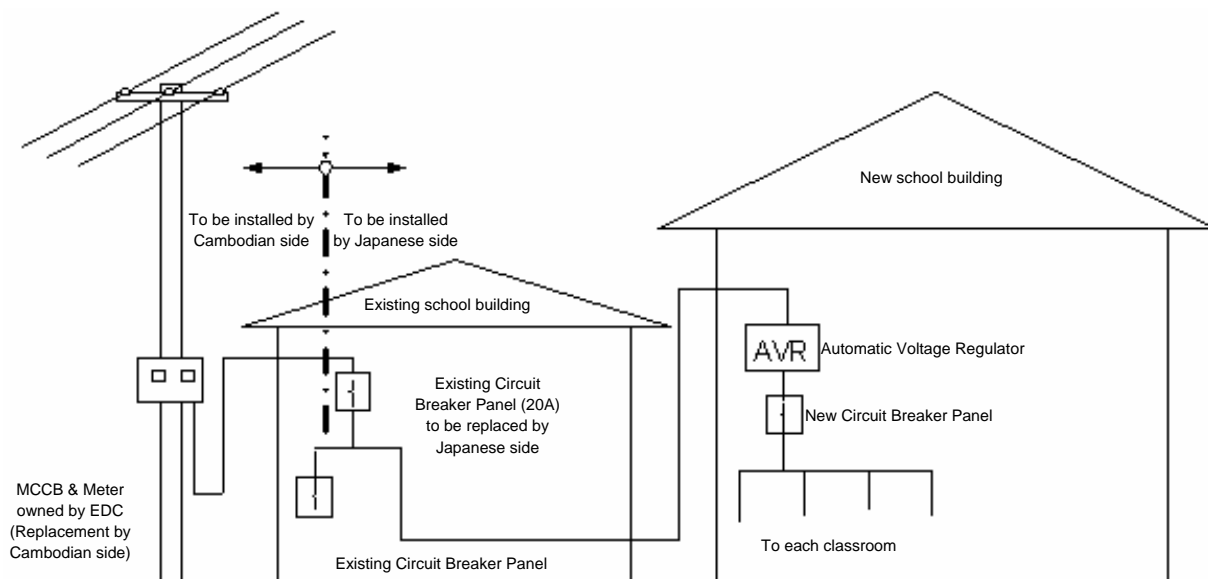


Figure 2-7 Distribution Diagram of Power Supply and House Wiring

Extinguishing System

Since wood is used for furniture and other fittings the potential for fire in the facilities under the Project is high. Consequently, fire extinguishers will be installed in all staircases on the second floor and higher.

7) Construction Materials Plan

Construction materials were carefully selected after comparing and examining each material for durability, local availability, thermal insulation, maintenance and cost, etc.

Materials to be acquired for the Project are listed in the following table.

Table 2-11 List of Construction Materials to be Acquired

Building Components	General Construction Method & Materials	Construction Method & Materials to be Acquired	Reasons for Selection
Main Structure			
Roof Frame	Wooden trusses	Steel frame	Termite control & durability
Main Structure	Reinforced concrete	Reinforced concrete	Durability, conforming to local construction method
Walls	Hollow brick	Hollow brick or concrete blocks	Economical, conforming to local method
Floors	Upper floor: Concrete floor slabs	Cement tile	Economical, conforming to local method
	1 st floor: Earthen floor concrete		
Outside Finishing			
Roof	Porcelain roofing tile & Ceramic tile	Colored cement roof tile	Comprehensive judgment of above-mentioned matters
Outside Walls	Mortar coating	Mortar coating	Economical, easy maintenance & repair, conforming to local method
Openings	Wooden window louvers, coated	Wooden window louvers, coating	Economical, easy maintenance & repair, conforming to local method
Interior Finishing			
Ceiling	Top Floor	Tile roof exposed	Roof board exposed with painting
	1 st & 2 nd Floors	Plaster	Paint on concrete surface
Walls	Wooden vertical panel siding Mortar coating	Mortar coating	Economical, easy maintenance & repair, conforming to local method
Floor	Cement board	Cement tile	Conforming to local method, economical
Toilet Wall	Mortar coating	Upper wall: Mortar coating Lower wall: Tile	Easy maintenance & repair, deodorization
Toilet Floor	Mortar trowel finishing	Mosaic tile	Easy maintenance & repair, deodorization

2.2.2.2 Equipment Plan

Furniture and furnishings to be prepared at each school are shown in Table 2-12. Two types of desks and chairs for pupils will be set up for lower and higher grades, and the number of pieces prepared will be in accordance with the current number of pupils.

Table 2-12 Installation Criteria For Furniture and Furnishings

Type of Furniture or Furnishings	Installation Criteria
Whiteboards 1,200 × 2,400	2 boards in each classroom to be newly constructed
Desks & chairs for pupils (Large: for 4 to 6 grades, 2-person sitting)	20 units each for 40% of classrooms to be newly constructed
Desks & chairs for pupils (Small: for 1 to 3 grades, 2-person sitting)	20 units each for 60% of classrooms to be newly constructed
Desks for teachers	1 unit for each classroom to be newly constructed
Chairs for teachers	1 unit for each classroom to be newly constructed

The contents of facilities, furniture and furnishings to be installed at each target school are shown in the following.

Table 2-13 Contents of Facilities, Furniture and Furnishings to be installed

No.	School	Desks & Chairs for Pupils (for 2-person sitting) *	Desks & Chairs for teachers (in classrooms)	Whiteboards (2.4 x 1.2m)
		Set	Set	Board
1	Phoum Russey	360	18	36
2	Chak Tomuk	240	12	24
3	Sophak Mongkul	480	24	48
4	Pochen Tong	300	15	30
5	Chamreun Rath	480	24	48
6	Chamreun Cheat	400	20	40
Total		2,260	113	226

* Sixty (60) % small ones for lower grades and 40% large ones for higher grades.