MINISTRY OF SCIENCE AND TECHNOLOGY
THE REPUBLIC OF THE UNION OF MYANMAR

PREPARATORY SURVEY REPORT ON THE PROJECT FOR ENHANCING TECHNOLOGICAL UNIVERSITIES IN MYANMAR

JULY 2014

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

INTEM CONSULTING, INC.
YAMASHITA SEKKEI INC.
PADECO CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to the consortium of INTEM Consulting, Inc., Yamashita Sekkei Inc. and PADECO Co., Ltd.

The survey team held a series of discussions with the officials concerned of the Government of Myanmar, and conducted 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.

July, 2014

Takao Toda
Director General
Human Development Department
Japan International Cooperation Agency

Summary

SUMMARY

Overview of the Country

The Republic of the Union of Myanmar (hereinafter referred to as "Myanmar") is located to the west of the Indochinese Peninsula and is bordered by China to the northeast, Laos to the east, Thailand to the southeast, Bangladesh to the west and India to the northwest. Myanmar faces the Andaman Sea and the Bay of Bengal to the south. Mountains spread to the east and the west from the north, and there is a large canyon and plains in the central area. The Ayeyarwady River has a total length of 1,992 km, beginning at the southern end of the Himalayas and flowing into the Andaman Sea longitudinally from north to south. The land area is approximately 680,000 square kilometers (about 1.8 times the size of Japan) and the population is about 5,280 million (World Data Bank 2012). Administrative divisions of Myanmar are divided into 7 regions mainly inhabited by Burmese and 7 states inhabited by other ethnic minorities. The Mandalay, Zakain and Magwe regions are located in upper Myanmar and the rest of the regions are divided within lower Myanmar. The capital city is Nay Pyi Taw.

Myanmar has a tropical monsoon climate (except the northern mountainous area) with the following three seasons; hot season (from March to mid-May), rainy season (late-May to October) and dry season (November to February). Annual rainfall in Yangon, one of the sites of the Project, is 2,880 mm. Annual rainfall of Mandalay is relatively less than the south coast area. Damage is frequently caused by cyclones generated in the Bay of Bengal. The lowest monthly average temperature is between 25°C to 30°C. It is hot throughout the year. Sagaing Fault, which is an active and massive fault, runs from south to north in the central part of the country. Earthquakes of M7.0 or more have frequently occurred in the past.

Regarding the economic situation, the GDP is 531.4 billion USD and the GDP per capita is 835 USD (IMF: 2012 estimate). Myanmar is the second largest country after Vietnam in terms of GDP among the less developed countries of ASEAN (Cambodia, Laos, Myanmar and Vietnam). However, for the GDP per capita, Myanmar ranks in the lowest among the four countries (World Bank: World Data Bank 2012).

Myanmar's economy, which has been reliant on agriculture for a long time, has started to show a different structure; contribution of agriculture to GDP has been declining sharply since 2000 while manufacturing industry and service sector has risen. The service sector, which was the second largest after agriculture, steadily increased its contribution to GDP and surpassed agriculture in 2011. The manufacturing industry, which had the lowest contribution to GDP among the three major sectors, has increased rapidly in the last 10 years, rising from 14.3% (2003) to 32.1% (2012) and exceeded agriculture. The contribution made by major industry in 2012 in descending order were: service (37.5%), industry (32.1%) and agriculture (30.5%). (Asian Development Bank: Key Indicators for Asia and the Pacific 2013).

With regard to trade, the import value continues to exceed the export value since 2007 and the gap continues to widen. In 2012, the value of imports was 16.9 billion USD and the value of

exports was 83 billion USD. Main partner countries for exports in 2012 were Thailand (3.36 billion USD), India (1.22 billion USD), China (1.18 billion USD) and Japan (610 million USD). The main partner countries for imports are China (6.24 billion USD), Thailand (3.42 billion USD), Singapore (1.47 billion USD), South Korea (1.46 billion USD) and Japan (1.38 billion USD). (Asian Development Bank: Key Indicators for Asia and the Pacific 2013).

Background, History and Outline of the Requested Japanese Assistance

The contribution of industry sector to the GDP has been increasing rapidly in recent years. The industrial structure is shifting from agriculture-centered to industry-centered. Looking at medium- to long-term predictions for the GDP generated in each of the 7 major industrial sectors[1], manufacturing is estimated to be in the top position among all industrial fields in 2030. Agriculture and infrastructure will share the second position[2]. However, to support the development of the manufacturing industry, various challenges currently facing Myanmar such as 1) infrastructure development (in particular, transportation, electrical power, information and communication, etc.) and 2) diversification of the industrial structure (breaking away from primary products which depend on price fluctuations and market demands), shall be achieved[3]. To solve the issues mentioned above, for infrastructure development, skilled human resources of civil engineering, electric power engineering, and information and technology shall be needed and for industrial development (especially for process manufacturing), skilled human resources of mechanical engineering, electronic engineering and the mechatronic engineering(the mixed field of mechanical and electronic engineering), shall be necessary.

In a policy paper developed at the end of 2012 entitled “Development Plan for Human Resources for Science and Technology (2011/12 – 2030/31),” the Ministry of Science and Technology (hereinafter referred to as “MOST”) designated Yangon Technological University (hereinafter referred to as “YTU”) and Mandalay Technological University (hereinafter referred to as “MTU”) as Center of Excellence (hereinafter referred to as “COE”) universities, which lead engineering education and research for lower Myanmar and upper Myanmar, respectively. Both universities aim to upgrade their level of education and research equivalent to those in ASEAN countries by 2020. However, as universities in Myanmar had limited access to the private sector before the new government was established in 2011, YTU and MTU have faced difficulties in offering practical education that will provide the techniques and skills required by the private sector.

There is an urgent need for human resources that possess not only theoretical knowledge, but also practical skills. Universities are expected to provide practical, hands-on experience and applied skills in their education and research to ensure that future labor market entrants are equipped for the workplace. Furthermore, some private companies have shown an interest in

[1] Manufacturing, Agriculture, Infrastructure, Energy/Mining, Tourism, Finance and Telecommunication

[2] McKinsey Global Institute, 2013,McKinsey Global Institute, June 2013, “Myanmar’s moment: Unique opportunities, major challenges”

[3] ADB, 2012, Myanmar in Transition – Opportunities and Challenges -

receiving testing and measuring services from the Universities that require advanced equipment and facilities.

As equipment and facilities of YTU/MTU for education and research have not been renewed for a long time, their improvement and upgrading would be necessary. Improving the equipment and facilities at YTU/MTU and improving the quality of their education and research are pressing issues that must be resolved in order to develop and produce the human resources that meet the expectations of the private sector, especially in the industrial sector.

The Project aims to improve the education and research environment of YTU/MTU by enhancing the equipment for education and research. The provision of said equipment and facilities in 6 departments[4] that closely correspond to industrial development (especially, process-oriented manufacturing industry) will contribute to the implementation of practical education and enhancement of research capacity.

Outline of the Survey Results and Description of the Project

Receiving the request from Myanmar, the Japanese Government decided to conduct a Preparatory Survey on the Project. Japan International Cooperation Agency (hereinafter referred to as "JICA") organized a Survey Team for the development of outline design from December 8 to 29, 2013. The Survey Team conducted a site survey based on the request by the Myanmar side and held discussions with personnel from MOST, YTU/MTU, and other relevant bodies in Myanmar. Subsequently, in Japan, the Team analyzed documents and information collected during the survey and prepared a Draft Preparatory Survey Report. The Team identified and prioritized educational equipment and the key facilities where said equipment need to be installed to conduct practical experiments. The Survey Team returned to Myanmar from June 11 to 20, 2014, explained the contents of the Draft Report to the Myanmar side, and finalized this Preparatory Survey Report.

The major contents of the Project, which has been developed based on the series of discussions with the Myanmar side, are as follows.

(1) Scope of Works/Components

The Project aims to develop skilled and practical-oriented human resources needed for industrial development. The Project consists of three main components: (1) procurement of 134 items of equipment for bachelor of engineering education to be installed in the departments of existing buildings at YTU/MTU, (2) the procurement of 135 items of equipment for research and development at YTU/MTU, and (3) the construction of the Common Measuring Equipment Building (provisional name) and the Civil and Electrical Engineering Building (provisional name) on the premises of YTU. The main purpose of the Project is to provide practical equipment for education and research. Therefore, facilities to be included in the Project shall be limited to the minimum laboratories and relevant rooms. They will accommodate the equipment, which cannot be installed in the existing buildings due to

[4] Civil Engineering, Mechanical Engineering, Electric Power Engineering, Electronic Engineering, Information Technology, and Mechatronic Engineering

its size and function.

(2) Equipment Plan

1) Equipment Selection Criteria

The equipment for the Project has been selected with the following criteria, for the purpose of developing practical, skilled human resources and strengthen collaboration with industrial sector.

A. Equipment for education and advanced engineering subjects necessary for the implementation of the (COE) B.E. Program (G4 or above: corresponding to 2nd and 3rd academic years of universities in Japan).
B. Equipment for educational, research, and development purposes necessary for masters and doctoral programs at YTU/MTU.
C. Equipment for research and development necessary for accumulating knowledge and bringing local development by teaching staff of YTU/MTU.
D. Equipment conforming to the technical level of teaching staff and could be easily maintained by a technician in each department.

2) Procedures for Selecting the Equipment

For further analysis of the validity of the requested equipment, the following selection criteria have been considered:

A. Advanced practical equipment necessary for other academic years except the years mentioned in item 1) A. above;
B. Equipment that does not need expensive consumables and spare parts;
C. Equipment that can be used for technical services such as inspections and testing to be offered to private companies;
D. Equipment which can be substituted for other requested equipment or for which there is overlap with other requested equipment;
E. Equipment which has no other equivalent product and there is no justifiable reason for designating a specific model;
F. Equipment that is not used frequently and widely and/or is not cost-effective;
G. Equipment that can be made by teaching staff and/or students; and
H. Equipment that is difficult to be included in the Project due to budget limitations or that requires major improvement of the facilities.

3) Criteria for Quantity

Equipment quantities were calculated taking into consideration of equipment's primary usage and its frequency of use (number of groups, the cycle set in class). Appropriate amount has been determined through discussions with each department of YTU/MTU based on the number of students in class and the number of groups that engage in experiments and practical sessions. .

(3) Facility Plan

A. For proper installation and maintenance of the equipment and its effective and efficient use, a minimum amount of building facilities will be newly planned to accommodate the

equipment unsuitable for installation in the existing buildings. The existing buildings are more than 50 years old and partially damaged. In addition, they don't have any insulation for heat, noise, or electromagnetic waves. The utilities necessary for installing the new facilities such as electrical power and drainage are limited. Moreover, some of the building structures cannot bear the weight of heavy equipment.

B. In order to make up for such building inadequacies when installing new equipment, two new facilities will be built. The first one is for civil and electrical engineering experiments and will require a large space as the equipment is large in size and generates much noise, vibration, and microwaves. The second facility is for common measurement equipment. This equipment is sensitive and needs special protection from microwaves and vibration. It is desirable that these two buildings are separated from one another.

C. YTU is located within Yangon City, where land prices are rising rapidly. Thus, new buildings should be planned to maximize the use of limited property and to secure space to enable future development.

D. Consideration shall be given to energy saving measures (shielding out direct sunlight, ensuring thermal insulation performance, etc.) to minimize operation/maintenance costs.

E. The facility plan should be feasible in terms of volume, size, and the technical abilities of Myanmar and the neighboring regions.

Project Schedule and Cost Estimate

The implementation period for the Project will be about 21 months in total; 3.5 months for the detailed design, 2.5 months for tender procedures and 15 months of construction work, including the procurement and installation of equipment. The total cost to be borne by the Myanmar side is estimated at approximately 0.38 million yen.

Project Evaluation

(1) Relevance

The Project is considered relevant as a Japanese Grant Aid Project based on the following points.

1) Beneficiary of the Project

The targeted area of the Project is Yangon City and Mandalay City, where YTU and MTU are located. The two universities receive students from all over the country; YTU receives students from lower Myanmar and MTU receives students from upper Myanmar. Graduates of both Universities are expected to be employed at higher educational institutions such as technological universities (hereinafter referred to as "TU"), in the private sector, or at governmental ministries. Direct beneficiaries are approximately 900 teaching staff

members of TU nationwide and approximately 2,800 students who will graduate from YTU/MTU after being educated with the equipment and facilities provided by the Project. As YTU and MTU are the leading universities in the field of engineering in Myanmar, and the Project will contribute significantly to the industrial development.

2) Viewpoint of Human Security

Human security is a concept that encourages people's freedom from fear (such as conflicts and disasters), and want (poverty), ensuring that they live in safety and dignity. It involves thorough and comprehensive consideration for socially vulnerable people, and establishes mechanisms to protect and empower them. Through the implementation of the Project, opportunities for practical experiments at YTU/MTU will be increased and the capacity of the graduates will be enhanced, giving them more freedom to learn and empower themselves, eventually contributing to Myanmar's industrial advancement. Thus, the Project is consistent with the human security perspectives in improving the standard of living of Myanmar people.

3) Contribution to the Achievement of the Medium/Long Term Development Plan

Myanmar is currently in the process of developing the National Comprehensive Development Plan (2011-2031). In the draft outline of the plan, growth, richness in diversity, and the establishment of a sustainable economy are described as long-term goals. Furthermore, the following are mentioned as strategic priority areas; the development of sector competitiveness and a foreign direct-investment environment, the expansion of connectivity, the strengthening of governance, and human resources development.

For the higher education sector, the Ministry of Education, which leads overall coordination and planning, has developed a higher education development plan consisting of 13 items. It includes an action plan to achieve international standard education, the enhancement of the network with foreign universities, capacity building of teachers and clerical and technical staff members of the university, and the improvement of student quality.

On the other hand, the Ministry of Science and Technology, which has jurisdiction over the Engineering Universities, has formulated a development plan (2011/12-2030/31) for human resources in industry, especially for science and technology. The development plan consists of 4 phases of five years each: first phase (2011-2015), second phase (2016-2020), third phase (2021-2025), and forth phase (2026-2030). The main points are as follows.

1st Phase (2011-2015)

- YTU, MTU, University of Computer Studies, Yangon, University of Computer Studies, Mandalay, University of Technology, Yatanarpon Cyber City, and Myanmar Aerospace Engineering University shall be designated as (COE) and the level of these universities shall be equivalent to top ASEAN universities by 2020.
- An intranet-based e-library shall be prepared at each higher educational organization as a priority.
- The curriculum for the new bachelor program shall be prepared and in-service education and training programs for existing teaching staff shall be conducted.

2nd Phase (2016-2020)

・The universities designated as (COE) shall be strengthened as research-oriented universities.

・The level of approx. 30% of TU and Universities of Computer Studies shall be increased to the same level as universities designated as (COE) in the 1st Phase.

・A one-year diploma course of training technological teaching staff shall be established.

3rd Phase (2021-2025)

・The collaboration between the private sector and the universities shall be strengthened by establishing an office for collaboration within the universities.

・Universities shall be reformed to match the needs of the industrial sector in terms of the level of its graduates.

・(COE) universities will rank in the top 100 of major Asia-Pacific universities.

・The level of approx. 30% of TU and Universities of Computer Studies shall be increased to the same level as universities designated as (COE) in the 1st Phase.

4th Phase (2026-2030)

・Universities other than (COE) universities will provide research activities, not only education.

・The universities designated as (COE) will rank in the top 100 in global rankings.

・The level of the rest of the universities and Universities of Computer Studies shall be increased to the same level as universities designated as (COE) in the 1st Phase.

Through the implementation of the Project, YTU/MTU will strengthen its role as the provider of skilled human resource responsive to Myanmar's emerging market needs. . From this point of view, the validity of the Project is acknowledged.

4) Consistency with Japanese Policy for Official Development Assistance

In the ODA Policy for Myanmar, the following were raised as important issues: , assistance for human resource development necessary for fostering economic growth, the promotion of student exchange programme and educational improvement This is consistent with the objective of the Project, which is to improve the educational and research environment of YTU/MTU's 6 targeting departments in order to develop highly skilled and practical human resources that can contribute to socio-economic and industrial development in Myanmar. Thus, the validity of the Project in relation to Japanese ODA policy is ensured.

(2) Effectiveness

The following table shows the outputs expected by implementing the Project.

1) Quantitative Effects

Indicators	Baseline (2014)	End line (2019) (3 years after completion of the Project)
① The number of departments provided with equipment for practice at G5 or above of (COE)B.E. program	0	YTU: 6 MTU: 6
② The number of students enrolled at 6 targeted departments. (unit: persons)	0	YTU: 1,500 MTU: 1,300

2) Qualitative Effects

① For the targeted 6 departments of YTU/MTU, through conducting a practical education and research utilizing the equipment procured, skilled graduates and teaching staff with practical skills will be developed.

② Through the employment of skilled graduates from YTU/MTU in the labor market in Myanmar in various fields of the public and private sectors, the Project will contribute to socio-economic development in Myanmar.

③ Collaborative activities such as internships, testing and measuring services for private companies, joint research, etc. with private companies (including Japanese companies) and universities will be strengthened based in the facilities constructed by the Project on the YTU premises.

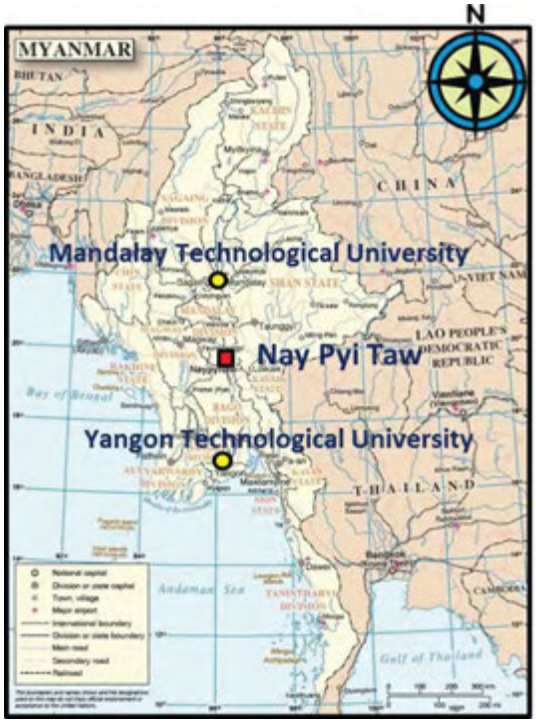
④ Conference reports and /or articles utilizing the equipment will be developed.

⑤ Technical services will be provided utilizing the newly procured equipment.

In conclusion, the validity of the Project to be implemented by Japanese Grant Aid has been ascertained and its anticipated effectiveness is also recognized.

CONTENTS

LOCATION MAP



PERSPECTIVE

PERSPECTIVE－1

PERSPECTIVE－2

PERSPECTIVE－3

LIST OF FIGURES AND TABLES

ABBREVIATIONS

Abbreviation	Original Name
ASEAN	Association of South-East Asian Nations
COE	Center of Excellence
DAC	Development Assistance Committee
DAST	Department of Advanced Science and Technology
DTVE	Department of Technical and Vocational Education
EEHE	Project for Enhancement of Engineering Higher Education in Myanmar
GDP	Gross Domestic Product
GTC	Government Technical College
GTI	Government Technical Institute
HDI	Human Development Index
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JIS	Japan Industrial Standard
MoE	Ministry of Education
MOST	Ministry of Science and Technology
MTU	Mandalay Technological University
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PPP	Public Private Partnership
SEZ	Special Economic Zone
TU	Technological University
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
VAT	Value Added Tax
YCDC	Yangon City Development Committee
YTU	Yangon Technological University

Chapter 1 Background of the Project

Chapter 1 Background of the Project

1-1 Background, History and Outline of the Requested Japanese Assistance

According to the GDP indicators for each of the 7 major industrial sectors[5] of the Republic of the Union of Myanmar (hereinafter referred to as "Myanmar"), agriculture is ranked in the top position. Infrastructure is ranked second and manufacturing is the third. However, manufacturing is predicted to be in the top position of all industrial fields by 2030. Agriculture and infrastructure will share the second position, and tourism and finance will also increase their shares. Manufacturing, infrastructure and energy/mining are predicted to grow 7-fold, 4.6-fold, and 2.7-fold, respectively, by 2030[6]. Manufacturing, infrastructure and tourism will be the major sectors absorbing the labor force. Approximately 5.8 million new jobs will be generated in manufacturing in 2030. Furthermore, for infrastructure and tourism, approximately 1.8 million and 2.0 million new jobs will be generated respectively. Approximately 92% of the workforce will be involved in these 3 sectors. The 6 university departments (Civil Engineering, Mechanical Engineering, Electrical Power Engineering, Electronic Engineering, Information Technology, and Mechatronics Engineering) targeted for the Project will play a critical role in producing the skilled human resources working in these 3 industrial sectors, which could be a major driving force for labor market expansion as well as economic development.

In a policy paper developed at the end of 2012 entitled the "Development Plan for Human Resources for Science and Technology (2011/12 – 2030/31)," the Ministry of Science and Technology (hereinafter referred to as "MOST") designated Yangon Technological University (hereinafter referred to as "YTU") and Mandalay Technological University (hereinafter referred to as "MTU") as Center of Excellence (hereinafter referred to as "COE") universities, which lead engineering education and research for lower and upper Myanmar. Both universities aim to provide a level of education and research equivalent to those in ASEAN countries by 2020. However, as universities in Myanmar had limited access to private sector before the new government was established in 2011, they have faced difficulties in offering practical education that will provide the techniques and skills required by the private sector. There is an urgent need for human resources that possess not only theoretical knowledge, but also practical skills. Practical education and research taking place in the university laboratories is considered contribute to enhance those practical skills.

As equipment and facilities of YTU/MTU for education and research have not been renewed for a long time, their improvement and upgrading would be necessary. Improving the equipment and facilities at these top two engineering universities in Myanmar as well as improving its quality of education and research are pressing issues that must be resolved in order to develop and produce the human resources that meet the expectations of the private sector, especially in the industrial field.

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[5] Manufacturing, Agriculture, Infrastructure, Energy/Mining, Tourism, Finance and Telecommunication

[6] McKinsey Global Institute, 2013,McKinsey Global Institute, June 2013, "Myanmar's moment: Unique opportunities, major challenges"

1-2 Natural Conditions

Myanmar is located to the west of the Indochinese Peninsula and is bordered by China to the northeast, Laos to the east, Thailand to the southeast, Bangladesh to the west, and India to the northwest. Mountains spread to the east and the west from the north, and there is a large canyon and plains in the central area. The Ayeyarwady River has a total length of 1,992 km, beginning at the southern end of the Himalayas and flowing into the Andaman Sea longitudinally from north to south. The land area is approximately 680,000 square kilometers and the population is about 5,280 million (World Data Bank 2012). Administrative divisions of Myanmar are divided into 7 regions mainly inhabited by Burmese, and 7 states inhabited by other ethnic minorities.

(1) Geography

The premises of YTU encompass approximately 500,000 m2. The academic area is concentrated on the Insein road side (northwest) and there is a staff housing area comprising two-thirds of the site on the east side. There is a difference in ground height of about 3 m on the premises. Tall trees form a relatively compact coppice. In addition, there is a pond on the axis that was planned in the original master plan.

(2) Geology and Soil Conditions

Yangon generally has soft ground. It was the result of a less proof stress of N support continues to 20m depth from the surface of the ground by the survey at the Project site. Some silt layer was found, but, mostly it is a clay layer.

(3) Climate

Myanmar has a tropical monsoon climate. Temperature records the highest during the hot season (from March to mid-May). Annual rainfall in Yangon is 2,880 mm. Annual rainfall in Mandalay is comparatively less than the southern coastal area. Intense rainfalls are seen in a short time. Damage is frequently caused by cyclones generated in the Bay of Bengal.

1-3 Environmental and Social Considerations

The Project does not require large-scale, on-site construction nor large-scale tree felling for construction. Since the site is within the premises of YTU, surrounding neighborhood will not be affected.

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

The objective of the Project is to enhance the education and research capability of YTU and MTU through the provision of equipment and facilities for education and research, in order to contribute to the development of highly skilled human resources, which are essential for the industrial and socio-economic development of Myanmar.

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policies

The Project aims to solve the issue of the development of skilled and practical-oriented human resources needed for industrial development. The Project consists of three main components: (1) procurement of 134 items of equipment for bachelor of engineering education to be installed in the departments of existing buildings at YTU/MTU, (2) the procurement of 135 items of equipment for research and development at YTU, and (3) the construction of the Common Measuring Equipment Building (provisional name) and the Civil and Electrical Engineering Building (provisional name) for the 6 engineering departments(Civil Engineering, Mechanical Engineering, Electrical Power Engineering, Electronic Engineering, Mechatronic Engineering, and Information Technology) on the premises of YTU. Based on the request from the Myanmar side and as a result of the survey and the series of discussions with the Myanmar side, the contents of the Project were formulated with the following policies.

(1) Equipment Planning

In selecting the equipment, priority is given to items necessary for materialization of the (COE) B.E. program, which has been part of educational policy of Myanmar Government since FY 2012. More specifically, first priority is given to educational and research equipment for the (COE) B.E. program that is necessary to build the capacity of human resources for advanced industrial fields requiring practical knowledge and skills. Equipment that can be utilized by several departments shall be given second priority. Equipment utilized for technical services such as measuring, testing, and prototype-modelling services offered to the business sector (including Japanese firms) as well as government organizations (universities and research institutes) will have third priority.

(2) Facility plan

For proper installation and maintenance of the equipment and its effective and efficient use, a minimum amount of building facilities are to be newly planned to accommodate the equipment unsuitable for installation in the existing buildings. The existing buildings are more than 50 years old and some of the building structures cannot adequately bear the weight of heavy equipment. In addition, there is no insulation for heat, noise, or electromagnetic waves

in these buildings. The utilities necessary for installing the new facilities such as electrical power and drainage are limited.

In order to make up for such building inadequacies when installing new equipment, two new facilities will be built. The first one is for civil and electrical engineering experiments and will require a large space as the equipment is large in size and generates much noise, vibration, and microwaves. The second facility is for common measurement equipment. This equipment is sensitive and needs special protection from microwaves and vibration. It is desirable that these two buildings are separated from one another.

YTU is located within Yangon City, where land prices are rising rapidly. Thus, new buildings should be planned to maximize the use of limited property and to secure space to enable future development.

Consideration shall be given to energy saving measures (shielding out direct sunlight, ensuring thermal insulation performance, etc.) to minimize operation/maintenance costs.

The proposed Project should be feasible in terms of volume, size, and the technical abilities of Myanmar and the neighboring regions.

(3) Site selection

Taking into account the current campus plan and the surrounding environment, the construction sites for the Common Measuring Equipment Building and the Civil and Electrical Engineering Building were selected as explained below.

Site A： Common Measuring Equipment Building (provisional name)

This site is located behind the corridor that connects the main Building-1, Building-5, and canteen buildings. Located next to the Main Building, the proposed site is highly visible from across the campus and provides easy access from all academic departments. Since the site is at a good distance from the Insein Road, it is considered as a quiet and vibration-free location, suitable for the Common Measuring Equipment Building. The only existing building that needs to be demolished by the Myanmar side is an abandoned one-story house of about 90 m2. The site layout should be designed to preserve a gigantic tree adjacent to the Common Measuring Equipment Building.

Site B：Civil and Electrical Engineering Building (provisional name)

The site used to be a football ground, and can be directly accessed by large vehicles. Since the spacious grounds will mitigate impact on the surrounding area, Site B is considered suitable for the Civil and Electrical Engineering Building. There are no existing buildings that need to be demolished prior to construction.

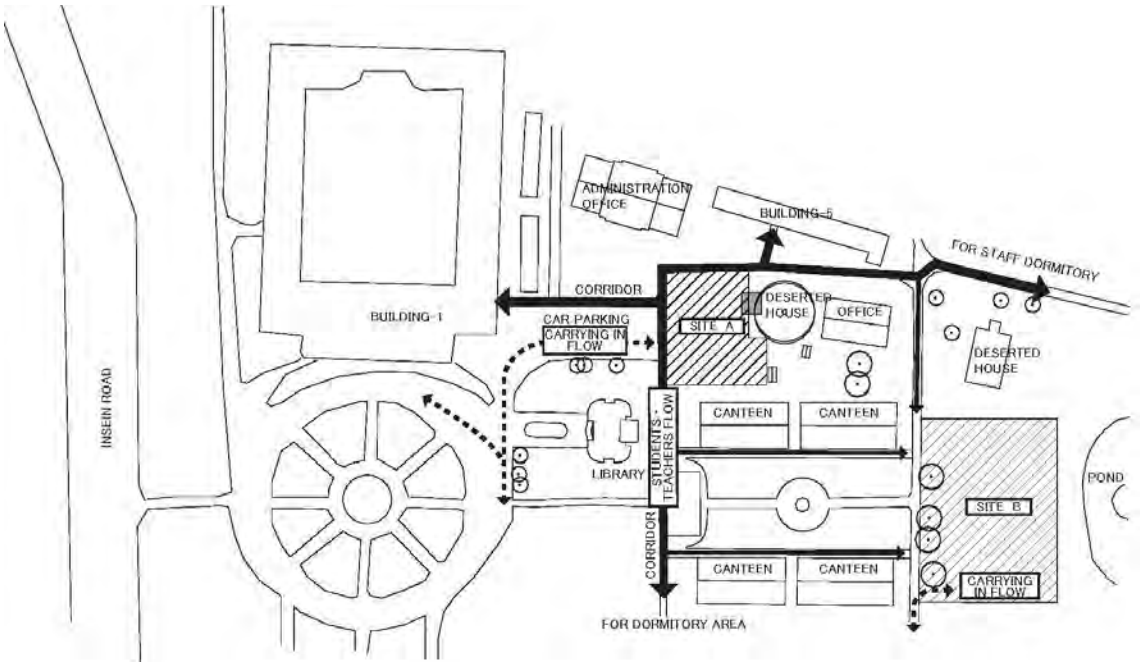


Fig 2-1 Current Situation of the site

2-2-1-2 Policy regarding the Natural Environmental Conditions

(1) Temperature and Sunshine

With an average annual temperature of 27.5°C, Yangon is hot all year round, especially in March and April towards the end of the dry season. The transfer of external heat indoors can be reduced by improving the thermal insulation of the walls and roof. Furthermore, the wall surface area exposed to the sun can be reduced by providing eaves.

(2) Rain

With frequent torrential and heavy rainfalls, the annual precipitation is approx. 2,700 mm. In order to ensure prompt rainwater discharge, the ground level of the buildings will be raised and an efficient drainage system will be provided.

(3) Storms

Since YTU suffered damage from cyclone Nargis in April 2008, effective measures against wind pressure will be considered while designing the buildings.

2-2-1-3 Policy regarding the Social and Economic Conditions

(1) Consideration on Equipment Planning

The number of Japanese firms that have branched out into Myanmar as of October 2013 is

156. The increase over the previous year is 71.4%, which is 3 times the number of firms in 2010, which was 52. The industrial categories that showed a steep increase within the past year are service, manufacturing, and transportation/communication. The needs of human resources for those 3 categories, including the needs of Japanese firms advancing into Myanmar market, shall be considered when developing the equipment plan.

(2) Intensive Land Use

The Project site is located in an expensive area of Yangon City, where land prices are rising. Considering the possibility for future development, intensive land use will be planned.

(3) Collaboration with the Private Sector

The Project plans to provide technical services (carrying out strength testing of concrete, analysis of the cause of various defects, and seeking for internship opportunities, etc.) for the private sector and strengthen partnership. .

2-2-1-4 Policy for the Conditions of Procurement and Construction

(1) Situation of the Possibility for Local Procurement

Equipment for experiments, which shares a major part of the equipment plan, shall be procured in Japan; however, module type equipment for experiments shall be procured from the USA and/or European countries and/or be locally procured if an agent is appointed in Myanmar. Computers and furniture shall basically be locally procured. Equipment that requires frequent replacement of consumables and has a local agent in Myanmar will also be locally procured. Availability of local procurement of materials shall be confirmed.

(2) Policy regarding Construction Laws and Design Regulations

The Project will be planned according to the requirements of the Yangon City Development Committee (YCDC) for building development within Yangon City.

2-2-1-5 Policy relating to the Use of Local Material

The major materials and equipment for building construction are to be selected among locally available items, except for some special electrical equipment and machinery. Therefore, the construction plan for the Project will be designed based on local products or imported products in local market.

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

(1) Policy for Operation and Maintenance of Equipment

Although teaching staff at YTU/MTU is responsible for taking care of the equipment, the assignment of a professional technician for each department is necessary for operation and maintenance. The management system shall be structured by the commencement of the installation work.

For some equipment procured under the Project, securing safety and the frequent monitoring of accuracy and repair will be necessary. When such necessity arises, a skilled engineer from the manufacturer shall be dispatched. The activities of on-going TCP will also enhance YTU/MTU staff's ability to operate and maintain the equipment. Moreover, within the scope of the Project, operation training will be organized to familiarize the staff with basic operation and maintenance.

(2) Policy for Operation and Maintenance of Facilities

Although there is the division for operation and maintenance of facilities at YTU, it can only carry out simple procedures. To ensure sustainability, simple equipment for building service, which does not require complex operation and maintenance, will be selected. Moreover, affordable and available consumables and spare parts in the local market will also be considered.

2-2-1-7 Policy of the Level of Equipment and Facilities

(1) Policy of the Level of Equipment

YTU and MTU are the leading engineering universities in Myanmar, where many teaching staff hold doctorates and/or master's degree. The graduates from YTU/MTU are acknowledged for their ability to serve in the managerial positions of governmental organizations and firms. The purpose of some equipment planned for the Common Measuring Equipment Building and Civil and Electrical Engineering Building at YTU shall be research and development linked with TCP activities. Therefore, current teaching staff will gain many opportunities to exercise their skills, eventually providing technical services for inspections and testing for the business sector.

(2) Policy of the Level of Facilities

The level of the proposed building and utilities shall be determined by referring to the design and specification of existing and similar buildings and placing priority on usage, operation and maintenance, and durability. A minimum level of functionality shall be provided for the laboratory.

2-2-1-8 Policy relating to Construction Methods, Procurement Methods and Construction Schedule

(1) Construction Methods

Local construction techniques in Myanmar have made great progress in recent years. The Project will take advantage of such local construction techniques, which ensure quality and lowered costs.

(2) Construction Schedule

Construction work may be suspended during the Myanmar New Year holidays (10 days in the middle of April), and progress might be delayed during the rainy season from May to September (especially from June to August). These circumstances will be taken into account

while the construction schedule is being planned.

2-2-2 Basic Plan (Equipment/Construction Plan)

2-2-2-1 Equipment Plan

(1) Outline of Design Policy

Regarding the equipment procured for the Project, equipment for advanced engineering subjects (G4 or above of the (COE) B.E. Program) and practical research and development that helps build the capacity of industrial human resources shall be selected.

1) Basic Priority

1. Equipment for education in advanced engineering subjects necessary for the implementation of the (COE) B.E. Program of YTU/MTU
2. Equipment for educational, research, and development purposes necessary for master and doctoral programs at YTU/MTU
3. Equipment for research and development necessary for accumulating knowledge and for development by local teaching staff at YTU/MTU

2) Selection Criteria

Through discussions with the Myanmar side during the site survey, the validity and the priority of each requested equipment item have been confirmed as follows.

- The equipment is consistent with the contents of education and research, methods, and curriculum of the targeted departments.
- The equipment is consistent with the technical level of teaching staff in utilizing the equipment.
- The equipment has a relatively long-life-value in the market and will not become obsolete rapidly.
- The equipment does not need frequent replacement of expensive consumables.
- The equipment is able to be managed under proper maintenance conditions by technicians of each department.

3) Procedures for selecting the equipment

For further analyzing of the validity of the requested equipment, the following selection criteria have been considered.

- Almost all of the equipment necessary for AY2015/16 (4th Year) and AY2016/17 (5th Year) from the list above and the advanced equipment necessary for the other academic years.
- Equipment for education and research necessary for masters and doctoral degrees from YTU/MTU and/or equipment that does not need expensive consumables and spare parts.
- Equipment that can be used for technical services such as inspections and testing to be

offered to private companies.

In the course of drafting the planned equipment list, other equipment has been added to contribute further to the Project's purpose. PC-related equipment, etc. shall be procured using the budget of TCP and excluded from the Project.

Furthermore, the following equipment has been deleted from the requested equipment list.

- Equipment that has already been donated or that will be donated by other partners.
- Equipment which can be substituted for other requested equipment or for which there is overlap with other requested equipment.
- Equipment which has no other equivalent product and there is no justifiable reason for designating a specific model.
- Equipment that is not used frequently and widely and/or is not cost-effective.
- Equipment that can be made by teaching staff and/or students.
- Equipment that is difficult to be included in the Project due to budget limitations or that requires major improvement of the facilities.

4) Criteria for Quantity

Regarding equipment quantities, necessary amount depends on the equipment's primary usage and its frequency of use (number of groups, the cycle set in class). An appropriate amount has been determined through discussions with each department of YTU/MTU based on the number of students in class and the number of groups engaging in experiments and practical sessions.

The current situation of the existing equipment and the policy for planning the new equipment are summarized in the Table 2-1 below.

5) Measures for Power Supply Variation

Regarding the variation of power supply at YTU/MTU, the level of variation is around +/-10%. For utilizing general practical equipment, the variation will not cause any major problem. However, for the following equipment with delicate functions, AVR (Automatic Voltage Regulator) and/or UPS (Uninterruptible Power Supply) with AVR function shall be attached.

- Milling machine, lathe, factory automation trainer, Scanning electron microscope, liquid nitrogen generator, powder x-ray diffraction spectrometer, X-ray fluorescence spectrometer

6) Review of Equipment Location Installation

① Equipment for YTU

The existing laboratories at YTU are located in buildings more than 50 years old. For some planned equipment, there is no appropriate place for installation in the existing buildings. The following table shows the categories of the planned equipment in terms of building services and infrastructure, and the results of the review.

Table 2-1 Consideration for Places where the Equipment to be installed

	Category of Equipment	Results of Review
A	Small and light equipment that requires improvement of infrastructure such as electrical capacity, etc.	After repairing internal finishing, building service infrastructure, and external equipment, etc., equipment shall be installed in existing laboratories.
B	Large and heavy equipment with impact and/or vibration.	Categorized as follows by structure testing:
		①Equipment to be installed in the existing laboratories located in buildings where sufficient concrete strength has been confirmed.
		②Equipment that cannot be installed in the existing buildings will require a new building.
C	Equipment that requires the addition of special infrastructure such as drainage, neutralization chambers, high voltage wires, etc.	Equipment requires a new building since it cannot be installed in the existing buildings.
D	Equipment that requires a special structure such as a large space, underground pit, etc.	Equipment requires a new building since it cannot be installed in the existing buildings.
E	Equipment that requires a special room with features such as constant temperature environment, etc.	Categorized as follows by type of the equipment:
		①Equipment which needs to cut off outside effects such as electromagnetic shields, vibration, etc.
		②Equipment for which the conditions above do not need to be considered.

Based on the review above, it is judged that the equipment in category A and B① can be installed in the existing buildings. However, the equipment in category B②, C, D, and E require a new building. Furthermore, equipment which needs to cut off outside effects such as electromagnetic shields, vibration, etc., shall be installed in a building separated from other buildings.

②Equipment for MTU

The buildings where the existing laboratories are located are relatively new. As almost all buildings are single-story and the equipment shall be installed on an earthen-floor, heavy equipment can be installed in the existing laboratories. Furthermore, infrastructure conditions such as the availability of an extra high voltage supply are also sufficient.

Therefore, all the equipment procured in the Project shall be installed in the existing buildings.

7) Equipment Planning Policy for YTU

Table 2-2 shows the equipment planning policy for YTU.

Table 2-2 Equipment Planning Policy for YTU

【Equipment which can be installed in the existing buildings at YTU】

Department	Equipment Planning Policy
Civil Engineering	Items provided for soil, concrete, structure, hydraulics, and environment.
Mechanical Engineering	A Brinell Rockwell hardness tester, universal vibration apparatus, structural dynamic experiment set, and environmental handheld meters, etc. shall be provided.
Electrical Power Engineering	Basic measuring equipment such as an AC/DC power supply, load module, motor experiment module, etc. shall be provided.
Electronic Engineering	Item such as modular laboratories, control technology training kits, and a PCB prototyping machine shall be provided.
Information Technology	Items such as microprocessor trainers, embedded network trainers, signal processing trainers, etc. shall be provided, not including equipment that has been duplicated by other donors.
Mechatronic Engineering	Items such as industrial electronic and electrical trainers, power electronics trainers, bio-measuring systems, etc. shall be provided

【Equipment which cannot be installed in the existing buildings at YTU】

Department	Equipment Planning Policy
Civil Engineering	For testing concrete and metal materials in the field of civil engineering and construction, items such as a structure testing system (including 500kN dynamic jack set, 5000kN static jack set, frame set, and measuring and control set), static displacement measuring system for structure testing system, dynamic displacement measuring system for structure testing system, vibration testing machine, 2000kN universal testing machine, 200kN fatigue testing machine, etc. shall be provided.
	For analyzing soil samples in the field of civil engineering and construction, items such as an air tank, standard triaxial compression testing machine, drying oven, distillation machine, automatic compaction testing machine with CBR testing machine, electric balance, etc. shall be provided.
	For testing concrete materials in the field of civil engineering and construction, items such as a 1000kN concrete beam bending testing machine, 2000kN compression testing machine, concrete mixer, slump testing machine, mortar mixer, etc. shall be provided.
	For testing of aggregates in the field of civil engineering and construction,

	items such as an aggregate test sieves set, aggregate measure, coarse aggregate specific gravity test apparatus, thermostatic constant humidity chamber for alkali aggregate, etc. shall be provided.
	For testing of fluid characteristics in the field of civil engineering and construction, items such as a wind tunnel, etc. shall be provided.
Electrical Power Engineering	For testing in the field of electrical distribution, items such as a high voltage system, oscilloscope, etc. shall be provided.
Electrical Power Engineering/ Electronic Engineering/ Mechanical Engineering/ Mechatronic Engineering/ Information Technology/ (Common equipment for the above departments)	For the observation of the structure of elements of metal materials, items such as a scanning electron microscope, ion coating machine, etc. shall be provided.
	For the vacuum coater and manual prober, items such as a liquid nitrogen generator, pressurized system liquid nitrogen container, etc. shall be provided.
	For calibration of measuring equipment, items such as a standard volume JCSS reference device thermometer, standard signal generator, analytical electric balance, electric balance, etc. shall be provided.
	For analyzing molecule structure in the field of electric, electronics and semiconductors, items such as a multi-channel spectrometer, Fourier transform infrared spectrophotometer, UV-visible spectrophotometer, Raman spectrophotometer with microscope, etc. shall be provided.
	For design practice for semiconductor devices, items such as a high frequency sputtering system, vacuum coater, clean booth, digital microscope, fume hood, etc. shall be provided.
	For the visualized observation of fluid characteristics, items such as a YAG laser measuring machine, etc. shall be provided.
	For bio-engineering research and development in the field of Mechatronics, items such as an equipment locker, laboratory table, etc. shall be provided.
	For analyzing elements in the field of environmental engineering, items such as a gas chromatography machine, liquid chromatography machine, atomic absorption spectrophotometer, etc. shall be provided.
	For measuring parameters in the field of electric and electronics, items such as an impedance meter, power analyzer, curve tracer, manual prober, frequency counter, etc. shall be provided.
	For analyzing elements of metal materials, items such as a powder X-ray diffraction spectrometer, X-ray fluorescence spectrometer, etc. shall be provided.
	For chemical experiments and research and development in each field, items such as a laboratory table with chemical shelf, fume hood, etc. shall be provided.

8) Equipment Planning Policy for MTU

Table 2-3 shows the equipment planning policy for MTU.

Table 2-3 Equipment Planning Policy for MTU

Department	Equipment Planning Policy
Civil Engineering	Items for soil experiments such as compression test apparatus, for hydraulic experiments such as a hydraulic engineering experiment set, and for environmental analysis such as a water bath, etc.
Mechanical Engineering	Items such as a vertical milling machine (medium and small), boring machine, etc. shall be provided.
Electrical Power Engineering	Items such as a PLC module for the control of industrial process, basic generator protection equipment set, etc. shall be provided.
Electronic Engineering	Items such as a modular laboratory, PCB prototyping machine, control technology training kit, etc. shall be provided.
Information Technology	Items such as a microprocessor trainer, PC hardware trainer, etc. shall be provided.
Mechatronic Engineering	Items such as an industrial electronic and electrical trainer, power electronics trainer, factory automation trainer, etc. shall be provided.

(2) Plan for YTU

1) Equipment

The outline of the planned equipment and its purpose of use are as follows.

Tentative Plan for YTU

Table 2-4 List of Major Equipment for YTU

【For Existing Buildings of YTU】

Department	Description	Purpose of Use	Qty
Civil Engineering	Electric heating furnace	For drying soil samples for testing in high temperatures	1 set
	CBR testing machine	For CBR testing by penetrating a 5cm diameter piston into a soil sample	2 sets
	Incubator	For storing samples for soil testing at constant temperature conditions	1 set
Mechanical Engineering	Brinell Rockwell Hardness Tester	For testing both of Brinell hardness and Rockwell hardness of metal materials	1 set
	Charpy and Izod Impact Testing Unit	For testing metal materials with high shock resistance using the parameters of absorbed energy at shock occurrence	1 set
	Universal Testing Machine	For testing tension, pressing, and bending of metal materials by mechanical power generated by a motor	1 set

	Engine Research and Test Bed	For experiments on the characteristics of output power conducted by reproducing engine driving conditions	1 set
Electrical Power Engineering	Basic Generator Protection Equipment Set	For basic experiments in controlling generators	1 set
	PLC Module with Software	For basic experiments in controlling methods of PLC sequencing, etc.	2 sets
	Spectrum Analyzer	A device for showing a two-dimensional graph of the X-axis of frequency and the Y-axis of electric power and/or voltage	3 sets
Electronic Engineering	Vector Signal Generator	For generating vector signals for various communication systems	2 sets
	PCB Prototyping Machine	For experiments in processing printed circuit boards	1 set
	Power Electronics and Electrical Motors Machine Lab.	For experiments in the rectification of a power supply such as conversion from AC to DC	2 sets
	Modular Laboratory	For experiments in assembling electrical-controlled basic logic circuits	5 sets
	Signal Analyzer	A device for detecting irregular waves and measuring high-speed signals	2 sets
	Network Analyzer	For measuring the characteristics of frequency of passing and reflecting power in high-frequency networks	2 sets
Information Technology	Microprocessor Trainer	For experiments of logic in IC control devices and configurations	4 sets
	PC Based Basic Electricity & Electronics Trainer	For basic experiments on AC/DC circuit, AC-DC/DC-AC conversion, transistors, amplifiers, etc.	4 sets
	Digital Signal Processing Trainer	For experiments of logic in digital signal processing and configurations	4 sets
	Embedded Network Experiment Apparatus	For experiments in digital communication protocol and development of internet installation boards	4 sets
Mechatronic Engineering	Industrial Electronic and Electrical Trainer	For experiments in assembling electric-controlled circuits of industrial fields	1 set
	Power Electronics Training System	For experiments in the rectification of a power supply such as conversion from AC to DC	1 set
	Factory Automation Trainer	For experiments in module-configuration relating to factory automation	1 set

	Advanced FPGA Development System	For assisting in the development of integrated-circuit programming for process control	1 set
	Biomedical Measurement and Data Acquisition System	For measuring biological data such as SPO2 and ultrasound, electrocardiograph, respiration system, blood pressure, etc.	1 set

【For New Buildings of YTU】

Department	Description	Purpose of Use	Qty
Electrical Power Eng./ Electronic Eng./ Mechanical Eng./ Mechatronic Eng./ Information Technology/ (Common equipment for the above departments)	Scanning Electron Microscope	For analyzing elements included in samples with an electron level	1 set
	Liquid Nitrogen Generator	For generating liquid nitrogen directly from the air for various experiments and research activities	1 set
	Pneumatic Pressure Standard with Air Compressor	For generating standard pneumatic pressure	1 set
	UV-Visible Spectrophotometer	For conducting quantitative analysis by measuring an absorbed spectrum of samples with UV-Vis light	1 set
	YAG Laser Measuring Machine	For measuring dimensional-velocity ingredients by visualizing gas flow, etc.	1 set
	X-ray Fluorescence Spectrometer	For analyzing elements of samples using fluorescence X-ray	1 set
Civil Eng./ Electrical Power Eng. (Civil and Electrical experimental equipment)	Structure Testing System	For testing the strength of static and dynamic properties of construction materials	1 set
	Vibration Testing Machine	For testing vibration-resistance of samples on a table applying horizontal vibration	1 set
	1000kN Concrete Beam Bending Testing Machine	For testing concrete beam samples on 4-point bending strength	1 set
	2000kN Compression Testing Machine	For experiments on strength in concrete samples conducted by applying pressure and bending loads	1 set
	2000kN Universal Testing Machine	For experiments on tension, pressure, and bending conducted by measuring the strength of metal materials	1 set
	200kN Fatigue Testing Machine	For experiments on the tension of samples and pressing directional fatigue of various materials	1 set

	Wind Tunnel	For experiments on the influence of air flow around the sample	1 set
	High Voltage Experiment Equipment	For experiments on insulation-resistance by sparkling AC/DC high voltage discharge and lightning discharge	1 set

2) Outline of the Building Planning

Table2-5　Basic Requirements of Major Rooms（YTU）

Building	Room Name	Basic Requirements
Common Measuring Equipment Building （YTU）	Microstructure Observation Room	A scanning electron microscope is used to observe the outermost surface of samples at the nano level. It needs to be free from electromagnetic waves, temperature change, and vibration.
	Standard Measurement Equipment Room	Working space and equipment storage racks for calibration activities are required.
	Preparation Rooms	Instrument shelves and testing tables are required according to the size of the room.
	Optical Measuring Chamber Room	To measure various values relating to light using a spectroscope and other equipment, this room shall be a dark room.
	Electric Design and Fabrication Room	Clean booth and a work space are required to design and assemble semiconductor substrate.
	Biomedical Measurement Room	Various measurements and observations of living creatures including body temperature, EMG, brain waves, etc. are carried out.
	Electrical Electronic Properties Evaluation Room	Electric current, voltage, impedance etc. are to be measured. All processes from sample preparation to an analysis are to be carried out.
	X-Ray Measuring Chamber	Various X-ray measurements are to be carried out. A dedicated preparation room should be provided.
	General-purpose Laboratory	Common room among all disciplines as a standard laboratory.
	Department rooms	This room is for the staff for operations and management of measuring equipment.
	Server Room	LAN facilities are to be installed in new buildings.
	Nitrogen Production Room	A liquid nitrogen production device, which is used for various experiments is to be installed.
Civil and Electrical Engineering	Structural Testing Room	This room accommodates a reaction wall/floor, a shaking table, and a universal testing machine, etc. It is necessary to ensure enough space for this equipment and an overhead travelling crane.

Building （YTU）	Measuring/ Control Room	The control units for the hydraulic jacks, etc. used in the Structural Testing Room and various data collectors are to be installed here.
	Hydraulic Power Source	The hydraulic power source for the jacks and shake-table used in the Structural Testing Room are to be installed.
	Ground Model Room	This room should be located on the ground floor in order to share the shake-table in the Structural Testing Room.
	Soil Basic Lab	Various soil experiments (under non-constant temperature) are carried out. This room should be planned to be as large as possible, for future changes in the layout.
	Thermostatic Room	Various soil experiments (under constant temperature) are carried out.
	Concrete Mixing Room	The properties of fresh concrete etc. are tested. Easy conveyance of materials is required. In the lower level of this room a neutralization tank should be installed.
	Concrete Curing Room	A water tank for the curing of concrete test pieces should be installed.
	Concrete Testing Room	In order to bring the test pieces from outside, this room should be located in an area which ensures easy transport of the carriage.
	Cement Storage	This room is used as storage space for the cement used in the concrete mixing tests, etc.
	High Voltage Room	The size of the room should be big enough to accommodate the equipment with the headspace open to a height of two floors.
	Wind Testing Room	This room size should be big enough for the installation of the equipment and the materials for wind tunnel testing.
	Department rooms	This room is for the staff for operations and management of equipment.
	Electrical Room	This room accommodates a switchboard, an automatic voltage regulator, and an emergency generator common throughout the new buildings.

(3) Plan for MTU

1) Equipment

The outline of the planned equipment and its purpose of use are as follows.

Tentative Plan for MTU

Table 2-6 List of Major Equipment for MTU

Department	Description	Purpose of Use	Qty
Civil Engineering	Standard compression testing machine set	For testing concrete beam samples on 4-point bending strength	1 set
	CBR testing machine	For CBR testing by penetrating a 5cm diameter piston into soil samples	1 set
	Incubator	For storing samples for soil testing at a constant temperature	1 set
	Hydraulic bench with accessories	For testing water hammer phenomena, the power of hydraulics, and for conducting various experiments	1 set
Mechanical Engineering	Vertical Milling Machine (Medium)	For milling metal materials with a vertical processing device	1 set
	Universal Cylindrical Grinding Machine	For grinding a wide range of metal materials with various grindstones	1 set
Electrical Power Engineering	Modular Trainer for Electro technics	For basic experiments in electrical engineering such as power distribution, switch dynamics, etc.	1 set
	Spectrum Analyzer	A device for showing a two-dimensional graph of the X-axis of frequency and the Y-axis of electric power and/or voltage	2 sets
Electronic Engineering	PCB Prototyping Machine	For experiments on processing a printed circuit board	1 set
	Power Electronics and Electrical Motors Machine Lab.	For experiments on the rectification of a power supply such as conversion from AC to DC	3 sets
	Modular Laboratory	For experiments on assembling electrical-controlled basic logic circuits	6 sets
Information Technology	Microprocessor Trainer	For experiments on logic in IC control devices and configurations	2 sets

	Local Area Network Trainer	For experiments on basic Ethernet communication systems	2 sets
	PC Based Basic Electricity & Electronics Trainer	For basic experiments on AC/DC circuits, AC-DC/DC-AC conversion, transistors, amplifiers, etc.	2 sets
	Digital Signal Processing Trainer	For experiments on logic in digital signal processing and configuration	2 sets
	Communication System Trainer	For experiments on the principles of analog and digital communication	2 sets
Mechatronic Engineering	Industrial Electronic and Electrical Trainer	For experiment on assembling electric-controlled circuits in industrial fields	1 set
	Power Electronics Training System	For experiments on the rectification of a power supply such as conversion from AC to DC	1 set
	Factory Automation Trainer	For experiments on module-configuration relating to factory automation	1 set

(4) Existing YTU laboratories to be renovated to install new equipment by the Myanmar Side

Civil Engineering Department:
Soil Mechanics Laboratory, Construction Material Laboratory, Environmental Laboratory, Hydraulic Laboratory, Structural Laboratory

Mechanical Engineering Department:
Strength of Materials Laboratory, Machine Shop, Refrigeration & Air Condition Laboratory, Thermo Dynamics Laboratory, Vice president preparations room (Robot), Mechanical Laboratory

Mechatronic Engineering Department:
Mechatronics Laboratory, Electronics Laboratory

Information Technology Department:
IT, Communication Network Laboratory

Electronic Engineering Department:
Control Engineering Laboratory, Microcontroller and Microprocessor Laboratory, Fundamental Laboratory, Communication Laboratory, Power and Industrial Electronics Laboratory

Electrical Power Engineering Department:

High Voltage Laboratory, Measurement & Instrumentation Laboratory, Electrical Machine Laboratory, Power Electronics & Drive Laboratory, Power System Laboratory, Elementary Laboratory, Renewable Energy System Laboratory, Electrical Power Laboratory

2-2-2-2 Building Plan

(1) Sites: Building Location Planning

The equipment to be procured through Japanese Grant Aid under the Project is assessed by installation conditions. New buildings will be planned to give appropriate installation space for the equipment judged not suitable for accommodation in the existing buildings. Equipment without special installation conditions such as equipment for the (COE) B.E. Program can be installed in existing laboratories, the finishing and utilities will be renovated upon confirming existing conditions.

Equipment with special installation conditions are classified to two categories. The first type needs a durable environment for heavy loads, vibration, special utilities, large workshops, and thermostatic control. The other type needs protective environment such as electromagnetic shields or a vibration-free structure. Consequently, two detached buildings to accommodate the equipment of each category are to be provided.

Site A： Common Measuring Equipment Building (provisional name)

Site A is surrounded by covered corridors and a gigantic tree. On the west of the site is sloping ground. The building should be planned considering intensive land use with the proper setbacks from the corridors and the slope. The building will be 5 stories high to meet the minimum requirements of the rooms.

Because there is a 3 m height difference within the site, the main entrance will be planned on the first floor, which can provide direct access from the parking area. The sub-entrance will provide access from the corridor connected to the No. 5 Building.

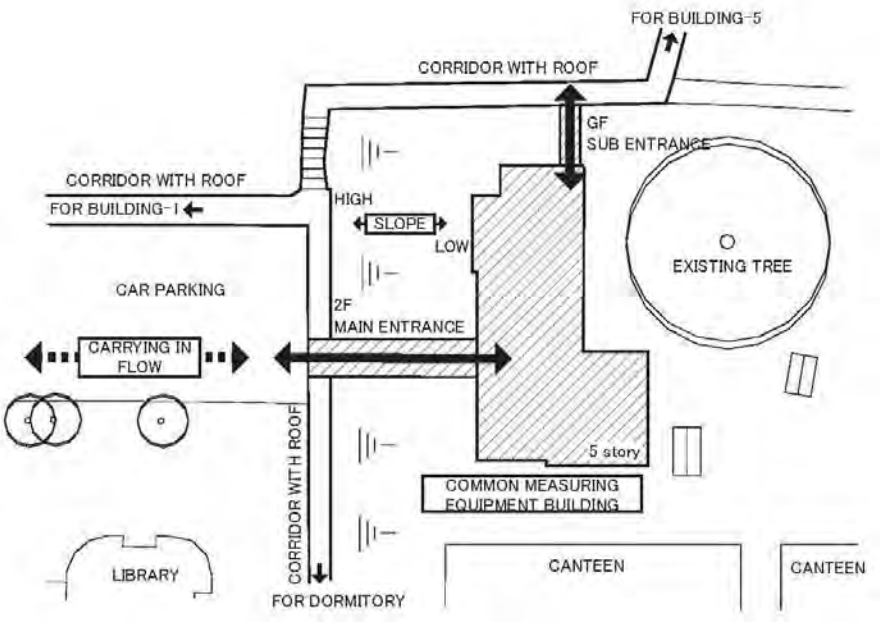


Fig 2-2 Site A Plan

Site B：Civil and Electrical Engineering Building (provisional name)

Because there are trees not only in front of the existing pond, but also along the roads on the site, an appropriate setback from the trees should be taken into account in the plan. A stepped setback of the façade will be designed to reduce the oppressive feeling by people walking in front of the building.

Transport vehicles such as trucks can directly access the building through the internal road on the site for transporting heavy equipment.

In addition, an auxiliary building comprising an electrical room and a machinery room will be planned on Site B to provide the electricity and water supply needed on both Sites A and B.

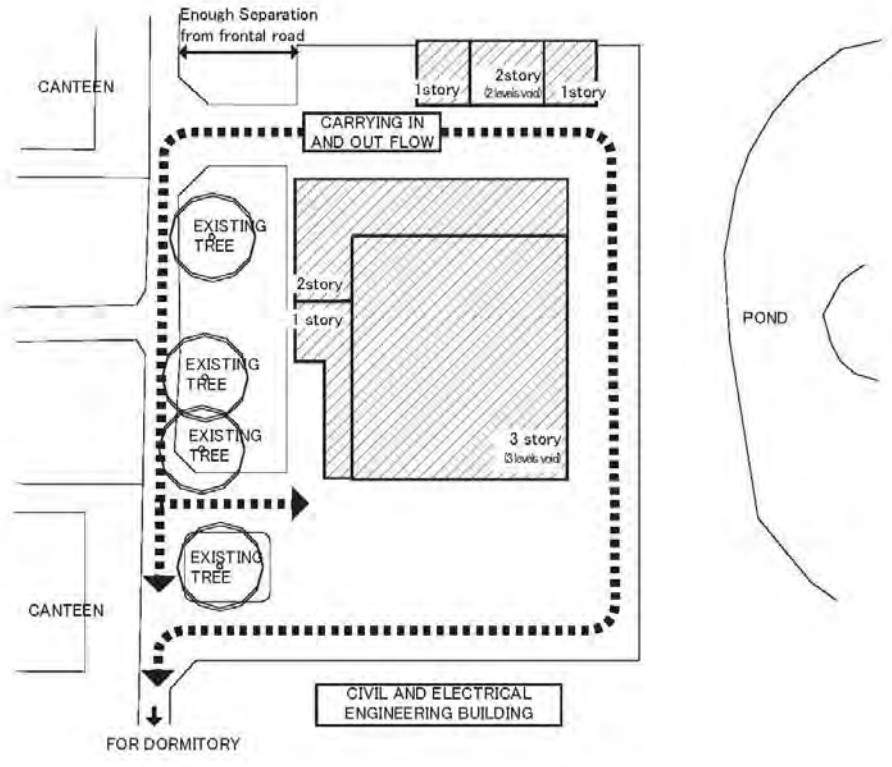


Fig 2-3 Site B Plan

(2) Architectural Planning

1) Floor Plan

Site A： Common Measuring Equipment Building (provisional name)

Since the land is limited, it is necessary to minimize the common space to make maximum use of the inner spaces for the laboratory. The plan will be a simple configuration with the laboratories arranged along the corridor, which opens to the outdoor space.

It is planned to have 3 or 4 laboratories on each floor by ensuring minimum room space for each laboratory. The laboratories that need special experimental environments and that are easily affected by the outside environment will be arranged on each floor. These laboratories should be windowless, and the walls should have features such as heat insulation, light insulation, or electromagnetic shields.

In order to reduce heat in the building, rooms which do not require windows are located on the east and west sides. The central part of the building utilizes the north-south ventilation. To protect the building from direct exposure to sun and rain, external corridors and balconies are provided on the northern and southern sides of the buildings. Furthermore, the corridors and balconies are designed with hanging eaves.

Elevators will also be installed for transporting devices for experiments, as well as test samples and liquid nitrogen. Stairs will be provided at both ends of the corridor to ensure evacuation routes in two directions.

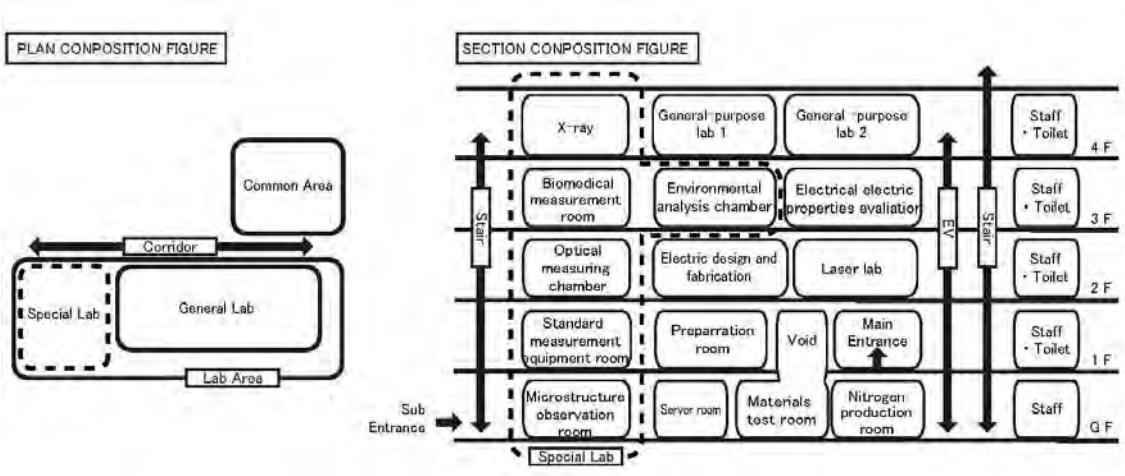


Fig 2-4 Common Measuring Equipment Building　Basic Construction Diagram

Site B：Civil and Electrical Engineering Building (provisional name)

The laboratory building will be a 3-story building containing a concrete testing area, soil properties testing area, and wind testing areas on each floor. The structural testing area will require three stories in height. The structural testing area is planned in a manner that minimizes the effects of the noise and vibrations it causes. As the High Voltage Room will have high demands for electricity, it will be close to the Electrical Room in the auxiliary building. The Structural Testing Room will be planned with reaction walls and floor.

Laboratories that use heavy devices that need to be moved frequently will be placed on the ground floor. The room will be planned as large as possible to enable flexible usage in the future.

In order to share the experiment devices, interconnected rooms are planned with each room having a separate entrance. Stairs will be provided at both ends of the corridor to ensure evacuation routes in two directions.

Industrial vehicles such as cranes can directly access the building through the internal road on site for the transportation of heavy equipment.

Heavy devices can be lifted up to the soil properties testing area on the first floor through the structural testing room by a ceiling crane. The heavy devices can also be brought into the wind testing area on the second floor by chain hoist.

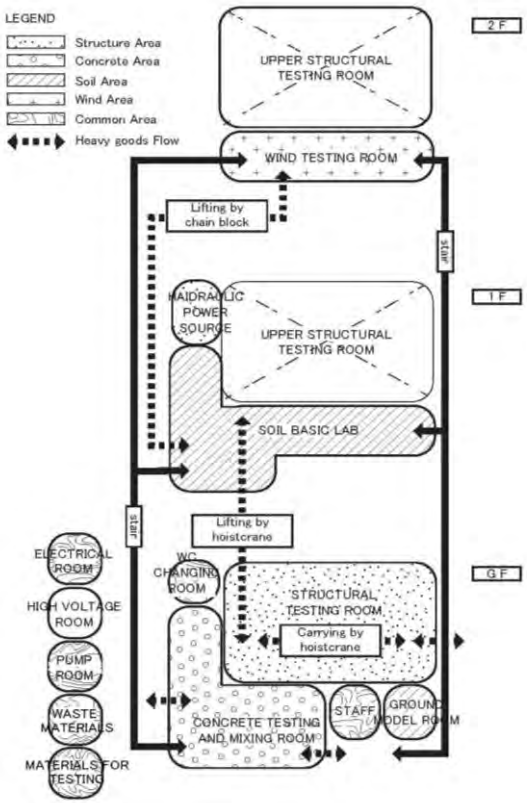


Fig 2-5 Civil and Electrical Engineering Building Basic Construction Diagram

In order to provide protection from direct sunlight and rainfall, eaves and louvers are to be installed on the building facades facing the front road side. Natural ventilation is introduced through the void in structural testing room located in the central part of the building.

The main rooms in the Common Measuring Equipment Building and the Civil and Electrical Engineering Building are as follows.

Table 2-7 Main Rooms in the Common Measuring Equipment Building

Depart-ment	Floor	Name of Room	Floor Area	Remarks
Common testing	G	Microstructure Observation Room	69	It is possible to observe the outermost surface of samples at the nano level using a scanning electron microscope. The entire observation process, which consists of sample making, observation, and data archiving, is carried out here. It is necessary to provide protection from electromagnetic waves, temperature and humidity control, and protection against vibration in order to install the electron microscope.
	1	Standard Measurement Equipment Room	69	In this room the management of standards for calibration (standard volume meter, standard scales, standard thermometer, standard pressure tester, etc.) and the calibration of the equipment are carried out. Shelves for storing the standards and work space for calibration of the standards should be secured.

	3	Environmental Analysis Room	54	Microanalysis (detection) of the atmosphere/liquids and the measurements of metallic element concentrations in samples are carried out here. The equipment installed requires dry and wet bulb temperature conditions and local ventilation; various types of specialty gases are used. Everything from the preparation of samples to measurement is carried out here.
	4	General-purpose Laboratory (1)	60	This room must have standard laboratory equipment (testing table, shelves for equipment and materials, fume hoods, etc.) installed to be used by all departments. In addition, General-purpose laboratory (1) should have a space to deal with large-size samples.
		General-purpose Laboratory (2)	45	
	1	Preparation Rooms	39	Instrument shelves and testing tables should be positioned according to the size of the room.
	2		40	
	3		25	
Machinery	G	Standard Measurement Equipment Room	90	The impact of tension, compression, torsion, etc., on a substance is examined by exerting a high level of pressure on the substance over prolonged periods of time. This room should have enough space for the installation of a universal testing machine and a fatigue testing machine, etc. for the preparation of test pieces.
	2	Laser Lab	47	The processing of metal plates (welding, cutting) using YAG laser and laser measuring/analysis are carried out here. In addition, the preparation of the metal plates as test pieces is carried out.
	4	X-Ray Measuring Chamber	90	Observations are carried out to clarify the elemental composition of substances of unknown structure. An x-ray machine is used to carry out the quantitative analysis of a substance (crystal). An x-ray fluorescence spectrometer is used to analyze the types and concentrations of the elements comprising mainly non-organic solid bodies. As observation using x-ray equipment requires the sample to be pulverized or to have a smooth surface, a dedicated preparation room will be provided.
Electrical	2	Optical Measuring Chamber Room	38	As various values relating to light (light flux, luminance, luminosity, etc.) will be measured using a spectroscope and other equipment, this room will be a dark room.
		Electric Design And Fabrication Room	70	Every process is carried out here, from the design of semiconductor substrates, etc. to their manufacture and assembly. The equipment and materials for manufacture should be provided, as well as a clean space for assembly and a space for preparatory work.
	3	Electrical Electronic Properties Evaluation Room	46	Electric current, voltage, impedance, etc. are measured. The equipment installed should use liquid nitrogen. All processes from sample preparation to measurement and analysis are carried out.
Mechatronic	3	Biomedical Measurement Room (1)	40	Various measurements and observations of living creatures are carried out including body temperature, EMG, brain waves, etc.

		Biomedical Measurement Room (2)	29	
Infra-structure	G	Server Room	7	LAN facilities are installed in this room for the Common Measuring Equipment Building and the Civil and Electrical Engineering Building.
Auxiliary	G-4	Department rooms (5)	27 x5 rooms	Assuming that dedicated staff will be assigned to three laboratories on each floor, department rooms should be for three persons to use. The area planned per person will be 9 m^2 including working space.
	1	Meeting Room	28	A meeting space with seating for 12 persons or so should be planned.
	G	Nitrogen Production Room	7	Facilities for liquid nitrogen production should be installed as it will be used for the electron microscope and in other laboratories. Enough space will be set aside for the installation of production facilities and to allow for the work of transferring the liquid nitrogen into containers for its transport to other locations.
		Blowers Room	7	Air blowers for the septic tank should be installed.
		Storage Room	15	Storage of consumables and supplies.
	1-4	Bathrooms	11 x4 rooms	Toilet facilities for males will be positioned on the first and third floors, and for females on the second and fourth floors. It is planned to equip each toilet facility with the minimum required amount of sanitary equipment.

Table 2-8 Main Rooms in the Civil and Electrical Engineering Building

Depart-ment	Floor	Name of Room	Floor Area	Remarks
Structural	G	Structural Testing Room	353	This room will be comprised of a reaction floor measuring approximately 13m x 10m, an L-shaped reaction wall approximately 5m x 8m and 5m high, a shake-table with a loading platform measuring approximately 1m x 1.5m, a universal testing machine work space, and fatigue testing machine work space. An overhead travelling crane with a 10t live load should be installed. The plan should allow for large-size test specimens to be brought in and out directly by truck. The headspace should be open to a height of 3 floors.
		Measuring/ Control Room (including Anteroom)	38	Storage for the control units for the hydraulic jacks and shake-table used in the Structural Testing Room and equipment for the collection of data from the measurement of deformation, etc. Access to and from the Structural Testing Room should be through the Anteroom.
	1	Observation Balcony	48	A space for observation of structural testing which should be installed in the upper floor of the Structural Testing Room,

				with access via stairs. This space should also be used for unloading into the Soil Basic Lab using the overhead travelling crane.
		Hydraulic Power Source	47	The hydraulic power source for the jacks and shake-table used in the Structural Testing Room should be positioned here. Taking into account the updating of the equipment, the entrance will be located in the exterior wall.
Concrete	G	Concrete Testing Room	101	Strength testing, durability testing, and mortar testing, etc. will be carried out here. On the assumption that test pieces will be brought in from outside, planning should allow for the easy transport of test pieces and materials on trolleys, etc.
		Concrete Mixing Room	96	The properties of fresh concrete, etc. will be tested here. Positioning and the opening should be planned so as to allow the easy conveyance of materials from the materials storage area located in the back yard. In the lower pit level of this room should be installed a neutralization tank for the alkali wastewater generated in the mixing of the concrete.
		Cement Storage	16	Storage for the cement used in the concrete mixing tests, etc.
		Concrete Curing Room	15	A water tank for curing concrete test pieces will be installed. Heating and cooling equipment should be installed in order to provide a curing environment at any temperature desired.
Soil Properties	G	Ground Model Room	37	This room should be located on the ground floor in order to enable shared use of the shake-table installed in the Structural Testing Room.
	1	Soil Basic Lab	127	The equipment and materials needed for various soil property experiments were divided between the Thermostatic Room and the non-Thermostatic Room, according to the environment in which they are used, and placed accordingly. The plan should be for the room to be as large as possible, allowing for future changes in the layout. It is planned that heavy items being brought in will be unloaded from the overhead travelling crane onto the Observation Balcony of the Structural Testing Room, after which they will be brought into the Soil Basic Lab.
		Thermostatic Room	84	
		Compressor Room	14	The power source for the Soil Basic Lab and the equipment used in the Compressor Room should be installed here. Taking into account the updating of the equipment, the entrance should be located in the exterior wall.
Wind	2	Wind Testing Room	146	The size of the Testing Room should be sufficient for the installation of equipment and materials for wind tunnel testing in appropriate proportions. A space allowance should also be made for the preparation of experimental models.

Electrical	G	High Voltage Room	38	The size of the room should be the minimum necessary, including the AC/impulse power source and peripheral equipment, with the headspace open to a height of two floors. Taking electrical power consumption into consideration, the room should be planned inside the auxiliary building with the Electrical Room.
Infrastructure	G	Electrical Room	35	The distribution boards, automatic voltage regulators, and emergency generators for the Common Measuring Equipment Building and the Civil and Electrical Engineering Building will be installed here. It is planned to build the room inside the auxiliary building.
		Pump Room	35	The water supply pumps and fire water pumps for the Common Measuring Equipment Building and the Civil and Electrical Engineering Building should be installed here. It is planned to build the room inside the auxiliary building.
Auxiliary	G	Meeting Room	17	A meeting space with seating for 8 persons or so should be planned.
		Changing Room	10	It is planned to provide lockers for between 12 and 16 persons, both male and female.
		WC	20	It is planned to equip both male and female toilet facilities with the minimum required amount of sanitary equipment.
		Department rooms	19	Allowing 9 m^2 per person including work space, it is planned to provide a department room for 2 on the ground floor and a department room for 5 on the first floor.
	1		46	

2) Section Planning

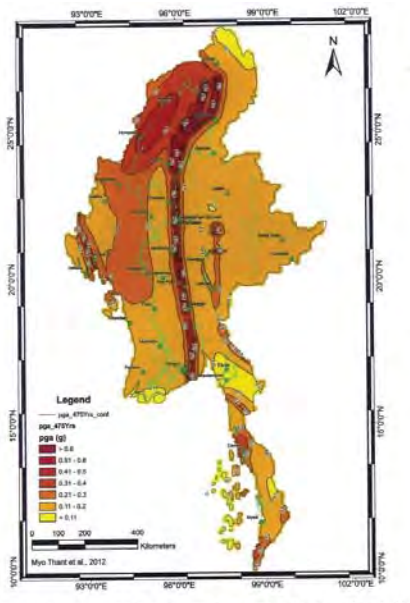
It is planned to use the entire space between floor slabs without suspended ceilings to ensure flexible installation of equipment.

Eaves and screens will be installed in corridors and windows to provide protection from rain and sunlight.

In the Structural Testing Room in the Civil and Electrical Engineering Building, in order to ensure enough space above the 5m reaction wall for movement of the ceiling crane, the structural testing room requires a height of 3 floors and basement space under the reaction floor for test equipment installation.

3) Structure Design

①Soil Conditions of the Project Site and the Foundation Plan



Probabilistic Seismic Hazard Map of Myanmar for 10% probability of exceedance in 50 years (475 years recurrent interval), the seismic hazard is described in term of peak ground acceleration (PGA) in g (firm rock).

Fig 2-6 Myanmar Earthquake Zone Map
Source: Dr .Myo Thant, et al. 2012

The results of a ground survey show that buildings with a relatively large vertical load require a pile foundation. Both the 5-story Common Measuring Equipment Building and 3-story Civil and Electrical Engineering Building are to be designed with precast concrete piles

②Superstructure Design

The superstructure will be basically designed with a rigid concrete frame and general concrete block walls. Seismic-resistant concrete walls can be provided as necessary. The roof structure of the Civil and Electrical Engineering Building should be a steel frame to allow for a large span.

③Load conditions

Loads and forces are based on natural environmental conditions in Yangon and the functions of the building.

a) Dead Load

Calculated according to the all construction materials used in the design.

b) Wind Load

Calculated according to Myanmar standards (110 mile/hour).

c) Live Load

Calculated according to applicable standards.

d) Seismic Load

Calculated according to the map of earthquake zones in Myanmar.
According to the map, the Project site is located in seismic zone II (Moderate Zone) and ground acceleration is 0.2 gal.

e) Construction Materials

Table 2-9 Main Used Materials

Material		Specifications
Concrete	Building construction materials	Strength Fc=24 N/mm2
	Reaction floor/Reaction wall	Strength Fc≧30 N/mm2
Reinforcing Bar		Yield Strength 345 N/mm2 , 295 N/mm2
Steel frame		Yield Strength 235N/mm2 or more

*An investigation is required to ensure that the materials used are compatible with local conditions.

f) Other

Pre-stressed concrete will be used for reaction floors and walls in the Structural Testing Room of the Civil and Electrical Engineering Building in the plan.

4) Electrical Plan

① Power Receiving and Transforming Facilities

6.6kV of power is supplied to the YTU campus via underground cables from the existing transformer substation facing Insein Street, and is supplied to the 5 sub-transformer rooms on campus via the main transformer room at the northeast corner of the Building-1 school building.
As a precautionary measure to voltage fracture, an Automatic Voltage Regulator (AVR) is to be installed to stabilize the voltage supplied to the buildings.
As a precautionary measure for blackouts, an emergency generator with an automatic change device is to be installed.
A transformer room for the new facilities should be newly established in the Civil and Electrical Engineering Building, to supply power to the Common Measuring Equipment Building and Civil and Electrical Engineering Building. Connecting power supply cables to the transformer room is the responsibility of the Myanmar side.

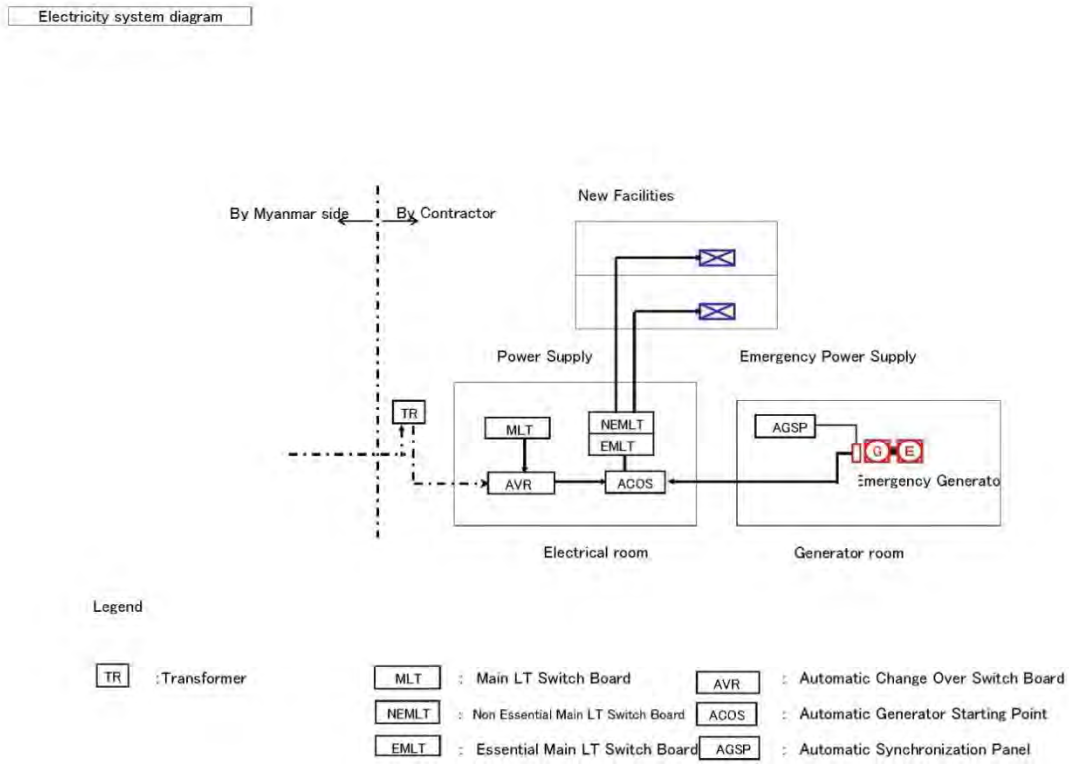


Fig 2-7 Power Distribution Diagram

② Power Supply

・Main Power Supply

The power is supplied through the underground wiring on the Project site from the panel board to the lighting distribution switchboard and the power control board in the new facilities.

・Emergency Generator

An emergency power supply should be installed in order for facilities to maintain minimum function during blackouts. The power supply for the following facilities should partially use an emergency generator circuit. To reduce the maintenance cost, the generator is to be installed indoors to avoid deterioration. Also, installing high-performance insulation materials in the special equipment rooms will considerably reduce the air conditioning load.

Table 2-10 Load of Emergency Generator Power Supply

Building name	Room name	Load
Common Measuring Equipment Building	Microstructure Observation Room	Air conditioning, Microscope-related machine parts
	Standard Measurement Equipment Room Optical Measuring Chamber Environmental Analysis Chamber X-ray Measuring Chamber	Air conditioning
	Server Room	Server
Civil and Electrical Engineering Building	Concrete Curing Room Thermostatic Room	Air conditioning
Shared equipment		Pumps

③ Lighting and Power Outlets

Distribution boards for electric lights are to be installed on each floor along with the appropriate circuit configurations. Secondary piping and wire is planned for routing lighting and electrical outlets from the board.

・Lighting

General Lighting: Lighting fixtures mainly using LED lamps are to be selected to reduce power consumption.

Emergency Lighting: Built-in battery wall-type emergency lighting equipment are installed in necessary rooms and corridors.

・Power Outlets

Receptacles for general use are to include grounding terminals and shall be installed in appropriate quantities.

④ Telephone System

An internal telephone line is to be provided to major rooms in each building from the server room located in the Common Measuring Equipment Building.

⑤ LAN System

LAN outlets along with cabling are to be provided to major rooms from the server room located in the Common Measuring Equipment Building.

⑥ Fire Alarm System

A fire alarm system should be installed in each building as required by the fire authority.

⑦ Lightning Protection System

A lightning conductor is to be installed on the roof for lightning protection.

5) Mechanical Plan

① Air Conditioning

As these are education and research facilities, indoor temperature conditions should be taken into consideration while performing various kinds of tests. In terms of air conditioning facilities, a cooling heat pump (HP) distributed model air conditioning method should be used with respect to reducing the costs of maintenance and management, dealing with equipment failure, and the scale of the facility. Air conditioning methods for each zone are shown below.

Table 2-11 Air Conditioning Methods

Building Name	Room Name	Load
Common Measuring Equipment Building	Laboratories, etc.	Cooling HP/Multiple type outdoor air conditioner units + indoor
	Microstructure Observation Room Standard Measurement Equipment Room Optical Measuring Chamber Environmental Analysis Chamber X-ray Measuring Chamber	Packaged air conditioners (split type/for hot and cold use)
	Server Room	Packaged air conditioners (split type/for hot and cold use)
Civil and Electrical Engineering Building	Laboratories, etc.	Cooling HP/ Multiple type air conditioner units
	Thermostatic Room Curing Room	Packaged air conditioners (split type/for hot and cold use)
Shared equipment		Pumps

② Ventilation

Mechanical ventilation equipment is to be installed to supply each habitable room with fresh air.

In addition, exhaust fans should be installed in the toilets and electrical rooms, etc., to remove bad odors, heat and dust, etc. Filters are to be placed over the air intake in major rooms.

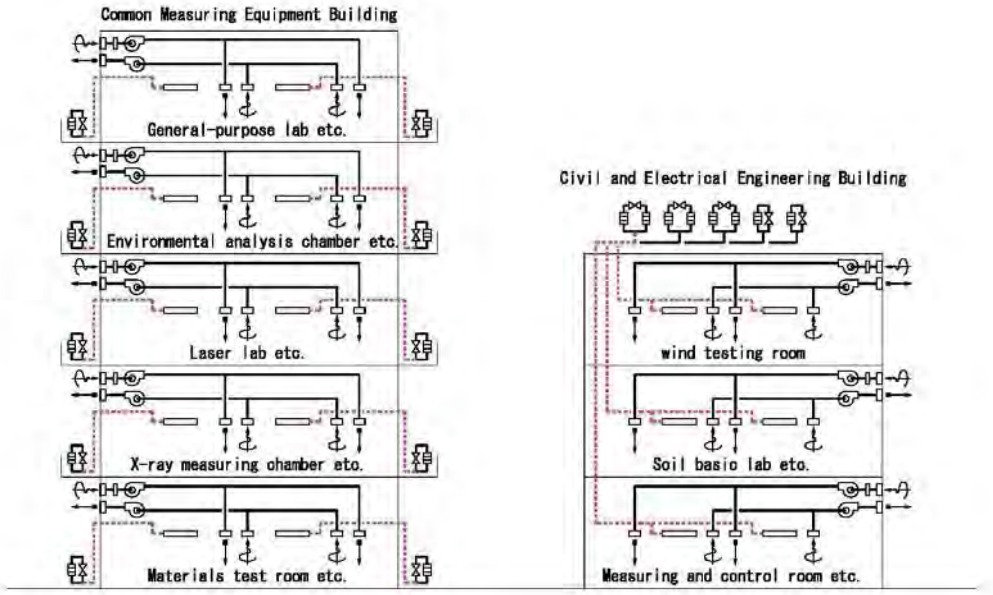


Fig 2-8 Air Conditioning/Ventilation Concept Image

6) Sanitary Equipment Plan

① Sanitary Equipment

Sanitary equipment such as low tank western-style toilets seats, flushing valve urinals, and wash basins are to be installed. Western-style toilets seats (with an attached hand shower) should be selected.

② Water Supply System

In terms of the water supply for the entire campus, well water is supplied from the water tank on the other site. However, it cannot ensure a sufficient water supply for existing facilities, especially in the dry season. Therefore, a new water well is planned near the site to supply water to the new facilities.

Filtration should be carried out to remove grit and iron from water pumped from the well. The water should be stored in a water supply tank and supplied to the required locations using a pressurized water supply pump. There should be two water supply pump systems for the Common Measuring Equipment Building and the Civil and Electrical Engineering Building.

■Estimation of water supply amount

Table 2-12 Estimation of Water Supply Amount

Target	Estimated no. of people	Estimated water supplied per unit (liter/person/day)	Estimated water supplied per day (m^3/day)
Number of students/staff (Common Measuring Equipment Building)	200	(60L/person x 0.8)	9.6 m^3 →10 m^3
Number of students/staff (Civil and Electrical Engineering Building)	150	(60L/person×0.8)	7.2 m^3 →8 m^3
Water for testing (Civil and Electrical Engineering Building)	-	15L x 10 times/hr. x 8hrs	1.2 m^3 →2 m^3
Total			→20 m^3

Note: The estimated water supplied per unit (liter/person day) is calculated at 80 percent of the Japanese standard.

■Capacity of each water supply

Reservoir tank 20m3（necessary water supply amount per day）

Deep well pump Pumping discharge 100L/min（satisfying necessary water supply amount for one day in 3 hours）

Lifting pump（Common Measuring Equipment Building）Pumping discharge 400L/min

Lifting pump（Civil and Electrical Engineering Building）Pumping discharge 300L/min

③ Drainage System

The existing septic tank at YTU does not function properly.

Therefore, it is planned to install a unit-type combined septic tank in both the Common Measuring Equipment Building and the Civil and Electrical Engineering Building. The treated wastewater is to be discharged to nearby drainage channels.

Rainwater is to be discharged to nearby drainage channels.

Treatment ability of unit-combined septic tank (common to each unit)

Input water quality: BOD200ppm, SS200ppm

Output water quality: less than BOD30ppm, SS50ppm

Table 2-13 Capacity of Treatment in Each Unit

Target		Treatment Capacity
Common Measuring Equipment Building	Domestic sewage	Common Measuring Equipment Building
Civil and Electrical Engineering Building	Domestic sewage	Civil and Electrical Engineering Building
	Mixing area	

④ Fire Extinguishing Equipment

Fire extinguishing equipment including stand pipes, fire hydrants, and fire extinguishers are to be installed in both the Common Measuring Equipment Building and the Civil and Electrical Engineering Building.

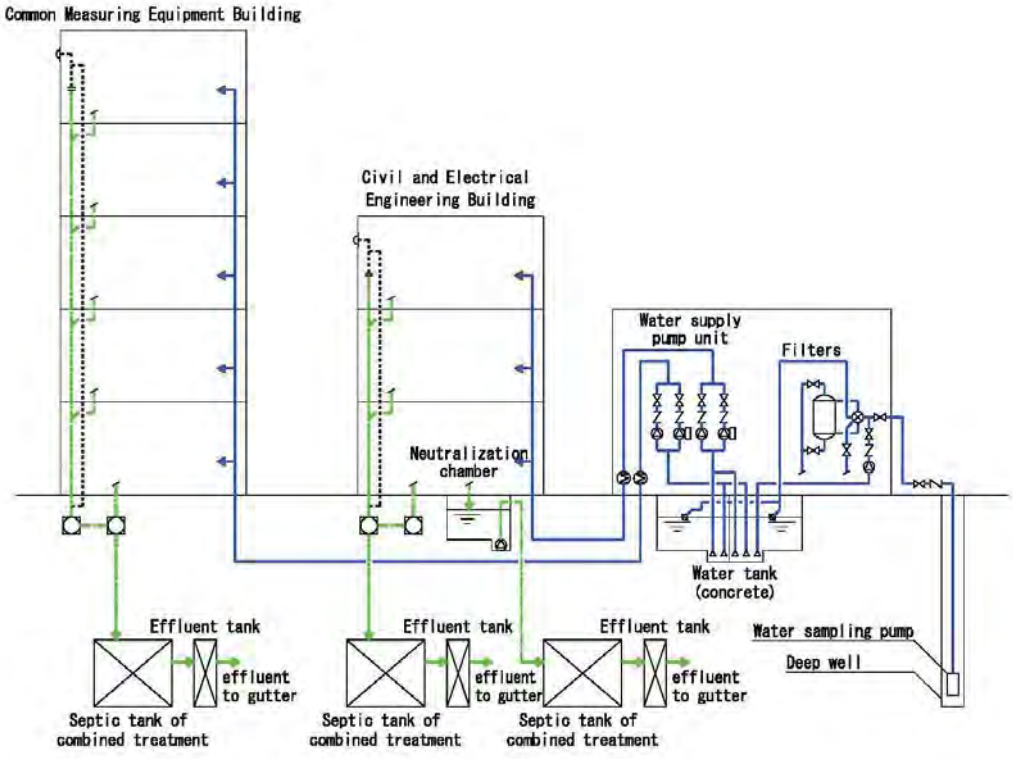


Fig 2-9 Diagram of Water Supply System

7) Construction Material Plan

① Basic Policy

a) The use of as much locally procured material as possible is encouraged to reduce construction costs and the period of construction.

b) Considering the climate, it is important to use weather-resistant and easily maintainable

material to reduce the running costs of the facilities.

c） Considering its function as a research facility, materials with a high level of chemical resistance and durability will be used.

② Materials

a） Structure Materials

The new buildings are to be constructed with a reinforced concrete frame, which is widely used in local construction methods, as well as in existing buildings. The walls consist of concrete blocks and the roof of the Civil and Electrical Engineering Building, which requires a large space, is to be constructed with a steel frame structure.

b） Exterior Finish Materials

The main exterior finish materials are as follows.

Table 2-14 Main Materials of Exterior Finish

Part	Material	Remark
Roof	Dry insulating materials with waterproof layer, Metal roof	Prioritize thermal insulation
Exterior wall	Coating finish, metal surface material + insulating materials	Prioritize thermal insulation
Exterior Door and Windows	Steel door, Aluminum anodized	Prioritize high durability
Exterior	Interlocking block pavement Concrete pavement	Prioritize availability in local market

c） Interior Finish Materials

The main interior finish materials are as follows.

Table 2-15 Materials of Interior Finish for Common Measuring Equipment Building

Category	Room Name	Floor	Wall	Ceiling	Remark
Common	General laboratory Preparation Room	Tiles	Paint	Coating finish over exposed ceiling	Durable/ Easy to clean
	Corridor	Tiles	Paint	Coating finish over exposed ceiling	Durable/ Easy to clean
	Toilet	Tiles	Tiles	Rock wool sound- absorbing board	Durable/ Easy to clean

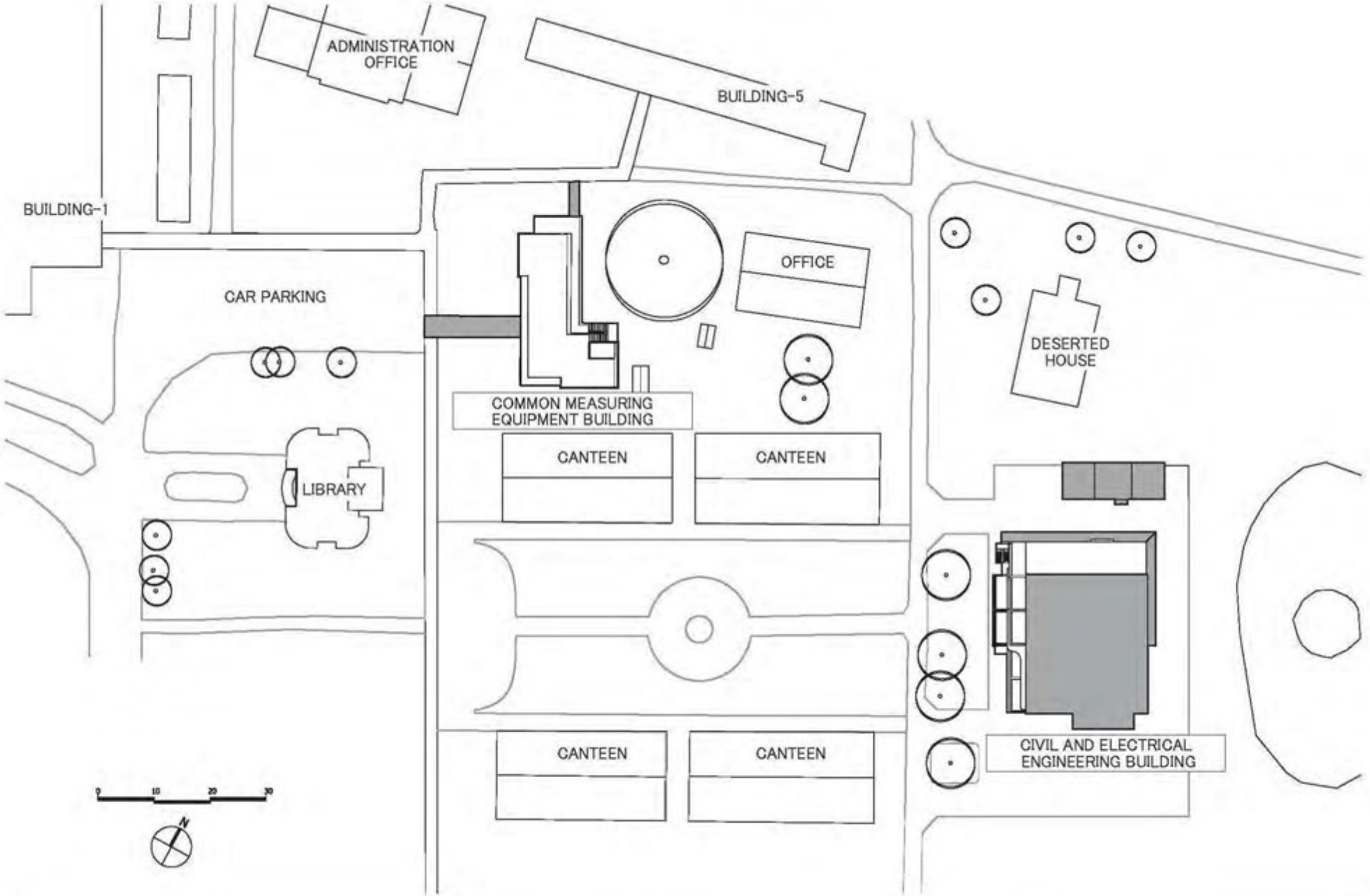
	Department room	Tiles	Paint	Rock wool sound- absorbing board	Durable/ Easy to clean
Other	Microstructure Observation Room	Tiles	Paint	Rock wool sound- absorbing board	Durable/ Easy to clean
	Materials Test Room	Coating finish	Paint	Glass wool sheet	Durable/Absorbs sound
	Entrance hall	Tiles	Paint	Grid ceiling	Durable/ Easy to clean

Table 2-16 Materials of Interior Finishing for Civil and Electrical Engineering Building

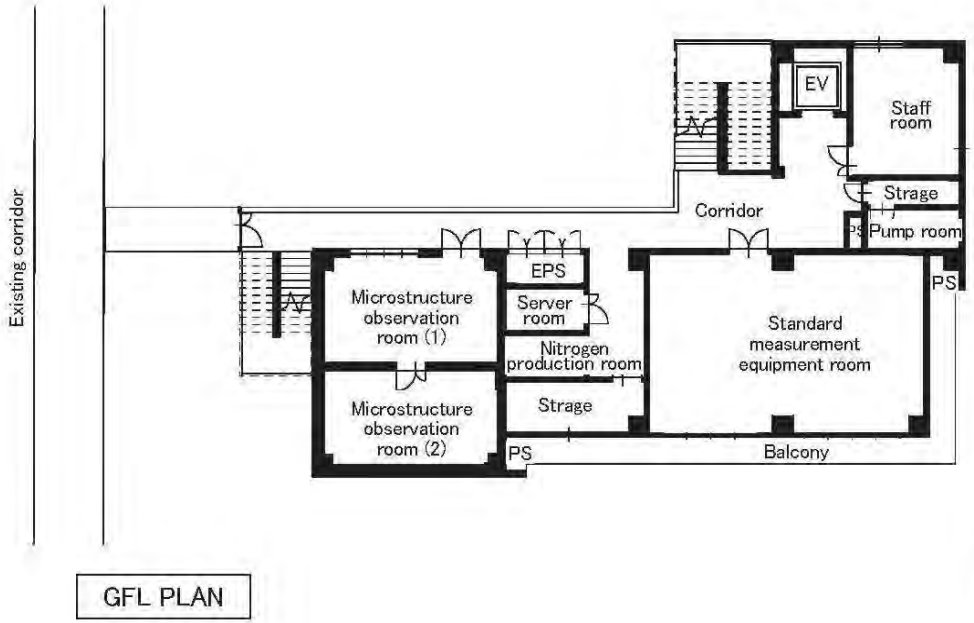
Category	Room Name	Floor	Wall	Ceiling	Remark
Common	General laboratory	Coating finish	Paint	Coating finish over exposed ceiling	Durable
	Department Room	Tiles	Paint	Rock wool sound- absorbing boarding	Durable/ Easy to clean
	Toilet	Tiles	Tiles	Rock wool sound- absorbing boarding	Durable/ Easy to clean

2-2-3 Outline Design Drawing

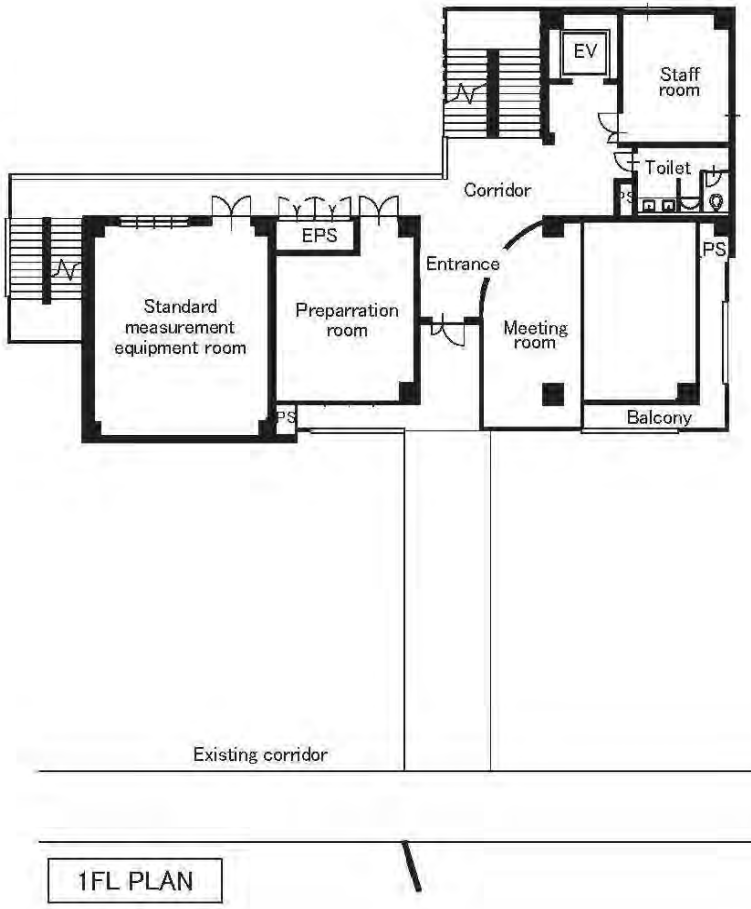
The Outline Design Drawing is shown as follows.



THE PROJECT FOR ENHANCING TECHNOLOGICAL UNIVERSITIES IN MYANMAR | SITE PLAN



GFL PLAN



1FL PLAN

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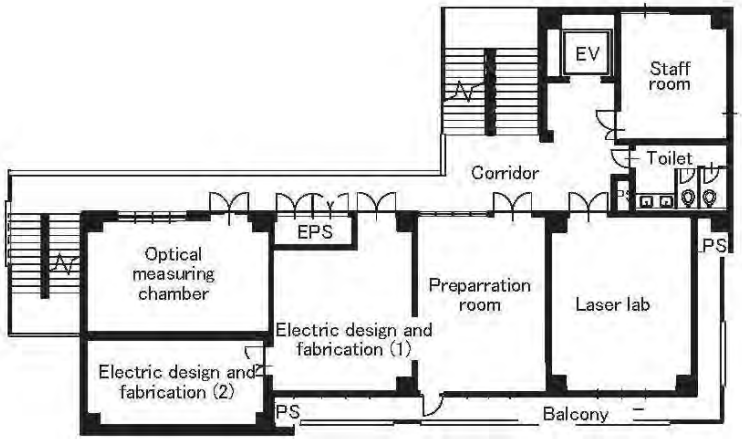
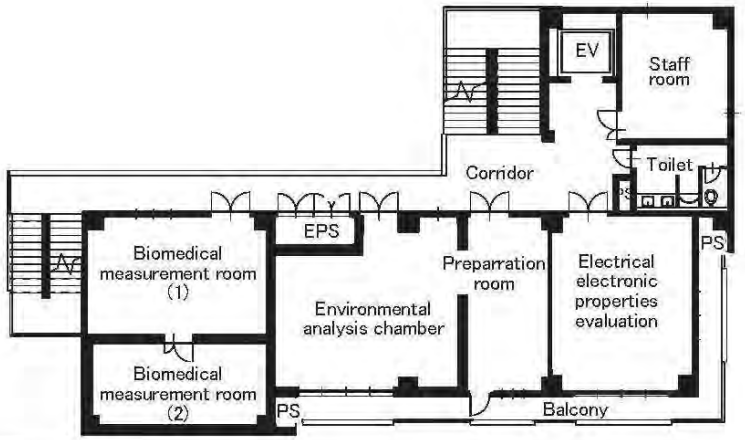


2FL PLAN



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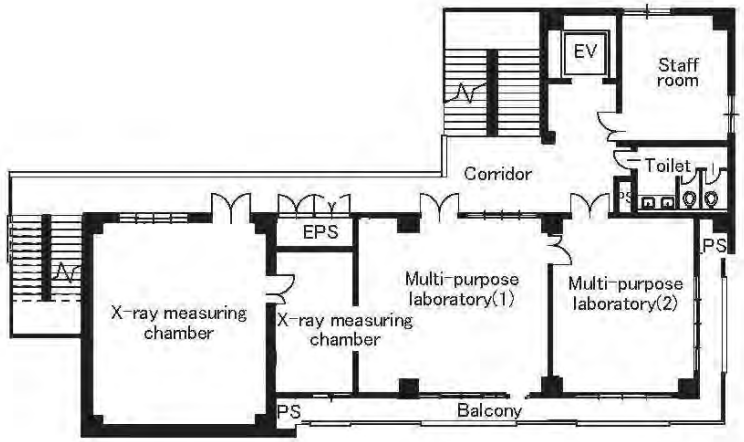

4FL PLAN

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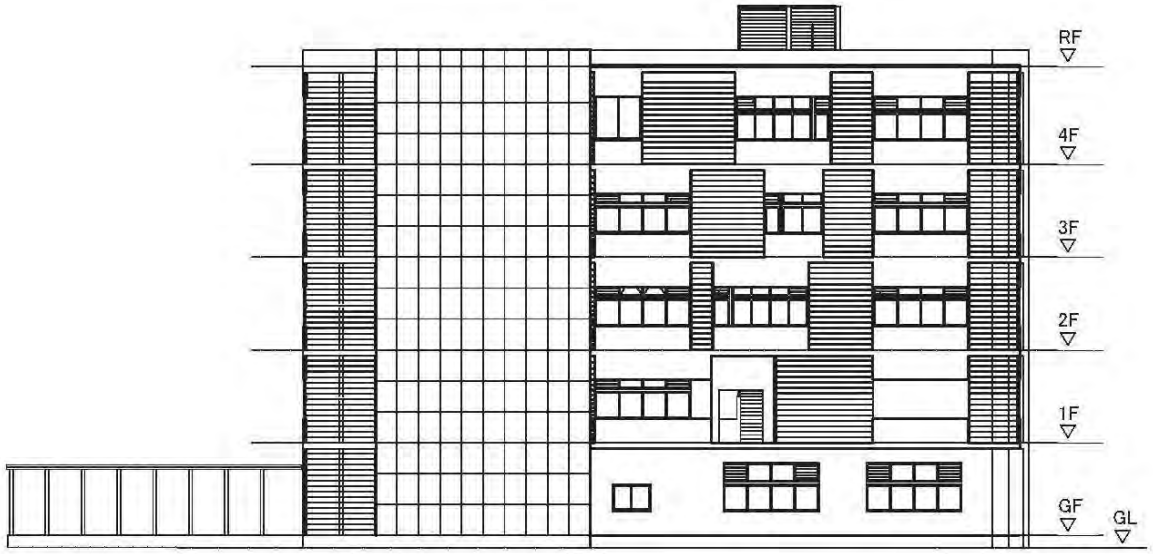
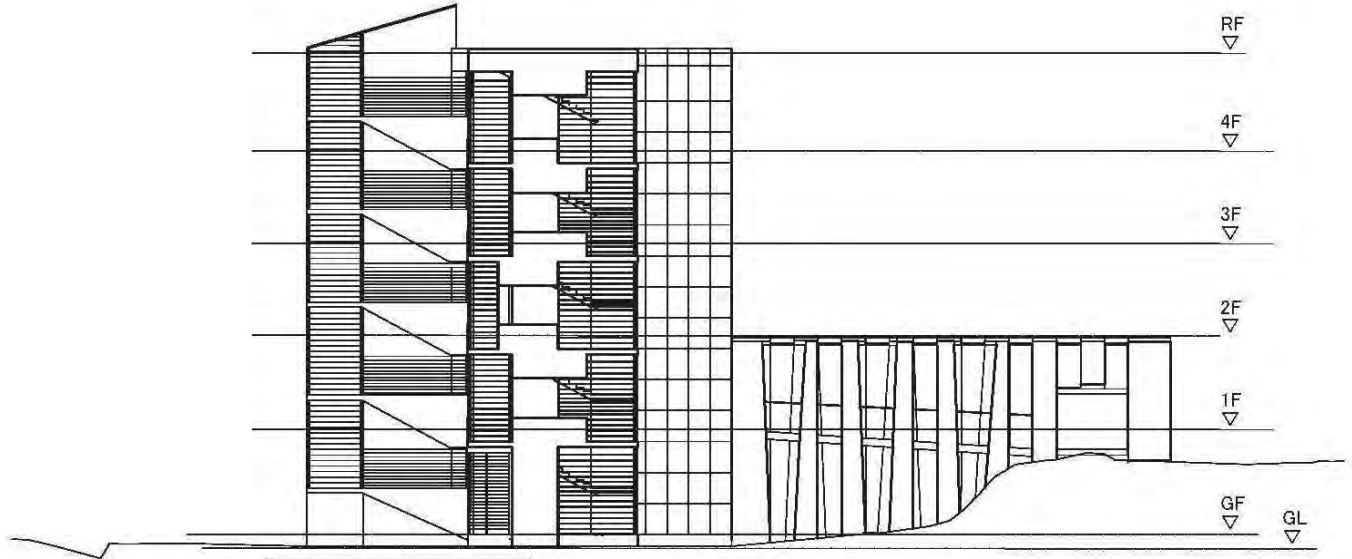


WEST ELEVATION



NORTH ELEVATION

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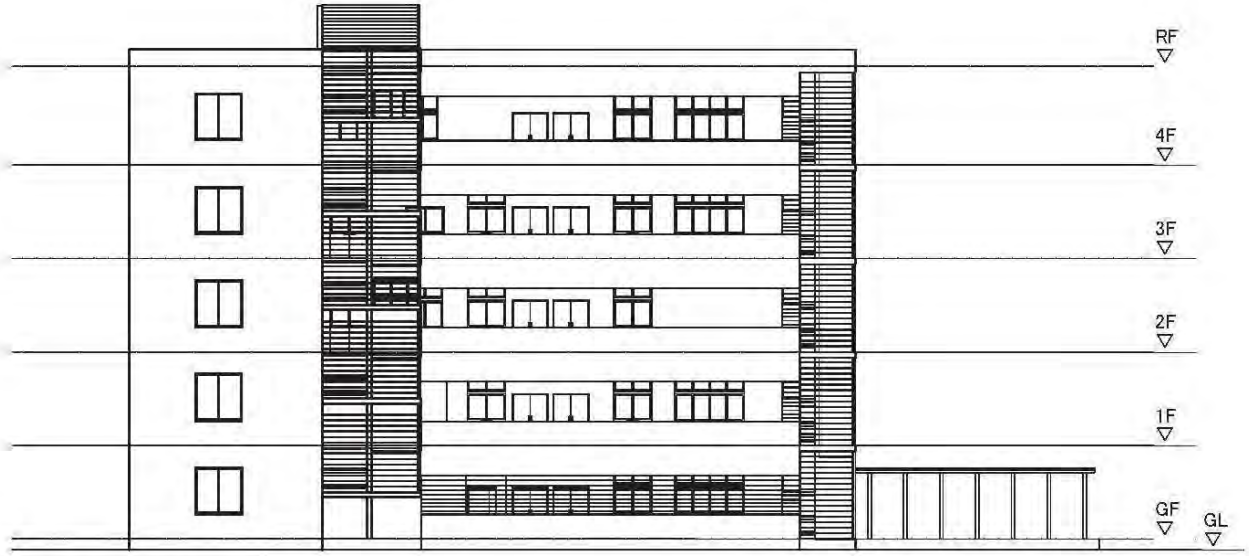
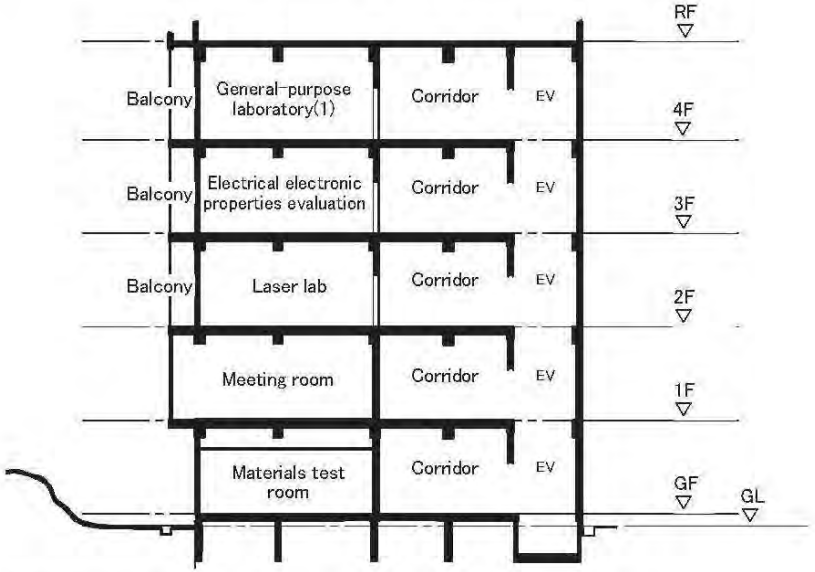


EAST ELEVATION



SECTION

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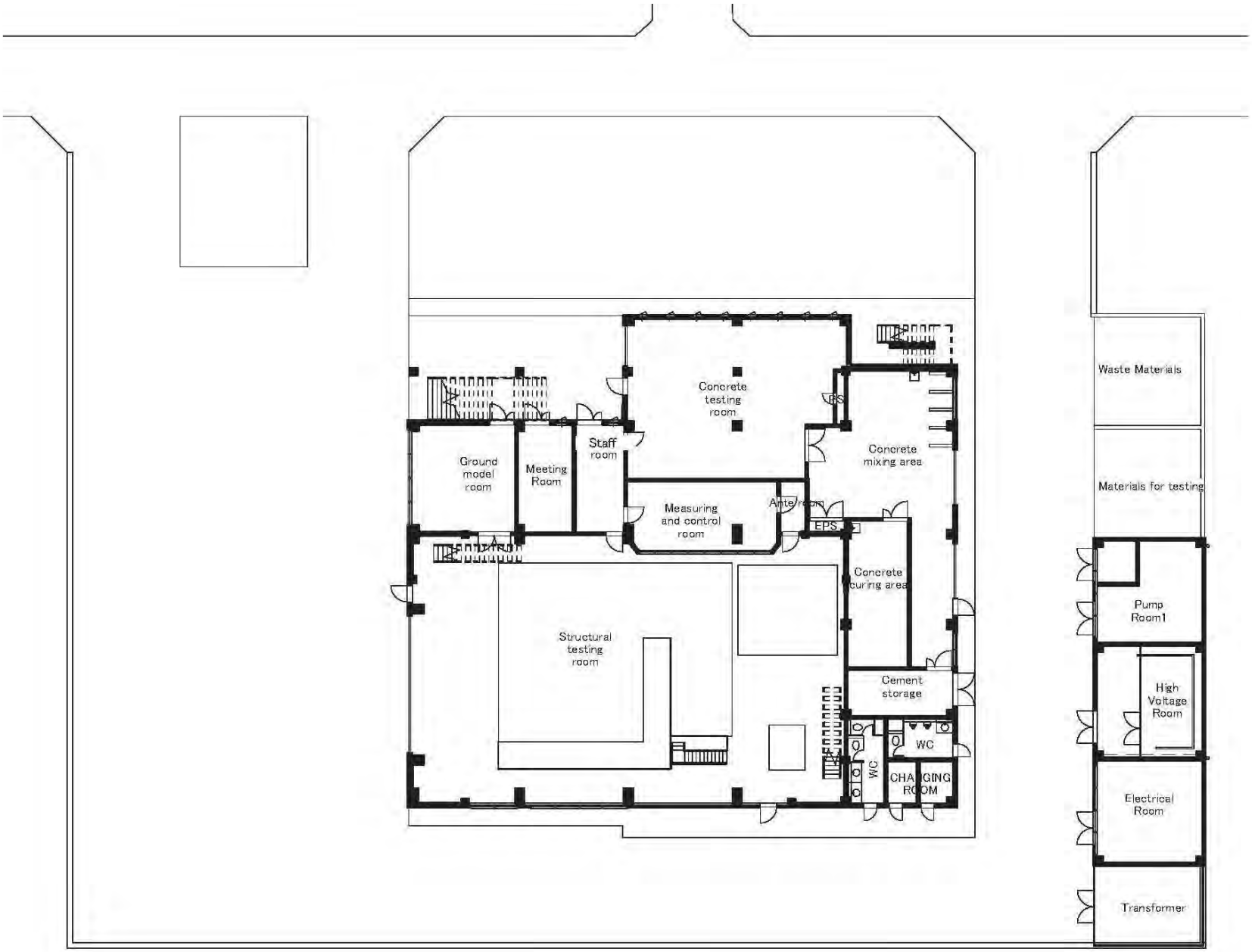

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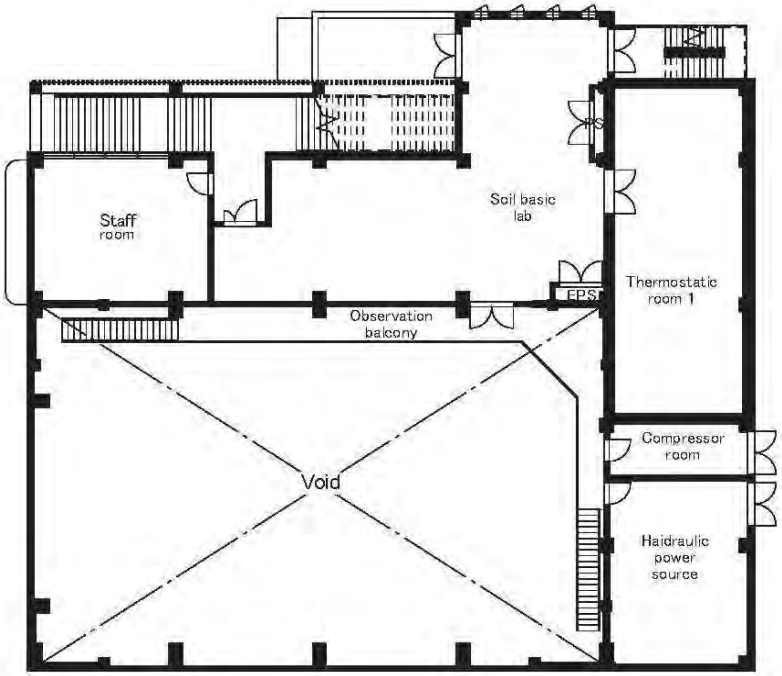
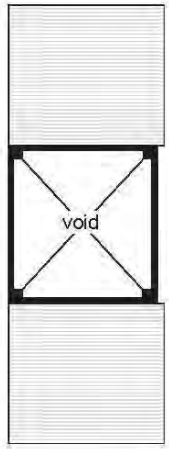
THE PROJECT FOR ENHANCING TECHNOLOGICAL UNIVERSITIES IN MYANMAR | CIVIL AND ELECTRICAL ENGINEERING BUILDING | GROUND FLOOR PLAN





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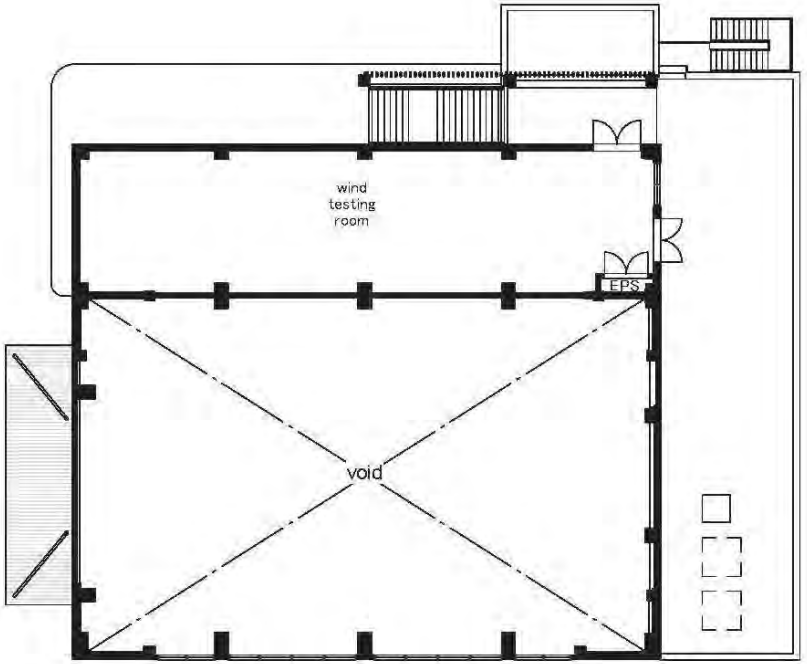
THE PROJECT FOR ENHANCING TECHNOLOGICAL UNIVERSITIES IN MYANMAR | CIVIL AND ELECTRICAL ENGINEERING BUILDING | 1st FLOOR PLAN



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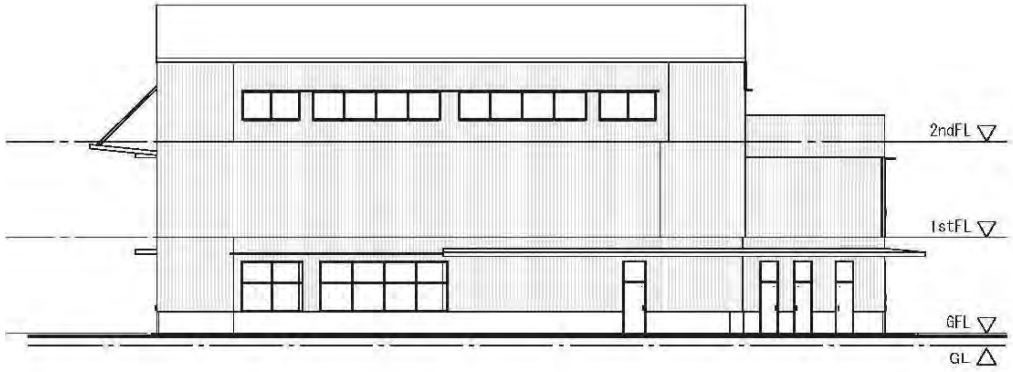
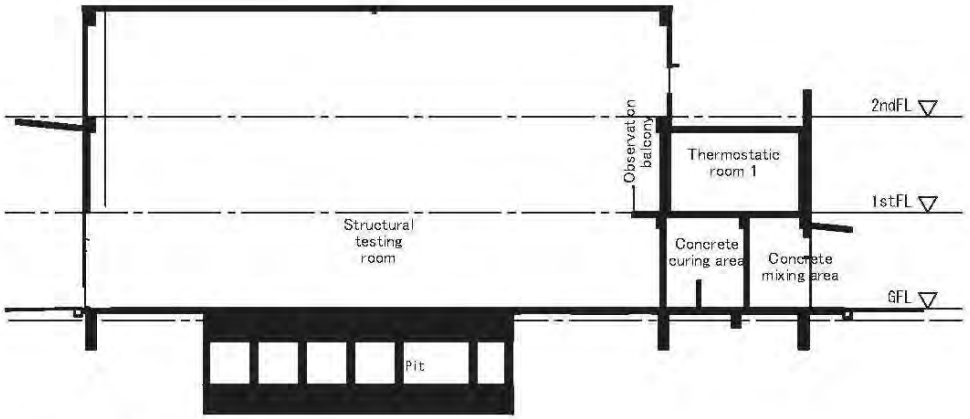
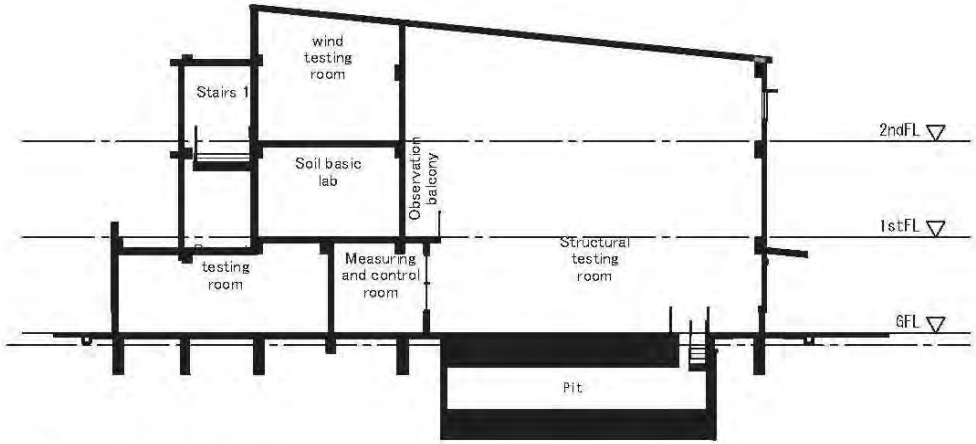


EAST ELEVATION



A-A SECTION

SOUTH ELEVATION



B-B SECTION

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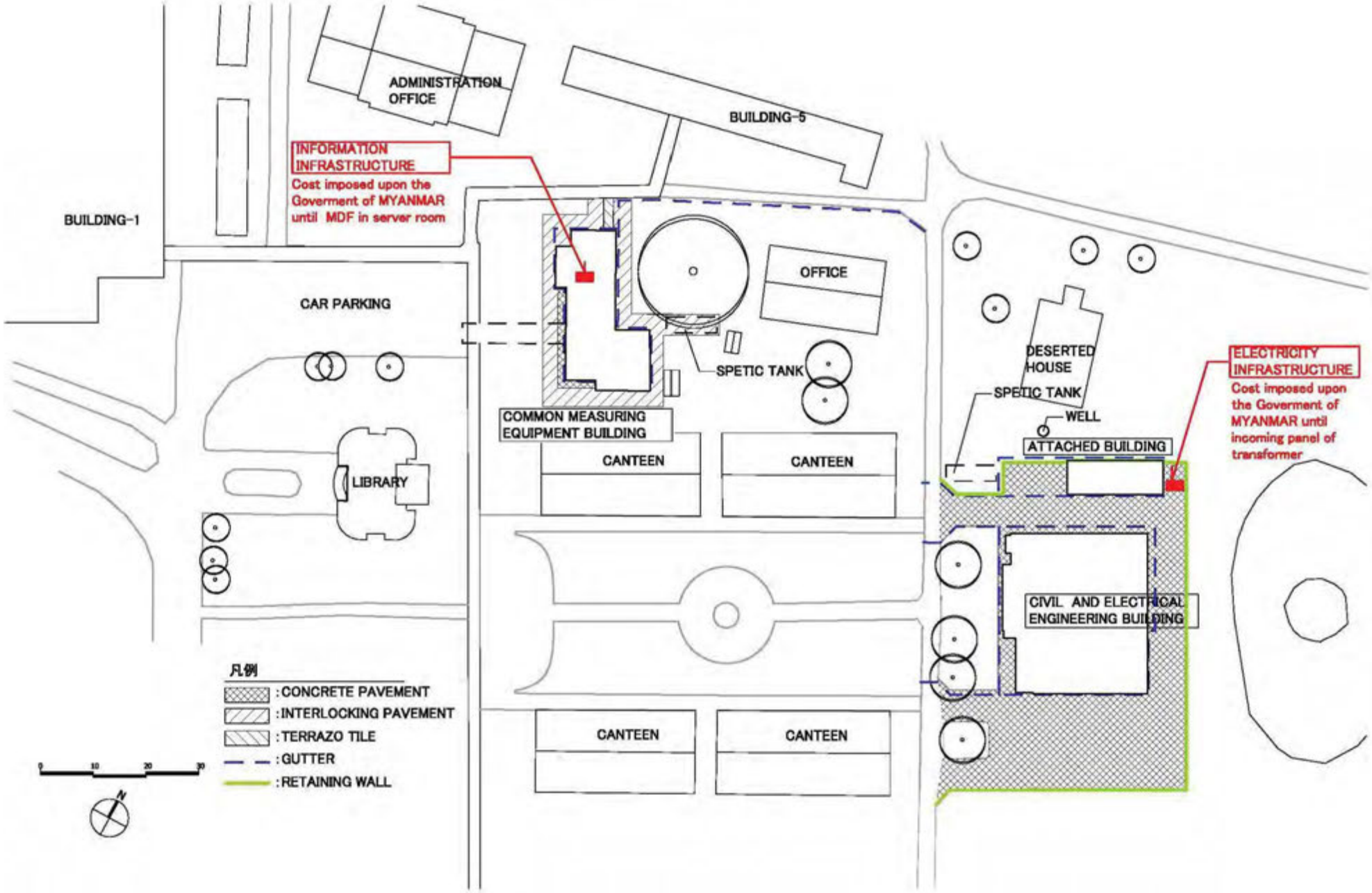
THE PROJECT FOR ENHANCING TECHNOLOGICAL UNIVERSITIES IN MYANMAR | CIVIL AND ELECTRICAL ENGINEERING BUILDING | ELEVATION・SECTION



THE PROJECT FOR ENHANCING TECHNOLOGICAL UNIVERSITIES IN MYANMAR | EXTERIOR PLAN

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

(1) Basis for Project Implementation

The Project will be implemented through the following procedures: Exchange of Notes (E/N) between the Governments of Japan and Myanmar, a Grant Agreement (G/A) between JICA and the Government of Myanmar, and Official Development Assistance (ODA) by the Government of Japan. After the signing of the G/A, the Government of Myanmar will sign a contract regarding the equipment and facilities with the consultant in Japan. After the completion of detailed design and tender documents, tendering procedures will take place for the selection of a contractor and an equipment supplier in Japan. The contracts between the consultant, contractor, and the equipment supplier shall be verified by JICA in order to fulfill accountability to Japanese taxpayers. When the construction begins, authorities on the Myanmar side, consultants, equipment suppliers, and contractors should coordinate with each other to supervise the construction works.

(2) Project Implementation System

1) Implementing Organization on the Myanmar Side

The Ministry of Science and Technology (MOST) and the Department of Advanced Science and Technology (DAST), which is under the jurisdiction of MOST, are responsible for the Project. The implementing organizations of this project are Yangon Technological University (YTU) and Mandalay Technological University (MTU). As the main constituent and also the main construction supervision from MOST/DAST, YTU and MTU will be in charge of the construction work, site preparations, and other matters on site after the handover.

2) Consultant

After the signing of the E/N and the G/A, DAST will obtain approval and sign the contract with the Japanese consultant and JICA on the design and supervision work. The consultant will prepare detailed design and tender documents based on the Preparatory Survey Report (hereinafter referred to as “the Report”), and obtain consent from DAST. The consultant is to assist in tendering procedures, supervision work, installation, and operation testing work based on the tender documents.

In implementing tenders and construction work, the consultant is to assist tendering procedures for facilities and shall supervise the construction works base on the tender documents. Also, for the equipment work, the consultant is to assist in tendering procedures and supervise procurement, installation, and operation training works based on the tender documents.

(3) Detailed Design

The services are to design the building in detail and to review the equipment plan based on the Report, and prepare tender documents including drawings, specifications, instructions to bidder, and draft contracts.

(4) Assistance of Tendering

Consultants should conduct assistive services and procedures for contracts and provide a project report to the government of Japan.

(5) Supervision

Services are to confirm whether the contracted obligations are properly fulfilled by the contractors and equipment suppliers, and to give instructions and advice on their work. Details of supervision services are as follows.

- Check the equipment specifications, construction plan, construction drawings, and the other relevant documents supplied by the contractors and the equipment suppliers.
- Check the quality of the construction materials and the equipment used.
- Check the delivery, installation, and instruction for the equipment.
- Observe and report the progress of the construction works.
- Inspect the completed facilities and the installed equipment.

In addition to the above, services also include reporting the progress of the Project, payment procedures, and handover after completion, etc. to the relevant authorities of Japan such as JICA.

1) The Construction Contractor and the Equipment Supplier

The contractor and the equipment supplier are to be selected from Japanese firms by the open tender process. DAST will sign the contract with the lowest bidder. The contractor and the equipment supplier must provide services such as construction work, installation, and testing of equipment to the Myanmar side in accordance with the contract.

2) JICA

As the implementing organization for the Japanese government, JICA shall carry out work required to promote the implementation of this project.

3) Use of Local Construction Companies

Local consultants shall be used as assistant supervisors to the Japanese consultants. Also, local contractors will be used as assistants for the Japanese contractors.

2-2-4-2 Implementation Conditions

(1) Construction Conditions

The construction markets in Myanmar are described as follows.

- In Yangon, there are numerous sales agencies dealing with PC parts and furniture, and there are many after-sale service providers, including those which supply and replace parts.
- Although there are local businesses which deal in engineering equipment, it is appropriate to dispatch engineers for installation work and usage guidance from the manufacturers.
- Contractors in Yangon have substantial technical capabilities in the local markets.
- Many construction materials are regularly imported from neighboring countries such as

Thailand and China, so they can be easily acquired from local markets.

- Reinforced-concrete rigid frame structure with concrete-block or brick walls is becoming popular in Myanmar.
- Necessary skilled workers can be recruited in Yangon.
- The building permit will be obtained within about one month through the examination of the blueprints by the Yangon City Development Committee.

(2) Precautions for equipment procurement

Regarding the equipment to be procured under the Project, the tender shall be divided into 4 lots. These 4 lots will consist of 2 lots of equipment for existing laboratories and 2 lots of equipment for new buildings to be constructed within the Project. For the lots for installation in existing laboratories, the procurement schedule shall be adjusted with the year-by-year planning of use of the equipment based on 6-year (COE) B.E. Program. The implementation of installation work and operation training work shall be decided with YTU and MTU considering the schedule of the universities.

For the equipment to be installed in the new buildings, tendering shall be conducted for each building (Common Measuring Equipment Building/Civil and Electrical Engineering Building). The procurement schedule shall be adjusted with the schedule of facilities construction.

For securing the appropriate and continuous utilization of the procured equipment in laboratories, training on proper operation and maintenance is critical. Thus, the contents of tender documents shall be developed so that skilled engineers with enough knowledge for installation work will be assigned. Furthermore, the Project will offer initial training work and operation training work for staff (technicians) of YTU/MTU so that the procured equipment may be utilized effectively.

(3) Precautions for construction

1) Schedule Management

The schedule of construction works will be influenced by rain and rain water for five months during the rainy season from May to September. In order to complete the Project on schedule, it is necessary to secure a flood-free temporary working area and road, and a water discharge system for rain and underground water during foundation work and external work. It is necessary to have regular meetings with relevant agencies of the Government of Myanmar, consultants, and contractors to manage the implementation schedule in consideration of the above-mentioned constraints in order to complete the Project on schedule.

2) Security Control

By providing a limited number of gates for the Project and enclosing the site with temporary fences, the construction contractor will control vehicles and workers coming into the site for the safety of people related to university.

In order to ensure the security of the university, the contractor will enclose the site with temporary fences and set specified gates for use by construction vehicles and workers.

3) Security Measures

Guards should be on duty for 24-hours in 3 shifts to ensure the security of the goods.

2-2-4-3 Scope of Works

The Project is based on the cooperation of the governments of Japan and Myanmar. The government of each side is responsible for the work as follows.

(1) Work to be borne by the Japanese side

Consulting services, construction of facilities, and procurement and installation of equipment as described below are to be the responsibility of the Government of Japan.

1) Consulting Services

- Preparation of detailed design and tender documents of the facilities/equipment.
- Assistance for selection of and contracting with a construction contractor and an equipment supplier.
- Supervision of construction of facilities, procurement, installation, and initial operation and maintenance training of equipment.

2) Procurement and Installation of Equipment and Construction of Facilities

- Trial operations and equipment adjustments.
- Explanations and initial training on operation and maintenance of equipment.
- Construction of the facilities.
- Procurement, transportation to the Project site, and installation of construction materials, furniture, and equipment.

(2) Scope of Work for Both Countries

The following table shows the work to be borne by each Government.

Table 2-17 Work to be borne by each Government

Items	To be borne by the Japanese side	To be borne by the Myanmar side
Water supply	Water supply work from well excavation to the connection point in the building	—
Power supply	Installation of transformer and electrical work in the building from the connection point	Extension of power cable to the new transformer installed by Japanese side
Drainage	Extension of the waste water ditch up to existing sewage drainage and its connection	—
	Installation of septic tank	—
Telephone and internet	Installation of information panel and telephone and internet work in the building from the connection point	Extension of telephone cable to the new panel installed by Japanese side

2-2-4-4 Consultant Supervision

(1) Supervision Policies

In accordance with Japan's Grant Aid Scheme, the consultant is to form a project team to ensure smooth implementation of the Project based on the Report. The principles for the supervision of construction work and equipment work are as follows.

- In order to ensure the completion of construction on schedule, it is necessary to keep close contact with the authorities who are in charge of the Project.
- The consultant shall give proper instructions and advice to the contractor, the equipment supplier, and other related authorities.
- The consultant shall give proper instructions and advice on the operation and maintenance of the equipment after the handover. They shall obtain confirmation from MOST after the completion of the construction work.

(2) Supervision Plan

Because the buildings of the Project have complicated function and occupy large areas, the following engineers will be dispatched to the site if necessary. Permanent supervisors and local engineers will also be dispatched to the site.

- Chief Consultant/Deputy Chief Consultant: Overall supervision
- Architectural Design: Checks design drawings and materials used
- Structural Design: Checks strength of soil and structural materials
- Mechanical Design: Midterm and final inspection of plumbing and air-conditioning work
- Electrical Design: Midterm and final inspection of electrical work
- Equipment Planning: Instruction of equipment installation, adjustment of construction work, checking of initial operation and maintenance training, operational training, etc.

(3) Supervisors from contractor

In order to complete the construction as scheduled, the contractor should coordinate with local sub-contractors and manage the construction work. The permanent supervisors should familiarize themselves with the local conditions to ensure a high quality for the Project.

(4) Technical Supervisor of Procurement, etc.

A permanent technical supervisor should be dispatched to be in charge of the installation and adjustments of machinery. As similar installation work will be going on at YTU/MTU at the same time, two technical supervisors shall also be dispatched.

2-2-4-5 Quality Control Plan

As there is a concrete plant in Yangon, ready-mix concrete will be used. The average highest temperature is above 35° C in March and April, so the measures for working in the heat are necessary.

From the survey report of underground water, it is necessary to pump out ground water during

foundation construction whether it is dry or the rainy season. Measures to handle these conditions should be included in the construction plan.

The quality control plan of the main construction work types is as follows.

Table2-18 Quality Control Plan

Work Type	Control Parameter	Control Value	Test Method	Quality Standards	Frequency of Measurement	Analysis of Results
Earth work	Slope angle	Within planned range	Gauge, visual	JIS	As needed	Photos, documents
	Bedding accuracy	Within +0 ~ -5cm	Level, visual		〃	〃
	Supporting layer height	Within +0 ~ -3cm	〃		〃	〃
	Thickness of replaced soil	+5cm ~ 0	〃		〃	〃
Reinforcement bars	Reinforcement cover thickness	Places not in contact with soil: 30m/m	Visual, measurement	Specifications	As needed	Photos, documents
		Places in contact with soil: Other 40m/m	〃	〃	〃	〃
	Processing accuracy	Stirrup, hoop ±5m/m	〃	〃	〃	〃
		Other ±10m/m	〃	〃	〃	〃
	Tensile test	Standard strength or more	On-site sampling or sampling at shipping	BS	1 test on 3 test pieces per 200t of steel bars with given diameter*	Test result report
Concrete work (mixing at site)	Compressive strength	Designed strength $21N/mm^2$ or more	Attending at test site (any time)	BS, ASTM	3 or more test pieces for each placing and per $50m^3$	Test result report
	Slump value	15cm±2.5cm	Attending at work site	〃	For each placing	Photos, documents
	Chloride content	$0.3kg/m^3$ or less	Test pieces, attending at work site	〃	〃	〃
	Air content	45% ±1.5%	Attending at work site	〃	For each placing	〃
	Concrete temperature	35 deg. or less	Attending at work site	〃	For each placing	〃
	Performance accuracy	10mm per 1m or less	Measuring	JIS	After form removal	〃
Masonry (concrete block)	Compressive strength	According to each plant management value	Attending at compression test site after selection of adopted factory	BS	Once before shipment from factory	Test result report

Work Type	Control Parameter	Control Value	Test Method	Quality Standards	Frequency of Measurement	Analysis of Results
Plastering, Painting, Roof waterproofing, Fixtures	Materials, storage methods, work methods, mixing, coating thickness, curing, work accuracy	According to particular specifications	Same as left	Same as left	As needed	Photos, documents
Water supply & drainage	Water supply pipes Drainage pipes	Leaking 〃	Water pressure test (1.75MPa for 60 min.) Water filling test	BS 〃	On completion of pipe laying, for each system 〃	Test result report 〃
Electrical work	Cables	Within planned range	Insulation test Conductivity test	BS, JIS	〃	〃

2-2-4-6 Procurement Plan

(1) Procurement of Equipment

Regarding the equipment to be procured for the Project, Japanese products and/or third country products, for which local agents and/or agents in neighboring countries can provide after-sales-service, shall be provided. For third country products, in addition to cost effectiveness, experience in using similar products at YTU/MTU and/or other universities /organizations, the existence of a local agent, and the diffusion rate shall also be considered. The quality of third country products shall also be assured by checking qualification criteria of DAC and/or OECD members.

Table 2-19 Country of Procurement（Equipment）

Description		Country of Procurement			Remarks
		Local	Japan	Third country	
Civil Engineering	Standard Compression Testing Machine Set		○		
	CBR Test Set		○		
	Incubator		○		
Mechanical Engineering	Vertical Milling Machine (Medium size)		○		
	Universal Cylindrical Grinding Machine		○		
	Boring Machine		○		
	Universal Material Testing Units		○		
Electrical	Module Laboratory for Electric	○			

Power Engineering	Engineering				
	Multi-function Electrical Protection Station	○			
	PLC Module			○	Germany
	Spectrum Analyzer		○		
Electronic Engineering	Modular Laboratory		○		
	PCB Prototyping Facility			○	UK
	Network Analyzer			○	USA
Information Technology	Local Network Experiment Apparatus			○	UK
	Microprocessor Trainer	○			
	Digital Signal Processing Trainer	○			
	Communication System Trainer	○		○	
Mechatronic Engineering	Industrial Electronic Trainer			○	Italy
	Factory Automation Trainer			○	Germany
	Advanced FPGA Development System for Mechatronics Engineering	○			
Common Measuring Equipment Building	Scanning Electron Microscope		○		
	Liquid Nitrogen Generator			○	USA
	UV-visible Spectrophotometer		○		
	X-ray Fluorescence Spectrometer		○		
Civil and Electrical Engineering Building	Structure Testing System		○		
	Vibration Testing Machine		○		
	Wind Tunnel		○		
	High Voltage Experiment Equipment		○		
		7.0 (%)	87.0 (%)	6.0 (%)	

(2) Construction Materials

1) Procurement Policy

・Local materials shall be used as much as possible in order to reduce construction costs and to shorten the work period.

・In order to reduce maintenance/management costs, durable materials that are easy to manage and that can also adapt to the local climate and geography shall be chosen.

・Materials that have strong chemical resistance and durability for the research facility shall be chosen.

2) Procurement Plan

・Structural Frame Works

Materials such as reinforcing bars, concrete, and concrete blocks will be procured locally.

・Interior and Façade construction

Materials for the interior and façade construction such as aluminum sashes, timbers, tiles, ribbed metal roofing, paint, and glass, etc. will be procured in local markets.

・Air-Conditioning and Plumbing Work

Air-conditioners, exhaust fans, ceiling fans, pumps, tanks and sanitary ware, etc. will be procured in local markets.

・Electrical Works

Lighting fixtures, power panels, cables/wires and conduit/pipes, etc. will be procured in local markets.

Table2-20 Procurement Plan of Major Construction Materials（Architecture）

Item	Procurement Plan			Remarks
	Local	Japan	Third Country	
(Material)				
Portland Cement	○			
Aggregate	○			
Deformed bar	○			
Veneer Form	○			
Concrete Block	○			
Portland Cement	○			
Glass Block	○			
Waterproofing Material	○			
Light Gauge steel material	○			
Color Metal Roofing	○			
Aluminum panel	○			
Steel Doors and Windows	○			
Aluminum Door/Window	○			
Wooden Door	○			
Glass	○			
Tile	○			
Cement Board	○			
Sound Absorbing Ceiling Material	○			
Electromagnetic Shielding Materials	○			
Paint	○			
(Mechanical/Electrical Works)				
Air-conditioner	○			
Ceiling Fan	○			
Pump	○			
Pipe	○			
Sanitary Ware	○			
Distribution Panel	○			
Conduit Pipe, wire	○			
Lighting Fixtures	○			
Condenser Lightning Arrester	○			
Fire Hydrant	○			
（Construction Equipment）				

Crane 20 ~ 30t	○			
Backhoe	○			
Truck 1t ~10t	○			
Percentage (%)	100%	0%	0%	

(3) Route of Transportation of Materials

The equipment to be procured from Japan shall be transported by sea freight in containers. The port of discharge shall be Yangon port. After discharging the goods, custom clearance procedure shall be started. The Project shall be exempted from import tax. The tax exemption should be approved within around a week when the master list is submitted in advance. There is a frequent consolidated liner from Japan to Yangon port. Customs clearance shall be done at a bonded warehouse, after which the cargo shall be transported on a trailer to the site by the supplier.

2-2-4-7 Operational Guidance Plan

Regarding the equipment procured for the Project, under the management of the supplier, initial operation and maintenance training will be provided by an experienced installation engineer and/or Japanese engineer and/or local manufacturer engineer. Besides initial training, operation training shall be implemented mainly for the equipment for the Common Measuring Equipment Building and Civil and Electrical Engineering Building so that the procured equipment can be utilized effectively. Operation and maintenance manuals and a list of equipment manufacturer and local agents will be included in handover documents to enhance the system for operation and maintenance.

2-2-4-8 Soft Component Plan

No soft component will be implemented in the Project.

2-2-4-9 Implementation Schedule

Under Japanese Grant Aid, the Project shall be implemented in the following phases after the signing of the E/N and G/A between both Governments.

(1) Detailed Design (approx. 3.5 months)

The Consultant will conclude a consultancy agreement with the implementing organization of Myanmar and develop detailed design drawings and tender documents. The Consultant will come to Myanmar to meet with the implementing organization when they commence their work and explain the drawings and tender documents for final approval, which will complete the work. The period from the conclusion of agreement to the completion of this phase is estimated to be about 3.5 months.

(2) Tender (approx. 2.5 months)

Upon approval of the tender documents, the Consultant acts on behalf of the implementing

organization, advertises an invitation for prequalification (hereinafter referred to as “P/Q”) on a paper, and conducts the P/Q to confirm the capability and resources of potential tenderers in performing the particular work. The tender documents will be delivered to the approved tenderers and the prepared tenders will be opened in the presence of the representatives from the implementing organization.

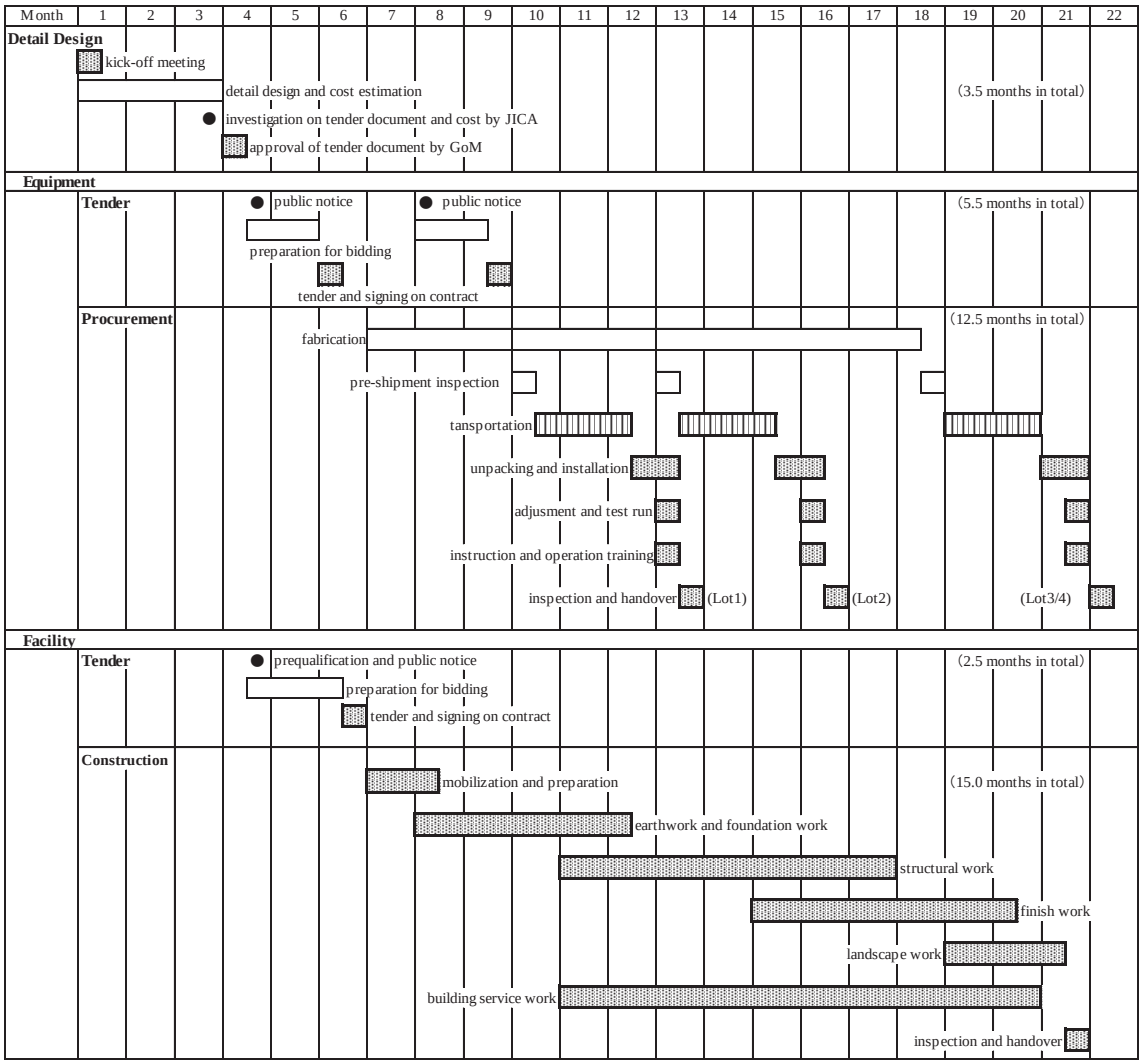
The tenderer who proposes the lowest price will win if the content of the bid is evaluated as appropriate. They will then conclude a contract on the construction work and equipment procurement with the implementing organization. The period required between the public announcement of the P/Q and conclusion of the contract is estimated to be about 2.5 months.

(3) Construction/Procurement (approx. 15.0 months)

After signing the contract, the Contractor will commence the construction work and the procurement of equipment. In consideration of the scale, specific conditions of the construction work, and local labor efficiency, it will take about 15.0 months to perform the construction, procurement, and installation work. This estimation assumes the material and equipment procurement will proceed smoothly, the necessary procedures will be conducted promptly by the organizations concerned on the Myanmar side, and that the work undertaken by the Myanmar side will proceed smoothly.

The implementation schedule is as follows.

Table 2-21 Implementation Schedule



2-3 Obligations of Recipient Country

(1) Procedural Issues

The Project will be implemented by Grant Aid from the Japanese Government. Items that must be done by Myanmar side are as follows.

1) Preparation work, etc.

- Securing the Project site
- Demolishing of existing storehouses, relocation of telephone poles, etc., and removal of trees on the Project site
- Preparation of the Project site (removing plants and rocks)
- Infrastructure installation (Electrical power and LAN equipment)
- Repair of existing facilities (Renewal of floors, walls, and ceilings in the rooms for equipment installation)

2) Operation and Maintenance

- Procurement and installation of general furniture, equipment, and fittings, etc. not within the scope of Japanese Grant Aid (curtains, blinds)
- Procurement of consumables and spare parts necessary for the proper maintenance of the facilities and equipment
- Appropriate and effective operation of the facilities and equipment

3) Procedures

- Payment of commissions, namely advising commissions for the A/P and commissions to the Japanese bank for banking services based on the B/A
- Applying for building permissions
- Provision of all the relevant licenses that may be necessary for the Project.
- Ensuring prompt unloading, customs clearance, tax exemption, and providing assistance for the inland transportation of equipment and materials imported from Japan and/or third countries based on the verified contracts
- The exemption of Japanese nationals engaged in the implementation of the Project from custom duties, internal taxes, and other fiscal levies which may be imposed in Myanmar.
- Facilitation in providing long term visas for staying in Myanmar for the Japanese staff working on this project.
- Bearing all the expenses, other than those covered by Japanese Grant Aid, necessary for the implementation of the Project

(2) Tax exemption

To have tax exemption in Myanmar, the acquisition of an import license and a tax-free certificate for imported goods is required. It is important to submit the required documents such as invoices, equipment lists, etc. to the relevant departments more than one month prior to the commencement of tax exemption procedures at Yangon port since it takes time to complete the necessary procedures to acquire an import license and tax-free certificate for imported goods after the submission of the required documents in Myanmar.

2-4 Project Operation Plan

(1) System for Maintenance

The responsible agency of the Project is DAST and the executing agency of the Project is YTU and MTU. Each university shall manage the procured equipment and constructed facilities under the Project. As autonomy for higher education institutions in Myanmar has not been established and is still under discussion, basically YTU and MTU need to submit requests to DAST of MOST for the budget and personnel allocation necessary for the operation and maintenance of the equipment and facilities arranged by the Project.

Top management of the Project are the rectors of YTU and MTU, and the heads of department shall supervise the operation of the Project at the departmental level. Although teaching staff at YTU/MTU is responsible for taking care of the equipment, assignment of a professional technician for each department is necessary for operation and maintenance. The management system shall be structured by the commencement of the installation work.

DAST has committed to take necessary measures for securing budget and personnel required for operation and maintenance for the procured equipment and constructed facilities under the Project.

Furthermore, with regard to the new buildings (Common Measuring Equipment Building, Civil and Electrical Engineering Building) at YTU, it is necessary to restructure workshops at YTU and establish a new center specializing in managing operation and maintenance of the facility and equipment. This center will have the following features: (i) a high level manager/director, officials, several academic/technical staff, and technicians who operate and manage the newly procured equipment installed in the new building and workshop in the existing building, and (ii) close contact with existing departments and the private sector for conducting surveys on the market and social needs regarding technological issues, as well as the provision of various technical services to staff and students not only at YTU, but also to private companies and other institutions. A more concrete plan for operation and maintenance shall be developed through the use of operational training to be implemented under the Project, as well as through the activities to be carried out in the TCP stated as “the strengthening of the management system for proper operation and maintenance of equipment.”

(2) Maintenance Method

1) Equipment

The organizational arrangements, concrete plan, and procedures for the operation and maintenance (O&M) for the procured equipment shall be developed by the commencement of the installation work. An outline of O&M procedures is as follows.

- Responsible personnel in charge of O&M shall be selected before the commencement of installation and initial training and operational training.

・ Not only the responsible personnel in charge of O&M, but other lecturers/users shall also be trained by an engineer from the equipment manufacturer during the initial training and operational training.

・O&M of the equipment: routine maintenance and checking of the equipment shall be conducted according to the equipment manual.

・The management of maintenance records and consumable/spare parts shall be conducted using an inventory list.

・When there is trouble with the equipment, appropriate measures shall be taken.

① A technician of YTU/MTU shall judge the level of the trouble that has occurred (major/minor).

② When the trouble is minor, it shall be managed by a technician of YTU/MTU.

③ When the trouble is major, an engineer from the manufacturer and/or a local agent shall respond.

2) Facilities

Daily cleaning and repair for wear, breakage, and aging are important for the maintenance of facilities.

Repair is mainly for decorative materials with the major repair work conducted every 10 years.

Details for methods of periodical inspection and repair work will be submitted by the contractor. The outline of such is as follows.

Table 2-22 Outline of Periodical Inspection (Facilities)

	Contents of Inspection	Numbers of Inspection
Exterior	・Repair/repainting of exterior walls	Repaint once/5 years, Repair once/3 years
	・Inspection and repair of roofs	Inspection once/3 years, Repair once/10 years
	・Inspection and repair of sealing of exterior fittings	Once/1 year
	・Regular inspection and cleaning of gutters and manholes	Once/1 year
Interior	・Review of the interior	As needed
	・Repair/repainting of partition walls	As needed
	・Renewal of ceiling materials	As needed
	・Adjustment of doors and windows	Once/1 year
	・Replacement of fixtures and fittings	As needed

3) Facility equipment

It is important to conduct daily maintenance on facility equipment before it malfunctions or requires replacement parts. The life of equipment can be extended under the proper care such as inspection/fueling/cleaning/repair, etc. Daily inspections can also prevent dangerous accidents.

The generator and pumps need maintenance and inspections by professional companies once a year. The life span of the main equipment is as follows.

Table 2-23 Life-span of Equipment

	Equipment	Life-span
Electrical	Distribution Panel	20 – 30 years
	LED Lamp	20,000 – 40,000 hours
	Generator	30 years
Plumbing	Pump, Pipe, Valve	15 years
	Tank	20 years
	Sanitary Ware	25 – 30 years
Air-conditioning	Air-conditioner	10 years
	Exhaust Fan	20 years

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

Details of the estimated expenses to be borne on the Myanmar side are as follows based on the conditions for calculating the amount shown in (2), when the Project is implemented through Japanese Grant Aid.

(1) Expenses to be borne by the Myanmar Side

Estimated Project cost: Approximately 38.0 million JPY

Table 2-24 Expenses to be borne by the Myanmar Side

No.	Items borne by the Myanmar side	Items borne	Estimated Cost (MMK)	Items borne by the Myanmar side
1	Demolition of existing structures	**YTU Site A(Common Measuring Equipment Building)** Demolition of approximately 90sqm storehouse	447,000	Ministry of Science and Technology
2	Relocation of telegraph poles/power cables	**YTU Site A(Common Measuring Equipment Building)** Relocation of telegraph poles/power cables (approximately 100m) at the project site	1,623,000	As above
3	Tree removal/stumping	**YTU Site A・B** **(Common Measuring Equipment Building・Civil and Electrical Engineering Building)** Stumping and removing trees that are obstacles to building work	619,000	As above
4	Ground preparation at the project site	**YTU Site A・B** **(Common Measuring Equipment Building・Civil and Electrical Engineering Building)** Removal of obstacles at the project site and ground leveling by manpower	1,834,000	As above
5	Infrastructure installation	**YTU Site A・B** **(Common Measuring Equipment Building・Civil and Electrical Engineering Building)** Installation of high voltage line (approximately 300m) and telephone line (approximatery 170m)	7,374,000	As above
6	Supply of general furniture/equipment	**YTU Site A・B** **(Common Measuring Equipment Building・Civil and Electrical Engineering Building)** Procurement od outside equipment (Curtains and blinds) targeted for Japan cooperation	9,041,000	As above
7	Repair of existing facilities	**YTU Existing Building** Repair of existing laboratory(approx. 4,100sqm)(Renewal of finishing materials such as flooring and wall and windows & doors).	403,283,000	As above
		Dep. / Room name		
		Civil: Soil Mechanics Lab、Construction Material Lab、Soil Mechanics Lab、Environmental Lab ×2、Hydraulic Lab、Structural Lab		
		Mechanical: Strength of Materials Lab、Machine Shop、Refrigiration & Air Condition Lab、Thermo Dynamics Lab×2、Vice president preparations room(Robot)、Mehcanical Lab×3		
		Mechatronics: Mechatronics、Electronics、Mechatronics×2		
		IT: IT×2、Communication Networ Lab		
		Electronics: Control Engineering Lab、Microcontroller and Microprocessor Lab、Fundamental Lab、Communication Lab、Power and Industrial Electronics Lab		
		Electric power: High Voltage、Measurement & Instrumentation、Electrical Machine Lab、Power Electronics & Drive、Power System Lab、Elementary Lab、Renewable Enargy System Lab、Electrical Power Lab		
8	Payment comition	Comition for authorization for pay and bank handling charges	5,356,410	As above
Total			429,577,410	

FY 2014 Total Cost	5,658,410
FY 2015 Total Cost	414,288,000
FY 2016 Total Cost	9,631,000
Grand Total	429,577,410

(2) Estimation Conditions

① Estimated as of: December 2013
② Exchange rate: 1USD ＝99.99JPY
③ Construction/procurement schedule: The required duration for design and construction and procurement stages is as shown in the Table 2-21 Implementation schedule.
④ Other: Cost estimation shall be calculated based on the system of Japanese Grant Aid.

2-5-2 Operation and Maintenance Cost

(1) Operation and Maintenance Costs at YTU

1) Consumables for the Equipment

For the equipment planned for the Project, the consumables required are as follows.

Table 2-25 Annual Expense for Additional Consumables by Implementing the Project

Description	Name of Consumable	Unit Price	Quantity needed	Amount (Million Kyat)
Ultrapure water system	Prefilter	0.23	2	0.46
	Final filter	0.20	2	0.40
Air compressor with air tank and dryer	Draw filter element	0.05	10	0.50
	Oil filter element	0.08	3	0.24
	Spacer	0.24	3	0.72
	Oil	0.20	1	0.20
Scanning electron microscope	Filament	0.43	2	0.86
Gas Chromatograph	Analytical reagent	0.05	2	0.10
Liquid Chromatograph	Analytical reagent	0.05	2	0.10
Atomic Absorption Spectrophotometer	Analytical reagent	0.05	2	0.10
Total				3.68

2) Operation and Maintenance Costs

Maintenance and management costs at the current and new sites are estimated as follows.

Table 2-26 Operation and Maintenance Costs of YTU by Implementing the Project

(Unit: Million Kyat)

Item	Project Expenses (after completion)
1. Current Site	
(1) Electric utility costs	0.82
(2) Equipment maintenance	1.70
2. New Site	
(1) Electric utility costs	12.67
(2) Fuel costs	1.97
(3) Facility maintenance costs	5.47
(4) Maintenance costs for elevators and overhead travelling crane	3.50
Total	26.13

Basis of the Estimates

① Electricity charges

Electricity charges are calculated considering the capacity of increase and inflation rate.

21,544,000MMK /year×800/1,460×1.073≒12,667,000MMK/year

② Fuel/oil

・Emergency power generator

The set of a diesel-type power generator will increase the charge. Suppose that the generator works 30 min a day and 5 days per week, and inflation rate is 7.3%.

③ Maintenance costs (the average for 10 years after completion of the Project)

・Facilities repair costs

Although the facilities repair cost varies year by year, the average for 10 years after completion of the Project is assumed to be 0.1 percent of the construction cost.

1,849,000 MMK (c)

・Building equipment repair costs

The cost of equipment repair is not much in the first 5 years, but increases gradually in the next 5 years. The average cost of repairs for the first 10 years is assumed at approximately 0.2 percent of the equipment construction cost.

3,617,000 MMK (d)

(c)＋(d)＝5,466,000 MMK/year

④ Maintenance costs for elevators and ceiling crane

・Maintenance costs for elevators

The expected monthly maintenance costs for elevators by local agencies and manufacturers.

US$150 x 12 months x 972MMK = approx.1,750,000MMK

・Maintenance costs for overhead travelling crane

The expected monthly maintenance costs for the ceiling crane by local agencies and manufacturers.

US$150 x 12months x 972MMK = approx. 1,750,000MMK

(2) Operation and Maintenance Cost of MTU

Table 2-27 Operation and Maintenance Costs of MTU by Implementing the Project

(Unit: Million Kyat)

Item	Project Expenses (after completion)
1. Current Site	
(1) Electric utility costs	1.20
(2) Equipment maintenance	2.52
Total	3.72

(3) Analysis of Operation and Maintenance

Annual expenses for additional maintenance costs generated by implementing the Project are 29,810 thousand Kyat (approx. 2,683 thousand Japanese Yen), which is the total cost of the equipment and facility. The amount is approximately 3.7% of 809,860 thousand Kyat (approx. 72,888 thousand Japanese Yen), which is the total annual expenses for maintenance of equipment and facilities (cost for equipment, consumables, light, fuel, etc., and cost for repair, operation and maintenance for facility, equipment, vehicles, etc.) in fiscal year 2013/14 as shown in the Table 2-28. Since the average annual budget between 2011/12 and 2013/14 is 653,530 thousand Kyat (approx. 58,817 thousand Japanese Yen), it is assumed that the additional amount will be fully covered.

Table 2-28 Transition of Annual Budget of YTU/MTU

Items	2011-2012	2012-2013	2013-2014
YTU			
Laboratory			1,012.375
Cost for Research	0.186		

Language Learning Materials	3.388	242.073	84.988
ICT Environment	7.733	14.274	37.360
Books and Journals		49.024	
Campus Environment		241.69	999.192
New Facilities			400.000
Salary for Teaching and Other Staff	288.909	482.650	664.343
Travel Expenses and Allowance	7.633	22.265	27.300
Cost for Equipment, Consumables, Light, Fuel, etc.	110.190	137.494	255.261
Cost for Repair, Operation and Maintenance for Facility, Equipment, Vehicles, etc.	383.834	127.932	43.783
Scholarships	2.065	0	3.500
Other		81.920	45.010
Total	803.938	1,399.322	3,573.112
MTU			
Laboratory			
Cost for Research	1.132		
Language Learning Materials	3.494		363.542
ICT Environment	8.042	28.667	224.198
Books and Journals	3.819	41.475	224.191
Campus Environment			67.530
New Facilities		3055.394	164.612
Salary for Teaching and Other Staff	526.346	679.703	817.418
Travel Expenses and Allowance	5.841	26.202	25.560
Cost for Equipment, Consumables, Light, Fuel, etc.	96.095	135.844	158.565
Cost for Repair, Operation and Maintenance for Facility, Equipment, Vehicles, etc.	36.717	122.606	352.255
Scholarships	0.239	0.17	0.51
Other	4.274	72.245	78.120
Total	685.999	4,162.306	2,476.501

YTU/MTU Total			
Cost for Equipment, Consumables, Light, Fuel, etc.	206.285	273.338	413.826
Cost for Repair, Operation and Maintenance for Facility, Equipment, Vehicles, etc.	420.551	250.538	396.038
Grand Total	1,489.937	5,561.628	6,049.613

Chapter 3 Project Evaluation

Chapter 3 Project Evaluation

3-1 Preconditions

The Project consists of the procurement of educational and research equipment for new and existing laboratories and construction of a laboratory building on the premises of YTU. There are no preconditions regarding site acquisition. However, Project prerequisites include the timely implementation of the obligations of the Government of Myanmar as described in Chapter 2 regarding the acquisition of building permits, tax exemption procedures, and other items.

3-2 Necessary Inputs by Recipient Country

To complete the entire Project, the following points must be properly prepared and implemented by the Myanmar side.

- The implementation of the obligations of the Myanmar side mentioned in Chapter 2.
- Securing the necessary manpower and budget for use and maintenance of the procured equipment and constructed facilities.
- Securing the necessary space and utilities for the equipment installed in the laboratories of existing buildings

3-3 Important Assumptions

The Project involves procuring the necessary equipment for implementing the curriculum and syllabus of the COE B.E. program of each department and constructing new laboratories. The effective utilization of the procured equipment by teaching staff at YTU/MTU and the continuous implementation of high-quality exercises and experiments is required to generate skilled YTU/MTU graduates. To accomplish these goals, improvement of the curriculum and documents for experiments using equipment procured under the Project is required with the Technical Cooperation Project (EEHE) currently implemented, centering on the departments of YTU/MTU targeted by the Project.

3-4 Project Evaluation

3-4-1 Relevance

The Project is considered valid as a Japanese Grant Aid project in terms of the following points.

(1) Beneficiary of the Project

The targeted area of the Project is Yangon City and Mandalay City, where YTU and MTU are located. YTU and MTU receive students from all of both lower and upper Myanmar. Graduates of both Universities are expected to be employed at higher educational institutions such as the nationwide TU, in the private sector, or at governmental ministries. Direct beneficiaries are approximately 900 teaching staff members of TU nationwide and

approximately 2,800 students who will graduate from YTU/MTU after being trained with the equipment and facilities provided by the Project. As YTU and MTU are the top higher educational institutions of engineering in Myanmar, and the Project will contribute significantly to the development of industry in Myanmar, its validity is observed.

(2) Viewpoint of Human Security

Human security is a concept that encourages personal independence and the creation of a sustainable society through protection and empowerment to realize the abundant potential inherent in each individual. It is also intended to focus on the individual human being and protect people from a broad and serious threat to their survival, livelihood, and dignity. Through the implementation of the Project, opportunities for practical education and research at YTU/MTU will be increased and the capacity of YTU/MTU graduates will be enhanced in terms to their contributions to the development of Myanmar industry and society. From that perspective, the Project is consistent with the essence of human security and is related to efforts in improving the lives of Myanmar people.

(3) Contribution to Achieving the Medium/Long Term Development Plan

Myanmar is currently in the process of developing the National Comprehensive Development Plan (2011-2031). In the draft outline of the plan, growth, richness in diversity and the establishment of a sustainable economy are described as long-term goal. Also in the plan, the development of sector competitiveness and a foreign direct investment environment, the expansion of connectivity, the strengthening of governance, and human resources development are mentioned as strategic priority areas.

For the higher education sector cited as a strategic priority area in the development of human resources, among the 12 presiding ministries, the Ministry of Education, which leads justification and planning, compiles area planning and has drafted a higher education development plan consisting of 13 items. In the plan, to achieve a higher education system equivalent to the level of ASEAN countries, action plans have been formulated for the realization of international standard education, the enhancement of the network with foreign Universities, capacity building of teachers and clerical and technical staff members of the university, and the improvement of student quality.

On the other hand, the Ministry of Science and Technology, which has jurisdiction over the Engineering Universities, has formulated a development plan (2011/12-2030/31) for human resources in industry, especially for science and technology. The development plan consists of 4 phases of five years each: first phase (2011-2015), second phase (2016-2020), third phase (2021-2025), and forth phase (2026-2030). The main contents are as follows.

1st Phase (2011-2015)

- YTU, MTU, University of Computer Studies, Yangon, University of Computer Studies, Mandalay, University of Technology, Yatanarpon Cyber City, and Myanmar Aerospace

Engineering University shall be designated as (COE) and the level of these universities shall be equivalent to top ASEAN universities by 2020.

・An intranet-based e-library shall be prepared at each higher educational organization as a priority.

・The curriculum for the new bachelor program shall be prepared and in-service education and training programs for existing teaching staff shall be conducted.

2nd Phase (2016-2020)

・The universities designated as (COE) shall be strengthened as research-oriented universities.

・The level of approx. 30% of TU and Universities of Computer Studies shall be increased to the same level as universities designated as (COE) in the 1st Phase.

・A one-year diploma course of training technological teaching staff shall be established.

3rd Phase (2021-2025)

・The collaboration between the private sector and the universities shall be strengthened by establishing an office for collaboration within the universities.

・Universities shall be reformed to match the needs of the industrial sector in terms of the level of its graduates.

・(COE) universities will rank in the top 100 of major Asia-Pacific universities.

・The level of approx. 30% of TU and Universities of Computer Studies shall be increased to the same level as universities designated as (COE) in the 1st Phase.

4th Phase (2026-2030)

・Universities other than (COE) universities will provide research activities, not only education.

・The universities designated as (COE) will rank in the top 100 in global rankings.

・The level of the rest of the universities and Universities of Computer Studies shall be increased to the same level as universities designated as (COE) in the 1st Phase.

Through the implementation of the Project, the provision of skilled human resources needed in Myanmar's industrial sector and who have graduated from YTU/MTU is expected. From this point of view, the validity of the Project is acknowledged.

(4) Consistency with Japanese Policy for Official Development Assistance

In the ODA Policy for Myanmar, the following were raised as important issues: assistance for human resource development necessary for fostering economic growth, and the promotion of student exchange programme and educational improvement. This is consistent with the objective of the Project, which is to improve the educational and research environment of YTU/MTU's 6 targeting departments in order to develop highly skilled and practical human resources that can contribute to socio-economic and industrial development in Myanmar. Thus, the validity of the Project in relation to Japanese ODA policy is ensured.

3-4-2 Effectiveness

The following shows the outputs expected by implementing the Project

1) Quantitative Effects

Indicators	Baseline (2014)	End line (2019) (3 years after completion of the Project)
① The number of departments provided with equipment for practice at G5 or above of the (COE) B.E. program	0	YTU: 6 MTU: 6
② The number of students enrolled at 6 targeted departments. (unit: persons)	0	YTU: 1,500 MTU: 1,300

2) Qualitative Effects

① For the targeted 6 departments of YTU/MTU, through conducting a practical education and research utilizing the equipment procured, skilled graduates and teaching staff with practical skills will be developed.

② Through the employment of skilled graduates from YTU/MTU in the labor market in Myanmar in various fields of the public and private sectors, the Project will contribute to socio-economic development in Myanmar.

③ Collaborative activities such as internships, testing and measuring services for private companies, joint research, etc. with private companies (including Japanese companies) and universities will be strengthened based in the facilities constructed by the Project on the premises of YTU.

④ Conference reports and /or articles utilizing the equipment will be developed.

⑤ Technical services will be provided utilizing the newly procured equipment.

In conclusion, the validity of the Project to be implemented by Japanese Grant Aid has been confirmed and its anticipated effectiveness is also fully recognized

Appendices

1. **Member List of the Survey Team**
2. **Survey Schedule**
3. **List of Parties Concerned in the Recipient Country**
4. **Minutes of Discussions (M/D)**
5. **Other Relevant Data**
6. **References**

Appendix 1. Member List of the Survey Team

1-1. Field Survey 1 (8- 29 December, 2013)

No.	Name	Position	Organization
1	Mr. Hiroshi SHIRAKAWA	Leader	Senior Advisor to the Director General, Human Development Department, JICA
2	Mr. Daisuke UEDA	Project Coordinator	Advisor, Technical and Higher Education Division, Higher Education and Social Security Group, Human Development Department, JICA
3	Mr. Akihiro OKAMOTO	Chief Consultant/ Equipment, Operation and Maintenance Planning I	INTEM Consulting, Inc.
4	Ms. Midori OZAWA	Sub-Chief Consultant/Higher Education Planning	PADECO Co., Ltd.
5	Mr. Tomohiro TAMAKI	Equipment, Operation and Maintenance Planning II	INTEM Consulting, Inc.
6	Mr. Tadayoshi TSUMOTO	Architectural Design/ Structure Planning	Yamashita Sekkei Inc.
7	Mr. Eisuke YAMAMOTO	Building Services Planning I	Yamashita Sekkei Inc.
8	Mr. Kaung Zan	Building Services Planning II	Yamashita Sekkei Inc.
9	Mr. Shingo KURODA	Construction and Cost Planning I	Yamashita Sekkei Inc.
10	Mr. Takao KONDO	Construction and Cost Planning II	Yamashita Sekkei Inc.
11	Mr. Ryoji OKAMOTO	Equipment, Operation and Maintenance Planning III/Equipment Procurement/Cost Estimation I	INTEM Consulting, Inc.
12	Ms. Misato OHARA	Equipment Procurement/ Cost Estimation II	INTEM Consulting, Inc.

1-2. Field Survey 2 (11-20 June, 2014)

No.	Name	Position	Organization
1	Mr. Daisuke UEDA	Leader	Director, Technical and Higher Education Division, Higher Education and Social Security Group, Human Development Department, JICA
2	Ms. Akiko KOMORI	Project Coordinator	Deputy Director, Technical and Higher Education Division, Higher Education and Social Security Group, Human Development Department, JICA
3	Mr. Akihiro OKAMOTO	Chief Consultant/ Equipment, Operation and Maintenance Planning I	INTEM Consulting, Inc.
4	Ms. Midori OZAWA	Sub-Chief Consultant/Higher Education Planning	PADECO Co., Ltd.
5	Mr. Tadayoshi TSUMOTO	Architectural Design/ Structure Planning	Yamashita Sekkei Inc.
6	Mr. Takao KONDO	Construction and Cost Planning II	Yamashita Sekkei Inc.
7	Mr. Ryoji OKAMOTO	Equipment, Operation and Maintenance Planning III/Equipment Procurement/Cost Estimation I	INTEM Consulting, Inc.

Appendix 2. Survey Schedule

2-1. Field Survey 1

Working Schedule			Official Members	PM/Equipment, Operation and Management Planning Ⅰ	Sub-PM/Higher Education Planning	Equipment, Operation and Management Planning Ⅱ	Architectural Design/ Structure Planning	Facility Planning Ⅰ	Facility Planning Ⅱ	Construction and Cost Planning Ⅰ	Construction and Cost Planning Ⅱ	Equipment, Operation and Maintenance Planning Ⅲ /Equipment Procurement/Cost Estimation Ⅰ	Equipment Procurement/Cost Estimation Ⅱ
Name				Akihiro OKAMOTO	Midori OZAWA	Tomohiro TAMAKI	Tadayoshi TSUMOTO	Eisuke YAMAMOTO	Kaung Zan	Shingo KURODA	Takao KONDO	Ryoji OKAMOTO	Misato OHARA
Days			10	16	22	22	22	8	11	16	9	15	22
1	8th Dec	Sun			(Arrive to Yangon)								Arrive to Yangon
2	9th Dec	Mon			Courtesy call on JICA ・Myanmar Engineering Society ・Comprehensive Education Sector Review	Survey at YTU			Preparing for Survey on Infrastructure				Survey at YTU
3	10th Dec	Tue	(Tokyo→Yangon)		Survey on Higher Education and Industry Capacity Building planning (Private companies) at Yangon	Survey at YTU			Survey at YTU	(Tokyo→Yangon)			Survey at YTU
4	11th Dec	Wed	Courtesy call on Embassy, Meeting atJICA Office, Discussion at YTU		Courtesy call on Embassy, Meeting atJICA Office, Discussion at YTU				Courtesy call on Embassy, Meeting atJICA Office, Discussion at YTU	Survey at YTU, Passing Questionnaire for Cost Planning,			Courtesy call on Embassy, Meeting atJICA Office, Discussion at YTU
5	12th Dec	Thu	(Yangon→Nay Pyi Daw), Discussion at MOST on Inception Report, (Nay Pyi Daw→Mandalay)		(Yangon→Nay Pyi Daw), Discussion at MOST on Inception Report, (Nay Pyi Daw→Mandalay)				(Yangon→Nay Pyi Daw), Discussion at MOST on Inception Report, (Nay Pyi Daw→Mandalay)				Survey at YTU on Existing Equipment
6	13th Dec	Fri	Survey at MTU, (Mandalay→Yangon)		Survey at MTU, (Mandalay→Yangon)				Survey at MTU, (Mandalay→Yangon)				Survey at YTU on Existing Equipment
7	14th Dec	Sat	Team meeting	(Tokyo→Yangon)	Team Meeting				Team Meeting				Team Meeting
8	15th Dec	Sun	Data filing	Team meeting	Data filing	Team meeting	Data filing	(Tokyo→Yangon)		Survey on Construction status		(Tokyo→Yangon)	Data filing
9	16th Dec	Mon	Survey at YTU	Survey at YTU		(Yangon→Mandalay), Discussion at MTU on Equipment planning	Survey at YTU					Survey at YTU	(Yangon→Mandalay) Discussion at MTU on Equipment planning
10	17th Dec	Tue	(Yangon→Nay Pyi Daw), Discussion with MOST on the draft Minutes, Signing of Minutes (Nay Pyi Daw→Yangon→Tokyo)	(Yangon→Nay Pyi Daw), Signing of Minutes, (Nay Pyi Daw→Yangon)		Discussion at MTU on Equipment planning	(Yangon→Nay Pyi Daw), Signing of Minutes, (Nay Pyi Daw→Yangon)	Survey at YTU	Survey at YTU	Discussion on Site survey		Survey at YTU	Discussion at MTU on Equipment planning
11	18th Dec	Wed	Tokyo	Discussion at YTU on Equipment Plan, Existing equipment	Survey on Higher Education and Industry Capacity Building planning(Governmental authorities) at Yangon	Discussion at MTU on Equipment planning	Discussion at YTU on Requested plan	Discussion at YTU on Requested plan/Discussion at MES on Design Standard	Discussion at Fire and Water Departments	Survey of Construction and Cost Planning		Discussion at YTU on Equipment Plan	Discussion at MTU on Equipment planning
12	19th Dec	Thu		Discussion at YTU on Equipment Plan	Survey on Higher Education and Industry Capacity Building planning (Other donors) at Yangon	Discussion at MTU on Operation and Management Plan	Discussion at YTU on Architectural Structure	Discussion at YTU on Facility Plan	Discussion at Electric power company and Telephone company	Cost and Construction Survey		Discussion at YTU on Equipment Plan	Discussion at MTU on Equipment planning
13	20th Dec	Fri		Discussion at YTU on Equipment Plan	Survey on Higher Education and Industry Capacity Building planning(YTU) at Yangon	Survey on Installation and Facility	Discussion at YTU on Architectural Structure	Discussion at YTU on Facility Plan	Preparing Infrastructure plan	Cost and Construction Survey		Discussion at YTU on Equipment Plan	Discussion at MTU on Equipment planning
14	21st Dec	Sat		Team meeting				(Yangon→Tokyo)		Team meeting	Tokyo→Yangon	Team meeting	
15	22nd Dec	Sun		Data filing			Preparing Architectural Structure Plan	Tokyo		Survey on Construction status		Data filing	(Mandalay→Yangon)
16	23rd Dec	Mon		Discussion at YTU on Equipment Plan	Survey on Higher Education and Industry Capacity Building planning(MTU) at Yangon	Survey on Installation and Facility	Discussion at YTU on Architectural Structure			Attend to Mesurement and Boring survey	Survey at YTU	Discussion at YTU on Equipment Plan	Visiting Agents of Equipment Procurement
17	24th Dec	Tue		Survey on Operation and Management Plan	Survey on Higher Education and Industry Capacity Building planning(Governmental authorities) at Yangon	Preparing Equipment plan	Discussion at YCDC			Cost and Construction Survey (Yangon→Tokyo)	Survey on Operation and Management Plan	Discussion at YTU on Equipment Plan	Visiting Agents of Equipment Procurement
18	25th Dec	Wed		Preparing Equipment specification, (Yangon→Nay Pyi Daw)	(Yangon→Nay Pyi Daw)	(Mandalay→Yangon)	(Yangon→Nay Pyi Daw)			Tokyo	(Yangon→Nay Pyi Daw)	Data filing	
19	26th Dec	Thu		Signing of Technical Notes, (Nay Pyi Daw→Yangon)		Visiting agents	Signing of Technical Notes, (Nay Pyi Daw→Yangon)				Signing of Technical Notes, (Nay Pyi Daw→Yangon)	Discussion at YTU on Equipment Plan	Visiting Agents of Equipment Procurement
20	27th Dec	Fri		Meeting at JICA office.		Visiting agents	Meeting at JICA office.				Meeting at JICA office.	Discussion at YTU on Equipment Plan	Visiting Agents of Equipment Procurement
21	28th Dec	Sat		(Yangon→Tokyo)							(Yangon→Tokyo)		
22	29th Dec	Sun		Tokyo							Tokyo		

2-2. Field Survey 2

No.	Date		Schedule						
			JICA		CONSULTANTS				
			Leader	Cooperation Planning	PM/Equipment, Operation and Management Planning Ⅰ	Sub-PM/Higher Education Planning	Architectural Design/ Structure Planning	Construction and Cost Planning Ⅱ	Equipment, Operation and Maintenance PlanningⅢ /Equipment Procurement/Cost
			Daisuke UEDA	Akiko KOMORI	Akihiro OKAMOTO	Midori OZAWA	Tadayoshi TSUMOTO	Takao KONDO	Ryoji OKAMOTO
	Days		6	10	10	10	11	11	10
1	11-Jun	Wed		(11:00) Depart Narita (15:40) Arrive in Yangon Meeting with EEHE Project Secretariat					
2	12-Jun	Thu		(9:00 -) Meeting with YTU personnel on Draft Report @ YTU					
3	13-Jun	Fri		(9:00-)Meeting with YTU personnel on Draft Report @ YTU					
4	14-Jun	Sat		Internal meeting/Analysis					
5	15-Jun	Sun	(11:00) Depart Narita (15:40) Arrive in Yangon Internal Meeting	Internal meeting/Analysis					
6	16-Jun	Mon	(9:30) Courtesy call on EOJ (11:30) Move from YGN to NPT (by air) (Afternoon) Discussion with DAST (Director. Dr. Mi Mi Khin)		(9:30) Coutesy call on EOJ (Afternoon) Supplementarily Study		Supplementarily Study		
7	17-Jun	Tue	Internal meeting/Analysis		(7:30) Move from YGN to NPT (by air) (Afternoon) Internal meeting/Analysis		Supplementarily Study		
8	18-Jun	Wed	(9:30) Explanation on Draft Report, MD Discussion at MOST (with DG, U Kyaw Zwa Soe) (Afternoon) Internal meeting/Analysis				Supplementarily Study		
9	19-Jun	Thu	(9:00) Signing of MD at MOST (12:30-13:30) Report back to EoJ (14:00) Move from NPT to YGN (by car) (21:45) Depart Yangon				Supplementarily Study		Supplementarily Study (21:45) Depart Yangon
10	20-Jun	Fri	(06:50) Arrive in Narita				Supplementarily Study (21:45) Depart Yangon		(06:50) Arrive in Narita
11	21-Jun	Sat					(06:50) Arrive in Narita		

Appendix 3. List of Parties Concerned in the Recipient Country

Organization/Section		Position	Name
Ministry of Science and Technology(MOST)		Union Minister	H.E. Dr. Ko Ko Oo
		Deputy Minister	H.E. Prof. Dr. Aung Kyaw Myat
		Deputy Minister	H.E. Prof. Dr. Ba Shwe
	Department of Advanced Science and Technology(DAST)	Director General	Mr. Kyaw Zwa Soe
	Department of Technical abd Vocational Education	Director General	Dr. Zaw Win
	Department of Advanced Science and Technology(DAST)	Director	Dr. Mie Mie Khin
	Department of Advanced Science and Technology(DAST)	Depty Director	Dr. May Phyo Oo
	Foreign Relations Department, Department of Advanced Science and Technology(DAST)	Assistant Director	Mr. Kyaw Thet Oo
	Foreign Relations Department, Department of Advanced Science and Technology(DAST)	Assistant Director	Mr. Aung Ko Ko Kyaw
	Myanma Scientific and Technological Research Department	Deputy Director General	Mr. Win Khaing Moe
		Chairman of Steering committee for YTU & MTU, Advisor to Ministry of Science & Technology	Prof. NYI Hla Nge
Ministry of Education	Department of Higher Education (Lower Myanmar)	Deputy Director General	Dr. Zaw Myint
Comprehensive Education Sector Review Office		Task Manager in charge of higher education and TVET	Ms. Ohnmar Thein
		International Consultant for higher education	Mr. Nigel Billany
YTU		Rector	Prof.Dr. Aye Myint
		Pro-Rector	Dr. Khin Than Tu
	Information Technology		Dr. Kyi Than Ko
	Electrical Engineering		Dr. Thet Pewy Phyo
	Mechanical		Dr. Than Than Hlilce
	Mechatronics Engineering		Dr. Drung Kyaw Hei
	Mechatronics Engineering	Associate Professor and Head	Dr. Aung Kyaw Hein
	Mechatronics Engineering	Associate Professor and Vice Head	Dr. Khin Thu Zar Win
	Electrical Power Engineering		Dr. Sue Win
	Civil Engineering		Dr. Toe Toe Win
	Foreign Rolation		Mr. K Hin Maung Zaw
	Mechanical Engineer	Lecturer	Ms. Soe Soe Nu
	Mechanical Engineer	Professor	Dr. Yin Yin Tun
	Information Technology		Dr. Myo Min Than
	Electrical Power Engineering		Dr. Than Zaw Htwe
	Electrical Engineering		Dr. Myo Myint
	Mechanical		Dr. Aung Hyz Hei
	Architector		Dr. Theigai
	Mechanical		Dr. Than Than Hlice
	Foreign Relations		Mr. Khin Maung Eaw
	Foreign Relations		Ms. Li Li Aung
MTU		Pro-Rector	Dr. Myint Thein
	Electrical Engineering	Associate Professor and Head	Dr. Hla Myo Tun
	Information Technology	Associate Professor and Head	Dr. Aung Myint Aye
	Bio	Associate Professor and Head	Dr. Myo Myint
	Mechatronics Engineering	Associate Professor and Head	Dr. Wut Yi Win
		Associate Professor	Dr. Nu Nu Win
	Ch.E	Associate Professor	Dr. Chaw Su Su Hmwe
	Electrical Power Engineering	Associate Professor and Head	Dr. Khin Thu Zar Soe
	Mechanical Engineering	Associate Professor and Head	Dr. Ei Ei Htwe
		Associate Professor	Dr. Myat Myat Soe
	Civil Engineering	Associate Professor	Dr. Aye Mya Cho
		Associate Professor	Dr. Nilar Aye
	NT	Associate Professor	Dr. Khin Khin Lay
Embassy of Japan in the Republic of the Union of Myanmar		Counsellor （Economic & ODA）	Mr. Hideaki Matsuo
		Second Secretary	Ms. Sumie Arima
		Coordinator for Economic Cooperation	Ms. Ayaka Ishihara
JICA Myanmar Office		Chief Representative	Mr. Masahiko Tanaka
		Senior Representative	Mr. Kyosuke Inada
		Representative	Mr. Kohei Isa
		Representative	Ms. Ami Ikeda
		Program Assistant	Ms. K Thwe Aung
		Administrative Assistant	Ms. Shwe May Kyaw

Organization/Section		Position	Name
Project for Enhancement of Engineering Higher Education in Myanmar		Chief Advisor	Dr. Hiroshi Shirakawa
		Academic Advisor	Dr. Takeshi Koike
		Academic Advisor	Dr. Toru Shigechi
		Project Coordinator	Mr. Isamu Hamada
Myanmer Engineering Society		Chief Executive Officer	Mr. Myint Soe
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United Engineering Co., Ltd	Operations and Works	Director	Mr. Zaw Min
	Engineering	General Manager	Mr. Po Aye
Super mega Engineers Group & Trading Co., Ltd.		Exective Director	Mr. Aye Hnin Mu Thant
		Managing Director	Ms. Khin Maung Win
Business area of Japanese-affiliated firms in Myanmar		Position	
Plant Engineering	Japan Myanmar Joint-Venture Company	Managing Director	
External Trade	Yangon Office	Senior Advisor	
Japan Myanmar Culture & Economic Exchange		Director & Secretary General	
Civil Engineering	Yangon branch	Manager	
International Accounting Consultation		Manager	
Electrical Transmission Line Construction, Electrical Works, Air Conditioning Works	Yangon Office	General Manager	
Sales and Maintenance of Construction Machinery	Yangon branch	Manager	
Sales of Industrial Machinery Water & Environment Business	Yangon branch	Deputy General Manager	
Infrastructure and Manufacturing	Yangon branch	General Manager	
Construction	Myanmar Office	General Manager	
ICT Solution, Telecommunications business	Sales Department	Manager	
Japanese manufacturers' product distributor		Advisor	

MINUTES OF MEETINGS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE AUTHORITIES CONCERNED OF
THE GOVERNMENT OF THE REPUBLIC OF THE UNION OF MYANMAR
ON
THE PREPARATORY SURVEY
ON
THE PROJECT FOR ENHANCING TECHNOLOGICAL UNIVERSITIES
IN MYANMAR

Based on previous discussions with Government of the Republic of the Union of Myanmar (hereinafter referred to as "Myanmar"), the Government of Japan decided to conduct a Preparatory Survey on the Project for Enhancing Technological Universities in Myanmar (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Myanmar a Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Dr. Hiroshi Shirakawa, Senior Advisor to Director General, Human Development Department, JICA Headquarters from December 10th to December 17th, 2013.

The Team held discussions with the officials concerned of the Myanmar side and conducted a field survey at the study area.

In the courses of discussions and field survey, both sides confirmed the main points described in the attachment. The Team will proceed to further works and prepare the Preparatory Survey Report.

Nay Pyi Taw, December 17, 2013

Dr. Hiroshi Shirakawa
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

U Kyaw Zwa Soe
Director General
Department of Advanced Science and Technology
Ministry of Science and Technology
The Republic of the Union of Myanmar

ATTACHMENT

1. Background

Upon the political transition in 2011, the Government of the Republic of the Union of Myanmar has planned to carry out major reforms in various aspects in education. Among all, improvement of higher education in engineering field is considered as a vital part of efforts to promote industrial and economic development in Myanmar.

Yangon Technological University ((hereinafter referred to as "YTU") and Mandalay Technological University ((hereinafter referred to as "MTU") are the two leading engineering universities in Myanmar. The limited availability of resources in the past, however, has prevented YTU and MTU from securing sufficient number of qualified academic staff, as well as maintaining and renewing education and research equipment and facilities. Responding to this challenge, MOST decided to enhance the capacity of YTU and MTU by designating them as COE (Center of Excellence), and had newly launched COE Bachelor of Engineering Program (COE-BE) to upgrade the quality of their undergraduate program. The curriculum is identical at YTU and MTU in order to ensure equal quality of education at these two leading universities. The policy of Ministry of Science and Technology (hereinafter referred to as "MOST") also emphasizes the upgrading of education level equivalent to other ASEAN countries. In order to realize this initiative effectively, MOST requested the Government of Japan to support upgrading of education infrastructure of YTU and MTU.

2. Objective of the Project

The objective of the Project is to enhance the education capacity of and realize practical education at Yangon Technological University and Mandalay Technological University, through the provision of equipment for education and research, in order to contribute to development of highly skilled human resources which are necessary for industrial development and socio-economic development of Myanmar.

3. Target Organizations

(1) Target Universities: YTU (primary target) and MTU (secondary target)

(2) Target Departments: mainly 6 departments
(Civil Engineering, Mechanical Engineering, Electric Power Engineering, Electronic Engineering, Information Technology, Mechatronic Engineering)

4. Responsible and Implementing Agency

The responsible agency is MOST, and the implementing agencies are YTU and MTU.

5. Items requested by the Government of the Republic of the Union of Myanmar

5-1. Myanmar side submitted the tentative list of equipment to be provided to YTU and MTU as shown in ANNEX-1. Both sides confirmed the selection/consideration process to be taken as follows:

(1) Priorities will be given to the equipment which can be utilized by larger number of people, and by many departments instead of single department. Specifically, the priority will be based on the following criteria (in order of higher priority):

(i) Education equipment for COE-BE

(ii) Education equipment for graduate courses

(iii) Equipment utilized by academic staff for providing technical service to business sector (including Japanese firms) as well as government organizations (universities and research institutes)

(2) The Team will also consider the priority of Myanmar side in addition to the above mentioned criteria for prioritization. The Team, however, does not necessarily assure that all the equipment in the list or even high prioritized equipment can be provided due to the availability of budget, validity of equipment. In addition, there are some possibilities that he Team cannot list equipment which has some specified models with names of brands in accordance with the regulation of Grant-Aid scheme.

5-2. Both sides confirmed that the existing facilities at YTU and MTU shall be utilized to the maximum extent possible to accommodate the equipment mentioned in 4-1. above, in order to assure the optimal usage of the limited budget of the Grant Aid Project. Both side further confirmed that there is a need to develop new facilities to ensure proper operation and maintenance of the selected equipment.

5-3. JICA will assess the appropriateness of the request and will report the findings to the Government of Japan for approval.

6. Japan's Grant Aid Scheme

6-1. Myanmar side understood the Japan's Grant Aid Scheme explained by the Team, as described in ANNEX-2 and ANNEX-3.

6-2. Myanmar side will take the necessary measures, as described in ANNEX-4, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

7. Tentative Schedule of the Survey

7-1. The Team will prepare the draft Preparatory Survey Report and will dispatch a mission team around mid-May 2014, in order to explain its contents to Myanmar side and make the Minutes of Discussions between both sides.

7-2. In case that the contents of the draft report are accepted in principle by Myanmar side, the Team will complete the final Preparatory Survey Report and send it to the Government of the Republic of the Union of Myanmar around mid-June 2014.

8. Other relevant issues

8-1. Operation and maintenance

Myanmar side agreed to secure and allocate necessary budget and appropriate staff members for the proper operation and maintenance of the equipment and facilities to be provided by the Project.

8-2. Collaboration with the ongoing Technical Cooperation Project by JICA

Both sides agreed that the Project will be implemented in collaboration with ongoing Technical Cooperation Project by JICA in higher education sector in terms of improving quality of education and research.

(END)

ANNEX-1 Tentative List of equipment requested for YTU and MTU
ANNEX-2 Japan's Grant Aid Scheme
ANNEX-3 Flow Chart of Japan's Grant Aid Procedures
ANNEX-4 Major Undertakings to be taken by Each Government

Requested Equipment for YTU

Department	No.	Description	Amount	Unit
Electronic Engineering	1	Shear cutters	30	sets
	2	Wire Cutters	30	sets
	3	ESD-safe tweezers	30	sets
	4	Screwdriver set	30	sets
	5	Universal Crimp tool	30	sets
	6	Soldering tools	30	sets
	7	Solder sucker / Desolder pump	30	sets
	8	Small circuit board holder	30	sets
	9	Large circuit board holder	10	sets
	10	PCB Shear	2	sets
	11	Decade Box (Resistance)	30	sets
	12	Decade Box(Capacitance)	30	sets
	13	Decade Box (Inductance)	30	sets
	14	Digital Multimeter	30	sets
	15	LCR Meter	30	sets
	16	DDS Function Generator	10	sets
	17	Digital Oscilloscope	10	sets
	18	Variable Dc Power Supply	10	sets
	19	Switching Power Supply	10	sets
	20	Frequency Counter 0-10 MHz	4	sets
	21	Local Area Network Trainer	2	sets
	22	Power Electronic Trainer	2	sets
	23	Microprocessor and Embedded Controller Trainer	2	sets
	24	Industrial PLC /SCADA/DCS Trainers	2	sets
	25	Image Processing Trainer	1	set
	26	VLSI embedded System trainer	1	set
	27	FPGA trainer	1	set
	28	Personal computer	20	sets
	29	Electronic Work Bench	10	sets
	30	Electrical Work Bench	5	sets
	31	SATSOFT (Software)	1	set
	32	LabView (Software)	5	sets
	33	Quatus II (Software)	2	sets
	34	Induction Motor	1	set
	35	Power Break	1	set
	36	Torque Sensor	1	set
	37	PinPoint Sigma	1	set
	38	Data Capture Pod	1	set
	39	S790 Series 2	1	set
	40	Printer	4	sets
Electrical Power Engineering	41	HV KIT Elements for 100 kV AC	1	set
	42	High Voltage Transformer 100 kV, 0.1 A	1	set
	43	Regulating Transformer 7.5 kVA	1	set
	44	Control unit for KIT with housing Spark gap plug-in Unit	1	set
	45	Multimeter	3	sets
	46	Micrometer	2	sets
	47	IGBT	12	sets
	48	DC/AC Ammeter	5	sets
	49	AC Voltmeter	5	sets
	50	Multi Meter	5	sets
	51	Energy meter (P meter)	5	sets
	52	Power Meter (Q meter)	5	sets
	53	Wattmeter	5	sets
	54	RMS Meter	5	sets
	55	Power Factor Meter	5	sets
	56	Moving Iron Meter 6 A	5	sets
	57	Moving Iron Meter 100/400 V	5	sets
	58	Moving Iron meter 600 V	5	sets
	59	Variable Resistor	1	set
	60	Choke	5	sets
	61	Fuse	20	sets
	62	Tumbler Switch	5	sets
	63	3 way switch 2	5	sets
	64	4 way switch 2	5	sets
	65	lamps	5	sets
	66	Fluorescent lamp	5	sets
	67	Decade Resistance Boxes	3	sets
	68	Electronic Galvanometer	1	set
	69	Dry cell	1	set
	70	Circuit Tester	1	set
	71	Pushbutton Switches	2	sets
	72	Portable Wheatstone Bridge	1	set

	73	Precision Wheatstone Bridge	1	set
	74	Carbon Film Resistors & Wire Wound Resistors	5	sets
	75	Incandescent lamps:	1	piece
	76	Heater	1	set
	77	Electromagnetic Relay	1	piece
	78	EEL -2007 Electrical DC Machines I	1	set
	79	EEL -2225 DC Supply	1	set
	80	EEL-2226 AC/DC load	1	set
	81	EEL 2201 Three phase lab	1	set
	82	EEL -2006 Three Phase Induction Motor	1	set
	83	EEL-2004 Single phase Transformer Lab	1	set
	84	Manual/automatic winding machine for transformers and motors	2	sets
	85	Kit for Construction of an asynchronous motor	2	sets
	86	Kit for Construction of 2 transformer	2	sets
	87	Software for the design of electric machines	1	set
	88	Digital Tachometer	2	sets
	89	Digital Tachometer Set	1	set
	90	EEL- 2001 Basic Electricity	1	set
	91	EEL- 2201 Three-phase Lab	1	set
	92	EEL- 2005 Power measurement by two wattmeter method	1	set
	93	EEL – 2025-Single phase energy meter trainer	1	set
	94	EAL:Network Analyzer Unit	2	sets
	95	PLC Module with software	2	sets
	96	Personal Computer and MATLab software	20	sets
	97	AE7. Multi-function Electrical Protection Station:AL1o1. Industrial mail Power Supply, CAR08. 3phase	1	set
	98	HV KIT Elements for 100 kV AC	1	set
	99	High Voltage Transformer 100 kV, 0.1 A	1	set
	100	Regulating Transformer 7.5 kVA	1	set
	101	Control unit for KIT with housing Spark gap plug-in Unit	1	set
	102	Digital Oscilloscope with sampling frequencies up to 200 MHz (4 channel)	1	set
	103	Digital Oscilloscope with sampling frequencies up to 400 MHz (4 channel) UHF probe	1	set
	104	Acoustic Sensors	4	set
	105	Pre-amplifiers	4	set
	106	Amplifier box	1	set
	107	High-End Measurement and Analysis System for Partial Discharges	1	set
	108	Needle-sphere electrode as a PD source	1	set
	109	TRNSYS	1	set
	110	Printer	4	sets
Mechatronic Engineering	111	Digital Storage Oscilloscope	5	sets
	112	Digital Multi-meter	20	sets
	113	Solder less Breadboard	20	sets
	114	Arbitrary Waveform and Function Generator	5	sets
	115	Logic Analyzer	5	sets
	116	Servo DC Motor Trainer	1	set
	117	Pneumatic Trainer System	2	sets
	118	Hydraulic Trainer System	2	sets
	119	Factory Automation Trainer	1	set
	120	SCARA Robotic Trainer	1	set
	121	PLC trainer (FPLC-T060)	1	set
	122	LabView Training System	1	set
	123	Electronic Circuits Lab(KL-200)	1	set
	124	Advanced FPGA Development System	1	set
	125	Autotronic Training System	1	set
	126	Industrial Electronic Trainer	1	set
	127	Biomedical Measurement Data Acquisition System	1	set
	128	Biomedical Measurement System	1	set
	129	Image Processing Trainer	1	set
	130	DSP Development And Experiment System	1	set
	131	Power Electronics Training System	1	set
	132	Machining System for Mechatronic Workshop	1	set
	133	Personal Computer	20	sets
	134	Printer	4	sets
Mechanical Engineering	135	Personal Computer with CAD and CAM Software	30	sets
	136	Single welding transformer (120 Amps) with full accessories	2	sets
	137	Welding wire – 15 ft.	3	sets
	138	Earth welding wire – 10 ft.	3	sets
	139	hand shield, lather apron, glove	20	sets
	140	Welding holder, chopper hammer	3	sets
	141	Steel wire brush	6	sets
	142	Motor – 2 kW, with blower	1	unit
	143	Vernier Caliper – 8 inch	6	sets
	144	Steel rule – 1 ft.	6	sets
	145	Ball Center	3	sets

146	Drill Chuck 0.66 in, 0.5 in	2	sets
147	Screw pitch gauge	3	sets
148	Drill tip – 11 mm	6	sets
149	Turning tool , boring tool, (carbide)	15	sets
150	Cutting tools (carbide 12mm, high speed – 10 mm, 8 mm, 6 mm)	6	sets
151	Gear oil – 10 gallons	10	sets
152	Grinding stone (carbide) – 1 ft.	4	sets
153	2-lb hammer (round)	15	sets
154	4-lb hammer (round)	6	sets
155	10-lb hammer	4	sets
156	Hand grippers (various shape)	15	sets
157	Chisel (to cut heated metal)	4	sets
158	9 in Vice	3	sets
159	Water tank – 25 gallon	2	sets
160	Fire-fighter	3	sets
161	Coal	250	kg
162	Bench	5	sets
163	Grinder , 1 hp 1 unit, grinding wheel	2	sets
164	Room 2/1-50, carpenter bench – 6´4 ft., carpenter vice – 9 in	4	sets
165	Room 2/1-50, carpenter bench – 6´4 ft. , carpenter vice – 9 in	12	sets
166	Tri-square 6 in	10	sets
167	Claw hammer	10	sets
168	Cross cut saw, 20 in	6	sets
169	Circular saw – 2 ft.	1	set
170	Mortice chisel 0.33 in	3	sets
171	Bevel edge chisel 0.75 in, 5 in plane iron, wedge	15	sets
172	Morticer , 0.33 in, 0.5 in	1	set
173	Planer tooth – 30 in	8	sets
174	Folding ruler – 2 ft.	15	sets
175	Oil stone 10 in	4	sets
176	Saw set	2	sets
177	Tape 3 m	2	sets
178	Triangular file – 6 in	3	sets
179	Triangular file – 4 in	12	sets
180	Ball peen hammer, straight peen hammer – 2 lb.	15	sets
181	Cold chisel	15	units
182	Flat file	15	units
183	Round file	15	units
184	Square file	15	units
185	Half-round file	15	units
186	Triangular file	15	units
187	Single cut file	15	units
188	Double cut file	15	units
189	Divider	15	units
190	Outside caliper	15	units
191	Inside caliper	15	units
192	Steel ruler	15	units
193	Center punch	15	units
194	Die and die stock	15	units
195	Tap and tap wrench	15	units
196	Try square	15	units
197	Drill chick – 0.66 in	4	sets
198	Drill tip- 11 in	12	sets
199	Grinding stone	1	sets
200	Dial Gauge – 0~2/3 in (Analog/Digital)	3	sets
201	Micrometer – 4 in (Analog/Digital)	3	sets
202	Bevel Protractor	2	sets
203	Sine Bar	2	sets
204	CNC Lathe	1	set
205	CNC Milling machine	1	set
206	Teaching aids for non-traditional machining processes such as electro-chemical machining	1	set
207	An automation system	1	set
208	Governor apparatus	1	set
209	Cam Analysis Machine	1	set
210	Balancing of Reciprocating Masses	1	set
211	Teaching aids for robotic engineering, and training for a robotic programming language	1	set
212	Bomb Calorimeter Set	1	set
213	Marcet Boiler	1	set
214	Signal conditioning for data logging for existing Two Shaft Gas Turbine	1	set
215	Extensometer	1	set
216	Brinell Hardness Testing Unit	1	set
217	Charpy and Izod impact testing unit	1	set
218	Beam deflection apparatus combined with unsymmetrical cantilever unit	1	set
219	Strut unit	1	set
220	Fatigue testing unit	1	set

221	Pipe surge and water hammer apparatus	1	set
222	Stability of a floating body testing unit	1	set
223	overhead water tanks for hydraulic lab and engine test – 100 gallon	2	sets
224	Teaching aids for wind energy such as wind-tunnel and training course, and training course for application software of aerofoil design for various usages such as wind-turbines, gas-turbines, hydro turbines	1	set
225	computer and printer for office use	2	sets
226	Engine research and test bed (gasoline) + optional accessories, with exhaust gas analysis device	1	set
227	Computer controlled diesel engine and electricity generator with load bank	1	set
228	Teaching aids for wind energy such as wind-tunnel	1	set
229	Personal computers with engineering computation and simulation software	30	sets
230	MATLAB	30	sets
231	SolidWork	30	sets
232	Pro-Engineering	30	sets
233	AutoDesk	30	sets
234	CAD/CAM	30	sets
235	Internal combustion engine simulation software	30	sets
236	Software for aerofoil design for various usages such as wind-turbines, gas-turbines, hydro turbines	30	sets
237	Tension testing machine, Bending testing machine	1	set
238	Fatigue testing machine	1	set
239	Multichannel spectrophotometer	1	unit
240	Fourier transform infrared spectrophotometer (FT-IR)	1	unit
241	Ultra-violet and visible spectrophotometric	1	unit
242	thermo-hygrostat incubator	1	unit
243	AC generator (100kV, nominal voltage 33kV, for pressure test)	1	unit
244	Impulse generator (300kV, nominal voltage 33kVA, for pressure test)	1	unit
245	Oscilloscope	5	units
246	Field Emission Scanning Electron Microscope	5	units
247	Microscope	5	units
248	Transmission electron microscope(TEM), (200kV, including CCD system and EDS)	1	set
249	Sputtering instrument	1	set
250	Electron-beam deposition, resistance heating evaporation system	1	set
251	Clean booth	1	set
252	X-ray machine	1	set
253	Motion capture instrument	1	set
254	X-ray CT machine	1	set
255	YAG laser (for processing)	1	set
256	YAG laser (for measuring)	1	set
257	Impedance meter	5	sets
258	Power analyzer	5	sets
259	Curve tracer	5	sets
260	Frequency counter	5	sets
261	Manual prober station set	5	sets
262	Network analyzer	5	sets
263	Locker	5	sets
264	Standard volume	5	sets
265	Standard mass	5	sets
266	JCSS standard thermometer	5	sets
267	AC voltage current standard	5	sets
268	Pneumatic pressure standard	5	sets
269	Mixed signal oscilloscope	5	sets
270	Standard signal generator	5	sets
271	Precision power analyzer	5	sets
272	GC/MS	1	set
273	LC/MS	1	set
274	XRD	1	set
275	X-ray fluorescence spectrometers	1	set
276	X-ray machine	1	set
277	Powder X-ray diffraction spectrometer	1	set
278	Laboratory table	4	units
279	Laboratory chair	20	units
280	Electronic balance	5	units
281	Chemical cabinet	2	units
282	Equipment cabinet	4	units
283	Fume hood	2	units
284	Triaxial machining center	1	set
285	CAD	20	sets
286	Desktop PC	20	sets
287	Insulation resistance tester	5	sets
288	Thermography	1	unit
289	High magnetic filed generator	1	unit
290	Thickness meter	5	units
291	Spectrum analyzer	5	units
292	Precise universal tester	1	unit
293	Pressure distribution tester	1	unit
294	Digital multi-meter	20	units
295	Tesla meter	20	units
296	High Voltage Insulation HITESTER	1	unit
297	Anechoic chamber	1	set
298	Reverberation chamber	1	set
299	Radiation shielding panel	1	set

	300	Electro-Magnetic shielding panel	1	set
	301	liquid nitrogen generator/storage	1	set
	302	Back up generator	1	set
	303	Gas piping/storage system for testing equipment	1	set
	304	Cooling water system	1	set
	305	Waste liquid storage system	1	set
	306	Server and data storage system	1	set
	307	Air conditioning system	each room	
	308	Voltage regulator	1	set
	309	Compressed air supply system	1	set
	310	Printer	4	sets
	311	Electronic microscope	1	set
	312	Atomic absorption photometer	1	set
Information Technology	313	42U Rack	2	sets
	314	9U Rack	3	sets
	315	Rack Monitor, Kb and mouse	1	set
	316	Cisco Fiber Switch	2	sets
	317	Cisco L3 48 Ports Switch	2	sets
	318	Cisco L2 48 Ports Switch	2	sets
	319	Cisco Router	2	sets
	320	Fiber Cable (Meter) (indoor multi mode)	12	sets
	321	10 KVA online UPS	1	set
	322	Dell R420 Server	2	sets
	323	Dell R520 Server	2	sets
	324	42U Open Frame Rack with 2 or 3 extension Power cord	3	sets
	325	AMP 19" Fiber patch panel	4	sets
	326	UTP Cat 6 Cable (300M)Box	23	sets
	327	UTP Cat 5e cable (300M)box	3	sets
	328	AMP Path Panel	12	sets
	329	AMP Cable Manager	12	sets
	330	SOGO Basement Box	16	sets
	331	UTP Cat5e Femail Jack Box	16	sets
	332	UTP Cat5e Face Plate Box	16	sets
	333	SOGO Trunking (Box)(4"x6')	6	sets
	334	RJ45 Connector (100)box	5	sets
	335	1200VA UPS	3	sets
	336	Fiber Path Cord Cable (3M)	16	sets
	337	Fiber Termination	16	sets
	338	Firewall PA500 (for training and teaching only)	1	set
	339	Monitoring Ex-320 (for training and teaching only)	1	set
	340	RJ45 UTP (100pcs) box	4	sets
	341	PC Based Basic Electricity & Electronics Trainer	4	sets
	342	Logic Probe	15	sets
	343	Logic Pulser	15	sets
	344	Computer Servicing Tool Kit (1)	2	sets
	345	Computer Servicing Tool Kit (2)	2	sets
	346	Computer Servicing Tool Kit (3)	2	sets
	347	Computer Cleaner Kit	50	sets
	348	Universal Project Box	10	sets
	349	Potting Case	10	sets
	350	Potting Case	10	sets
	351	Circuit Box	10	sets
	352	Project Case	10	sets
	353	Hand Held Cases	10	sets
	354	Universal PC Board	20	sets
	355	IC Test Clips	10	sets
	356	IC Tools	10	sets
	357	Bread boarding & Accessories	10	sets
	358	Advanced Digital Logic Trainer	4	sets
	359	Electronics Demonstration System	1	set
	360	Microprocessor Trainer	4	sets
	361	Digital Signal Processing Trainer	4	sets
	362	Embedded Network Experiment Apparatus	2	sets
	363	Image Processing Trainer	2	sets
	364	Personal Computer	300	sets
	365	LabView Training System	4	sets
	366	Printer	4	sets
Civil Engineering	367	Sieve Analysis Set	1	set
	368	Atterberg Limit Test Set	1	set
	369	Standard Proctor Compaction Test Set	1	set
	370	CBR Test Set	1	set
	371	Consolidation Test Set	1	set
	372	Le Chatelier's Moulds	1	set
	373	Digital Reactor Block	1	set
	374	Jar Test Apparatus	1	set

375	Water Analysis Apparatus	1	set
376	Prismatic Compass Set	1	set
377	Plane table	1	set
378	Automatic level Set	1	set
379	Theodolite Set	1	set
380	Sun glass	1	set
381	Portable stereoscope	1	set
382	Parallax bar	1	set
383	Prism staff for total station	1	set
384	Meta centric Height	1	set
385	Glass sided Tilting Flume	1	set
386	Cement density measure	1	set
387	Cement tearing tester	1	set
388	Cyclic hollow torsional shear testing apparatus	1	set
389	Sieve experiment set for aggregate	1	set
390	Measuring capacity and actual capacity ratio set	1	set
391	Density and water absorbency tester set	1	set
392	Experiment set for mixing concrete (mixer etc.)	1	set
393	Consistency experiment set for High workable concrete	1	set
394	Universal testing machine (100T)	1	set
395	Dynamic-strain measuring instrument	5	sets
396	Bridge box	5	sets
397	Data logger	5	sets
398	Switching box	5	sets
399	Displacement detector	5	sets
400	Accelerometer	5	sets
401	Recorder	5	sets
402	Load detector or Load cell	5	sets
403	Model bridge set (truss 5units, beams, etc.)	1	set
404	Basic Hydraulic experiment set 50cm(W); (flume, water supply tank, water pump)	1	set
405	Hydraulic experiment set for multi purpose wave-making (water tank, wave-making instrument, water supply tank)	1	set
406	Current meter	5	units
407	Wave height meter	5	units
408	Water content test apparatus	6	units
409	Partivle density test apparatus	6	units
410	Liquid limit test apparatus	6	units
411	Plastic limit test apparatus	6	
412	Minimum and maximum density test apparatus	6	units
413	Manual compaction test apparatus	6	units
414	Automatic compaction test apparatus	1	units
415	Constant head permeability test apparatus	6	units
416	Dam model test apparatus for demonstrating flow lines	1	set
417	Sheet pile model test apparatus for demonstrating quick sand	3	sets
418	Oedometer test apparatus: one-dimensional standard consolidation	3	units
419	Constant pressure direct shear test apparatus	6	units
420	Unconfined compression test apparatus	6	units
421	Triaxial compression test apparatus	1	unit
422	Compact size compressor	1	unit
423	Drying oven	1	unit
424	Water distillator	1	unit
425	Working table	12	units
426	Vernier caliper	12	units
427	Soil container	12	units
428	Stopwatch	12	units
429	Calculator	12	units
430	Electronic balance (0.1mg min.resolution)	1	unit
431	Electronic balance(0.01g min. resolution)	2	unit
432	Electronic balance(0.1g min. resolution)	1	unit
433	Electric heating furnace	1	set
434	Air meter for fresh concrete	2	sets
435	Internal vibrator	3	sets
436	Splitting tensile test concrete specimen mould	5	sets
437	Bending test concrete specimen mould	10	sets
438	Pre-tensioning center hall hydraulic jack	1	set
439	Contact strain gauge (Whittemore strain gauge)	2	sets
440	Concrete core cutter	1	set
441	Digital venire calipers	3	sets
442	Shaking table	1	unit
443	L-shaped reaction wall system (W:10m xD:15mxH:5m)	1	set
444	Reaction floor system (W:10mxD:20m)	1	set
445	Reacton Frame (500t)	1	set
446	Overhead traveling hoist crane (10t)	2	set
447	200KN dynamic jack system (±200mm)	2	set
448	500KN dynamic jack system (±200mm)	1	set
449	1000KN dynamic jack system (±300mm)	1	set

450	5000KN static jack system (±300mm)	1	set
451	Data logger	20	sets
452	Switching box 100ch	20	sets
453	Dynamic-strain measuring instrument 20ch	20	sets
454	Displacement meter	20	sets
455	Accelerometer	20	sets
456	Universal testing machine (2000KN)	5	set
457	Fatigue testing machine (200KN)	1	set
458	Shaking Floor system	1	set
459	Underground pit (W:10mxD:20m)	1	set
460	Hydraulic power source system 1040L	1	set
461	Cooling water system	1	set
462	Folk lift(5ton)	1	set
463	Concrete Mixing Plant	1	set
464	Water tank for concrete curing	1	set
465	Basic Hydraulic experiment set 50cm(W); (flume, water supply tank, water pump)	4	sets
466	Hydraulic experiment set for quick sand experiment (flume, water supply tank, collecting quick sand)	4	sets
467	Hydraulic experiment set for multi purpose wave-making (water tank, wave-making instrument, water supply tank)	4	sets
468	Hydraulic experiment set for reproducing marine area (marine model, wave-making instrument)	4	sets
469	Current meter	20	sets
470	Wave height meter	20	sets
471	Microclimate monitoring instrument for hydraulic data (rain gauge 3units, infrared radiometer 2units, thermohygrometer 3units, wind meter 3units, earth thermometer 3units, data logger 1unit, solar battery 1unit)	1	set
472	Soil moisture meter	1	unit
473	Water supply and pump system	1	set
474	Cyclic triaxial testing apparatus	1	unit
475	High voltage triaxial testing apparatus	1	unit
476	Cyclic hollow torsional shear testing apparatus	1	unit
477	Soil water retentive skill meter	2	units
478	Triaxial apparatus for unsatured soil	1	unit
479	Oedometer tester (3tribes x 1unit)	1	set
480	Constant strain rate consolidation test	1	set
481	Universal testing machine for hard rock	1	unit
482	Air tank	2	units
483	Vibration table	4	units
484	Automatic compacting tester	20	sets
485	Air compressor 1.4MPa	1	unit
486	Drying oven	2	units
487	Distillator	1	unit
488	Carpenter bench	4	sets
489	Electronic balance (min. resolution:0.1mg)	1	unit
490	Electronic balance(min. resolution:0.01g)	2	units
491	Electronic balance(min. resolution 0.1g)	1	unit
492	Constant temperature & humidity chamber (W:10mxD:20m)	1	set
493	Wind tunnel set; main instrument 5.0m(W) x 3.0m(H) x 25.0m(L)	1	set
494	Wind tunnel set; monitoring room 5.0m(W) x 8.0m(H) x 20.0m(L)	1	set
495	Wind tunnel set; workshop 5.0m(W) x 8.0m(H) x 20.0(L)	1	set
496	Vibration testing machine	1	set
497	Glass sided Tilting Flume	1	set
498	Cyclic Triaxial Test	1	set
499	Resonant-Column Test set	1	set
500	Arc Hydro software	1	set
501	Sediment Transport model	1	set
502	Groundwater model	1	set
503	Model for Urban Storm Water Management	1	set
504	Hydrologic Modelling for Flood Forecasting	1	set
505	Hydrodynamics Modelling for Flood Forecasting	1	set
506	Back up generator	1	set
507	Voltage regulator	1	set
508	Air conditioning system	each room	
509	Server and data storage system	1	set
510	Personal Computer	20	sets
511	Printer	4	sets
512	Duplicate printer (lithography)	2	sets
513	Electronic microscope	1	set
514	Wire-electrical discharge machine	1	set
515	Plastic injection molding machine	1	set
516	Ultrasonic flaw detetors	1	set
517	3D printer	1	set

Requested Equipment list for MTU

Department		Description	Amount	Unit
Mechanical Engineering	1	Base Panel for Solid Mechanics '	1	set
	2	Statics Experiments	1	set
	3	Load Elevation Mechanisms	1	set
	4	Friction Experiments	1	set
	5	Transmissions Experiments	1	set
	6	Dynamics Experiments	1	set
	7	Special Mechanisms Experiments	1	set
	8	Fluid Statics and Manometry	1	set
	9	Fluid Properties Apparatus	1	set
	10	Universal Material Testing Units	1	set
	11	Demonstration Francis Turbine	1	set
	12	Hydraulic Flow Demonstrator	1	set
	13	Bending Moment and Shearing Force Apparatus	1	set
	14	Twist and Bend Testing Machine	2	sets
	15	Temperature Measurement and Calibration	3	sets
	16	Pressure Measurement	4	sets
	17	Bomb Calorimeter Set	2	sets
	18	Computer Controlled Thermo-Electric Heat Pump	2	sets
	19	Axial Flow Gas Turbine	1	set
	20	C1 MKII Compressible Flow Units	1	set
	21	Recirculating Air Conditioning Unit	1	set
	22	Simple Vibration Apparatus	1	set
	23	Series /Parallel Pumps	1	set
	24	Pelton Turbine	1	set
	25	Computer Controlled Heat Exchanger Training	1	set
	26	Conveyor, Linear Transfer, Pick and Place Unit	1	set
	27	Solar and Wind Hybrid System	1	set
	28	FFT Analyzer	1	set
	29	Oscilloscope	1	set
	30	Accelerometer	5	sets
	31	Signal Conditioner	2	sets
	32	Charge Amplifier	1	set
	33	Impact Hammer	1	set
	34	Function Generator	1	set
	35	High Performance Computer for Numerical Computation	2	sets
	36	Solar Power Meter	2	sets
	37	Temperature Probe	10	sets
	38	Environmental Handheld Meter	2	sets
	39	General Purpose Pressure Sensor	2	sets
	40	Strain Gauge Power Supply	1	set
	41	Strain Gauge and Meter	5	sets
	42	Piezoelectric Transducer	10	sets
	43	Force Sensor	2	sets
	44	Exhaust Gas Analyzer	2	sets
	45	Displacement Sensor	5	sets
	46	Peristaltic Pump	1	set
	47	Modal Exciter	1	set
	48	Dual-Range Turbidity Meters	1	set
	49	Torque Detector	1	set
	50	Voltage Meter	1	set
	51	DC Tachometer	6	sets
	52	Stepper Motor	6	sets
	53	Sound Level Meter	1	set
	54	Weight Scale	1	set
	55	Small Vibration Exciter	1	set
	56	Spectrum Analyzer	1	set
	57	Laser Vibrometer	1	set
	58	Benchtop Wind Tunnel	1	set
	59	Universal Testing Machine	1	set
	60	Hand Saw	20	sets
	61	Long Plane	20	sets
	62	Long Plane Tool	20	sets
	63	Claw hammer	20	sets
	64	Chisel 1/4"	20	sets
	65	Chisel 1/2"	20	sets
	66	Chisel 3/4"	20	sets
	67	Chisel 1"	20	sets
	68	Meter tape 10'	20	sets
	69	Pencil	4	sets

	70	Saw tool	2	sets
	71	Plane Stone	5	sets
	72	Circular Saw Cutter (8")	3	sets
	73	Holder	40	sets
	74	Goggle	20	sets
	75	Cover	20	sets
	76	Glove	20	sets
	77	Welding Electrode	50	sets
	78	Grinder Wheel	5	sets
	79	Hammer (4 lbs)	10	sets
	80	Cover	20	sets
	81	Hot Chisel	10	sets
	82	Flatter	3	sets
	83	Gate	10	sets
	84	Charcoal	30	sets
	85	Clamp	10	sets
	86	Tap (1.5")	20	sets
	87	Drilling Tool(1 1/8")	20	sets
	88	Center Punch	20	sets
	89	Ball Pen hammer (1lbs)	20	sets
	90	Turning Tool (Carbide)	200	sets
	91	Cutting Tool (Carbide)	100	sets
	92	Boring tool	50	sets
	93	Coolent Oil	5	sets
	94	Grinder Wheel (Soft)	4	sets
	95	Shaper Tool	20	sets
	96	Gear Cutter (Dp 8)	1	set
	97	Gear Cutter (Dp 16)	1	set
	98	Cut Off Machine	1	set
	99	Personal Computer	20	sets
	100	Printer	4	sets
Electrical Power Engineering	101	24V AC/12V DC Circuits Analyzer	1	set
	102	Power and Torque Measurements of Electrical Motors	1	set
	103	Home Automation Installation Trainer	1	set
	104	PLC Module for the Control of Industrial Process	1	set
	105	Personal Computer	20	sets
	106	Printer	4	sets
Electronic Engineering	107	Analog Electronic Trainers	1	set
	108	Antenna/Satellite/Radar/RFID /GPS Trainers	1	set
	109	Bread Board Trainers	1	set
	110	Communication Trainers	1	set
	111	Consumer Electronic Trainers	1	set
	112	Digital Electronic Trainers	1	set
	113	Microprocessor, Microcontroller, VLSI, Embedded Trainers	1	set
	114	Fiber Optic Trainers	1	set
	115	IC Testers and Programmers	1	set
	116	Microwave Test Benches	1	set
	117	Power Electronics and Electrical Motors/ Machine Lab	1	set
	118	Biomedical Engineering Trainers	1	set
	119	Verilog Hardware Description Language (VHDL) Trainers	1	set
	120	Trainer for Interactive Multipurpose Electronics	1	set
	121	Automatic Control Technology- DELORENZO	1	set
	122	Personal Computer	20	sets
	123	Printer	4	sets
Mechatronic Engineering	124	PLC trainers	2	sets
	125	Industrial Electronic and Electrical Trainer	1	set
	126	Pneumatic Trainer & Hand Tools and their accessories	1	set
	127	Hydraulic trainer & Hand Tools and their accessories	1	set
	128	CNC Machine	1	set
	129	Personal Computer	20	sets
	130	MATLAB Software	1	suit
	131	LABVIEW Software	1	suit
	132	DAQ Card	2	sets
	133	Digital Control System Trainer	1	set
	134	Image Processing Trainer	1	set
	135	Image Frame Grapper	1	set
	136	CCD Camera	1	unit
	137	Factory Automation Trainer	1	set
	138	Data Acquisition and Monitoring Kits	1	set
	139	Sensor Acquisition and Testing System	1	set
	140	Fuzzy Logic Trainer	1	set

	141	Control and Simulation Trainer	1	set
	142	Robotic Trainer	1	set
	143	LABVIEW Acquisition and Monitoring System	1	set
	144	Printer	4	set
Information Technology	145	PC Hardware Trainer	1	set
	146	Electrical and Electronic System Trainer	1	set
	147	Microprocessor/Microcontroller Trainer	1	set
	148	Communication System Trainer	1	set
	149	Embedded System Trainer	1	set
	150	Broadcasting, Communication, Convergence Service IPT Platform Education	1	set
	151	Ubiquitous Home Network Training Kit	1	set
	152	Desktop Computer System	30	sets
	153	24 Port Switch	2	units
	154	Network Accessories	1	set
	155	Local Area Network Trainer	1	set
	156	Digital Signal Processing Trainer	1	set
	157	Digital Multimeter	10	sets
	158	LCR Meter	2	sets
	159	DDS Function Generator	2	sets
	160	Digital Oscilloscope	2	sets
	161	Embedded Network Experiment Apparatus	1	set
	162	Embedded Software Design Platform	1	set
	163	Wireless Embedded Training System	1	set
	164	CDMA Communication System	1	set
	165	Wireless Gigabit Router	3	units
	166	Integrated Service Router	2	units
	167	Wireless Access Point	1	unit
	168	Image Processing Trainer	1	set
	169	ARM Processor Training Kit	2	sets
	170	Standard PLC Trainer	1	set
	171	Personal Computer	300	sets
	172	Printer	4	sets
Civil Engineering	173	Sieve Analysis Set	1	set
	174	Atterberg Limit Test Set	1	set
	175	Standard Proctor Compaction Test Set	1	set
	176	CBR Test Set	1	set
	177	Consolidation Test Set	1	set
	178	Le Chatelier's Moulds	1	set
	179	Tensile Testing Machines	1	set
	180	Digital Reactor Block	1	set
	181	Jar Test Apparatus	1	set
	182	Water Analysis Apparatus	1	set
	183	Prismatic Compass Set	1	set
	184	Plane table	1	set
	185	Automatic level Set	1	set
	186	Theodolite Set	1	set
	187	Sun glass	1	set
	188	Portable stereoscope	1	set
	189	Parallax bar	1	set
	190	Prism staff for total station	1	set
	191	Meta centric Height	1	set
	192	Glass sided Tilting Flume	1	set
	193	Electric heating furnace	1	set
	194	Air meter for fresh concrete	2	sets
	195	Internal vibrator	3	sets
	196	Splitting tensile test concrete specimen mould	5	sets
	197	Bending test concrete specimen mould	10	sets
	198	Pre-tensiioning center hall hydraulic jack	1	set
	199	Contact strain gauge (Whittemore strain gauge)	2	sets
	200	Concrete core cutter	1	set
	201	Digital venire calipers	3	sets
	202	Tension testing machine (2000kN)	1	set
	203	Shaking Table (1m x 1m) & Controller)	1	set
	204	Water content test apparatus	6	units
	205	Partivle density test apparatus	6	units
	206	Liquid limit test apparatus	6	units
	207	Plastic limit test apparatus	6	units
	208	Minimum and maximum density test apparatus	6	units
	209	Manual compaction test apparatus	6	units
	210	Automatic compaction test apparatus	1	units
	211	Constant head permeability test apparatus	6	units
	212	Dam model test apparatus for demonstrating flow lines	1	set
	213	Sheet pile model test apparatus for demonstrating quick sand	3	sets

	214	Oedometer test apparatus: one-dimensional standard consolidation	3	units
	215	Constant pressure direct shear test apparatus	6	units
	216	Unconfined compression test apparatus	6	sets
	217	Triaxial compression test apparatus	1	set
	218	Compact size compressor	1	unit
	219	Drying oven	1	unit
	220	Water distillator	1	unit
	221	Working table	12	units
	222	Vernier caliper	12	units
	223	Soil container	12	units
	224	Stopwatch	12	units
	225	Calculator	12	units
	226	Electronic balance (0.1mg min.resolution)	1	unit
	227	Electronic balance(0.01g min. resolution)	2	unit
	228	Electronic balance(0.1g min. resolution)	1	unit
	229	Water Level Data Logger	1	unit
	230	Current Meter	1	unit
	231	Electrical Conductivity Data Logger	1	unit
	232	Turbidity Meter	1	unit
	233	Simplified Water Quality Analyzer	1	unit
	234	Glass sided Tilting Flume	1	set
	235	Cyclic Triaxial Test	1	set
	236	Resonant-Column Test set	1	set
	237	Arc Hydro software	1	set
	238	Sediment Transport model	1	set
	239	Groundwater model	1	set
	240	Model for Urban Storm Water Management	1	set
	241	Hydrologic Modelling for Flood Forecasting	1	set
	242	Hydrodynamics Modelling for Flood Forecasting	1	set
	243	Personal Computer	20	sets
	244	Printer	4	sets
	245	Duplicate printer (Lithography)	2	set

JAPAN'S GRANT AID

1. Japan's Grant Aid

GOJ is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1-1 Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures:

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal & Approval
  - Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Determining of Implementation
  - The Exchange of Notes (E/N) exchanged between the GOJ and a recipient country
- Grant Agreement (G/A)
  - Agreement concluded between JICA and a recipient country
- Implementation
  - Implementation of the Project on the basis of the G/A

1-2 Preparatory Survey

(1) Contents of the Survey

The aim of the Preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of a outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of

Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

1-3 Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

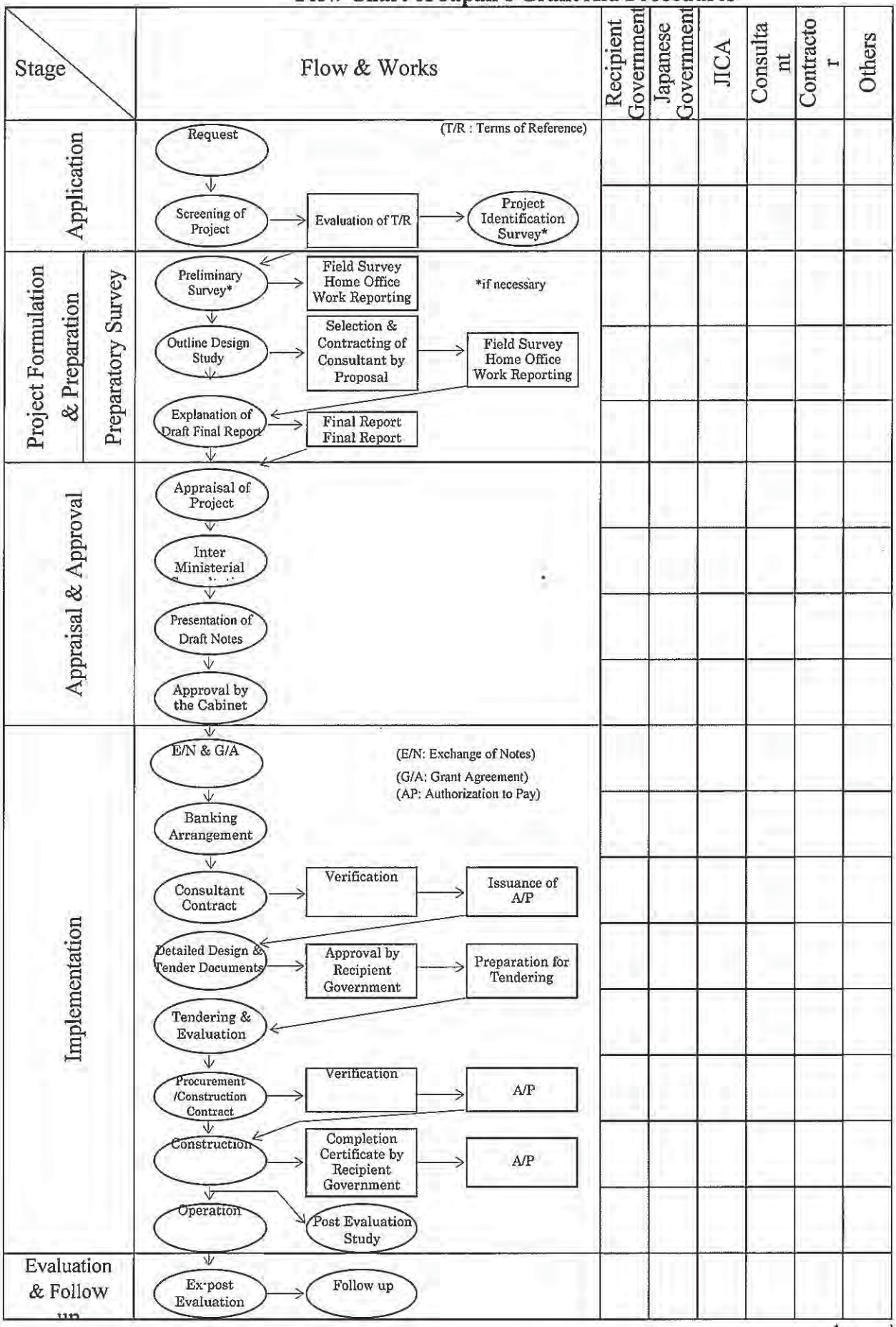
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

GRANT AID PROCEDURES

Flow Chart of Japan's Grant Aid Procedures



Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure land		●
2	To clear, level and reclaim the site when needed		●
3	To construct gates and fences in and around the site		●
4	To construct the parking lot	●	
5	To construct roads		
	1) Within the site	●	
	2) Outside the site		●
6	To construct the buildings	●	
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1) Electricity		
	a. Contract with electricity distributor and installing line the designated point within the site		●
	b. Wiring from the designated point to proposed buildings	●	
	c. Installing a main circuit breaker on the designated point	●	
	2) Water Supply (in case of city water)		
	a. Contract with water supplier and installing pipe to the designated point within the site		●
	b. Installing a water supply system including receiving and elevated tank from the designated point	●	
	3) Drainage for toilet sewer, ordinary waste, storm water (in case of sewage system)		
	a. Contract with drainage authority and installing pipe to the designated point within the site		●
	b. Installing drainage system from the designated point	●	
	4) Gas Supply		
	a. Contract with gas supplier and installing pipe to the designated point within the site	N/A	N/A
	b. Installing a gas supply system from the designated point	N/A	N/A
	5) Telephone and internet System		
	a. Contract with telephone and internet service provider and installing cables to a main distribution frame/panel (MDF) of the building		●
	b. Installation of a telephone and internet system of building including a MDF	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
8	To bear the following commissions to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
9	To ensure unloading and customs clearance at port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and customs clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
10	To accord Japanese nationals, whose services may be required in connection with the supply of the products and the services under the verified contact, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.		●
11	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.		●
12	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant		●
13	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment		●

(B/A: Banking Arrangement, A/P: Authorization to pay)

MINUTES OF DISCUSSIONS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE AUTHORITIES CONCERNED OF
THE GOVERNMENT OF THE REPUBLIC OF THE UNION OF MYANMAR
ON
THE PREPARATORY SURVEY
ON
THE PROJECT FOR ENHANCING TECHNOLOGICAL UNIVERSITIES
IN MYANMAR

In December 2013, the Japan International Cooperation Agency (hereinafter referred to as "JICA") had conducted the field survey as a part of the Preparatory Survey on the Project for Enhancing Technological Universities in Myanmar (hereinafter referred to as "the Project"). Based on the results of the field survey and subsequent technical examinations conducted in Japan, JICA prepared the Draft Preparatory Survey Report.

In order to explain the contents of the report and discuss with the officials concerned of the Government of the Republic of the Union of Myanmar, JICA sent the Survey Team (hereinafter referred to as "the Team") from June 11 to 19, 2014, headed by Mr. Daisuke Ueda, Director of Technical and Higher Education Division, JICA Human Development Department.

As a result of discussions, both sides have confirmed the main items described in the attached sheet.

Nay Pyi Taw, June 19, 2014

Mr. Daisuke UEDA
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

U Kyaw Zwa Soe
Director General
Department of Advanced Science and Technology
Ministry of Science and Technology
The Republic of the Union of Myanmar

ATTACHMENT

1. Contents of the Draft Report

The Myanmar side agreed and accepted in principle the contents of the draft report as explained by the Team.

2. Components to be Covered by the Project

Both sides confirmed that the Project will cover equipment for education [(COE)BE Program], research (graduate courses), and those utilized for providing technical service to the private sector, as well as facilities which accommodates equipment that cannot be installed in the existing facilities, as shown in ANNEX-1 and ANNEX-2.

The Myanmar side understood that there is a possibility to adjust the volume of components in response to fluctuation in the exchange rates and as a result of the tenders. In case the volume of components should be reduced, the priority is given to the equipment necessary for (COE)BE Program.

3. Major Undertakings to be taken by the Myanmar side

The Myanmar side understood the Japan's Grant Aid Scheme, and assured that it shall take necessary measures as described in ANNEX-4 of the Minutes of Meetings signed by both parties on 17 December, 2013. Particularly, the Myanmar side agreed to take full responsibility for land preparation, provide electricity, telecommunication line to Project sites, and to allocate necessary budget for the Project, mentioned in the attached ANNEX-3.

Furthermore, with regard to the new buildings (Common Measuring Equipment Building, Civil and Electrical Engineering Building) at YTU, Myanmar side understood the necessity to restructure workshop in YTU and establish a new organization (herein after referred to as "the Center") specialized in managing operation and maintenance of facilities and equipment that have the following features: (i) the Center has the high level manager/director, officials, several academic/technical staffs and technicians who operate and manage newly-procured equipment installed in the new building and workshops in the existing buildings, and (ii) the Center, in close contact with existing departments and the private sector, carries out surveys on the market/social needs regarding technological issue and plan to provide various technical services to staffs and students not only in YTU but also in private companies and other institutions, if necessary.

4. Project Cost Estimation

The Myanmar side understood that the Project cost estimation as shown in ANNEX-3 was not final at this stage and would be set and approved by the Government of Japan after thorough examinations.

5. Operation and Maintenance

Both sides agreed on items and tentative cost for operation and maintenance for the facility and equipment after completion of the Project as shown in ANNEX-3. The Myanmar side assured the Team that they would allocate necessary budget and assign a responsible technician at each department who will manage the condition of the equipment on a daily basis.

Furthermore, the Myanmar side understood that proper use and daily maintenance of the Common Measuring Equipment Building, which will be shared among several

departments, was indispensable for their long-term use. The Myanmar side would establish a special center (as mentioned in the article 3 above and summarized in ANNEX-4) with the active involvement of parties concerned and in consultation with the ongoing Technical Cooperation Project (TCP) Japanese Experts.

6. Confidentiality of the Project Design

Both sides confirmed that all information related to the Project including design documents of facilities, furniture and equipment shall not be released to any outside parties before concluding all contracts for the Project. Furthermore, both sides agreed that the estimated cost of the Project as described in ANNEX-3 shall never be duplicated or released to any outside parties before concluding all contracts for the Project.

7. Schedule of the Study

JICA will finalize the report in accordance with the results of discussions and forward it to the Government of Myanmar soon after the Government of Japan approves the Project officially. Tentative schedule of the Project is shown in the ANNEX-5.

8. Other relevant issues

8-1 Collaboration with TCP

Both sides acknowledged that close collaboration with TCP activities will further enhance the effectiveness and impact of the Project.

8-2 Names of the New Buildings and the Center

Both sides acknowledged the necessity to change the new facilities' name (currently named as Common Measuring Equipment Building and Civil and Electrical Engineering Building) so that they would express distinctive features of the equipment in the building and their collective function. Furthermore, both sides agreed to give the appropriate name to the Center. The new names will be discussed and decided in case Japanese government approves this Project.

END

ANNEX-1 Tentative Plan for YTU
ANNEX-2 Tentative Plan for MTU
ANNEX-3 Project Cost Estimation
ANNEX-4 Obligation for Operation and Maintenance of Myanmar Side
ANNEX-5 Tentative Schedule of the Project

ANNEX-1

Tentative Plan for YTU

(1) List of Major Equipment

Department	Description	Purpose of Use	Q'ty
Civil Engineering	Electric heating furnace	For drying soil sample for testing in high temperature	1 set
	CBR testing machine	For CBR testing by penetrating 5cm dia. Piston into soil sample	2 sets
	Incubator	For storing sample for soil testing in a constant temperature condition	1 set
Mechanical Engineering	Brinell Rockwell Hardness Tester	For testing both of Brinell hardness and Rockwell hardness of metal materials	1 set
	Charpy and Izod Impact Testing Unit	For testing metal materials of high shock resistant using the parameter of absorbed energy at shock occurrence	1 set
	Universal Testing Machine	For testing of tension, pressing and bending of metal materials by mechanical power generated by a motor	1 set
	Engine Research and Test Bed	For the experiment of the characteristics of the output power by reproducing the situation of engine driving	1 set
Electrical Power Engineering	Basic Generator Protection Equipment Set	For the basic experiment of controlling generators	1 set
	PLC Module with Software	For the basic experiment of controlling method of PLC sequencing and etc.	2 sets
	Spectrum Analyzer	For the device of showing a two-dimensional graph of X-axis of frequency and Y-axis of electric power and/or voltage	3 sets
Electronic Engineering	Vector Signal Generator	For generating vector signals for various communication system	2 sets
	PCB Prototyping Machine	For the experiment of processing a printed circuit board	1 set
	Power Electronics and	For the experiment of the	2 sets

	Electrical Motors Machine Lab.	rectification of power supply such as the conversion from AC to DC	
	Modular Laboratory	For the experiment of assembling of electrical-controlled basic logic circuits	5 sets
	Signal Analyzer	For the device of detecting irregular waves and measuring high-speed signals	2 sets
	Network Analyzer	For measuring the characteristics of frequency of passing and reflecting power in the network of high-frequency	2 sets
Information Technology	Microprocessor Trainer	For the experiment of logic of IC control device and configuration	4 sets
	PC Based Basic Electricity & Electronics Trainer	For the basic experiment of AC/DC circuit, AC-DC/DC-AC conversion, transistor, amplifier and etc.	4 sets
	Digital Signal Processing Trainer	For the experiment of logic of digital signal processing and configuration	4 sets
	Embedded Network Experiment Apparatus	For the experiment of digital communication protocol and development of internet installation board	4 sets
Mechatronic Engineering	Industrial Electronic and Electrical Trainer	For the experiment of assembling electric-controlled circuit of industrial fields	1 set
	Power Electronics Training System	For the experiment of the rectification of power supply such as the conversion from AC to DC	1 set
	Factory Automation Trainer	For the experiment of module-configuration relating to factory automation	1 set
	Advanced FPGA Development System	For assisting the development for integrated-circuit programming of process control	1 set
	Biomedical Measurement and Data Acquisition System	For measuring biological data such as SPO2 and ultrasound, electrocardiograph, respiration system, blood pressure and etc.	1 set

Common Measuring Equipment Building	Scanning Electron Microscope	For analyzing elements included in samples with an electron level	1 set
	Liquid Nitrogen Generator	For generating liquid nitrogen directly from the air for various experiments and resaech activities	1 set
	Pneumatic Pressure Standard with Air Compressor	For generating standardpneumatic pressure	1 set
	UV-Visible Spectrophotometer	For conducting the quantitative analysis by measuring absorbed spectre of samples with UV-Vis light	1 set
	YAG Laser Measuring Machine	For measuring dimensional-velocity ingrediants by visualizing gas flow and etc.	1 set
	X-ray Fluorescence Spectrometer	For analyzing elements of samples using fluorescence X-ray	1 set
Civil and Electrical Engineering Building	Structure Testing System	For testing the strength of static and dynamic of construction materials	1 set
	Vibration Testing Machine	For testing vibration-resistance of samples on a table putting a horizontal vibration	1 set
	1000kN Concrete Beam Bending Testing Machine	For testing beam sample made of concrete on the strength of 4 points bending	1 set
	2000kN Compression Testing Machine	For the experiment of the strength of concrete samples putting pressure and bending loads on them	1 set
	2000kN Universal Testing Machine	For the experiment of tension, pressure and bending by measuring the strength of metal materials	1 set
	200kN Fatigue Testing Machine	For the experiment of tension of samples and pressing directional fatigue of various materials	1 set
	Wind Tunnel	For the experiment of the influence of air flow around the sample	1 set
	High Voltage Experiment Equipment	For the experiment of insulation-resistance by sparkling AC/DC high voltage discharge and lightening discharge	1 set

(2) New Facilities

1) Common Measuring Equipment Building (YTU)

- Microstructure observation rooms
- Standard measurement equipment room
- Preparation room
- Optical measuring chamber
- Electric design and fabrication room
- Biomedical measurement room
- Electrical properties evaluation
- X-ray measurement Chamber
- Multipurpose laboratories
- Incidental facilities
-

2) Civil and Electrical Engineering Building (YTU)

- Structural testing room
- Control and measurement area
- Hydraulic power room
- Ground model room
- Soil basic lab
- Thermostatic room
- Concrete mixing area
- Concrete curing area
- Concrete testing room
- Cement storage
- High voltage room
- Wind testing room
- Incidental facilities

(3) Existing YTU laboratories to be renovated to install new equipment by Myanmar Side

Civil Department :

Soil Mechanics Laboratory, Construction Material Laboratory, Environmental Laboratory, Hydraulic Laboratory, Structural Laboratory

Mechanical Department :

Strength of Materials Laboratory, Machine Shop, Refrigeration & Air Condition Laboratory, Thermo Dynamics Laboratory, Vice president preparations room (Robot) , Mechanical Laboratory

Mechatronics Department :

Mechatronics Laboratory, Electronics Laboratory

IT Department :

IT, Communication Network Laboratory

Electronics Department :

Control Engineering Laboratory, Microcontroller and Microprocessor Laboratory, Fundamental Laboratory, Communication Laboratory, Power and Industrial Electronics Laboratory

Electric Power Department :

High Voltage Laboratory, Measurement & Instrumentation Laboratory, Electrical Machine Laboratory, Power Electronics & Drive Laboratory, Power System Laboratory, Elementary Laboratory, Renewable Energy System Laboratory, Electrical Power Laboratory

ANNEX-2

Tentative Plan for MTU

List of Major Equipment

Department	Description	Purpose of Use	Q'ty
Civil Engineering	Standard compression testing machine set	For testing beam sample made of concrete on the strength of 4 points bending	1 set
	CBR testing machine	For CBR testing by penetrating 5cm dia. Piston into soil sample	1 set
	Incubator	For storing sample for soil testing in a constant temperature condition	1 set
	Hydraulic bench with accessories	For testing water hammer phenomina, the power of hydraulics and various experiments	1 set
Mechanical Engineering	Vertical Milling Machine (Medium)	For milling of metal materials with vertical processing device	1 set
	Universal Cylindrical Grinding Machine	For grinding of a wide range of metal materials with various grindstones	1 set
Electrical Power Engineering	Modular Trainer for Electro technics	For the basic experiment of electrical engineering such as power distribution, switch dynamics and etc.	1 set
	Spectrum Analyzer	For the device of showing a two-dimensional graph of X-axis of frequency and Y-axis of electric power and/or voltage	2 sets
Electronic Engineering	PCB Prototyping Machine	For the experiment of processing a printed circuit board	1 set
	Power Electronics and Electrical Motors Machine Lab.	For the experiment of the rectification of power supply such as the conversion from AC to DC	3 sets
	Modular Laboratory	For the experiment of assembling of electrical-controlled basic logic circuits	6 sets
Information Technology	Microprocessor Trainer	For the experiment of logic of IC control device and configuration	2 sets
	Local Area Network Trainer	For the experiment of basic Ethernet communication system	2 sets
	PC Based Basic Electricity & Electronics Trainer	For the basic experiment of AC/DC circuit, AC-DC/DC-AC conversion, transistor, amplifier and etc.	2 sets

	Digital Signal Processing Trainer	For the experiment of logic of digital signal processing and configuration	2 sets
	Communication System Trainer	For the experiment of the principle of analog and digital communication	2 sets
Mechatronic Engineering	Industrial Electronic and Electrical Trainer	For the experiment of assembling electric-controlled circuit of industrial fields	1 set
	Power Electronics Training System	For the experiment of the rectification of power supply such as the conversion from AC to DC	1 set
	Factory Automation Trainer	For the experiment of module-configuration relating to factory automation	1 set

ANNEX-3

Project Cost Estimation

1. Costs to be borne by the Japanese Side

This Part is closed due to the confidentiality.

2. Initial Costs to be borne by the Myanmar Side

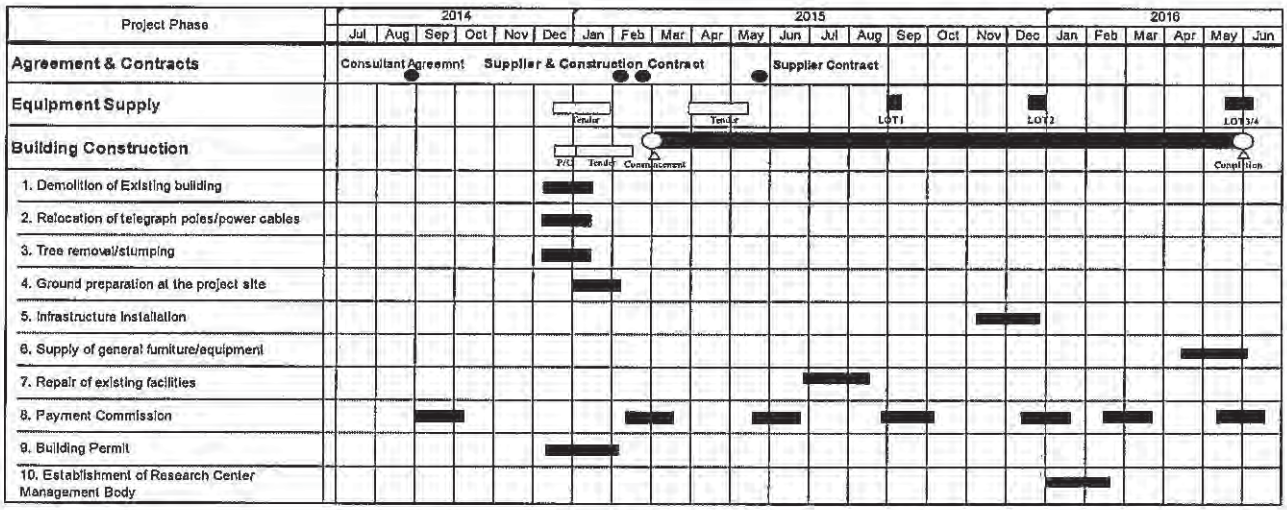
(1) Items and Estimated Costs

No.	Items borne by the Myanmar side	Items borne	Estimated Cost (MMK)	Items borne by the Myanmar side
1	Demolition of existing structures	YTU Site A(Common Measuring Equipment Building) Demolition of approximately 90sqm storehouse	447,000	Ministry of Science and Technology
2	Relocation of telegraph poles/power cables	YTU Site A(Common Measuring Equipment Building) Relocation of telegraph poles/power cables (approximately 100m) at the project site	1,623,000	As above
3	Tree removal/stumping	YTU Site A･B (Common Measuring Equipment Building･Civil and Electrical Engineering Building) Stumping and removing trees that are obstacles to building work	619,000	As above
4	Ground preparation at the project site	YTU Site A･B (Common Measuring Equipment Building･Civil and Electrical Engineering Building) Removal of obstacles at the project site and ground leveling by manpower	1,834,000	As above
5	Infrastructure installation	YTU Site A･B (Common Measuring Equipment Building･Civil and Electrical Engineering Building) Installation of high voltage line (approximately 300m) and telephone line (approximatery 170m)	7,374,000	As above
6	Supply of general furniture/equipment	YTU Site A･B (Common Measuring Equipment Building･Civil and Electrical Engineering Building) Procurement od outside equipment (Curtains and blinds) targeted for Japan cooperation	9,041,000	As above
7	Repair of existing facilities	YTU Existing Building Repair of existing laboratory(approx. 4,100sqm) (Renewal of finishing materials such as flooring and wall and windows & doors).	403,283,000	As above
		Dep. / Room name		
		Civil: Soil Mechanics Lab、Construction Material Lab、Soil Mechanics Lab、Environmental Lab ×2、Hydraulic Lab、Structural Lab		
		Mechanical: Strength of Materials Lab、Machine Shop、Refrigiration & Air Condition Lab、Thermo Dynamics Lab×2、Vice president preparations room(Robot)、Mehcanical Lab×3		
		Mechatronic: Mechatronics、Electronics、Mechatronics×2		
		IT: IT×2、Communication Networ Lab		
		Electronics: Control Engineering Lab、Microcontroller and Microprocessor Lab、Fundamental Lab、Communication Lab、Power and Industrial Electronics Lab		
		Electric power: High Voltage、Measurement & Instrumentation、Electrical Machine Lab、Power Electronics & Drive、Power System Lab、Elementary Lab、Renewable Enargy System Lab、Electrical Power Lab		
8	Payment comition	Comition for authorization for pay and bank handling charges	5,356,410	As above
		Total	429,577,410	

The breakdown of the estimated initial cost:

FY 2014 Total Cost	**5,658,410**
FY 2015 Total Cost	**414,288,000**
FY 2016 Total Cost	**9,631,000**
GRAND TOTAL	**429,577,410**

(2)Budgetary schedule



3. Operation and Maintenance Costs to be borne by YTU

(1) Consumables

For the newly planned equipment for the Project, the consumables required annually are as follows:

Description	Name of Consumable	Unit Price	Quantity annually needed	Amount (Million Kyat)
Ultrapure water system	Prefilter	0.23	2	0.46
	Final filter	0.20	2	0.40
Air compressor with air tank and dryer	Draw filter element	0.05	10	0.50
	Oil filter element	0.08	3	0.24
	Spacer	0.24	3	0.72
	Oil	0.20	1	0.20
Scanning electron microscope	Filament	0.43	2	0.86
Gas Chromatography	Analytical reagent	0.05	2	0.10
Liquid Chromatography	Analytical reagent	0.05	2	0.10
Atomic Absorption Spectrophotometer	Analytical reagent	0.05	2	0.10
	Total			3.68

(2) Operation and Maintenance Costs

Maintenance and management costs at the current and new sites are estimated as follows.

(million Kyat)

Item	Project Expenses (after completion)
1. Current Site	
(1) Electric utility costs	0.82
(2) Equipment maintenance	1.70
2. New Site	
(1) Electric utility costs	12.57
(2) Fuel costs	1.97
(3) Facility maintenance costs	4.16
(4) Maintenance costs for elevators and overhead travelling crane	3.47
Total	24.69

4. Operation and Maintenance Costs to be borne by MTU

(million Kyat)

Item	Project Expenses (after completion)
1. Current Site	
(1) Electric utility costs	1.20
(2) Equipment maintenance	2.52
Total	3.72

5. Conditions for Estimate

1) Time of Estimation : December 2013
2) Exchange Rate : 1USD = 99.99 JPY
3) Implementation Period : Approx.15 months
4) Other Conditions : Project implementation intended to be in compliance with the Japan's Grant Aid scheme

ANNEX-4

Obligation for Operation and Maintenance of Myanmar Side

(1) Equipment

Although teaching staff at YTU/MTU is responsible for taking good care of the equipment, assignment of professional technician for each department is necessary for operation and maintenance. The management system shall be structured by the commencement of the installation work.

Furthermore, with regard to the new buildings (Common Measuring Equipment Building, Civil and Electrical Engineering Building) at YTU, it is necessary to restructure workshops in YTU and establish a new organization (hereinafter referred to as "the Center") specialized in managing operation and maintenance of facility and equipment that has the following features:

- The center has the high level manager/director, officials, several academic/technical staffs and technicians who operates and manages newly procured equipment installed in the new building and workshop in the existing building
- Responsible personnel in charge of operation and maintenance shall be selected before the commencement of Installation and Initial Training and Operation Training.
- Not only the responsible personnel in charge of operation and maintenance but also other lecturers/users shall be trained by an engineer of manufacturer at the Initial Training and Operation Training.
- Operation and maintenance of the equipment: routine maintenance and checking of the equipment shall be conducted according to the equipment manual.
- The management of the maintenance record and consumable/spare parts shall be conducted by an inventory list.
- When equipment malfunction, appropriate measures shall be taken, such as
  - ① A technician of YTU/MTU shall assess the level of the problem occurred (major/minor).
  - ② When the problem is minor, a technician of YTU/MTU shall manage for it.
  - ③ When the problem is major, an engineer of manufacturer and/or local agent shall take care of it.

(2) Facilities

- Daily cleaning and repair of attrition, break and aging are important for the maintenance of facilities.
- Repair for the interior and exterior finishing will occur every 10 years.
- Guidance on periodical inspection and repair works will be provided by the contractor. The outline is as follows.

Table 4-1 Outline of Periodical Inspection (Facilities)

	Contents of Inspection	Numbers of Inspection
Exterior	・Repair/ repaint of exterior walls	Repaint once/5 years,
	・Inspection and repair of roofs	Repair once/3 years
	・Inspection and repair of sealing of exterior fittings	Inspection once/3 years, Repair once/10 years
	・Regular inspection and cleaning of gutters and manholes	Once/1 year
		Once/1 year
Interior	・Review of the interior	As needed
	・Repair / repaint of partition walls	As needed
	・Renewal of ceiling materials	As needed
	・Adjustment of doors and windows	Once/1 year
	・Exchange of fixtures of fittings	As needed

Tentative Schedule of the Project

The implementation schedule of the Project consists of detail design stage, tender stage and procurement and construction stage.

The table below shows the processes in the Project after the conclusion of E/N to the completion.