Ministry of Agriculture and Irrigation
Republic of the Union of Myanmar

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR STRENGTHENING HUMAN DEVELOPMENT INSTITUTIONS IN AGRICULTURE
IN
THE REPUBLIC OF THE UNION OF MYANMAR

February 2013

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

SYSTEM SCIENCE CONSULTANTS INC.,

RD
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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct preparatory survey and entrust the survey to System Science Consultants Inc.

The survey team held a series of discussion with the officials concerned of the Government of Republic of the Union of Myanmar, and conducted a field investigations. As a result of further studies in Japan, 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.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Myanmar for their close cooperation extended to the survey team.

February, 2013

Mr. Kumashiro Teruyoshi
Director General
Rural Development Department
Japan International Cooperation Agency

Summary

(1) Overview of the country

The Republic of the Union of Myanmar (hereinafter “Myanmar”), located between 10 degrees and 28 degrees north latitude. has a national land that stretches from South to North. The interior parts have frontiers with China, Thailand, Laos, India, and Bangladesh with a total 4,600 km length of the frontier. Coastal areas face the Gulf of Martaban, the Bay of Bengal and the Indian Ocean with 2,000 km of coastal lines. The country area is 680,000 ㎢ (1.8 times larger than Japan) and the capital is the city of Nai Pyi Taw which is located at the center of the country. The capital was relocated from Yangon to Nai Pyi Taw by starting the construction of the city by the new administrative capital in 2003 and transferring Ministries and other government offices to Nai Pyi Taw in November 2005.

Agriculture is regarded as the most important sector in Myanmar as it accounts for about 30% of GDP and the agricultural population comprises over 60% if the total population.

(2) Background of the Project

As mentioned above, in the economy of Myanmar, agricultural dependence is very high as is made clear from the fact that the agricultural population comprises over 60% of the total population and the agricultural sector accounts for about 30% of GDP, and the new Government that took office in March 2011 regards agriculture and its associated industries as the most important sector for economic development. The Ministry of Agriculture and Irrigation (MOAI) has set a basic strategic agricultural policy of (1) development of new farmlands, (2) supply of sufficient irrigated water, (3) provision and support of agricultural mechanization, (4) application of latest agricultural technology, and (5) development and use of new breeds for the main agricultural strategy of “supporting research and development of agricultural products for improvement of quality and production.” In this situation, the new Government has aimed at human resource development for agricultural development through training centers and higher education institutions and is promoting measures to build up these agricultural human resource development organizations.

Of these institutions for agricultural human resource education, Yezin Agricultural University (YAU) is the only agricultural college in Myanmar that serves as a higher education institution for fostering officials of MOAI and agricultural engineers in the private sector. Under MOAI, the Central Agricultural Research and Training Center (CARTC) and Vegetables and Fruits Research and Development Center (VFRDC) operate as centers for accumulating expertise and technology as well as providing regular training courses to foster officials of MOAI as personnel who can teach agricultural technologies, under a training curriculum for each theme to educate and train farmers and extension workers from rural areas throughout the country. These human resource education programs will contribute to the spread of agricultural technologies, improvement of the quality of agricultural products and increase of crop yields for the agricultural development of Myanmar.

On the other hand, the market economy that has advanced in recent years has diversified and advanced the needs of markets and producers for cultivation technologies to meet the diverse agricultural environmental conditions in Myanmar and the production of quality agricultural products with high market value. To respond to these needs, it is necessary to foster human resources to be engaged in technical development. However, the cultivation of such human resources is impeded by

the fact that the equipment and instruments installed in the educational and training facilities have become dilapidated and are out of order.

In February 2012, upon the request made by MOAI for improvement of equipment at YAU, the grand aid “Project for Strengthening Human Development Institutions in Agriculture” (hereinafter “Project”) was requested. In response to this request, the “Needs Assessment Study for the Project for Improvement of Equipment for Human Resource Development in Agriculture in Myanmar” was carried out in Myanmar from May 20, 2012 until May 27, 2012 and the needs for the Project were confirmed.

Based on the study result, JICA dispatched a study team for preparatory study of the “Project for Improvement of Equipment for Human Resource Development in Agriculture” firstly from July 8, 2012 until August 19, 2012 and secondly from August 27, 2012 until September 15, 2012. In addition, the study team for the renamed “Project for Strengthening Human Development Institutions in Agriculture” conducted the preparatory survey from December 12, 2012 until December 27, 2012.

(3) Outline of the study result and contents of the Project

This Project examined the need and relevance of the project as well as the need and relevance of the provision of equipment to four facilities and construction of a new facility at YAU through study at YAU located in Nai Pyi Taw District, Department of Agricultural Research (DAR) that has control of research institutes including the seed bank, the Central Agricultural Research and Training Center (CARTC) and Vegetables and Fruits Research and Development Center (VFRDC) which are controlled under the Department of Agriculture (DOA). Main facilities and equipment checked by this project are summarized as follows:

【Facilities】

Experiment and Lecture Building-1 (Total area 2,157.7 ㎡)

First floor:

- Department of Agricultural Chemistry: Research and practical work room, preparation room, storage, staff room
- Department of Agricultural Economics: Research and practical work room, meeting room, staff room
- Common laboratories: Laboratory 1, Laboratory 2, Laboratory 3, and Laboratory 4
- Miscellaneous: Stairway 1, Stairway 2, Toilet 1, Toilet 2, corridors/passageways, balconies. Machinery room

Second floor:

- Department of Plant Pathology: Research and practical work room, preparation room, storage, staff room
- Department of Entomology: Research and practical work room, preparation room, storage, staff room
- Miscellaneous: Stairway 1, Stairway 2, Toilet 1, Toilet 2, corridors/passageways, balconies

Experiment and Lecture Building-2 (Total area 2,157.7 ㎡)

First floor:

- Department of Botany: Research and practical work room, preparation room, cold storage room, storage, staff room
- Department of Animal Science: Research and practical work room, staff room, multi-purpose room
- Department of Agricultural Engineering: Research and practical work room, staff room, multi-purpose room
- Miscellaneous: Stairway 1, Stairway 2, Toilet 1, Toilet 2, corridors/passageways, balconies. Electric machinery room

Second floor:

- Department of Agronomy: Research and practical work room, preparation room, storage, staff room
- Department of Horticulture: Research and practical work room, media preparation room, culture room, Adaptation/acclimation room, staff room
- Miscellaneous: Stairway 1, Stairway 2, Toilet 1, Toilet 2, corridors/passageways, balconies

【Equipment】

YAU:

- Department of Agronomy: Dockage tester, Grain taste analyze, Draft chamber, Plant growth chamber, Heliograph, Photosynthesis meter, UV-Vis Spectrophotometer
- Department of Botany: Plant growth chamber, Photosynthesis meter, Microscope (with camera), Clean bench, Photosynthesis meter, Thermostatic germinator
- Department of Agricultural Chemistry: Draft chamber, Atomic absorption spectrophotometer, Gas chromatography, Refrigerated centrifuge, Real time PCR, Growth chamber
- Department of Plant Pathology: Draft chamber, Clean bench, Photosynthesis meter, Refrigerated centrifuge, Real time PCR, Growth chamber
- Department of Entomology: Draft chamber, Microscope (with camera), Temperature and humidity control room, High performance liquid chromatography, High speed refrigerated centrifuge
- Department of Horticulture: Plant growth chamber, Clean bench, Refrigerated centrifuge, Real time PCR, UV image recorder, Micro spectrophotometer, Gas chromatograph (TCD), Gas chromatograph (FID)
- Department of Agricultural Economics: Computer
- Department of Agricultural Engineering: Tractor (45HP), Roll baler, Combine harvester

DAR

- Department of Horticulture: Seed germination chamber
- Department of Biotechnology: Photosynthesis meter

- Department of Plant pathology: Clean bench
- Seed Bank: UV-Vis Spectrophotometer

CARTC
- Agricultural Chemistry/Soil Science: UV-Vis Spectrophotometer
- Agricultural Machinery: Tractor (45HP), Combine harvester

VFRDC
- Department of Training: Heliograph
- Department of Agricultural Machinery: Tractor (45HP)

(4) Project Implementation Schedule and Cost

The total period of the implementation of the Project is estimated to be 20.5 months (6.5 months for designing and 14.0 months for construction work and procurement of equipment). The cost to be borne by the Myanmar side is estimated to be 1.35 million yen to execute this Project.

Costs to be borne by Myanmar side

Item of Myanmar's Responsibility	Amount of Share (1000 Ks)	Yen equivalent (1000 yen)	Remarks
Before the commencement of the construction work Removal and relocation of obstacles (trees and existing structures) and ground leveling in construction work area	1,543	150	
During the construction period Lead-in wiring to the distribution box	3,087	300	
After the completion of the construction work Equipment and cable, planting and furniture and fixtures out of the scope of works by the Japanese side	7,203	700	
Other expenditures Commissions for banking arrangement (B/A) and authorization to pay (A/P)	2,058	200	
Total	13,891	1,350	

(5) Project Evaluation

- Relevance

This Project is to provide assistance to YAU which is the only agricultural college in Myanmar that serves as a higher education institution for fostering officials of MOAI and to CARTC and VFRDC that carries out research as well as provide training courses. The content of the assistance is in line with Myanmar's long-term development plan. In addition, the Project beneficiaries include a wide range from farmers, agricultural engineers (government agricultural technicians, agricultural extension workers, researchers, teaching staff of educational institutions such as agricultural high schools, to private agricultural engineers) and agricultural students. Therefore, the benefit is expected to be provided to a wide range of people. Taking a great number of beneficiaries, development of human

resources, and high coherency with long-term development plan of Myanmar into account, the relevance of the Project is considered quite high.

- Effectiveness

Following effects are expected to be generated by this Project:

1) It is highly expected that proportion of hours spent on experimental practice at YAU will increase (38 hours for experimental work (9.2%) out of 411 hours in total). As a result of this, final year students are also provided the opportunity to conduct experimental practice. Consequently, the number of curriculum is estimated to increase.
2) While approximately 40 research papers are submitted at YAU every year, the total number of submitted papers is expected to increase as more research is conducted with the implementation of this Project.
3) Whilst YAU has trained approximately 200 agricultural engineers every year, more training is expected to be provided.
5) As academic activities become active, the number of students and teaching staff is estimated to increase. The implementation of this Project is expected to increase the number of research, which results in the increase in the number of submitted paper and as well as of the trainings accordingly.
6) CARTC annually trains 785 persons. With the implementation of this Project, training activities are expected to be more active.
9) VFRDC annually trains around 780 persons. With the implementation of this Project, training activities are expected to be more active.

Taking a great number of beneficiaries, development of human resources, and high coherency with long-term development plan of Myanmar into account, the relevance of the Project is considered quite high.

The expected quantitative and qualitative outputs are as follows:

1) Quantitative output

The expected quantitative output is presented as below:

Table Quantitative output of this Project

Indicators		Baseline (2011)	Benchmark (2017) 3 years after the Project
YAU			
1.	Proportion of experimental hours out of total lesson hours in 9 departments	9%	12%
2.	Number of curriculums	76	87
3.	Number of submitted research papers	42	60
4.	Number of training participants	204	420
5.	Number of students and teaching staff	9,891	10,880
DAR			
6.	Number of submitted research papers	13	20
7.	Number of trained staff	24	29
8.	Number of trained farmers	6	8
9.	Number of trained students	141	170
10.	Number of trained agricultural engineers	73	88
CARTC			
11.	Number of total training participants	785	942
VFRDC			
12.	Number of trained agricultural engineers	452	542
13.	Number of trained farmers	143	172
14.	Number of trained students	139	167

2) Qualitative output

The following qualitative output is expected to be generated with the implementation of this Project:

1) Educational/training curriculum and content of test research will satisfy needs of farmers.

2) Outputs as a research result of university and each research institute will meet consumers' needs.

3) Techniques, knowledge, and motivation of agricultural human resources will improve.

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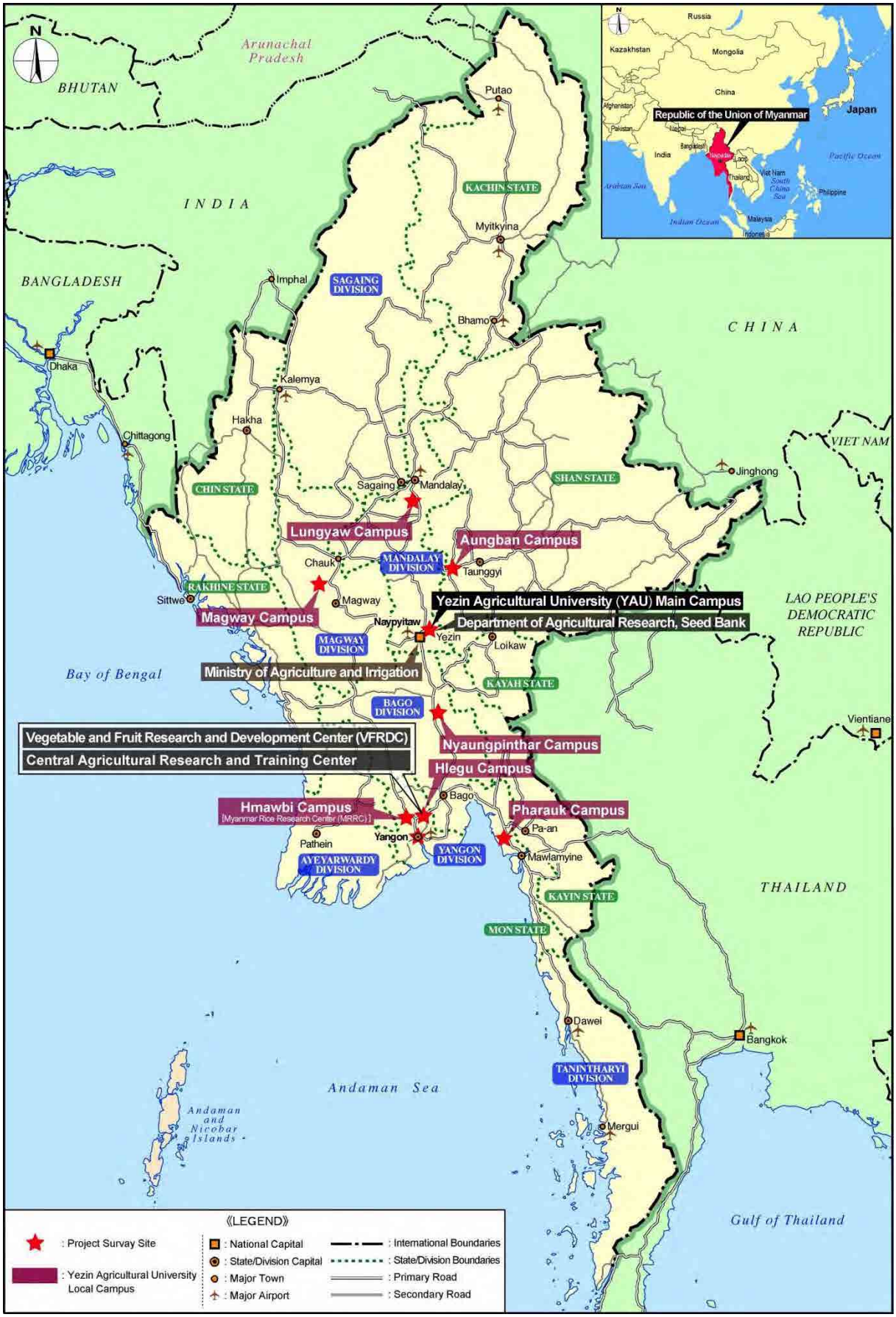
Chapter 3 Project Evaluation

Appendices:

Location Map



Perspective (Laboratory-2)

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Abbreviations

ACI	American Concrete Institute
AGORA	Global Online Research in Agriculture
AMD	Agricultural Mechanization Department
ASEAN	Association of South East Asian Nations
AVR	Automatic Voltage Regulator
BS	British Standards
CARTC	Central Agriculture Research and Training Center
CEC	Council for Exceptional Children
DAC	Development Assistance Committee
DAP	Department of Agricultural Planning
DAR	Department of Agriculture　Research
DOA	Department of Agriculture
EC	Electric Conductivity
E/N	Exchange of Notes
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization　Statistical Database
GDP	Gross Domestic Product
GNP	Gross National Product
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
HDI	Human Development Index
HP	Horsepower
ID	Irrigation Department
IEE	Initial Environmental Examination
IMF	International Monetary Fund
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JIS	Japan Industrial Standards
JSPS	Japan Society for the Promotion of Science
KOICA	Korea International Cooperation Agency
LBVD	Livestock Breeding and Veterinary Department
MOAI	Ministry of Agriculture and Irrigation
MPI	Multidimensional Poverty Index
MRRC	Myanmar Rice Research Center
NGO	Non-Governmental Organization
OARE	Online Access to Research in the Environment
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
PRSP	Poverty Reduction Strategy Paper
SAI	State Agricultural Institute
SD	Survey Department
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture
SLRD	Settlement and Land Records Department
UNDP	United Nation Development Programme

UNFPA	Untied Nation Population Fund
UNICEF	United Nation Children's Fund
UPS	Uninterruptible Power Supply
USAID	United States Agency for International Development
USDP	Union Solidarity and Development Party
VFRDC	Vegetables and Fruits Research Development Center
UV-VIS	Ultra Violet Visible
WB	World Bank
WFP	World Food Programme
WHO	World Health Organization
WRUD	Water Resources Utilization Department
WTO	World Trade Organization
YAU	Yezin Agricultural University

Chapter 1. Background of the Project

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1-1 Background of the Project

In the economy of the Republic of the Union of Myanmar (hereinafter, Myanmar), agricultural dependence is very high as is made clear from the fact that the agricultural population comprises over 60% of the total population and the agricultural sector accounts for about 30% of GDP, and the new Government that took office in March 2011 regards agriculture and its associated industries as the most important sector for economic development. The present Government is planning to develop human resources for agricultural development through training centers and higher education institutions, and is promoting measures to build up these agricultural human resource development organizations.

Myanmar is blessed with abundant and diverse agricultural resources. The income level is certainly low, but the dietary habits of the people are not poor and they have no experience of suffering from hunger in their past history. Agriculture has been stagnant and exhausted and Myanmar's standing as the world's largest rice exporting country has long declined due to political failure under the Burmese style socialistic regime since 1962. However, the development potential of this country is still very high. The country has adequate leeway to change in the emphasis on production increase by traditional overdependence on rice, and develop and promote a cultivation system and technologies that are adequate for the local diverse agricultural environmental conditions, and develop domestic and export markets through development of quality agricultural products and processed goods with high market value. Therefore, it is necessary to promote these measures actively. The needs of the markets and the producers will diversify and advance in future, and it will be mandatory to develop advanced human resources to meet those needs.

The agricultural human resource development institutions in Myanmar include agricultural high schools, State Agricultural Institutes (SAI), Yezin Agricultural University (YAU), and training centers of the Ministry of Agriculture and Irrigation (MOAI). YAU is the only agricultural college in Myanmar, and it functions as the basic higher education institution in the agricultural sector and educates MOAI staff and private agricultural engineers. On the other hand, SAI institutes which have been set up in 7 locations train agricultural extension workers who work with the Department of Agriculture (DOA) of MOAI. YAU has the function of educating the senior extension workers and managerial staff of DOA. Graduates from YAU accounted for 36%, or 1,576 of 4,325 officials in DOA as of the end of June 2006. Most of the instructors who undertake the education and training of extension workers in the 7 SAI institutes and in the Central Agricultural Research and Training Center (CARTC) for training of extension workers in active service graduated from YAU. YAU is the source of human resources including researchers engaged in agriculture-related institutions.

YAU has an Agricultural Engineering Department, but it has no graduate school. YAU cannot educate the managerial technical staff of the Irrigation Department (ID), Water Resource Utilization Department (WRUD), or Agricultural Mechanization Department (AMD) of MOAI, and it is forced to depend on Yangon Technological University and others.

Livestock breeding, fisheries and forestry which are closely associated with agriculture in a narrow

sense fall under the jurisdiction of the Ministry of Livestock and Fisheries and the Ministry of Forestry respectively. The education of the managerial staff of these ministries is undertaken by individual higher education institutions. However, the livestock breeding college under the control of the Ministry of Livestock and Fisheries places emphasis on livestock sanitation (veterinary science) and implements a work-sharing system with YAU's Department of Animal Science for the study of animal science in a wide sense including grassland science and feed science, but the relationship between them is still weak. In addition, YAU's Department of Animal Science has no graduate school. Therefore, system buildup will be a future task.

1-2 Natural Conditions

1-2-1 Meteorology (Temperature, Rainfall and Wind)

As Myanmar is a long country from north to south, the atmospheric temperature and rainfall differ from region to region. The southern and central regions that occupy the greater part of the country belong to the tropical monsoon climate zone while the northern region is in the temperate zone. Nai Pyi Taw is located in the tropical monsoon climate zone and has a rainy season (late May to late October) and a dry season (early November to mid-May). In the middle 4-month period from November to February in the dry season, the temperature and humidity are comfortably low. The hottest period is the 3 months from March to May and the monthly average highest temperature is 35°C to 40°C with the peak in April.

In the rainy season, the humidity is very high and the rainfall does not continue for a long time, but it is concentrated several times a day. During the change from the rainy to the dry season, thunder often occurs, so lightning arresters are installed even on many two-story buildings.

No cyclones retain their strength as far as Nai Pyi Taw. It will not be necessary to consider any impact on the facilities to be constructed.

The winds blow in a north-easterly direction in the dry season (March to mid-May) and in a south-westerly direction in the rainy season (mid-May to late October). The prevailing winds blow from the south in the middle period (November to late February). The monthly maximum and minimum temperatures and the monthly rainfall for the past 3 years in Nai Pyi Taw are shown in the tables1-01 and table 1-02 respectly.

Table 1-01 Monthly maximum and minimum temperatures in Nai Pyi Taw (2009 – 2011)

(Unit: °C)

Year		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2009	Max.	32.4	36.1	37.9	38.3	37.5	33.5	32.0	32.4	33.9	34.7	34.7	32.4
	Min.	16.6	17.9	21.8	24.8	25.4	24.5	24.9	24.8	25.0	24.9	21.4	15.6
2010	Max.	33.8	36.4	38.2	41.9	38.8	34.3	33.5	32.5	33.7	33.0	34.0	30.8
	Min.	16.5	17.7	21.4	24.8	26.4	25.0	24.9	24.6	24.6	23.5	18.9	16.4
2011	Max.	31.1	34.6	36.1	36.8	34.9	33.0	33.1	32.3	32.9	33.3	34.24	31,1
	Min.	15.7	15.6	20.1	23.6	24.4	24.7	24.5	24.2	24.1	22.9	18.2	17.2

Source: DAR

Table 1-02 Monthly rainfall (2009 – 2011) (Unit: mm)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
2009	0	0	0	26	178	114	143	282	148	133	0	0	1,024
2010	0	0	0	0	156	119	209	274	182	185	33	0	1,158
2011	0	0	60	116	89	263	95	344	241	235	0	40	1,483

Source: DAR

1-2-2 Topography and Geology (Study Results of Natural Conditions)

The topographic and geologic conditions of the survey sites are outlined in the table 1-03.

Table 1-03 Outline of survey of current status (topography and geology)

Survey Item		Survey Site	Survey Method	Period of Survey
Study of Existing Materials	Topographic and geologic conditions	Planned sites and surrounding areas		
Field Survey	Ground Survey Laboratory Test	Planned sites	Field reconnaissance	Jul. 24 – Aug. 13, 2012
			Boring survey Standard penetration test	Jul. 31 – Aug. 17, 2012
			Laboratory test	Aug. 15 – Aug. 25, 2012

(1) Purpose and Method of Survey

A study of the existing materials on the topographic and geologic conditions of YAU premises and the surrounding area was conducted and a ground survey (by field reconnaissance, boring survey and laboratory test) was carried out through a subcontracted field survey to investigate the impact on safety such as the topology and bearing capacity of the soil. The results of the surveys as well as the results of the study of existing materials were arranged for analysis.

(2) Survey Sites

A boring survey was conducted at the planned construction sites on YAU premises as designated by YAU. The boring survey was carried out at 6 points (No. 1 – No. 6) and the survey range of each planned construction site including the surrounding area was approximately 11.0 ha. The boring survey site locations are shown in the figure 1-01.

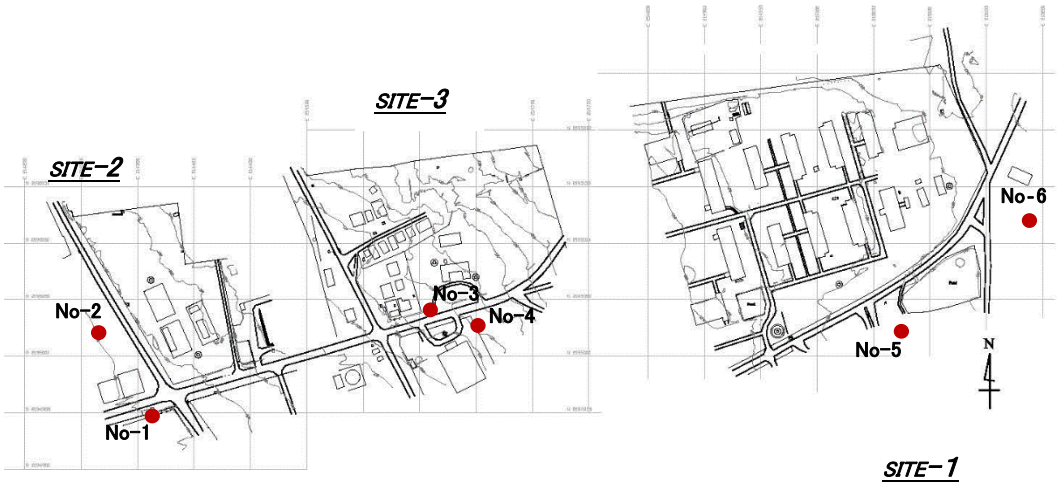


Fig. 1-01 Location site maps of boring survey points and premises survey sites

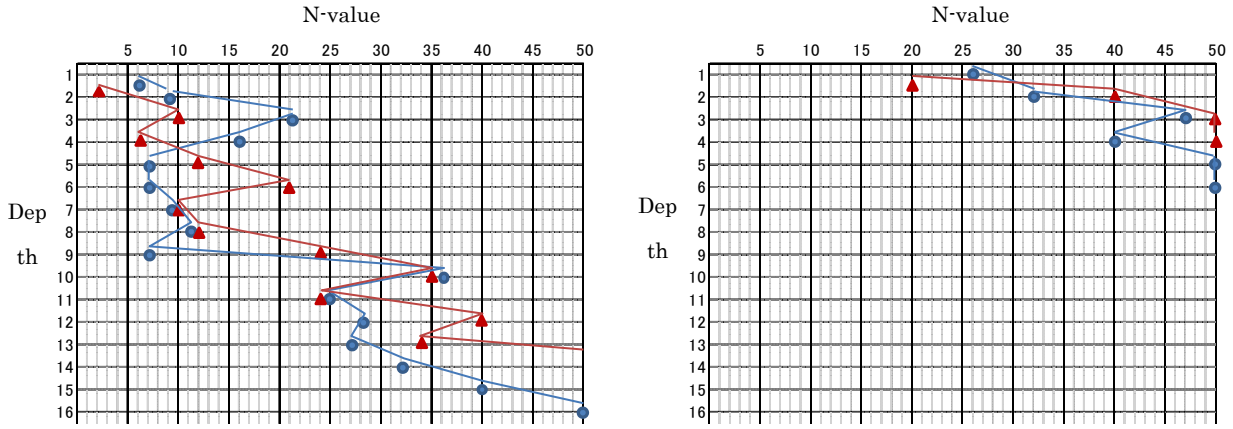
(3) Survey Results

1) Topographic conditions

YAU is located at an altitude of about 100 to 130 m in the gentle alluvial fan in the Shan Mountains with an altitude of 600 to 700 m extending from south to north in the east of YAU. Military facilities are built on the slopes of the mountains. Yezin Dam, a gravity type dam, is located to the west of YAU to provide household water and irrigation water for the rice paddies in the dry season. Valleys extend at right angles to the mountain ridges. The geologic feature of these sites is that mainly clay-mixed sand, gravel and clay are distributed.

2) Geologic conditions (results of boring survey and laboratory test)

The results of the boring survey and laboratory test at each site (geographic and geologic features) are outlined in the figure 1-02. Site-1 is located on a plateau on YAU premises, where sand-mixed gravel is deposited on the surface layer with a layer thickness of about 1 m and an N-value of over 20 (No.-5 and No.-6). The general tendency is that the site is composed of gravel, sand and clayish soil, indicating that the N-value increases as the depth increases. Therefore, the ground is evaluated as relatively hard and stable.



Site-2 Boring Log (No.-1 and No.-2) **Site-1 Boring Log (No.-5 and No.-6)**

Fig. 1-02 The results of the boring survey and laboratory test

Site-2 is located at the bottom of a slope, where soil and sand flow off the plateau and are deposited. It has been confirmed that the stratum seems to be relatively new and consists of continuously deposited gravel, sand, silt and clay. Therefore, the N-value was 2 to less than 9 at around the surface layer and the average N-value at a depth of 9m below the surface was 10.55, so relatively soft. No aquifer (groundwater) that may impact the construction of the facilities and their foundation structures was confirmed.

The results of the laboratory tests are shown in the table 1-04.

Table 1-04 Results of laboratory tests

Laboratory Test Item	BH No.	Sampling Depth (m)	Test Result			
Specific gravity test	2	1.5 – 2.0	2.70			
	4	2.5 – 3.0	2.50			
	3	1.5 – 2.0	2.50			
Water content test (%)	2	1.5 – 2.0	9.81			
	4	1.5 – 2.0	9.70			
	1	1.5 – 2.0	9.02			
Atterberg limit test			Liquid Limit	Plastic Limit	Plasticity Index	Soil
	1	2.5 – 3.0	21.43	14.28	7.15	Clay
	4	1.5 – 2.0	51.22	30.02	21.2	Clay silt
	5	1.5 – 2.0	30.19	23.53	6.66	Silt
Density test (Bulk density)	4	1.5 – 2.0	1.73			
	2	5.5 – 6.0	1.71			
	1	2.5 – 3.0	2.10			
PH test	5	0.5 – 1.0	5.88			
	3	1.5 – 2.0	7.18			
	1	2.0 – 2.5	7.85			

1-2-3 Earthquakes

As seen from the earthquake distribution map (refer to fig 1-03), earthquakes are active in the area from Mandalay to Kachin State in the Northwestern Region to Kachn State. In the fault map, Sagaing fault between the Bago Mountains and Shan Mountains divides Myanmar into east and west. This fault is very long from the south of Shan State to the Gulf of Mottama, and Nai Pyi Taw is located between this Sagaing fault and the Papun fault zone in the Shan Plateau to the east. Therefore, Nai Pyi Taw is in zone 3 (horizontal seismic coefficient – ratio of horizontal acceleration imposed on the structure to gravity acceleration in the event of an earthquake = 0.2 to 0.3g) of 5 earthquake distribution zones. Therefore, it is necessary to draw up a structural plan with proper consideration for seismic force.

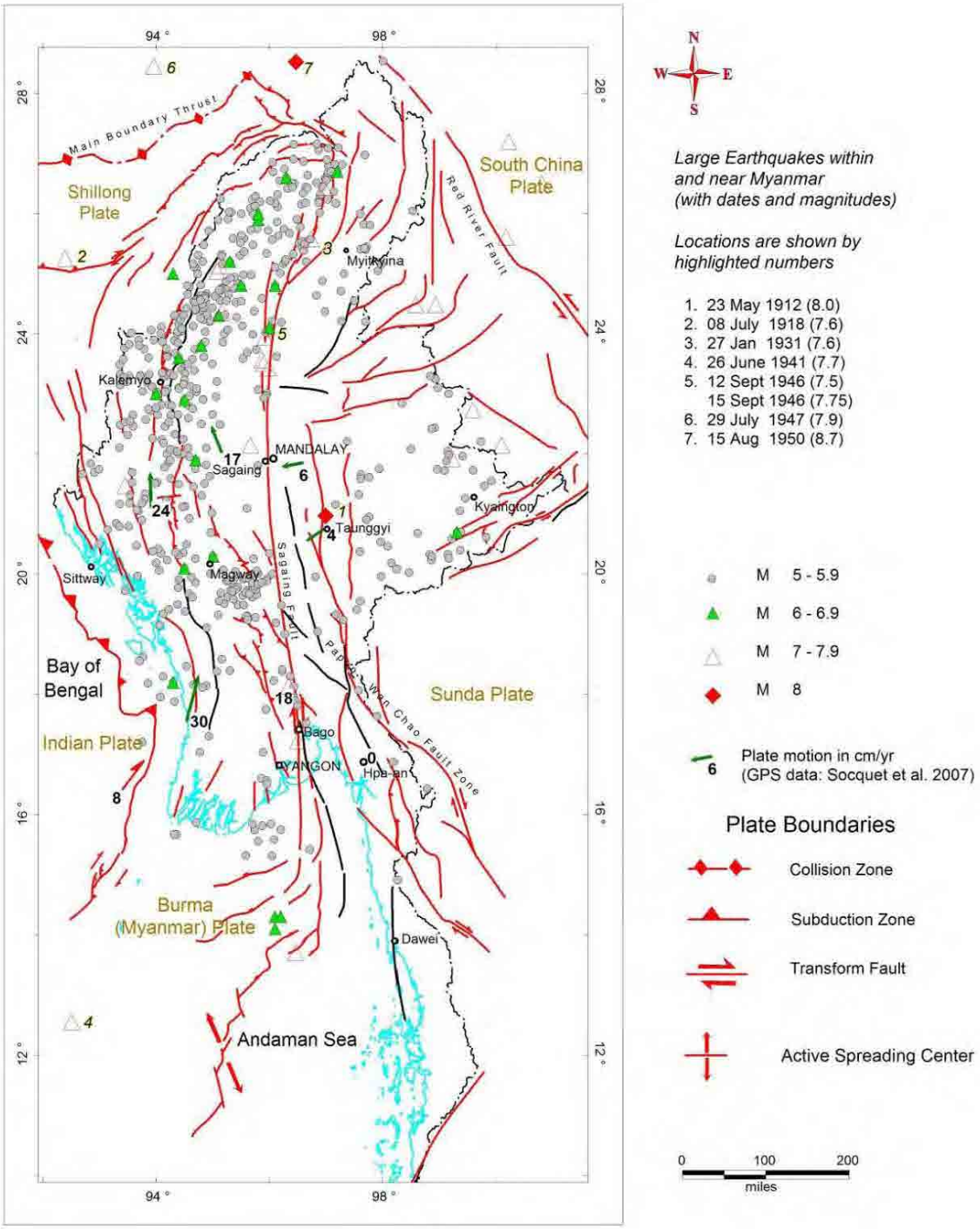


Fig. 1-03 Seismic structure map of Myanmar Source: Hazard Profile of Myanmar, July 2009

1-3 Environmental and Social Considerations

JICA has categorized the undesirable impact on the environment and society in this Project as level C (having little or minimal impact). The reason is that the facilities to be constructed in this Project will be built on YAU premises and any undesirable impact which the use and purpose of the facilities, or the development carried out in association with this Project, may have on the environment and society will be very limited. If the environmental standards in Myanmar are applied to such possible impact, it will not be of a level that is regulated by EIA or IEE.

However, the environmental and social considerations and countermeasures to be taken for the planned sites when implementing this Project are shown in the table 1-05.

Table 1-05 Environmental considerations and alleviating measures

Main Impacts	Act	Alleviating Measures	Japan Side	Myanmar Side
Waste	Residual soil disposal in foundation work Industrial waste in construction work	Check final treatment plant before start of work and segregation of waste	○	
Topography and Geology	Cut and embankment	Calculation of slope inclination based on geological survey, maintenance and protection of appropriate slope	○	
Noise and Vibrations	Operation of heavy machines in construction work	Establishment of appropriate time of operation	○	
Water Pollution	Waste water treatment/ Operation after handover of facilities (in research or practical work)	Adoption of waste water treatment method to meet the standards in Myanmar, separation of chemicals that cause water pollution	○	○
Accidents	Prevention of third-party accidents in construction work	Reinforcement of safety measures	○	
Bad Smell	Operation after handover of facilities (in research or practical work)	Reduction of bad smells by installing filters		○
Air Pollution Soil Contamination	Operation after handover of facilities (in research or practical work)	Separation and reduction of substances that cause air pollution and soil contamination		○
Items with little impact in this Project: Use of water, bio-/ecosystem, global warming, involuntary resettlement of residents, local economy including employment and means of livelihood, land use and use of local resources, social capital and social organizations such as local decision-making organizations, existing social infrastructure and social services, the poor/indigenous people/ethnic minorities, uneven distribution of damages and benefits, interests of the community, gender, etc.				

1-4 Global Issues

As described above, agriculture in Myanmar accounts for over 60% of the total labor population and nearly 30% of GDP. The main agricultural products are rice, sesame and legumes, and rice is the most important export. YAU is the only agriculture-specified university in Myanmar, from which a number of human resources are engaged in administration, related agencies, research and development and technical guidance in the agricultural sector. However, the existing facilities in the university are not designed for research and practical training and have become very superannuated in the nearly 30 years since their construction, but they cannot be rehabilitated yet.

The experimental equipment and instruments have also experienced physical and social deterioration and it cannot be denied that many of them are old-fashioned and in poor condition for research and practical exercises.

In these circumstances, to put the efforts in this Project in order, the facilities and experimental equipment and instruments to be developed in this Project are expected to boost the capacity of the human resources who will play a key role at political level in agricultural administration and support and complement the university functions and researches. On this assumption, this Project will play a part in providing indirect support for "reduction of poverty" as one of the 6 issues that the international community must tackle. In other words, if the facilities and experimental equipment and instruments to be developed in this Project are used effectively, it is expected that the capacity of the personnel who will be Myanmar's leaders will be built up under certain conditions and their knowledge and experience will enable them to implement policies and working systems for the poor, agricultural development, farming support, technical guidance, etc., thereby contributing to ① alleviation of the economic vulnerability of the poor; ② maintenance and improvement of incomes through sustainable agriculture; and ③ reduction of the chronic poverty that has continued over the medium and long term. Therefore, the "Design Policies and Basic Plan" will be based on these considerations and will reflect properly that this Project will be a cooperative project to support capacity-building of human resources in Myanmar.

Chapter 2. Contents of the Project

Chapter 2. Contents of the Project

2-1 Basic Concept of the Project

The Ministry of Agriculture and Irrigation (MOAI) adopted as one of its main agricultural policies the slogan, "the promotion of research and development of agriculture for the quality improvement and the production expansion". Based on the present conditions, the new Government is promoting the cultivation of human resources for agricultural development through training centers and higher education institutions and the modernization of these institutions for agricultural human resource education and training.

Of these institutions for agricultural human resource education, YAU is the only agricultural college in Myanmar that serves as a higher education institution for fostering officials of MOAI and agricultural engineers in the private sector. Under MOAI, the Central Agricultural Research and Training Center (CARTC) and Vegetables and Fruits Research and Development Center (VFRDC) operate as centers for accumulating expertise and technology as well as providing regular training courses to foster officials of MOAI as personnel who can teach agricultural technologies, under a training curriculum for each theme to educate and train farmers and extension workers from rural areas throughout the country. These human resource education programs will contribute to the spread of agricultural technologies, improvement of the quality of agricultural products and increase of crop yields for the agricultural development of Myanmar. On the other hand, the market economy that has advanced in recent years has diversified and advanced the needs of markets and producers for cultivation technologies to meet the diverse agricultural environmental conditions in Myanmar and the production of quality agricultural products with high market value. To respond to these needs, it is necessary to foster human resources to be engaged in technical development. However, the cultivation of such human resources is impeded by the fact that the equipment and instruments installed in the educational and training facilities have become dilapidated and are out of order.

This Project is intended to support the cultivation of agricultural human resources in Myanmar by renewal of the equipment and instruments and construction of facilities for research and practical training using the new equipment in YAU under the control of MOAI's Department of Agricultural Research (DAR) which has control of research institutes including the seed bank set up under Japan's grant aid, and the Department of Agriculture (DOA) which has control of CARTC and VFRDC which were set up under Japan's grant aid.

2-2 Outline Design of Japanese Assistance

2-2-1 Design Policy

Prior to the outline design, the requests from YAU were checked in field surveys. The requests for construction of facilities are as follows:

- Construction of a new Experiment and Lecture Building for the existing 9 departments
- Renewal of the existing library on the second floor of the Administration Building.

The scope of Japanese assistance is limited by the project scale including installation of the equipment. Therefore, the discussions with YAU on the details of assistance have reached mutual agreement that a

priority order should be set. As a result, the highest priority was placed on construction of the Experiment and Lecture Building and the second priority on construction of a new library from the viewpoint of the necessity and importance of the facilities.

As a result of assessment and examination of all the requests including the request for equipment, it was inevitable that a lower priority would be placed on the construction of the new library in this Project from the following perspectives: 1) the project scale gets larger than expectations of the Japanese side, and 2) the project purpose is to procure the equipment and construct facilities for research and practical training. For this reason, it was concluded that the construction of the new library as the second priority was excluded from the scope of assistance in this Project.

Based on the above discussions, the outline design was created and the items to be recommended for the Assistance Project (draft) were listed. The detailed course of the examinations and the guidelines that were subsequently output are described in detail below.

2-2-1-1 Facilities

(2) Site selection and layout plan

Three (3) construction sites were proposed by YAU for this Project, of which 2 sites were for the Experiment and Lecture Buildings and one site for the new library. YAU intended to divide the 9 departments into 2 sites for reasons of positional relation with the existing departments. Importance was attached to association with the existing facilities. For this purpose, the conditions of the construction sites as proposed by YAU (boundaries, positional relation with existing facilities, structures, feed-in equipment, size and form of each site, and ground conditions such as altitude and geology) were checked for selection of the sites. As a result, it was determined that the construction sites as proposed by YAU had no factors impeding the construction and operation of the facilities though it was necessary to work out a layout plan. Therefore, it was decided to implement the layout plan as intended by YAU.

In the layout plan, the following points were considered:

- Creating an appropriate layout plan taking into consideration the functional relation with the existing facilities of the departments, the flow lines and pathways of students and university staff.
- Making effective use of the sites through appropriate layout of the facilities
- Making sure to design the external space with comfort by bringing the open space together and maintaining tracts of green land

(3) Floor/flow line plan

When drawing up the floor/ flow line plan, a questionnaire and interviews with the representatives of the departments for which the facilities were to be constructed were conducted in order to confirm the needs and problems, because the modes of use are different depending on the curriculum and research themes of the departments. The results of the questionnaire and interviews were reflected in the outline design plan. In particular, the following points were considered in the floor/flow line plan:

- Considering the functions and research and practical items of each room based on the mode of use by each department in order to draw up a user-friendly floor/ flow line plan.

- Drawing up an easy-to-see floor plan by bringing the facility components together in each department.
- Providing evacuation routes in an easy-to-see manner and securing two-way evacuation routes as a rule.
- Securing flexibility for each room in an appropriate manner with consideration for various modes of use and probable functional changes.
- Arranging piping and cabling spaces in appropriate locations with consideration for horizontal and vertical connections and maintainability.

(3) Considerations for equipment design

- Considering control of the load on the building equipment by prevention of heat loss and gain.
- Considering the usage conditions to set the appropriate capacity of each facility including the number of persons to be admitted.
- Maintaining an appropriate room environment and considering the design and spatial character of each room in which lighting equipment, air conditioners and others are installed to meet its purpose of use.
- Designing easy-to-use fitting positions and types of switches and wall sockets with consideration for the users and methods of use depending on the layout of the experimental equipment in each room and its purpose of use.

(4) Considerations for costs and grades

- Considering the appropriate distribution of construction costs to the main body, finishing, equipment and exterior work of the building and the appropriate life-cycle cost of the building.
- Using materials whose quality, performance, construction method, prices, and marketability have been fully considered.
- Maintaining functionality and flexibility in the dimensions of the span arrangement, story height and external fittings and taking economic reasonableness into full consideration.
- Considering cost reduction by adoption of standardized building materials and energy-saving construction methods.

(5) Policy on natural environmental conditions

The natural conditions that are characteristic of Myanmar and past data are described in 1-2 Natural Conditions. Taking into general consideration the described natural conditions, the condition of the existing facilities, the use of the planned facilities, the surrounding environment and locations, as well as the initial costs and running costs, the design policy for the natural environment is as follows:

a) Use of wind (Adoption of natural ventilation system)

- Considering Myanmar's climatic conditions of high temperature and high humidity, a natural ventilation system that uses as little mechanical power as possible is adopted to reduce costs in the midterm.

b) Use of daylight

- Planning to obtain a good lighting environment by installing external corridors and eaves to provide shelter from intensive sunlight in the daytime and obtaining appropriate sunlight.

c) Consideration for direction of rain blowing in

- The prevailing wind blows rain from a south-westerly direction in the rainy season. Consideration should be given especially to apertures facing south-west to prevent rain from blowing in and to provide waterproofness.

d) Consideration for locality (installation of lightning arresters)

- Lightning occurs frequently during the change of seasons in Nai Pyi Taw, causing damage. Buildings of 2 or more stories are fitted with lightning arresters. In this Project, lightning arresters will be provided in accordance with local specifications.

(6) Policy on building/procurement conditions or special conditions/commercial practices of the industry

1) Building conditions (Permits, licenses and standards)

The building standards of Myanmar are legalized by the Development Committee that is set up in each district such as Yangon District, Nai Pyi Taw District or Mandalay District. The standards are mainly established for form regulations including district of use, building structure, floor height, lighting and stairs. There are no standards established by Myanmar, but various standards such as BS, JIS, ACI and CP are adopted. The firefighting standards are based on BS standards. When constructing a building, it is necessary to apply for a permit to the relevant authority and to acquire approval by attendance inspection of the completed building and specified works.

For a grant aid project for which an exchange of notes is made, however, it is unnecessary to take the above procedures for permits. In addition, the standards can be selected at the discretion of the assisting country. Based on the information, this Project was planned in accordance with the Building Standard Act, the Standard Specifications for Structures and JIS standards that are used in Japan.

2) Procurement conditions (Quality of local equipment and materials and difficulty of procurement)

The primary building materials including cement, aggregates, bricks, reinforcing bars and wood are produced in Myanmar, but other materials are imported from third countries (mainly Thailand, Singapore, Malaysia, China and Korea). Furthermore, there are many manufacturing plants of Japanese manufacturers in the above third countries and a considerable volume of products from Japanese manufacturers are available on the domestic market in Myanmar.

A logistics system for imported equipment and materials has been established in Myanmar and the materials can be procured easily through agents and on the market. The building equipment and materials for this Project will be locally procured in principle and some specific equipment and materials will be procured from Japan.

(7) Policy on use of local contractors

In the field surveys, the reconnaissance of some building sites (middle-ranking construction companies) and interviews with the company personnel were conducted to check the technical level (such as quality, working capacity and manpower) of the local construction companies. As a result, it was confirmed that Myanmar has medium level technical capacity in relative comparison with neighboring countries (Singapore and Thailand > Myanmar > Laos and Bangladesh).

The reason for such technical level is that many of the engineers interviewed on the building sites had experience studying or working in foreign countries and had a good command of English, and they have maintained a certain or higher level of quality in construction. Therefore, local middle-ranking construction companies are judged to have knowledge and skills in basic construction technology and they have the technical level and capacity necessary to implement the work for the grant aid project of Japan. Taking into account that this Project does not require any special engineering methods, this Project will be implemented based on a policy of making effective use of local construction companies as subcontractors under the control of a Japanese construction company as the contractor.

(8) Policy on operation and maintenance

The operation capacity of YAU is relatively high and an operation system has been established in each of its departments. Therefore, it is presumed that there will be no problems after completion of this Project if a small-scale review of personnel assignment is made to ensure more efficient operation within the existing operation framework in which each department is responsible for the operation and maintenance of their individual facilities.

In YAU, the Estate Engineering Department is responsible for the operation and maintenance of the university facilities. The staff consists of 16 personnel including one manager (electrical engineer) and the annual budget has been increased to about 480,000,000 ks from this year. However, some problems with the hardware maintenance of the buildings and facilities have been found from the present status of the existing facilities. For instance, the buildings have deteriorated and become dilapidated in rapid steps due to the high temperature and humidity of the climate and insufficient maintenance.

To solve these problems, this Project will ensure the maintenance of the facilities taking into consideration the weather resistance of the building materials, ease of maintenance and appropriate selection of building materials in order to reduce and optimize the maintenance costs. On the other hand, it is necessary for the YAU side to make more active efforts for the operation and maintenance of the facilities.

(9) Policy on grades of facilities

The policies on the facility construction plans, aimed at the project purpose, have been described above. The overall review of those policies reached the conclusions as summarized as follows:

- The Project will meet the climatic and natural features of Myanmar by suppressing the use of mechanical power taking into consideration the natural environmental conditions in the range of long-time vision.

- The Project will have diversity and flexibility to meet the characteristics of the facilities and the locality taking into consideration the economic, social and construction conditions of Myanmar, thereby contributing to creation of a good and sound environment.
- The Project will design an appropriate floor plan and room environment that allow the users and university staff to work efficiently, and will give consideration to making comfortable space.
- The Project will select the construction equipment and materials in consideration of secular changes and failures and for reduction of operation and maintenance costs.

(10) Policy on construction/procurement method and construction period

1) Construction method

In this Project, the facilities will be constructed by the construction method using a reinforced concrete rigid frame structure (RC structure) which is generally used for public buildings in Myanmar. The main walls will be made of bricks. The RC structure has excellent vibration resistance and durability and it is surely appropriate to adopt this construction method in this Project, but it will be very important to ensure quality control of the construction work, most of which will be done at the sites. Therefore, the construction plan and quality control plan will be created before starting each work in order to guarantee the proper quality of the work.

2) Procurement method

The construction equipment and materials will be procured according to the work schedule. The procurement plan will be drawn up by defining the carry-in time, quantity and volume accurately and arranging the procurement routes, transportation method and other conditions clearly.

3) Construction period

The construction period is closely associated with the deployment and cost of the construction machines, temporary construction materials/equipment and labor, and the construction control schedules of the constructors. Therefore, the construction period should be fixed taking the following points into consideration:

- Defining the mutual relation of work, such as whether to do any preceding work, whether to do some works in parallel, or whether to use some equipment for other work in order to reduce the materials on hand or reworking, and managing the main works with higher priority in order to start any work that will take a long time early.
- Standardizing the works for the entire construction period, and defining the critical path as one of the priority management items.
- Setting the construction period in an appropriate manner taking into consideration the preparatory period, clean-up period, various formalities, installation and dismantling periods of temporary works, and the procurement period of equipment and materials.

As a result of the above examinations, the construction period in this Project was set at 14.0 months.

2-2-1-2 Equipment

(1) Basic Policy

1) Yezin Agricultural University (YAU)

YAU is strongly tinctured as a college for educating public officials because most of the officials (except the engineering staff) of MOAI graduated from this university. In recent years, through the Minister's intention, YAU has desired to add courses and laboratories in new academic fields (such as biotechnology and food science), and to reinforce the Agricultural Engineering Department, aiming at creation of added value from the viewpoint of introduction of practical technology and response to industrialization.

Most of the facilities and equipment in the university have not been renewed since the 1970s and 1980s, and the basic experimental equipment (including microscopes) is too poor to enable basic lectures and practical work (for students to practice and check the events described in the textbooks themselves or formulate and prove a hypothesis) as is normal in higher education institutions. Therefore, it is deemed preferable that YAU acquires the minimum functions as a scientific university by providing it with experimental equipment (including basic equipment and other equipment on a level to allow graduates and professors to conduct research activities). In addition to the necessity of installing such equipment, the infrastructure (such as electricity, water supply and drainage) and departmental buildings with existing laboratories (a total of 9 departments: Agricultural Chemistry, Agricultural Economics, Plant Pathology, Entomology, Botany, Horticulture, Animal Science, Agronomy and Agricultural Engineering) have become dilapidated and need to be rehabilitated to install such equipment. In addition, the number and space of the rooms are insufficient to implement experimental courses. Thus, it is desired to construct new facilities to meet the layout of equipment and instruments, but not to rehabilitate the existing facilities.

YAU has local campuses in 8 districts in Myanmar (Yangon, Magway, Bago, Mandalay, Shan State and Mon State) and adopts the system in which agricultural exercises and training are provided to 4th grade students for one year. Originally, the request for equipment installation was made for the local campuses, but based on the intention of YAU to provide the necessary equipment by itself and concentrate on the main campus in this Project, and for the purpose of developing mechanized agriculture in Myanmar, this Project will install the necessary equipment in 9 departments on the main campus (including some laboratories and the Basic Education Department) and construct a new research/practical training building for the courses to meet the installed equipment level, ensuring more accurate experiments and practical training mainly for undergraduates.

2) DAR/Seed Bank

DAR is located on a site adjacent to YAU premises. The Seed Bank which was completed in 1990 under Japanese grant aid is on DAR premises. DAR has objectives such as ① development of high crop yields and high quality cereals; ② promotion of a cereal cultivation system and technology to bring high profits; ③ research and development of bioengineering; ④ distribution of high quality seeds to farmers, and ⑤ cultivation of agricultural human resources. The DAR staff consists of 639 members at present, comprising 18 doctors, 52 masters and 173 bachelors.

DAR provides courses including ① Rice; ② Corn and other cereals; ③ Wheat; ④ Seeds; ⑤

Legumes; ⑥ Industrial crops; ⑦ Horticulture; ⑧ Agronomy; ⑨ Soil Science ⑩ Water Utilization; ⑪ Bioengineering; ⑫ Plant Protection; and ⑬ Plant Genetic Engineering.

The Seed Bank was constructed more than 20 years ago and much of the equipment and instruments have deteriorated to an unusable level, and the remaining usable equipment is used with great care. The experimental equipment and instruments that are now operated have high universality and are put into frequent use in the daily work of the research staff.

They use a small quantity of equipment and instruments to continue their researches and make reports on the results in each department. The equipment and instruments are also used for the training of researchers. However, in reality, their activities are limited due to lack of the necessary equipment.

On the other hand, it is recognized that the technical level of the staff is so high that they fully understand the purposes of use and the operation methods of the equipment and they have the necessary knowledge and technology as well as much experience. Although the training is insufficient due to lack of equipment, training is continuously furnished to researchers. If this equipment is fully installed, their activities will be greatly improved and can be expected to contribute significantly to human resource education in Myanmar. Therefore, of the equipment that is out of order, it is planned to renew the types of equipment and instruments that have universality and high frequency of use.

Meanwhile, DAR has little experience in operation of advanced equipment and its maintenance and operation costs are low except for the Soil Science course. For the high-level and high-cost equipment, therefore, it is planned to check the background of the request, the level of the engineers and the conditions for appropriate operation and maintenance costs in order to select the relevant types of equipment.

3) Central Agricultural Research and Training Center (CARTC)

CARTC is located in Hlegu Township in Yangon District, about 58 km northwest of Yangon City. For CARTC, the construction of facilities and installation of equipment were implemented under Japanese grant aid in 1984 and the buildings, roads (approx. 14 ha) and fields (approx. 8 ha) are provided in an area of approx. 24 ha. The equipment, including experimental equipment and agricultural machines, was provided mainly for 3 laboratories (Soil Science Lab, Plant Protection Lab and Plant Tissue Culture Lab). CARTC consists of a Field Section, Training and Information Section, Farm Machinery Section and Administration and Account Section, and its staff consists of 55 members as of July 2012, including one Principal, one Deputy Principal, 8 Staff Officers, 12 Deputy Staff Officers and 7 Assistant Staff Officers. They are engaged in research of agricultural technology for increased production of agricultural products (including rice and vegetables) and undertake the training of officials from the Department of Agriculture and other agencies.

Most of the equipment and machines has exceeded the legal service life[1] (8 years), but many of them are still used at present. The experimental equipment that is operated has universality and high frequency of use, and the research officers use it in their daily work. It is recognized that the research officers fully understand the purpose of use and the operation method of the equipment and

[1] Taxation reform in 2008 (National Tax Agency, Ministry of Finance)

have the necessary knowledge and technology as well as much experience. Also, staff officers who use farm machinery are recognized to fully understand the mechanism and the operation method of the machinery and have the necessary knowledge and technology as well as much experience. If the necessary equipment is installed, it is also expected that training will be provided to a wide range of students and farmers and their activities will be improved, thereby contributing greatly to human resource cultivation in Myanmar. Therefore, of the equipment that is out of order, it is planned to renew the types of equipment which have universality and high frequency of use and meet the objectives of the Center.

4) Vegetables and Fruits Research and Development Center (VFRDC)

VFRDC is located in Hlegu Township in Yangon District, about 56 km northeast of Yangon City (at a location about 5 minutes by car from CARTC, as described above). As for this Center, the construction of facilities and installation of equipment were implemented under Japanese grant aid in 1986 and the buildings and roads (approx. 26 ha), vegetable field (approx. 4 ha), and fruit field (approx. 51 ha) were provided in an area of approx. 101 ha. The equipment, including experimental equipment was provided mainly for 5 laboratories (Vegetable Lab, Fruit Lab, Soil Nutrition Lab, Plant Protection Lab and Plant Tissue Culture Lab). VFRDC consists of these fields, 5 laboratories, and an administration department and other sections, and its staff consists of 43 members in total as of July 2012, including 2 Deputy Directors, 2 Officers, 16 Deputy Officers and 2 Laboratory Assistants. The Center is engaged in the production and distribution of high quality vegetable and fruit seeds, guidance and promotion of agricultural technology to farmers, production of vegetable seeds and research into fruits, aimed at agricultural improvement.

The equipment and machines of VFRDC have exceeded their legal service life (8 years), the same as that of CARTC, but much of the equipment and machines are still used. The experimental equipment and instruments that are operated have high universality and high frequency of use and the officers use them for their daily work. VFRDC dispatches instructors for the training courses held by CARTC. If the necessary equipment is installed, it is expected that the training furnished by the instructors and the activities of the research officers will be improved, thereby contributing to human resource cultivation in Myanmar. Of the equipment that is out of order, therefore, it is planned to renew the types of equipment that have universality and high frequency of use, and meet the objectives of the Center.

(2) Policy on Natural Environmental Conditions

The 2 planned districts for equipment installation (YAU and DAR are located in Nai Pyi Taw and CARTC and VFRDC in Hlegu Township in the vicinity of Yangon City) have a high-temperature and high-humidity climate. As for the equipment including microscopes with expensive lenses, it is necessary to simultaneously install desiccators for mold prevention or to take countermeasures on the facility side.

(3) Policy on Operation and Maintenance

1) Operation and maintenance capacity of YAU

About 20 staff members who obtained their degrees in Japan are on the register in YAU and several members are studying in Japan at present. These staff members who have studied in Japan are mainly the teachers who instruct the students, but the level of the other teachers is also high. The Administration Department, including the President's room, is well equipped and it is deemed that there are no problems with the capacity of equipment operation. On the other hand, it cannot be said that the budget for operation and maintenance is ample. Therefore, it is planned to examine the types of equipment that will require high maintenance and operation costs and check the backing of the budget, and not to install the equipment unless such budget backing is confirmed.

2) Implementing capacity of DAR

As described in the section on Basic Policy, many doctors, masters and bachelors are working at DAR and it is deemed that there are no problems with the operation of universal experimental equipment. However, it is supposed that the operation of high level equipment is difficult in the courses other than Soil Science. As the maintenance and operation costs are not high, it is planned to check the backing of the budget for maintenance and operation even if high-level equipment is procured for the Soil Science course, and if such budget backing is not confirmed, it is planned not to install such high-level equipment.

3) Implementing capacity of CARTC

3 masters and 7 bachelors (all of whom graduated from YAU) are on the register in CARTC and they are familiar with the operation of the necessary equipment through the training furnished by CARTC. The existing equipment is also operated with great care. Therefore, it is deemed that there is no problem with the implementing capacity to introduce the new equipment. On the other hand, the budget necessary for operation and maintenance is not ample. Therefore, it is planned to examine the equipment which requires high maintenance and operation costs and check the backing of the budget, and if such backing of the budget is not confirmed, it is planned not to install such equipment.

4) Implementing capacity of VFRDC

In VFRDC, 4 masters and 18 bachelors (all of whom graduated from YAU) are on the register and they are familiar with operation of the necessary equipment through the training furnished by VFRDC. As in CARTC, the existing equipment is operated with great care. Therefore, it is deemed that there is no problem with the implementing capacity to introduce the new equipment. On the other hand, the budget necessary for operation and maintenance is not ample. Therefore, it is planned to examine the equipment which requires high maintenance and operation costs and check the backing of the budget, and if such backing of the budget is not confirmed, it is planned not to install such equipment.

(4) Capacity for Operation and Daily Maintenance of Equipment

The general equipment in all the facilities in this Project will be operated by the teachers and research officers. Therefore, it deemed that there is no problem with their technical capacity. In addition, it is planned to provide initial training in operation of all types of equipment. On the other hand, for high-level equipment (such as the liquid chromatograph, gas chromatograph and atomic absorption

spectrometric instruments), it is planned to provide initial training in operation of such equipment for the necessary period of days.
Daily maintenance can be performed by the teachers and research officers themselves who use the equipment in all the facilities in this Project. If any problems such as failures occur, repair companies which specialize in physical and chemical instruments and which have their main office or branch offices in Nai Pyi Taw and Yangon are used to deal with such problems.

(5) Periodical Maintenance Capacity
The above repair companies which specialize in physical and chemical instruments also deal with periodical maintenance. However, high-level equipment is directly dealt with by the manufacturer and the repair of such equipment may be difficult if the manufacturer has no agent or depot in Myanmar.

(6) Policy on Procurement of Spare Parts
It is planned to examine the procurement of mainly regular replacement parts and consumable parts as required in the initial stage of operation and implement the initial maintenance of the provided equipment in an appropriate and smooth manner in order to enhance the availability of the equipment.
In Myanmar, repair companies which specialize in physical and chemical instruments deal with repairs, but the necessary spare parts may not be available at all times. Thus, it is estimated that the period in which such specialist repair companies can deal with spare parts is one year at most and it is planned to provide the spare parts for one year.

(7) Policy on Setting the Equipment Grades
As for the equipment, Japanese products which are basically excellent in terms of performance and quality will be procured. If any equipment is manufactured by only one company in Japan, alternative equipment equivalent to the Japanese product in performance and quality may be procured from any third country.

2-2-2 Basic Plan

2-2-2-1 Facility Developments

The discussion concerning the scale of the construction plan is described below (refer to fig 2-01) Since it has already been concluded that the construction of a library should not be included in the scope of the cooperation as mentioned above, construction of a library is not mentioned in the following.

(1) Site Plan and Layout Plan
1) Site 1
This site is located at the northeastern edge of the university campus. It is near the core facilities of the university, the University Head Office and classroom building block, and also adjacent to the Student Auditorium under construction. It is considered to be an appropriate site for the construction

of the practical work and experiment buildings due to the convenience of the location to the existing classroom buildings of the various departments. The site is trapezoid in shape with dimensions of 100 m east-west by 80 m north-south. There are a few trees on the site. The site has an elevation difference of approx. 2 m toward the northeast. The site is adjacent to the road to the University of Forestry and the Forestry Research Institute which are situated in an adjacent plot. However, there is a wall between the site and the road, and there is little automobile traffic on the road. Therefore, noise from the road is likely to be too minimal to be a problem.

2) Site-2

This site is located at the intersection of the trunk road separating the main campus and the experimental field of the university and the main access road to the main campus. It is located along the trunk road and at a symbolic site for the facility. The site is rectangular with dimensions of 100 m east-west by 120 m north-south. Since it has sufficient space and is located close to the four departments located in the field, this site is considered to be an appropriate site to construct the facilities for these departments. As the site is bordered by roads on two sides, it is easily accessible by vehicles.

1. Agricultural Chemistry
2. Agricultural Botany
3. Plant Pathology
4. Agricultural Botany
5. Agricultural Economics
6. Agronomy
7. Agricultural Engineering
8. Animal Science
9. Horticulture
10. Lecture Building Zone

A. Council Hall
B. Lecture Building
C. Canteen
D. District Hospital

a. Administration Building
b. Gymnasium
c. Lecture Hall
d. Lecture Hall

Fig. 2-01 Existing site plan

(2) Layout Plan

The facilities for the nine departments to be constructed in this Project will be constructed on two separate sites, Site-1 within the university main campus and Site-2 along the road in front of the university field. The facilities for four departments and common laboratories will be constructed on Site-1 and the facilities for the remaining five departments will be constructed on Site-2.

The table 2-01 shows the preferences of each department regarding the site and floor. These preferences were used in the preparation of the facility layout plan.

Table 2-01 Preferences of the departments regarding site and floor

	Dept. of Horticulture	Dept. of Animal Science	Dept. of Agricultural Engineering	Dept. of Agronomy	Dept. of Agricultural Chemistry	Dept. of Entomology.	Dept. of Botany	Dept. of Plant Pathology	Dept. of Agricultural Economics
Preferred site	Site 2	Site 2	Site 2	Site 2	Site 1	Site 1	Site 1	Site 2	Site 1
Preferred floor	First	No preference	First	Second	Second	No preference	No preference	No preference	No preference

1) Experiment and Lecture Building-1

In accordance with the preferences mentioned above, the facilities for the four departments, *i.e.* the Departments of Agricultural Chemistry, Agricultural Economics, Plant Pathology and Entomology, will be constructed as components of Experiment and Lecture Building-1. The block will consist of two two-story buildings and a separate one-story classroom building without water supply or sewerage facilities for the Department of Agricultural Economics. Since these four departments require the same experimental apparatuses and materials, four common laboratories will be constructed on the first floor of one of the two two-story buildings. The section plan in the figure 2-02 shows the locations of the facilities in the block.

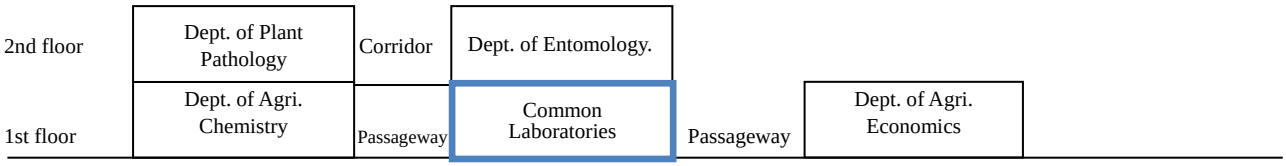


Fig 2-02 Section plan of Experiment and Lecture Building -1

2) Experiment and Lecture Building-2

The facilities for the four departments with experiment and lecture buildings on the field, *i.e.* the Departments of Horticulture, Animal Science, Agricultural Engineering and Agronomy, and the facilities for the Department of Botany will be constructed as Experiment and Lecture Building-2 (refer to Fig 2-03). The facilities for the Department of Botany will be constructed on Site-2, because it has facilities for practical training on the field which is located near Site-2 and it has a close relationship with the Department of Horticulture.

Of the five departments, the Department of Agricultural Engineering intends to use part of the new facilities as a workshop. Therefore, the facilities for this department will be constructed as a separate one-story building. The facilities for the Department of Animal Science will be located on the first floor of one of the two two-story buildings. Since it does not require as much space as the other departments, a conference room will be constructed on the same floor for common use by all the departments.

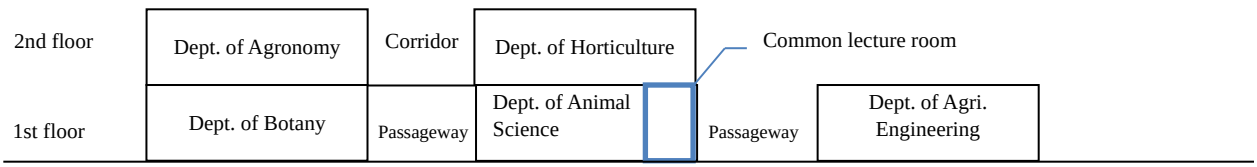


Fig.2-03 Section plan of the Experiment and Lecture Building on Site-2

(3) Architectural Design

1) Floor Plan

A study was conducted of the types and appropriate dimensions of the rooms required by each department following the procedures described below for the preparation of the floor plans.

i. Measurement of the existing lecture building of each department and a study of its use
ii. Distribution of questionnaires to and discussion with the nine departments concerned with this Project on the contents of the request of the Myanmar side for verification of the contents
iii. A study of each component of the facilities requested by each of the nine departments concerned
iv. Estimation of the appropriate dimensions

2) Discussion and Verification of Individual Contents of the Request for the Construction of Experiment and Lecture Buildings

As the nine departments concerned use different curricula and have different ways of using their facilities, the Japanese side requested the representatives of the departments to fill in a questionnaire on the individual contents of the request and held discussions with them to verify the contents. The tables 2-02 show the results of the verification.

Table 2-02 Verification of individual contents of the request for the construction of Experiment and Lecture Buildings

Department	Contents of the request		
【Agricultural Economics】	Problems of the existing facilities	Expected contents of facility construction	Required rooms (priority order)
	1. The number of existing lecture rooms is too small to provide the lectures required by the curriculum. 2. There is not enough space in the existing computer practice room.	1. The department would like to have a larger classroom with access to the Internet 2. The department would also like to have a PC room and a seminar/conference room for socio-economic analysis 3. When the new curriculum is adopted, the total number of students will be approximately 200, 40 to 50 students in each of the second to fifth years. In order to offer lessons effectively, a new classroom is required urgently.	PC room x 1, for 40 to 50 students (A) Meeting/conference room x 1, for 10 to 20 people (A) Professor's office x 1 (A) Associate professor's office x 1 (A) Senior Lecturer's office x 8 (B) Lecturer's office x 20 (B) Storage room x 1 (A)
Discussed and verified matters	a. Approx. 10 new staff members, including a professor and an associate professor, are expected to move to the new building. The planned staff room has sufficient space to accommodate them. Alternatively, the number of staff moving to the new building will be decided on the basis of the accommodation capacity of the planned staff room. b. The new experiment and lecture room to be constructed will be used as a computer room. Computer desks similar in size to those in the library will be installed in the room to accommodate approx. 50 students. c. The room designed as a storage room will be used as a supplementary classroom (with an accommodation capacity of 30 to 40 students)		

【Agricultural Chemistry】	Problems of the existing facilities	Expected contents of facility construction	Required rooms (priority order)
	1. The existing practical work room does not have enough space. 2. The existing facilities do not have ventilation fans for the laboratory or sewerage system.	1. It is desirable to provide the new facilities with an environment appropriate for experimental apparatuses, such as water supply and sewerage system.	Laboratory x 1 Cold room x 1 Staff room x 1 Storage room x 1
Discussed and verified matters	a. A storage room for the freezer (1.8 m x 1.8 m) and an independent storage room to store reference materials and samples will be constructed. b. Approximately six staff members (presumably including a professor and an assistant professor) are expected to move to the new building. Although the planned staff room has sufficient space to accommodate them, the number of staff moving to the new building will be decided on the basis of the accommodation capacity of the planned staff room. c. The possibility of gas generation in experiments shall be taken into consideration when designing the facility layout.		

【Plant Pathology】	Problems of the existing facilities	Expected contents of facility construction	Required rooms (priority order)
	1. The existing facilities are not appropriate for research activities because they are old and the roofs are damaged.	1. The department would like to have facilities which can be used as an appropriately functioning laboratory.	Laboratory x 1 Professor's office x1 Staff room x 1 Conference room x 1 Storage room x 1
Discussed and verified matters	a. An independent incubation room equipped with storage facilities and an independent storage room for equipment, reference materials and samples will be constructed adjacent to the experiment and lecture room. b. The exact number of staff members moving to the room prepared for administrative work in the new building has not been decided. However, it will be decided on the basis of the accommodation capacity of the provided room. c. The department will not require its own conference room, if a conference room for common use is provided.		

【Entomology】	Problems of the existing facilities	Expected contents of facility construction	Required rooms (priority order)
	1. The number of classrooms is too small. 2. The existing facilities are too old and dilapidated to be restored to a state which meets the requirements for providing students with practical lessons.	1. The department would like to have facilities sufficiently equipped for research activities.	Laboratory x 1 Professor's office x 1 Constant temperature chamber x 1 Staff room x 1 Storage room x 1
Discussed and verified matters	a. A space for installing a refrigerator and for its operation (about 2.7 m x 2.7 m) will be secured. b. An independent storage room will be required for the storage of equipment and samples. c. A room for staff members required for operation of the experiment and lecture room (They are expected to move to the new building with a professor and an assistant professor.) d. The department will not require its own meeting room.		

【Botany】	Problems of the existing facilities	Expected contents of facility construction	Required rooms (priority order)
	1. The existing facilities do not have sufficient space to conduct practical exercises. (The department has 90 students. They are divided into two groups and practice is provided to each group separately.) 2. The existing facilities are too old and dilapidated to be equipped with new equipment for practical exercises. 3. Because of the launch of a new course, the number of the students will increase by 45 in this school year. However, the department does not have the facilities to accommodate them. 4. There are not enough toilets for the students.	1. The department requires a safe laboratory in which the latest models of equipment required for experiments can be installed.	Laboratory x 1 (for 45 students) Professor's/Associate professor's office x 1 Staff room x 1 (for 9 staff members) Storage room x 1 Toilets
Discussed and verified matters	a. Space for installing a refrigerator and for operation and maintenance (about 1.8 m x 1.8 m) b. An independent storage room to store equipment and samples c. A room for staff members for operation of the experiment and lecture room (They are expected to move to the new building with a professor and an associate professor.) d. The department prefers the site near the experimental farm because it has facilities on the farm.		

【Agronomy】	Problems of the existing facilities	Expected contents of facility construction	Required rooms (priority order)
	1. The existing facilities were constructed approx. 30 years ago. Because of lack of maintenance, the condition of the facilities, especially those in which water is used, has deteriorated severely.	1. The department would like to have facilities that are sufficiently equipped for providing up-to-date practical lessons on farming technologies.	Laboratory x 1 Small lecture room x 1 Chief staff member's office x 1 Staff room x 2 Storage room x1 Toilets
Discussed and verified matters	a. Space for installing and operating a refrigerator (about 1.8 m x 1.8 m) b. An independent storage room to store equipment and samples c. A room for staff members for operation of the experiment and lecture room (About 10 staff members, including a professor and an assistant professor, are expected to move to the new building.) d. The room for common use to be constructed in another building will be used as a small conference room as the department does not have one. e. Toilets will be constructed in the common area.		

【Animal Science】	Problems of the existing facilities	Expected contents of facility construction	Required rooms (priority order)
	1. Because the existing facilities are seriously dilapidated, new facilities will have to be constructed. 2. Deterioration of the toilets is extremely severe. 3. Partitions in the existing facilities are not appropriate for practical lessons.	1. The department would like to have a practical work room in which various types of student practical lessons can be implemented efficiently.	Laboratory x 1 (for 60 students) Lecture room x 1 Lecturer's office x 2 Chief staff member's office x 1 Staff room x 1 Storage room x 1 Toilets
Discussed and verified matters	a. A staff room for two staff members who are expected to move to the new building will be constructed. b. A storage room with a scale similar to the existing one will be constructed. c. A room in the area assigned to the department will be used as a common room (*e.g.* for conferences) and shared with the other departments.		

【Agricultural Engineering】	Problems of the existing facilities	Expected contents of facility construction	Required rooms (priority order)
	1. The existing laboratory is too small for 50 students. The laboratory has no space to store teaching materials for practical lessons.	1. The department would like to have both a lecture room and a workshop.	Lecture room x 1 (for 50 students) Workshop x 1 Dean's office x 1 Lecturer's office x 1 Conference room x 1 Staff room x 1 Storage room x 1
Discussed and verified matters	a. A storage room to store relatively large teaching equipment b. Facilities to replace the extremely old and dilapidated existing facilities c. The department will not require its own meeting room as long as it can use a common meeting room. Therefore, a common room will be constructed in its area of the experiment and lecture building.		

【Horticulture】	Problems of the existing facilities	Expected contents of facility construction	Required rooms (priority order)
	1. The ceiling and windows of the existing facilities are damaged. 2. There is no permanent space for graduate students to conduct practical work. 3. The water supply and sewerage systems are not functioning. 4. Students cannot do physiological (post-harvest) experiments because of the lack of facilities.	1. The department would like to use the new facilities for studies in bioengineering. 2. The department would also like to make the facilities a place for the implementation of technical cooperation and other projects.	Various rooms required for tissue culture.
Discussed and verified matters	a. Four rooms corresponding to the different stages in tissue culture will be constructed. b. The staff room will require space for only two staff members required for maintenance of the facilities. c. Since the department does not have sufficient classrooms (especially for graduate students), it intends to use the common room (a room in the zone of the Department of Animal Science) as a supplementary classroom.		

The minimum requirement for facility construction deduced from analysis of the individual contents of the request mentioned above is “a room with a size appropriate for the required laboratory work and practice, or a room equipped appropriately for laboratory work and practice.” “A storage (preparation) room and a staff room as facilities to support the above-mentioned activities” are indispensable components of the facilities.

A [research and practical work room + storage (preparation) room + staff room] will be considered as the basic components of facility construction in this Project. Other types of rooms, such as conference rooms, shall be incorporated into this basic component where the need for such rooms exists (refer to fig.2-04).

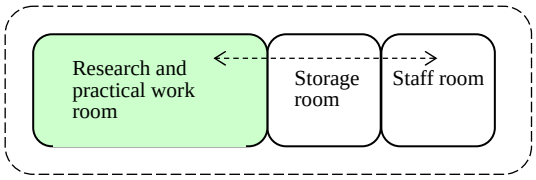


Fig. 2-04 Basic facility components of each department

3) Study of the Facility Components for the Nine Departments Concerned and Calculation of the Appropriate Dimensions of Various Rooms

The next step was to decide the dimensions and areas of the components of each department. The Project Team has concluded that it is best to “standardize” each component so that equal space is allocated to each department in this Project, because this impartial distribution of the area and, thus, the project budget will eliminate the possibility of some departments with an area smaller than the others considering themselves discriminated against.

The study of the facility components for each department was conducted elaborately since the results would be an important factor forming the basis for the zoning and span arrangement in the layout planning.

The appropriate scales of the facility components in each department unit deduced from the above-mentioned discussions, verification and study are described below.

The final decision on the dimensions of the facilities in the department units have been made by estimating the appropriate dimensions of the experiment and practical work room from the equipment layout, taking into consideration the design dimensions of the existing facilities in YAU and the numbers of students in the classes.

4) Dimensions and Floor Plan of Research and Practical Work Room

A research and practical work room for 50 students, the number of students in a class derived from the study on the actual use of lecture rooms, with the dimensions determined as mentioned below (refer to fig. 2-05) will be used as the basic design in this Project.

Six laboratory benches (2.4 m in width x 1.2 m in depth; 8 or 9 students per bench) shall be installed in the research and practical work room. A distance of approx. 1.5 m shall be allowed between the laboratory benches and the laboratory sink attached to the wall. A distance of approx. 1.5 m and 1.2 m shall be allowed between adjacent laboratory benches on the long side and short side, respectively,

to ensure sufficient space for the movement of students. Since the room is long, a wooden platform will be installed for lecturers as in the existing classrooms.

Fifteen meters, consisting of 7.5 m/span x 2 spans, and 8.5 m were selected as the lengths of the long and short sides of the room, respectively, in order to accommodate furniture with the required space allowances in-between mentioned above and to conform to the structural design. Therefore, the research and practical work room will have an area of 127.5 m^2 (= 8.5 m x 15 m). Although this figure is about 10 % smaller than the floor areas of the existing lecture rooms which are 126 – 140m^2 (= 9 to 9.5 m x 14 to 15 m), a functional and efficient educational environment can be realized in this room by efficient furniture arrangement.

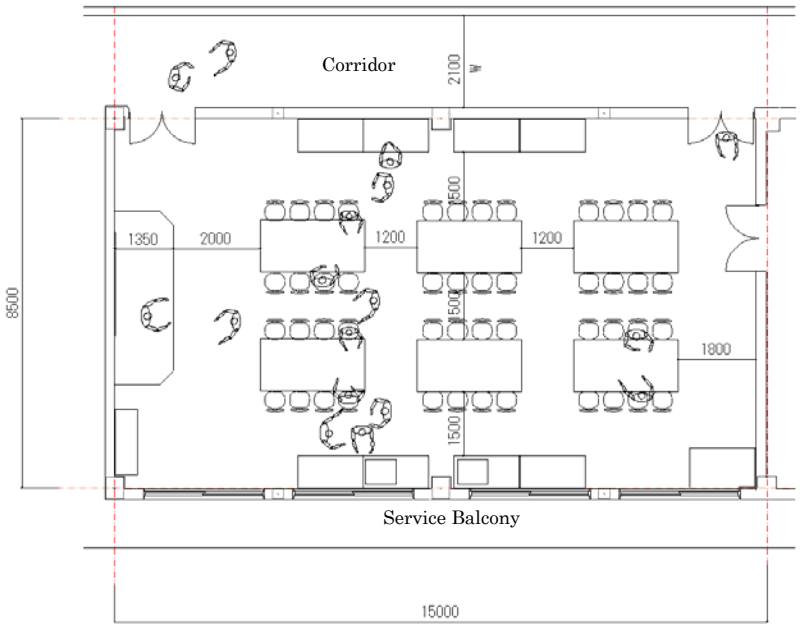


Fig 2-05 Floor plan of the research and practical work room

5) Floor Plans of Areas for the Departments Concerned

Both the storage/preparation room and staff room will have a span of 7.5 m. Therefore, the dimensions of the entire component will be 30 m (= 7.5 m/span x 4 spans) on the long side by 8.5 m on the short side. The following describes the room arrangement and the floor plan of the area for each of the nine departments concerned, finalized in the discussions between the Project Team and the representatives of the departments.

a) Department of Agronomy

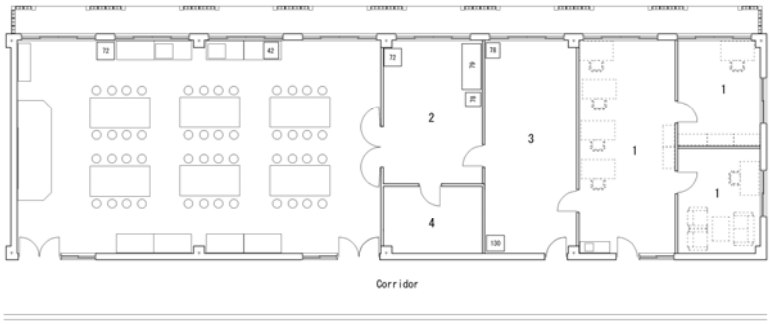
A research and practical work room, a storage/preparation room and a staff room will be constructed on the floor for the Department of Agronomy. A partitioned freezer will be constructed in the storage/preparation room (refer to fig. 2-06).

1. Staff room, 2. Storage/preparation room, 3. Research and practical work room

Fig. 2-06 Floor plan of the area for the Department of Agronomy

b) Department of Botany

A research and practical work room, a storage/preparation room and a staff room will be constructed on the floor for the Department of Botany. A partitioned freezer will be constructed in the storage/preparation room (refer to fig 2-07).



1. Staff room, 2. Storage, 3. Research and practical work room

Fig.2-07 Floor plan of the area for the Department of Botany

c) Department of Agricultural Chemistry

A research and practical work room, a storage/preparation room and a staffroom shall be constructed on the floor for the Department of Agricultural Chemistry. A partitioned freezer room will be constructed in the storage/preparation room (refer to fig. 2-08).

1. Staff room, 2. Storage/preparation room, 3. Research and practical work room

Fig.2-08 Floor plan of the area for the Department of Agricultural Chemistry

d) Department of Plant Pathology

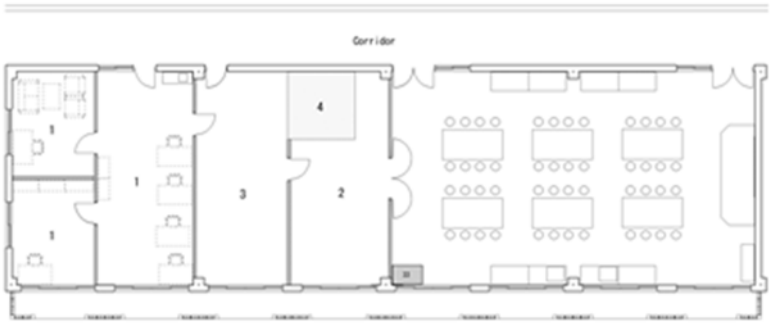
A research and practical work room, a storage/preparation room and a staff room will be constructed on the floor for the Department of Plant Pathology. A partitioned freezer room will be constructed in the storage/preparation room (refer to 2-09).

1. Staff room, 2. Preparation room, 3. Storage, 4. Research and practical work room

Fig.2-09 Floor plan of the area for the Department of Plant Pathology

e) Department of Entomology and Zoology

A research and practical work room, a storage/preparation room and a staff room will be constructed on the floor for the Department of Entomology and Zoology. A partitioned constant temperature chamber will be constructed in the storage/preparation room for the storage of specimens (refer to fig. 2-10).

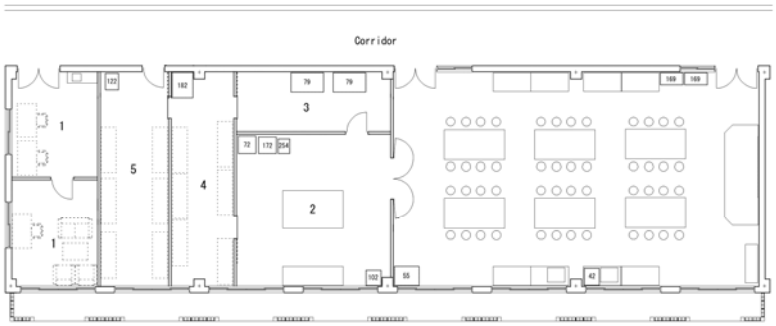


1. Staff room, 2. Storage, 3. Research and practical work room

Fig. 2-10 Floor plan of the area for the Department of Entomology and Zoology

f) Department of Horticulture

A research and practical work room, a storage/preparation room and a staff room will be constructed on the floor for the Department of Horticulture. The research and practical work room will be for 30 students and will be equipped with a freezer. Four laboratories, one for each of the four steps in tissue culture (preparation of culture media, sample preparation, culture and anaerobic process), will be constructed adjacent to the research and practical work room (refer to 2-11).

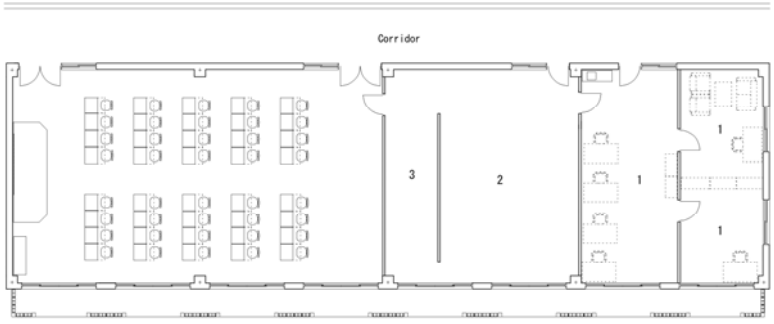


1. Staff room, 2. Media preparation room, 3. Preparation room, 4. Culture room, 5. Anaerobic room, 6. Research and practical work room

Fig.2-11 Floor plan of the area for the Department of Horticulture

g) Department of Agricultural Economics

The research and practical work room of the Department of Agricultural Economics will be constructed as a PC room (for about 50 students). As an associated facility, a room which can be used for workshops and conferences is included in the plan (refer to 2-12).



1. Staff room, 2. Conference room, 3. PC room

Fig. 2-12 Floor plan of the area for the Department of Agricultural Economics

h) Department of Animal Science

A research and practical work room, a storage/preparation room and a staff room will be constructed on the floor for the Department of Animal Science. As the area required by the department is smaller than that of the other departments, a room for common use by all the departments will be constructed in an area occupying a quarter of the floor (refer to fig 2-13).

1. Staff room, 2. Storage/preparation room, 3. Common lecture room, 4. Research and practical work room

Fig.2-13 Floor plan of the area for the Department of Animal Science

i) Department of Agricultural Engineering

A research and practical work room, a storage/preparation room and a staff room will be constructed on the floor for the Department of Agricultural Engineering. Workshop space will be provided in the storage/preparation room adjacent to the research and practical work room (refer to fig 2-14)

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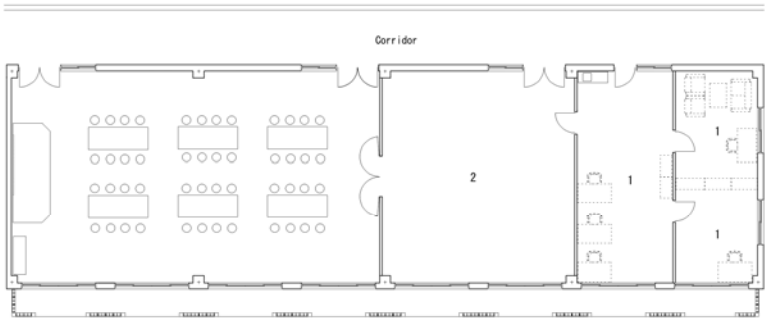

1. Staff room, 2. Storage/preparation room, 3. Research and practical work room

Fig.2-14 Floor plan of the area for the Department of Agricultural Engineering

The table 2-03 shows the floor areas by room and by department.

Table 2-03 Floor areas of the rooms in the student laboratories by department

【Experiment and Lecture Building-1】

Floor	Department	Room	Total area (m^2)		Criteria used and notes
			Room area (m^2)	Department subtotal	
1st	Agricultural Chemistry	Research and practical work room	127.5	255.1	Number of students in practice and furniture arrangement
		Cold storage room	31.9		1.8 m x 1.8 m space for freezer and storage facility
		Storage/preparation room	31.9		3.75 m x 8.5 m
		Staff room	63.8		Number of staff members required for operation and maintenance of the planned experiment and lecture room

	Common Laboratories	Laboratory-1	63.8		7.5 m x 8.5 m
		Laboratory-2	63.8		7.5 m x 8.5 m
		Laboratory-3	63.8		7.5 m x 8.5 m
		Laboratory-4	63.7	255.1	7.5 m x 8.5 m
	Agricultural Economics	PC room	127.5		Computer lecture room for 50 to 60 students
		Multi-purpose room	63.8		7.5 m x 8.5 m
		Staff room	63.8	255.1	Number of staff members required for operation and maintenance of the planned experiment and lecture room
	Miscellaneous (Common use area)	Stairway-1	21.7		3.5 m x 6.2 m
		Stairway-2	21.7	43.4	3.5 m x 6.2 m
		Toilet-1	23.8		2.8 m x 8.5 m
		Toilet-2	23.8	47.6	2.8 m x 8.5 m
		Corridors/passageways	296.6	269.6	All corridors and passageways including roofed parts
		Electricity/machine room	56.3		In accordance with the locations of water tanks and machines
	Subtotal: 1st floor ①			1182.2	
2nd	Plant Pathology	Research and practical work room	127.5		Number of students in practice and furniture arrangement
		Cold storage room	31.9		Installation of a laminar flow cabinet and sinks
		Storage/preparation room	31.9		For storage of equipment
		Staff room	63.8	255.1	Number of staff members required for operation and maintenance of the planned experiment and lecture room
	Entomology	Research and practical work room	127.5		Number of students in practice and furniture arrangement
		Constant temperature and humidity chamber room	31.9		2.7 m x 2.7 m space for constant temperature and humidity chamber and accessory storage facility
		Storage/preparation room	31.9		For storage of equipment and specimens
		Staff room	63.8	255.1	10 staff x 2.5 m^2
	Miscellaneous (Common use area)	Stairway-1	21.7		3.5 m x 6.2 m
		Stairway-2	21.7	43.4	3.5 m x 6.2 m
		Toilet-1	23.8		2.8 m x 8.5 m
		Toilet-2	23.8	47.6	2.8 m x 8.5 m
		Corridors/passageways		178.4	All corridors and passageways including roofed parts
	Subtotal: 2nd floor ②			779.6	
Total (①+②)				1961.8	

【Experiment and Lecture Building-2】

Floor	Department	Room	Total area (m^2)		Criteria used and notes
			Room area (m^2)	Department subtotal	
1st	Botany	Research and practical work room	127.5		Number of students in practice and furniture arrangement
		Cold storage room	31.9		1.8 m x 1.8 m space for freezer and storage facility
		Storage/preparation room	31.9		3.75 m x 8.5 m
		Staff room	63.8	255.1	Number of staff members required for operation and maintenance of the planned experiment and lecture room
	Animal Science	Research and practical work room	127.5		7.5 m x 8.5 m
		Storage/preparation room	63.8		
		Staff room	25.3		7.5 m x 3.5 m
		Multi-purpose room	37.5	255.1	7.5 m x 5.0 m
	Agricultural Engineering	Research and practical work room	127.5		Computer lecture room for 50 to 60 students
		Multi-purpose room	63.8		7.5 m x 8.5 m
		Staff room	63.8	255.1	Number of staff members required for operation and maintenance of the planned experiment and lecture room
	Miscellaneous (Common use area)	Stairway-1	21.7		3.5 m x 6.2 m
		Stairway-2	21.7	43.4	3.5 m x 6.2 m
		Toilet-1	23.8		2.8 m x 8.5 m
		Toilet-2	23.8	47.6	2.8 m x 8.5 m
		Corridors/passageways	296.6	269.6	All corridors and passageways including roofed parts
		Electricity/machine room	56.3		In accordance with the locations of the water receiving tanks and machines
	Subtotal: 1st floor ①			1182.2	
2nd	Agronomy	Research and practical work room	127.5		Number of students in practice and furniture arrangement
		Cold storage room	31.9		1.8 m x 1.8 m space for freezer and storage facility
		Storage/preparation room	31.9		For storage of equipment
		Staff room	63.8	255.1	Number of staff members required for operation and maintenance of the planned experiment and lecture room
	Horticulture	Research and practical work room	127.5		Number of students in practice and furniture arrangement
		Workshop	31.9		2.7 m x 2.7 m space for constant temperature and humidity chamber and accessory storage facility
		Staff room	9.3		For storage of equipment and specimens
		Clean bench room	22.5		Installation of a laminar flow cabinet
		Culture room-1	31.9	255.1	3.75 m x 8.5 m

		Culture room-2	31.9		3.75 m x 8.5 m
	Miscellaneous (Common use area)	Stairway-1	21.7	43.4	3.5 m x 6.2 m
		Stairway-2	21.7		3.5 m x 6.2 m
		Toilet-1	23.8	47.6	2.8 m x 8.5 m
		Toilet-2	23.8		2.8 m x 8.5 m
		Corridors/passageways		178.4	All corridors and passageways including roofed parts
	Subtotal: 2nd floor ②			779.6	
Total (①+②)				1961.8	

(4) Cross Section Plan

A cross section plan appropriate for the local environmental conditions and with little environmental load which enables effective functioning of the buildings, facilities and equipment was prepared (refer to fig. 2-15).

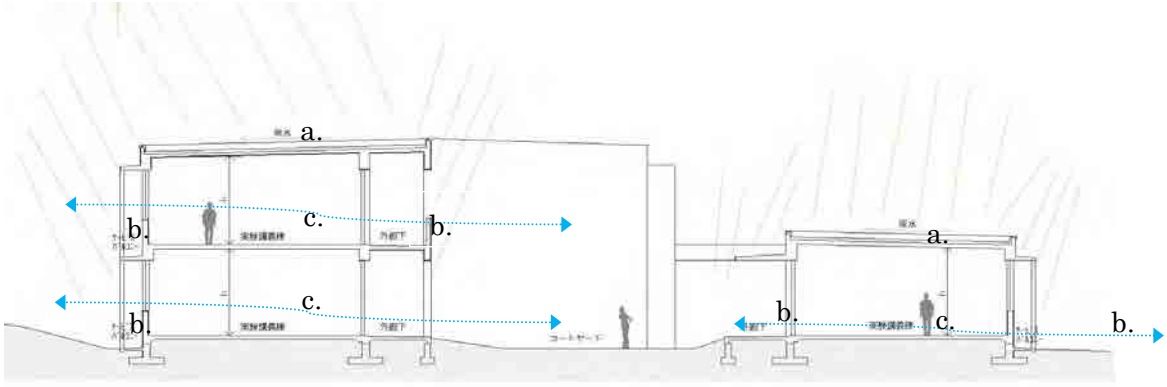

Fig.2-15 Cross section plan drawing

a. A construction method incorporating the external insulation method which prevents radiant heat on the roof surface created by strong solar radiation during the dry season from increasing the room temperature and waterproofing work will be used for the construction of the roofs.

b. In order to prevent solar radiation in the dry season and rainwater during occasional storms in the rainy season from entering the buildings, eaves will be constructed above the openings in the external walls.

c. Fixtures at the openings in the external walls shall have small windows for ventilation in their top parts in order to facilitate natural ventilation inside the buildings and to reduce the load on the mechanical air-conditioning systems.

(5) Structural Design

The natural conditions and the results of geological surveys at the construction sites were analyzed and characterized for structural planning and a structure design which would enable the construction of structures which would be safe against various types of loads and would satisfy various functional requirements for the elimination of hindrance to their use at a reasonable cost was prepared. It was

decided that RC rigid frames widely used in Myanmar should be adopted as the structure of the building to be constructed and that 8.5 m x 7.5 m should be the basic span arrangement, on the basis of the results of the studies of the practical lessons provided in the research and practical work rooms and the equipment layout plan. It was also decided to use independent footing as the form of the foundation and replace the natural ground below the foundation with gravel in order to reinforce the soil bearing power of the ground.

The allowable stress calculation method used in Japan was used for the structural calculation. The basic requirements for the structural design are as follows:

Span arrangement	: 7.5 m × 8.5 m
Story height	: 3.5 m
Seismic force	: 0.13 (base shear coefficient)
Loads, etc.	: Japanese Design Standards are to be followed
Reinforcement bars	: SD295A, SD345 (JIS Standards)
Design strength of concrete	: 24 N/mm^2 (quality control strength, 27 N/mm^2)

(6) Facility Plan

1) Electric Facilities

a) Power Receiving System

There are overhead power lines providing low-voltage electric power close to the construction site of Experiment and Lecture Building-1. Therefore, power lines will be extended from an electric pole near the site to provide electric power to the site.

While there are single-phase two-line aerial power lines near the construction site of Experiment and Lecture Building-2, there are no three-phase three-line power lines nearby. Taking into consideration the reduction in voltage of the power transmission cable and cost-efficiency, it was decided that power transmission lines should be extended from a power plant near the site and the high-voltage power transmitted through the lines should be transformed into low-voltage electric power by a transformer to be installed on the site.

b) Power-Receiving and Substation Facilities

The power receiving system shall have a generator because of the low reliability of the power distribution lines of the power supplier and as a measure against power outages. The required capacities of the power-receiving/substation facilities was estimated by calculating the load system capacity from the load density decided on the basis of usage, purpose and rating of the facilities and maximum power demand using demand factors estimated from the operation patterns of the load systems. The parameters used for estimation of the capacity of the power-receiving and substation facilities are in the table 2-04:

Table 2-04 Load system capacities

Load system	Experiment and Lecture Building-1	Experiment and Lecture Building-2	Demand factor (%)
Lighting	10.99KVA	10.89 KVA	0.8
Wall sockets	5.46KVA	5.10 KVA	0.45
General power supply (pumps, etc.)	0.88 KVA	0.88 KVA	0.5
Power supply to the air conditioning systems	40.33 KVA	40.35 KVA	0.8
Ventilation fans, etc.	1.06 KVA	0.82 KVA	0.7
Equipment, etc.	8.85 KVA	9.30 KVA	0.7
Total	67.56 KVA	67.34 KVA	66

Estimation of the power-receiving and substation facilities (kVA) in Experiment and Lecture Building-1

The following equation shall be used for estimation of the capacity of the power-receiving system.

$$Pr = \Sigma \left[\frac{P}{Pf \times (\eta \times 1/100)} \right] \times \frac{Df}{100} \times \frac{1}{F}$$

Where, Pr : Power-receiving capacity
P : Total capacity of installed load systems (67.56)
Pf : Power factor of the load systems (80%)
H : Efficiency of the load systems (90%)
Df : Demand factor (66 %)
F : Diversity factor (1.0)

The above-mentioned equation gives 50.00 kVA as the capacity of the power-receiving system (Pr) of Experiment and Lecture Building-1. Since Experiment and Lecture Building-2 is expected to have load systems similar to Experiment and Lecture Building-1, the total capacity of the power-receiving facilities in this Project is estimated at 100.00 kVA.

c) Independent Power Generation System

The load systems requiring a backup power supply from the generators are the lighting and wall sockets in the staff room, water pumps, experimental equipment (refrigerators, freezers, constant temperature chambers and incubators) and fire prevention equipment. A 30 kVA independent power generator will be installed in Experiment and Lecture Buildings-1 and -2.

d) Lighting and Wall Sockets

YAU has no classes or lectures during the night. Therefore, the number of lighting fixtures to be installed was decided on condition that the lighting fixtures of the direct lighting system are used to supplement daylight illuminance during the daytime. Type BF three-pin wall sockets (BS 1363) widely used in Myanmar will be installed as standard sockets.

e) Fire Alarm System

A smoke detector will be installed in approximately every 75m^2 of the planned facilities. A control panel will be installed in the staff room on the first floor and integrated panels will be installed on the corridors. An ABC fire extinguisher will be installed in each research and practical work room and corridor for emergency firefighting.

f) Lightning Arresting System

A roof-top lightning conductor will be installed on the parapet of each building.

g) Communication Facilities

The practical work room of the Department of Agricultural Economics on the first floor of Experiment and Lecture Building-1 will be designated as a free-access floor and floor LAN outlets will be installed in the room. Wall LAN outlets will be installed in the staff rooms. As it was decided that the Myanmar side would be responsible for the installation of outdoor communication lines, the scope of this Project will include installation of communication cables and conduits inside the buildings and the external walls.

2) Water Supply, Sewerage and Sanitation Facilities

a) Water Supply System

A pumping system will be used for the water supply in this Project. In this system, water diverted from the main water pipe on the university campus and stored in water receiving tanks will be pumped to the facilities to be constructed in this Project by booster pumps. The pressure of the pressurized water pumped to the facilities will be adjusted to a level appropriate for the intended use by pressure reducing valves and the depressurized water delivered to the places of use. The capacity of the water receiving tanks was estimated from the number of users of the facilities, the average volume of water used by each user and the total floor area of the facilities. The parameters used in estimation of the required capacity of the water receiving tanks are described below:

Volume of water supply per day (Qd) = (Total floor area) x (unit water supply volume) x (correction factor)
Total floor area ≈ 1,700 m^2
Unit water supply volume: 4L/m^2 (Air-conditioning and Sanitation Technology Data Book)
Correction factor: 60 %
Qd = 4,080 L/day → 4.0 ton

or

Volume of water supply per day (Qd) = (number of users: 250 people) x (average volume of water used by each user: 15 L)
Qd = 3,570L/day → 4.0 ton

On the basis of the results of the estimation mentioned above, 4.0 tons was adopted as the capacity of each water-receiving tank in the facility plan.

The specifications for the booster pumps were decided by estimating the water supply volume from the water supply load unit numbers and water pressure required for the water supply using the piping head.

b) Wastewater and Gray Water

Wastewater will be treated using solid-liquid separation by sedimentation and the water-purifying reaction of aerobic and anaerobic bacteria for sanitary treatment of wastewater and environmental protection. Treated wastewater will be allowed to infiltrate directly into the ground through infiltration tanks. However, the structure of the infiltration tanks shall also allow pumping of treated wastewater.

The capacity of the septic tanks was estimated as mentioned below, in accordance with the "Standards for Estimation of the Number of People Whose Waste will be Treated in a Septic Tank by Type of Building."

$0.25P = 0.25 \times 250/2 = 31.25$ (tanks for 30 people)

= A tank with a capacity of at least 15 m^3 at each site (as septic tanks are to be installed at two locations for each Experiment and Lecture Building).

Gray water will be discharged directly into the infiltration tanks through the drainage pipes connected directly to the infiltration tanks, without being treated in the septic tanks.

c) Drainage of Rainwater

Rainwater that falls on the roofs and roads will be drained directly into the existing gutters through gutters and storm-water inlets to be constructed in this Project.

3) Air-conditioning and Ventilation Systems

Independent wall-mounted air-conditioners will be installed in each research and practical work room and staff room. The air conditioning load calculation method was used for estimation of the required cooling capacities of the air-conditioners in order to select those with appropriate performance.

(7) Construction Material Plan

Construction materials and equipment to be used in this Project shall be those procurable in Myanmar. The basic policy for selection of the materials is to select materials for a finish similar to the finish of the existing lecture buildings and practical work facilities in YAU.

The table 2-05 and 2-06 shows the finish of the main parts of the buildings in this Project.

Table 2-05 Exterior finish

		Finishing method	Reason for selection of the method
Roofs		Asphalt heat insulation and waterproofing of protective concrete surface leveled with trowels	As local standard methods had problems in quality and durability, asphalt waterproofing was adopted.
Pillars and beams		EP finish (for exterior surfaces)	To follow the specifications of the existing facilities
Walls		EP finish (for exterior surfaces) on mortar surface	ditto
Corridors and balconies		Mortar finished with steel trowels with application of hardener	To use hardener as a finishing material to prevent cracking of the mortar
Eaves	Upper surfaces	Membrane waterproofing	To use membrane waterproofing in consideration of the climate in Myanmar
	Lower surfaces	EP finish (for exterior surfaces)	To follow the specifications of the existing facilities
Fixtures	Windows	Aluminum sashes (to be procured in Japan)	Watertightness of the windows cannot be guaranteed with locally available aluminum sashes.
	Doors	Steel sashes (to be procured in Japan)	To use sashes made in Japan for better precision and durability

Legend
EP: Abbreviation for synthetic resin emulsion paint
CSB: Abbreviation for non-asbestos calcium silicate board

Table 2-06 Interior finish

Room		Finishing method	Reason for selection of the method
Research and practical work room	Ceiling	Repaired fair-faced concrete with EP coating	To follow the specifications of the existing facilities
	Wall	Mortar finish with EP coating	ditto
	Base Board	Mortar joint with EP coating	ditto
	Floor	Concrete leveled with trowels	The floors of the existing facilities are finished with mortar. However, it was decided to use trowel finish in order to prevent cracking of the floors.
Preparation/ storage room	Ceiling	Repaired fair-faced concrete with EP coating	To follow the specifications of the existing facilities
	Wall	Mortar finish with EP coating	ditto
	Base Board	Mortar joint with EP coating	ditto
	Floor	Concrete leveled with trowels	The floors of the existing facilities are finished with mortar. However, it was decided to use trowel finish in order to prevent cracking of the floors.
Staff room	Ceiling	T-bar suspension ceiling with PB surface and EP coating	To follow the specifications of the existing facilities
	Wall	Mortar finish with EP coating	ditto
	Base Board	Mortar joint with EP coating	ditto
	Floor	Concrete leveled with trowels	The floors of the existing facilities are finished with mortar. However, it was decided to use trowel finish in order to prevent cracking of the floors.
Toilet	Ceiling	CSB with EP coating	To follow the specifications of the existing facilities
	Wall	Porcelain tile facing	ditto
	Base Board	Porcelain tile facing	ditto
	Floor	Porcelain tile facing	ditto

Staircase	Ceiling	Repaired fair-faced concrete with EP coating	To follow the specifications of the existing facilities
	Wall	Mortar finish with EP coating	ditto
	Base Board	Mortar joint with EP coating	ditto
	Floor	Mortar finished with steel trowels	ditto
Machine room/Electricity room	Ceiling	Repaired fair-faced concrete with EP coating	To follow the specifications of the existing facilities
	Wall	Mortar finish with EP coating	ditto
	Base Board	Mortar joint with EP coating	ditto
	Floor	Concrete leveled with trowels	The floors of the existing facilities are finished with mortar. However, it was decided to use trowel finish in order to prevent cracking of the floors.

Legend
EP: Abbreviation for synthetic resin emulsion paint
CSB: Abbreviation for non-asbestos calcium silicate board

2-2-2-2 Equipment

(1) Overall Plan

All the equipment to be procured in this Project is for use in the laboratories/practical work rooms and experimental fields of the university and research institutions. The policy for the selection of equipment for each institution is described in the following.

1) Equipment to be procured for YAU

i. Priority Rank A: Educational equipment and basic experimental equipment required for the education of YAU undergraduate students

ii. Priority Rank B: Equipment required frequently by graduate students and teaching staff of YAU for their studies, excluding equipment requiring highly sophisticated maintenance technology or high maintenance costs

iii. A deliberate study shall be conducted of procurement of general-purpose equipment taking into consideration maintenance cost, technology required for operation and purpose of use.

iv. The YAU side will be responsible for the procurement of reagents. However, discussions between the Japanese and YAU sides will be held on procurement of specific reagents which cannot be procured in Myanmar.

v. The syllabi for the students include many field trips, practical work and training courses outside the university. However, since YAU does not own a bus for students' field work, it is difficult for the teaching staff to find a means of transport for field work. Therefore, at least two 20-seater buses will be procured in order to provide a means of transport for up to about 50 students and provide flexibility in the use of buses, *e.g.* use of one bus for field work by 20 students.

vi. While the minister requested procurement of agricultural machinery for mechanized agriculture, it was decided in discussions between the Project Team and the President of YAU that machinery for small- and medium-scale agriculture widely practiced in Myanmar should be procured in the Project. A project for the provision of agricultural machinery under the 2KR

scheme in the planning stage is also intended for small- and medium-scale farmers. Therefore, training students using machinery similar in scale to that to be provided to farmers is likely to reduce the gap between the practical training provided to the students and the agriculture practiced in the actual fields.

vii. In addition to the above-mentioned agricultural machinery, equipment which enables students of the Department of Agricultural Engineering to practice basic machine drawing, measurement and machining technologies will be procured.

2) Policy for the Provision of Equipment to the Department of Agricultural Research (DAR) (including Seed Bank), the Central Agricultural Research and Training Center (CARTC) and the Vegetables and Fruits Research and Development Center (VFRDC)

The Project Team will confirm the need for the procurement of educational and experimental equipment at the three institutions in this Project, from the viewpoint of conformity to the purpose of this project of providing equipment for human resources development and selection of types of equipment to be procured on the basis of its applicability to education and training, the need for replacement and as new equipment required for updating farming technologies in accordance with trends in the agriculture sector.

(2) Contents of Curricula, Research and Training at the Institutions

1) Curricula and Syllabi of YAU

Appendix 01 shows the curricula for students of YAU. The curricula consist of classroom lectures and practical work/experiments provided in parallel. Most of the departments in YAU have courses with experiments and practical work and syllabi include many field courses and trips. The quality of the classes in the Department of Animal Science is poorer than in other departments.

2) Research and Training at DAR and Subjects of Research

Appendix 02 shows the research and training activities and the subjects of studies implemented in the Departments of Horticulture, Soil Science, Bioengineering, Entomology and Plant Pathology in the past three years obtained from DAR. Highly sophisticated studies have been conducted in DAR and informative reports have been published by DAR. Because of the locational proximity to YAU, DAR has a close relationship with YAU.

3) Contents of the Training at CARTC

Appendix 03 shows the contents of the training courses provided at CARTC in the past three years. CARTC does not have a mandate to publish reports because it is a training institution. CARTC provided training to 490, 802 and 1,065 trainees in fiscal 2009/2010, 2010/2011 and 2011/2012, respectively. In other words, the center provided training to 2,357 people in this three-year period. Meanwhile, as it has space to provide more training courses, it seems possible to increase the number people receiving training at the center by the installation of new equipment.

4) Details of Research at VFRDC

Appendix 04 shows the contents of the training provided at VFRDC in the past three years. VFRDC provided 2,114 people with relatively short-term training courses in the same period. VFRDC has also provided training to a total of 61 teaching staff at Yangon University, Dagon University and YAU since 2004. The center will be able to conduct more training courses and research with the installation of new equipment.

(3) Equipment Requested for Procurement and Results of Evaluation of Relevance

The Japanese side and the Myanmar side held discussions on the contents of the lists of requested equipment submitted by YAU, DAR, CARTC and VFRDC and the equipment requested by the teaching staff of the university and staff of the research institutions to evaluate the need for mainly the items of equipment to which the Myanmar side had given priority ranks A and B and to decide their provisional specifications and quantities.

The numbers of students, trainees and researchers who are expected to use a specific piece of equipment were used in the evaluation of the quantities of the equipment concerned in the request. The quantities of the equipment to be procured were adjusted taking into consideration the availability of existing equipment. Then, a study of the specifications of the equipment concerned, focusing on confirmation of the relevance of the equipment to the research subjects and the need for expensive consumables, was conducted. If a specific circumstance requires procurement of a certain type of equipment, such circumstance was provided in the equipment list used for the determination of the quantities and priority ranks of the equipment implemented after the discussions.

The major Equipment Plan of Project is in the table 2-07;

Table 2-07 Major equipment planning

No.	Equipment Name	Main specification	Q'ty	Purpose
		Department of Agronomy		
10	Dockage Tester	3 Sieves for wheat and corn	1	To separate corps by size and quality
30	Grain Taste Analyzer	Protein, moisture and amylose measurement of brown rice and white rice	1	To measure tastes of rice
33	Draft Chamber	Width 1500mm with fan	1	To exhaust harmful gas to outside
55	Plant Growth Chamber	Temperature, illuminance and humidity control, 290 liter	1	To cultivate plants under artificial control
60	Heliograph	Bimetal type	2	Metrological equipment
65	Photosynthesis Meter	Chlorophyll and Photosynthesis measuring	1	To measure photosynthesis condition
103	UV-VIS Spectrophotometer	Double beam, 200 to 900nm	1	Organic and non-organic sample analysis
		Department of Botany		
55	Plant Growth Chamber	Temperature, illuminance and humidity control, 290 liter	1	To cultivate plants under artificially control
60	Heliograph	Bimetal type	1	Metrological equipment
65	Photosynthesis Meter	Chlorophyll and Photosynthesis measuring	1	To measure photosynthesis condition
67	Microscope with Camera and Computer	Microscope with digital camera	1	Plant observation and taking photograph
79	Clean Bench	Vertical air flow, width 1300mm, with HEPA filter	1	For dust protection
103	UV-VIS Spectrophotometer	Double beam, 200 to 900nm	1	Organic and non-organic sample analysis
274	Thermostatic Germinator	300 liter, temperature range 10～40℃	1	Germinator under artificial control
		Department of Agricultural Chemistry		
33	Draft Chamber	Width 1500mm with fan	1	To exhaust harmful gas to outside
88	Atomic Absorption Spectrophotometer	Flame type, applicable element K,Ca,Mg,Zn and etc.	1	Analysis of heavy metal in the soil
89	Gas Chromatography	FID、ECD column	1	For measuring greenhouse gas
97	Refrigerated Centrifuge	Number of rotations : 10,000rpm or more、capacity 500 mL	1	To separate mixed samples
103	UV-VIS Spectrophotometer	Double beam, 200 to 900nm	1	Organic and non-organic sample analysis

No.	Equipment Name	Main specification	Q'ty	Purpose
		Department of Plant Pathology		
33	Draft Chamber	Width 1500mm with fan	1	To exhaust harmful gas to outside
79	Clean Bench	Vertical air flow, width 1300mm, with hepa filter	1	For dust protection
103	UV-VIS Spectrophotometer	Double beam, 200 to 900nm	1	Organic and non-organic sample analysis
110	Refrigerated Micro Centrifuge	Number of rotations : 10,000rpm or more、capacity 500 mL	1	To separate mixed samples
115	Real Time PCR	Number of sample : 96 well, sample capacity 20μliter	1	Monitoring under DNA amplifying
120	Plant Growth Chamber	Temperature, illuminance and humidity control, 290 liter	1	To cultivate plants under artificial control
		Department of Entomology and Zoology		
33	Draft Chamber	Width 1500mm with fan	1	To exhaust harmful gas to outside
67	Microscope with Camera	Microscope with digital camera	1	Entomology observation and taking of photograph
129	Temperature and Humidity Control Room	Area 6.6m2, temperature control 10～40℃	1	Artificial culturing room for insect
134	High Performance Liquid Chromatography	Detector UV-VIS with data analyzing apparatus	1	To measure residual pesticides
142	High Speed Refrigerated Centrifuge	Rotating speed 10,000rpm or more、capacity 500mL or more	1	To separate mixed samples
		Department of Horticulture		
55	Plant Growth Chamber	Temperature, illuminance and humidity control, 290 liter	1	To cultivate plants under artificial control
79	Clean Bench	Vertical air flow, width 1300mm, with hepa filter	2	For dust protection
97	Refrigerated Centrifuge	Number of rotations : 10,000rpm or more、capacity 500 mL	1	To separate mixed samples
115	Real Time PCR	Number of sample : 96 well, sample capacity 20μliter	1	Monitoring under DNA amplifying
176	UV Image Recorder	UV iluminator wave length 300nm、with CDD camera	1	To print Gel sample
179	Micro Spectrophotometer	Sample 5μliter, wave length renge200nm to 800nm	1	To analyze of plant nucleic acids, protain and organic acids
202	Gas Chromatography (TCD)	TCD column, with deta analyzing apparatus	1	Rate of plant breath and Ethylene displacement
203	Gas Chromatography (FID)	FID column, with data analyzing appratus	1	Rate of plant breath and Ethylene displacement
		Department of Agricllturing Economy		
218	Computer	Desktop type with monitor	40	for economic analysis for students
		Deaprtment of Engineering		
221	Tractor (45HP)	45 house power	1	for students technical training for farm mechanization
231	Roll Baler	Roll size 850×900mm	1	for students technical training for farm mechanization
237	Combine Harvester	Harvesting width 1500mm or more	1	for students technical training for farm mechanization
		DAR		
	Horticulture			
242	Thermostatic Germinator	300 liter, temperature range 10～40℃	1	Germinator under artificial control
	Biotechnology			
120	Plant Growth Chamber	Temperature, illuminance and humidity control, 290 liter	1	To cultivate plants under artificial control
	Water Utilization			
65	Photosynthesis Meter	Chlorophyll and Photosynthesis measuring	1	To measure photosynthesis condition
	Plant Pathology			
79	Clean Bench	Vertical air flow, width 1300mm, with hepa filter	1	For dust protection
	Seed Bank			
103	UV-VIS Spectrophotometer	Double beam, 200 to 900nm	1	Organic and non-organic sample analysis
		CARTC		
	Agro chemistry, Soil Science			
103	UV-VIS Spectrophotometer	Double beam, 200 to 900nm	1	Organic and non-organic sample analysis
	Farm Machinery			
221	Tractor (45HP)	45 house power	1	Cultivating and other farm works
237B	Combine Harvester	2 row harvesting	1	Harvesting and threshing of paddy
		VFRDC		
	Training			
60	Heliograph	Bimetal type	1	Metrological equipment
	Farm Machinery			
221	Tractor (45HP)	45 house power	1	Cultivating and other farm works

(4) Decision on the Basic Specifications of Each Type of Equipment

The specifications and quantities of each type of equipment shown in the attached equipment list were determined on the basis of purpose of use, frequency of use (capacity) and number of users. This list will be re-examined and re-analyzed in detail in the next phase of work in Japan. Manufacturers' names and models in the list are only for reference and the final decision on manufacturers and models of equipment will be made by comparison of the products of three manufacturers.

2-2-3 Original Design Drawing

Original Design Drawings are attached for the following item:

Overall Site Plan	Fig 2-16

≪Experiment and Lecture Building-1≫

Site Plan	Fig 2-17
Ground floor Plan	Fig 2-18
1st floor Plan	Fig 2-19
Elevation	Fig 2-20
Cross-section	Fig 2-21

≪Experiment and Lecture Building-2≫

Site Plan	Fig 2-22
Ground floor Plan	Fig 2-23
1st floor Plan	Fig 2-24
Elevation	Fig 2-25
Cross-section	Fig 2-26

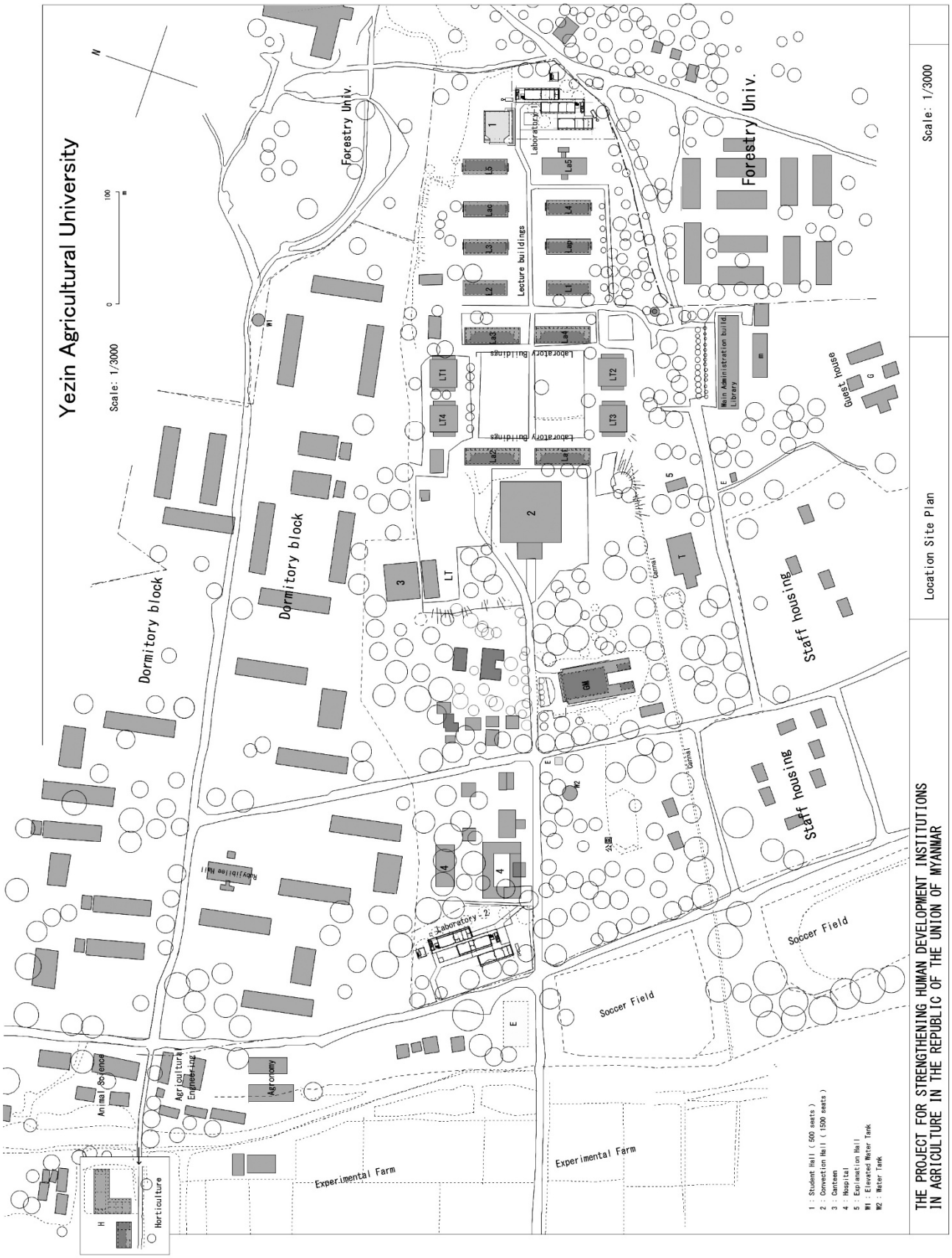

Fig 2-16 Overall site plan

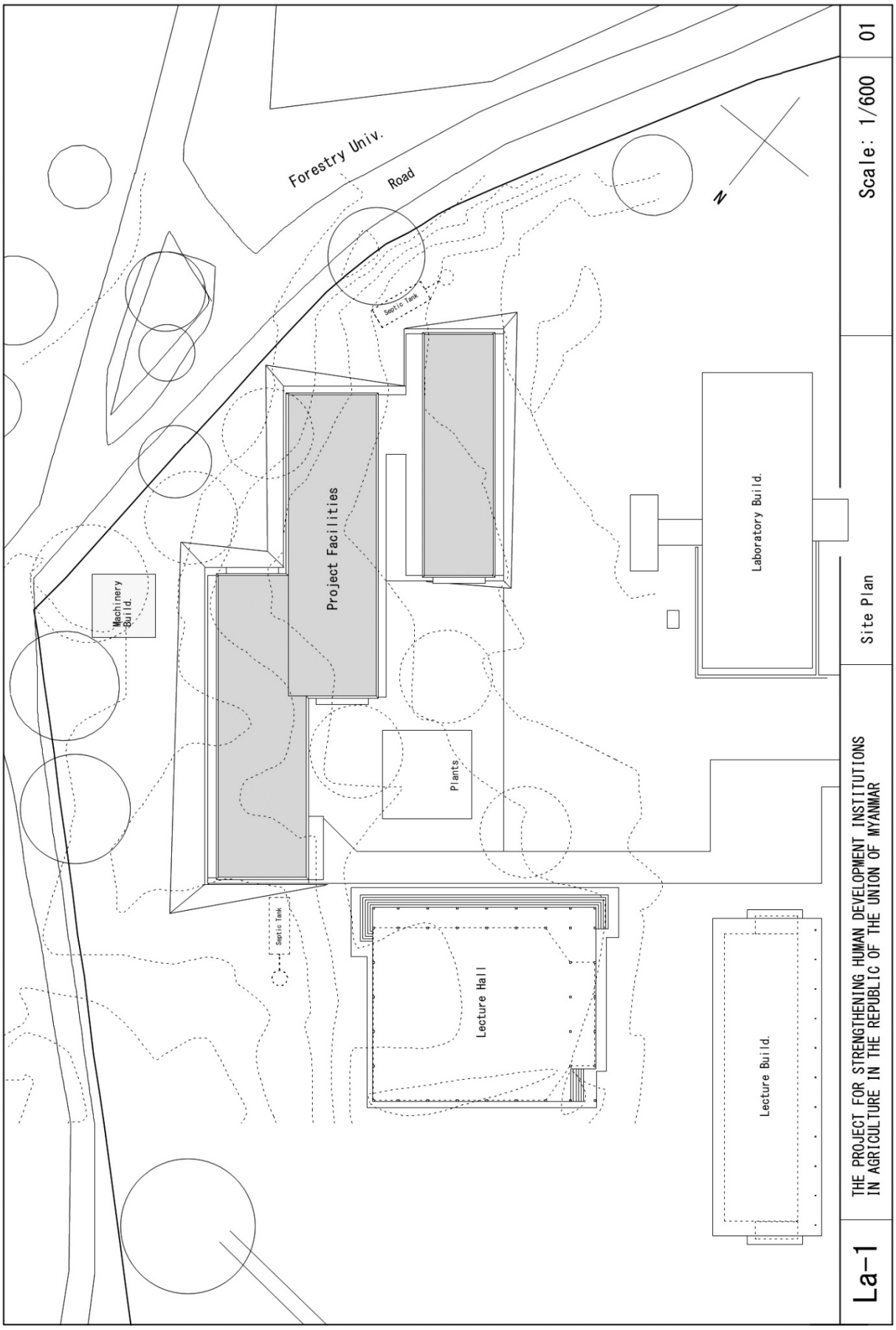

Fig 2-17 Experiment and Lecture Building-1 Site plan

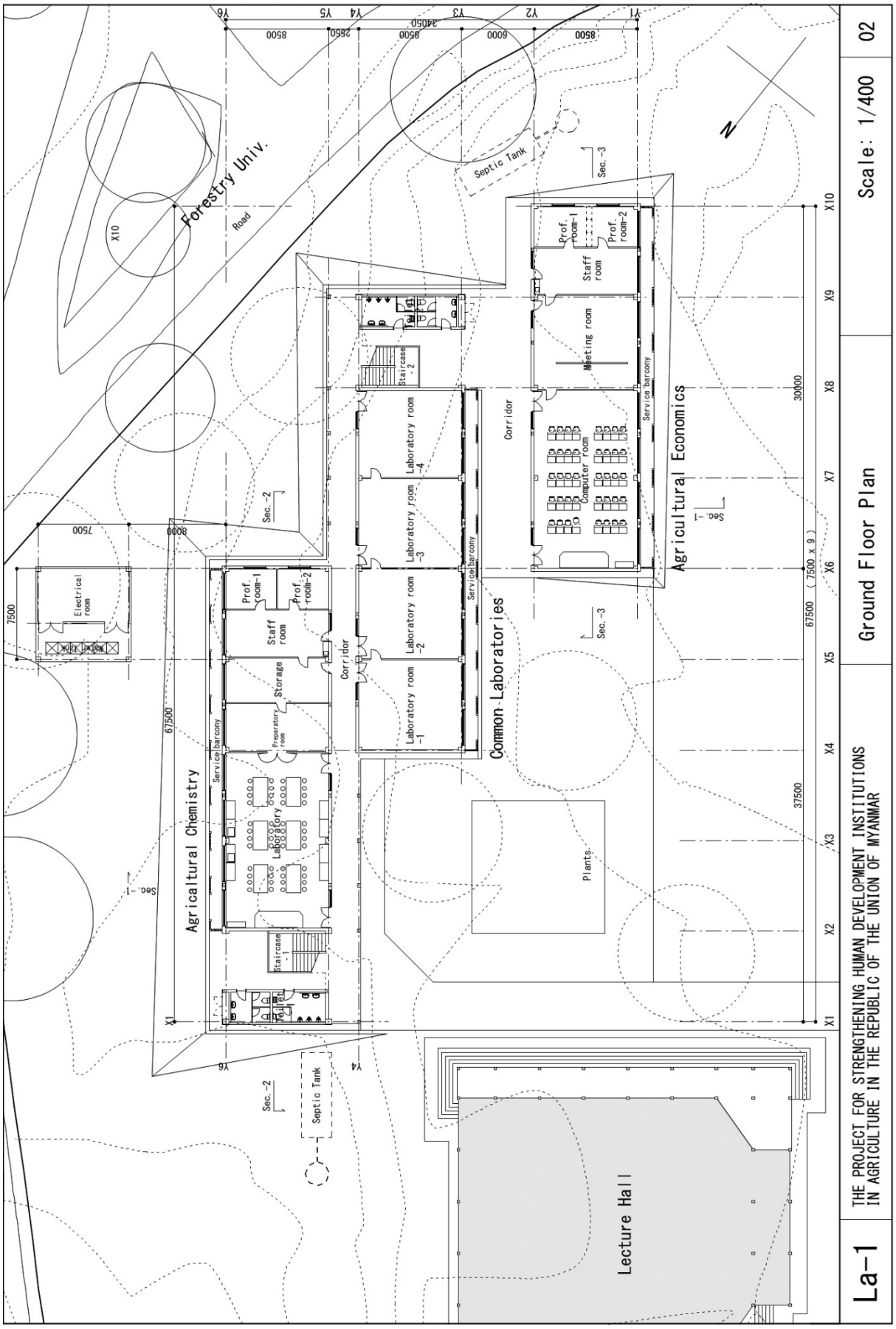

Fig 2-18 Experiment and Lecture Building-1 Ground floor plan

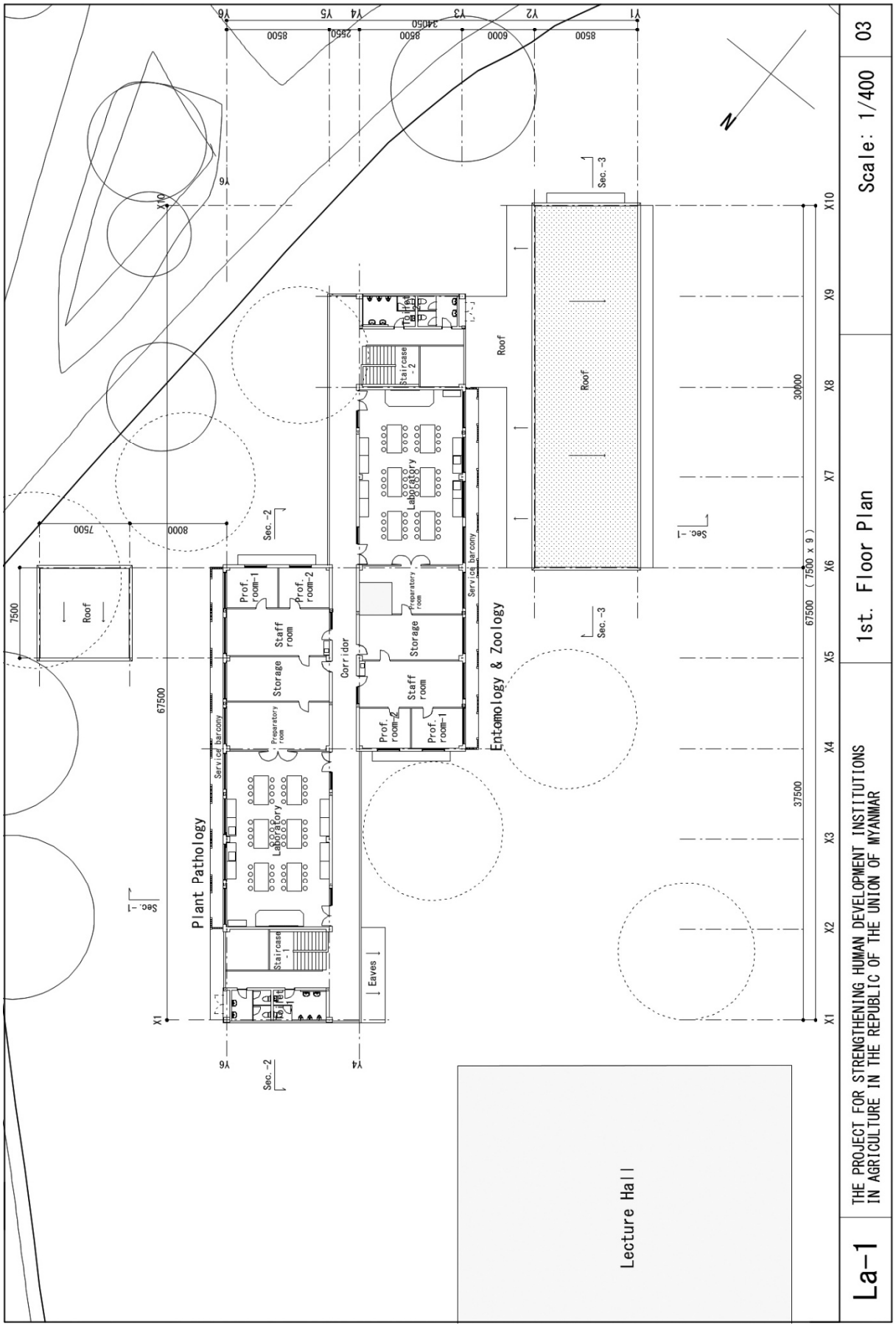

Fig 2-19 Experiment and Lecture Building-1: 1st floor plan