National University of Laos
Lao People's Democratic Republic

Preparatory Survey Report
on
the Project for Improvement of Facilities and Laboratory Equipment in the Faculty of Engineering, National University of Laos in the Lao People's Democratic Republic

January 2022

Japan International Cooperation Agency (JICA)

Mohri, Architect & Associates, Inc.
INTEM Consulting, Inc.
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Preface

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to the joint venture of Mohri, Architect & Associates, Inc., INTEM Consulting, Inc. and PADECO Co., Ltd.

The survey team held a series of discussions with the officials concerned of the Government of Lao Peoples' Democratic (Lao PDR), and conducted a field investigations. As a result of further studies in Japan, the present report was finalized.

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

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

January, 2022

Jun SAKUMA
Director General,
Human Development Department
Japan International Cooperation Agency

Summary

1. Outline of the Country

Lao People's Democratic Republic (Lao PDR) is an inland state having land borders with Thailand, China, Vietnam, Cambodia and Myanmar, with the land area of approximately 240,000km^2 and the population of approximately 7.28 million (World Bank databank, 2020). About 80% of the land is mountains and highlands, and flat fields spread only along Mekong River.

Lao PDR was established as a socialist state in 1975. On the economic front, the country introduced a "New Economic Mechanism" in 1986 to reform its economy. In the 8th party congress in 2006, the Lao People's revolutionary Party stated the policy to graduate from the least developed country (LDC) status by 2020. The 11th party congress in 2021 also stated about the policy to graduate from LDC as one of the slogans.

The major industries of the country are agriculture, mining and manufacturing. Lao PDR has enjoyed a high economic growth rate until 2019, however, the economy has recessed and the GDP growth in 2020 dropped to 0.4% (World Bank databank) due to the COVID-19 pandemic. The composition of GDP is 42% for the service, 15% for the agriculture, 32% for the industry (manufacturing, mining and construction), and 11% for the tax revenue (Ministry of Planning and Investment: MPI, 2019), thus the service sector has the largest share. Per capita GDP is 2,654USD (MPI, 2019).

2. Background of the Project

In the economic structure of Lao PDR, the share of industry sector is gradually increasing in line with the country's modernization. The 9th National Socio-Economic Development Plan 2021-2025 (NSEDP9) sets towards "a direction of a quality, green and sustainable growth", having the targeted annual growth rate for the industry sector at 4.1% so that it will account for 32.3% of GDP by 2025, and thus, the industry sector is expected to drive higher economic growth than other sectors. NSEDP9 also refers to the utilization of new technologies, economic diversification, greater productivity, and greater involvement of regional and international supply chain, for a sustainable economic growth. However, because most engineers in Lao PDR do not have sufficient professional expertise and/or technical skills, foreign experts are more likely to be employed for engineering and managing positions than their Lao counterparts. Under the current situation, developing high-quality human resources for the industry sector is recognized as a key challenge.

The government of Lao PDR, in the 8th Education Sector Development Plan 2016-2020 (ESDP8), pointed out that higher education sector had not been able to respond to the needs of labor market which demands human resources with higher knowledges and skills. ESDP8 aimed at strengthening higher education, through the development of curriculums focusing on improving quality on education. In addition, the 9th Education and Sports Sector Development Plan 2021-2025 (ESSDP9) sets a priority on upgrading facilities and equipment of natural sciences and engineering programs for universities.

In particular, ESSDP9 targets to upgrade facilities and equipment of Faculty of Engineering (FEN) of National University of Laos (NUOL), which produces the largest number of graduates in the faculties

of engineering field among four public universities in the country. Meanwhile, it is necessary to improve facilities and equipment of FEN-NUOL, since students of FEN-NUOL cannot have enough practical/experimental work due to shortage of adequate facilities and equipment.

"The Project for Improvement of Facilities and Laboratory Equipment in the Faculty of Engineering, National University of Laos" (the Project) aims at developing high-quality human resources for the industry sector through enhancement of education and research environment by improving facilities and equipment of FEN-NUOL, and the Project is recognized as a prioritized project indispensable to achieve the development of human resources for the industry sector, which is targeted by the government of Lao PDR.

3. Outline of Study and Contents of the Project

Based on the request from the Government of Lao PDR, JICA carried out Field survey I from March 28 to April 25, 2021, and Field survey II (the Explanation of Draft Outline Design (DOD)) from November 9 to 21, 2021. Considering contents of the request from the Government of Lao PDR, outcomes of the field surveys, studies in Japan, and a series of discussions among the stakeholders, it has been determined that the Project is planned in accordance with the following policies.

3–1. Basic Concept of the Project

The objective of the Project is to improve education and research environment of FEN-NUOL, thereby contributing to developing human resources in the engineering field to meet the needs from the industrial sector. In parallel to the Project, a technical cooperation project "Project for Strengthening Human Resource Development of Engineering and Technology for Industry Development" (HUGETECH) is underway. HUGETECH currently sorts out to list up the necessary laboratory activities and equipment in order to implement curriculums which are now being revised.

Considering the curriculum revision and the activities of HUGETECH, this Project is planned to procure necessary equipment to implement the new curriculums and necessary education/research activities and to construct buildings where the selected equipment will be used effectively and efficiently.

(1) Fields and Departments to be covered by the Project

The Project shall target three (3) academic fields, namely mechanical engineering, civil engineering, and electrical/electronic engineering. The said fields cover the following six (6) departments of FEN-NUOL.

Target Fields and Departments

Target Field (3)	Target Department (6)
Mechanical engineering	・ Mechanical Engineering Department
Civil engineering	・ Civil Engineering Department ・ Road & Bridge Engineering Department ・ Transportation & Logistics Engineering Department
Electrical/electronic engineering	・ Electrical Engineering Department ・ Electronic & Telecommunication Engineering Department

(2) Equipment Planning Policy

The Project is planned to procure equipment necessary for experimental/practical work to the 6 departments of the 3 engineering fields. The Project assumes that the new equipment will be placed in the buildings constructed by the Project. As for equipment for the respective departments, considering the current status and use of the existing equipment and the current education/research activities, the Project will procure equipment for basic experimental/practical work, rather than equipment for higher level academic research. Meanwhile, some higher-level equipment that may be used for graduation research and academic-industrial collaboration activities of all departments of FEN-NUOL will also be included in the Project.

Moreover, in order to maximize the cooperation effect with the limited budget, the quantity of equipment is determined in consideration with some items to be commonly used by several departments, thereby allowing more varied items to be procured by the Project.

The requested items are prioritized, and the relevance of which are studied based upon the educational planning as well as the industrial trend. Since HUGETECH will also procure basic equipment necessary for the courses of 1st and 2nd years, the Project is planned to avoid duplication with the items covered by HUGETECH.

(3) Facility Planning Policy

Following a series of discussions with FEN-NUOL and the equipment planning based upon the new curriculums, the following buildings are planned under the Project.

Outline of Building Components

Name of the Building	Outline
Center of Engineering for Sustainable Development：CESD	• A building called "Center of Engineering for Sustainable Development: CESD" aims: ➢ to become a center of academic-industrial collaboration, ➢ to improve education/research environment of FEN-NUOL, and ➢ to be used commonly by all departments of FEN-NUOL. • CESD will be equipped with: ➢ computers which may be commonly used across all departments, ➢ equipment for relatively high-level academic research, ➢ meeting room/space for academic-industrial collaborations ➢ an exhibition room to display academic achievements, and ➢ necessary administrative offices for CESD.
Laboratory Blocks	• Laboratory Blocks consisting of laboratories and training rooms equipped with equipment for basic experimental/practical work for the target 3 engineering fields (6 departments). • Part of the equipment categorized as CESD equipment which causes vibrations and noise, or produces a large amount of waste are to be installed in Laboratory Block instead of CESD, considering possible negative impact on some sensitive items installed in CESD. • Of equipment items to be installed in Laboratory Blocks, ones designated for mechanical engineering and civil engineering fields are mostly large-sized and need to be placed on the first floor. In order to secure a large area on the first floor, Laboratory Blocks shall be separated into three buildings: One 3-story building (Laboratory Block-1) and two 1-story buildings (Laboratory Block-2 and Block-3).

Since FEN-NUOL has enough general lecture rooms and administration offices (except for ones necessary for CESD administration), the Project will not cover them.

3–2. Contents and Scale Setting of Building Components

(1) CESD

FL	Category	Room	Floor Area
1	CESD	Chemical Analysis Lab., Electron Microscope Lab., X-ray Analysis Lab., High-Voltage Lab., CESD Lecturers' Rm	304.50m^2
	Administration	Administration Office/ Pantry, Director's Office	70.00m^2
	Common	Main Entrance, Corridor, Meeting Corner, Slope, Stairs, Toilet, Elec Rm, Server Rm, Storage, etc.	526.51m^2
CESD 1st Floor Area			**901.01m^2**
2	CESD	Solid Forming Lab., Computer Room (1) (2), Physical Measurement Lab., Electrical and Electronic Measurement Lab., Meeting Rom, Exhibition Rm	467.98m^2
	Common	Corridor, Meeting Corner, Slope, Stairs, Toilet, etc.	342.44m^2
CESD 2nd Floor Area			**810.42m^2**
R	Common	Stairs	24.50m^2
CESD Roof Floor Area			**24.50m^2**
CESD Grand Total Floor Area			**1,735.93m^2**

(2) Laboratory Blocks

FL	Category	Room	Floor Area
1	Mechanical Eng. Dept.	Machine Training Room, Metal Working Training Room (including preparation room), Fluid Mechanics Lab., Engine Lab.	305.60m^2
	Administration	Guards' Rm	18.00m^2
	Common	Courtyard, Corridor, Slope, Stairs, Toilet, Elec Rm, Sever Rm, etc.	412.47m^2
Laboratory Block-1 1st Floor Area			**736.07m^2**
1	CESD	Material Testing Lab.	63.00m^2
	Civil Eng. Dept. Road & Bridge Eng. Dept.	Concrete Testing Lab. (including preparation room)	162.00m^2
Laboratory Block-2 1st Floor Area			**225.00m^2**
1	Civil Eng. Dept. Road & Bridge Eng. Dept.	Asphalt Testing Lab., Soil Testing Lab.	160.00m^2
	Common	Toilet	32.00m^2
Laboratory Block-3 1st Floor Area			**192.00m^2**
Connecting Corridor			90.72m^2
Laboratory Block 1-3 + Connecting Corridor 1st Floor Area			**1,243.79m^2**
2	Electrical Eng. Dept.	Electrical Eng. Lab. (1) (2)	196.00m^2
	Civil Eng. Dept.	Civil Eng. Lab.	67.60m^2
	Road & Bridge Eng. Dept.	Road & Bridge Eng. Lab.	70.00m^2
	Common	Students Lounge, Corridor, Slope, Stairs, Toilet, etc.	294.48m^2
Laboratory Block-1 2nd Floor Area			**628.08m^2**
3	Electronic & Telecom Eng. Dept.	Electronic & Telecommunication Eng. Lab. (1) (2)	196.00m^{22}
	Transportation & Logistics Eng. Dept.	Transportation & Logistics Eng. Lab. (1) (2)	137.60m^2
	Common	Students Lounge, Corridor, Slope, Stairs, Toilet, etc.	294.48m^2
Laboratory Block-1 3rd Floor Area			**628.08m^2**
R	Common	Stairs	28.00m^2
Laboratory Block-1 Roof Floor Area			**28.00m^2**
Laboratory Block-1 Total Floor Area			**2,020.23m^2**
Laboratory Block-2 Total Floor Area			**225.00m^2**
Laboratory Block-3 Total Floor Area			**192.00m^2**
Connecting Corridor Total Floor Area			**90.72m^2**
Laboratory Blocks Grand Total Floor Area			**2,527.95m^2**

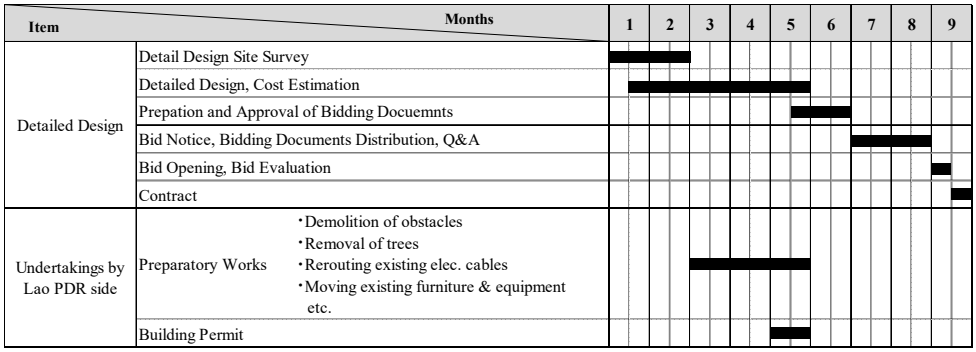
3-3. Contents and Scale Setting of Equipment Components

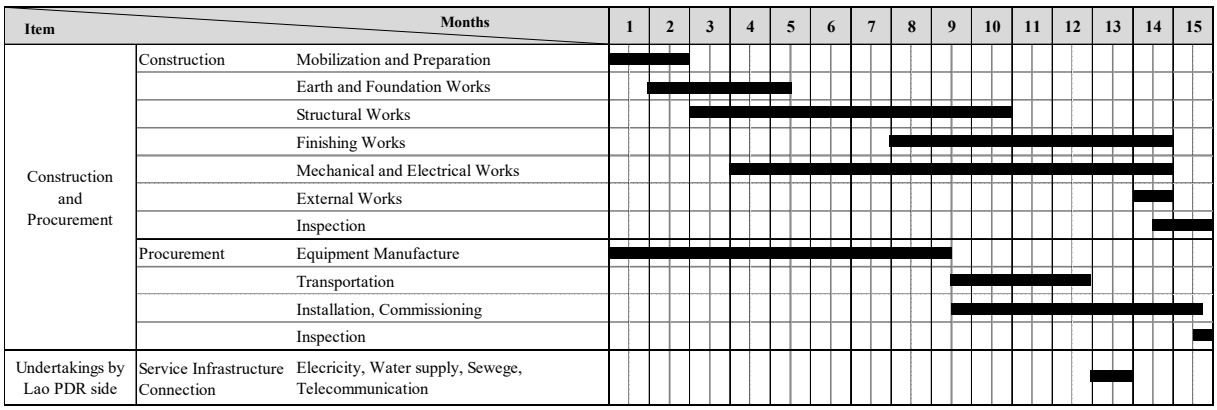
Category	Outline of Planned Equipment	
CESD	Equipment items for graduation research and academic-industrial collaboration activities of all departments of FEN-NUOL.	• Infrared spectroscopy • Sequential X-Ray fluorescence particle size analysis • Universal testing machine • High-voltage experimental equipment, etc.
Mechanical Eng. Dept.	Equipment items currently used for experimental/ practical work, but lacking in quantity or having a problem arising from different specifications.	• Welding machines • Machining equipment, etc.
Civil Eng. Dept.	Equipment items currently used for experimental/ practical work, but lacking in quantity or having a problem arising from different specifications.	• Small compressive testing machines • Soil testing equipment, etc.
Road & Bridge Eng. Dept.	Equipment items for basic experimental/ practical work to alternate the existing items in failure.	• Survey equipment • Asphalt testing equipment, etc.
Transportation & Logistics Eng. Dept.	Equipment for traffic simulation and field research which are most needed, since the department does not own any equipment.	• Computer and software for traffic simulation • Traffic survey equipment, etc.
Electrical Eng. Dept.	Equipment in short supply.	• Equipment for measurement and control system, etc.
Electronic & Telecommunication Eng. Dept.	Equipment items for basic experimental/ practical work to alternate the existing items in failure.	• Electronic measurement equipment • Various practical equipment, etc.

4. Project Implementation Schedule

After signing on the Consultant Agreement, the detailed design and the bidding will be proceeded, then the Contracts with the Contractor and the Supplier will be concluded respectively. It will take 6 months for the detailed design, and 3 months for the bidding. The implementation period for construction and procurement is estimated as 15 months. The provisional implementation schedule of the Project is as follows.

Project Implementation Plan (Provisional)





5. Project Evaluation

5-1. Relevance

The direct beneficiaries of the Project are faculty members and students of FEN-NUOL. It is expected that their education/research activities will be enhanced by the cooperation of the Project which provides the new buildings and necessary equipment. The graduates of FEN-NUOL are expected to be employed by the government or major private companies to play center roles in the industrial sector. Furthermore, collaboration within FEN-NUOL departments and academic-industrial collaboration facilitated by the Project may energize the entire industrial sector, thereby boosting the economic development of the country. Therefore, the nation will be indirectly benefitted from the Project.

ESSDP9 and NESDP9 set the policy to strengthen the human resources for the industrial sector and thus emphasize the importance of enhancing the curriculums and the quality of educational equipment and research ability of the engineering field. In particular, the former sets one of its intermediate goals as to upgrade the facilities and equipment of FEN-NUOL. Therefore, the Project will directly contribute towards the goal.

Moreover, NSEDP9 upholds an economic policy reform to gear towards "a direction of a quality, green and sustainable growth." It also refers to utilization of new technologies, economic diversification, greater productivity, and greater involvement of regional/ international supply chain, for a sustainable economic growth.

The Project aims to upgrade the facilities and equipment of the target departments so that the students may gain basic knowledges and skills through experimental/practical work. Furthermore, it is expected that the students will gain advanced analytical skills in their specialization to be the human resources who will contribute to the economic development aimed in NSEDP9.

In the Japanese Country Assistance Policy for Lao PDR, the "diversification of industries, and enhancing competitiveness and human resource development" is upheld as one of 4 pillars of the policy, addressing the enhancement of basic education and higher education as important issues. The policy further stipulates that Japan will focus on the assistance toward the engineering field of higher education so as that Lao PDR will have the human resources to meet the need of the industrial sector. Therefore, the Project is consistent with the Japanese Assistance Policy.

Moreover, the Project is likely to achieve higher effect, because of the expected synergy effect in tandem with the two technical cooperation projects "HUGETECH" and "AUN/SEED-Net[1]" both of which are currently underway to strengthen the capacity of FEN-NUOL.

5-2. Effectiveness

The Project is expected to bring about the following quantitative results.

[1] ASEAN University Network / Southeast Asia Engineering Education Development

Quantitative Results

Indicators	Base Value (Actual value in 2021)	Target Value (Year:2027. 3yr after the completion)
The number of course programs which uses the equipment procured by the Project (Remark1)	0	16
The number of laboratories equipped with the equipment procured by the Project	0	26
The number of students* who carry out experimental/practical work using the equipment procured by the Project (3rd and 4th year students of the 4-year program and 1st and 2nd year students of the 2-year continuing program) (Remark 2)	0	1,820

(Remark 1) Target value is the total of all course programs of 6 target departments

Department	Programs	No. of Programs
Mechanical Engineering Department	BS General Program (4-year program) • Mechanical Engineering • Industrial Engineering • Material Engineering BS Continuing Program (2-year program) • Mechanical Engineering	4
Civil Engineering Department,	BS General Program (4-year program) BS Continuing Program (2-year program)	2
Road & Bridge Engineering Department	BS General Program (4-year program) BS Continuing Program (2-year program)	2
Transportation & Logistics Engineering Department	BS General Program (4-year program)	1
Electrical Engineering Department	BS General Program (4-year program) • Electrical Engineering • Hydro-power Energies Engineering BS Continuing Program (2-year program) • Electrical Engineering	3
Electronic & Telecommunication Engineering Department	BS General Program (4-year program) • Electronic Engineering • Telecommunication Engineering BS Continuing program (2-year program) • Electronic Engineering • Telecommunication Engineering	4

(Remark 2) The target value is the total quota of 3rd and 4th year students in the ten 4-year BS general programs and 1st and 2nd year students in the six 2-year BS continuing programs.

In addition, the Project is expected to bring about the following qualitative results.

- The education/research environment will improve with the new buildings and equipment to be covered by the Project.
- Human resources meeting the need of the industrial sector will be developed through enhancing the quality of higher education.

From the above, it is deemed highly relevant and effective for the Project to be implemented.

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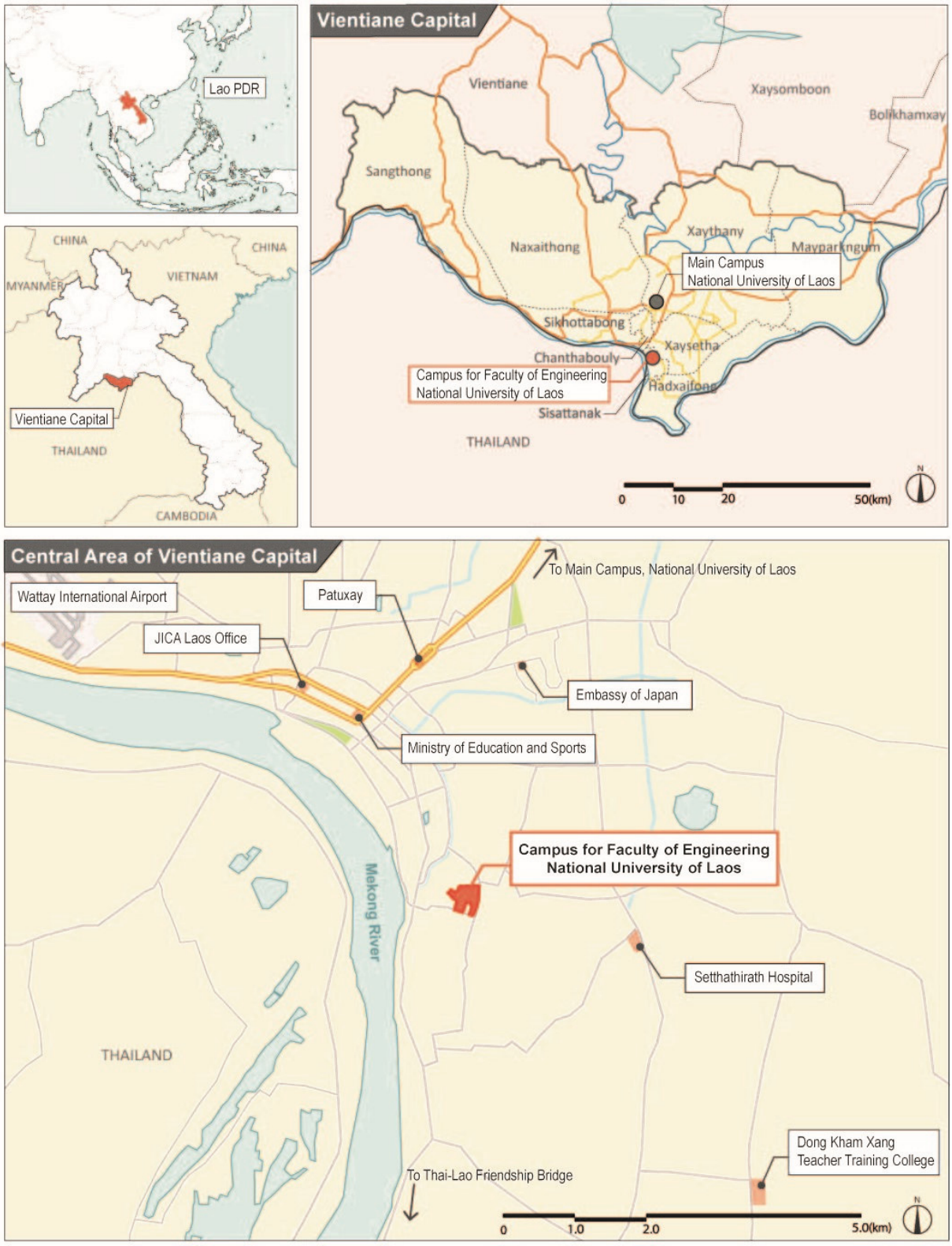
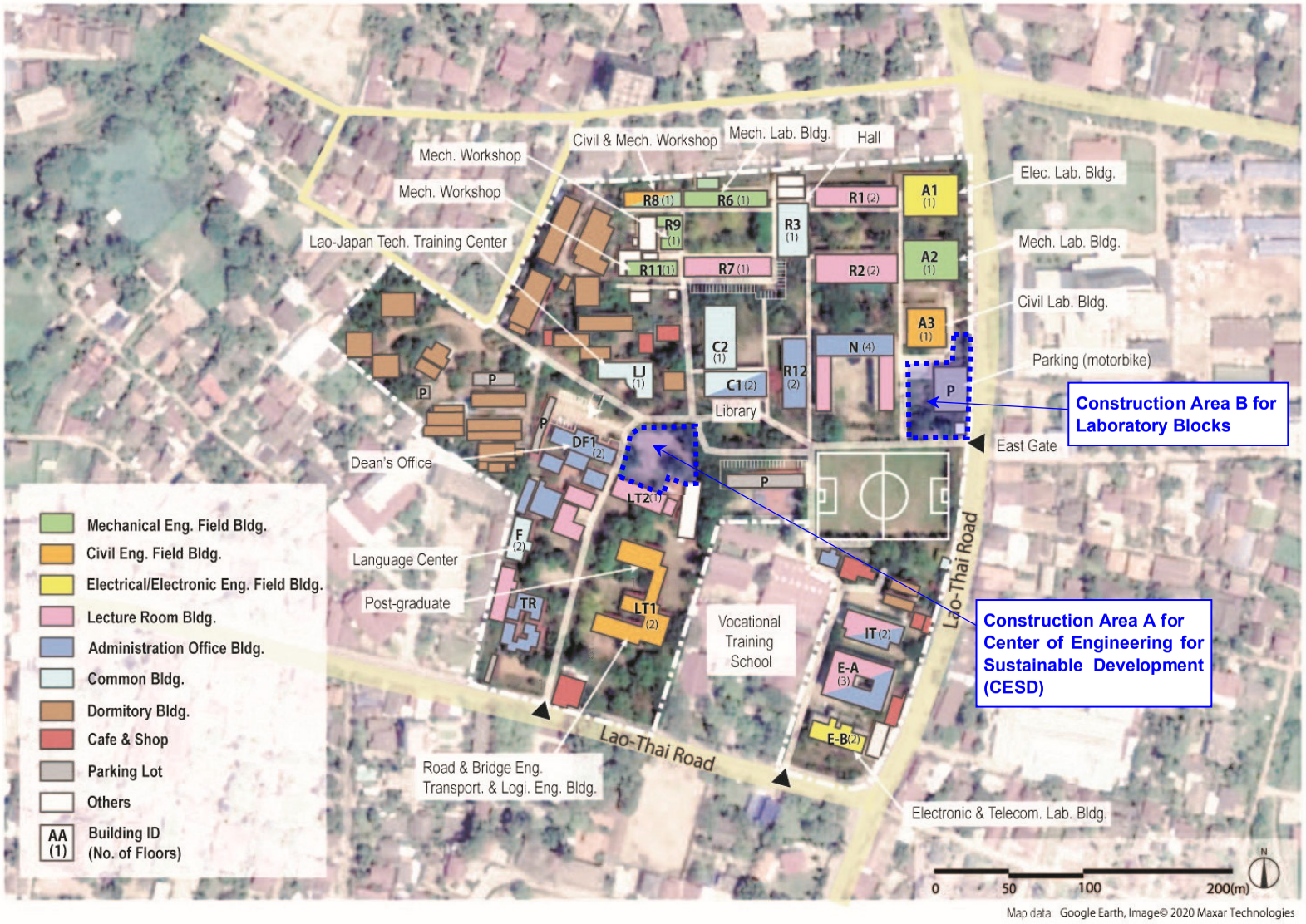


Project Site Map-1



Project Site Map-2 (Campus Map of Faculty of Engineering, National University of Laos)

Bird’s-eye Perspective (Laboratory Blocks (Front) and Center of Engineering for Sustainable Development (Far Left)

Perspective (Center of Engineering for Sustainable Development)

List of Tables and Figures

Abbreviations

ADB	Asian Development Bank
ASTM	ASTM International (formerly known as “American Society for Testing and Materials”)
BOL	Bank of the Lao PDR
BS	British Standards
CESD	Center of Engineering for Sustainable Development
CO	Cabinet Office
COE	Center of Excellence
DAC	Development Assistance Committee
DER	Department of External Relations
DHE	Department of Higher Education
DOD	Description of Outline Design
DPWT	Department of Public Works and Transport
E/N	Exchange of Notes
EDL	Électricité du Laos
ESDP	Education Sector Development Plan
ESSDP	Education and Sports Sector Development Plan
ESIA	Environmental and Social Impact Assessment
FEN	Faculty of Engineering
G/A	Grant Agreement
ICT	Information and Communication Technology
IEE	Initial Environmental Examination
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
MOES	Ministry of Education and Sports
MOF	Ministry of Finance
MONRE	Ministry of Natural Resources and Environment
MPI	Ministry of Planning and Investment
MPWT	Ministry of Public Works and Transport
NSEDP	National Socio-Economic Development Plan
NUOL	National University of Laos
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
SDGs	Sustainable Development Goals
VAT	Value Added Tax

Chapter 1 Background of the Project

Chapter 1 Background of the Project

1-1 Background of the Grant Aid

In the economic structure of the Lao People's Democratic Republic (Lao PDR), the share of industry sector is gradually increasing in line with the country's modernization. The 9th National Socio-Economic Development Plan 2021-2025 (NSEDP9) sets towards "a direction of a quality, green and sustainable growth", having the targeted annual growth rate for the industry sector at 4.1% so that it will account for 32.3% of GDP by 2025, thus, the industry sector is expected to drive higher economic growth than other sectors. NSEDP9 also refers to the utilization of new technologies, economic diversification, greater productivity, and greater involvement of regional and international supply chain, for a sustainable economic growth. However, because most engineers in Lao PDR do not have sufficient professional expertise and/or technical skills, foreign experts are more likely to be employed for engineering and managing positions than their Lao counterparts. Under the current situation, developing high-quality human resources for the industry sector is recognized as a key challenge.

The government of Lao PDR, in the 8th Education Sector Development Plan 2016-2020 (ESDP8), pointed out that higher education sector had not been able to respond to the needs of labor market which demands human resources with higher knowledges and skills. ESDP8 aimed at strengthening higher education, through the development of curriculums focusing on improving quality on education. In addition, the 9th Education and Sports Sector Development Plan 2021-2025 (ESSDP9) sets a priority on upgrading facilities and equipment of natural sciences and engineering programs for universities.

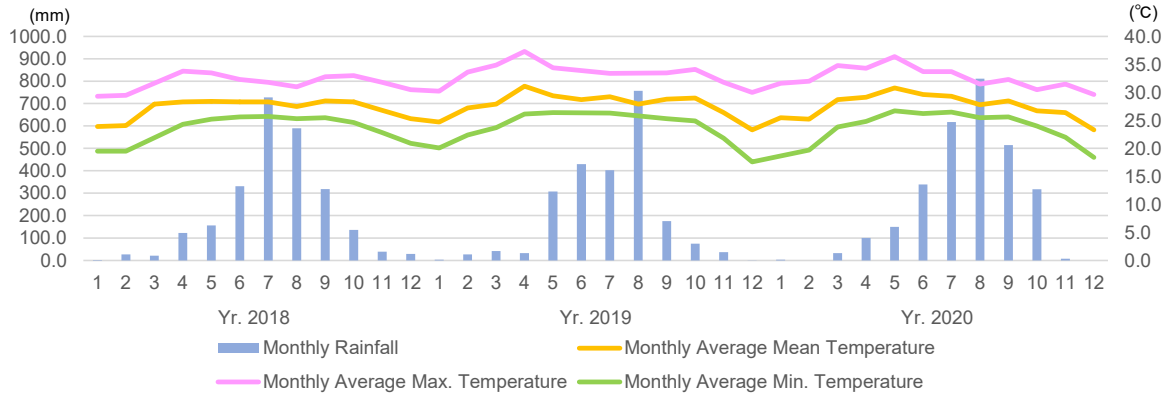
In particular, ESSDP9 targets to upgrade facilities and equipment of Faculty of Engineering (FEN) of National University of Laos (NUOL), which produces the largest number of graduates in the engineering field among four public universities in the country. Meanwhile, it is necessary to improve facilities and equipment of FEN-NUOL, since students of FEN-NUOL cannot have enough practical/experimental work due to shortage of adequate facilities and equipment.

"The Project for Improvement of Facilities and Laboratory Equipment in the Faculty of Engineering, National University of Laos" (the Project) aims at developing high-quality human resources for the industry sector through enhancement of education and research environment by improving facilities and equipment of FEN-NUOL, and the Project is recognized as a prioritized project indispensable to achieve the development of human resources for the industry sector, which is targeted by the government of Lao PDR.

1-2 Natural Conditions

(1) Climatic Conditions

The Lao PDR belongs to the tropical monsoon climate zone having hot and humid climate in general, and it has the distinct rainy season and dry season. In Vientiane Capital, where the Project site is located, April at the end of dry season tends to have the highest temperature in a year. Monthly average mean temperature in April is about 30 degrees Celsius, and there are some days with daily high temperature over 40 degrees Celsius in the month. The lowest temperature tends to be recorded in December or January, when dry season starts. Monthly average low temperature in such months is about 25 degrees Celsius, while it sometimes drops around 10 degrees Celsius. Rainy season is from May to October in general, and July and August have ample precipitation.



(Source: Temperature data: Japan Meteorological Agency (Climatview), Rainfall data: worldweatheronline.com)

Figure 1-1 Climate Data of Vientiane Capital (Year 2018-2020)

(2) Seismic Conditions

The northern part of Lao PDR is susceptible to earthquakes. In fact, in November 2019, an earthquake of magnitude 6.1 occurred near the border with Thailand in the northwestern part of Lao PDR. Thus, the Project incorporates seismic design, referring to the seismic hazard map of Lao PDR and the seismic force of the northern part of the country.

(3) Geographic and Topographic Conditions

FEN-NUOL campus is located about 750m away from the Mekong River with its land area of approximately 120,000m^2. The campus has gently undulating landscape, and it slopes upward from the north-west corner (about 172m above sea level) to the south-east corner (about 180m above sea level). The east side of the Mekong River where the campus is located is at a higher altitude than Thai side (west side of the Mekong River), thus the campus was not submerged by the heavy flooding in 2008 that hit the areas around Vientiane Capital. Topographic survey for the entire campus was conducted under this preparatory survey, and its outcome is shown in “Appendix 5-1 Topographic Survey Map”.

(4) Soil Conditions

The ground of FEN-NUOL campus consists of sandy clay and/or sandy silt with gravel from the Mekong River. This preparatory survey conducted boring tests (including standard penetration tests, sampling, sample laboratory tests, and groundwater level measurement, etc.) at ten points in three candidate areas for construction. Furthermore, sounding tests were additionally conducted for a certain area where it deems necessary to obtain more data as a result of boring tests. After such soil investigation, it was confirmed that the soil at the construction areas have medium hardness and density, while the soil conditions vary from place to place within the campus due to sedimentary layers. Outcome of the soil investigation is shown in “Appendix 5-2 Outcome of Soil Investigation”.

(5) Underground Structure

This preparatory survey also conducted a survey to identify underground structures within the candidate construction areas, after information collection through visual observation and interviews. In practice, designated points, such as areas around existing building foundations, expected underground service lines, etc., were tentatively excavated, and positions and shapes of such underground structures were figured out as photo records and drawings. The outcome of the underground structure survey is show in “Appendix 5-3 Outcome of Underground Structure Survey”.

1-3 Environmental and Social Considerations

1-3-1 System and Organization of Environmental and Social Considerations

Ministry of Natural Resource and Environment (MONRE), which was established in 2011, is responsible for environmental issues in Lao PDR.

Under the Article 19 of the revised constitution 2003, which stipulates that all authorities and the nation are obliged to protect the environment and natural resources, important environment-related laws and regulations in the country are as follow: "Water and water resource law (1996)", "Land law (1997)", "Mining law (1997)", "Electricity law (1997)", "Environmental protection law (promulgated in 1999 and revised in 2012)" and "Forestry law (revised in 2007)", etc.

As for the Initial Environmental Examination (IEE) and the Environmental and Social Impact Assessment (ESIA), the following rules have been established under the Environmental protection law.

① Rule concerning EIA

Decree on Environmental Impact Assessment, issued on 31 January 2019, No.21/GOL

② Rule to categorize development projects as to determine whether IEE or ESIA is required

Ministerial Agreement on the Endorsement and Promulgation of List of Investment Projects and Activities Requiring for Conducting the Initial Environmental Examination or Environmental and Social Impact Assessment, issued on 7 December 2013, Ref no. No. 8056/MONRE

③ Rule concerning IEE procedures

Ministerial Instruction on the process of Initial Environmental Examination of the Investment Project and Activities (IEE), issued on 17 December 2013, Ref no. 8029/MONRE

④ Rule concerning EIA procedures

Ministerial Instruction on the process of Environmental and Social Impact Assessment of the Investment Projects and Activities (ESIA), issued on 17 December 2013, Ref no. 8030/MONRE

1-3-2 Project Components which might affect Environment and Society

In accordance with the above rules, it has been confirmed that both the content (i.e., construction of school buildings) and the size of the Project are not categorized into Group 1 which requires an IEE or Group 2 which requires an ESIA. Accordingly, the Project is categorized as "C," which is likely to have minimal or little adverse impact on the environment and society, based upon "JICA Guidelines for Environmental and Social Consideration".

Chapter 2　Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Outline of the Project

This Project will provide necessary buildings and equipment mainly for the fields of mechanical engineering, civil engineering, and electrical/electronic engineering of FEN-NUOL. With this, it is expected to contribute to developing human resources for the industry sector through enhancement of education and research environment of FEN-NUOL. The following table summarizes the planned building and equipment components to be covered by the Project.

Table 2-1 Outline of the Project

Target	Details
Project site	NUOL Faculty of Engineering Campus (Sisattanak District, Vientiane Capital, Lao PDR)
Academic fields to be covered	・ Mechanical engineering (Mechanical Engineering Department) ・ Civil engineering (Civil Engineering Department, Road & Bridge Engineering Department, and Transportation & Logistics Engineering Department) ・ Electrical/electronic engineering (Electrical Engineering Department and Electronic & Telecommunication Engineering Department)
Building component	・ Center of Engineering for Sustainable Development: CESD): 2-story 2,030.00m^2 ・ Laboratory Blocks:2,527.95m^2 (Laboratory Block-1: 3-story 2,020.23m^2 , Laboratory Block-2: 1-story 225.00m^2、 Laboratory Block-3: 1-story 192.00m^2, Connecting passageway 90.72m^2)
Equipment component	<Equipment to be Procured> ・ Equipment for education and academic research (Laboratory activities, practices, measurement, and machining, etc.) <Items/Departments to be Covered> ・ CESD : 29 Items ・ Mechanical Engineering Department (ME) : 39 Items ・ Civil Engineering Department (CE) : 51 Items ・ Road and Bridge Engineering Department (RB) : 31 Items ・ Transportation & Logistics Engineering Department (TL) : 10 Items ・ Electronical Engineering Department (EL) : 24 Items ・ Electronics Engineering Department (ER) : 20 Items

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

As stated above, the objective of the Project is to improve education and research environment of FEN-NUOL, thereby contributing to developing human resources in the engineering field to meet the needs from the industrial sector. In parallel to the Project, a technical cooperation project "Project for Strengthening Human Resource Development of Engineering and Technology for Industry Development" (HUGETECH) is underway. HUGETECH currently sorts out to list up the necessary laboratory activities and equipment in order to implement curriculums which are now being revised.

Considering the curriculum revision and the activities of HUGETECH, this Project is planned to procure necessary equipment to implement the new curriculums and necessary education/research activities and to construct buildings where the selected equipment will be used effectively and efficiently.

(1) Fields and Departments to be covered by the Project

The Project shall target three (3) academic fields, namely mechanical engineering, civil engineering, and electrical/electronic engineering. The said fields cover the following six (6) departments of FEN-NUOL.

Table 2-2 Target Fields and Departments

Target Field (3)	Target Department (6)
Mechanical engineering	・ Mechanical Engineering Department
Civil engineering	・ Civil Engineering Department ・ Road & Bridge Engineering Department ・ Transportation & Logistics Engineering Department
Electrical/electronic engineering	・ Electrical Engineering Department ・ Electronic & Telecommunication Engineering Department

(Source: the study team)

The present curriculums consist of lectures, experimental/practical works, internship and graduation research, however, as a large part of equipment is currently out of order or outdated in FEN-NUOL, necessary experimental/practical works have not been sufficiently implemented and lectures are major part of the curriculums.

On the other hand, under the new curriculums, more course credits will be allocated to laboratory activities/practicum and internship, while the number of the course credits for lectures will be reduced. Furthermore, in the new curriculums, incorporating feedbacks from enterprises which accept student interns, the timing of internship will be extended to the second semester of 2nd year or the first semester of 3rd year, so that students can do an internship after studying the basics. In addition, courses for 4th year will be reduced to secure more time for graduation research.

Originally the new curriculums were planned to be in place from September 2021, the academic year of 2021/22, however, it is now planned to be introduced in September 2022, as the approval process took longer.

As described, the details of the Project are made, considering the new curriculums and the activities

of HUGETECH. Thus, the Project establishes the basic policies of the equipment planning, based upon which the facility planning is established.

(2) Equipment Planning

1) Equipment Planning Policy

The Project is planned to procure equipment necessary for experimental/practical work to the 6 departments of the 3 engineering fields. The Project assumes that the new equipment will be placed in the buildings constructed by the Project. As for equipment for the respective departments, considering the current status and use of the existing equipment and the current education/research activities, the Project will procure equipment for basic experimental/practical work, rather than equipment for higher level academic research. Meanwhile, for CESD in particular, some higher-level equipment that may be used for graduation research and academic-industrial collaboration activities of all departments of FEN-NUOL will also be included in the Project.

Moreover, in order to maximize the cooperation effect with the limited budget, the quantity of equipment is determined in consideration with some items to be commonly used by several departments, thereby allowing more varied items to be procured by the Project.

The requested items are prioritized, and the relevance of which are studied based upon the criteria in Table 2-2, and the educational planning as well as the industrial trend. Since HUGETECH will also procure basic equipment necessary for the courses of 1st and 2nd years, the Project is planned to avoid duplication with the items covered by HUGETECH.

2) Setting the Scale of Equipment Components

The requested items were shortlisted following discussion with each target department in which the reasons of the request, the relevance with the industrial trend, and the department's future plan, etc. had been confirmed. Furthermore, the items were prioritized according to the followings.

- Priority A : Items indispensable for experimental/practical work
- Priority B : Items necessary for experimental/practical work, but require further analysis in Japan

During the analysis stage in Japan, the survey team studied the requested items, using the following selection criteria to make the equipment planning. In the equipment planning for this Project, no item which did not meet all criteria is not included.

Table 2-3 Equipment Selection Criteria

1	Relevance to the human resource needs in the industrial sector
2	Relevance to the curriculums
3	Relevance to the number of students in the respective departments Relevance to the number of students/laboratory groups when in use
4	Relevance to the actual or the future plan for operation and maintenance (e.g., organizational arrangement and staff and budget allocation)
5	Relevance of the specification level of the requested item to the actual level and the target levels set by the technical cooperation

6	Whether or not NUOL may purchase its consumables and/or spare parts of the item
7	Whether or not the item shall be outdated soon
8	Durability of the item
9	Relevance to the facility planning (locations to be set, consistency with the mechanical service planning, and budget allocation)
10	Item not for administration purposes

(Source: the study team)

The quantity of each item is planned according to the usage (demonstration by a faculty member, group work, or solo work, etc.). When setting the quantity, the following table was referred to. The number of students and groups vary one experimental/practical work to another.

Table 2-4 Number of Students and Group at an Experimental/Practical Work

Department	No. of Student	No. of Group
Mechanical Engineering	40	2-10
Civil Engineering	40	2-10
Road and Bridge Engineering	50	6
Transportation & Logistics	40	2or 5
Electronical Engineering	20-50	2-20
Electronics Engineering	40	5-17

(Source: Interview by the study team from FEN-NUOL)

Concerning the equipment to be used among students of different academic years, if there is only one laboratory, the Project assumes that FEN-NUOL shall coordinate the timetable to avoid the simultaneous use by students of different academic years. As for large-size equipment, the quantity is set considering the equipment layout in each laboratory.

(3) Facility Planning

1) Planned Buildings

Following a series of discussions with FEN-NUOL and the equipment planning based upon the new curriculums, the following two buildings are planned under the Project.

Table 2-5 Outline of Building Components

Name of the Building	Outline
Center of Engineering for Sustainable Development：CESD	• A building called “Center of Engineering for Sustainable Development: CESD” aims: ➢ to become a center of academic-industrial collaboration, ➢ to improve education/research environment of FEN-NUOL, and ➢ to be used commonly by all departments of FEN-NUOL. • CESD will be equipped with: ➢ computers which may be commonly used across all departments, ➢ equipment for relatively high-level academic research, ➢ meeting room/space for academic-industrial collaborations ➢ an exhibition room to display academic achievements, and ➢ necessary administrative offices for CESD.

Laboratory Blocks	• Laboratory Blocks consisting of laboratories and training rooms equipped with equipment for basic experimental/practical work for the target 3 engineering fields (6 departments). • Part of the equipment categorized as CESD equipment which causes vibrations and noise, or produces a large amount of waste are to be installed in Laboratory Block instead of CESD, considering possible negative impact on some sensitive items installed in CESD. • Of equipment items to be installed in Laboratory Blocks, ones designated for mechanical engineering and civil engineering fields are mostly large-sized and need to be placed on the first floor. In order to secure a large area on the first floor, Laboratory Blocks shall be separated into three buildings: One 3-story building (Laboratory Block-1) and two 1-story buildings (Laboratory Block-2 and Block-3).

(Source: the study team)

Since FEN-NUOL has enough general lecture rooms and administration offices (except for ones necessary for CESD administration), the Project will not cover them.

2) Setting the Scale of Building Components

The buildings which are to be covered by the Project need to be designed in a way of effective and efficient use of the equipment to be procured. As described, the equipment items and their quantities are determined based upon the subjects[2] under the new curriculums, the number of students per subject (40 students for most subjects, 20 or 50 for some subjects) and the way of experimental/practical work (demonstration by a faculty member, groupwork consisting of 4-25 students per group, or solo work by a student, etc.)

Each laboratory/training room is planned to be equipped with several different items and used by different subjects. The way how the laboratory/training room is used will differ from one subject to another. Considering these points, the Project sets the accommodation capacity of each laboratory/training room at 40 students and provides 40 seats or 20 seats (for the latter case, the assumption is made that 20 students will engage in an experiment/practice, while the other 20 students stand and see the fellow students exercising the experiment/practice).

As for computer rooms of CESD, 40 sets of tables and chairs for students are planned, while the other laboratories of CESD are designed assuming that the students will watch demonstrations carried out by a faculty member.

In Laboratory Blocks, in principle, each department will have its own laboratories for exclusive use, but Civil Engineering Department and Road & Bridge Engineering Department will share their laboratories/rooms and equipment, as the two departments have many common or similar subjects.

3) Selection of Construction Areas

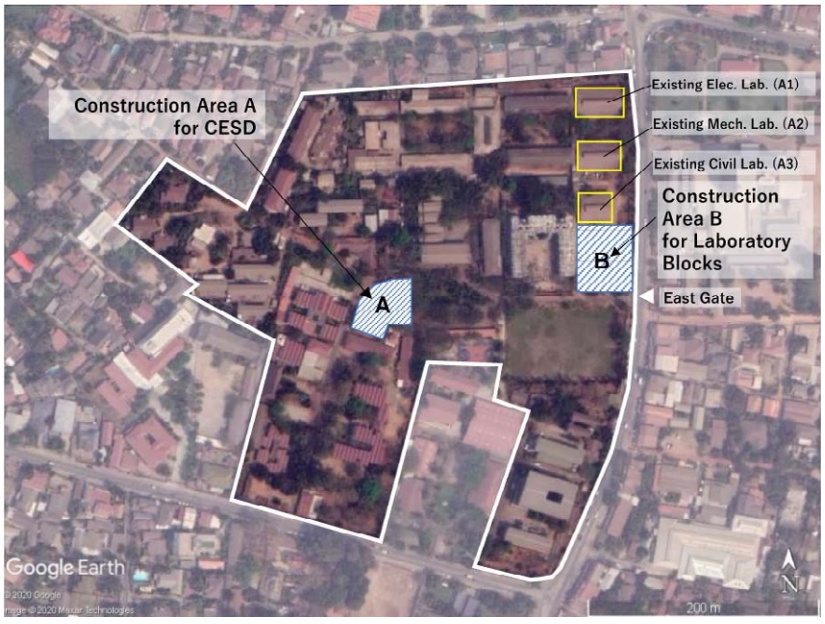
"Site Location Map-2" shown earlier in this report indicates that FEN-NUOL campus has many existing buildings and there are not many large plots available for new construction. Accordingly, the survey team discussed with FEN-NUOL including a possibility to demolish some existing

[2] Syllabuses and guidebooks on laboratory activities for students are now being drafted or revised by the technical cooperation project.

structures and carefully selected construction areas, considering the necessary functions required by the respective planned buildings.

Construction Area A with about 2,000 m^2 (refer to the map below), which is located in the center of the campus and close to the Dean's office is selected for CESD. This is the best location for CESD as a symbolic building of FEN-NUOL, as it is accessible from all parts of the campus. On top of that, CESD is likely to enhance a presence and visibility of a Japanese grant aid project. Currently the Construction Area A is vacated land, while there remain old floor slabs and underground structures of demolished buildings. These old structures and several trees in the area need to be removed as undertakings by Lao PDR side.

Construction Area B with about 3,000 m^2 (refer to the map below), which is on the right-hand side (north) of the east gate of the campus is selected for Laboratory Blocks. The area currently has a guard house and roofed motorbike parking lot, the latter of which is now prepared for relocation to make this area available for new construction. As for the guard house, FEN-NUOL has already agreed to demolish it by Lao PDR side. On the north side of the Construction Area B, there are existing laboratory buildings of Electrical Engineering Department, Mechanical Engineering Department and Civil Engineering Department, thus it is easy to coordinate activities/communications among the departments with new Laboratory Blocks. Moreover, the Construction Area B faces the main road (Lao-Thai Road) and thus is also a good location to appeal a presence and visibility of a Japanese grant aid project. Owing to the urban planning regulation of Vientiane Capital, the new buildings shall be set back from the center of the main Lao-Thai Road by 16.5m.



(Source: The survey team)

Figure 2-1 Constrction Areas for Planned Buildings

2-2-1-2 Policy for Natural Conditions

(1) Climatic Conditions

To cope with the climatic conditions of high temperature and humidity in Lao PDR, a comfortable room environment will be maintained by heat insulation to control the temperature. In addition, the necessary mechanical and electrical service facilities shall be installed to maintain the appropriate education/research environment as the engineering departments of a prestigious national university. External finishing materials and sectional plan of the buildings are designed considering possible stains stemming from the high temperature and humidity.

(2) Soil Conditions

FEN-NUOL campus is located about 750m away from the Mekong River and its soil consists of sandy clay and/or sandy silt with gravel from the Mekong River. The ground has sedimentary layers, and the soil conditions vary from place to place within the campus, while the soil at the construction areas have medium hardness and density. The foundations of planned buildings are designed based upon the results of soil investigation of the respective construction areas.

(3) Flooding

As described above, FEN-NUOL campus is closely located to the Mekong River, but Sisattanak District (east side of the Mekong River) where FEN-NUOL campus is located was not submerged by the heavy flooding in 2008 that hit the areas around Vientiane Capital. It resulted from the geographical reason that east side of the Mekong River is at a higher altitude than Thai side (west side of the Mekong River). Thus, the campus seems to be at low risk of flooding. The first-floor level of the planned buildings is set, referring to the levels of the existing buildings and rainwater drainage of the campus in torrents.

(4) Earthquake

The northern part of Lao PDR is susceptible to earthquakes. In fact, in November 2019, an earthquake of magnitude 6.1 occurred near the border with Thailand in the northwestern part of Lao PDR. Thus, the Project incorporates seismic design, referring to the seismic hazard map of Lao PDR and the seismic force of the northern part of the country.

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

(1) Considerations to Perspectives on Inclusion and Gender

In architectural planning, the following points are incorporated for considerations of diverse users, including the handicapped, from perspectives on inclusion and gender.

- LED street lights are planned along the campus road connecting the two planned buildings and around the buildings. The safety of campus will be improved with the lightings, thereby increasing the sense of safety of various users, including the handicapped and female students. In doing so, education/research activities may be carried out for a longer period.

- The planned buildings will have slopes, which do not require much maintenance cost, so that all laboratories/training rooms will be accessible for diverse users.
- Toilet blocks on the respective floors will have a universal toilet compartment (for wheelchair users and all gender users) with pictogram signs.
- Male and female toilets of toilet blocks on the respective floors are designed in consideration of separation of physical and visual approaches. Likewise, pictogram signs indicating male and female toiles will be installed.
- In 2020 academic year, the female student rate of the 6 target departments of FEN-NUOL is about 16%[3], while the one for the entire FEN-NUOL is 24%. In case of European counties, the female student rate is about 25%[4]. Assuming 160 students per floor (40 students x 4 laboratories or rooms) and the rate of simultaneous use of 60%[5], the necessary number of male toilet compartments and urinals remains unchanged when the percentage of female students is between 16-25%. If the percentage of female students is between 16-20%, the necessary number of female toilet compartments is one, while if the percentage is increased to 25%, two female toilet compartments are necessary. Thus, the Project sets the number of toilet compartments and urinals, on the assumption of 25% of female students.

Table 2-6 Study on Ratio of Female Students and No. of Toilets

% of female students	Accommodation capacity per floor	Simultaneous use	No. of male users	No. of female users	No. of toilet compartment/urinals[6]		
					Male compartment	(Male) Urinal	Female compartment
16%	160	60%	81	15	2	3	1
20%			77	19	2	3	1
25%			72	24	2	3	2

(Source: The survey team)

(2) Considerations for Less Costly Maintenance and Environmental Sustainability

The Project considers not only the reduction for maintenance costs for the sake of stabilized use for a long term, but also the environmental sustainability. The following points are incorporated into the architectural design.

- Eco-friendly electrical and mechanical service fixtures are planned as far as possible, whose

[3] The percentages of female students among the 6 departments were: 14.2% (2017), 17.4% (2018), 17.9% (2019), 15.9% (2020). In the academic year 2020, the percentage by department are: Civil Engineering department: 11%, Mechanical Engineering department: 12%, Electrical Engineering department:8%, Electronic & Telecommunication department: 21%, Road & Bridge Engineering department: 20%, and Transportation & Logistics Engineering Department:44%.

[4] According to a report by the Ministry of Education, Culture, Sport and Science and Technology of Japan (2019), the percentages of female students in the engineering field in Japan and Korea were 15% (2018) and 16% (2017), respectively, while the figures in UK and Germany were 21% (2016) and 23% (2016) respectively.

[5] The rate of simultaneous use of a university lecture room varies significantly and there is no standard rate. The Project referred to a study published by the Ministry of Education, Culture, Sport and Science and Technology of Japan on March 28, 2018, and a project document on the facility construction of Miyagi University (June 23, 2010). The former study indicates that an average rate of simultaneous use of a university lecture room was 58.6% (2014), while the latter describes that the facility management is likely to be difficult if the simultaneous use is above 60%. Referring to the study results, the Project sets the simultaneous use rate at 60%.

[6] According to Article 17 of sanitary standard of office buildings of Japan, one or more male toilet compartments for every 60 male users, one or more urinals for every 30 male users and one or more toilet compartments for every 20 female users.

spare parts are procurable in the local market.

- Stand-alone photovoltaic LED street lights, the spare parts of which are easily changed, are planned to reduce the electrical cost and appeal to the environmental sustainability.
- Slopes of 1/12 pitch are adopted for barrier-free purposes, instead of elevators which requires much cost for regular inspections and electricity.
- Common spaces (i.e., corridors, staircases, entrances, meeting areas, etc.) will not be equipped with air-conditioners, but it is planned that temperature and humidity for such spaces will be reduced by natural ventilation.
- Louvers, eaves or heat insulation will be adopted for the exterior walls, thereby avoiding strong sunlight and reducing the air-conditioning load.

(3) Academic-Industrial Collaboration

It is indispensable to provide practical education with collaboration with the industrial sector to develop highly qualified human resources for the engineering field. Indeed, HUGETECH sets one of the objectives to extend the academic-industrial collaboration. In order to contribute to this vision, the Project considers the following items in planning the buildings and equipment.

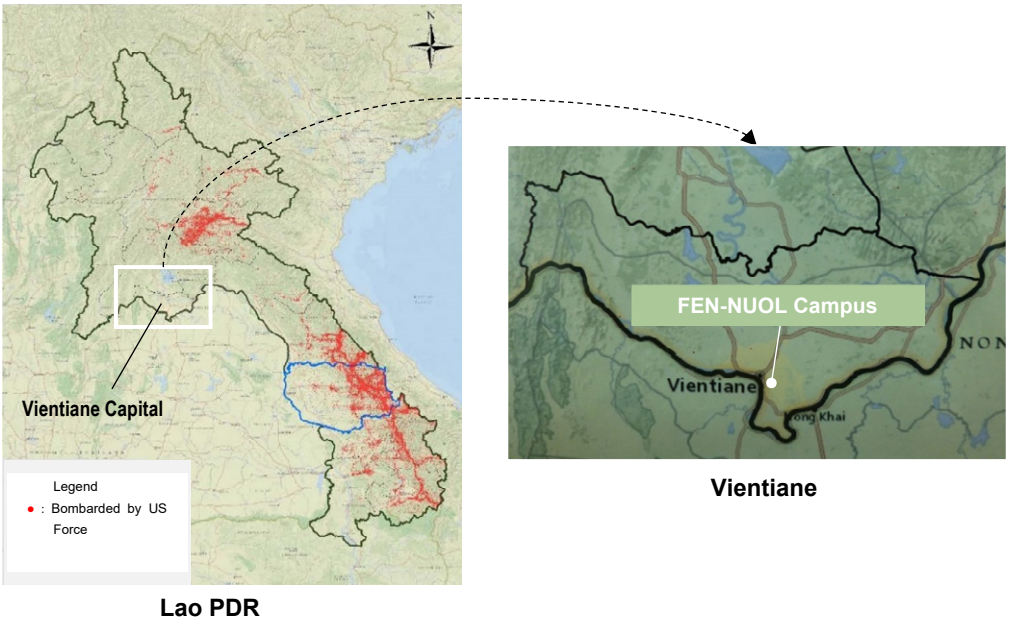
- Collaboration research/development using the equipment designated for CESD[7]
- Product inspections and performance tests by enterprises, using the CESD equipment
- Measurement and analysis services provided as a social service of FEN-NUOL for external organizations
- Facilitation of academic-industrial collaboration using meeting rooms in CESD
- Appeal the achievements of academic-industrial collaboration activities using the exhibition room in CESD.

(4) Risk of Unexploded Ordnance (UXO)

There still remains UXO in Lao PDR due to the extensive bombardment during the Indo-China war in 1946-1954 and 1965-1975. However, as the map below indicates that the southern provinces across which had a military supply route to North Vietnam (Ho-Chi Ming route) and Xiengkhouang province in the north which was dominated by Pathet-Lao[8] that fought against the-then Royal Lao army and US force were mainly bombed, while the Vientiane Capital remained almost intact.

[7]Some equipment items of higher specification which may be used across all departments, and for graduation research projects and academic-industrial collaboration activities shall be placed in CESD. However, some equipment designated for CESD, which causes noises and vibrations shall be placed in the Laboratory Blocks.

[8] A communist movement active between 1950s-70s. The force is the origin of the present Laos People's Revolutionary Party which forms the present government.



(Source: The survey team, based on US Bombing Sortie Map, 02/08/2016, The HALO Trust)

Figure 2-2 Map of UXO Contaminated Area (Lao PDR and Vientiane Capital)

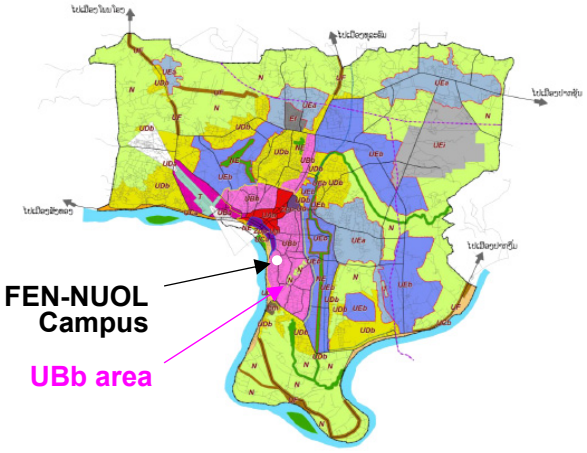
The survey team confirms with FEN-NUOL that the campus had not been bombed. The location of the present campus has been used as an educational institution belonging to the government of Lao PDR since 1968. In 1985, National Polytechnic Institute (NPI), the predecessor of FEN-NUOL, was established with assistance from the World Bank and the government of Switzerland. From 1985 to 1996, almost all presently existing buildings were constructed, and it was confirmed in writing[9] that no UXO was found in the campus during the period when the buildings were being constructed. Moreover, the construction sites of this Project used to have buildings or structures and had been excavated to build their foundations, but no UXO were found. Based upon the above information, the Project does not consider any risk of UXOs in the ground of the construction areas.

2-2-1-4 Policy for Local Industries of Construction and Procurement

(1) Building Permit

FEN-NUOL campus is in Sisattanak District, Vientiane Capital and belongs to UBb area which is subject to the urban planning regulation, according to the Department of Public Works and Transport (DPWT) of Vientiane Capital. Accordingly, the building permit must be obtained, complying with the regulations such as the setback and height limit in the area. During the Field Survey I, the survey team discussed with FEN-NUOL and DPWT to receive building permit document forms, and to confirm that FEN-NUOL takes all necessary procedures, and the building permit needs to be obtained before the commencement of construction works.

[9] A letter issued by the Dean of FEN-NUOL dated August 11, 2021 "No.:649/FEN "CERTIFICATION About Unexploded Ordnance in Faculty of Engineering, National University of Laos"



(Source: Made by the survey team based upon Vientiane Capital District Rules and Regulations 2018)

Figure 2-3 Urban Planning Map of Vientiane Capital and Location of FEN-NUOL Campus

(2) Building Standards

The construction law and urban planning law have already been established in Lao PDR, however, a national building code which stipulates detailed technical requirements has not been issued yet though it is under preparation. Thus, several technical standards of Japan, Thailand, US, Europe and so on are applied by material and by work in the construction fields of Lao PDR. The Project designs based upon the standards or work methods generally applied Lao PDR, while the relevant standards and specifications in Japan will be referred for the items which are unavailable or uncertain.

(3) Equipment Procurement

The planned equipment is to be procured from Japan, Lao PDR, or third countries, according to the availability of each item. ICT equipment, which are commonly available in Lao PDR, will be procured locally, while machining equipment will be imported from Japan. As for measurement and analysis items, they are planned to be primarily procured from Japan, but concerning some existing items used by the departments of Civil Engineering and Road & Bridge Engineering Departments which are not based on JIS but BS or ASTM, they may be procured from third countries. As for equipment items for trainings/practices, the Project assumes to procure US or European products and import from third countries adjacent to Lao PDR, where there are agents of the manufacturers. When planning the procurement, the Project considers selecting equipment of manufacturers which have agents in the neighboring countries so that they may easily dispatch their maintenance engineers as after-sale services. Moreover, equipment requiring frequent change of spare parts or consumables, is planned of general specifications so that FEN-NUOL may procure necessary spare parts and consumables in Vientiane.

2-2-1-5 Policy for Employing Local Firms

(1) Consultants

There are several consultants who have collaborated with Japanese or other foreign consultants in Lao PDR, however, there are few highly qualified engineers who may cope with high-level requirements.

The Project will hire highly experienced Lao consultants who have been engaged in several projects by Japan or other foreign countries.

(2) Construction Companies

There are about 500 construction companies[10] in Lao PDR. The construction companies are required to obtain a license by construction type from MPWT or DPWT, but the country does not have classification system according to the company's size or capacity. There are not many companies which have enough work experiences for foreign donors' projects and have capacities to complete works within the given period at certain quality levels. In general, there is a lack of good skilled workers in Lao PDR, thus it is necessary to consider hiring skilled workers from the neighboring third countries for specific works such as waterproofing, tiling and stonework.

(3) Equipment Suppliers

As for employment of Lao equipment suppliers, ICT equipment procurement from enterprises based in Lao PDR, purchasing consumables and spare parts from the local market, and maintenance for experimental/practical equipment by enterprises in Lao PDR are be presumed in the Project. However, because such local enterprises are not authorized as dealers or agents of the manufacturers, they are expected to function as windows to the manufacturers' authorized dealers or agents based in the neighboring countries. All such local agents have experienced in the past, Japanese projects and meet the minimum requirements.

2-2-1-6 Policy for Employing Japanese Firms

This Project is to be implemented under the scheme of Japanese Project Grant, where construction companies and equipment suppliers whose headquarters are registered under the Japanese law, shall be employed as the prime contractor and the prime supplier. Concerning the equipment procurement, as described above, machining equipment, tools, measurement/analysis equipment are assumed to be procured from Japan, thus Japanese companies are likely to be largely involved in the Project.

2-2-1-7 Policy for Operation and Management

The existing buildings and equipment of FEN-NUOL campus are maintained by Equipment & Facilities Management Division of FEN-NUOL, while the operation and maintenance budget of FEN-NUOL is managed by NUOL. As to be described in "2-5 Project Operation Plan", the denoted budget amount is so limited that maintenance activities by FEN-NUOL remains modest. Furthermore, it is noted that no equipment specialist who may maintain engineering equipment in FEN-NUOL. The policy for operation and maintenance of this Project is described below.

(1) Facility Maintenance

The maintenance budget of facility is not disbursed to FEN-NUOL at once, but FEN-NUOL requests

[10] 552 construction companies were registered in 2020, according to the Statistical Yearbook 2020, issued by Lao Statistics Bureau, MPI.

NUOL to pay the costs based upon payment orders and withdrawal slips. Under the current situation, the regular building maintenance is not always conducted, besides daily cleaning and fixing failures.

Thus, as described in "2-5 Project Operation Plan" and "2-6 Project Cost Estimation" hereafter, it is determined that a budget necessary for regular maintenance of the buildings to be constructed by the Project will be allocated to FEN-NUOL, through a discussion between NUOL and FEN-NUOL during the analysis stage of this Preparatory Survey. Meanwhile, the Project designs such buildings that require low-cost maintenance. In particular, no electrical and mechanical service fixtures requiring a large sum of recurrent for maintenance will be adopted by the Project.

(2) Equipment Maintenance

Thus far, there has been no established rules over operation and maintenance of the equipment in FEN-NUOL. Each department has an annual budget of about 2,000-2,500USD (approximately 200-250 thousand JPY), which usually ends up spent for a different purpose. When an item needs repair, if it is a minor problem, lectures in charge repair themselves, even purchasing spare parts on their own. But when an item requires an extensive repair, as FEN-NUOL does not have a sufficient budget, necessary action such as sending the item to the agent in the neighboring country or contacting local technicians, is not taken.

HUGETECH being implemented in parallel to this Project will assist FEN-NUOL to improve maintenance of the equipment, but it is necessary for FEN-NUOL to secure the maintenance budget at a certain level, as the new equipment to be procured by the Project will require a higher maintenance cost. As for the maintenance budget for the equipment to be procured by this Project, same as the one for the facility maintenance, it is determined that necessary budget will be allocated to FEN-NUOL as the result of discussion between NUOL and FEN-NUOL.

Initial operation training and maintenance guidance will be performed by the Suppler employed under the Project at the time of delivery of equipment, thus the faculty members will be trained for expected minor repairs, not to mishandle the equipment nor to order wrong spare parts to prevent them from using the limited budget for such troubleshooting through the training. The training will also aim that the faculty members understand well how to use the equipment effectively and correctly.

2-2-1-8 Policy for Grade Setting of Buildings and Equipment

(1) Buildings

The Project designs such appropriate grade buildings that will be a center of higher education in engineering as well as an academic-industrial collaboration in Lao PDR. The architectural designs consider not only climatic conditions featuring high temperature and long rainy season, natural conditions of soil and topography, surrounding environment and social issues, but also ease of maintenance and necessary functions to keep the safe and sound educational/research activities. The space and interior-finishing materials of each laboratory or room will serve the purpose of use, by providing appropriate grade of mechanical and electrical service facilities that keep the room environment. Furthermore, the exterior of the buildings is designed in such a way that it harmonizes with the surrounding environment and appeal its presence as a Japanese grant aid project.

(2) Equipment

The Project selects equipment items, considering the requirement of new curriculums of FEN-NUOL, the technical level of the lectures, and the use of existing equipment. Since HUGETECH which transfers the Japanese style engineering education emphasizing the experimental/practical works to FEN-NUOL is underway, the Project shall procure equipment of grade to be effectively used by HUGETECH. Furthermore, in setting the grade of the equipment designated for CESD, the Project assumes not only its use by the target 6 departments, but also its use for measurement analysis service outsourced by an external organization.

2-2-1-9 Policy for Methods and Schedule of Construction/Procurement

(1) Buildings

As previously stated, there are not enough good skilled workers for each construction work in Lao PDR. Thus, the building structure will be reinforced concrete, which is very common in Lao PDR and local workers are familiar with this. As for interior and exterior finishing, materials and methods shall be ones seen conventionally in Lao PDR, considering the skill level of the local workers.

(2) Equipment

The Project assumes that equipment shall be procured from Japan, Lao PDR, and third countries. The delivery timing of the equipment is set considering the manufacturing period, shipping/transportation period, installation period, and the facility construction period. Regarding a universal testing machine, as it must be delivered to the site for a partial installation during the construction period, the necessary schedule coordination is made to determine the appropriate procurement method and the delivery timing.

2-2-1-10 Policy for Construction Supervision

The construction work will be supervised according to design documents (technical specifications and drawings) and a supervision plan which stipulates the methods of supervision over quality, schedule, safety, etc. Concerning the safety management, the Consultant will refer to "the Guidance for the Management of Safety for Construction Works in Japanese ODA[11] Projects" of JICA in the supervision plan to supervise the Contractor's safety measures thoroughly. Details of the supervision plan are described in "2-2-4-4 Construction Supervision Plan/Procurement Supervision Plan".

2-2-1-11 Policy for Security Management

The Project shall take safety measures according to JICA's safety rules. As of January 2022, the Project site is categorized as "Level 1 (be cautious)[12]" area of danger according to the overseas safety information by Ministry of Foreign Affairs of Japan. In particular, common crimes such as robbery are on the rise in urban areas, thus, all the Project members shall take necessary safety measures.

[11] Official Development Assistance.
[12] Infectious disease safety level is at 2. (Recommended to suspend the travel outside a business purpose)

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

2-2-2-1 Site / Building Layout Plan

As stated previously, the Project will provide two buildings, namely CESD and Laboratory Blocks in FEN-NUOL campus.

CESD is to be located at Construction Area A, the center of the entire campus, which is the best location as a center of higher engineering education and research facility of the prestigious university, and academic-industrial collaboration. The shape of the building is designed in such a way that it takes an advantage of the unique shape of the area, thereby a big tree and its surrounding greenery in the southeast of the area will remain.

Laboratory Blocks will be located at Construction Area B which is close to the existing laboratory buildings of Electrical Engineering Department, Mechanical Engineering Department and Civil Engineering Department, allowing further coordination of educational activities. The location also has an advantage, because it faces the main road (Lao-Thai Road) and is an ideal location to appeal the assistance by Japan.

(Source: The survey team)

Figure 2-4 FEN-NUOL Campus Site Layout Plan

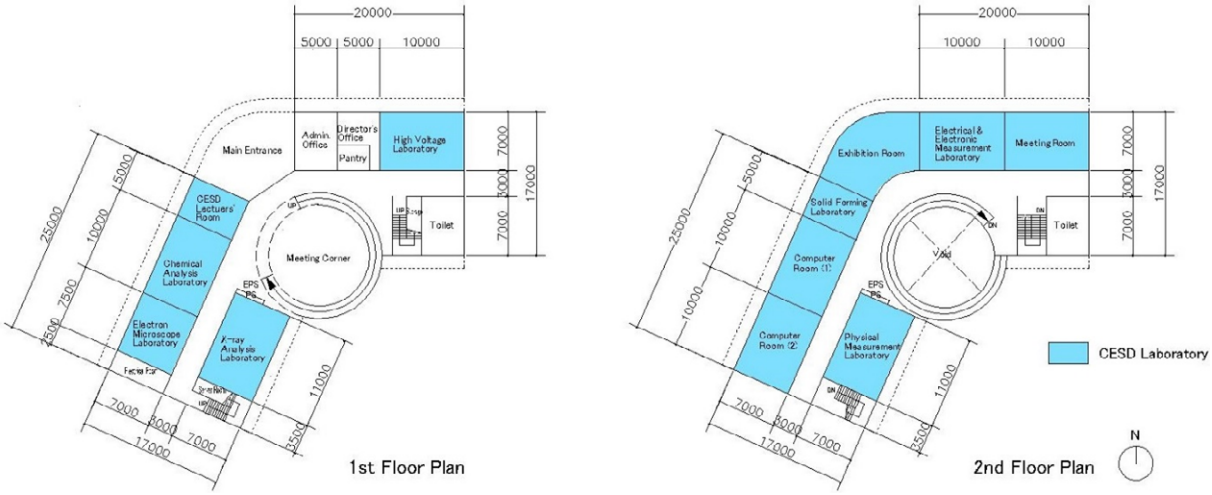
(1) CESD

CESD is assumed to be used not only by FEN-NUOL students and faculty members but also by visitors who will collaborate with the students and the faculty members and who wish to outsource measurement analysis to FEN-NUOL. The main entrance will be at the curve of the main road of the campus, stretching from the southwest gate to the east gate for an easy access from outside. The visitors and users are checked at the reception counter provided at the administration office. In front of the entrance, there will be a cylindrical atrium with a spiral slope to the upper floor, for accessibility for various users including the handicapped in consideration with less costly facility maintenance.

CESD will be equipped with computers and equipment for relatively high-level academic research to be used by all departments of FEN-NUOL. CESD will have laboratories, a meeting room for academic-industrial collaboration, an exhibition room to display the research achievements and offices to administrate CESD. The following equipment, though some items of which are intended to be categorized as CESD equipment, will be placed in Laboratory Blocks, instead of CESD.

- Equipment creating noises/vibrations:
  To avoid negative impact on other sensitive equipment
- Equipment producing a large amount of waste:
  Not suitable for a symbolic building located in the center of the campus

CESD is designed to arrange laboratories/rooms on both sides of a middle corridor. Each laboratory and room will have large windows on the corridor side, so that visitors may see the inside from the corridor to create a sense of open laboratories.



(Source: The survey team)

Figure 2-5 Room layout of CESD

Room composition of CESD is summarized in the next table.

Table 2-7 Room Composition of CESD

Fl.	Category	Room	Floor Area	Description
1	CESD	Chemical Analysis Laboratory	70.00m^2	· Spectrophotometer, electric balance, draft chamber and refrigerator. · Laboratory tables (8 sets), shelves and a whiteboard with consideration of future chemical analysis apparatus may be procured by FEN-NUOL. · Washbasins and an emergency shower
		Electron Microscope Laboratory	52.50m^2	· Laboratory for exclusively for an electron microscope. · A set of desk and chair for the microscope. Desks and chairs (4 sets) for analysis, a washbasin, a whiteboard, and shelves.
		X-ray Analysis Laboratory	77.00m^2	· Sequential X-Ray Fluorescence Spectrometer and Powder X-ray diffractometer (XRD) · Desks and chairs (4 sets) for analysis, washbasins, a whiteboard, and shelves.
		High-Voltage Laboratory	70.00m^2	· High Voltage Experimental Equipment installed within wire mesh fences of 2.0m high and operated by a controller outside the fences. · Worktables, stools, a white board, and shelves.
		CESD Lecturers' room	35.00m^2	· A room for faculty members who use CESD for lecture preparation. · Desks and chairs (6 sets) for faculty members of all departments.
	Admin.	Administration Office/ Pantry	44.18m^2	· Desks and chairs (2sets), shelves. · Necessary fixtures for the pantry/the reception.
		Director's Office	25.82m^2	· Desk and chair for the director, sofas for visitors, and shelves.
	Common	Main Entrance	80.99m^2	· Circular-sector-shaped entrance along the curve of the land. · A reception counter to be installed to control visitors.
		Corridor, Meeting corner, Slope, Stairs	368.17m^2	· Featuring a cylindrical atrium with a spiral slope to the upper floor. · Tables and chairs for a meeting corner.
		Toilet	35.00m^2	· Male, female toilets and a universal toilet.
		Electrical room, Sever room, Storage, EPS, PS	42.35m^2	· Electrical room, a server room under the staircase, and storage.
Total 1st Floor Area			**901.01m^2**	
2	CESD	Solid Forming Laboratory	35.00m^2	· Room exclusively for 3D printers. · Worktables (4), chairs (8), a washbasin, a whiteboard, and shelves.
		Computer Room (1)	70.00m^2	· Computer room of 40 student accommodation capacity with free-access floor. · 40 sets of computers for students, desks & chairs s for students and a faculty member, a whiteboard, shelves.
		Computer Room (2)	70.00m^2	· Computer room of 40 student accommodation capacity with free-access floor. · Desks & chairs s for students and a faculty member, a whiteboard, shelves. · 40 sets computers procured by HUGETECH will be transferred to the room.
		Physical Measurement Laboratory	77.00m^2	· Laboratory for physical measurement analysis, using high-speed camera, weld inspector, road surface friction coefficient test equipment, road roughness tester, thermographitric analysis device, and particle size analysis device. · Worktables (8) and stools (40) assuming group works. · Washbasins, a whiteboard, and shelves.
		Electrical and Electronic Measurement Laboratory	70.00m^2	· Laboratory for electrical/electronic measurement analysis, using weld inspection device, Traffic Monitoring System, Impedance Analyzer, Thermal Camera, vibration acceleration measuring device, etc. · Worktables (8) and stools (40) assuming group works. · A whiteboard and shelves.
		Meeting Room	70.00m^2	· Meeting room for academic-industrial collaboration, visitors outsourcing measurement analysis, etc. · Meeting tables (8), chairs (16), shelves and a whiteboard.
		Exhibition Room	75.980m^2	· To exhibit achievements of research and academic-industrial collaboration. Display shelves, display tables, display boards, bookshelves and benches to be arranged according to the circular-sector-shaped room.
	Common	Corridor, Meeting corner, Slope, Stairs	305.69m^2	· Meeting tables and chairs to be arranged along the atrium.
		Toilet	35.00m^2	· Male, female toilets and a universal toilet.
		EPS,PS	1.75m^2	
Total 2nd Floor Area			**810.42m^2**	
Roof Floor Area			**24.50m^2**	· Penthouse for staircase.
Total Floor Area of CESD			**1,735.93m^2**	

(Source: The survey team)

(2) Laboratory Blocks

Laboratory Blocks will be located on the north side of the east gate of the campus. In order to facilitate access to the existing laboratory buildings of Electrical Engineering Department, Mechanical Engineering Department, and Civil Engineering Department, a connecting corridor will connect from new Laboratory Blocks to that of the existing buildings. The main entrance will be on the south side, as it faces the campus main road. Besides, the building has sub-entrances at the southeast, northeast and northwest (connecting corridor side) sides so that students and faculty members may easily move around for experimental/practical works. The circulation is designed in such a way that the users from any of the entrances will enter the courtyard and then access to the laboratories/rooms. The outer side of Laboratory Blocks shall be paved for vehicles carrying equipment/materials to park next to the buildings. Furthermore, each room on the first floor will have doors at the outer side for the equipment/materials to be carried-in or carried-out.

Laboratory Blocks consist of 3 buildings, which are one 3-story building (Laboratory Block-1) and two 1-story buildings (Laboratory Block-2 and Block-3). The Blocks are separated into 3 to secure the first-floor area as large as possible, because the laboratories for the mechanical and civil engineering fields departments will be equipped with heavy equipment which need to be placed on the first floor. Moreover, a waste transfer station where the waste from experimental/practical work are temporarily placed for disposal will be set up on the north of the Blocks.

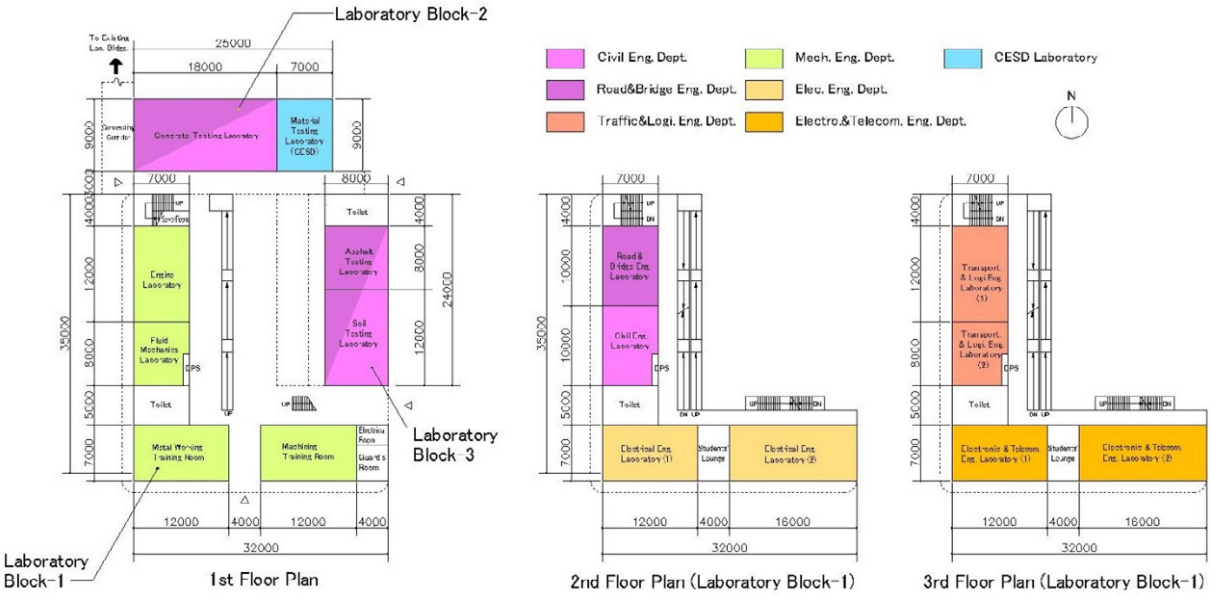
As is the case with CESD, Laboratory Block-1, which is 3-story, shall have a slope which connects different floor levels for the sake of accessibility for all users regardless of handicap, and less costly facility maintenance.

On the first floor of Laboratory Block-1, there will be laboratories/training rooms for the mechanical engineering field (Mechanical Engineering Department): Machining Training Room, Metal Working Training Room, Fluid Mechanics Laboratory, and Engine Laboratory. On the first floor of Laboratory Block-2, there will be Concrete Testing Laboratory for the civil engineering field (commonly used by Civil Engineering Department and Road & Bridge Engineering Department), and Material Testing Laboratory (commonly used by all departments as a part of CESD). On the first floor of Laboratory Block 3, there will be Asphalt Testing Laboratory and Soil Testing Laboratory, both of which are assumed to be used by Civil Engineering Department and Road & Bridge Engineering Department.

On the second floor of Laboratory Bock-1, there will be Civil Engineering Laboratory and Road & Bridge Engineering Laboratory for the civil engineering field, Electrical Engineering Laboratory (1) & (2) for the electrical and electronic engineering field.

Lastly on the third floor of Laboratory Bock-1, there will be Transportation & Logistics Engineering Laboratory (1) & (2) for the civil engineering field and Electronic & Telecommunication Engineering Laboratory (1) & (2) for the electrical & electronic engineering field.

The courtyard which is to be surrounded by the 3 buildings will be covered by large eaves to block the strong sunlight and torrent, as a result, a comfortable semi-outdoor space with natural ventilation will be provided there.



(Source: The survey team)

Figure 2-6 Layout of Laboratory Blocks

Room composition of Laboratory Blocks are summarized in the next table.

Table 2-8 Room Composition of Laboratory Blocks

Fl.	Category	Room	Floor Area	Description
Laboratory Block-1 (1st Floor)				
1	Mechanical Engineering	Machining Training room	84.00m^2	・ Lage-sized equipment such as grinder, surface grinding machine, band saw, lathe machine, milling machine, and small-sized equipment for tabletop use for machining training. ・ Worktables with vises (4) and stools (20), a desk and chair for a faculty member, worktables and stools for small equipment items, a washbasin, a whiteboard, and shelves.
		Metal Working Training Room (Including Preparation Room)	84.00m^2	・ Large-sized equipment such as welder, grinder, folding machine, cutting machine, rolling machines, shop press, etc. and electric furnace for metal melting for tabletop use. ・ Worktables with vises (4) and stools (20), a desk and chair for a faculty member, worktables and stools for small equipment items, a washbasin, a whiteboard, and shelves. ・ The training room will have a preparation room (with an air-conditioner, a meeting table, stools, and a shelf), since the training room needs to be ventilated whenever used.
		Fluid Mechanics Laboratory	53.60m^2	・ Large-sized water pumping circulation system, friction lost experimental device, and small-sized equipment for research/experiment over fluid mechanics, robot work, automatic controls. ・ Worktables with vises (4) and stools (20), a desk and chair for a faculty member, worktables and stools for small equipment items, a washbasin, a whiteboard, and shelves.
		Engine Laboratory	84.00m^2	・ Engine experimental device, gas turbine experimental device, calorimeter, dynamometer, exhaust gas analyzer, air conditioning experimental device, renewable energy experimental device etc. ・ Worktables (10) and stools (40), a desk and chair for a faculty member, a washbasin, a whiteboard, and shelves.
	Admin.	Guards Room	18.00m^2	・ Replacement of the existing guards' room to be demolished.
	Common	Courtyard, Corridor, Slope, Stairs	351.60m^2	・ A comfortable semi-outdoor space with natural ventilation, while blocking the strong sunlight and torrent. ・ A slope connecting the 1st floor to the 3rd floor for accessibility for all users regardless of the handicap.

		Toilet	35.00m^2	・ Male, female toilets and a universal toilet.
		Electrical room, Sever room, EPS	25.87m^2	・ Electrical room, EPS, a server room under the staircase, and storage.
Laboratory Block-1 Total Floor Area			**736.07m^2**	
Laboratory Block-2 (1st Floor)				
1	CESD	Material Testing Laboratory	63.00m^2	・ Room exclusively for the universal testing machine of CESD. The equipment will be placed in the room as it creates noises and vibrations, and a large-sized material will be tested. ・ As samples made in the Concrete Testing Laboratory are assumed to be tested with the equipment, the room is connected to the Concrete Testing Laboratory. ・ Worktables (2) and stools (4), a desk and chair for a faculty member, a washbasin, a whiteboard, and shelves.
	Civil Engineering Department, Road & Bridge Engineering Department	Concrete Testing Laboratory (Including Preparation Room)	162.00m^2	・ Laboratory to be commonly used by Civil Engineering Department and Road & Bridge Engineering Department. ・ Assumed for collaborative use with the existing laboratory building of Civil Engineering Department. ・ Equipment for concrete, concrete sample testing, worktables (10), stools (40), a desk and chair for a faculty member, a washbasin, a whiteboard, and shelves. ・ The laboratory will have a preparation room (with an air-conditioner, a meeting table, stools, and a shelf), since the laboratory needs to be ventilated whenever used.
Laboratory Block-2 Total Floor Area			**225.00m^2**	
Laboratory Block-3 (1st Floor)				
1	Civil Engineering Department, Road & Bridge Engineering Department	Asphalt Testing Laboratory	64.00m^2	・ Laboratory for asphalt material test equipment and equipment for road/road-surface tests. ・ Worktables (10) and stools (40), a desk and chair for a faculty member, a washbasin, a whiteboard, and shelves.
		Soil Testing Laboratory	96.00m^2	・ Laboratory for soil testing equipment (research and analysis device). ・ Worktables (4) and stools (20), a desk and chair for a faculty member, a washbasin, a whiteboard, and shelves.
	Common	Toilet	32.00m^2	・ Male, female toilets and a universal toilet.
Laboratory Block-3 Total Floor Area			**192.00m^2**	
Connecting corridor			**90.72m^2**	・ Roofed connecting corridor to connect the Laboratory Blocks with that of the existing laboratory buildings for functionality.
Laboratory Block 1-3 + Connecting Corridor Total Floor Area (1st Floor)			**1,243.79m^2**	
Laboratory Block-1 (2nd Floor)				
2	Electrical Engineering Department	Electrical Eng. Laboratory (1)	84.00m^2	・ Equipment for various laboratory activities. ・ (For each laboratory) Worktables (8) and stools (40), a desk and chair for a faculty member, worktables for tabletop use equipment, a washbasin, a whiteboard, and shelves.
		Electrical Eng. Laboratory (2)	112.00m^2	
	Civil Engineering Department	Civil Engineering Laboratory	67.60m^2	・ Research and measurement equipment for outside use. ・ Worktables (4) and stools (20), a desk and chair for a faculty member, worktables for tabletop use equipment, a washbasin, a whiteboard, and shelves for lecturing, and preparation/ documentation before and after outside activities.
	Road & Bridge Engineering Department,	Road & Bridge Engineering Laboratory	70.00m^2	・ Research and measurement equipment for outside use. ・ Worktables (4) and stools (20), a desk and chair for a faculty member, worktables for tabletop use equipment, a washbasin, a whiteboard, and shelves for lecturing, and preparation/ documentation before and after outside activities.
	Common	Students' Lounge	28.00m^2	・ Semi-outdoor space with natural ventilation located above the first-floor entrance for students to socialize across departments.
		Corridor, Slope, Stairs	229.08m^2	・ A slope for accessibility regardless of the handicap and for transporting heavy equipment.
		Toilet	35.00m^2	・ Male, female toilets and a universal toilet.
		EPS	2.40m^2	
Laboratory Block-1 Total Floor Area (2FL)			**628.08m^2**	
Laboratory Block-1 (3rd Floor)				

3	Electronic & Telecom. Engineering Department	Electro. & Telecom. Eng. Laboratory (1)	84.00m^2	・ Various laboratory equipment for the electro. & telecom. eng. field. ・ (For each Laboratory) Worktables (8) and stools (40), a desk and chair for a faculty member, worktables for tabletop use equipment, a washbasin, a whiteboard, and shelves.
		Electro. & Telecom. Eng. Laboratory (2)	112.00m^2	
	Transportation & Logistics Engineering Department	Transportation & Logistics Engineering Laboratory (1)	84.00m^2	・ 10 sets of computers; one computer shared by a group of 4 students. ・ Desks (10) and chairs + stools (40), a desk and chair for a faculty member, a worktable for tabletop use equipment, a whiteboard, and shelves. ・ Free-access floor.
		Transportation & Logistics Engineering Laboratory (2)	53.60m^2	・ Research and measurement equipment for outside use. ・ Worktables (4) and stools (20), a desk and chair for a faculty member, worktables for tabletop use equipment, a washbasin, a whiteboard, and shelves for lecturing, and preparation/ documentation before and after outside activities.
	Common	Students' Lounge	28.0m^2	・ Semi-outdoor space with natural ventilation located above the first-floor entrance for students to socialize across departments.
		Corridor, Slope, Stairs	229.08m^2	・ A slope for accessibility regardless of the handicap and for transporting heavy equipment.
		Toilet	35.0m^2	・ Male, female toilets and a universal toilet.
		EPS	2.40m^2	
Laboratory Block-1 Total Floor Area (3FL)			**628.08m^2**	
Laboratory Block-1 Total Floor Area (RF)			**28.00m^2**	・ Penthouse for staircase.
Laboratory Block-1 Total Floor Area			**2,020.23m^2**	
Laboratory Block-2 Total Floor Area			**225.00m^2**	
Laboratory Block-3 Total Floor Area			**192.00m^2**	
Connecting corridor Total Floor Area			**90.72m^2**	
Laboratory Block (1-3)+Connecting Corridor Grand Total Floor Area			**2,527.95m^2**	

（Source：The Survey team）

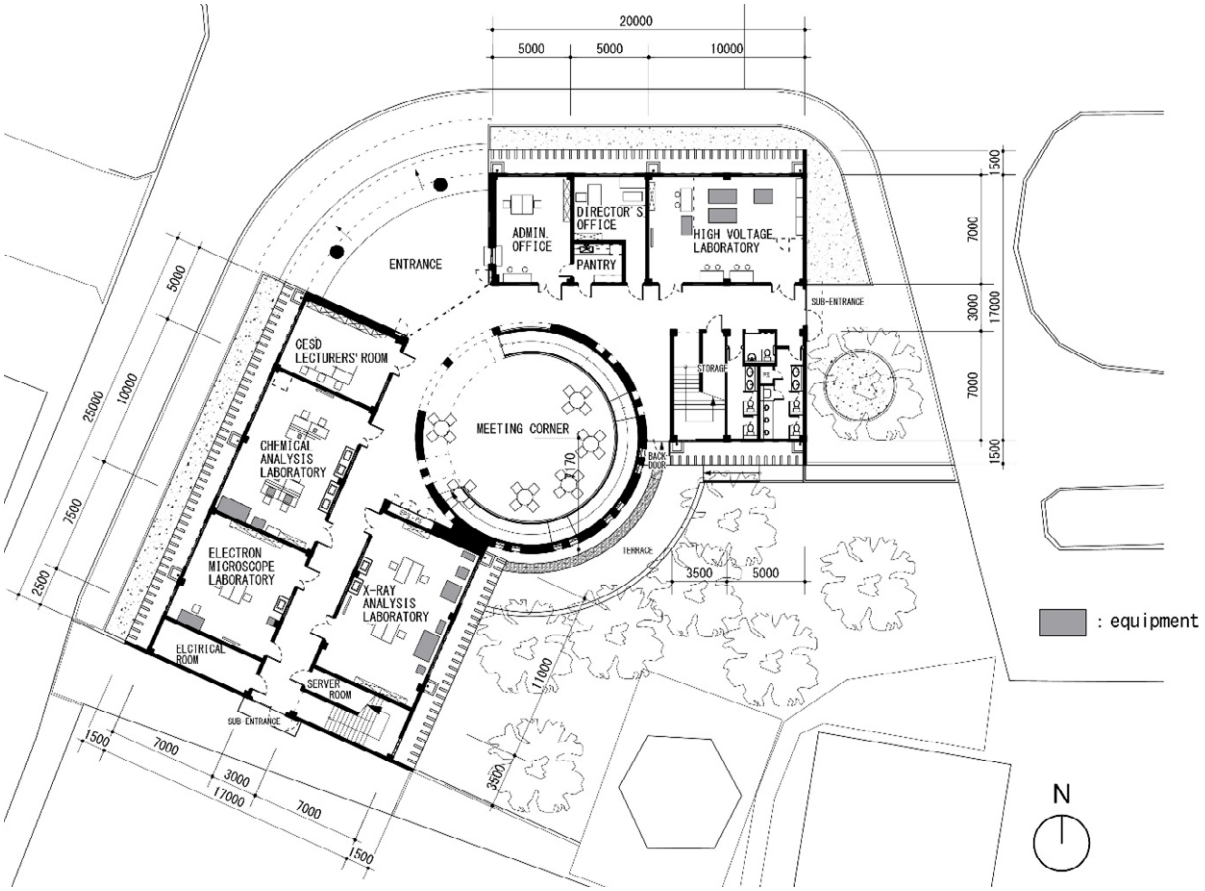
2-2-2-2 Architectural Planning

(1) Floor Plan

1) CESD

① 1st Floor Plan of CESD

In front of the main entrance, the meeting corner is featured in the cylindrical atrium with a spiral slope to the upper floor. The east wing of the building will have Administration Office, Director's Office, High Voltage Laboratory and Toilet. High Voltage Laboratory will be, for safety, partitioned by a wire-mesh fence to place high voltage equipment therein. On the other wing of southwest side, CESD Lecturers' Room, Chemical Analysis Laboratory, Electron Microscope Laboratory, and X-Ray Analysis Laboratory are allocated. The main entrance will have a horizontal pulling grid shutter for a nighttime security.

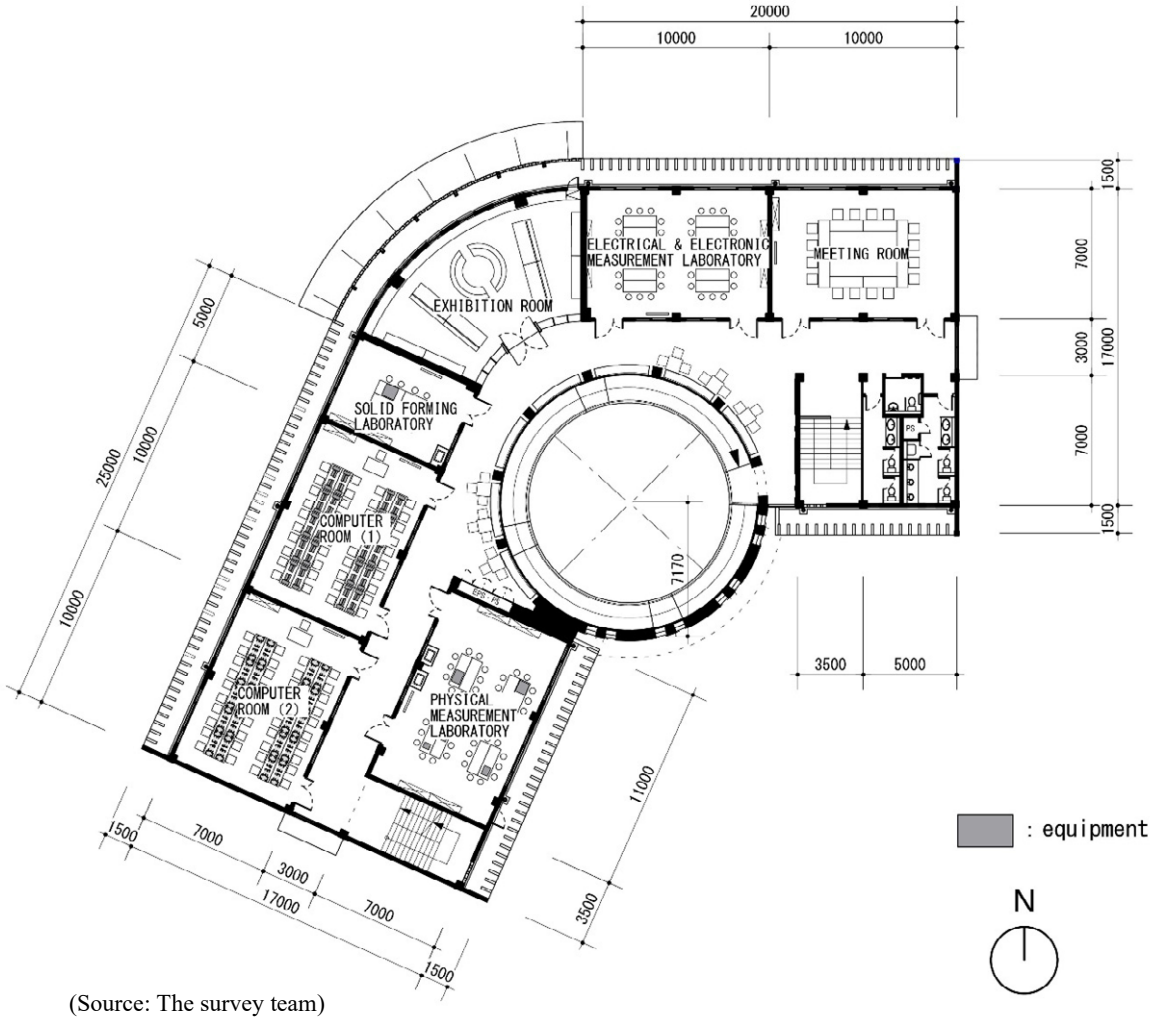


(Source: The survey team)

Figure 2-7 1st Floor Plan of CESD

② 2nd Floor Plan of CESD

Exhibition Room to display the achievements of education/research activities and academic-industrial collaboration will be placed in the center of floor, in front of the atrium. The room will be equipped with display shelves, display tables, display boards, bookshelves and benches for visitors. The east wing of the building will have Electrical & Electronic Measurement Laboratory, Meeting Room and Toilet, while the other wing of southwest side will have Solid Forming Laboratory, Physical Measurement Laboratory and two Computer Rooms. Computer Rooms will be equipped with free-access floor for flexible wiring arrangement.



(Source: The survey team)

Figure 2-8　2nd Floor Plan of CESD

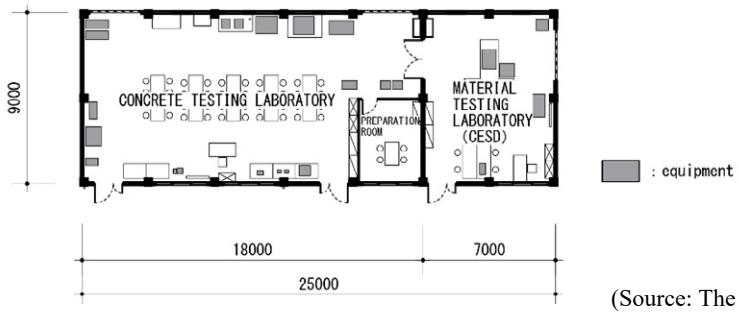
2)　Laboratory Blocks

Laboratory Blocks consist of a 3-story building (Laboratory Block-1), and two single-story buildings (Laboratory-Block 2 & Laboratory Block-3).

①　Concrete Testing Laboratory and Material Testing Laboratory (Laboratory Block-2)

Concrete Testing Laboratory is planned to be commonly used by Civil Engineering Department and Road & Bridge Engineering Department.　Material Testing Laboratory, next to Concrete Testing Laboratory, will have CESD functions, however, it is allocated in Laboratory Block-2, in order to avoid the negative impact, caused by vibrations from universal testing machine therein, to sensitive measurement and analysis equipment placed in CESD.

It is assumed that materials for tests are often carried in and out of Concrete Testing Laboratory, causing dust, as a result, the laboratory usually keeps its windows and doors open.　Therefore, the laboratory will be installed with ceiling fans, instead of air-conditioners, while a preparation room for faculty members within the laboratory will be equipped with an air-conditioner.

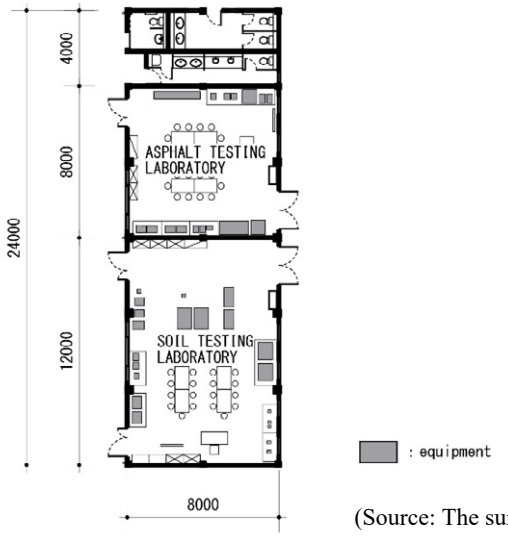


(Source: The survey team)

Figure 2-9 Concrete Testing Laboratory and Material Testing Laboratory (Laboratory Block-2, 1st Floor)

② Asphalt Testing Laboratory and Soil Testing Laboratory (Laboratory Block-3)

The laboratories are assumed to be used commonly by Civil Engineering Department and Road & Bridge Engineering Department, as both departments use almost the same equipment to test soil and asphalt. Sharing the laboratories by the departments facilitates the efficient use of the equipment.



(Source: The survey team)

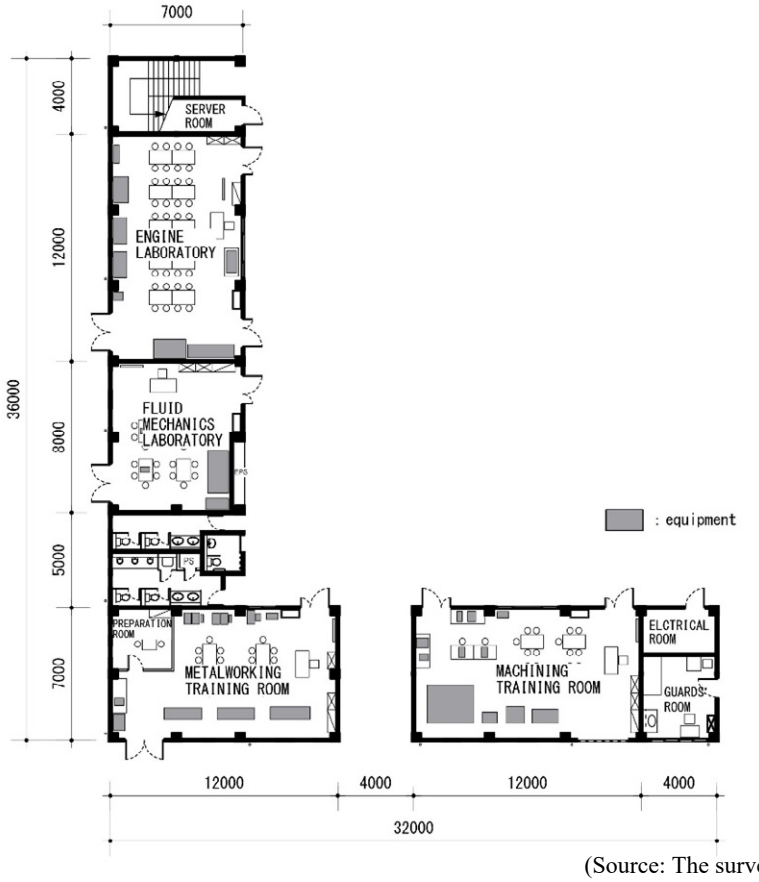
Figure 2-10 Asphalt Testing Laboratory and Soil Testing Laboratory (Laboratory Block-3, 1st Floor)

③ Mechanical Engineering Laboratories and Training Rooms (Laboratory Block-1)

Machining Training Room, Metal Working Training Room, Fluid Mechanics Laboratory, and Engine Laboratory are arranged on the first floor of Laboratory Block-1.

Ventilation fans will need to be kept running in Metal Working Training Room, due to heat from experimental/practical works such as welding. Thus, ceiling fans will be installed instead of air-conditioners, while a preparation room for faculty members within the laboratory will be equipped with an air-conditioner.

On the southeast corner of the building, Guards' Room will be provided to replace the existing one, which is to be demolished.

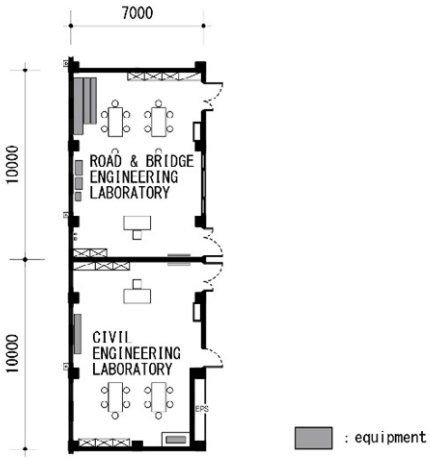


(Source: The survey team)

F igure 2-11　Mechanical Engineering Laboratories and Training Rooms (Laboratory Block-1, 1st Floor)

④　Civil Engineering and Road & Bridge Engineering Laboratories (Laboratory Block-1)

Civil Engineering Laboratory and Road & Bridge Engineering Laboratory are arranged on the westside of 2nd floor of Laboratory Block-1.

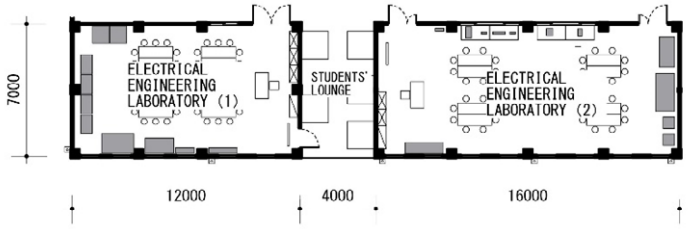


(Source: The survey team)

Figure 2-12　Civil Engineering Laboratory and Road & Bridge Engineering Laboratory (Laboratory Block-1, 2nd Floor)

⑤ Electronic & Telecommunication Engineering Laboratory (Laboratory Block-1)

On the southside of 1st floor of Laboratory Block-1, Electronic & Telecommunication Engineering Laboratory (1) and (2) are allocated.



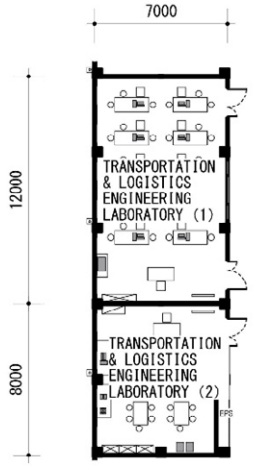
（Source： The survey team）

: equipment

Figure 2-13 Electronic & Telecommunication Engineering Laboratories (Laboratory Block-1, 2nd Floor)

⑥ Transportation & Logistics Engineering Laboratory (Laboratory Block-1)

Transportation & Logistics Engineering Laboratory (1) and (2) are allocated on the westside of the 3rd floor of Laboratory Block-1. The major part of the department's curriculums are their fieldwork and their analysis. Laboratory (1) is assumed for analytical work using the computers, while Laboratory (2) is for lecturing and analysis after the fieldwork. Laboratory (1) shall have a free-access floor.



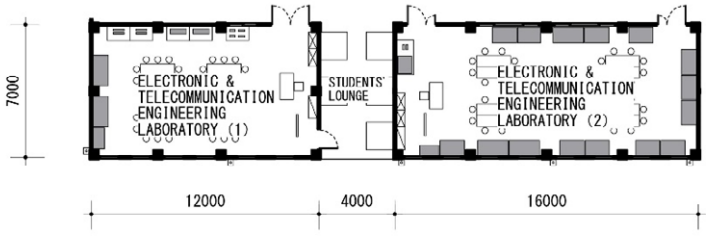
(Source: The survey team)

: equipment

Figure 2-14 Transportation & Logistics Engineering Laboratories (Laboratory Block-1, 3rd Floor)

⑦ Electronic & Telecommunication Engineering Laboratory

On the southside of 3rd floor of the Laboratory Block-1, Electronic & Telecommunication Engineering Laboratory (1) and (2) are allocated.



(Source: The Survey team)

: equipment

Figure 2-15 Electronic & Telecommunication Engineering Laboratories (Laboratory Block-1, 3rd Floor)

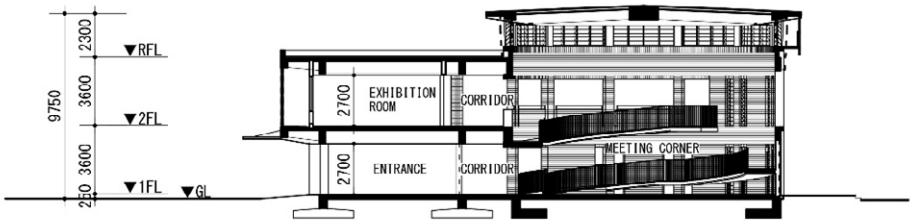
(2) Elevation and Cross-Section

The basic principles of designing the elevation and cross-section are as follows.

1) CESD

The building is planned as a 2-story building of reinforced concrete (RC) structure with having a flat roof. The building will have service balconies featuring vertical pre-cast concrete louvers or perforated brick walls, along with the windows on outer walls, in order to reduce the glare from the sun in the morning and the evening and to harmonize with the façade design of other buildings within the campus. Furthermore, by using the vertical louvers, it is intended to hide condenser units of air conditioners and ventilation pipes, rainwater pipes to be placed in the service balconies.

In order to connect the 1st and 2nd floors, two staircases and the slope which spirals around the afore-said meeting corner at the cylindrical atrium are planned. The pitch of the slope is set at 1/12 for the barrier-free purpose. The meeting corner features the atrium, where one may enjoy natural lighting and ventilation from the louver windows fixed at the roof level. The rooftop is accessible from the staircase on the southwest for maintenance.



(Source: The Survey team)

Figure 2-16 CESD Cross-Section

2) Laboratory Blocks

① Laboratory Block-1

The building is planned to be a 3-story building of RC structure with having a flat roof, which is stretched as far as to cover the slope and passage of the courtyard so that pedestrians may avoid rain and direct sunlight.

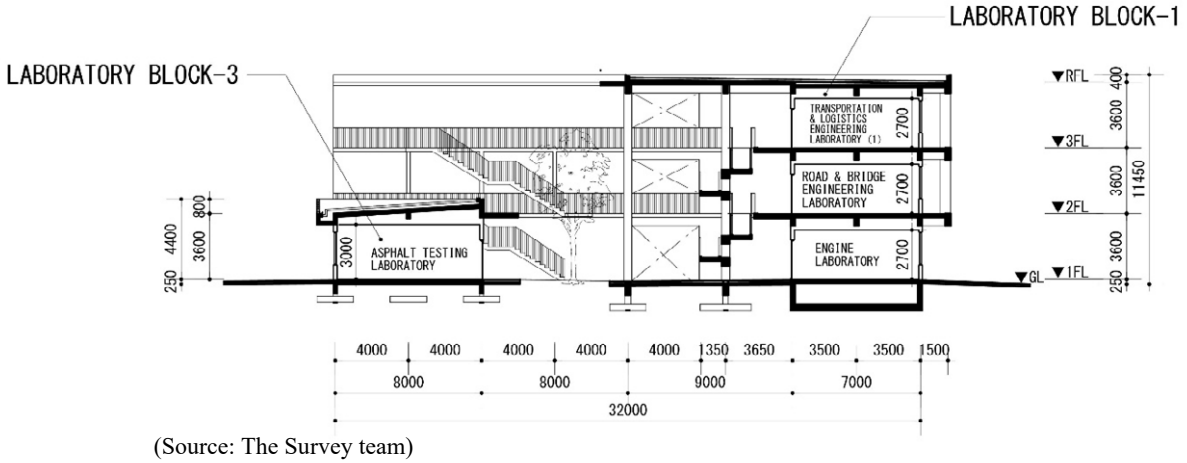
The outer walls (south and west sides of the building) of 2nd and 3rd floors will have service balconies featuring a vertical pre-cast concrete louver. The louvers at the westside are set at a 45-degree angle against the wall to prevent the strong low-angle sunlight from the west. Sliding windows of aluminum sashes with safety grills will be adopted for most of the windows. Shutter doors are also arranged on the outer side of the laboratories on 1st floor, considering that large-sized materials/equipment are carried in and out.

For the circulation across the different floors, two staircases and a slope of 1/12 pitch are arranged. The slope is not only for wheel-chair accessibility but also for transporting materials and equipment for experimental/practical works. The staircases and the slope are all set by the courtyard so that

one may see the vertical and horizontal movements of users from everywhere.

② Laboratory Block-2 & Laboratory Block-3

The two buildings are single-story, featuring slightly pitched RC roofs. The outer side and the courtyard side will have eaves for the users to carry in and out materials/equipment and to walk even in the rain. Since Material Testing Laboratory shall be equipped with the universal testing machine of 5 meter-high, the ceiling-height of the laboratory is set accordingly.



(Source: The Survey team)

Figure 2-17 Cross-section of Laboratory Blocks

(3) Structure and Construction Plan

The basic principles of structure and construction planning are as follows.

- The northern part of Lao PDR experiences some earthquakes, and a magnitude 6.1 earthquake struck in the north-west part of the country, nearly on the border with Thailand, in November 2019. The structural calculation and design for this Project is examined considering the seismic force (base sheer coefficient: CO) of the northern part of the country, referring to the seismic hazard map of Lao PDR. While the seismic calculations (Qi) are analyzed based on the Building Standard Law of Japan.
- The foundations are designed according to the results of the soil investigations of each construction area. From the said investigations, the soil of 2 meters depth of the construction areas is sandy clay or sandy silt with gravels, having N-value at 10-20. According to these results, the following foundation types are adopted.

Table 2-9 Foundation Types of Planned Buildings

Building		No. of Floors	Foundation Type
CESD		2	Independent and mat foundations
Laboratory Blocks	Laboratory Block-1	3	Mat foundation
	Laboratory Block-2	1	Independent foundation
	Laboratory Block-3	1	Independent foundation

(Source: The Survey team)

- Load capacity design follows the Building Standard Law of Japan.
- The wind load is set in reference to the relevant standards in Thailand; the wind speed is at 30m/s.
- Reinforced concrete structure, which is common and easy even for local contractors in the regions, is adopted as the main building structure. The major materials for structural works are as follows.
  - Concrete : Fc 21
  - Reinforcing steel bar（D10-D20） : SD390
  - Structural Steel : SS400（Yield stress＝235N/mm^2）
- Ready-mixed concrete is planned to be adopted.
- According to JASS 5, the strength correction factor of concrete is set as follows.
  - Daily average temperature below 25 degrees Celsius : 3N/mm^2
  - Daily average temperature above 25 degrees Celsius : 6N/mm^2

(4) Electrical and Plumbing Installation Plan

The basic plans of the electrical and mechanical service installation are as follows.

1) Electrical System

① Substation

A power outage longer than 5 minutes rarely occurs in Vientiane Capital, apart from a blackout caused by an accident. Voltage fluctuation is within 5 % and thus is stable there. A new substation of 630KVA equivalent is planned, considering the maximum power consumption. Because of the stable power supply and stable voltage in Vientiane Capital, no Automatic Voltage Regulator (AVR) or emergency power generator is planned. For each laboratory equipment item that requires a more stable power supply, an Uninterruptible Power Supply (UPS) is planned separately in the equipment planning. The electrical plan for this Project according to the electrical system of Electricity du Laos (EDL) and present wiring status is as follows.

- Medium voltage lead-in: EDL→22kv 3 phase 3-wire 50Hz
- The existing concrete electrical pole of 500KVA locating to the east of the existing laboratory buildings shall be used for leading-in. The substation shall be set on the ground and be surrounded by fences.
- Power receiving method: Transformer capacity of 630KVA, 22 kV /400V/230V

Table 2-10 Expected Load Capacity

Source of the Load	Load density (VA/m^2)	Floor Area (m^2)	Load Capacity (KVA)	Remarks
Lighting fixture outlets	30	5,000	150	
Laboratory Equipment	30	3,500	105	
Air conditioners	100	3,500	350	
Sanitary Service Facilities			20	
Total			625	⇒Transformer capacity : 630(KVA)

(Source: The Survey team)

② Trunk Cable System

Trunk cables will be laid out underground to connect between the substation to be built outside and Laboratory Blocks and CESD. A low-voltage main distribution board is planned in EPS of each building to distribute power to each distribution board.

- Low-voltage power distribution : 3 Phase, 4-wire, 380V/220V
- Earthing system : TN-C (A combined conductor of both a protective earth conductor and a neutral conductor)

③ Lighting and Power Outlet System

Lighting fixtures of each room/laboratory are planned as LED, considering ease of maintenance and reduction of the running cost. As for power outlets, two separate circuits are planned, that is, one for general use and the other for laboratory equipment use. The power distribution system is planned as 1 phase 2-wire 220V. The illuminance of each room/laboratory is planned as follows.

Table 2-11 Illuminance of Main Room/Laboratory

Room/Laboratory	Illuminance (lx)
Laboratory	300
Administration office, Meeting room, Director's Room	300
EPS, Server Room	200
Entrance	150
Corridor, Store, Toilet	100

(Source: The Survey team)

④ Telecommunication Service System

Currently, there laid are 3 different optical fiber cables within FEN-NUOL campus, the telecommunication speed of which is between 25M-500Mbps.

A combined service of data and telephone communication is to be introduced for the Project. Although landline telephones are not frequently used in the campus, as faculty members use their own personal smartphones, landline telephones are planned to be installed for administration offices for administrative reasons. LAN and Wi-Fi are to be installed for data communication. The Project will adopt the following telecommunication system, according to the available service in Lao PDR.

- Lead-in method of the telecommunication system : Optical fiber cable
- The use of the existing lead-in pole. Connection to each building is through underground conduits.

⑤ Fire Alarm System/ Emergency Exit Light

A fire alarm system and emergency exit lights are planned to be installed for quick evacuation in case of fire. A basic alarm system of ease of maintenance (bells, fire transmitters, exit lights) are to

be installed in the corridors so that one may check an alarm sound with the device installed in the administration offices of CESD and the Guards' room of Laboratory Blocks.

⑥ Lightning Protection System

To avoid damage to buildings from lightnings, a lightning protection system is planned to be installed. The system is planned according to the applicable standards in Lao PDR.

⑦ Security Camera System

Security cameras are planned to be installed at corners of the entrance, corridors, staircases, computer rooms, etc. The monitors are planned to be set in Administration Office of CESD and Guards' Room of Laboratory Blocks.

⑧ Outdoor Lighting Fixtures

Photovoltaic LED street lights are planned to be installed along the campus main road that connects CESD and Laboratory Blocks and around the new buildings. They are beneficial for the campus safety at night, while they will maintain less costly operation and maintenance together with an appeal on environmental sustainability. In addition, they will be utilized for practical works of Electrical Engineering Department and Electronic & Telecommunication Engineering Department.

The stand-alone type will be adopted so as not to negatively impact on another electric system, when in trouble. The outline of the street lights is as follows.

- LED lights with a storage battery (rainproof) and LED 8.5W or equivalent
- Photovoltaic cells of 85W or equivalent, Storage battery capacity of DC 12V 60Ah
- Pole=3.5m high. Maximum lighting hours: 14 hours

2) Mechanical System

① Water Supply System

Water main is laid out in the main road surrounding FEN-NUOL campus. There is no water failure throughout the year, however, the water pressure is not stable there. Thus, water reservoir tanks, water pumps and elevated water tanks are necessary. In order to plan a stable water supply, water will be led-in anew, that is, not led-in from the existing water supply system within the campus. As two facilities to be constructed by the Project are sufficiently apart, each of them shall have a set of water reservoir tanks and elevated water tanks.

Calculation of Water Consumption

The number of simultaneous users of CESD and Laboratory Blocks is calculated as follows, taking into account the estimated simultaneous use of 60%.

- CESD: No. of users = Accommodation capacity (218 people) x 0.6 = 133 → 150 Users
- Laboratory Blocks: No. of users = Accommodation capacity (620 people) x 0.6 = 378 → 400 Users

Design Amount of Water Consumption per Person

According to the standard in Japan[13], approximately 70-100 liters of water/person-day is used in the case of a university. On the other hand, referring to the Bangladesh National Building Code, a country of which is geographically close to Lao PDR, water consumption at an educational facility is 45 liters/person-day.

From the above, the Project adopts the design amount of water consumption per person-day of Bangladesh, as the country has more similarities than Japan with Lao PDR. In addition to that, as experimental/practical works using a water tank or testing concrete will take place in Laboratory Blocks, additional 10m^3 of water use per day is assumed.

- Assumed daily water consumption (CESD)
  150 users x 45 liters/person-day = 6,750 liters/day ≒7.0 m$^{3/}$day
- Assumed daily water consumption (Laboratory Blocks)
  400 users x 45 liters/person-day = 18,000 liters/day ≒18.0m^3/day
- Water for Experimental/practical works: 10.0m^3/day
- Total water consumption per day = 18.0+10.0 ＝28.0m^3/day

Capacity Calculation of Water Reservoir Tank and Elevated Water Tank

The Project follows the Bangladesh National Building Code to calculate the necessary capacity of a water reservoir tank and elevated water tank of the respective facilities.

• CESD	:	Reservoir Tank	:	7.0 m^3
		Elevated Water Tank	:	3.5 m^3
• Laboratory Blocks	:	Reservoir Water Tank	:	28.0 m^3
		Elevated Water Tank	:	14.0 m^3

② Wastewater Drainage System

Sewer main is installed underground the main road surrounding FEN-NUOL campus (on the east road, a sewer main of about 1.0m diameter is set 1.0m under the road surface). At this moment, there is no public wastewater treatment plant in Vientiane Capital[14]. Currently, wastewater flows into That Luang swamp via open canals.

Following a recently constructed wastewater drainage system within the campus, the Project plans to provide aeration treatment septic tanks to be connected to the sewer main so that it decreases effluent load. Moreover, as two facilities to be constructed by the Project are apart from each other, each facility is planned to have a septic tank.

Wastewater from Concrete Testing Laboratory, Material Testing Laboratory, Asphalt Testing

[13] 14th Edition of Handbook issued by the Society of Heating, Air-conditioning and Sanitary Engineers of Japan
[14] The design of the system has been finished with assistance from JICA. The construction is planned to be finished in 2024.

Laboratory and Soil Testing Laboratory, all of which are to be laid out on the first floor of Laboratory Blocks, is likely to become alkalinity containing solid matters, thus unable to be treated in the said septic tank. Thus, a separate drainage system with sedimentation tank is planned to be installed for the laboratories, and overflowing fluid will be discharged to the sewer main.

Rainwater falling on the roofs will be merged with the treated water from the septic tanks and be flown into the sewer main.

Design Amount of Wastewater per Day

Daily wastewater amount is calculated as follows, assuming the same water supply amount.

- CESD : 150 users x 45 liters/(person-day)＝6,750 liters/day ≒10 m^3/day
- Laboratory Blocks : 400 users x 45 liters/(person-day)＝18,000 liters/day ≒20 m^3/day

③ Sanitary Fixtures

On each floor of CESD and Laboratory Blocks, male toilet, female toilet, and universal toilet (for wheel-chair users and all genders) are planned. The toilet bowls are planned to be of western type with a hand shower following the Laotian custom. Each laboratory (except rooms for electrical and electronic fields and for computers) shall have washbasin(s) to clean laboratory equipment after-use.

④ Air-conditioners

To realize the suitable interior environment for a higher engineering education facility of a prestigious university, air-conditioners are planned in the laboratories, and administration offices. As an exception, Concrete Testing Room and Metal Working Training Room which need to keep their ventilation fans running will be equipped with ceiling fans instead of air-conditioners, due to dust from materials and heat from welding. Regarding the two laboratories, however, a small preparation room with an air-conditioner for faculty members is provided in such laboratories.

Indoor Design Temperatures

The Japanese building service standards of 2018 stipulates that the indoor design temperature and humidity of summertime is 26-28 degrees Celsius and 50-45% respectively. On the other hand, according to the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE), the comfort temperature zone with an air-conditioner is between 24-26 degrees Celsius.

Considering the two references, the indoor temperature design with an air-conditioner is set at 26 degrees Celsius, the middle value of the two.

⑤ Ventilation System

Some laboratories/rooms are planned to have ventilation system to dispense odor, heat, and humidity. Referring to the above-mentioned ASHRAE and Japanese design standards, the Project is planned to install ventilation system as follows.

Table 2-12 Ventilation System for the Project

Room	Type of Ventilation	Ventilation volume/frequency	Remarks
Laboratory	Exhaust fan Air inlet with filter	3 times/h	Fresh air supply, exhaust heat and polluted air
Administration office	Exhaust and supply fans	30 m^3/person-h	Fresh air supply
Meeting Room	Exhaust and supply fans	30 m^3/person-h	Fresh air supply
Storage	Exhaust fan only	5 times/h	
Toilet	Exhaust fan only	10 times/h	Removal of odor
EPS	Exhaust fan only	10 times/h	Removal of heat
Server Room	Exhaust fan only	10 times/h	Removal of heat

(Source: The survey team)

⑥ Fire Extinguisher

The new buildings are planned to be equipped with the appropriate fire extinguishers according to the usage and scale of the buildings. As a result of discussions with Fire Prevention and Protection Division of Vientiane Capital, carbon dioxide (CO_2) fire extinguishers are planned for laboratories, and dry chemical powder (ABC) fire extinguishers for the other rooms.

(5) Construction Materials

The proposed buildings by the Project are designed to utilize construction materials and equipment available in Lao PDR, in principle. The following table shows assumed construction materials to be used in the Project.

Table 2-13 Construction Material Schedule (Finishing Material Schedule)

Bldg. / Part	CESD	Laboratory Block-1	Laboratory Block-2&3
Building Structure			
No. of Story	2	3	1
Roof	Reinforced concrete slab	Reinforced concrete slab	Pitched reinforced concrete slab
Wall	Brick Masonry	Brick Masonry	Brick Masonry
Column/beam	Reinforced concrete	Reinforced concrete	Reinforced concrete
Foundation	Individual/Mat	Mat	Individual
Exterior Finishing			
Roof	Water proof coating ＋ protective concrete layer	Water proof coating ＋ protective concrete layer	Water proof coating
Wall	Vertical louvers of pre-casting concrete and Honeycomb brick masonry wall (partial) Brick + mortar plaster with paint finish	Vertical louvers of pre-casting concrete and Honeycomb brick masonry wall (partial) Brick + mortar plaster with paint finish	Brick + mortar plaster with paint finish
Door/Window	Aluminum, Steel	Aluminum, Steel	Aluminum, Steel
Floor	Floor tile	Floor tile	Floor tile
Interior Finishing			
Ceiling	LGS backing, gypsum board + rockwool acoustic board	LGS backing, gypsum board + rockwool acoustic board	LGS backing, gypsum board + rockwool acoustic board
Wall	Mortar plaster with paint	Mortar plaster with paint finish	Mortar plaster with paint finish

	finish, Stone finish (for wet rooms) Ceramic tile finish	(for wet rooms) Ceramic tile	(for wet rooms) Ceramic tile
Door/Window	Aluminum	Aluminum	Aluminum
Floor	Floor tile, Free-access floor + Vinyl-tile, Epoxy resin floor paint	Floor tile, Free-access floor + Vinyl-tile, Epoxy resin floor paint	Floor tile, Epoxy resin floor paint

(Source: The survey team)

(6) External Work Plan

1) CESD

The walkway along the campus main road is planned to be paved with interlocking blocks. A part of the walkway will have greenery, horticulture is planned to be carried out by Lao PDR side. A terrace is planned in the south garden along the round-shaped meeting corner. Rainwater on the roof will be drained, through gutters and storm drains to the sewer main of the northwest road (outside campus at the dormitory zone side).

2) Laboratory Blocks

The outer sides of the 3 buildings will be surrounded by asphalt roads. The walkway on the south is planned to be paved with interlocking blocks, while the courtyard is planned to be paved with floor tiles. The courtyard is designed to have a walkway for users and to have greenery, horticulture is planned to be carried out by Lao PDR side. On the west side of Laboratory Blocks, a roofed connecting corridor is planned to connect the existing corridor. To the east of Laboratory Blocks, a waste transfer station, substation and septic tank will be placed. Like CESD, rainwater on the roof is planned to be drained, through gutters and storm drains connecting the sewer main of the east road (Lao-Thai Road).

(7) Furniture and Other Fixtures Plan

1) Furniture

The Project plans to procure the furniture as follows.

Table 2-14 Furniture List

Room	**Furniture** (( ) shows quantity per room)
CESD	
Chemical Analysis Laboratory	Laboratory table (2), Chair (8), Book cabinet (1), Chemical storage cabinet (1), Whiteboard (1)
Electron Microscope Laboratory	Desk (4), Chair (5), Book cabinet (2), Whiteboard (1)
X-ray Analysis Laboratory	Desk (4), Chair (4), Book cabinet (3), Whiteboard (1)
High-Voltage Laboratory	Worktable (3), Stool (6), Book cabinet (1), Open rack (1), Whiteboard (1)
CESD Lecturers' Room	Desk (6), Chair (6), Cabinet (6)
Solid Forming Laboratory	Worktable (4), Stool (8), Book cabinet (2), Whiteboard (1)
Computer Room (1) (2)	Desk (21), Chair (41), Book cabinet (1), Whiteboard (1)
Physical Measurement Laboratory	Worktable (8), Stool (40), Book cabinet (4), Whiteboard (1)
Electrical and Electronic Measurement Laboratory	Worktable (8), Stool (40), Book cabinet (4), Whiteboard (1)

Meeting Room	Meeting table (8), Chair (16), Book cabinet (1), Whiteboard (1)
Exhibition Room	Bookshelf, Display board, Display table, Display shelf, Bench
Administration Office/ Pantry	Desk (2), Chair & Stool (4), Cabinet (2), Book cabinet (1), Cupboard (1)
Director's Room	Desk (1), Chair (1), Sofa & table (1), Cabinet (1)
Meeting Corner	Table & chair (6)
Laboratory Blocks	
Machining Training Room	Worktable with 2 vices (4), Worktable (4), Stool (22), Desk (1), Chair (1), Open shelf (1), Cabinet (2), Whiteboard (1)
Metal Working Training Room	Worktable with 2 vices (4), Worktable (4), Stool (20), Desk (1), Chair (1), Open shelf (1), Cabinet (2), Whiteboard (1)
(Preparation Room)	Meeting table (1), Chair (4), Open shelf (1)
Fluid Mechanics Laboratory	Worktable (4), Stool (20), Desk (1), Chair (1), Open shelf (1), Cabinet (2), Whiteboard (1)
Engine Laboratory	Worktable (11), Stool (40), Desk (1), Chair (1), Open shelf (1), Cabinet (2), Whiteboard (1)
Material Testing Room (CESD)	Worktable (2), Stool (4), Desk (1), Chair (1), Open shelf (2), Cabinet (2), Whiteboard (1)
Concrete Testing Room	Worktable (17), Stool (40), Desk (1), Chair (1), Open shelf (2), Cabinet (3), Whiteboard (1)
(Preparation Room)	Meeting table (1), Chair (4), Open shelf (1)
Asphalt Testing Room	Worktable (9), Stool (20), Desk (1), Chair (1), Open shelf (1), Cabinet (2), Whiteboard (1)
Soil Testing Room	Worktable (9), Stool (20), Desk (1), Chair (1), Open shelf (1), Cabinet (5), Whiteboard (1)
Electrical Engineering Laboratory (1)	Worktable (8), Stool (40), Desk (1), Chair (1), Open shelf (1), Cabinet (3), Whiteboard (1)
Electrical Engineering Laboratory (2)	Worktable (14), Stool (40), Desk (1), Chair (1), Open shelf (1), Cabinet (2), Whiteboard (1)
Civil Engineering Laboratory	Worktable (5), Stool (20), Desk (1), Chair (1), Open shelf (1), Cabinet (5), Whiteboard (1)
Road & Bridge Engineering Laboratory	Worktable (4), Stool (20), Desk (1), Chair (1), Open shelf (1), Cabinet (5), Whiteboard (1)
Electronic & Telecom. Engineering Laboratory (1)	Worktable (13), Stool (40), Desk (1), Chair (1), Open shelf (1), Cabinet (2), Whiteboard (1)
Electronic & Telecom. Engineering Laboratory (2)	Worktable (11), Stool (40), Desk (1), Chair (1), Open shelf (1), Cabinet (2), Whiteboard (1)
Transportation & Logistics Engineering Laboratory (1)	Meeting table (11), Chair (40), Desk (1), Chair (1), Book cabinet (1), Whiteboard (1)
Transportation & Logistics Engineering Laboratory (2)	Worktable (6), Stool (21), Desk (1), Chair (1), Open shelf (1), Cabinet (3), Whiteboard (1)
Guards' Room	Desk (1), Table (1), Chair (2), Book cabinet (1), Bed (1)
Students' Lounge	Table & bench (6-seat x 5 sets)

(Source: The survey team)

2) Sign (Pictogram)

Building name of CESD and Laboratory Blocks will be indicated with laser cut metal letters at or nearby the respective entrances. Each room/laboratory shall have a room name plate. A pictogram sign is planned to be set on each toilet.

3) Project Plaque, etc.

Two project plaques of marble are to be prepared. One will be set on the entrance of CESD and the other is to be set on Laboratory Blocks. A sticker of the Japanese flag will be attached to each item of furniture procured by the Project.

2-2-2-3 Equipment Plan

As previously stated, the purpose of the Project is to improve the research/education environment of the target 6 departments by procuring necessary equipment for experimental/practical work, thereby contributing to develop human resources meeting in the industrial sectors. Thus, the equipment planning is required to consider the industrial trend, required human resources, and the curriculums which are now being revised. Moreover, it requires to analyze the technical level of faculty members, the frequency of use of equipment, cost-benefit effect, maintenance cost, ease of maintenance, and possibility of procurement of spare parts and consumables, etc.

In planning the equipment, based upon the requested equipment list attached to the Minutes of Discussions during the Field Survey I (refer to the Appendix 4-1), and the afore-mentioned selection criteria, the survey team further considered the following matters to finalize the equipment list to be covered by the Project.

- Whether or not it is necessary and relevant as an item to be covered by the Project
- Whether or not it requires reconsideration, taking into the frequency of use and cost-benefit effect
- Whether or not there is an alternative item, or it could be purchased by FEN-NUOL on their own budget in the future
- Whether or not competitiveness can be secured in bidding

The equipment specifications of each selected item is determined, analyzing the technical level of the faculty members, the frequency of use, cost-benefit effect, and possibility of a competitive bidding, etc. The following describes the basic principles in planning the equipment for department by department.

(1) Mechanical Engineering Department (Mechanical Engineering Field)

The Project intends to complement equipment items currently used for experimental/practical works, which are lacking in quantity or having a problem arising from different specifications (welding machines, machining equipment, etc.) Furthermore, equipment items which may be used for collaboration work with other departments in FEN-NUOL or outside institutions, and for measurement analysis services to be outsourced by other institutions, are planned as CESD equipment. For example, Infrared Spectroscopy, Sequential X-Ray Fluorescence, Particle size Analysis, etc. are categorized as CESD equipment.

(2) Civil Engineering Department (Civil Engineering Field)

Likewise, the Project intends to complement equipment items currently used for experimental/practical work, which are lacking in quantity or having a problem arising from different specifications (small compressive testing machine, soil testing equipment, etc.) Furthermore, equipment items which may be used for collaboration work with other departments in FEN-NUOL or outside institutions, and for measurement analysis services to be outsourced by other institutions, are planned as CESD equipment. For example, Universal Testing Machine, etc. are categorized as CESD equipment.

(3) Road & Bridge Engineering Department (Civil Engineering Field)

The variety and quantity of existing equipment items are not sufficient, and many items are out of order, making the department difficult to carry out basic experimental/practical work. Thus, the equipment plan aims to procure items necessary for such basic experimental/practical work. Furthermore, several equipment items, which may be used for research and measurement analysis services for outsiders, are planned to be arranged by CESD.

(4) Transportation & Logistics Engineering Department (Civil Engineering Field)

Currently, the department does not have its own equipment items for experimental/practical works at all. Therefore, computers and software which are most needed to carry out traffic simulation are prioritized in the equipment planning. Moreover, field research items and their relevant equipment for traffic survey are mainly planned, as they are used in the organizations (ministerial or regional department offices, etc.) where the department graduates are employed.

(5) Electrical Engineering Department (Electrical/Electronic Engineering Field)

Laboratory equipment items such as motors and generators seem relatively equipped well, on the other hand, items for measurement and control system seem inadequate. Since measurement equipment may be used not only for basic study but for advanced research, making it in demand, such items are prioritized in the equipment planning. In addition, some equipment items which are important in the academic field but not yet have been introduced to the department due to its initial costs, such as High Voltage Experimental Equipment are included in the Project as CESD equipment.

(6) Electronic & Telecommunication Engineering Department (Electrical/Electronic Engineering Field)

Many existing equipment for experimental/practical work is more than 20-years-old, outdated, and/or out of order, thus are left unused. It is required to procure variety of items covering basic items to advanced equipment including ones for CESD. Taking into the number of students per class, as well as the demonstration use by a faculty member, the quantity is set for each item to be procured.

The major equipment list has been put together, following the above-mentioned study.

Table 2-15 Major Equipment List

Item No.	Request No.	Equipment Name	Main specifications	Q'ty	Usage
1	CESD-01	High Speed Camera	Composition: Main unit, standard accessories Sensor type: COMS Resolution: 640x480 pixels or better Maximum FPS: 2,000 or more under the conditions of 640x480 pixels or better	1	Photography and observation of physical phenomena

Item No.	Request No.	Equipment Name	Main specifications	Q'ty	Usage
2	CESD-02	Sequential X-Ray Fluorescence Spectrometer(XRF)	Composition: Main unit, standard accessories Specification use: Equipment to examine the type and content of elements constituting a sample by analyzing the energy (wavelength) and intensity of fluorescent X-rays generated by irradiating the sample with X-rays. Maximum output of X-ray tube: 3kw or more Spectroscopic crystals: 4 or more types Detector: Scintillation counter for heavy elements For light elements: Proportional counter Standard accessories: Complete set required for operation of main unit	1	Type and content analysis of elements in a sample
3	CESD-03	Powder X-ray diffractometer (XRD)	Composition: Main unit, standard accessories Specification Application: Equipment for measuring the atomic arrangement of crystals using X-rays Maximum output power of X-ray tube: 3kw or more X-ray tube type: Cu Radius of onigometer: 275 mm or more Detector: Scintillation counter Standard accessories: Complete set required for operation of main unit	1	Analysis of polymer materials, etc.
4	CESD-04	UV-Visible Spectrophotometer	Composition: Main unit, standard accessories Specification Use: Equipment to measure the absorption spectrum of solutions and individuals for quantitative analysis using the UV and visible light regions. Measurement wavelength range: Wider than 190-1100nm Band width: 1nm Standard accessories: Complete set required for operation of main unit	1	Analyze the absorbance and transmittance of samples
6	CESD-06	Electric Furnace for Metal Melting	Composition: Main unit, standard accessories Type: Lifting type Capacity：3L or more Maximum temperature: 1700° or more	2	Sample dissolution, firing, heat treatment, etc.
9	CESD-11	Scanning Electron Microscope (SEM) /Coating machine	Composition: Main unit, accessories Specification use: Equipment for high magnification observation of microstructures Maximum resolution: Higher than 4nm Magnification (direct detection camera): 300000 Filament: Pre-centered tungsten Acceleration Voltage: 20KV or more EDX: equipped Accessories: 1 set of peripheral equipment required for operation of the main unit	1	Observation of microstructure
10	CESD-13	2000kN Universal Testing Machine	Composition: Main unit Purpose of use: Equipment for testing various materials in tension, compression and bending. Maximum testing force: 2000kN Tensile test gripping device: Hydraulic type Maximum distance between grips: 1100mm Round bar gripping tool: φ20-55mm Gripping tool for different diameter bar: D60-51mm Flat plate gripping tool: 0-90mm(W90mm) Max. pressure plate distance: 950mm Max. distance between fulcrums for bending test: 900mm Cart for bending test piece: Equipped Test force accuracy: ISO7500 class 1 Automatic load control: Ram stroke control, test force control Data processing unit: PC, printer, software Displacement and elongation measurement unit: included	1	Material Testing
11	CESD-16	Fiber tensile strength testing machine	Composition: Main unit, standard accessories Load capacity: 1500N or more Positional accuracy: 0.1% of indication value or less, or 0.002mm or less Maximum load speed: 1000mm/m or more	1	Material Testing

Item No.	Request No.	Equipment Name	Main specifications	Q'ty	Usage
13	CESD-20	Ultrasonic weld inspection	Composition: Main unit, standard accessories Resolution: 16 bits or more Maximum repetition pulse frequency: 12 kHz or higher Standard accessories: Included	1	Non-destructive testing
15	CESD-23	Soil Investigation Drilling Machine	Composition: Main unit, standard accessories Spindle stroke: 500 mm or more Winding capacity: 14.7 kN or more Maximum rotation speed: 460 or more	1	Boring survey
17	CESD-26	Ground Penetrating Radar (GPR)	Composition：Main unit, Standard accessories Search object：Rebar Maximum search seismic intensity：46cm or more(concrete) Model：Handy type	1	Rebar search
19	CESD-29	Road Roughness Tester	Composition: Main unit, standard accessories Standard: Able to perform tests in accordance with ASTM D 1195 and D 1196 Maximum load: 500 kN or more Standard accessories: Included	1	Evaluation of road pavements
21	CESD-35	Traffic Simulation Software	Composition: Main unit Purpose of use: Simulation of traffic conditions Learning objectives : Development of traffic plans, reproduction of the current status of traffic flows and the effects of measures, analysis of the interaction of traffic conditions	1	Simulation of traffic conditions
22	CESD-36	Impedance Analyzer	Composition: Main unit, standard accessories Frequency range: 50Hz~1MHz or wider Measurement signal level (Vrms): 10mV~1Vrms or wider Measurement signal level (Arms): 200μA~20mArms or wider	1	Impedance Analysis
26	CESD-41	Spectrum Analyzer/Signal Analyzer	Composition: Main unit, standard accessories Frequency range: 9kHz~3.6GHz or wider Resolution: 1Hz or better	1	Waveform component analysis
27	CESD-43	High Voltage Experimental Equipment	Maximum output voltage for AC test: 60kV Maximum output voltage for DC test: 75kV Maximum output voltage for impulse test: 200kV Control panel: Desktop type voltage indicator Peak hold: Equipped Waveform observation device: Equipped Rectifier, current divider, voltage divider: Equipped Ball gap, insulation, and withstand voltage tester in oil:Equipped Suspension insulator:Equipped Connecting cable between each unit:Equipped Insulation equipment and safety devices: Equipped	1	High Voltage Experiment
29	CESD-47	Draft chamber	Composition: Main unit, Accessories Model: Draft chamber with wet scrubber Outside dimensions (assembled): 2100mm x 750~800mm x 2250~2300mm Ventilation airflow: 12m^3/s or more Accessories: Complete set required for operation of main unit	1	Chemistry experiment
33	ME-05	Metal Specimen Processing Machine	Composition: Grinding machine, Cutting machine, Dryer Grinding machine model: Double-round grinding wheel diameter: 200mm Cutting machine wheel dimensions: 150 mm	2	Grinding and cutting of samples

Item No.	Request No.	Equipment Name	Main specifications	Q'ty	Usage
34	ME-07	Rockwell Hardness Tester	Composition: Main unit, Standard accessories Maximum Rockwell test force: 1471N or more Maximum Brinell test force: 1839N or more	2	Material hardness test
35	ME-08	Thermogravitric Analysis (TGA/DSC)	Composition：Main unit, accessories Setting temperature range：From room temperature to 1500 degrees or wider TG resolution：0.1μg or better Accessories：Complete set required for operation of main unit	1	Thermal analysis of samples
36	ME-09	Infrared Spectroscopy (FTIR)	Composition: Main unit, accessories Purpose of use: this device can irradiate infrared light to a sample, measure the amount of light transmitted or reflected, and obtain the molecular structure from the spectrum. Wavenumber range: 350~7800cm or wider Sample: Applicable to powder, individual and liquid Microscope system: included Accessory: Complete set required for operation of main unit	1	Analysis of molecular structure, etc. of samples
37	ME-11	Particle size analysis (PSA)	Composition: Main unit, accessories Purpose of use: device for measuring the particle size of powders and dispersions using laser diffraction/scattering technology Measured particle size: 17nm~2500μm or wider Accessories: Complete set required for operation of main unit	1	Measurement of the particle size of a sample
38	ME-13	Impact Testing Machine	Composition: Main unit, Notch processing machine, Standard accessories Type: Charpy type Maximum energy level: 15J or more Notch processing machine: Equipped	1	Impact testing of polymer materials, etc.
39	ME-15	Structural Mechanics Experimental Device	Composition: Main unit, accessories Learning objectives: Bending moment test apparatus for beams to evaluate bending and shear forces in structures, shear force test apparatus for beams, buckling test apparatus for columns	1	Structural Mechanics Practice
41	ME-17	Air Conditioning Experimental Device	Composition: Main unit Learning objectives: control of air conditioning, each component for air conditioning, computer of the air conditioning equipment about the control of temperature and humidity forced ventilation	1	Air conditioning system practice
42	ME-18	Renewable Energy Experimental Device	Composition: Main unit Learning objectives: Use of solar panels and power measurement, use of wind turbines and power measurement, storage of renewable energy, use of renewable energy in industrial sites	1	Practical training in renewable energy
43	ME-19	Gasoline+Diesel Engine Experimental Device	Composition: Diesel Engine Bench, Gasoline Engine Bench, Dynamometer Learning objectives: Engine Torque, How tousle Dynamometer, Excess Air Rate, Differences between Diesel and Gasoline Engines	1	Practical training on gasoline and diesel engines
44	ME-20	Gas turbine Experimental Device	Composition: Main unit Learning objectives: Principle of operation of a gas turbine, Control of a single-shaft gas turbine, Relationship between fuel consumption and rotational speed, Components of a gas turbine	1	Gas Turbine Practice
45	ME-21	Exhaust Gases Analyzer	Composition: Main unit, standard accessories Measurement items CO: 0~10% or wider HC: 0ppm~10000ppm or wider CO^2: 0~20% or wider AFR: 10~24 or wider LAMBDA: 0.680~1.840 or wider	1	Gasoline engine exhaust gas analysis
46	ME-22	DC Welder	Composition: Main unit, standard accessories Rated current: 200A or more Rated voltage: 200~220V Usage rate: 40% or more	2	Arc welding

Item No.	Request No.	Equipment Name	Main specifications	Q'ty	Usage
47	ME-23	TIG + MIG Welder	Composition: TIG welding machine, MIG welding machine, dust collector, standard accessories TIG welding machine rated output: 200A or more MIG welding machine maximum rated output: 200A or more Dust collector: Equipped	1	TIG/MIG welding
49	ME-25	Surface Grinding Machine	Composition: Main unit, standard accessories Table travel: 750x440mm Grinding wheel dimensions: Φ355/305x38xΦ127mm Working area: 605x400 mm min.	1	Metal processing (surface grinding)
50	ME-26	3D Printer (plastic)	Composition: Main unit Build method: SLA Maximum build size: W335 x D200 x 300 mm Minimum build pitch: 25-300 um Materials used: Resin	1	Modeling of three-dimensional objects
52	ME-28	Band Saw	Composition: main unit Table dimensions: 550 x 450 mm min. Saw blade length: 2620 mm min. Max. saw blade speed: 100 m/min. min.	1	Metal processing (cutting)
53	ME-29	Table Top CNC Vertical Milling Machine	Composition: Main unit, standard accessories Spindle shape: MT3 Head vertical travel: 250 mm or more Spindle travel: 95 mm or more CNC control function: Equipped	5	Metal processing (milling)
54	ME-30	Multi Joint Robot	Composition: Main unit Learning objectives: Learning of grabbing, placing and other actions by robot arm, learning of robot arm control by sensor sensing, learning of robot arm operation by automatic control	1	Practical training on control of multi-joint robots, etc.
55	ME-32	Lathe machine	Composition：Main unit, standard accessories Horizontal feed speed：Range wider than 0.05~0.35mm/rev Distance between centers：About 610mm Max. spindle speed：1700rpm or more	1	Metal processing (cutting)
57	ME-34	Milling Machine	Composition: Main unit Machinable materials: Iron, aluminum, brass Spindle hole taper: MT3 Table dimensions: 190x585mm or more Max. speed: 2150rpm or more Spindle travel: 95mm or more	1	Metal processing (milling)
58	ME-35	Blade sharpener (floor type)	Composition: Main unit Table dimensions: 740~940(L) x 135~166(W)mm Front-back x vertical movement: 220~250 x 250mm Horizontal/vertical rotation of grinding wheel spindle:360° Grinding wheel spindle speed: 2300, 3100, 4900min-1 Center height: 130mm Grinding wheel diameter: 150mm Swing over table: 0.75 kW 250 mm Wheel spindle motor: 0.75 kW	1	Sharpening of cutting tools
59	ME-36	Folding machine	Composition: Main unit, accessories Operation method: Rotary handle Bendable width: 1250mm or more Bendable thickness: 2.3mm or more Max. opening interval: 200mm or more Accessories: 1 set of dies, etc. required for bending	1	Bending of steel plate

Item No.	Request No.	Equipment Name	Main specifications	Q'ty	Usage
60	ME-37	Cutting machine	Composition: Main unit, Accessories Operating method: Manual lever or rotary handle Bendable width: 1250mm or more Cuttable thickness: 2.3mm or more Maximum opening interval: 200mm or more Accessories: 1 set of dies, etc. required for cutting	1	Cutting of steel plate
61	ME-38	Rolling machine	Composition: Main unit Minimum machining diameter: 90mm or less Working: 1300mm or more Motor power: 0.75kw or more	1	Roll bending of steel plate
62	ME-39	Water Pumping Circulation system	Composition: Main unit Learning objectives: Relationship between pressure head and flowrate, how a water pump works, how pump efficiency relates to flow rate, how flow rate relates to pressure drop	1	Water pump practice
65	ME-42	Friction Lost Experimental Device	Composition: Main unit Learning objectives: pressure loss in pipes, relationship between flow velocity and pressure loss, technology of pressure, measurement nature of angle valves and gate valves	1	Practical training on friction of fluids
66	ME-43	Oxygen bomb calorimeter	Composition: Main unit Measurement range: 13~37℃ or wider Temperature sensor: thermistor Display format: Joule	1	Measurement of Constant Volume Combustion Heat
70	CE-02	Specimen grinding machine	Composition: Main unit, standard accessories Standard: test specimen which is adopted ASTM D4543 standard can be made Rotation speed: 1400rpm or more Wheel diameter: 180mm or more	1	Making a Rock Core
73	CE-05	Marking-off machine for steel specimen	Composition: Main unit Effective marking length: 900mm (±10%) Applicable sample size: 45mm (±10%) Marking step: 5, 10mm	1	Marking on the test specimen
76	CE-13	Blaine Air Permeability Testing Apparatus	Composition: Main unit Purpose of use: Cement fineness test Standard: Must be able to perform the test in accordance with ASTM C204 Standard Control: Control by PC	2	Air permeability test of compressed body
80	CE-21	Concrete compression machine 1500 kN semi-automatic,	Composition: Main unit, standard accessories Standard: Must be able to perform tests in accordance with ASTM C39 standard and AASHTO T22 standard Power: Motorized Load capacity: 1500 kN or more	1	Compaction of concrete samples
81	CE-26	Shaking Table	Composition: Main unit, accessories Maximum excitation force: 30 kg or more Maximum acceleration: 0.665 m/s or more Table dimensions: 500 mm x 460 mm or more Accessories: necessary set for the operation of the main unit	1	Sample separation, etc.
82	CE-27	Set of Vibration Acceleration Measuring Device in vertical	Composition: Main unit, standard accessories Max. number of channels: 1000 Internal memory: 1 GB or more Compatible measurement methods: 1 gauge method, 2 gauge method, 4 gauge method	2	Strain measurement
93	CE-51	Direct Shear Teseter	Composition: Main unit, standard accessories Standard: Able to perform tests in accordance with ASTM D3080 standard Interface: Digital display Maximum horizontal load: 5kN or more Maximum vertical load: 500N or more Shear rate: 0.00001~15.00000mm/min or more range	2	Strength test of soil

Item No.	Request No.	Equipment Name	Main specifications	Q'ty	Usage
95	CE-53	Triaxial Compression Tester complete set with accessaries	Composition: Main unit, standard accessories Maximum load: 50kN Speed range: 0.00001~12mm/min or wider Maximum sample size: 70 mmx70 mm or more	2	Triaxial compression test
119	CE-98	Pitot Tubes	Composition: Main unit, standard accessories sLearning objectives: Velocity measurement using pitottubes, Relationship between static head, total head and dynamichead, Dynamic pressure generated by water flow in a pressurized pipe, Relationship between pipe diameter and dynamic pressure	1	Practical training of flow measurement with pitot tube
133	RB-15	Ductivity Apparatus	Composition：Main unit, standard accessories Standard：Must be able to perform the test according to ASTM D113 and D6084 Standard Temperature control function：Equipped Testing speed：50mm/min	1	Flexural test
135	RB-17	Travelling Beam Device	Composition: Main unit, standard accessories Purpose of use: Measurement of road surface flatness Beam length: 3 m Graduation: 2 mm (up to 10 mm), 5 mm (up to 25 mm)	1	Flatness measurement of road surface
140	RB-22	Total Station	Composition：Main unit, standard accessories GSI certification：2 class A or better Magnification：26~30x Resolution：3.5" or better	1	Surveying practice
143	RB-26	Ecocenter	Composition: Main unit, standard accessories Maximum measurement depth: 200m or more Accuracy: 2.5% or better Digital display: Equipped and capable of displaying echoes	2	Surveying practice
144	RB-27	RTK	Composition: Main unit, standard accessories Supported signals: GPS, GLONASS, Galileo, BeiDou, QZSS Number of channels: 220 or more Accuracy: 0.5m or better	2	Surveying practice
145	RB-34	Soil Investigation Drilling Machine	Composition: Main unit, standard accessories Penetration: 75cm or more per 1 time Movement: Crawler type carrier Control: Regulator type	1	Geotechnical survey
147	RB-39	Ground Penetrating Radar (GPR)	Composition：Main unit, Standard accessories Search object：Rebar Maximum search seismic intensity：46cm or more (concrete) Model：Handy type	2	Rebar search
148	RB-40	Dynamic Pile Load Test System	Purpose of use: Impact loading test of piles Standard: To be able to perform the test in accordance with ASTM D4945 Standard Number of channels: 4 or more	1	Impact Loading Test of Piles
154	TL-05	Vehicle Emissions Testing System	Composition: Main unit, standard accessories Measurement range: 0~9.999m^-1 Measurement method: Opacimeter type Printer: equipped with the main unit	2	Exhaust gas analysis of diesel engines
155	TL-06	Portable Axle Weigh Pads	Composition: Main unit, standard accessories Purpose of use: Weight measurement of vehicles Measurable weight per 1 piece: 10 tons or more Number of pieces: 2 pieces in 1 set Standard accessories: equipped	2	Vehicle weight measurement

Major Equipment List

Item No.	Request No.	Equipment Name	Main specifications	Q'ty	Usage
159	TL-14	RFID Reader and printer	Composition: Reader, RFID printer, standard accessories Reader Purpose of use: RFID reading Interface: Wifi, Bluetooth and other wireless standards RFID printer Resolution: 600dpi or more	2	RFID reading and printing
161	EL-08	Coil winding tester	Composition：Main unit, standard accessories Measurement range：50μ~100mH or wider Maximum output voltage：1000V or more	1	Impulse winding test
168	EL-17	Electric Circuit Trainer	Composition: main unit, standard accessories Learning objectives: how to construct a circuit using single-throw and twin-throw switches, Control of lighting (ON, OFF, brightness adjustment), Properties of AC and DC	4	Practical training on fundamentals of electric circuits
169	EL-21	3 Phase AC Motor Trainer	Composition: Main unit, standard accessories Learning objectives: Mechanism of three-phase AC motor, Control of three-phase AC motor, Measurement of starting power of motor, Relationship between motor speed, voltage and frequency	1	Practical training on three-phase AC motors
170	EL-27	High Voltage Receiving Equipment Trainer	Composition: Main unit, standard accessories Learning objectives: the mechanism of the receiving and transforming equipment, Calculation of the conversion efficiency of transformers, Interface of the power transmission system	1	Practical training on power receiving and transforming equipment
173	EL-37	PLC Trainer and conveyer system	Composition: Main unit, standard accessories Learning objectivess: connection of electromagnetic switch and PLC, mechanism of timer circuit, control of equipment by PLC, PLC programming	5	Practical training on PLC control
174	EL-38	SCADA trainer	Composition: Main unit, standard accessories Learning objectives: SCADA system construction procedure, Interface of SCADA system,Control of equipment by SCADA system	2	Practical training on industrial control systems
175	EL-39	Sensor Trainer	Composition: Main unit, standard accessories Learning objectives: Principles of optical sensors and proximity sensors, How to control equipment using sensors, Selecting sensors for measurement objects	2	Practical training on control by sensor
178	EL-42	Relay Circuit Trainer	Composition: Main unit, standard accessories Learning objectives: How protective relay circuits work, How to construct relay circuits, About contact points a, b, and c	2	Practical training on relay circuits
179	EL-43	Electrical Protection trainer (Substation and transmission line)	Composition: Main unit, standard accessories Learning objectives: about high-voltage power transmission, transformer protection mechanism, substation, transmission line, etc., understanding of power transmission model	2	Practical training on high-voltage power transmission
183	EL-51	Safety and continuity of elctrical power supply	Composition：Main unit, standard accessories Learning objectives：About circuit protection in the event of an earthquake, the mechanism of uninterruptible power supply, the mechanism of the breaker, the short circuit of the operating circuit	1	Practical training on circuit protection
184	EL-52	Hybrid renewable energy : Photovoltaic & Wind generator	Composition: Main unit, standard accessories Learning objectives: the mechanism of solar and wind power generation, features, the role of inverters in the use of renewable energy, the use of solar panels and power measurement, the use of wind turbines and power measurement, the storage of renewable energy	1	Practical training on renewable energy

Item No.	Request No.	Equipment Name	Main specifications	Q'ty	Usage
191	ER-14	Satellite Communications Training System	Composition: Main unit, standard accessories Learning objectives: Understanding the properties of electromagnetic waves and microwaves, how satellite communication systems work, understanding the model, how satellite radio receivers work, how relay stations work	1	Practical training on satellite communication technology
192	ER-16	HMI Trainer	Composition: Main unit, standard accessories Learning objectives: Basic design of HMI software, Design policy of HMI, concept of standardization Touch panel for practical training: equipped	1	Practical training on HMI
193	ER-19	Profinet IO Trainer	Composition: Main unit, standard accessories Learning objectives: Remote control mechanism, specification of Profinet protocol, classes of devices in Profinet IO, main differences between Profinet and Ethernet	3	Practical training on Profinet protocol
194	ER-21	Inverter Control Trainer	Composition: Main unit, standard accessories Learning objectives: Principle and usage of three-phase inverter, Speed control of three-phase AC motor by inverter, Generation of pulse wave by PWM control	1	Practical training on inverter control
198	ER-32	Radar technology Trainer	Composition: Main unit, standard accessories Learning objectives: about each component of radar technology (transmitter, antenna, receiver, indicator), charactaritics of the antennas, summary of radar technology, principle of the planar position indicator	3	Practical training on radar technology
199	ER-33	PC Interface Trainer	Composition: Main unit, standard accessories Learning objectives: computer network (physical layer) practice, optical line standards, communication technology, about modulation and demodulation in wireless communication Resistance, capacitance, inductance, and characteristic impedance per unit length of coaxial cable	5	Practical training on ICT technology
200	ER-35	PBX System Trainer	Composition: Main unit, standard accessories Learning objectives: how an analog phone line works, how a digital PABX works, how a VoIP device works, how an ISDN device works	3	Practical training on the premises switching system
201	ER-36	WLAN Bridgelink Radio Trainer	Composition: Main unit, standard accessories Learning objectives: how modems work, how ADSL works, how wireless LANs work, major standards for wireless LANs, bridge connections between LANs	3	Practical training on wireless LAN
202	ER-37	Antenna System Trainer	Composition: Main unit Learning objectives: Characteristics of monopole, dipole, and Yagi antennas, analysis of received electromagnetic waves, view of directional images Software for analysis: included	3	Practical training on the properties of antennas
203	ER-40	Microwave System Trainer	Composition：Main unit Learning objectives: Characteristics of microwaves, Characteristics of horn antennas, Characteristics of parabolic mirrors, polarization of antennas	3	Practical training on communication by microwaves

Full equipment list is as follows.

Table 2-16 Full Equipment List

Item No.	Request No.	Name of Equipment	Quantity
1	CESD-01	High Speed Camera	1
2	CESD-02	Sequential X-Ray Fluorescence Spectrometer(XRF)	1
3	CESD-03	Powder X-ray diffractometer (XRD)	1
4	CESD-04	UV-Visible Spectrophotometer	1
5	CESD-05	Water Distiller	1
6	CESD-06	Electric Furnace for Metal Melting	2
7	CESD-07	Refrigerator	1
8	CESD-08	Electric Balance Set	4
9	CESD-11	Scanning Electron Microscope (SEM) w/Coating machine	1
10	CESD-13	2000kN Universal Testing Machine	1
11	CESD-16	Fiber tensile strength testing machine	1
12	CESD-17	Concrete Permeability Testing	1
13	CESD-20	Ultrasonic weld inspection	1
14	CESD-21	Magnetic particle inspection for Surface crack detection	1
15	CESD-23	Soil Investigation Drilling Machine	1
16	CESD-24	Dynamic cone penetrometer tool	1
17	CESD-26	Ground Penetrating Radar (GPR)	1
18	CESD-28	Road Surface Friction Coefficient Test Equipment	1
19	CESD-29	Road Roughness Tester	1
20	CESD-33	Digital Noise Meter for Noise Level Testing	4
21	CESD-35	Traffic Simulation Software	1
22	CESD-36	Impedance Analyzer	1
23	CESD-37	Thermal Camera	1
24	CESD-38	Digital Oscilloscope	1
25	CESD-39	Function/Arbitrary Waveform Generator	1
26	CESD-41	Spectrum Analyzer/Signal Analyzer	1
27	CESD-43	High Voltage Experimental Equipment	1
28	CESD-46	Desktop Computer	40
29	CESD-47	Draft chamber	1
30	ME-01	Hand Tool Set	40
31	ME-02	Power Tool Set	10
32	ME-03	Dimension Measuring Equipment Set	40
33	ME-05	Metal Specimen Processing Machine	2
34	ME-07	Rockewll Hardness Tester	2
35	ME-08	Thermogravitric Analysis (TGA/DSC)	1
36	ME-09	Infrared Spectroscopy (FTIR) (Reconsider)	1
37	ME-11	Particle size analysis (PSA)	1
38	ME-13	Impact Testing Machine	1
39	ME-15	Structural Mechanics Experimental Device	1
40	ME-16	Boiler Experimental Device	1
41	ME-17	Air Conditioning Experimental Device	1
42	ME-18	Renewable Energy Experimental Device	1
43	ME-19	Gasoline+Diesel Engine Experimental Device	1
44	ME-20	Gasturbine Experimental Device	1
45	ME-21	Exhaust Gases Analyzer	1
46	ME-22	DC Welder	2
47	ME-23	TIG + MIG Welder	1
48	ME-24	Double Headed Grinder	2

Item No.	Request No.	Name of Equipment	Quantity
49	ME-25	Surface Grinding Machine	1
50	ME-26	3D Printer (plastic)	1
51	ME-27	Oxyacetylene Welding Set	2
52	ME-28	Band Saw	1
53	ME-29	Table Top CNC Vertical Milling Machine	5
54	ME-30	Multi Joint Robot	1
55	ME-32	Lathe machine	1
56	ME-33	Bench drilling machine	1
57	ME-34	Milling Machine	1
58	ME-35	Blade sharpener (floor type)	1
59	ME-36	Folding machine	1
60	ME-37	Cutting machine	1
61	ME-38	Rolling machine	1
62	ME-39	Water Pumping Circulation system	1
63	ME-40	Hot air Oven	1
64	ME-41	Shop press	1
65	ME-42	Friction Lost Experimental Device	1
66	ME-43	Oxygen bomb calorimeter	1
67	ME-44	Laboratory emission monitoring system (LEMS)	1
68	ME-45	Solar power meter	1
69	CE-01	Pallet Truck Hydraulic	2
70	CE-02	Specimen grinding machine	1
71	CE-03	Specimen cutting machine for Con.	1
72	CE-04	Specimen cutting machine for steel	1
73	CE-05	Marking-off machine for steel speciment	1
74	CE-11	Los Angeles Testing Machine	1
75	CE-12	Aggregate Crusher	1
76	CE-13	Blaine Air Permeability Testing Apparatus	2
77	CE-15	Mortar Mixer	2
78	CE-16	Pull-Off Tester (Bond Strength Tester)	1
79	CE-18	Set of Vebe Test equipment	2
80	CE-21	Concrete compression machine 1500 kN semi-automatic,	1
81	CE-26	Shaking Table	1
82	CE-27	Set of Vibration Acceleration Measuring Device in vertical	2
83	CE-28	Half cell potential tester, corrosion test	1
84	CE-36	Deflectometer with telescopic	2
85	CE-41	Soil Particle Size Measuring Instrument (Hydrometer method)	2
86	CE-42	Soil Liquid Limit Measuring Instrument	4
87	CE-43	Motorized liquid limit device	2
88	CE-44	Soil Constant Temperature Dryer	2
89	CE-46	CBR Testing Machine	2
90	CE-47	Constant Water Level Permeability Tester	1
91	CE-49	Falling Head Permeability Tester	2
92	CE-50	Soil Consolidation Tester	2
93	CE-51	Direct Shear Teseter	2
94	CE-52	Uniaxial Compression Tester	2
95	CE-53	Triaxial Compression Tester complete set with accessaries	2
96	CE-54	Sand density cone apparatus	2
97	CE-58	Plate bearing equipment, 200 kN, 3 dial gauges	1
98	CE-60	Field CBR test set	2
99	CE-61	Electric Balance	3
100	CE-63	Hot plates	2

Item No.	Request No.	Name of Equipment	Quantity
101	CE-64	Test sieves for soil testing conform to ASTM D 442-63	3
102	CE-67	Soxhlet modified method	2
103	CE-68	Skid resistance and friction tester	2
104	CE-70	The Marshell Stability machine	1
105	CE-72	15kg Buoyancy Balance Set for gravity of aggregates.	1
106	CE-73	BS Conpaction Pedestal With Compaction Hammer	1
107	CE-74	Mashall Compaction Moulds(set)	10
108	CE-75	Bitmen Picnometer, Hubbard-Carmick specific gravity	7
109	CE-76	Gas pycnometer for Aggregrate and Sand, Cone pyknometer	4
110	CE-77	Quantative Extraction (set)	3
111	CE-78	Benkelmam Beam	2
112	CE-79	Flash and Fire Point Betum (set)	2
113	CE-80	Traffic Counter	5
114	CE-81	Speed Counter	5
115	CE-82	Sound Level Meter	3
116	CE-83	GPS Positioning System	5
117	CE-86	Digital Level	4
118	CE-96	Pressure measurement Bench	1
119	CE-98	Pitot Tubes	1
120	RB-01	Sieve Set	2
121	RB-02	Sedimentation Test Set	2
122	RB-03	Plastic Index Liquid Limit Test Set	2
123	RB-04	Compaction Test Equipment Set	1
124	RB-05	CBR Testing Equipment	1
125	RB-06	Field CBR Testing Equipment	1
126	RB-07	Field Density Test Set	2
127	RB-08	Specific Gravity Test Set	2
128	RB-09	Aggregate Test Set	1
129	RB-11	Alkali test set	1
130	RB-12	Thin Film Oven	1
131	RB-13	Penetration of Bituminous	2
132	RB-14	Flash & Fire Point Tester	1
133	RB-15	Ductivity Apparatus	1
134	RB-16	Distillation of Cut-Back Asphalt (Bituminous) Products	2
135	RB-17	Travelling Beam Device	1
136	RB-18	Benkelman Beam	1
137	RB-19	Core Drill for Asphalt	1
138	RB-20	Aluminum Staff	9
139	RB-21	Auto-Leveling	2
140	RB-22	Total Station	1
141	RB-23	Theodolite	4
142	RB-25	Hand GPS	2
143	RB-26	Ecocenter	2
144	RB-27	RTK	2
145	RB-34	Soil Investigation Drilling Machine	1
146	RB-38	Sonic Integrity Test (SIT)	2
147	RB-39	Ground Penetrating Radar (GPR)	2
148	RB-40	Dynamic Pile Load Test System	1
149	RB-41	Road Surface Friction Coefficient Test Equipment	1
150	RB-42	Road Roughness Tester	1
151	TL-01	Desktop Computer	10
152	TL-02	Printer	1

Item No.	Request No.	Name of Equipment	Quantity
153	TL-04	Laser Speed Gun	5
154	TL-05	Vehicle Emissions Testing System	2
155	TL-06	Portable Axle Weigh Pads	2
156	TL-07	Handy GPS	3
157	TL-08	Digital Noise Meter for Noise Level Testing	5
158	TL-09	Roadside Alcohol Testing Devices market segmentation	10
159	TL-14	RFID Reader and printer	2
160	TL-15	Barcode Scanner and printer	6
161	EL-08	Coil winding tester	1
162	EL-09	Variable DC voltage source (For transformer resistor testing)	1
163	EL-10	Variable AC voltage source (For transformer testing)	1
164	EL-11	Contact resistance tester	1
165	EL-12	Relay tester (For protection)	1
166	EL-13	Transformer turn ratio meter	1
167	EL-16	Field Intensisty Meter	8
168	EL-17	Electric Circuit Trainer	4
169	EL-21	3 Phase AC Motor Trainer	1
170	EL-27	High Voltage Receiving Equipment Trainer	1
171	EL-34	Electronics Circuit Trainer	2
172	EL-35	Logic Circuit Trainer	2
173	EL-37	PLC Trainer and conveyer system	5
174	EL-38	SCADA trainer	2
175	EL-39	Sensor Trainer	2
176	EL-40	Home Appliance Set for Training	2
177	EL-41	Microprocessor Trainer	5
178	EL-42	Relay Circuit Trainer	2
179	EL-43	Electrical Protection trainer (Substation and transmission line)	2
180	EL-48	Portable power meter	1
181	EL-49	Handy tachometer	5
182	EL-50	Lux meter	2
183	EL-51	Safety and continuity of elctrical power supply	1
184	EL-52	Hybrid renewable energy : Photovoltaic & Wind generator	1
185	ER-01	Logic Circuit Training kit	5
186	ER-02	Pulse Circuit training Kit	5
187	ER-06	IC Trainer with IC Set	5
188	ER-11	Operation Amplifier Trainer Set	10
189	ER-12	AD/DA Conversion Trainer Set	10
190	ER-13	Optical Transmission Trainer Set	5
191	ER-14	Satellite Communications Training System	1
192	ER-16	HMI Trainer	1
193	ER-19	Profinet IO Trainer	3
194	ER-21	Inverter Control Trainer	1
195	ER-28	Builging Electric Installation System Trainer	2
196	ER-29	Trainer for High-pass/Low-pass, Bandpass/Bandstop, Band Filters, Series and Parallel Resonant Circuits	10
197	ER-30	Trainer for 2nd and 4th Order Low-pass and High-pass Filters, 2nd Order Band-pass and Band-stop Filters	10
198	ER-32	Radar technology Trainer	3
199	ER-33	Information and Communication Technology training equipment	5
200	ER-35	PBX System Trainer	3
201	ER-36	WLAN Bridgelink Radio Trainer	3
202	ER-37	Antenna System Trainer	3
203	ER-40	Microwave System Trainer	3
204	ER-46	Basic Protocal Trainer	10

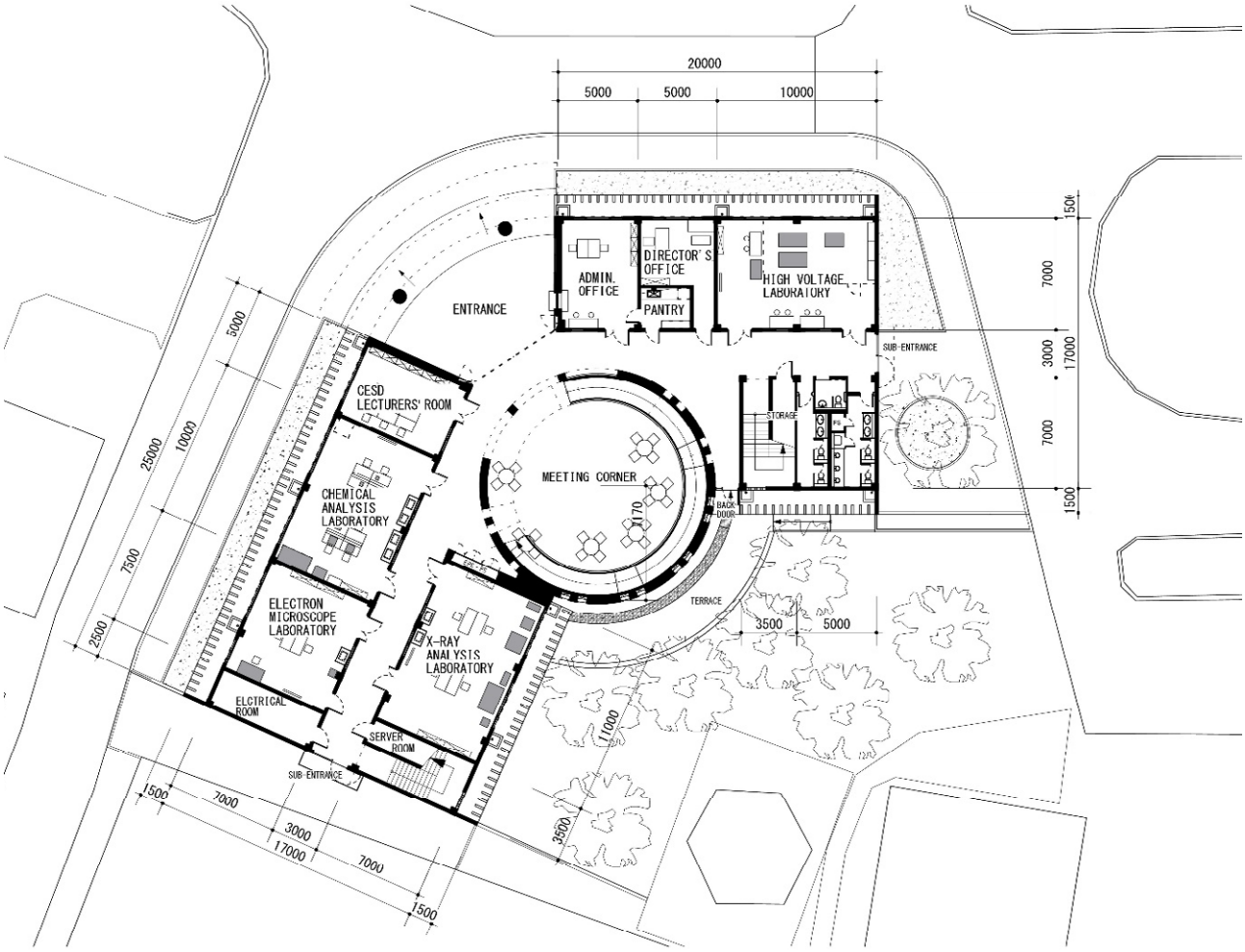
2-2-3 Outline Design Drawings

The outline drawings for this Project are listed below.

Table 2-17 List of Outline Design Drawings

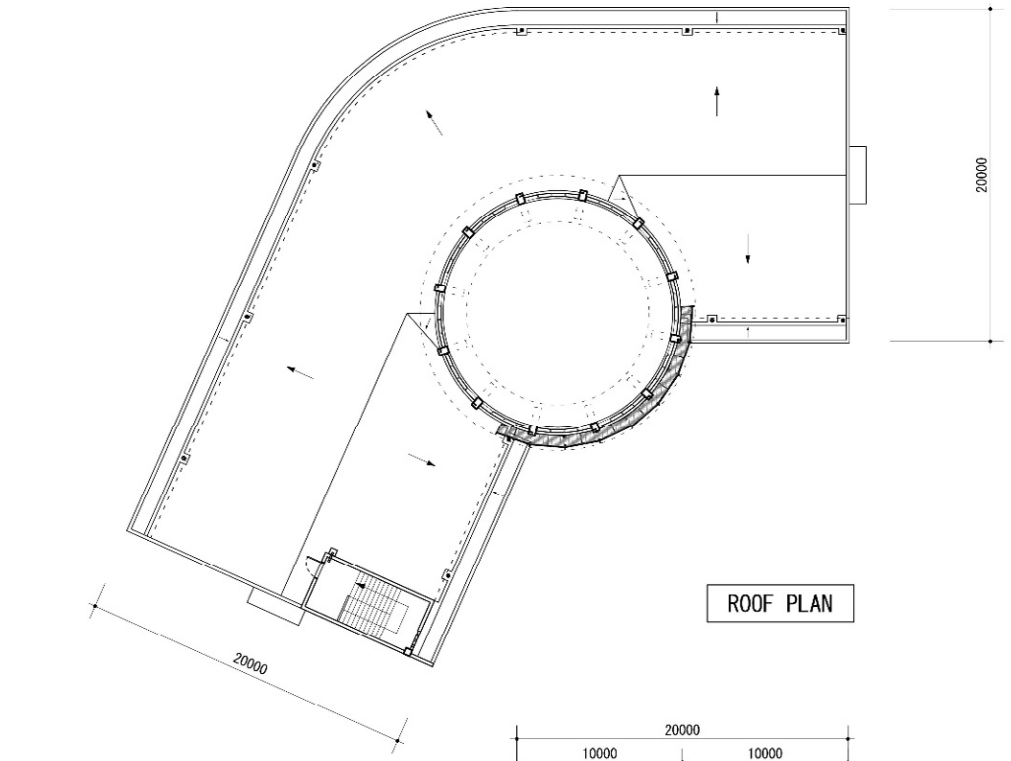
LAYOUT PLAN

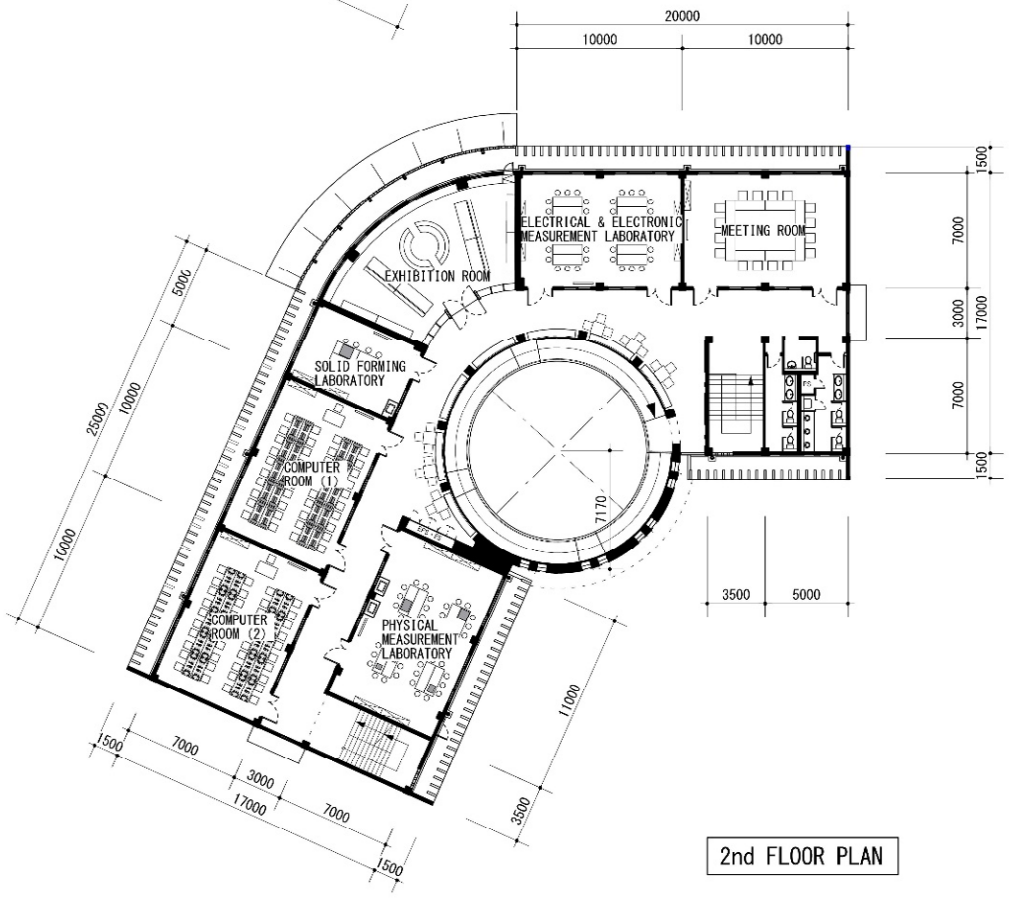

LABORATORY BLOCKS
EAST GATE
FOOTBALL FIELD
Lao-Thai Road
SOUTHWEST GATE
Center of Engineering
for Sustainable Development (CESD)
SOUTHEAST GATE
N
0
100m

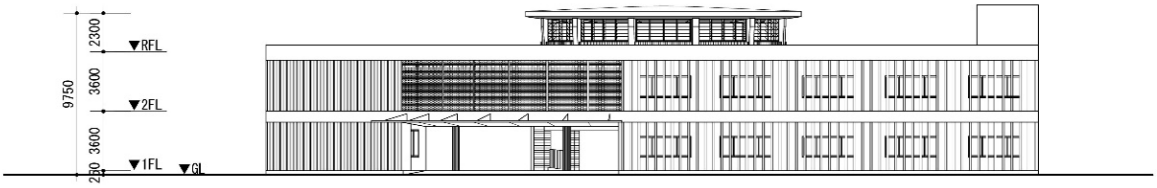


1st FLOOR PLAN

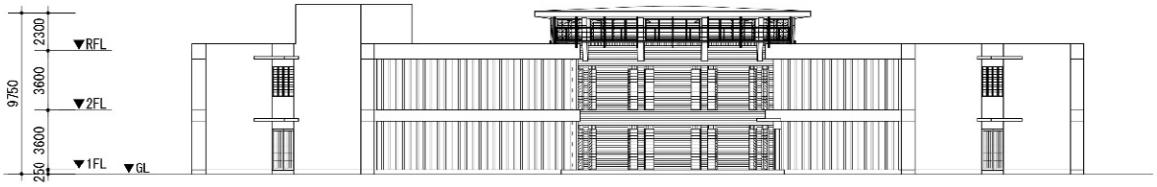
N


20000
20000
ROOF PLAN

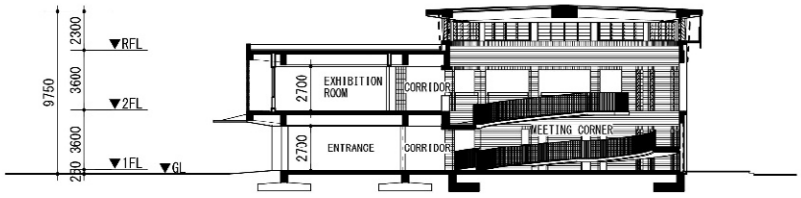

20000
10000
10000
1500
7000
3000
17000
7000
1500
ELECTRICAL & ELECTRONIC MEASUREMENT LABORATORY
MEETING ROOM
EXHIBITION ROOM
SOLID FORMING LABORATORY
COMPUTER ROOM (1)
COMPUTER ROOM (2)
PHYSICAL MEASUREMENT LABORATORY
7170
3500
5000
5000
10000
25000
10000
11000
3500
1500
7000
3000
17000
7000
1500
2nd FLOOR PLAN
N



NORTHWEST ELEVATION

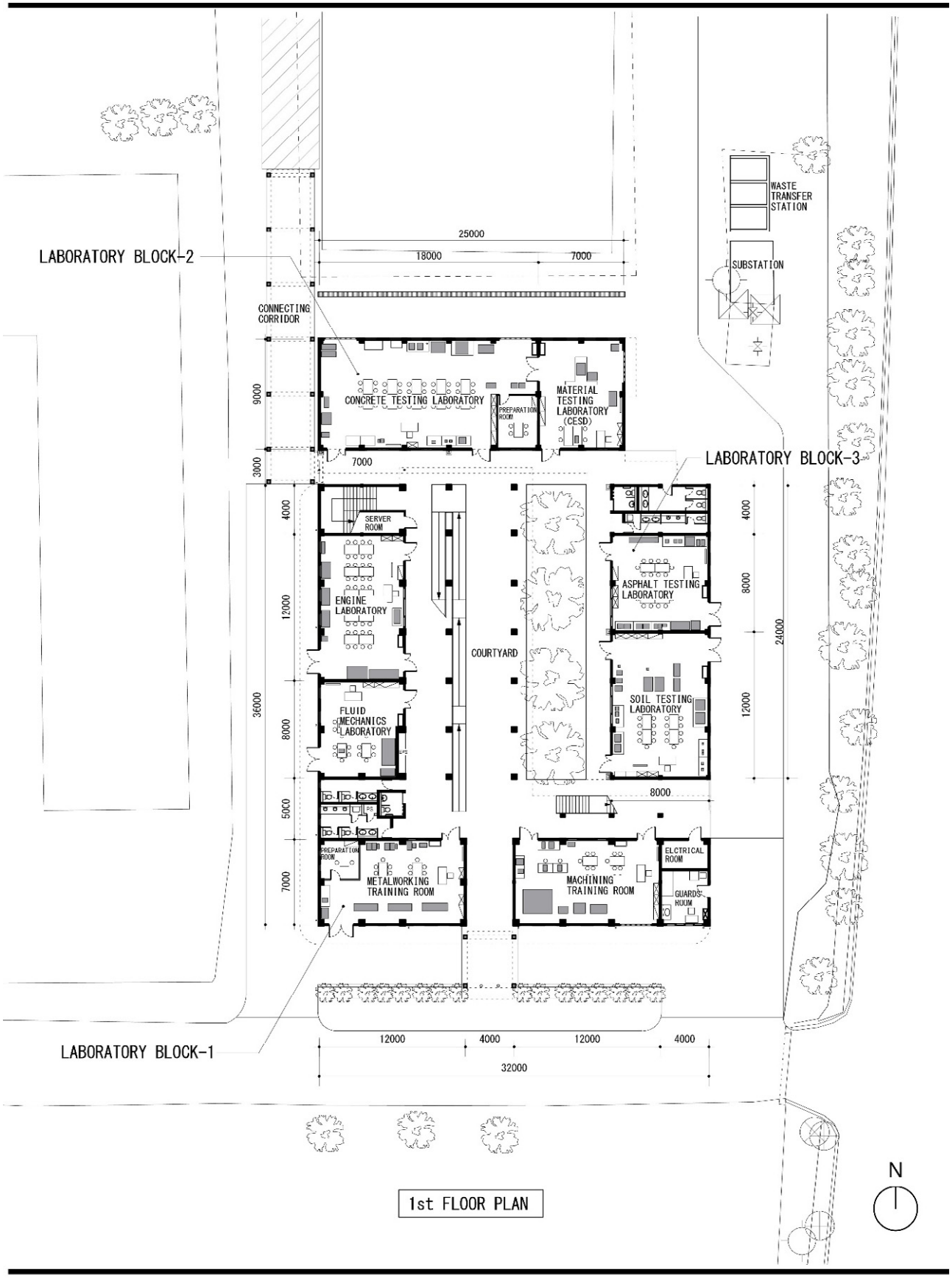


SOUTHEAST ELEVATION

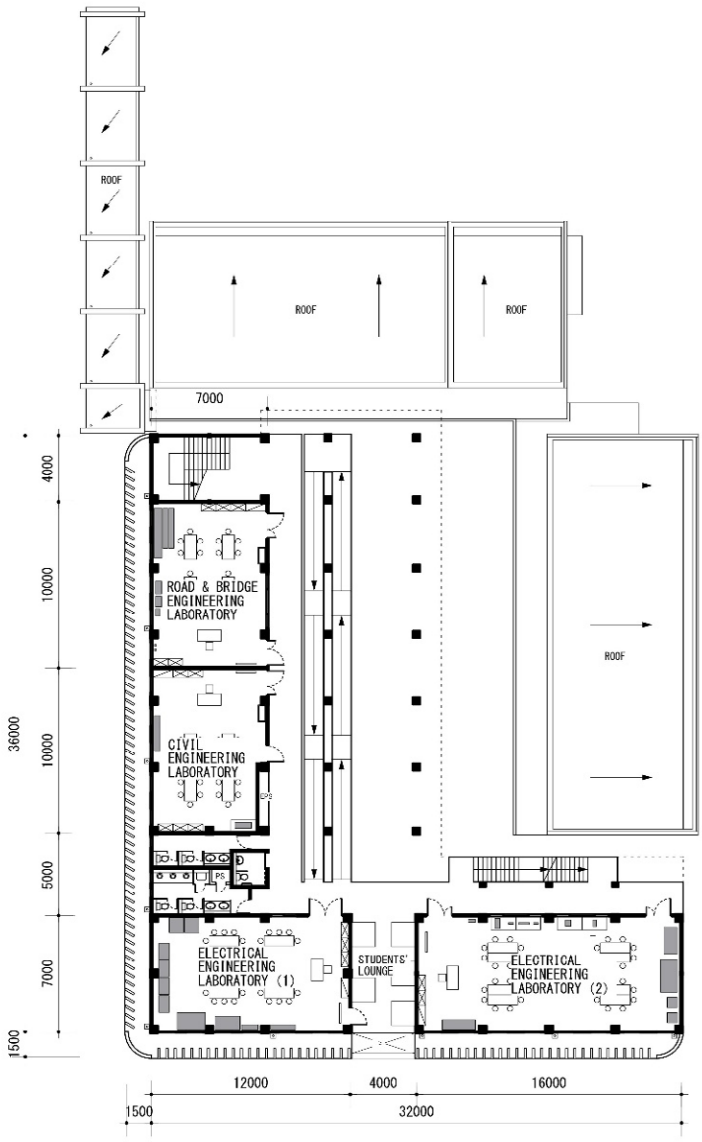


SECTION

LABORATORY BLOCKS FLOOR PLAN (1st FLOOR)



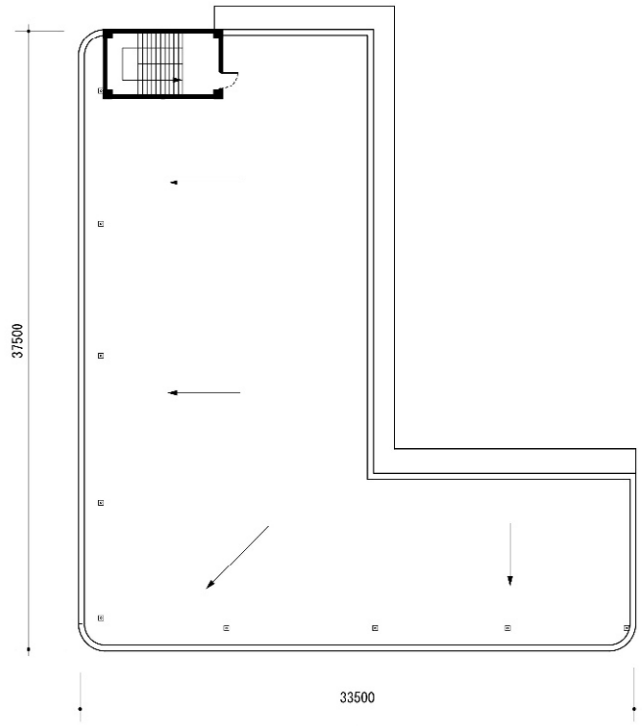
LABORATORY BLOCKS FLOOR PLAN (2nd FLOOR)



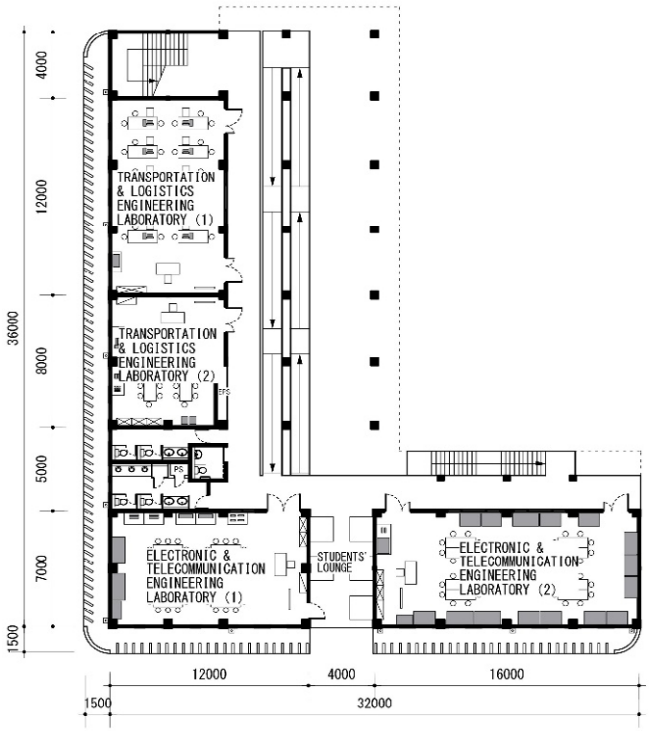
2nd FLOOR PLAN

N

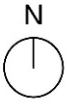
LABORATORY BLOCKS FLOOR PLAN (3rd FLOOR、ROOF)



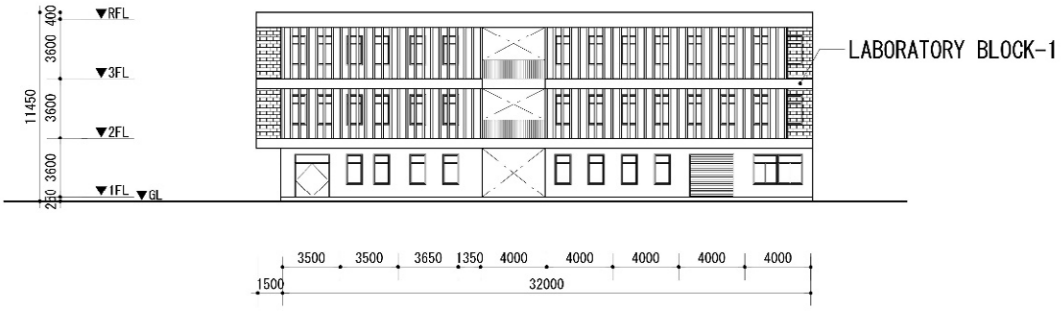
ROOF PLAN



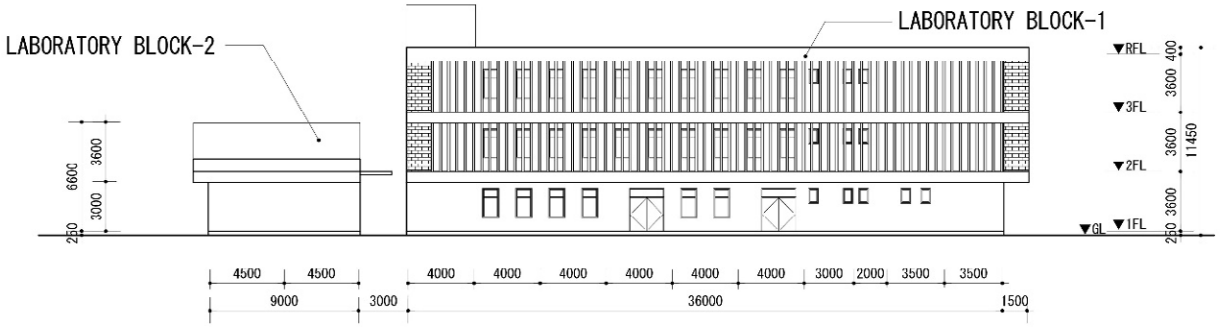
3rd FLOOR PLAN



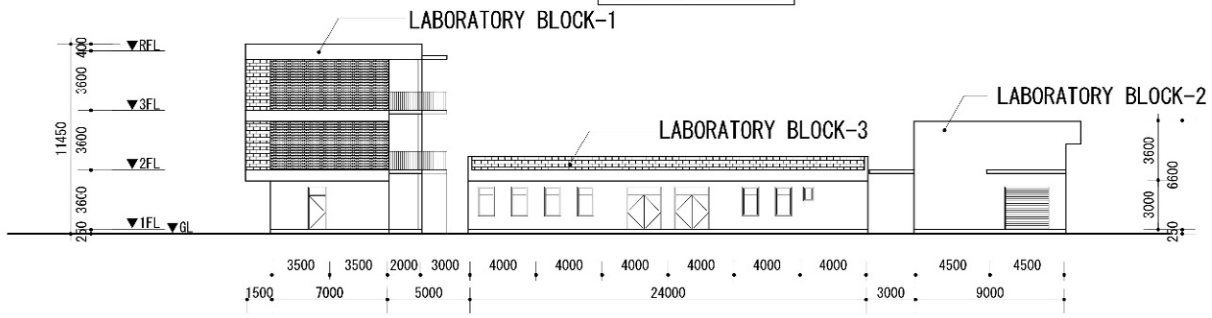
LABORATORY BLOCKS ELEVATION、SECTION



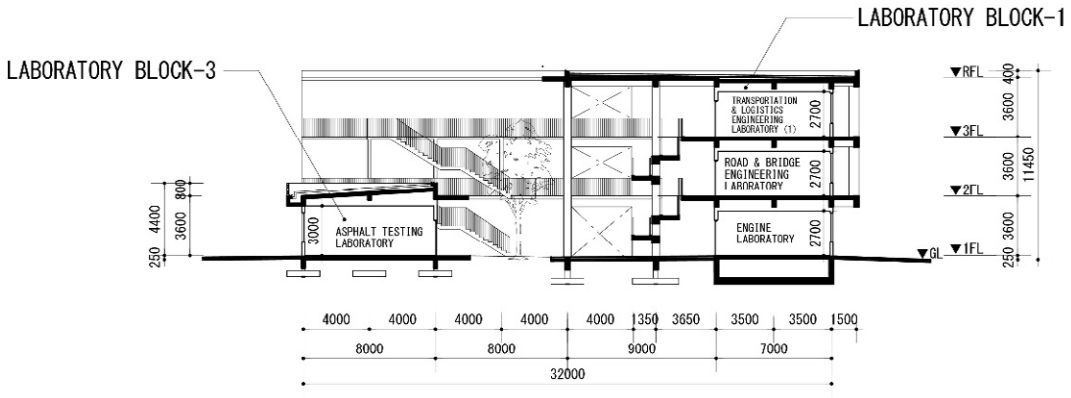
SOUTH ELEVATION



WEST ELEVATION



EAST ELEVATION



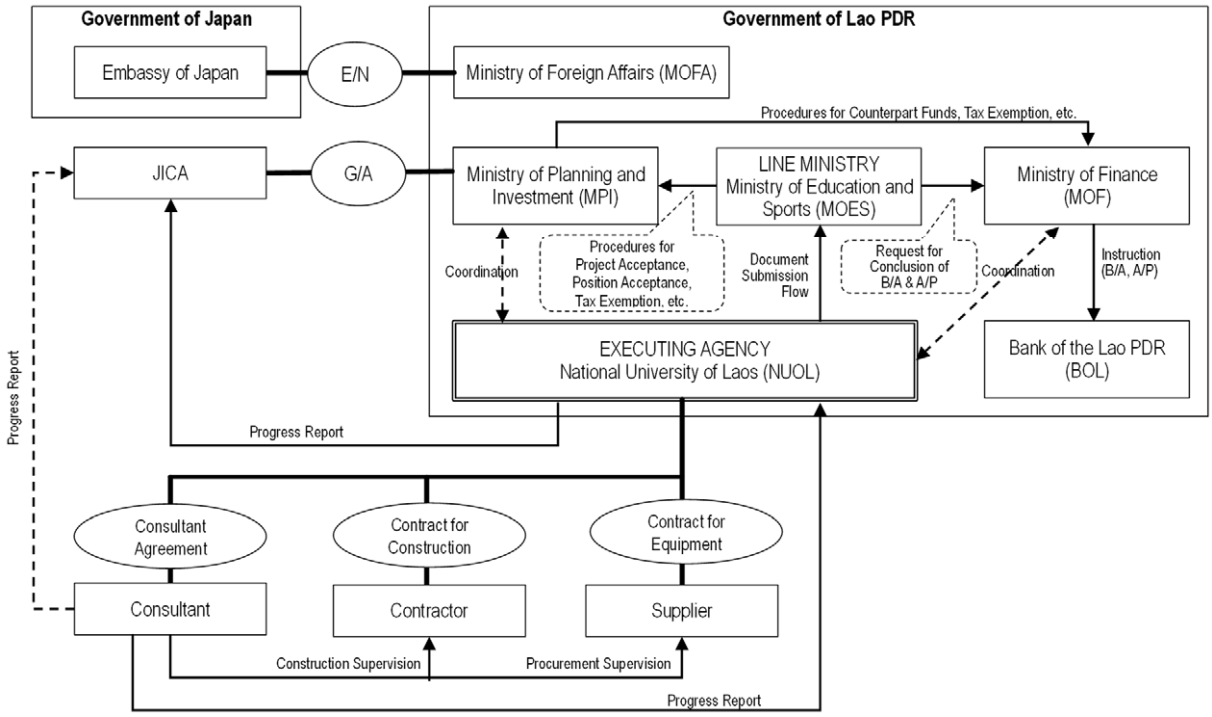
SECTION

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

This Project is to implement building construction and equipment procurement for FEN-NUOL under the Japanese Project Grant scheme. The Project will commence after concluding the Exchange of Notes (E/N) between the governments of Lao PDR and Japan, and the Grant Agreement (G/A) between the government of Lao PDR and JICA, following the approval by the cabinet of government of Japan.

Based on the framework of G/A, NUOL as Executing Agency, and Ministry of Foreign Affairs (MOFA) as the signer of E/N, and Ministry of Planning and Investment (MPI) as the signer of G/A will be involved in the Project from Lao PDR side. In addition, Ministry of Education and Sports (MOES), the line ministry of NUOL, will support NUOL as Executing Agency of the Project, in coordination among the government of Lao PDR at ministry level. Ministry of Finance (MOF) and Bank of the Lao PDR (BOL) will also be involved in the Project for concluding Banking Arrangement (B/A) and Authorization to Pay (A/P)[15].



(Source: The survey team based upon the answers to the questionnaires to MPI)

Figure 2-18 Project Implementation Organogram

(1) Executing Agency

NUOL, Executing Agency of this Project, is the only national university[16] who is authorized to operate independently. NUOL is one of the five state institutions selected for conducting a trial

[15] The roles and responsibilities of ministries/agencies for ODA projects in Lao PDR are stipulated in "Decree on Management and Utilization of Official Development Assistance, No. 357/GOL, October 9, 2019".

[16] There are four national universities in Lao PDR, namely NUOL, Souphanouvong University, Savannakhet University and Champasack University, however, only NUOL is operated independently while other three universities are operated under Department of Higher Education of MOES.

financially self-sufficiency scheme of the government of Lao PDR, and it was decided to be implemented three years from the latter half of 2021 by the government[17]. NUOL has been financially independent even before commencing the trial self-sufficient scheme, and the budget of NUOL used to be directly requested and allocated to/from MOF. After the introduction of the self-sufficiency policy, the personnel cost (salary and allowance) will be budgeted by the government of Lao PDR, while the administration cost (costs for operation and maintenance), the accumulative cost (costs for activities on educational quality improvement, cultural/social events, etc.), and the cost for purchasing administrative assets will be managed by the technical budget of NUOL, the major fund source of which is tuition from students.

Meanwhile, executive positions and curriculums/syllabuses of NUOL shall be approved by MOES, the line ministry of NUOL.

As described above, MOFA, MPI, MOES, MOF and BOL in addition to NUOL will be involved in the Project. In principle, NUOL, as Executing Agency, shall be responsible for coordinating with the concerned ministries and agencies, however, all governmental documents shall be submitted to such ministries and agencies through MOES, as the line ministry of NUOL.

(2) Consultant

After signing of E/N and G/A for the Project, the Executing Agency of the Project and a Consultant in Japan will sign an agreement for the consulting services. The Consultant will carry out the following works.

1) Detailed Design Stage

Preparation of bidding documents, including detailed design drawings and technical specifications for construction work and equipment procurement, and assistance in obtaining necessary approvals for the bidding documents.

2) Bidding Stage

Assistance to Executing Agency in the bidding and contractual procedures (including bid notices, bidding documents distribution, answers to questions from bidders, bid openings, bid evaluation, contracts with Contractor and the Supplier).

3) Construction and Procurement Stage

Supervision for construction work and equipment procurement (including installation, operational guidance and maintenance guidance of equipment).

4) Search Over the Defects (One Year Inspection)

Search over the defects for the facilities constructed by the Project one year after the date of handing-over.

[17] The governmental decision was made based on Prime Minister Office's Notice (No.856/PMO dated on August 12, 2020), Finance Minister's Guideline on Management of Income and Expenditure of Financially Self-sufficient Technical Service Unit (No.2257/MOF dated on May 21, 2020), and Agreement on Approval of 5 Technical Service Units for Trial Financially Self-sufficiency (No.2301/MOF dated on May 27, 2021). The five institutions selected for 3-years trial self-sufficient scheme are Mittaphab Hospital, Mahosot Hospital, Setthathirath Hospital, NUOL, and the Pakpasak Technical College.

(3) Contractor and Supplier

Complying with the Japanese grant aid scheme, the Contractor for construction work and the Supplier for equipment procurement will be selected through general competitive bidding opened to Japanese companies who satisfy the required eligibilities. The selected Contractor and Supplier will make contracts with Executing Agency of Lao PDR side for construction work and equipment procurement respectively. Then, the Contractor and the Supplier will conduct their work in accordance with the contract documents.

(4) JICA

JICA will sign on G/A with the government of Lao PDR, and will monitor the Project implementation, in line with the Japanese grant aid scheme.

2-2-4-2 Implementation Conditions

(1) Considerations to Operation of FEN-NUOL during Construction Period

The construction work of this Project will be carried out in the same campus where FEN-NUOL continues to operate. Therefore, the area for FEN-NUOL operation, the area for construction work (temporary fenced area for construction), and the separation of traffic/pedestrian routes for FEN-NUOL users and the construction engineers/workers were discussed and confirmed with FEN-NUOL.

- The east campus gate will be solely used for the construction work, and FEN-NUOL users will use the other gates during the construction period.
- The west plot to the existing civil engineering laboratory building (A3 building) (about 2,000m^2) and the rotary between Construction Area A and the football field (about 1,800m^2) will be utilized for temporary facilities, such as a temporary site office (including an office for the Consultant), material yards, workers' camp, etc., during the construction period. The areas utilized for temporary facilities shall be restored by the Contractor, as his responsibility, after the completion of construction work.
- Prior to the commencement of work by Japanese side, the A3 building will be temporarily closed, and furniture and equipment in the building shall be transferred to the other designated building within the campus by Lao PDR side. The building may be utilized by the Contractor for temporary purpose. If the building is utilized by the Contractor, he shall be responsible to protect equipment which remains within the building, and to restore the building after the completion of work.
- The area and routes for the construction work and the FEN-NUOL operation shall be clearly demarcated by temporary fences. However, because the southside parking lots and the northside existing buildings are separated by the temporary fences, a temporary gate for pedestrians which is to be controlled by a guard, will be provided in the middle of campus main road within the fenced area, taking into account FEN-NUOL users convenience.

(Source: The survey team)

Figure 2-19 Temporary Plan during Construction Period

(2) Safety Control for Construction Work

The supervision plan and the construction safety plan will be prepared in reference to "the Guidance for the Management of Safety for Construction Works in Japanese ODA Projects" of JICA. The plans will also include the specific factors of this Project, such as the legislation in Lao PDR, the situations and practices of construction industry there, the location of the Project site, and the contents of the Project, etc. It is essential to maintain and update the safety measures and to improve awareness of safety by means of the Contractor's safety measures and activities following the plans (including activities for accident prevention, such as toolbox meetings, safety meetings, and safety patrols) as well as the Consultant's supervision and instructions.

(3) Work Schedule Coordination between Construction Works and Equipment Procurement

The universal testing machine which is to be placed in Material Testing Laboratory cannot be delivered and installed after the completion of construction work because the equipment is too big. Thus, the equipment shall be delivered and installed during the construction period. Once the Contractor and the Supplier for the Project are selected and contracted, the work schedules will be discussed and coordinated.

(4) Tax Exemption

"Decision on Official Development Assistance Financial Management Rules, No. 2695/MOF, dated on November 1, 2010" and the other legislations for each type of tax stipulate about tax exemption for ODA projects in Lao PDR. Meanwhile, careful attention needs to be paid to the practical procedure of tax exemption, because it may take half a year for the tax exemption procedure resulting from unclear regulations and operational confusions. Thus, it is important to confirm the updated information before starting the tax exemption process.

In the past Japanese grant aid projects, value added tax (VAT) and the import duty used to be exempted once master lists thereof were approved. However, the internal procedure for ODA project tax exemption has been recently changed according to "Decree on Management and Utilization of Official Development Assistance, No. 357/GOL, dated on October 9, 2019" and "Guideline on the Management and Utilization of Government Counterpart Funds for the Implementation of Official Development Assistance Projects, No. 1987/MPI, November 27, 2020". The new decree and guideline stipulate that an executing agency of each ODA project shall report the amount of the governmental contribution (namely Counterpart Funds), including the tax amount to be exempted, to MPI by May 15 (every year). Then, it shall be endorsed by the National Assembly (in November) after necessary procedures in MPI and MOF. Revision of the approved Counterpart Funds can be requested two times per year, at the timing of supplementary budget in addition to the ordinary budget.

Although the tax amount to be exempted will not be actually disbursed nor expensed, the MPI guideline regulates to include such amount into Counterpart Funds as "In cash contribution as transaction records in the form of exemption of import duties, income tax and value added tax as part of the project agreements[18]". According to MPI and MOF, an executing agency of an ODA project may request Counterpart Funds for 10-15% of the total amount of the project, if it submits breakdowns of the annual expenses including tax exemption amount.

The tax exemption procedures for each tax item are described below.

1) Import Duty

Materials and equipment to be imported for the Project by the Contractor and the Supplier will be exempted from import duties if the master lists thereof are approved. A master list prepared by the Contractor or the Supplier will be submitted to Executing Agency for submission to MPI (in some cases, it may be reviewed by MPWT before submission to MPI). After confirmation of MPI, the master list will be finally approved by Department of International Cooperation (DIC) of MOF, and then Department of Customs of MOF will issue a certificate of tax exemption. The procedures for import duty exemption have been in place, however, attention will be paid to that it takes longer time for the entire process if the items are many.

[18] Guideline No. 1987/MPI stipulates 4 categories of Government Counterpart Funds; **"1 In cash contribution"**, "2 Contribution in the form of tax, duties and other fees", "3 In kind contribution", and "4 Public investment project". Among them, "1 In cash contribution" has two sub-categories; "(1) Expenses which the government is committed to contribute" and **"(2) Transaction records in the form of tax exemption"**. This section describes about "(2) Transaction records in the form of tax exemption" of "1 In case contribution".

2) VAT

Following the similar process of import duty, materials and equipment to be purchased for the Project by the Contractor and the Supplier will be exempted from VAT, by obtaining certificates of tax exemption issued by Department of Tax, MOF. However, take note that it tends to take longer for the process comparing to the ones for import duty.

3) Income Tax and Corporate Tax

Personal income tax for a foreign expert involved in an ODA project used to be exempted without any conditions. As for corporate tax, it used not to be imposed on an enterprise not registered in Lao PDR, while it might be instructed to file for zero (0) case by case. However, it is noted that a note verbal needs to be concluded between the two governments for confirmation of the extent of tax exemption for income tax and corporate tax for each ODA project, in recent years.

(5) Project Implementation under the Impact of COVID-19

As of January 2022, severe adverse impacts caused by the global pandemic of COVID-19 have continued for transportation and working environment in both of Japan and Lao PDR, and travelling and transportation between the two countries. It is difficult to assume whether it will become improved before the commencement of the Project, and how much/far it will affect the Project. If the situation as of January 2022 continues for a while in both countries, the following impacts to the Project are expected, in addition to supplementary costs for the preventive measures against COVID-19.

- Construction material procurement from the neighboring countries:
  As for materials supplied by the specialized manufacturers in the neighboring countries, such as Thailand and Vietnam, procurement schedule for such materials might be delayed due to closures of the manufacturing factories and/or difficulty to travel for the manufacturers' experts.
- Equipment procurement:
  Because it takes longer time to procure materials and parts, the production time period especially for machining equipment and equipment for practical works will be set to 8-9 months which is longer than the usual period of 6 months or so.

2-2-4-3 Scope of Work

The scope of work for Japan and Lao PDR sides are determined as follows.

(1) Japan Side

- Construction of the planned buildings
- Procurement, installation, commissioning, initial operation/maintenance training of the planned equipment

(2) Lao PDR Side

- Demolition of structural and underground obstacles

  For CESD (Construction Area A)

  - Rerouting the existing electrical/telephone cables including relocation of a pole.
  - Rerouting the existing underground service line (if any).

  For Laboratory Blocks (Construction Area B)

  - Demolition of the existing guard house and concrete platform behind the guard house (including underground structure).
  - Rerouting the existing underground service line (if any).
  - Rerouting the existing electrical/telephone cables including relocation of poles.
- Removal of trees
- Rerouting (or lifting) the existing loose electrical/telephone cables around the east gate.
- Removal of temporary facilities (fence, sheds, etc.) of the contractor for the 4FL classroom building.
- Moving the existing furniture and equipment in the existing civil engineering building (A3 building) (except the ones not in use and/or difficult to move), which will be temporarily closed during the construction period, to an alternative building within the campus.
- New connection of service infrastructures
  - New electrical power connection from the EDL MV service line (22kV) along Lao-Thai road at the east side to the primary side of transformer at the substation to be provide by the Project.
  - New water supply connection with d=75mm supply pipe from the water main along Lao-Thai road at the east side to a water meter for the project.
  - New sewage connection for:
    - water from septic tank for Laboratory Blocks: with d=200 mm sewage pipe from the sewage main along Lao-Thai road at the east side to a manhole near the road boundary.
    - water used for concrete test and rainwater for Laboratory Blocks: with d=200 mm sewage pipe from the sewage main along Lao-Thai road at the east side to a manhole near the road boundary.
    - water from septic tank and rainwater for CESD: with d=250mm sewage pipe from the sewage main along the road at the northwest side (near the dormitory zone) to a manhole near the road boundary.
  - New optical cable connection to a router to be installed in Server Room in Laboratory Blocks.
- Installation of the existing equipment, etc. upon the completion of construction work
  - Installation of 40 computers to Computer Room (2) in CESD.
  - Reinstallation of furniture and equipment to A3 building.

2-2-4-4 Consultant Supervision

The Consultant will supervise the building construction and equipment procurement, taking into consideration the following basic principles and issues so that the Project will be implemented smoothly under the scheme of Japanese grant aid.

(1) Building Construction Supervision

- The Consultant will always closely communicate with the stakeholders of both Japan and Lao PDR sides and coordinate the building construction and equipment procurement so that the Project will be finished as scheduled.
- The Consultant will advise to the Contractor and its stakeholders on the construction schedule management, construction quality management and construction safety management in a timely, appropriate and fair manner.
- The Consultant will establish a clear report line between Executing Agency and relevant authorities to swiftly cope with any issues and problems when arise.
- The Consultant will facilitate Lao PDR side to implement their undertakings without delay.

(2) Equipment Procurement Supervision

- The Consultant will closely communicate with the stakeholders of both Japan and Lao PDR sides so that the equipment will be procured without delay.
- The Consultant will advise and/or instruct to the Supplier and their stakeholders in a timely, appropriate and fair manner.
- The Consultant will advise and/or instruct the stakeholders of FEN-NUOL on the operation and management of the equipment after the procurement and installation.
- Following the installation and confirming that the contracts are fulfilled, the Consultant will attend the inspection and hand-over. The Consultant will finish their work upon the approval by Lao PDR side.

2-2-4-5 Quality Control Plan

(1) Building Construction

The Contractor will submit the Consultant documents and materials such as the work plans, shop drawings and sample of the construction materials, according to the contract document including technical specifications and drawings. The Consultant will study the submitted documents or materials for approval. The Contractor will carry out various inspections in accordance with the specifications and work plans. The Consultant will attend inspections as may be necessary and confirm the test results submitted by the Contractor. The major items of quality control for the building construction are summarized in the table below.

Table 2-18 Major Quality Control Items

Work	Item	Inspection/Test	Frequency
Earth works	Bottom of excavation	Depth of excavated bottom level Soil conditions	Upon completion of excavation
Reinforcement and formwork	Rebar material	Verification of mill sheets or tensile tests	Upon delivery
	Rebar arrangement	Rebar arrangement inspection	Prior to concreting
	Form work	Form work inspection	Prior to concreting
Concrete works	Materials	Verification of cement type Grading of aggregate, specific gravity, chloride content	Upon mixing planning
	Mix proportion	(Document check) Unit cement content, unit water amount, aggregate content, water-cement ratio, slump of mix proportion	Upon trial mix
		(Tests upon trial mix) Slump, air content, concrete temperature, chloride content and compressive strength tests	
	Concrete quality (at the time of unloading from the concrete mixer truck)	Slump, air content concrete temperature, chloride content	Per casting part Per design concrete strength
	Concrete quality (at the time of casting)	Compression test on sample	
	Accuracy (after casting)	Inspection at the time of removing the forms	

(Source: The survey team)

(2) Equipment Procurement

Since all items to be procured for the Project are finished products, pre-shipment inspections either in the factories or at the shipping ports will be carried out to control the quality of the equipment. Of items to be procured from Japan, items packed under the responsibility of the manufacturers, delicate machinery and/or oversized equipment will be inspected at the respective factories before shipment.

As for the remaining items to be procured from Japan or third countries, they will be inspected in the warehouse at the port (or airport) of shipment. Shipping documents, the items to be exported, and contract documents will be cross-checked. The Consultant shall outsource the pre-shipment inspection to a third party, which will issue to the Consultant an inspection certificate after the inspection.

2-2-4-6 Procurement Plan

(1) Building Construction

The construction materials manufactured in Lao PDR do not vary, but the major construction materials from third countries are available in the local market. However, it is difficult to procure construction materials of certain quality in bulk. Thus, it is expected to import reinforcing bars, structural steel, metal products, finishing materials, and materials for electrical and mechanical work from neighboring countries such as Thailand and Vietnam. The table below shows the major construction materials and their sources.

Table 2-19 Sources of Major Construction Materials

Materials	Source of Procurement			Remarks (Country of Origin)
	Lao	Japan	Third Country	
Construction Materials				
Portland Cement	○		○	Domestic or imported products (Thailand, China, etc.)
Aggregate for concrete	○			
Reinforcing bar	○		○	Domestic or imported products (Thailand, Vietnam, etc.)
Structural steel	○		○	Domestic or imported products (Thailand, Vietnam, etc.)

Forms	○			
Plywood	○		○	Imported products (Thailand, China, etc.)
Concrete block	○			
Coating film (Water proof material)			○	Imported products (Thailand, etc.)
Ceramic tile	○		○	Imported products (Thailand, China, etc.)
Brick	○			
Wood/ Timber	○			
Aluminum doors/windows	○		○	Imported products (Thailand, Vietnam, etc.)
Painting materials	○		○	Domestic or imported products (Thailand, etc.)
Light gauze steel (LGS)	○		○	Imported products (Thailand etc.)
Gypsum board, Fiber cement board	○		○	Imported products (Thailand etc.)
Materials for Electrical Work				
Distribution board	○		○	Imported products (Thailand etc.)
Electrical Cable/Cable	○		○	Imported products (Thailand etc.)
Conduit pipe	○		○	Imported products (Thailand etc.)
Lighting fixture	○		○	Imported products (Thailand etc.)
Materials for Mechanical Work				
Sceptic tank (FRP, SUS)	○		○	Imported products (Thailand etc.)
Water pipe (steel)	○		○	Imported products (Thailand etc.)
Water pipe (uPVC)	○		○	Imported products (Thailand etc.)
Drain pipe	○		○	Imported products (Thailand etc.)
Valves, Accessories	○		○	Imported products (Thailand etc.)
Sanitary ware	○		○	Imported products (Thailand etc.)
Air-conditioner	○		○	Imported products (Thailand etc.)

(Source: The survey team)

(2) Equipment Procurement

As previously stated, the Project assumes to procure the equipment from Japan, Lao PDR, and third countries. In order to secure fair competition among suppliers, as for items which are manufactured by limited number of Japanese companies, the Project plans to include products from third countries. When the products manufactured in third countries are included, the Project prioritizes items from manufacturers which have a licensed agent in the neighboring countries of Lao PDR such as Thailand and Vietnam, for the sole purpose of easier installation and after-sale services. In order to secure the quality of the items to be procured, the Project shall narrow down the country of origins such as DAC or OECD countries. Furthermore, the Project shall consider the quality of the product as important as the price in the selection process.

Regarding items from Japanese, US, and/or European manufactures, but are made in China or Southeast Asian countries, the Project will include them on the condition that the headquarters of the manufactures are registered in Japan, DAC and/or OECD countries to secure the quality of the items.

2-2-4-7 Operational Guidance Plan

The Supplier shall be responsible for delivery, installation and commissioning test followed by the initial operation guidance to the end-users. Concerning training machines and machining equipment that require a certain technical skill to install, handle, adjust and operate a commissioning test, the Project plans that the manufactures or their licensed agents of items shall dispatch technicians from Japan or third countries to guide the end-users as to how to use and to maintain these items. Concerning other equipment, the initial operation guidance shall be carried out by technicians hired by the Supplier.

The Consultant shall supervise the initial operation and guidance to be executed in an appropriate manner.

At the time of handing-over, the representatives of FEN-NUOL and the concerned departments respective departments, the Consultant, and the Supplier shall check each other on the contents and their comprehension of the initial operation guidance. No training on the operation of equipment is covered by the Project.

2-2-4-8 Soft Component Plan

Considering that the initial operation guidance is to be carried out by technicians from the manufacturers or their agents, and HUGETECH assists FEN-NUOL in building the management capacity of the laboratory equipment maintenance, the Project does not include soft component activity.

2-2-4-9 Implementation Schedule

After signing on the Consultant Agreement, the detailed design and the bidding will be proceeded, then the Contracts with the Contractor and the Supplier will be concluded respectively. It will take 6 months for the detailed design (the site survey to the bidding documents approval), and 3 months for the bidding (the bid notice to the contracts for construction works and equipment procurement). The implementation period for construction and procurement is estimated as 15 months. The provisional implementation schedule of the Project is as follows.

Table 2-20 Project Implementation Schedule (Provisional)

Item		Months	1	2	3	4	5	6	7	8	9
Detailed Design	Detail Design Site Survey										
	Detailed Design, Cost Estimation										
	Prepation and Approval of Bidding Docuemnts										
	Bid Notice, Bidding Documents Distribution, Q&A										
	Bid Opening, Bid Evaluation										
	Contract										
Undertakings by Lao PDR side	Preparatory Works	・Demolition of obstacles ・Removal of trees ・Rerouting existing elec. cables ・Moving existing furniture & equipment etc.									
	Building Permit										

Item		Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Construction and Procurement	Construction	Mobilization and Preparation															
		Earth and Foundation Works															
		Structural Works															
		Finishing Works															
		Mechanical and Electrical Works															
		External Works															
		Inspection															
	Procurement	Equipment Manufacture															
		Transportation															
		Installation, Commissioning															
		Inspection															
Undertakings by Lao PDR side	Service Infrastructure Connection	Elecricity, Water supply, Sewege, Telecommunication															

(Source: The survey team)

2-3 Security Plan

The Project shall take safety measures according to JICA's safety rules. As of January 2022, the Project site is categorized as "Level 1 (be cautious)" area of danger according to the overseas safety information by Ministry of Foreign Affairs of Japan. Common crimes such as robbery are on the rise in urban areas, thus, all the Project staff shall take necessary safety measures.

Due to the COVID-19 pandemic, the current infection disease information status of Lao PDR is at 2, which advises potential travelers not to travel outside for business purpose. If the pandemic continues into the Project implementation period, all Project staff shall follow instructions from the government of Lao PDR and the Embassy of Japan to prevent from being infected and/or to cope with when staff is infected.

2-4 Obligations of Recipient Country

Specific obligations of Lao PDR side, which will NOT be funded by Japan are as follows.

(1) Before Bidding

1. To sign the banking arrangement (B/A) with a bank in Japan (the Agent Bank) to open bank account for the Grant.
2. To issue A/P to the Agent Bank for the payment to the consultant.
3. To bear the following commissions to the Agent Bank for the banking services based upon B/A.
   - Advising commission of A/P.
   - Payment commission for A/P.
4. To secure and clear the following land within FEN-NUOL campus.
   - Construction area for CESD (approx. 2,000m^2).
   - Construction area for Laboratory Buildings (approx. 3,000m^2).
   - Two lots of areas for temporary facilities (approx. 2,000m^2 + 1,800m^2).
5. To obtain the building permit.
6. To clear the construction areas by conducting the following preparatory works.
   - Demolition of structural and underground obstacles.

     <u>For CESD</u>
     - Rerouting the existing electrical/telephone cables including relocation of a pole.
     - Rerouting the existing underground service line (if any).

     <u>For Laboratory Blocks</u>
     - Demolition of the existing guard house and concrete platform behind the guard house (including underground structure).
     - Rerouting the existing underground service line (if any).
     - Rerouting the existing electrical/telephone cables including relocation of poles.
   - Removal of trees.
   - Rerouting (or lifting) the existing loose electrical/telephone cables around the east gate.
   - Removal of temporary facilities (fence, sheds, etc.) of the contractor for the 4FL classroom building.
7. To secure alternative facilities to accommodate functions of the existing civil engineering building (A3 building), which will be closed during the construction period, and to move the existing furniture and equipment in A3 building (except the ones not in use and/or difficult to move) to the alternative building.
8. To submit Project Monitoring Report (with the result of Detailed Design)

(2) During the Project Implementation

1. To issue A/P to the Agent Bank for the payment to the supplier and the contractor.

2. To bear the following commissions to the Agent Bank for the banking services based upon the B/A.
   - Advising commission of A/P.
   - Payment commission for A/P.

3. To ensure prompt customs clearance and to assist the Contractor/Supplier with internal transportation in the country of the Recipient.

4. To accord Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work.

5. To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted.

6. To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project.

7. To notify JICA promptly of any incident or accident, which has, or is likely to have, a significant adverse effect on the environment, the affected communities, the public or workers.

8. To submit Project Monitoring Report
   - To submit Project Monitoring Report.
   - To submit Project Monitoring Report (final) (including as-built drawings, equipment list, photographs, etc.)

9. To submit a report concerning completion of the Project.

10. To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the site(s).
    - New electrical power connection from the EDL MV service line (22kV) along Lao-Thai road at the east side to the primary side of transformer at the substation to be provided by the Project.
    - New water supply connection with d=75mm supply pipe from the water main along Lao-Thai road at the east side to a water meter for the Project.
    - New sewage connection for:
      - water from septic tank for Laboratory Blocks: with d=200 mm sewage pipe from the sewage main along Lao-Thai road at the east side to a manhole near the road boundary.
      - water used for concrete test and rainwater for Laboratory Blocks: with d=200 mm sewage pipe from the sewage main along Lao-Thai road at the east side to a manhole

near the road boundary.

- water from septic tank and rainwater for CESD: with d=250mm sewage pipe from the sewage main along the road at the northwest side (near the dormitory zone) to a manhole near the road boundary.

- New optical cable connection to a router to be installed in Server Room in Laboratory Blocks.

11. Installation of the existing equipment, etc. upon the completion of construction works.
    - Installation of 40 computers to Computer Room (2) in CESD.
    - Reinstallation of furniture and equipment to A3 building.

12. To ensure the safety of persons engaged in the implementation of the Project.

13. To take necessary measures for safety of the Project site, if required (measures for safety)
    - Maintaining the safety of workers and the general public by thorough implementation of safety measures and immediate action in the case of accident
    - Traffic control around the site(s) and on transportation routes of construction materials
    - Installation of fences around the site(s)

(3) After the Project

1. To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid
    - Allocation of maintenance cost
    - Operation and maintenance structure
    - Routine check/Periodic inspection

2-5 Project Operation Plan

2-5-1 Operation Plan

In parallel to this Project, HUGETECH has been underway from December 2020 to November 2025, and it will assist FEN-NUOL in improving experimental/practical work including revision of experimental/practical work manuals, in conducting graduation research, in promoting academic-industrial collaborations, and in improving maintenance of the equipment. It is expected that the utilization and management of the equipment of FEN-NUOL will be strengthened after handing-over the buildings and equipment by the Project through advices from HUGETECH.

2-5-1-1 Necessary Budget for Operation and Maintenance

The fund sources for the budget of NUOL and FEN-NUOL are classified into two; (1) the governmental budget and (2) the technical budget sourced from NUOL's tuition fees and other income from outsourced testing services and seminars, etc. The whole budget of NUOL, including tuition fee income comes from each faculty, is controlled by the finance division of NUOL headquarters in Dongdok campus, and it is reallocated to each faculty.

Up to the year 2020, the personnel cost (salary and allowance), the administration cost (cost for operation and maintenance), the accumulative cost (cost for activities on educational quality improvement, cultural/social events, etc.), and the cost for purchasing administrative assets used to be paid from both the governmental budget and the technical budget.

However, as stated above, the government of Lao PDR has set the policy on the trial financially self-sufficiency scheme of the selected five state institutions for three years from the latter half of 2021. Under the scheme, the governmental budget covers personnel costs (salary and allowance), while the technical budget (mainly sourced from NUOL's tuition fees) covers the operation and maintenance cost (O&M cost), the accumulative cost, and the cost for purchasing administrative assets.

The following table shows the NUOL[19] budgets from 2017 to 2021. The total annual budget of NUOL varies from 166 to 190 billion LAK (approx. 1,877 to 2,155 million JPY), while the governmental budget of which has been reduced by 32 billion LAK, from 151 to 121 billion LAK (approx. 340 million JPY, from 1,710 to 1,370 million JPY) for the past 5 years, against a background of financial difficulties in the government. Meanwhile, the technical budget of NUOL has increased from 40 billion LAK (approx. 450 million JPY) of 2017 to 45 billion LAK (approx. 510 million JPY) in 2021. According to the financial division of NUOL, the technical budget has been increased because of increase of number of students as well as price increase of tuition fee. As for the O&M cost, 28-36 billion LAK (approx. 320-410 million JPY) are annually budgeted, though it varied year by year. In the year 2021 budget, the government budget covers only personnel cost (with a budget for the president office activities), while the other budget items are planned as the technical budget.

[19] The JPY amounts in the table are calculated at the exchange rate specified for this preparatory survey (1 LAK=0.011327 JPY) as described in "2-6 Project Cost Estimation" of this report. The JPY amounts in this Chapter are also calculated with the same.

Table 2-21 NUOL Annual Budget by Fund Source (Year 2017-2021)

(Amount Unit: million LAK)

Year	Item	Government Budget		Technical Budget of NUOL		Total	
		Amount	Ratio	Amount	Ratio	Amount	Ratio
2017	**Total Budget Amount**	**148,914**	**79.0%**	**39,674**	**21.0%**	**188,588**	**100.0%**
	(converted in JPY)	**(1,687 mil. JPY)**		**(449 mil. JPY)**		**(2,136 mil. JPY)**	
	Personnel Costs	103,928	55.1%	20,199	10.7%	124,127	65.8%
	(converted in JPY)	(1,177 mil. JPY)		(229 mil. JPY)		(1,406 mil. JPY)	
	O&M Costs	16,371	8.7%	13,494	7.2%	29,865	15.9%
	(converted in JPY)	(185 mil. JPY)		(153 mil. JPY)		(338 mil. JPY)	
	Others	28,615	15.2%	5,981	3.1%	34,596	18.3%
2018	**Total Budget Amount**	**151,098**	**79.4%**	**39,124**	**20.6%**	**190,222**	**100.0%**
	(converted in JPY)	**(1,711 mil. JPY)**		**(443 mil. JPY)**		**(2,155 mil. JPY)**	
	Personnel Costs	103,778	54.6%	19,750	10.4%	123,528	65.0%
	(converted in JPY)	(1,175 mil. JPY)		(224 mil. JPY)		(1,399 mil. JPY)	
	O&M Costs	16,455	8.7%	14,885	7.8%	31,340	16.5%
	(converted in JPY)	(186 mil. JPY)		(169 mil. JPY)		(355 mil. JPY)	
	Others	30,865	16.1%	4,489	2.4%	35,354	18.5%
2019	**Total Budget Amount**	**137,741**	**74.0%**	**48,294**	**26.0%**	**186,035**	**100.0%**
	(converted in JPY)	**(1,560 mil. JPY)**		**(547 mil. JPY)**		**(2,107 mil. JPY)**	
	Personnel Costs	105,852	56.9%	22,352	12.0%	128,204	68.9%
	(converted in JPY)	(1,199 mil. JPY)		(253 mil. JPY)		(1,452 mil. JPY)	
	O&M Costs	16,236	8.7%	19,880	10.7%	36,116	19.4%
	(converted in JPY)	(184 mil. JPY)		(225 mil. JPY)		(409 mil. JPY)	
	Others	15,653	8.4%	6,062	3.3%	21,715	11.7%
2020	**Total Budget Amount**	**129,278**	**73.7%**	**46,149**	**26.3%**	**175,427**	**100.0%**
	(converted in JPY)	**(1,464 mil. JPY)**		**(523 mil. JPY)**		**(1,987 mil. JPY)**	
	Personnel Costs	106,285	60.6%	23,318	13.3%	129,603	73.9%
	(converted in JPY)	(1,204 mil. JPY)		(264 mil. JPY)		(1,468 mil. JPY)	
	O&M Costs	10,492	6.0%	17,342	9.9%	27,834	15.9%
	(converted in JPY)	(119 mil. JPY)		(196 mil. JPY)		(315 mil. JPY)	
	Others	12,501	7.1%	5,489	3.1%	17,990	10.2%
2021	**Total Budget Amount**	**121,118**	**73.1%**	**44,624**	**26.9%**	**165,742**	**100.0%**
	(converted in JPY)	**(1,372 mil. JPY)**		**(505 mil. JPY)**		**(1,877 mil. JPY)**	
	Personnel Costs	116,118	70.1%	0	0.0%	116,118	70.1%
	(converted in JPY)	(1,315 mil. JPY)		(0 mil. JPY)		(1,315 mil. JPY)	
	O&M Costs	0	0.0%	30,238	18.2%	30,238	18.2%
	(converted in JPY)	(0 mil. JPY)		(343 mil. JPY)		(343 mil. JPY)	
	Others (*)	5,000	3.0%	14,386	8.7%	19,386	11.7%

Personnel Costs : 60. Salary + 61. Supportive money

O&M Costs : 62. Administrative money

Others : 63. Accumlative money + 66. Purchase administrative assets

(Notes) 6x: Budget line item number

(*) 5,000 mil. LAK categorized in Others of 2021 govermental budget is for a budget for President Office activities.

(Source: Budget information provided by Finance Division of NUOL)

The following table shows the breakdown of O&M cost budget of NUOL and FEN-NUOL for the year 2021, which is covered by the technical budget of NUOL. The O&M cost consist of the consumable cost (for fuel, office consumables, tools & materials, water & electricity), the outsourcing cost (for maintenance and repair, insurance, telecommunication), the cost for business trip, the cost for seminar and training, and the social/festival purpose expenses, etc. The budget scale of the whole O&M cost for FEN-NUOL is 2,680 million LAK (approx. 30 million JPY), while of which the budget for building and equipment maintenance / repair is 755 million LAK (approx. 8.6 million JPY).

Table 2-22 Breakdown of O&M Cost Budget of NUOL and FEN-NUOL (Year 2021)

(Amount Unit: million LAK)

Item	NUOL (A)		FEN-NUOL (B)		% of FEN-NUOL
	Amount	Composition	Amount	Composition	(B) / (A)
Fuel	3,300	10.9%	0	0.0%	0.0%
(converted in JPY)	(37mil. JPY)		(0mil. JPY)		
Office equipment and printing	2,203	7.3%	231	8.6%	10.5%
(converted in JPY)	(25mil. JPY)		(3mil. JPY)		
Uniform	238	0.8%	0	0.0%	0.0%
(converted in JPY)	(3mil. JPY)		(0mil. JPY)		
Tools and materials	1,334	4.4%	50	1.9%	3.7%
(converted in JPY)	(15mil. JPY)		(1mil. JPY)		
Water supply and electricity	8,576	28.4%	0	0.0%	0.0%
(converted in JPY)	(97mil. JPY)		(0mil. JPY)		
Rental	62	0.2%	0	0.0%	0.0%
(converted in JPY)	(1mil. JPY)		(0mil. JPY)		
Maintenance and repair	6,401	21.2%	755	28.2%	11.8%
(converted in JPY)	(73mil. JPY)		(9mil. JPY)		
(break down) Building	*2,975*	*9.8%*	*475*	*17.7%*	*16.0%*
Vehicle	*424*	*1.4%*	*80*	*3.0%*	*18.9%*
Equipment	*1,398*	*4.6%*	*200*	*7.5%*	*14.3%*
Others	*1,604*	*5.3%*	*0*	*0.0%*	*0.0%*
Insurance	62	0.2%	10	0.4%	16.1%
(converted in JPY)	(1mil. JPY)		(0mil. JPY)		
Telecommunication	335	1.1%	62	2.3%	18.5%
(converted in JPY)	(4mil. JPY)		(1mil. JPY)		
Other outsourcing service	425	1.4%	0	0.0%	0.0%
(converted in JPY)	(5mil. JPY)		(0mil. JPY)		
Bussiness trip	755	2.5%	84	3.1%	11.1%
(converted in JPY)	(9mil. JPY)		(1mil. JPY)		
Seminar and training	1,793	5.9%	70	2.6%	3.9%
(converted in JPY)	(20mil. JPY)		(1mil. JPY)		
National festivals, etc.	1,399	4.6%	229	8.6%	16.4%
(converted in JPY)	(16mil. JPY)		(3mil. JPY)		
Others	3,355	11.1%	1,187	44.3%	35.4%
(converted in JPY)	(38mil. JPY)		(13mil. JPY)		
Total	30,238	100.0%	2,678	100.0%	8.9%
(converted in JPY)	(343mil. JPY)		(30mil. JPY)		

(Source: Budget information provided by Finance Divisions of NUOL and FEN-NUOL)

The additional O&M cost necessary for the new buildings and equipment provided by the Project shall be surely financed from the technical budget of NUOL, in consideration with the trial self-sufficiency scheme of NUOL. Thus, it is determined that the additional O&M budget necessary for the Project will be allocated to FEN-NUOL based on the discussion made between NUOL and FEN-NUOL during the analysis stage of this Preparatory Survey, and it is confirmed and agreed in the Minutes of Discussions during the Field Survey II (refer to the Appendix 4-2).

The above table shows the water supply and electricity cost for FEN-NUOL as “0”, because it is solely managed by NUOL instead of budget allocation to each faculty. While the government used to be responsible for such expenses by 2020, they have to be taken as an expense from the technical budget under the new scheme. Service utility cost necessary for the buildings and equipment to be provided by the Project is included in the operation and maintenance cost estimated in “2-6 Project Cost Estimation” hereafter.

2-5-2 Maintenance Plan

Equipment & Facilities Management Division of FEN-NUOL is responsible for maintenance of the buildings within FEN-NUOL campus. As shown in the following table, five staff members among six have technical backgrounds in maintenance, and each staff is assigned in a certain area depending on his/her background.

Table 2-23 Equipment & Facilities Management Division of FEN-NUOL

Ref.	Position	Assignment	Technical Background
1	Head of Division	Responsible for supervision on construction of building-road, facility repair and management of state properties.	Road & bridge engineering
2	Deputy Head of Division	Responsible for supervision on vehicle management and sanitation/cleaning work.	Road & bridge engineering
3	Head of Unit	Responsible for secretarial work of the division, and document management.	Basic professional in secretarial certificate
4	Head of Unit	Responsible for service/repair of air conditioners, refrigerators, and electrical equipment.	Air conditioners and refrigeration system
5	Technical Staff	Responsible for equipment and facility database, management, and report to NUOL and MOF.	Road & bridge engineering
6	Technical Staff	Responsible for work of electrical systems on lighting and wiring electricity.	Electrical engineering

(Source: Information provided by FEN-NUOL)

The existing buildings in FEN-NUOL campus are generally well maintained by the division, while the maintenance activities are limited due to the tight budget. Practical activities of facility maintenance in the campus, including daily cleaning[20], are conducted by outsourced companies under the supervision of the division. As for the equipment, because of lack of specialized technicians or mechanics, each equipment is maintained by a faculty member in-charge.

2-5-2-1 Facility Maintenance

Regular maintenance will be necessary for the new buildings provided by the Project in order to maintain them in good conditions.

From the aspects on the current situation of facility maintenance, it is assumed that the maintenance activities by Equipment & Facilities Management Division of FEN-NUOL are well-functioning. Thus, once the additional necessary budget necessary for the new buildings is secured, daily cleaning, measures against failures as well as regular inspection will be materialized. Since FEN-NUOL needs to outsource the daily cleaning work, regular inspections and re-painting work, the outsourcing cost for such have to be calculated and included in the future budget[21].

2-5-2-2 Equipment Maintenance

The Project selects the equipment items which do not require regular maintenance and frequent spare parts replacement, in principle. However, some items, mainly the ones for CESD, will be maintained with consumables and regular replacement of parts. Moreover, regular calibrations will be needed for

[20] In addition to cleaning works by an outsourced company, the students of FEN-NUOL are involved in cleaning activities once a week in order to generate cleanliness awareness in the students, as an extra-curricular activity.

[21] Outsourcing cost for the buildings to be provided by the Project is included in the operation and maintenance cost estimated in "2-6 Project Cost Estimation".

such equipment to guarantee qualities of measurement and analysis services to be provided as a social service of FEN-NUOL for external organizations. It is difficult for domestic agents to conduct such calibration work, thus engineers dispatched by the agents authorized by manufacturers in the neighboring countries, such as Thailand, have to be employed for this work. In the meantime, regular operations and daily checkups/cleaning will also be important to maintain the Project equipment in good condition. It is expected that unnecessary failures caused by wrong operation and misplacement of parts will be avoided through the activities of HUGETECH which will assist FEN-NUOL in improving maintenance of the equipment, in parallel to this Project.

2-6 Project Cost Estimation

2-6-1 Initial Cost Estimation

(1) Total Cost to be borne by Lao PDR Side

57,600 USD (about 6.17 million JPY)

Table 2-24 Breakdown of the Cost to be borne by Lao PDR side

Item	Amount (USD)	Amount (million JPY)
Building permit	1,000	0.11
Preparatory work (demolition of obstacles, removal of trees, re-routing electrical cables, moving furniture/equipment from the existing A3 building, etc.)	10,600	1.14
New connection of electricity, water supply sewage, telecommunication, etc.	25,000	2.68
Moving and installation of furniture/equipment of the existing A3 building, and installation of the existing equipment to CESD to be constructed by the Project (after completion of construction works).	2,000	0.21
Bank commissions	19,000	2.03
Total	57,600	6.17

(Source: The survey team)

(2) Conditions of Estimation

① Time of Estimation : April 2021

② Exchange rate : 1USD = 107.08 JPY
: 1 LAK = 0.011327 JPY
: 1THB = 3.5846 JPY

③ Construction/procurement period :
As per the Project implementation schedule.

④ Other remarks : Cost estimation was conducted based upon the principle of the Japanese Grant.

2-6-2 Operation and Maintenance Cost

The O&M cost for the new buildings and equipment provided by the Project are estimated as follows.

(1) Electricity Expense

Electricity expense for operating the buildings and equipment provided by the Project is preliminarily calculated as follows.

Table 2-25 Estimated Annual Electricity Expense

Electricity capacity	Actual load (50%)	Demand rate	Operation hours/day	Operation days/year [22]	Assumed electricity usage /year	Unit price[23] (LAK/kWh)
630 KVA	315 KVA	30%	7 hours	190 days	125,685kWh	749 LAK
Total amount of expense per year **94.1 mil. LAK** (approx. 1.1 mil. JPY, approx. 9.950 USD)						

(Source: The survey team)

(2) Water Supply Expense

Water supply expense for operating the buildings and equipment provided by the Project is preliminary calculated as follows.

Table 2-26 Estimated Annual Water Supply Expense

Building	No. of users[24]	General consumption/ day-person	Water for experiment/ day	Total consumption/ day	Total consumption/ year (190 days)	Unit price[25] (LAK/m^3)	Total amount of expense per year per building
CESD	150	45 L	--	7.0 m^3	1,330 m^3	2,440	3.2 mil. LAK
Laboratory Blocks	400	45 L	10 m^3	28.0 m^3	5,320 m^3		13.0 mil. LAK
Total amount of expense per year **16.2 mil. LAK** (approx. 0.2 mil. JPY, approx. 1,700 USD)							

(Source: The survey team)

(3) Telecommunication Expense

The telecommunication expense for internet and telephone land line is estimated as 38.4 mil. LAK (approx. 0.4 mil. JPY, approx. 4,050 USD), on the assumption of optical fiber cable communication with the maximum speed of 500 Mbps.

(4) Facility Maintenance Cost

Since FEN-NUOL employs a company for daily cleaning works, the cost for cleaning of the new buildings will be additionally budgeted. It is assumed that regular maintenance, other than daily cleaning, will not be required at least for one year after the handing-over, however, the following re-painting work and regular maintenance of service lines/equipment shall be included in the additional budget for the O&M cost.

[22] Operation days per year = 19 weeks x 5 days x 2 semesters = 190 days, on the basis of 19 week per semester in accordance with the current curriculums of FEN-NUOL.
[23] Unit price for medium voltage (22kV) for the governmental institutions.
[24] According to "2-2-2 (4) 2) Mechanical System".
[25] Unit price for the governmental institutions.

Table 2-27 Estimated Annual Facility Maintenance Cost

Item		Frequency	Annual Costs (LAK)		
			CESD	Laboratory Blocks	Total
Daily Cleaning[26]		Daily	4,583,000	6,674,000	11,257,000
Re-paint	External	Once every 15 years	8,320,000	19,255,000	27,575,000
	Internal	Once every 15 years	6,684,000	5,896,000	12,580,000
	Windows/Doors	Once every 10 years	1,482,000	2,317,000	3,799,000
Electrical/ mechanical service	Maintenance inspection/replacing consumables/cleaning etc.[27]	Once every 3 years	5,470,000	7,966,000	13,436,000
Total costs per year			26,539,000 (0.3 mil. JPY) (2,800 USD)	35,434,000 (0.5 mil. JPY) (4,500 USD)	**68,647,000** (0.8 mil. JPY) (7,300 USD)

(Source: The survey team)

(5) Equipment Maintenance Cost

The maintenance cost for the equipment provided by the Project is preliminary calculated as follows.

Table 2-28 Estimated Annual Equipment Maintenance Cost

Item	Consumables	Spear Parts	Amount (USD)	Remarks
Sequential X-Ray Fluorescence Spectrometer (XRF) and Powder X-ray Diffractometer (XRD)	Ion exchange resin, Specimen holder, RP gas, etc.	X-ray tube, Fuse tube, etc.	6,530	X-ray tube: once 5 years Others: once a year"
Thermogravitric Analysis (TGA/DSC), Particle Size Analysis (PSA), Infrared Spectroscopy (FTIR) (Reconsider), and other analytical equipment	Silica gel, Specimen holder, Oil for compressor, Nitrogen gas, etc.	Halogen lamp, Deuterium Lamp, Quartz cell, Filter, window for sample compartment, etc.	5,440	Once one or two years
Universal Testing Machine	Adhesive for strain-gauge, etc.	Filter element for hydraulic unit, etc.	930	Once a year
Scanning Electron Microscope (SEM) w/Coating Machine	Oil filter, Rotary pump oil, etc.	Cartridge filament, Objective-lens aperture, etc.	2,280	Once one or two years
Draft chamber, Water Distiller	Packing Material for Scrubber, Ion-exchange cartridge, etc.	Ultraviolet germicidal lamp	1,860	Once one or two years
TIG + MIG Welder, DC Welder and Oxyacetylene Welding Set	Welding rod, Argon gas, Oxygen gas, etc.	-	2,330	Once one or two years
Specimen Grinding Machine, Double Headed Grinder, etc.	Cutting disk, Grinder disk, Grinding stone, etc.	-	1,400	Once one or two years

[26] Based on the monthly unit price per m^2 of the cleaning company currently employed by FEN-NUOL (200 LAK/m^2), possible price escalation for the near future is added and set the unit price as 220 LAK/m2 for the estimation.

[27] The cost includes the estimated expenses for regular inspection of substations and fire protection facilities, inspection and replacing consumables of lighting fixtures, outlets and air-conditioners, cleaning of water reservoir tanks, elevated water tanks and septic tanks, and other maintenance-related works.

Surface Grinding Machine, Lathe Machine, Milling Machine, Blade Sharpener (floor type), Bench Drilling Machine, and other machining machine	Cutting tools, Cutting oil, Hydraulic oil, Drill, Grinding stone, etc.	-	2,800	Once one or two years
Exhaust Gases Analyzer and Vehicle Emissions Testing System	Filter element	-	50	Once a year
3D Printer (plastic)	Resin	-	1,120	Once a year
Electric Circuit Trainer, High Voltage Experimental Equipment, PLC Trainer and Conveyer System, Hybrid Renewable Energy (Photovoltaic & Wind) Generator, and other equipment for practical works	Grease for motor	Connector, Lead wire, etc.	230	Once a year
Personnel Expense for Specialists for Spare Parts Replacement or Repair Works	-	-	3,730	467USD x 2 persons x 4 days
Total costs per year			**28.700**	(approx. 271.7 mil. LAK) (approx. 3,1 mil. JPY)

(Source: The survey team)

(6) Total of Operation and Maintenance Cost

The total of estimated O&M cost, sum of calculations in (1) to (5) above, necessary for the new buildings and equipment provided by the Project are summarized in the following table. After the commencement of operation of the new buildings and equipment, 489.0 mil. LAK (approx. 5.6 mil. JPY, approx. 51,700 USD) shall be annually budgeted in addition to the O&M cost for the existing buildings and equipment.

Table 2-29 Estimated Annual O&M Cost for New Buildings and Equipment

Item	Amount in LAK	Amount in JPY	Amount in USD
Electricity expense (refer to (1))	94.1 mil. LAK	1.1mil. JPY	9,950 USD
Water supply expense (refer to (2))	16.2 mil. LAK	0.2mil. JPY	1,700 USD
Telecommunication expense (refer to (3))	38,4 mil. LAK	0.4mil. JPY	4,050 USD
Sub-total for Operational Costs	**148.7** mil. **LAK**	1.7mil. JPY	15,700 USD
Facility maintenance costs (refer to (4))	68.6 mil. LAK	0.8mil. JPY	7,300 USD
Equipment maintenance costs (refer to (5))	271.7 mil. LAK	3,1mil. JPY	28,700 USD
Sub-total for Maintenance Costs	**340.3 mil. LAK**	3.9mil. JPY	36,000 USD
Grand total of Operation and Maintenance Costs	**489.0 mil. LAK**	5.6mil. JPY	51,700 USD

(Source: The survey team)

Chapter 3 Project Evaluation

Chapter 3 Project Evaluation

3-1 Preconditions

Since the Project plans to construct buildings in areas within the existing campus, there is no precondition concerning securing the land. The preconditions of the Project are that the undertakings by Lao PDR side such as demolition of the existing structures within the construction area, obtaining a building permit, transferring furniture and equipment of A3 building to other buildings, tax exemptions, etc. in a timely manner. For details of the undertaking by Lao PDR side, refer to "2-4 Obligation of Recipient Country".

3-2 Necessary Inputs by Recipient Country

The following items shall be carried out by Lao PDR side for the effects of the Project to be produced and sustained:

① Implement the undertakings described in "2-4 Obligation of Recipient Country",
② Secure the appropriate number of students for FEN-NUOL,
③ Collaborate with HUGETECH to set the new curriculums, syllabuses, etc., based on which FEN-NUOL carries out education/research activities,
④ Allocate necessary faculty members to effectively use the buildings and equipment covered by the Project,
⑤ Secure the budget for operation and maintenance cost for the buildings and equipment including personnel cost, and
⑥ Establish the management system to operate and maintenance the buildings and equipment covered by the Project.

3-3 Important Assumptions

The important external factors critical to ensure that the Project outcome is effective and sustainable, but cannot be controlled by the Project activities, are as follows:

① There are no major changes of policy, deterioration of security or natural disasters which may cause the cancellation or long delays of the Project,
② There is no inflation higher than expected owing to a drastic change of the economic situation, and the necessary materials and equipment are procured as scheduled,
③ There is no major change of the education plan of the Lao PDR government over FEN-NUOL, and

3-4 Project Evaluation

3-4-1 Relevance

The Project is evaluated to be relevant and eligible as a Grant Aid project of Japan by the reasons mentioned below:

(1) The Coverage of the Project Beneficiaries

The direct beneficiaries of the Project are faculty members and students of FEN-NUOL. It is

expected that their education/research activities will be enhanced by the cooperation of the Project which provides the new buildings and necessary equipment. The graduates of FEN-NUOL are expected to be employed by the government or major private companies to play center roles in the industrial sector. Furthermore, collaboration within FEN-NUOL departments and academic-industrial collaboration facilitated by the Project may energize the entire industrial sector, thereby boosting the economic development of the country. Therefore, the nation will be indirectly benefitted from the Project.

(2) The Contribution to the Achievement of the Goal of Policies of Lao PDR.

ESSDP9 and NESDP9 set the policy to strengthen the human resources for the industrial sector and thus emphasize the importance of enhancing the curriculums and the quality of educational equipment and research ability of the engineering field. In particular, the former sets one of its intermediate goals as to upgrade the facilities and equipment of FEN-NUOL. Therefore, the Project will directly contribute towards the goal.

Moreover, NSEDP9 upholds an economic policy reform to gear towards "a direction of a quality, green and sustainable growth." It also refers to utilization of new technologies, economic diversification, greater productivity, and greater involvement of regional/ international supply chain, for a sustainable economic growth.

The Project aims to upgrade the facilities and equipment of the target departments so that the students may gain basic knowledges and skills through experimental/practical work. Furthermore, it is expected that the students will gain advanced analytical skills in their specialization to be the human resources who will contribute to the economic development aimed in NSEDP9.

(3) Consistency with Japanese Assistance Policy

In the Japanese Country Assistance Policy for Lao PDR, the "diversification of industries, and enhancing competitiveness and human resource development" is upheld as one of 4 pillars of the policy, addressing the enhancement of basic education and higher education as important issues. The policy further stipulates that Japan will focus on the assistance toward the engineering field of higher education so as that Lao PDR will have the human resources to meet the need of the industrial sector. Therefore, the Project is consistent with the Japanese Assistance Policy.

Moreover, the Project is likely to achieve higher effect, because of the expected synergy effect in tandem with the two technical cooperation projects "HUGETECH" and "AUN/SEED-Net[28]" both of which are currently underway to strengthen the capacity of FEN-NUOL.

3-4-2 Effectiveness

The project is expected to bring about the following results.

[28] ASEAN University Network / Southeast Asia Engineering Education Development

(1) Quantitative Results

Table 3-1 Quantitative Results

Indicators	Base Value (Actual value in 2021)	Target Value (Year:2027. 3yr after the completion)
The number of course programs which uses the equipment procured by the Project (Remark1)	0	16
The number of laboratories equipped with the equipment procured by the Project	0	26
The number of students* who carry out experimental/practical work using the equipment procured by the Project (3rd and 4th year students of the 4-year program and 1st and 2nd year students of the 2-year continuing program) (Remark 2)	0	1,820

(Source: The survey team)

(Remark 1) Target value is the total of all course programs of 6 target departments

Department	Programs	No. of Programs
Mechanical Engineering Department	BS General Program (4-year program) • Mechanical Engineering • Industrial Engineering • Material Engineering BS Continuing Program (2-year program) • Mechanical Engineering	4
Civil Engineering Department,	BS General Program (4-year program) BS Continuing Program (2-year program)	2
Road & Bridge Engineering Department	BS General Program (4-year program) BS Continuing Program (2-year program)	2
Transportation & Logistics Engineering Department	BS General Program (4-year program)	1
Electrical Engineering Department	BS General Program (4-year program) • Electrical Engineering • Hydro-power Energies Engineering BS Continuing Program (2-year program) • Electrical Engineering	3
Electronic & Telecommunication Engineering Department	BS General Program (4-year program) • Electronic Engineering • Telecommunication Engineering BS Continuing program (2-year program) • Electronic Engineering • Telecommunication Engineering	4

(Remark 2) The target value is the total quota of 3rd and 4th year students in the ten 4-year BS general programs and 1st and 2nd year students in the six 2-year BS continuing programs.

(2) Qualitative Results

① The education/research environment will improve with the new buildings and equipment to be covered by the Project.

② Human resources meeting the need of the industrial sector will be developed through enhancing the quality of higher education.

From the above, it is deemed highly relevant and effective for the Project to be implemented.

APPENDICES

Appendix 1. Member List of the Study Team

(1) Field Survey I (March 28 to April 25, 2021)

	Name	Assignment	Affiliation
1	Ms. Akiko SANADA	Team Leader	JICA Laos Office
2	Mr. Kazuma INOUE	Cooperation Planning 1	Technical and Higher Education Team, Human Development Department, JICA
3	Ms. Sena NUKATA	Cooperation Planning 2	JICA Laos Office
4	Ms. Shuko KUBOTA	Cooperation Planning 3	Technical and Higher Education Team, Human Development Department, JICA
5	Mr. Hisafumi MICHIKAWA	Chief Consultant/ Architectural Planning	Mohri Architect & Associates, Inc.
6	Mr. Tomohiro TAMAKI	Deputy Chief Consultant/ Equipment Planning/ O&M Planning	INTEM Consulting, Inc.
7	Ms. Tamiko ARAMATA	Architectural Design/ Natural Conditions Survey	Mohri Architect & Associates, Inc.
8	Mr. Takeshi FUKUSHIMA	Construction Planning/ Cost Estimate	
9	Mr. Ryoji OKAMOTO	Procurement Planning/ Cost Estimate	INTEM Consulting, Inc.
10	Ms. Akiko NAKANO	Higher Education Planning	PADECO Co., Ltd.

Notes 1: The JICA Headquarters officials joined the meetings online from Japan.
2: Mr. Masahiko SUZUKI, in charge of M&E Planning (from Mohri, Architect & Associates, Inc.) did not join Field Survey I, however, he remotely worked from Japan.

(2) Field Survey II (November 9 to 21, 2021)

	Name	Assignment	Affiliation
1	Ms. Akiko SANADA	Team Leader	JICA Laos Office
2	Mr. Kazuma INOUE	Cooperation Planning 1	Technical and Higher Education Team, Human Development Department, JICA
3	Ms. Sena NUKATA	Cooperation Planning 2	JICA Laos Office
4	Ms. Shuko KUBOTA	Cooperation Planning 3	Technical and Higher Education Team, Human Development Department, JICA
5	Mr. Hisafumi MICHIKAWA	Chief Consultant/ Architectural Planning	Mohri Architect & Associates, Inc.
6	Mr. Tomohiro TAMAKI	Deputy Chief Consultant/ Equipment Planning/ O&M Planning	INTEM Consulting, Inc.
7	Ms. Tamiko ARAMATA	Architectural Design/ Natural Conditions Survey	Mohri Architect & Associates, Inc.

Notes 3: The JICA Headquarters officials and a Consultant member (Architectural Design/Natural Conditions Suevey) joined the meetings online from Japan.

Appendix 2　Study Schedule

(1)　Field Survey I (March 28 to April 25, 2021)

			A	B	C	D	E	F	G
			JICA Officials	Chief Consultant/ Architectural Planning	Deputy Chief Consultant/ Equipment Planning/ O&M Planning	Architectural Design/ Natural Conditions Survey	Construction Planning/ Cost Estimate	Procurement Planning/ Cost Estimate	Higher Education Planning
			Akiko SANADA Kazuma INOUE Sena NUKATA Shuko KUBOTA	Hisafumi MICHIKAWA	Tomohiro TAMAKI	Tamiko ARAMATA	Takeshi FUKUSHIMA	Ryoji OKAMOTO	Akiko NAKANO
1	Mar 13, 2021	Sat		Tokyo >> Kuala Lumpur					
2	Mar 14, 2021	Sun		Kuala Lumpur >> Vientiane (Quarantine Day-1)					
				(Quarantine Period: 14 days until March 27, 2021)					
16	Mar 28, 2021	Sun		Team meeting Document preparation	Same as B	Same as B	Same as B	Same as B	Same as B
17	Mar 29, 2021	Mon		Courtesy call to and meeting with JICA Laos Office, Courtesy call to and meeting with FEN-NUOL	Same as B	Same as B	Same as B	Same as B	Same as B
18	Mar 30, 2021	Tue		Meeting with FEN-NUOL (Explanation of ICR, Site visit)	Same as B	Same as B	Same as B	Same as B	Same as B
19	Mar 31, 2021	Wed		Meeting with FEN-NUOL (Explanation of ICR, Visit to COE in NUOL main campus)	Same as B	Same as B	Same as B	Same as B	Same as B
20	Apr 01, 2021	Thu		Survey on arch. planning	Meeting with FEN-NUOL (Equipment for CESD)	Meeting with FEN-NUOL Preparation for topographic survey	Survey on construction planning, cost estimation and M&E planning	Same as C	Survey on higher education
21	Apr 02, 2021	Fri		Survey on arch. planning, Meeting with JICA (online)	Meeting with FEN-NUOL (Equipment for CESD), Meeting with JICA (online)	Document preparation Meeting with JICA (online)	ditto	Same as C	同上
22	Apr 03, 2021	Sat		Team mtg., Doc prep.	Same as B	Same as B	Same as B	Same as B	Same as B
23	Apr 04, 2021	Sun		Team mtg., Doc prep.	Same as B	Same as B	Same as B	Same as B	Same as B
24	Apr 05, 2021	Mon		Discussion with FEN-NUOL, Site survey, Survey on arch. planning	Meeting with FEN-NUOL (Equipment for target department), Survey on existing equipment	Discussion with FEN-NUOL, Site survey, Preparation for topo survey	Survey on construction planning, cost estimation and M&E planning	Same as C	Survey on higher education
25	Apr 06, 2021	Tue		ditto	ditto	ditto	ditto	Same as C	ditto
26	Apr 07, 2021	Wed		ditto	ditto	Study on the project implementation, Preparation for underground structure survey	ditto	Same as C	ditto
27	Apr 08, 2021	Thu		ditto	ditto	Survey on arch. design, Preparation for underground structure survey	ditto	Same as C	
28	Apr 09, 2021	Fri		Survey on arch. planning, Joint meeting with MOES, NUOL, FEN-NUOL and JICA	Survey on equipment planning, Joint meeting with MOES, NUOL, FEN-NUOL and JICA	Preparation for topo survey, Joint meeting with MOES, NUOL, FEN-NUOL and JICA	ditto	PCR test, Survey on equipment planning, Joint meeting with MOES, NUOL, FEN-NUOL and JICA	Survey on higher education, Joint meeting with MOES, NUOL, FEN-NUOL and JICA
29	Apr 10, 2021	Sat		Team mtg., Doc prep.	Same as B	Same as B	Same as B	Receipt of PCR test result, Team mtg, Doc. prep.	
30	Apr 11, 2021	Sun		Team mtg., Doc prep.	Same as B	Same as B	Same as B	Vientiane >> Kuala Lumpur	
31	Apr 12, 2021	Mon		Survey on arch. planning	Survey on equipment procurement	Preparation of the joint meeting minutes, Preration of M/D (draft)	Survey on construction planning, cost estimation and M&E planning	Kuala Lumpur >> Tokyo	
32	Apr 13, 2021	Tue		ditto	ditto	Preparation of M/D (draft)	ditto		
33	Apr 14, 2021	Wed		Team mtg., Doc prep.	Same as B	Same as B	Same as B		Same as B
34	Apr 15, 2021	Thu		Team mtg., Doc prep.	Same as B	Same as B	Same as B		
35	Apr 16, 2021	Fri	Lao New Year	Team mtg., Doc prep.	Same as B	Same as B	Same as B		
36	Apr 17, 2021	Sat		Team mtg., Doc prep.	Same as B	Same as B	Same as B		
37	Apr 18, 2021	Sun		Team mtg., Doc prep.	Same as B	Same as B	Same as B		Same as B
38	Apr 19, 2021	Mon		Survey on arch. planning, Meeting with JICA (online)	Survey on equipment procurement, Meeting with JICA (online)	Survey on arch. design, Meeting with JICA (online)	Survey on construction planning, cost estimation and M&E planning		Survey on higher education, Meeting with JICA (online)
39	Apr 20, 2021	Tue	(Online)Meeting with FEN-NUOL (Discussion on M/D)	Same as A	Same as A	Same as A	Survey on construction planning, cost estimation and M&E planning, Site meeting for topo survey		Same as A
40	Apr 21, 2021	Wed	(Online)Meeting with MOES, NUOL and FEN-NUOL (Discussion on M/D)	Same as A	Same as A	Same as A Preparation for soil investigation and underground structure survey	Survey on construction planning, cost estimation and M&E planning		Same as A
41	Apr 22, 2021	Thu	Signing on M/D (document circulation for signature due to the lockdown)	Document preparation	Same as B	Arrangement for natural condition surveys (including coordination for the works during the lockdown)	Survey on construction planning, cost estimation and M&E planning, Site meeting for soil investigation and underground structure survey		Same as A
42	Apr 23, 2021	Fri	(Online) Report to JICA Laos Office	PCR test, (Online) Report to JICA Laos Office	Same as B	Same as B	PCR test, Survey on construction planning, cost estimation and M&E planning		(Online) Report to JICA Laos Office
43	Apr 24, 2021	Sat		Receipt of PCR test result, Team meeting, Document preparation					Team mtg., Doc prep.
44	Apr 25, 2021	Sun		Vientiane >> Kuala Lumpur					
45	Apr 26, 2021	Mon		Kuala Lumpur >> Tokyo					

Notes:　Online report to Embassy of Japan was made on April 30, 2021 after the Consultant team returned to Japan.

(2) Field Survey II (November 9 to 21, 2021)

			A	B	C	D
			JICA Officials	Chief Consultant/ Architectural Planning	Deputy Chief Consultant/ Equipment Planning/ O&M Planning	Architectural Design/ Natural Conditions Survey
			Akiko SANADA Kazuma INOUE Sena NUKATA Shuko KUBOTA	Hisafumi MICHIKAWA	Tomohiro TAMAKI	Tamiko ARAMATA
1	Oct 28, 2021	Thu		Tokyo >> Incheon		
2	Oct 29, 2021	Fri		Incheon >> Vientiane (Quarantine Day-1)		
				(Quarantine Period: 14 days until November 11, 2021)		
13	Nov 09, 2021	Tue	(Online) Explanation and discussion on the preparatory survey report (draft)	(Online during the quarantie period) Explanation and discussion on the preparatory survey report (draft)	Same as B	Same as A
14	Nov 10, 2021	Wed	(Online) Discussion on the preparatory survey report (draft)	(Online during the quarantie period) Discussion on the preparatory survey report (draft)	Same as B	Same as A
15	Nov 11, 2021	Thu	(Online) Discussion on M/D (draft)	(Online during the quarantie period) Discussion on M/D (draft)	Same as B	Same as A
16	Nov 12, 2021	Fri		Discussion on equipment for CESD Interview with Vinetiane fire prevention/protection div.	Technical discussion on equipment for CESD	(Preparation of M/D and follow-up for the field survey and discussion)
17	Nov 13, 2021	Sat		Team mtg., Doc prep.	Same as B	
18	Nov 14, 2021	Sun		Team mtg., Doc prep.	Same as B	
19	Nov 15, 2021	Mon		Discussion on arch planning, Survey on arch planning	Technical discussion on equipment for civil engineering field	(Preparation of M/D and follow-up for the field survey and discussion)
20	Nov 16, 2021	Tue		Discussion on arch planning, Survey on arch planning	Technical discussion on equipment for mechanical and electric/electronic engineering field	
21	Nov 17, 2021	Wed		Preparation of M/D	Same as B	
22	Nov 18, 2021	Thu	(Online) Discussion and signing on M/D (document circulation for signature)	Discussion on M/D	Same as B	Same as A
23	Nov 19, 2021	Fri		PCR test, Team mtg., Doc. prep.	Team mtg., Doc prep.	
24	Nov 20, 2021	Sat		Receipt of PCR test result, Team mtg, Doc. prep.	Team mtg., Doc prep.	
25	Nov 21, 2021	Sun		Vientiane >> Kuala Lumpur	Document preparation	
26	Nov 22, 2021	Mon		Kuala Lumpur >> Tokyo		

Notes: Online report to Embassy of Japan and JICA Laos Office was made on November 24, 2021 after the Consultant team returned to Japan.

Appendix 3. List of Parties Concerned in the Recipient Country

National University of Laos (NUOL)

Name	Position (Position for Project Team)	Affiliation
Assoc. Prof. Dr. Houngphet CHANTHAVONG	Vice President	National University of Laos (NUOL)
Mr. Phouvong PHIMMAKONG	Deputy Director	Office of International Relations, NUOL
Mr. Amkheng PHENGLASY	Deputy Director	Office of International Relations, NUOL
Assoc. Prof. Dr. Khamphoui SOUTHISOMBATH	Dean (Project Manager)	Faculty of Engineering (FEN), NUOL
Dr. Somphone KANTHAVONG	Vice Dean	FEN-NUOL
Assoc. Prof. Dr. Sengprasong PHRAKONKHAM	Assistant Dean (Assistant Project Manager)	Electrical Eng. Dept., FEN-NUOL
Assoc. Prof. Dr. Khampaseuth THEPVONGSA	Acting Head (Assistant Project Manager)	Civil Eng. Dept., FEN-NUOL
Dr. Deuansavanh PHOMMAVONGSA	Head (Project Coordinator)	Administration Division, FEN-NUOL
Dr. Khamphao SISAAT	Deputy Head	Research and Academic Service Division, FEN-NUOL
Dr. Vilay VANNALADSAYSY	Deputy Head	Mechanical Eng. Dept., FEN-NUOL
Dr. Sounthisack PHOMMACHANH	Lecturer	Mechanical Eng. Dept., FEN-NUOL
Dr. Sengphet KEOKANGDONG	Deputy Head	Mechanical Eng. Dept., FEN-NUOL
Assoc. Prof. Sayphone HOUNGBOUNYUANG	Head	Mechanical Eng. Dept., FEN-NUOL
Mr. Phongsavanh SENGAPHONE	Lecturer	Mechanical Eng. Dept., FEN-NUOL
Mr. Bounladeth PHOTHITAI	Lecturer	Mechanical Eng. Dept., FEN-NUOL
Mr. Sane SOUVANHNAKHOOMAN	Lecturer	Mechanical Eng. Dept., FEN-NUOL
Ms. Phengsy BOUDIPONG	Lecturer	Mechanical Eng. Dept., FEN-NUOL
Mr. Bounthavy SOUVANHNY	Lecturer	Mechanical Eng. Dept., FEN-NUOL
Mr. Bounxuean BONPHAANKSONE	Lecturer	Mechanical Eng. Dept., FEN-NUOL
Mr. Souksavat PHOUNSAVAT	Lecturer	Mechanical Eng. Dept., FEN-NUOL
Assoc. Prof. Sengraty KITHAVONE	Lecturer	Mechanical Eng. Dept., FEN-NUOL
Mr. Xayyalack VILAIDA	Lecturer	Mechanical Eng. Dept., FEN-NUOL

Dr. Khamhou SAPHOUVONG	Deputy Head for Academic Affair	Civil Eng. Dept., FEN-NUOL
Mr. Chayphet Inthaboualy	Lecturer	Civil Eng. Dept., FEN-NUOL
Mr. khamseum SIOULIYAMAR	Head	Road & Bridge Eng. Dept., FEN-NUOL
Mr. Vernsone PHENGSOULITH	Lecturer	Road & Bridge Eng. Dept., FEN-NUOL
Mr. Phouthone SAYASEN	Head of Road Unit	Road & Bridge Eng. Dept., FEN-NUOL
Mr. Bounkhong KONGPHETSANAN	Head of Bridge Unit	Road & Bridge Eng. Dept., FEN-NUOL
Mr. Bounhome CHANSAVANG	Head of Unit	Road & Bridge Eng. Dept., FEN-NUOL
Mr. Silisack KEOPHOUVONG	Admin Head	Road & Bridge Eng. Dept., FEN-NUOL
Mr. Sengchan KYOPHANMAHA	Deputy Head of Unit	Road & Bridge Eng. Dept., FEN-NUOL
Mr. Anousone OUTTHALASADY	Head of Unit	Trans. & Logi. Eng. Dept., FEN-NUOL
Mr. Phongsavanh INTHAVONGSA (Louis)	Assistant Deputy Head	Trans. & Logi. Eng. Dept., FEN-NUOL
Mr. Sisouphanh PHOMMANIVONG	Deputy Head	Trans. & Logi. Eng. Dept., FEN-NUOL
Mr. Vonechith THEPKAYSONE	Head of Unit	Trans. & Logi. Eng. Dept., FEN-NUOL
Mr. Anousak THAMMAVONG	Head of Unit	Trans. & Logi. Eng. Dept., FEN-NUOL
Mr. Bounmy SAYSONGKHAM	Head of Unit	Trans. & Logi. Eng. Dept., FEN-NUOL
Mr. Phonesay DOUANGMACHANH	Lecturer	Trans. & Logi. Eng. Dept., FEN-NUOL
Mr. Chanpheng PHOMMAVONE	Lecturer	Trans. & Logi. Eng. Dept., FEN-NUOL
Assoc. Prof. Khampha SIHANAKHONE	Head	Electrical Eng. Dept., FEN-NUOL
Mr. Soumek INTHALA	Deputy Head	Electrical Eng. Dept., FEN-NUOL
Ms. Valasy CHOUNRAMANY	Lecturer	Electrical Eng. Dept., FEN-NUOL
Mr. Akasinh LUANGDUANGSITTHIDETH	Lecturer	Electrical Eng. Dept., FEN-NUOL
Mr. Vonevilay VILAYLUCK	Lecturer	Electrical Eng. Dept., FEN-NUOL
Mr. Miengma PHOMMAINH	Lecturer	Electrical Eng. Dept., FEN-NUOL
Assoc. Prof. Nouanchanh PANYANOUVONG	Head	Electro. & Telecom. Eng. Dept., FEN-NUOL
Dr. Khamphong KHONGSOMBOON	Deputy Head	Electro. & Telecom. Eng. Dept., FEN-NUOL
Dr. Phosy PHANTHONGSY	Lecturer	Electro. & Telecom. Eng. Dept., FEN-NUOL
Phutsavanh THONGPHANH	Lecturer	Electro. & Telecom. Eng. Dept., FEN-NUOL
Xaysamone DITTAPHONG	Lecturer	Electro. & Telecom. Eng. Dept., FEN-NUOL
Souksamai INSANKEOVILAY	Lecturer	Electro. & Telecom. Eng. Dept., FEN-NUOL
Mr. Somchay SAISNITH	Deputy	Facility & Equip. Mgmt. Div. FEN-NUOL
Mr. Boualy INDAVONG	Deputy	Facility & Equip. Mgmt. Div. FEN-NUOL

Mrs. Vankham VILAVONG	Head	Financial office, FEN-NUOL
Dr. Santi KONGMANY	Director	COE in Environment, NUOL

Ministry of Education and Sports (MOES)

Name	Position (Position for Project Team)	Affiliation
Dr. Daravone KITTIPHANH	Permanent Secretary	Cabinet Office
Assoc. Prof. Dr. Saykhong SAYNASINE	Director General (Chair Person)	Department of Higher Education
Assoc. Prof. Dr. Lavanh VONGKHAMSANE	Deputy Director General	Department of Higher Education
Mr. Sisamout SAENBOUTTARAJ	Head of Division	Department of External Relations

Vientiane Capital

Name	Position	Affiliation
Mr. Khammone CHOMMANIVONG	Head of Division	Dept. of Public Works and Transport Housing-Urban Planning & Env. Div.
Mr. Vientihane		Dept. of Public Works and Transport Housing-Urban Planning & Env. Div.
Mr. Thinnakone PHOMMAVONG	Public Official	Dept. of Public Works and Transport Water Supply & Environmental Mgmt. Unit
Mr. Lamkha XAIYASARN	Head of Division	Dept. of Public Works and Transport Transport Management Division
Mr. Soutchai DOUANGDALA	Deputy Head of Division	Dept. of Public Works and Transport Road & Bridge Division
Mr. Ouyphet Phaosikham	Deputy Chief	Fire Prevention and Protection Division

Électricité du Laos (EDL)

Name	Position	Affiliation
Mr. Vongphasal SOUVANNAVONG	Director	Technical Planning

Embassy of Japan in the Lao PDR

Name	Position	Affiliation
Mr. Toshimichi KOGA	First Secretary	Embassy of Japan
Ms. Asuka KATO	Second Secretary	Embassy of Japan
Mr. Taiju KIKUCHI	Third Secretary	Embassy of Japan

JICA Laos Office

Name	Position	Affiliation
Mr. Toshio NAGASE	Chief Representative	JICA Laos Office
Mr. Yasushi OSHIKIRI	Senior Representative	JICA Laos Office
Ms. Kittiyapha Phimpho	Program Officer	JICA Laos Office

Appendix 4. Minutes of Discussions

4-1. Minutes of Discussions 1 (signed on April 22, 2021)

Minutes of Discussions
on the Preparatory Survey on
the Project for Improvement of Facility and Laboratory Equipment
in the Faculty of Engineering, National University of Laos

In response to the request from the Government of Lao People's Democratic Republic (hereinafter referred to as "the Lao PDR"), Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of the Project for Improvement of Facility and Laboratory Equipment in the Faculty of Engineering, National University of Laos (hereinafter referred to as "the Project") to the Lao PDR. The Team held a series of discussions with the officials of the Government of the Lao PDR and the National University of Laos (hereinafter referred to as "NUOL") and conducted a field survey. In the course of the discussions, both sides have confirmed the main items described in the attached sheets.

Vientiane, 22nd April, 2021

SANADA Akiko
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Assoc. Prof. Dr. Oudom PHONEKHAMPHENG
Acting President
National University of Laos
Lao People's Democratic Republic

Witness

Assoc. Prof. Dr. Khamphoui SOUTHISOMBATH
Dean
Faculty of Engineering
National University of Laos
Lao People's Democratic Republic

Assoc. Prof. Dr. Saykhong SAYNASINE
Director General
Department of Higher Education
Ministry of Education and Sports
Lao People's Democratic Republic

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve education/research environment of the Faculty of Engineering (hereinafter referred to as "FEN"), NUOL by upgrading facility and equipment for education/research activities, thereby contributing to the development of engineering human resources to meet the needs of industry in the Lao PDR.

2. Title of the Preparatory Survey

Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey on the Project for Improvement of Facility and Laboratory Equipment in the Faculty of Engineering, National University of Laos".

3. Project site

Both sides confirmed that the site of the Project is in the FEN campus of NUOL, which is shown in Annex 1.

4. Responsible authority for the Project

Both sides confirmed the authorities responsible for the Project are as follows:

4-1. The NUOL will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be managed by relevant authorities properly and on time. The organization charts are shown in Annex 2.

4-2. The line ministry of the Executing Agency is the Ministry of Education and Sports (hereinafter referred to as "MOES"). The MOES shall be responsible for supervising the Executing Agency on behalf of the Government of the Lao PDR.

4-3. The Lao PDR side agreed to make further discussions with the concerned ministries and authorities to conclude "the Recipient" and "the Executing Agency" to be defined in the Grant Agreement for the Project, in accordance with the legislations of the Lao PDR and from the aspects of smooth implementation of the Project.

5. Items requested by the Government of the Lao PDR

5-1. As a result of discussions, both sides confirmed that the items and their priorities

requested by the Government of the Lao PDR and NUOL are as follows:

- The facility components as shown in Annex 3-1.
- The equipment list with priorities as shown in Annex 3-2.

5-2. JICA will assess the feasibility of the above requested items through the Preparatory Survey and will report the findings to the Government of Japan. The final scope of the Project will be subject to the approval by the Government of Japan.

6. Procedures and Basic Principles of Japanese Grant

6-1. The Lao PDR side agreed that the procedures and basic principles and basic principles of Japanese Grant (hereinafter referred to as "the Grant") as described in Annex 4 shall be applied to the Project.
As for the monitoring of the implementation of the Project, JICA requires the Lao PDR side to submit the Project Monitoring Report, the form of which is attached as Annex 5.

6-2. The Lao PDR side agreed to take the necessary measures, as described in Annex 6, for smooth implementation of the Project. The contents of the Annex 6 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report.
The contents of Annex 6 will be updated as the Preparatory Survey progresses, and eventually, will be used as an attachment to the Grant Agreement.

7. Schedule of the Survey

7-1. The Team will proceed with further survey in the Lao PDR until 24th April 2021.

7-2. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to the Lao PDR in order to explain its contents around November 2021.

7-3. If the contents of the draft Preparatory Survey Report is accepted and the undertakings for the Project are fully agreed by the Lao PDR side, JICA will finalize the Preparatory Survey Report and send it to the Lao PDR around March 2022.

7-4. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. The Lao PDR side confirmed to give due environmental and social considerations before and during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social

Considerations (April, 2010).

8-2. The Project is categorized as "C" from the following considerations:

Not located in a sensitive area, nor has it sensitive characteristics, nor falls it into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant.

9. Other Relevant Issues

9-1. Higher Educational Planning

(1) The Lao PDR side agreed to set an appropriate number of students and faculty members in order to utilize the equipment and facilities for effective experimental and practical works.

(2) The Lao PDR side agreed to provide the following documents by the end of April 2021.

- Annual School Census: 2018-19, 2019-20, 2020-21 (any data currently available)
- Budget for NUOL (income and expenditure from 2016/17 – 2020/21) and any available information on future budget plan.
- Budget for Higher Education (income and expenditure from 2016/17 – 2020/21) and any available information on future budget plan.

9-2. Equipment Planning

(1) Both sides confirmed the necessity of budget allocation by NUOL for operation and maintenance of the equipment to be procured by the Project. The approximate cost for operation and maintenance of the equipment will be calculated at the analysis stage in Japan.

(2) The Lao PDR side agreed to provide the following information by the end of April 2021.

- Future 5-year budget plan after hand over of the Grant Aid Project, such as operation and maintenance cost, additional staffing cost, etc.
- Information for the blank columns in "Requested Equipment List" requested to each target department on April 19, 2021.

9-3. Facility Planning

(1) Both sides confirmed about the proposed locations for new facilities construction as shown in Annex 3-1.

(2) Both sides agreed that details of facility planning to be prepared on the basis of the requested items shown in Annex 3-1 will be explained and discussed through a series of online meetings held between the Team and FEN-NUOL at the analysis stage in Japan.

(3) The Lao PDR side understood that furniture for new facilities to be constructed by

the Project, which are not included in the equipment components, will be provided as a part of the facility components. Details of furniture items will be explained to the Lao PDR side through email/online communication and when the mission is dispatched in order to explain Draft Preparatory Survey Report.

(4) The Lao PDR side understood that solar photovoltaic generation system requested by NUOL would be carefully considered in Japan whether it will be a part of facility components. Details of such system will be explained to the Lao PDR side when the mission is dispatched in order to explain Draft Preparatory Survey Report.

9-4. Construction Planning

(1) The Lao PDR side agreed that "A3" building (Civil Engineering Department building) will be temporarily closed during construction period in order to maintain safety of both the campus area and construction area. The Lao PDR agreed that Civil Engineering Department will be temporarily moved to other alternative facilities within the campus and necessary equipment, furniture, etc. will be transferred from/to "A3" building at the responsibility of FEN-NUOL.

(2) The Lao PDR side agreed that the East gate of FEN-NUOL campus may be occupied for construction purpose during construction period. Details of temporary plan will be studied in Japan, and it will be explained to the Lao PDR side when the mission is dispatched in order to explain Draft Preparatory Survey Report.

9-5. Demolition of Existing Structures and other Preparatory Works to be done by the Lao PDR Side

(1) The Lao PDR side agreed to be responsible for demolition of the designated structures, including but not limited to the followings, prior to implementation of the Project, in principle.

- Roofed motorbike parking lot near the East gate
- A guard house near the East gate
- Concrete slabs at the court yard near the Dean's office

(2) The Lao PDR agreed to demolish underground structures as well as superstructures, of and around the designated structures. The detailed extent of demolition works will be studied in Japan, and it will be explained to the Lao PDR side when the mission is dispatched in order to explain Draft Preparatory Survey Report.

(3) The Lao PDR side agreed that other preparatory works, such as removal of trees and rerouting of existing electrical cables, shown in Annex 6 are to be undertaken by the Lao PDR side prior to implementation of the Project. Detailed work items, expected costs and accurate deadlines of the preparatory works will be explained to the Lao PDR side when the mission is dispatched in order to explain Draft Preparatory Survey Report.

9-6. Operation and Maintenance of Center of Engineering for Sustainable Development

(1) The Lao PDR side explained and the Team understood about the concepts of "Center of Engineering for Sustainable Development (hereinafter referred to as "CESD") as follows:

- CESD is to be established as a center facility for FEN-NUOL, and it will be managed and operated under the responsibility of Vice Dean for Research &Academic Service Division, Post Graduate Studies Division and Student Affair Division of FEN-NUOL.
- CESD will contain education/research equipment which is utilized by all departments of FEN-NUOL, so that enhancement of academic communication/cooperation among different departments of FEN-NUOL is expected.
- CESD can contribute to academic-industrial collaboration through such comprehensive and academic cooperation among department of FEN-NUOL. CESD is expected to have meeting/conference rooms for such activities.
- CESD is expected to have an exhibition space for education/research activities.

(2) The Lao PDR side agreed to secure and allocate the necessary budget and staff for the proper operation and maintenance of CESD facilities and equipment.

9-7. Gender Mainstreaming

Both sides confirmed that following gender elements shall be duly reflected in the scope of Preparatory Survey.

(a) Collection of information and gender disaggregated data for assessment of gender needs.

(b) Examination of gender-responsive measures based on the assessment, such as:

- ✓ Facility design that reflects gender-specific needs.
- ✓ Selection of equipment that reflects gender-specific needs and ensure usability by women.
- ✓ Collection of gender-disaggregated data for monitoring and evaluation (in case gender-related data is included in the indicators for project objective).

9-8. Exemption from Customs Duties, Taxes and Fiscal leaves

Both sides confirmed that customs duties, internal taxes and other fiscal levies, which may be imposed in the Lao PDR with respect to the purchase of the products and/or the services, are to be exempted.

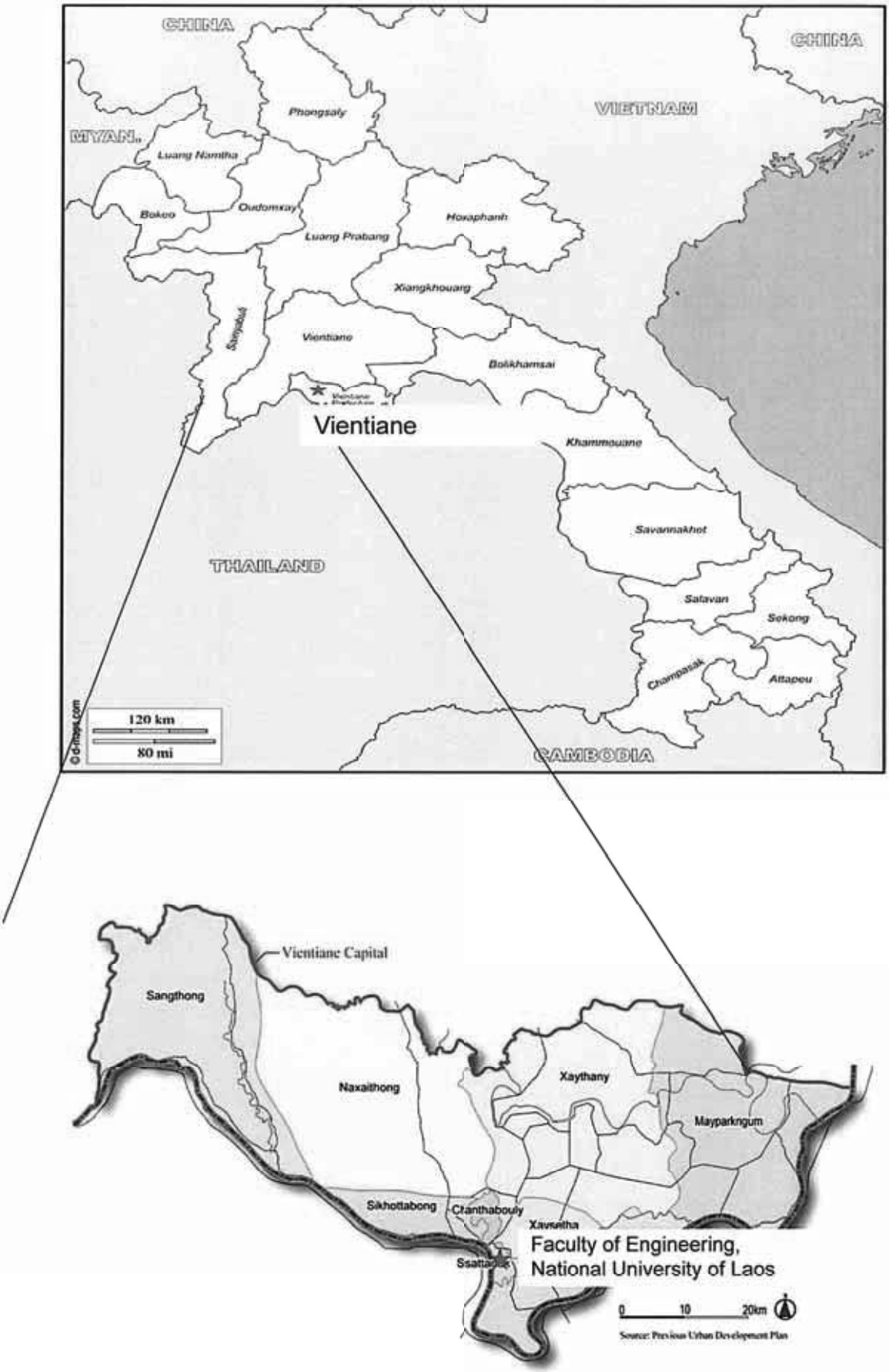
9-9. Measures related to Safety Management

As shown in Annex 6, both sides confirmed that NUOL shall take necessary measures to ensure and maintain the safety of the Project site and the persons related to the implementation of the Project, in cooperation with relevant authorities such as police.

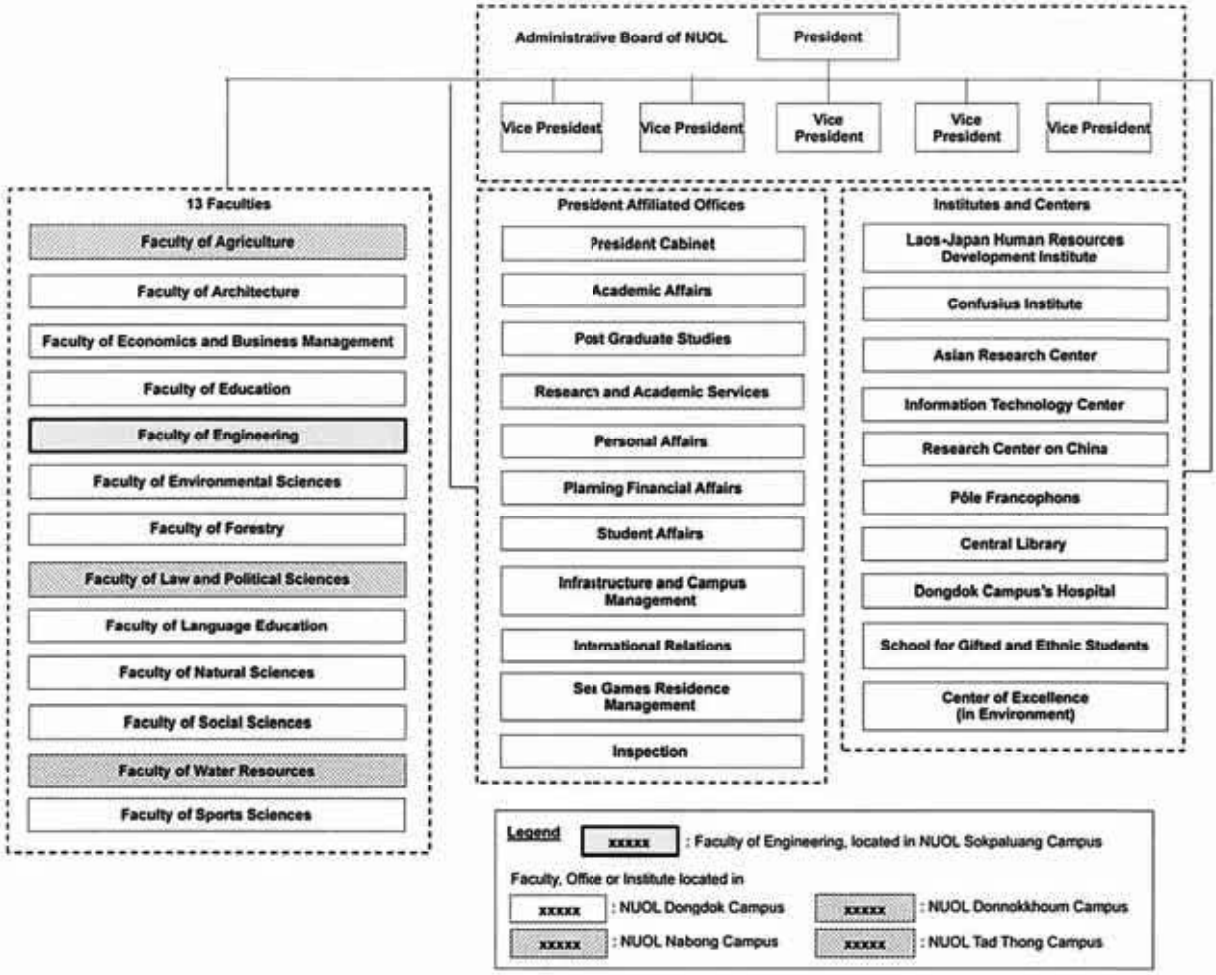
Annex 1 Project Site
Annex 2 Organization Chart
Annex 3-1 Requested Items (Facility Components)
Annex 3-2 Requested Items (Equipment List with Priorities)
Annex 4 Japanese Grant
Annex 5 Project Monitoring Report (template)
Annex 6 Major Undertakings to be taken by the Government of the Lao PDR

Annex 1

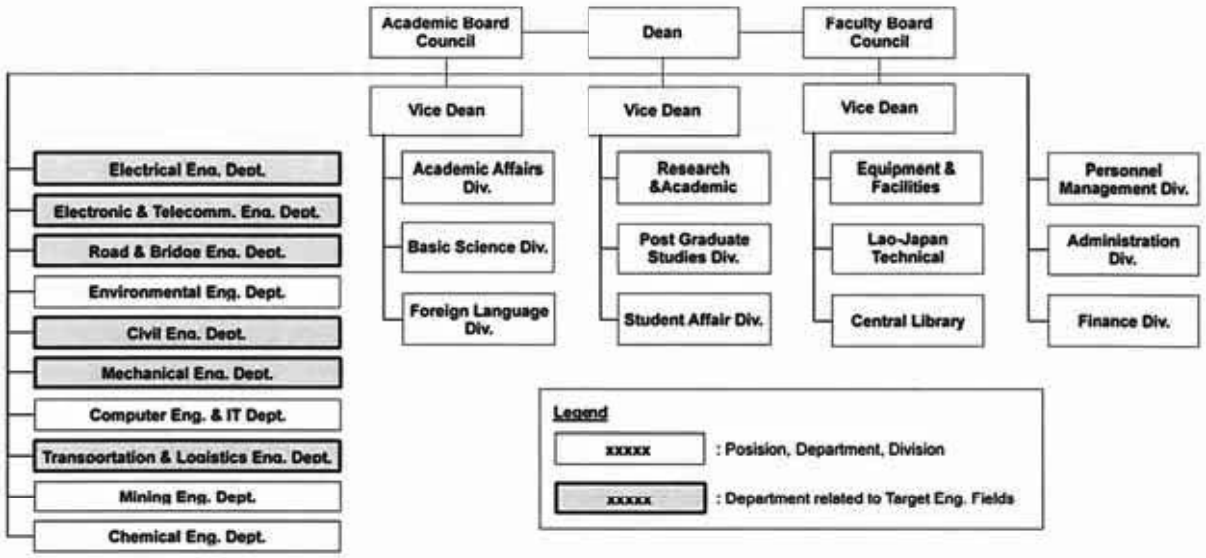
Project site



Annex 2



Organization Chart for National University of Laos (NUOL)



Organization Chart for Faculty of Engineering, NUOL

Annex 3-1 Requested Items (Facility Components)

(1) Proposed Locations for New Facilities Construction

- The proposed locations (sites) for new facilities construction are Sites A, B and C shown in the map.
- Center of Engineering for Sustainable Development (CESD) is planned to be constructed at Site A.
- Laboratory Buildings are planned to be constructed at Site B.
- Site C will be planned as temporary facility area for construction works, while it might be considered as alternative site for new construction if necessary.
- A3 building may be temporalily closed during construction period.

(2) Requested Items (Facility Components)

Notes: 1) Facility components are subject to change depending on the laboratory equipment to be selected.
2) Air conditioning system (A/C) will be planned for laboratory rooms, offices and meeting rooms, in principle. However, A/C/ will not be considered for laboratory rooms which materials are frequently carried in/out and/or whose doors/windows mostly keep open.

Center of Engineering for Sustainable Development (CESD)

No.	Room name	Floor	Remarks
Laboratories			
1	Chemical analysis equipment room	1	
2	Chemical analysis preparation room	1	
3	Physical Measurement Laboratory	1	
4	Precision Measuring & Solid Forming Laboratory	1	
5	Electron microscope room	1	
6	X-ray analysis room	1	
7	Electron microscope and X-ray analysis preparation room	1	
8	Flume laboratory	1	
9	High voltage laboratory	1	
10	High voltage preparation room	1	
11	Computer room (1)	2	
12	Computer room (2)	2	
13	Wind tunnel laboratory	2	
14	Wind tunnel and flume preparation room	2	
Common Facilities			
15	Administration office	1	For CESD management staff
16	Meeting Room (1)	2	Meeting for inside or outside FEN
17	Meeting Room (2)	2	Meeting for inside or outside FEN
18	Meeting Room (3)	2	Meeting for inside or outside FEN
19	Lecture Room (1)	2	Lecture on usage of equipment
20	Exhibition Room	2	Exhibition of research theme
21	Entrance hall, Corridor, Exhibition corridor, Stairs, Slope	1-2	
22	Toilet, Pantry	1-2	
23	Server Room	1	

Laboratory Block-1 (Mechanical, Road&Bridge, Transportaion&Logistics, Electrical and Electronics)

No.	Room name	Floor	Remarks
Mechanical Engineering Department			
24	Metalworking training room	1	
25	Machining training room	1	
26	Engine laboratory	1	
27	Fluid Mechanics Laboratory	1	
28	Machining training preparation room	1	
29	Material Measuring Laboratory	2	
30	Material Measuring Preparation room	2	
31	Engine preparation room	1	
Road and Bridge Engineering Department			
32	Soil testing laboratory (1)	1	Drain Pit
33	Soil testing laboratory (2)	1	Drain pit
34	Soil testing preparation room	1	
35	Surveying Instrument Room for R&B	2	
36	Material storage for RB Dept.	2	
Transportation & Logistics Engineering Department			
37	Transportation and Logistics Engineering Laboratory (1)	2	
38	Transportation and Logistics Engineering Laboratory (2)	2	
39	Computer room for T&L	2	
Electronics & Telecommunication Engineering Department			
40	Electronics laboratory (1)	3	
41	Electronics laboratory (2)	3	
42	Electronics laboratory (3)	3	
43	Electronics preparation room	3	
Electrical Engineering Department			
44	Electrical engineering laboratory (1)	3	
45	Electrical engineering laboratory (2)	3	
46	Electrical engineering laboratory (3)	3	
47	Electrical engineering preparation room	3	
Common Facilities			
48	Office	2	
49	Atrium, Corridor, Stairs, Elevator shaft, Electrical room	1-3	Elevator car is future work by the Client
50	Toilet, Pantry	1-3	
51	Server room	1-3	

Laboratory Block-2 (Civil Engineering & CESD)

No.	Room name	Floor	Remarks
Civil Engineering Department			
52	Concrete mixing room	1	Drain trench, test piece curing pool
53	Concrete testing laboratory	1	Concrete base
54	Structure testing laboratory	1	Concrete base
55	Concrete testing preparation room	1	
56	Soil testing laboratory	1	Drain pit
57	Soil testing preparation room	1	
58	Surveying Instrument room for CE	2	
59	Chemical analysis laboratory	2	
60	Chemical analysis preparation room	2	
61	Material storage for CE Dept.	2	
Center of Engineering for Sustainable Development (CESD)			
62	Material testing room	1	Ceiling height 5m or more, wide shutter
63	Material testing preparation room	1	
Common Facilities			
64	Atrium, Corridor, Stairs	1−2	
65	Toilet, Pantry	1	
66	Server room	1	

Annex 3-2 Requested Items (Equipment List with Priorities)

No.	Code No.	Name of equipment	Q'ty	Priority
1	CESD-1	High Speed Camera	1	A
2	CESD-2	Sequential X-Ray Fluorescence Spectrometer	1	B
3	CESD-3	Powder X-ray diffractometer (XRD)	1	A
4	CESD-4	UV-Visible Spectrophotometer	1	A
5	CESD-5	Water Distiller	1	B
6	CESD-6	Electric Furnace for Metal Melting	4	A
7	CESD-7	Refrigerator	1	B
8	CESD-8	Electric Balance Set	4	A
9	CESD-9	Electric vihecle charging test	4	A
10	CESD-10	EV Motor Test Bench	1	B
11	CESD-11	Scanning Electron Microscope (SEM) w/Coating machine	1	A
12	CESD-12	Wind Tunnel (for Civil Engineering Field)	1	B
13	CESD-13	2000kN Universal Testing Machine	1	A
14	CESD-14	Hydraulic Actuator Fatigue Tester (300kN) - Horizontal loading	1	B
15	CESD-15	Fatigue Testing Machine - Verticcal loading	1	B
16	CESD-16	Fiber tensile strength testing machine	1	A
17	CESD-17	Concrete Permeability Testing	1	A
18	CESD-18	Impact Echo	1	B
19	CESD-19	Infrared Thermography	1	B
20	CESD-20	Ultrasonic weld inspection	1	A
21	CESD-21	Magnetic particle inspection for Surface crack detection	1	A
22	CESD-22	Liquid Penetration Inspection (LPI)	1	B
23	CESD-23	Soil Investigation Drilling Machine	1	A
24	CESD-24	Dynamic cone penetrometer tool	1	A
25	CESD-25	Sonic Integrity Test (SIT)	1	B
26	CESD-26	Proceq GPR live	1	A
27	CESD-27	Dynamic Pile Load Test System	1	B
28	CESD-28	Road Surface Friction Coefficient Test Equipment	1	A
29	CESD-29	Road Roughness Tester	1	A
30	CESD-30	Road Length Measurement Wheel	1	B
31	CESD-31	Portable Axle Weigh Pads	2	B
32	CESD-32	Traffic Counting Camera	4	B
33	CESD-33	Digital Noise Meter for Noise Level Testing	4	A
34	CESD-34	Traffic Monitoring System	1	A
35	CESD-35	VISSIM Traffic Simulation Software with Computer	1	A
36	CESD-36	Impedance Analyzer	1	A
37	CESD-37	Thermal Camera	1	A
38	CESD-38	Digital Oscilloscope	1	A
39	CESD-39	Function/Arbitrary Waveform Gererator	1	A
40	CESD-40	Digital Multimeter	1	B
41	CESD-41	Spectrum Analyzer/Signal Analyzer	1	A
42	CESD-42	Logic Analyzer	1	B
43	CESD-43	High Voltage Experimental Equipment	1	A
44	CESD-44	Oscilloscope for High Voltage Measuring	1	A
45	CESD-45	Solar/Wind Energy Advanced Trainer	1	B
46	ME-1	Hand Tool Set	40	A

Annex 3-2

No.	Code No.	Name of equipment	Q'ty	Priority
47	ME-2	Power Tool Set	10	A
48	ME-3	Dimension Measuring Equipment Set	40	A
49	ME-4	Electric Furnace	3	A
50	ME-5	Metal Specimen Processing Machine	2	A
51	ME-6	Metallurgical Microscope	3	B
52	ME-7	Rockewll Hardness Tester	2	A
53	ME-8	Thermogravitric Analysis (TGA/DSC)	1	A
54	ME-9	Infrared Spectroscopy (FTIR) (Reconsider)	1	A
55	ME-10	X-Ray Fluorescence Spectrometer (XRF)	1	A
56	ME-11	Particle size analysis (PSA)	1	A
57	ME-12	Electric Balance	3	A
58	ME-13	Impact Testing Machine	1	A
59	ME-14	Vibration Experimental Device	1	B
60	ME-15	Structural Mechanics Experimental Device	1	A
61	ME-16	Boiler Experimental Device	1	A
62	ME-17	Air Conditioning Experimental Device	1	A
63	ME-18	Renewable Energy Experimental Device	1	A
64	ME-19	Gasoline+Diesel Engine Experimental Device	1	A
65	ME-20	Gasturbine Experimental Device	1	A
66	ME-21	Exhaust Gases Analyzer	1	A
67	ME-22	DC Welder	4	A
68	ME-23	TIG + MIG Welder	4	A
69	ME-24	Double Headed Grinder	2	A
70	ME-25	Surface Grinding Machine	1	A
71	ME-26	3D Printer (plastic)	2	A
72	ME-27	Oxyacetylene Welding Set	4	A
73	ME-28	Band Saw	1	A
74	ME-29	Table Top CNC Vertical Milling Machine	10	A
75	ME-30	Multi Joint Robot	2	A
76	ME-31	Automation Trainer	2	A
77	ME-32	Lathe machine	1	A
78	ME-33	Bench drilling machine	1	A
79	ME-34	Milling Machine	1	A
80	ME-35	Blade sharpener (floor type)	1	A
81	ME-36	Folding machine	1	A
82	ME-37	Cutting machine	1	A
83	ME-38	Rolling machine	1	A
84	ME-39	Water Pumping Circulation system	1	A
85	ME-40	Hot air Oven for 150degs.C	1	A
86	ME-41	Shop press	1	A
87	ME-42	Friction Lost Experimental Device	1	A
88	ME-43	Oxygen bomb calorimeter	1	A
89	ME-44	Laboratory emission monitoring system (LEMS)	1	A
90	ME-45	Solar power meter	1	A
91	ME-46	CHN Analyzer	1	A
92	ME-47	Engine Dynamometter	1	A
93	CE-01	Pallet Truck Hydraulic	2	A
94	CE-02	Specimen grinding machine	1	A

Annex 3-2

No.	Code No.	Name of equipment	Q'ty	Priority
95	CE-03	Specimen cutting machine for Con.	1	A
96	CE-04	Specimen cutting machine for steel	1	A
97	CE-05	Marking-off machine for steel speciment	1	A
98	CE-06	Deformed Bar Bending Cutting Machine	1	B
99	CE-07	Distiller	2	B
100	CE-08	Chemical Analysis Equipment Set	4	B
101	CE-09	Jartester	4	B
102	CE-10	Spectrophotometer	1	A
103	CE-11	Los Angeles Testing Machine	1	A
104	CE-12	Aggregate Crusher	1	A
105	CE-13	Blaine Air Permeability Testing Apparatus	2	A
106	CE-14	Cement Agglutination Test Apparatus	2	B
107	CE-15	Mortar Mixer	2	A
108	CE-16	Pull-Off Tester (Bond Strength Tester)	1	A
109	CE-17	Constant Temperature Bath	1	B
110	CE-18	Set of Vebe Test equipment	2	A
111	CE-19	Loss on ignition test mechine	1	B
112	CE-20	Concrete Breaker	2	B
113	CE-21	Concrete compression machine 1500 kN semi-automatic,	1	A
114	CE-22	Steel Tesile Testing Machine, 600 kN	1	B
115	CE-23	Concrete flexural machine 200 kN automatic,	1	B
116	CE-24	Cold bend testing machine	1	B
117	CE-25	Structural TM 1000KN w/ Electro-hydraulic control	1	B
118	CE-26	Shaking Table	1	A
119	CE-27	Set of Vibration Acceleration Measuring Device in vertical	2	A
120	CE-28	Half cell potential tester, corrosion test	1	A
121	CE-29	Pullout test apparatus	2	B
122	CE-30	Moisture meter "Surveymaster"	2	B
123	CE-31	Carbonation test	2	B
124	CE-32	Chloride field test system	2	B
125	CE-33	Chloride Ion penetration meter	2	B
126	CE-34	Digital resistivity 2-probe array meter	2	B
127	CE-35	Windsor pin penetrometer	2	B
128	CE-36	Deflectometer with telescopic	2	A
129	CE-37	Resonance Frequency	2	B
130	CE-38	Soil Sieve Shaker	2	B
131	CE-39	Soil crusher	1	B
132	CE-40	Soil Density Measuring Instrument	2	B
133	CE-41	Soil Particle Size Measuring Instrument (Hydrometer method)	2	A
134	CE-42	Soil Liquid Limit Measuring Instrument	4	A
135	CE-43	Motorized liquid limit device	2	A
136	CE-44	Soil Constant Temperature Dryer	2	A
137	CE-45	Soil Compaction Tester (Nuclear moisture density gauge)	1	B
138	CE-46	CBR Testing Machine	2	A
139	CE-47	Constant Water Level Permeability Tester	1	A
140	CE-48	Change Water Level Permeability Tester	1	B
141	CE-49	Falling Head Permeability Tester	2	A
142	CE-50	Soil Consolidation Tester	2	A

Annex 3-2

No.	Code No.	Name of equipment	Q'ty	Priority
143	CE-51	Direct Shear Teseter	2	A
144	CE-52	Uniaxial Compression Tester	2	A
145	CE-53	Triaxial Compression Tester complete set with accessaries	2	A
146	CE-54	Sand density cone apparatus	2	A
147	CE-55	Soil die cutter with Hollow punches and Tampers	2	B
148	CE-56	Particle size distribution - Pipette method	1	B
149	CE-57	Cross Hole Ultrasonic System,	2	B
150	CE-58	Plate bearing equipment, 200 kN, 3 dial gauges	1	A
151	CE-59	Field inspection pocket vane tester	2	B
152	CE-60	Field CBR test set	2	A
153	CE-61	Electric Balance	3	A
154	CE-62	Surface soil samplers	2	B
155	CE-63	Hot plates	2	A
156	CE-64	Test sieves for soil testing conform to ASTM D 442-63	3	A
157	CE-65	Wheel Tracking Testing Mashine	1	B
158	CE-66	Asphalt Tamping TM, ASC-Asphalt Shear Box Compactor	1	B
159	CE-67	Soxhlet modified method	2	A
160	CE-68	Skid resistance and friction tester	2	A
161	CE-69	Asphalt Mix Analyzer	1	B
162	CE-70	The Marshell Stability machine	1	A
163	CE-71	Constant Temperature Water Bath (set)	2	B
164	CE-72	15kg Buoyancy Balance Set for gravity of aggregates.	1	A
165	CE-73	BS Manual Conpaction Pedestal With Compaction Hammer	1	A
166	CE-74	Mashall Compaction Moulds(set)	10	A
167	CE-75	Bitmen Picnometer, Hubbard-Carmick specific gravity	7	A
168	CE-76	Gas pycnometer for Aggregrate and Sand, Cone pyknometer	4	A
169	CE-77	Quantative Extraction (set)	3	A
170	CE-78	Benkelmam Beam	2	A
171	CE-79	Flash and Fire Point Betum (set)	2	A
172	CE-80	Traffic Counter	5	A
173	CE-81	Speed Counter	5	A
174	CE-82	Sound Level Meter	5	A
175	CE-83	GPS Positioning System	5	A
176	CE-84	GPS Surveyor	4	B
177	CE-85	Set of RTK Base Stations	4	B
178	CE-86	Digital Level	4	A
179	CE-87	Fixed Wing UAV	1	B
180	CE-88	Computer + Pix4mapper Software	1	A
181	CE-89	Desktop computer including accessories	11	B
182	CE-90	Construction Planning tool (Primavera Software)	1	B
183	CE-91	BIM tool (Autodesk Revit Software)	1	B
184	CE-92	Construction cost estimate tool (PlanSwift Software)	1	B
185	CE-93	Construction Simulation and Management Software	1	B
186	CE-94	Infrastructure Simulation tool (Autodesk Civil 3D Software)	1	B
187	CE-95	Construction VDO recorder equipment (TIME Lapse Camera)	4	B
188	CE-96	Pressure measurement Bench	1	A
189	CE-97	Flow Visualisation	1	B
190	CE-98	Pitot Tubes	1	A

Annex 3-2

No.	Code No.	Name of equipment	Q'ty	Priority
191	CE-99	Impact of a Jet	1	B
192	CE-100	Flow Measurement Methods	1	B
193	CE-101	Francis Turbine	1	B
194	CE-102	Pelton Turbine	1	B
195	CE-103	Pipe Surge And Water Hammer	1	B
196	CE-104	Fluid Friction Apparatus	1	B
197	CE-105	Liquid Sedimentation Apparatus	1	B
198	CE-106	Weather Station	1	B
199	CE-107	Hydrology and Rainfall Apparatus	1	B
200	CE-108	Drainage and Seepage Tank	1	B
201	CE-109	Rainfall Hydrographs	1	B
202	CE-110	Ground Water Flow Unit	1	B
203	CE-111	River Flow Simulator	1	B
204	CE-112	Rainfall Simulator	1	B
205	CE-113	Demonstration Infiltration Apparatus	1	B
206	CE-114	Automatic Water Control Gates	1	B
207	CE-115	Discharge measurement	1	B
208	RB-1	Shieve Set	2	A
209	RB-2	Sedimentation Test Set	2	A
210	RB-3	Plastic Index Liquid Limit Test Set	2	A
211	RB-4	Compaction Test Equipment Set	1	A
212	RB-5	CBR Testing Equipment	1	A
213	RB-6	Field CBR Testing Equipment	1	A
214	RB-7	Field Density Test Set	2	A
215	RB-8	Specific Gravity Test Set	2	A
216	RB-9	Aggregate Test Set	1	A
217	RB-10	Polishing Stone Value Testing MC	1	B
218	RB-11	Alkali test set	1	A
219	RB-12	Thin Film Oven	1	A
220	RB-13	Penetration of Bituminous	2	A
221	RB-14	Flash & Fire Point Tester	1	A
222	RB-15	Ductivity Apparatus	1	A
223	RB-16	Distillation of Cut-Back Asphalt (Bituminous) Products	2	A
224	RB-17	Travelling Beam Device	1	A
225	RB-18	Benkelman Beam	1	A
226	RB-19	Core Drill for Asphalt	1	A
227	RB-20	Aluminum Staff	15	A
228	RB-21	Auto-Leveling	5	A
229	RB-22	Total Station	3	A
230	RB-23	Theodolite	6	A
231	RB-24	Pole set	15	B
232	RB-25	Hand GPS	4	A
233	RB-26	Ecocenter	2	A
234	RB-27	RTK	2	A
235	RB-28	Distance mesurment device	8	B
236	RB-29	pH Meter	2	B
237	RB-30	Turbility Test Device	2	B
238	RB-31	Color Test kit	1	B

Annex 3-2

No.	Code No.	Name of equipment	Q'ty	Priority
239	RB-32	Chloroscope Chlorine Test Kit	1	B
240	RB-33	Noise/Sound Level Meter	2	B
241	RB-34	Soil Investigation Drilling Machine	1	A
242	RB-35	Dynamic cone penetrometer tool	1	A
243	RB-36	Air Quality Monitor	2	B
244	RB-37	Schmidt Hamer Device	2	B
245	RB-38	Sonic Integrity Test (SIT)	2	A
246	RB-39	Proceq GPR live	2	A
247	RB-40	Dynamic Pile Load Test System	1	A
248	RB-41	Road Surface Friction Coefficient Test Equipment	1	A
249	RB-42	Road Roughness Tester	1	A
250	RB-43	Road Length Measurement Wheel	2	B
251	TL-01	Desktop Computer	40	B
252	TL-02	Printer	1	B
253	TL-03	Projector	1	B
254	TL-04	Laser Speed Gun	10	A
255	TL-05	Vehicle Emissions Testing System	2	A
256	TL-06	Portable Axle Weigh Pads	2	A
257	TL-07	Garmin GPS	8	A
258	TL-08	Digital Noise Meter for Noise Level Testing	5	B
259	TL-09	Roadside Drug Testing Devices market segmentation	10	A
260	TL-10	Traffic Monitoring System	2	B
261	TL-11	Car Driving Simulator Visual System	1	B
262	TL-12	Hand-held Traffic data collector	12	B
263	TL-13	GPS Tracking Device	8	B
264	TL-14	RFID Reader and printer	2	A
265	TL-15	Barcode Scanner and printer	6	A
266	TL-16	Semi automatic carton flap folding machine	2	A
267	TL-17	VISSIM Traffic Simulation Software	1	B
268	EL-01	Electric Hand Tool Set	40	B
269	EL-02	Power Tool Set	4	B
270	EL-03	Multimeter	40	A
271	EL-04	Crampmeter	40	B
272	EL-05	Insuration Resistance Tester	8	B
273	EL-06	Transformer oil testing	1	B
274	EL-07	Hi pot tester	1	B
275	EL-08	Coil winding tester	1	A
276	EL-09	Variable DC voltage source (For transformer resistor testing)	1	A
277	EL-10	Variable AC voltage source (For transformer testing)	1	A
278	EL-11	Contact resistance tester	1	A
279	EL-12	Relay tester (For protection)	1	A
280	EL-13	Transformer turn ratio meter	1	A
281	EL-14	Grounding Resistance Tester	8	B
282	EL-15	Power Analyzer	8	B
283	EL-16	Field Intensisty Meter	8	A
284	EL-17	Electric Circuit Trainer	8	A
285	EL-18	Coil Winding Machine	1	B
286	EL-19	DC Motor Trainer	2	B

Annex 3-2

No.	Code No.	Name of equipment	Q'ty	Priority
287	EL-20	Power Electronics Training Set	4	B
288	EL-21	3 Phase AC Motor Trainer	2	A
289	EL-22	3 Phase AC Generator Trainer	2	B
290	EL-23	Renewable Energy Trainer	1	B
291	EL-24	Inverter Control Trainer	4	A
292	EL-25	Tachometer	4	A
293	EL-26	Radiation Pyrometer	2	A
294	EL-27	High Voltage Receiving Equipment Trainer	1	A
295	EL-28	Low Voltage Wiring Trainer	4	B
296	EL-29	Electronics Hand Tool Set	40	B
297	EL-30	Power Supply	5	A
298	EL-31	Frequency Counter	4	A
299	EL-32	Oscilloscope	5	A
300	EL-33	Function Generator	5	A
301	EL-34	Electronics Circuit Trainer	5	A
302	EL-35	Logic Circuit Trainer	5	A
303	EL-36	A/D D/A Conversion Trainer	5	A
304	EL-37	PLC Trainer and conveyer system	5	A
305	EL-38	SCADA trainer	5	A
306	EL-39	Sensor Trainer	5	A
307	EL-40	Home Appliance Set for Training	8	A
308	EL-41	Microprocessor Trainer	8	A
309	EL-42	Relay Circuit Trainer	5	A
310	EL-43	Electrical Protection trainer (Substation and transmission line)	5	A
311	EL-44	Variac transformer AC/DC 0-400 V	2	B
312	EL-45	Hydro Electric speed governor trainer	2	B
313	EL-46	Excitation system trainer	2	B
314	EL-47	Impedance analyzer	1	B
315	EL-48	Portable power meter	1	A
316	EL-49	Handy tachometer	5	A
317	EL-50	Lux meter	2	A
318	EL-51	Safety and continuity of elctrical power supply	1	A
319	EL-52	Hybrid renewable energy : Photovoltaic & Wind generator	1	A
320	ER-01	Logic Circuit Training kit	17	A
321	ER-02	Pulse Circuit training Kit	17	A
322	ER-03	Oscilloscope	17	A
323	ER-04	Function Generator	17	A
324	ER-05	Power Supply	17	A
325	ER-06	IC Trainer with IC Set	17	A
326	ER-07	C Programming Software	50	B
327	ER-08	MatLab Softwares	50	B
328	ER-09	Electronics Circuit Trainer Set	17	B
329	ER-10	Quadripoles and Filters Trainer Set	17	B
330	ER-11	Operation Amplifier Trainer Set	17	A
331	ER-12	AD/DA Conversion Trainer Set	17	A
332	ER-13	Optical Transmission Trainer Set	17	A
333	ER-14	Satellite Communications Training System	1	A
334	ER-15	PLC Trainer	10	A

Annex 3-2

No.	Code No.	Name of equipment	Q'ty	Priority
335	ER-16	HMI Trainer	2	A
336	ER-17	Three Floors of Elevator Training	2	B
337	ER-18	Double Water Tank Set for Training	2	B
338	ER-19	Profinet IO Trainer	5	A
339	ER-20	Electric Heating Control Board Trainer	5	B
340	ER-21	Inverter Control Trainer	2	A
341	ER-22	Electromagnetism and Magnetic Circuit Trainer	5	B
342	ER-23	Single Phase Induction Motor Lab	5	B
343	ER-24	Three Phase Induction Motor Lab	5	B
344	ER-25	Transfer Function of DC Motor and Generator	5	B
345	ER-26	Variable AC voltage source (For transformer testing)	1	B
346	ER-27	Variable DC voltage source	1	B
347	ER-28	Building Electric Installation System Trainer	5	A
348	ER-29	Trainer for High-pass/Low-pass, Bandpass/Bandstop, Band Filters, Series and Parallel Resonant Circuits	10	A
349	ER-30	Trainer for 2nd and 4th Order Low-pass and High-pass Filters, 2nd Order Band-pass and Band-stop Filters	10	B
350	ER-31	A/D and D/A Converters Trainer	10	A
351	ER-32	Radar technology Trainer	10	A
352	ER-33	PC Interface Trainer	10	A
353	ER-34	Radio planing and optimization software	10	B
354	ER-35	PBX System Trainer	5	A
355	ER-36	WLAN Bridgelink Radio Trainer	10	A
356	ER-37	Antenna System Trainer	5	A
357	ER-38	Satellite Communications Trainer	5	A
358	ER-39	Computer Network Trainer	10	A
359	ER-40	Microwave System Trainer	5	A
360	ER-41	Opitcal Network Trainer	5	A
361	ER-42	Basic Frequency Analyzer Set	10	A
362	ER-43	High Frequency analysis Trainer	10	B
363	ER-44	Basic Modulation Trainer	10	A
364	ER-45	Physical Transmission Trainer	10	A
365	ER-46	Basic Protocal Trainer	10	A

Annex 4

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or 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. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the 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 necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant 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 an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take 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 executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) 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 feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

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 to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) 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 to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the

Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

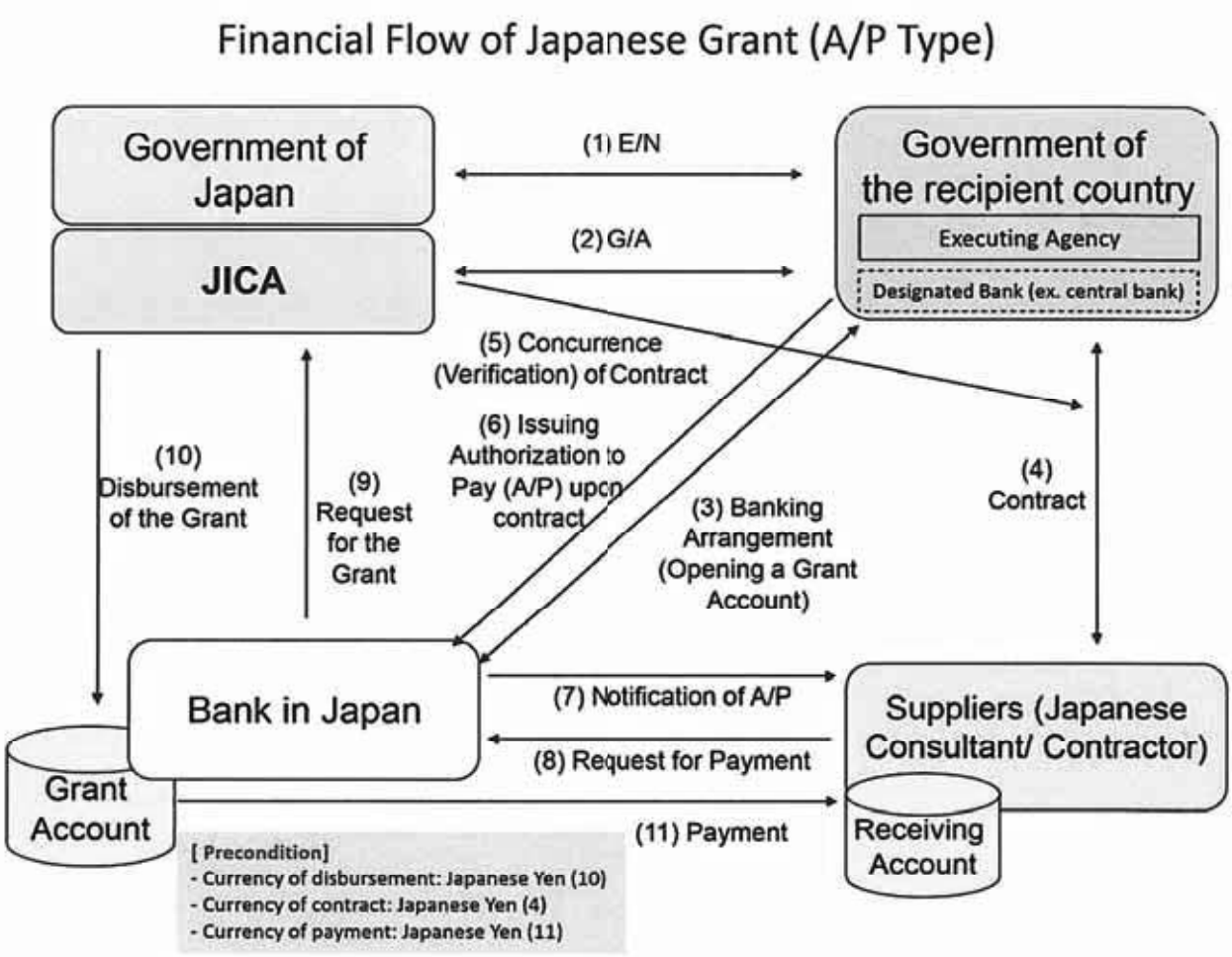
PROCEDURES OF JAPANESE GRANT

Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

notes:

1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.


Financial Flow of Japanese Grant (A/P Type)
Government of Japan
JICA
(1) E/N
(2) G/A
Government of the recipient country
Executing Agency
Designated Bank (ex. central bank)
(5) Concurrence (Verification) of Contract
(6) Issuing Authorization to Pay (A/P) upon contract
(10) Disbursement of the Grant
(9) Request for the Grant
(3) Banking Arrangement (Opening a Grant Account)
(4) Contract
Bank in Japan
(7) Notification of A/P
(8) Request for Payment
Suppliers (Japanese Consultant/ Contractor)
Grant Account
(11) Payment
Receiving Account
[Precondition]
- Currency of disbursement: Japanese Yen (10)
- Currency of contract: Japanese Yen (4)
- Currency of payment: Japanese Yen (11)

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Executing Agency	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Line Ministry	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

-
-
-

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

Annex 6

Major Undertakings to be taken by the Government of the Lao PDR

1. Specific obligations of the Government of the Lao PDR which will not be funded with the Grant

(1) Before the Bidding

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To sign the banking arrangement (B/A) with a bank in Japan (the Agent Bank) to open bank account for the Grant	within 1 month after the signing of the G/A	BOL/MOF NUOL		
2	To issue A/P to the Agent Bank for the payment to the consultant	within 1 month after the signing of the contract(s)	BOL/MOF NUOL		
3	To bear the following commissions to the Agent Bank for the banking services based upon B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	NUOL		
	2) Payment commission for A/P	every payment	NUOL		
4	To secure and clear the following lands within the campus of Faculty of Engineering (FEN), National University of Laos (NUOL) 1) project site for Center of Engineering for Sustainable Development (CESD) (approx. 2,000m^2), 2) project site for laboratory buildings (approx. 3,000m^2), 3) temporary construction yard and stock yard near the project sites (approx. 2,000m^2)	before notice of the bidding documents	NUOL		
5	To obtain the planning, zoning, building permit	before commencement of the construction works	NUOL		
6	To clear the sites by conducting the following preparatory works. 1) demolishing designated existing structures (including underground structures), 2) removing designated trees (including roots and stumps), 3) rerouting designated existing electric cables	before notice of the bidding documents	NUOL		
7	To secure alternative facilities to accommodate functions of A3 building for Civil Engineering Department, which will be closed during the construction period	before notice of the bidding documents	NUOL		
8	To move and store necessary furniture and equipment from A3 building for Civil Engineering Department	before notice of the bidding documents	NUOL		
9	To submit Project Monitoring Report (with the result of Detailed Design)	before preparation of the bidding documents	NUOL		

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to the Agent Bank for the payment to the supplier and the contractor	within 1 month after the signing of the contract(s)	BOL/MOF NUOL		
2	To bear the following commissions to the Agent Bank for the banking services based upon the B/A		BOL/MOF NUOL		
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	NUOL		
	2) Payment commission for A/P	every payment	NUOL		
3	To ensure prompt customs clearance and to assist the Supplier(s) with internal transportation in the country of the Recipient	during the Project	NUOL		
4	To accord Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work	during the Project	NUOL (MOES) MPI		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted–	during the Project	NUOL (MOES) MPI MOF		
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	NUOL		
7	To notify JICA promptly of any incident or accident, which has, or is likely to have, a significant adverse effect on the environment, the affected communities, the public or workers.	during the construction	NUOL		
8	To submit Project Monitoring Report	every month	NUOL		
	To submit Project Monitoring Report (final) (including as-built drawings, equipment list, photographs, etc.)	within 1 month after issuance of Certificate of Completion for the works under the contract(s)	NUOL		
9	To submit a report concerning completion of the Project	within 6 months after completion of the Project	NUOL		
10	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)				
	1) Electricity The distributing line to the site	before start of the construction	NUOL		
	2) Water Supply The city water distribution main to the site	before start of the construction	NUOL		
	3) Drainage The city drainage main (for storm, sewer and others) to the site	6 months before completion of the construction	NUOL		
11	To ensure the safety of persons engaged in the implementation of the Project	during the Project	NUOL in cooperation with MPS (Ministry of Public Security)		

12	To take necessary measures for safety of the Project site, if required (measures for safety) 1) maintaining the safety of workers and the general public by thorough implementation of safety measures and immediate action in the case of accident 2) traffic control around the site(s) and on transportation routes of construction materials 3)installation of fences around the site(s)	during the construction	NUOL		

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	After completion of the construction	NUOL		

2. Other obligations of the Government of the Lao PDR funded with the Grant

NO	Items	Deadline	Amount (Million Japanese Yen)*
1	1) To construct facilities a) Center of Engineering for Sustainable Development b) Laboratory buildings 2) To procure laboratory equipment		
2	To implement detailed design, bidding support and construction supervision (Consulting Service)		
3	Contingencies		
	Total		XXX

*The Amount is provisional. This is subject to the approval of the Government of Japan.

4-2. Minutes of Discussions 2
(signed on November 18, 2021)

Minutes of Discussions
on the Preparatory Survey on
the Project for Improvement of Facilities and Laboratory Equipment
in the Faculty of Engineering, National University of Laos
(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between National University of Laos (hereinafter referred to as "NUOL") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 22nd April 2021 and in response to the request from the Government of Lao People's Democratic Republic (hereinafter referred to as "the Lao PDR") dated 4th August 2017, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Improvement of Facilities and Laboratory Equipment in the Faculty of Engineering, National University of Laos (hereinafter referred to as "the Project"). As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Vientiane, 18th November, 2021

SANADA Akiko
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Assoc. Prof. Dr. Oudom PHONEKHAMPHENG
Acting President
National University of Laos
Lao People's Democratic Republic

Witness

Assoc. Prof. Dr. Khamphoui SOUTHISOMBATH
Dean
Faculty of Engineering
National University of Laos
Lao People's Democratic Republic

Assoc. Prof. Dr. Saykhong SAYNASINE
Director General
Department of Higher Education
Ministry of Education and Sports
Lao People's Democratic Republic

ATTACHEMENT

1. Objective of the Project

The objective of the Project is to improve education/research environment of the Faculty of Engineering (hereinafter referred to as "FEN"), NUOL by upgrading facilities and equipment for education/research activities, thereby contributing to the development of engineering human resources to meet the needs of industry in the Lao PDR.

2. Title of the Project

Both sides confirmed to change the name of the Project from "the Project for Improvement of Facility and Laboratory Equipment in the Faculty of Engineering, National University of Laos" to "the Project for Improvement of Facilities and Laboratory Equipment in the Faculty of Engineering, National University of Laos". The reason to change the name is that the plural form is usually used when referring to general facilities.

3. Project site

Both sides confirmed that the site of the Project is in FEN campus of NUOL, which is shown in Annex 1.

4. Responsible authority for the Project

Both sides confirmed the authorities responsible for the Project are as follows:

4-1. The NUOL will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care by relevant authorities properly and on time. The organization charts are shown in Annex 2.

4-2. The line ministry of the Executing Agency is the Ministry of Education and Sports (hereinafter referred to as "MOES"). The MOES shall be responsible for supervising and supporting the Executing Agency on behalf of the Government of the Lao PDR.

5. Contents of the Draft Report

After the explanation of the contents of the Draft Report by the Team, the Lao PDR

side agreed to its contents and components of which are described in Annex 3, Summary of Project Components (Provisional). JICA will report the confirmed contents and components to the Government of Japan. Based on the approval from the Government of Japan, JICA will finalize and send the Preparatory Survey Report to the Lao PDR side around March 2022.

6. Cost estimate

Both sides confirmed that the cost estimate including the contingency explained by the Team is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

7. Confidentiality of the cost estimate and technical specifications

Both sides confirmed that the cost estimate and technical specifications of the Project should never be disclosed to any third parties until all the contracts under the Project are concluded.

8. Procedures and Basic Principles of Japanese Grant

The Lao PDR side agreed that the procedures and basic principles of Japanese Grant (hereinafter referred to as "the Grant") as described in Annex 4 shall be applied to the Project. In addition, the Lao PDR side agreed to take necessary measures according to the procedures.

9. Timeline for the project implementation

The Team explained to the Lao PDR side that the expected timeline for the project implementation is as attached in Annex 5.

10. Expected outcomes and indicators

Both sides agreed that key indicators for expected outcomes are as follows. The Lao PDR side will be responsible for the achievement of agreed key indicators targeted in year 2027 and shall monitor the progress for Ex-Post Evaluation based on those indicators.

[Quantitative indicators]

Indicators	Base value (Actual value in 2021)	Target value (Year 2027: 3 years after the completion)
The number of course programs which uses the equipment procured by the Project	0	16
The number of students who carry out experimental/practical work using the equipment procured by the Project	0	1,820
The number of laboratories equipped with the equipment procured by the Project for research and experimental/practical work	0	26

[Qualitative indicators]

- The education/research environment will improve with the new buildings and equipment to be covered by the Project.
- Human resources meeting the need of the industrial sector will be developed through enhancing the quality of higher education.

11. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle, with respect to six evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability and Coherence). The result of the evaluation will be publicized. The Lao PDR side is required to provide necessary support for the data collection.

12. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 6. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in (5) of Annex 6, both sides confirmed that such customs duties, internal taxes and other fiscal levies, which shall be clarified in the bid documents by NUOL during the implementation stage of the Project.

The Lao PDR side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that the Annex 6 will be used as an attachment of G/A.

As shown in Annex 6, both sides confirmed that NUOL shall take necessary measures to ensure and maintain the security of the Project site and the persons related to the implementation of the Project, in cooperation with relevant authorities such as police.

13. Monitoring during the implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 7. The timing of submission of the PMR is described in Annex 6.

14. Project completion

Both sides confirmed that the project completes when all the facilities constructed and equipment procured by the Grant are in operation. The completion of the Project will be reported to JICA promptly by the Executing Agency, but in any event not later than six months after completion of the Project.

15. Items and measures to be considered for the smooth implementation of the Project

Both sides confirmed the items and measures to be considered for the smooth implementation of the Project as follows.

15-1 The Lao PDR side confirmed that when problems such as delay of construction works or procurement of equipment by contractor(s)/supplier(s) arises during the implementation of the Project, NUOL will take necessary measures in accordance with technical opinion of the consultant in a timely manner.

15-2 The Lao PDR side agreed that in case the amount of the Grant, which includes the contingency, is not enough to cover the entire cost of components as planned by the outline design, the Lao PDR side will take necessary measures such as revising specifications, reducing the Project scope, or absorbing the cost exceeding the amount of the Grant, based on technical analysis and opinions of the consultant.

16. Environmental and Social Considerations

16-1 General Issues

16-1-1 Environmental Guidelines and Environmental Category

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as C because the Project is likely to have minimal adverse impact on the environment under the Guidelines.

17. Other Relevant Issues

17-1. Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

17-2. Gender Mainstreaming

Both sides confirmed that gender mainstreaming should be duly practiced for the Project implementation as the project is categorized as GIP (Gender Equality Project or Project Targeting Women). In particular, both sides agreed on the following gender element to be integrated into the Project.

- Facility design that reflects gender-specific needs.

17-3. Counterpart Fund

Both sides confirmed that NUOL shall take responsibility as the Executing Agency of the Project in accordance with the Decree on Management and Utilization of Official Development Assistance (No.357/GOL, 3 October 2021) and the Guideline on the Management and Utilizations of Government Counterpart Funds for the Implementation of Official Development Assistance Projects (No. 1987/MPI, 27 November 2020). Both sides also confirmed that the estimated amount for major undertakings to be borne by the Lao PDR side, including the amount of taxes and duties to be exempted, shall be budgeted by NUOL and reported as "Counterpart Fund" to the Ministry of Planning and Investment (hereinafter referred to as "MPI") and the Ministry of Finance (hereinafter referred to as "MOF") by the middle of May 2022, for the National Assembly's approval, following the timeline set in the decree and guideline. Meanwhile, Japan side requested and the Lao PDR side confirmed that NUOL shall conduct and complete the preparatory works for the Project by the end of August 2022 in order for smooth implementation of the Project, apart from the timeline of Counterpart Fund procedures within the government of the Lao PDR.

17-4. Operation and Maintenance Cost

Both sides confirmed that the additional operation and maintenance cost necessary for the new buildings and equipment provided by the Project will be surely financed by NUOL. The Lao PDR side understood that the additional operation and maintenance cost to be annually budgeted by NUOL shall cover, but not limited to, (1) electricity expense, (2) water supply expense, (3) telecommunication expense, (4) facility maintenance cost for daily cleaning, re-paint work and electrical/mechanical service maintenance and (5) equipment maintenance cost for

consumables and spare parts, as estimated in the Preparatory Survey Report (Draft) for the Project.

17-5. Considerations to Operation of FEN-NUOL during Construction Period

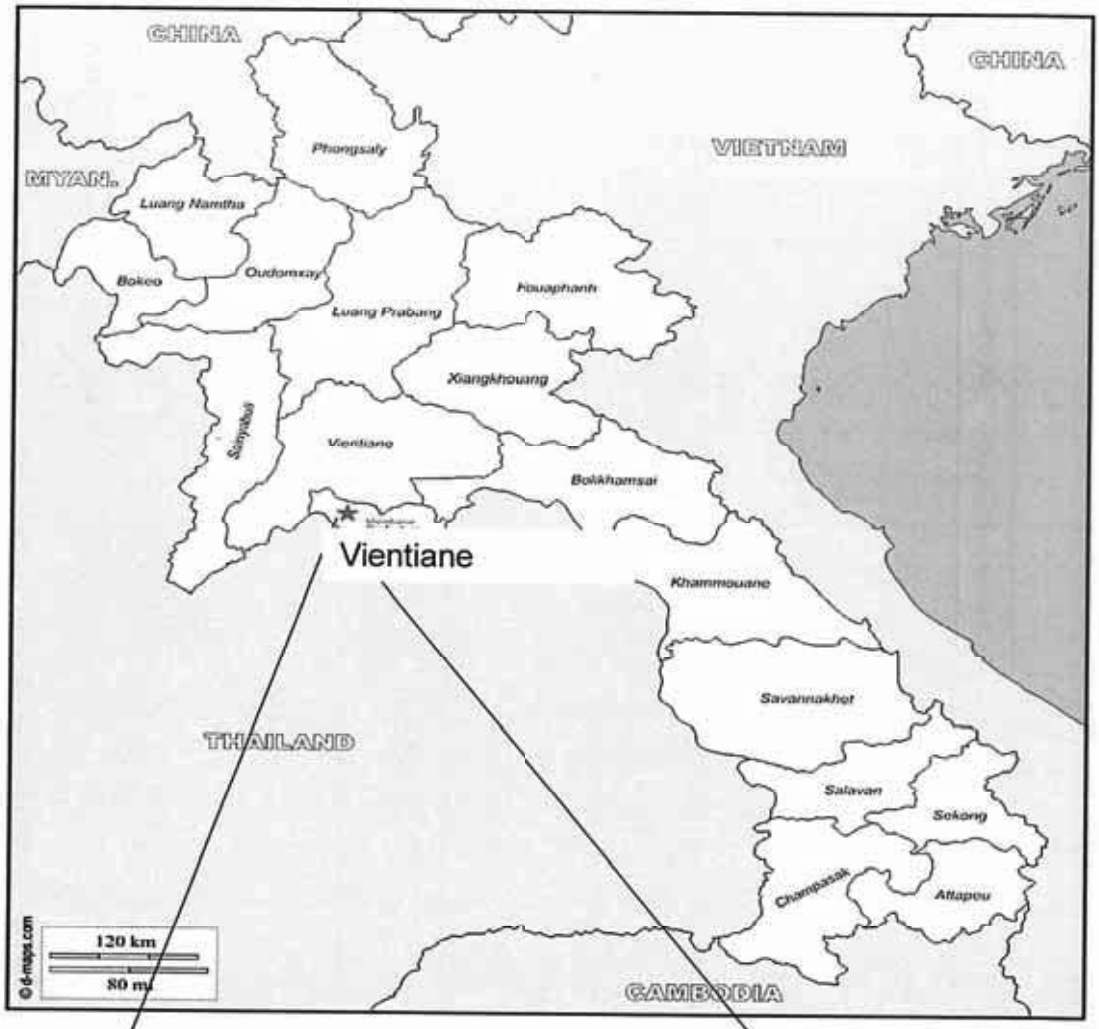
Both sides discussed and agreed on the temporary plan during construction, in order to carry out construction work in the same campus where FEN-NUOL continues its operation. The principles of temporary plan are as follows (also refer to Annex 8).

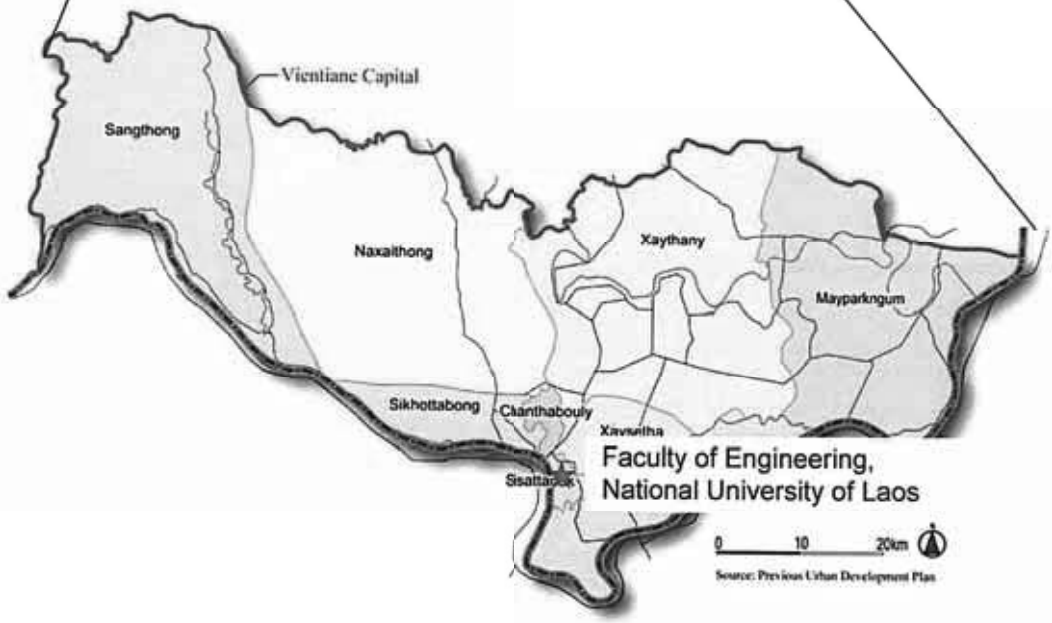
- The east campus gate will be solely used for the construction work, and FEN-NUOL users will use the other gates during the construction period.
- The west plot to the existing civil engineering laboratory building (A3 building) (about 2,000m^2) and the rotary near the football field (about 1,800m^2) will be utilized for temporary facilities during the construction period. The areas utilized for temporary facilities shall be restored by the Contractor, as his responsibility, after the completion of construction work.
- Prior to the commencement of work by Japanese side, the A3 building will be temporarily closed, and furniture and equipment in the building, except the ones not in use and/or difficult to move, shall be transferred to the other building by the Lao PDR side. The building may be utilized by the Contractor for temporary purpose. If the building is utilized by the Contractor, he shall be responsible to protect equipment which remains within the building, and to restore the building after the completion of work.
- The area and routes for the construction work and the FEN-NUOL operation shall be clearly demarcated by temporary fences. However, because the southside parking lots and the northside existing buildings are separated by the temporary fences, a temporary gate for pedestrians which is to be controlled by a guard, will be provided in the middle of campus main road within the fenced area, taking into account FEN-NUOL users convenience.

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Summary of Project Components (Provisional)
Annex 4 Japanese Grant
Annex 5 Project Implementation Schedule
Annex 6 Major Undertakings to be taken by the Government of the Lao PDR
Annex 7 Project Monitoring Report (template)
Annex 8 Temporary Plan during Construction Period

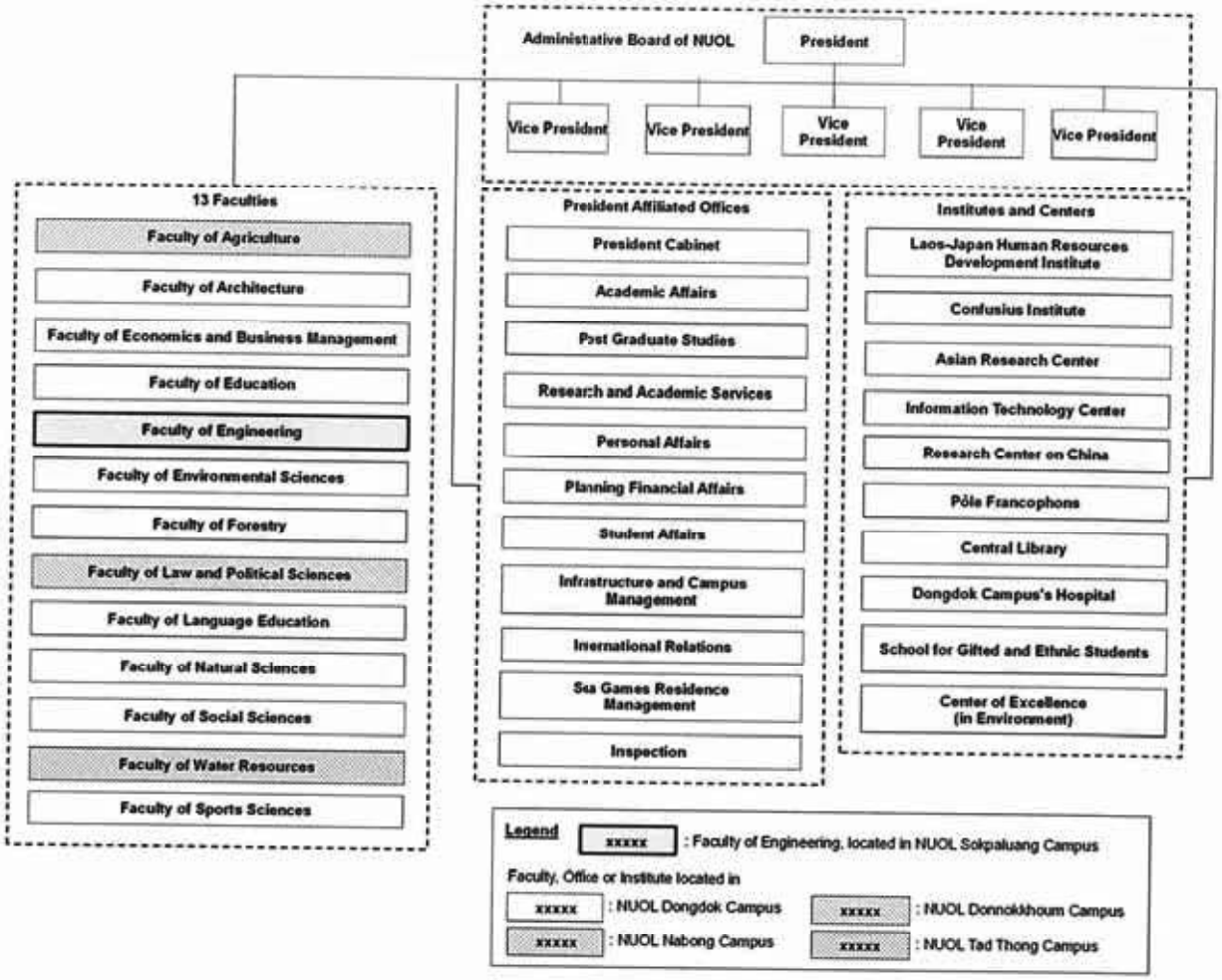
Annex 1

Project site

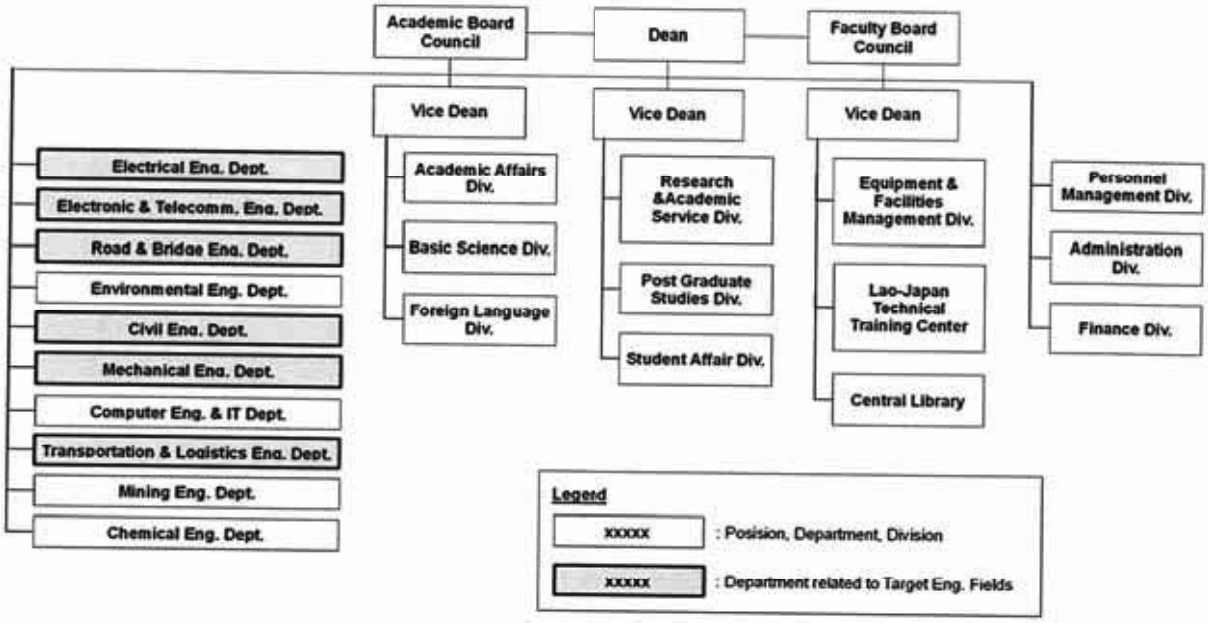




Annex 2



Organization Chart for National University of Laos (NUOL)



Organization Chart for Faculty of Engineering, NUOL

Annex 3

Summary of Project Components (Provisional)

1. Building Component (Provisional)

(1) Center of Engineering for Sustainable Development (CESD)

Fl.	Category	Room	Floor Area
1	CESD	Chemical Analysis Laboratory	70.00m²
		Electron Micrcscope Laboratory	52.50m²
		X-ray Analysis Laboratory	77.00m²
		High-Voltage Laboratory	70.00m²
		CESD Lecturers' room	35.00m²
	Admin.	Administration Office/ Pantry	44.18m²
		Director's Office	25.82m²
	Common	Main Entrance	80.99m²
		Corridor, Meeting corner, Slope, Stairs	368.17m²
		Toilet	35.00m²
		Electrical room, Sever room, Storage, EPS, PS	42.35m²
CESD Floor Area (1FL)			**901.01m²**
2	CESD	Solid Forming Laboratory	35.00m²
		Computer Room (1)	70.00m²
		Computer Room (2)	70.00m²
		Physical Measurement Laboratory	77.00m²
		Electrical and Electronic Measurement Laboratory	70.00m²
		Meeting Room	70.00m²
		Exhibition Room	75.980m²
	Common	Corridor, Meeting corner, Slope, Stairs	305.69m²
		Toilet	35.00m²
		EPS,PS	1.75m²
CESD Floor Area (2FL)			**810.42m²**
R	Common	Penthouse	24.50m²
CESD Floor Area (RFL)			**24.50m²**
CESD Grand Total Floor Area			**1,735.93m²**

(2) Laboratory Blocks

Fl.	Category	Room	Floor Area
1	Mechanical Eng. Dept.	Machining Training room	84.00m²
		Metal Working Training Room (Including Preparation Room)	84.00m²
		Fluid Mechanics Laboratory	53.60m²
		Engine Laboratory	84.00m²
	Admin.	Guards Room	18.00m²
	Common	Courtyard, Corridor, Slope, Stairs	351.60m²
		Toilet	35.00m²
		Electrical room, Sever room, EPS	25.87m²
Laboratory Block-1 Floor Area (1FL)			**736.07m²**
1	CESD	Material Testing Laboratory	63.00m²
	Civil Eng. Dept. and Road & Bridge Eng. Dept.	Concrete Testing Laboratory (Including Preparation Room)	162.00m²
Laboratory Block-2 Floor Area (1FL)			**225.00m²**
1	Civil Eng. Dept. and Road & Bridge Eng. Dept.	Asphalt Testing Laboratory	64.00m²
		Soil Testing Laboratory	96.00m²
	Common	Toilet	32.00m²
Laboratory Block-3 Floor Area(1FL)			**192.00m²**
Connecting corridor			**90.72m²**
Laboratory Block 1-3 + Connecting Corridor Floor Area (1FL)			**1,243.79m²**
2	Electrical Eng. Dept.	Electrical Eng. Laboratory (1)	84.00m²
		Electrical Eng. Laboratory (2)	112.00m²
	Civil Eng. Dept.	Civil Eng. Laboratory	67.60m²
	Road & Bridge Eng. Dept.	Road & Bridge Eng. Laboratory	70.00m²
	Common	Students' Lounge	28.00m²
		Corridor, Slope, Stairs	229.08m²
		Toilet	35.00m²
		EPS	2.40m²
Laboratory Block-1 Floor Area (2FL)			**628.08m²**
3	Electronic & Telecom. Eng. Dept.	Electro. & Telecom. Eng. Laboratory (1)	84.00m²
		Electro. & Telecom. Eng. Laboratory (2)	112.00m²
	Transportation & Logistics Eng. Dept.	Transportation & Logistics Eng. Laboratory (1)	84.00m²
		Transportation & Logistics Eng. Laboratory (2)	53.60m²
	Common	Students' Lounge	28.0m²
		Corridor, Slope Stairs	229.08m²
		Toilet	35.0m²
		EPS	2.40m²
Laboratory Block-1 Floor Area (3FL)			**628.08m²**
R	Common	Penthouse	28.00m²
Laboratory Block-1 Floor Area (RFL)			**28.00m²**
Laboratory Block-1 Total Floor Area			**2,020.23m²**
Laboratory Block-2 Total Floor Area			**225.00m²**
Laboratory Block-3 Total Floor Area			**192.00m²**
Connecting corridor Total Floor Area			**90.72m²**
Laboratory Blocks Grand Total Floor Area			**2,527.95m²**

2. Equipment List (Provisional)

Item No.	Request No.	Name of Equipment	Quantity
1	CESD-01	High Speed Camera	1
2	CESD-02	Sequential X-Ray Fluorescence Spectrometer(XRF)	1
3	CESD-03	Powder X-ray diffractometer (XRD)	1
4	CESD-04	UV-Visible Spectrophotometer	1
5	CESD-05	Water Distiller	1
6	CESD-06	Electric Furnace for Metal Melting	2
7	CESD-07	Refrigerator	1
8	CESD-08	Electric Balance Set	4
9	CESD-11	Scanning Electron Microscope (SEM) w/Coating machine	1
10	CESD-13	2000kN Universal Testing Machine	1
11	CESD-16	Fiber tensile strength testing machine	1
12	CESD-17	Concrete Permeability Testing	1
13	CESD-20	Ultrasonic weld inspection	1
14	CESD-21	Magnetic particle inspection for Surface crack detection	1
15	CESD-23	Soil Investigation Drilling Machine	1
16	CESD-24	Dynamic cone penetrometer tool	1
17	CESD-26	Ground Penetrating Radar (GPR)	1
18	CESD-28	Road Surface Friction Coefficient Test Equipment	1
19	CESD-29	Road Roughness Tester	1
20	CESD-33	Digital Noise Meter for Noise Level Testing	4
21	CESD-35	Traffic Simulation Software	1
22	CESD-36	Impedance Analyzer	1
23	CESD-37	Thermal Camera	1
24	CESD-38	Digital Oscilloscope	1
25	CESD-39	Function/Arbitrary Waveform Generator	1
26	CESD-41	Spectrum Analyzer/Signal Analyzer	1
27	CESD-43	High Voltage Experimental Equipment	1
28	CESD-46	Desktop Computer	40
29	CESD-47	Draft chamber	1
30	ME-01	Hand Tool Set	40
31	ME-02	Power Tool Set	10
32	ME-03	Dimension Measuring Equipment Set	40
33	ME-05	Metal Specimen Processing Machine	2
34	ME-07	Rockewll Hardness Tester	2
35	ME-08	Thermogravitric Analysis (TGA/DSC)	1
36	ME-09	Infrared Spectroscopy (FTIR) (Reconsider)	1
37	ME-11	Particle size analysis (PSA)	1
38	ME-13	Impact Testing Machine	1
39	ME-15	Structural Mechanics Experimental Device	1
40	ME-16	Boiler Experimental Device	1
41	ME-17	Air Conditioning Experimental Device	1
42	ME-18	Renewable Energy Experimental Device	1
43	ME-19	Gasoline+Diesel Engine Experimental Device	1
44	ME-20	Gasturbine Experimental Device	1
45	ME-21	Exhaust Gases Analyzer	1
46	ME-22	DC Welder	2
47	ME-23	TIG + MIG Welder	1
48	ME-24	Double Headed Grinder	2

Item No.	Request No.	Name of Equipment	Quantity
49	ME-25	Surface Grinding Machine	1
50	ME-26	3D Printer (plastic)	1
51	ME-27	Oxyacetylene Welding Set	2
52	ME-28	Band Saw	1
53	ME-29	Table Top CNC Vertical Milling Machine	5
54	ME-30	Multi Joint Robot	1
55	ME-32	Lathe machine	1
56	ME-33	Bench drilling machine	1
57	ME-34	Milling Machine	1
58	ME-35	Blade sharpener (floor type)	1
59	ME-36	Folding machine	1
60	ME-37	Cutting machine	1
61	ME-38	Rolling machine	1
62	ME-39	Water Pumping Circulation system	1
63	ME-40	Hot air Oven	1
64	ME-41	Shop press	1
65	ME-42	Friction Lost Experimental Device	1
66	ME-43	Oxygen bomb calorimeter	1
67	ME-44	Laboratory emission monitoring system (LEMS)	1
68	ME-45	Solar power meter	1
69	CE-01	Pallet Truck Hydraulic	2
70	CE-02	Specimen grinding machine	1
71	CE-03	Specimen cutting machine for Con.	1
72	CE-04	Specimen cutting machine for steel	1
73	CE-05	Marking-off machine for steel speciment	1
74	CE-11	Los Angeles Testing Machine	1
75	CE-12	Aggregate Crusher	1
76	CE-13	Blaine Air Permeability Testing Apparatus	2
77	CE-15	Mortar Mixer	2
78	CE-16	Pull-Off Tester (Bond Strength Tester)	1
79	CE-18	Set of Vebe Test equipment	2
80	CE-21	Concrete compression machine 1500 kN semi-automatic,	1
81	CE-26	Shaking Table	1
82	CE-27	Set of Vibration Acceleration Measuring Device in vertical	2
83	CE-28	Half cell potential tester, corrosion test	1
84	CE-36	Deflectometer with telescopic	2
85	CE-41	Soil Particle Size Measuring Instrument (Hydrometer method)	2
86	CE-42	Soil Liquid Limit Measuring Instrument	4
87	CE-43	Motorized liquid limit device	2
88	CE-44	Soil Constant Temperature Dryer	2
89	CE-46	CBR Testing Machine	2
90	CE-47	Constant Water Level Permeability Tester	1
91	CE-49	Falling Head Permeability Tester	2
92	CE-50	Soil Consolidation Tester	2
93	CE-51	Direct Shear Teseter	2
94	CE-52	Uniaxial Compression Tester	2
95	CE-53	Triaxial Compression Tester complete set with accessaries	2
96	CE-54	Sand density cone apparatus	2
97	CE-58	Plate bearing equipment, 200 kN, 3 dial gauges	1
98	CE-60	Field CBR test set	2
99	CE-61	Electric Balance	3
100	CE-63	Hot plates	2

Item No.	Request No.	Name of Equipment	Quantity
101	CE-64	Test sieves for soil testing conform to ASTM D 442-63	3
102	CE-67	Soxhlet modified method	2
103	CE-68	Skid resistance and friction tester	2
104	CE-70	The Marshell Stability machine	1
105	CE-72	15kg Buoyancy Balance Set for gravity of aggregates.	1
106	CE-73	BS Conpaction Pedestal With Compaction Hammer	1
107	CE-74	Mashall Compaction Moulds(set)	10
108	CE-75	Bitmen Picnometer, Hubbard-Carmick specific gravity	7
109	CE-76	Gas pycnometer for Aggregrate and Sand, Cone pyknometer	4
110	CE-77	Quantative Extraction (set)	3
111	CE-78	Benkelmam Beam	2
112	CE-79	Flash and Fire Point Betum (set)	2
113	CE-80	Traffic Counter	5
114	CE-81	Speed Counter	5
115	CE-82	Sound Level Meter	3
116	CE-83	GPS Positioning System	5
117	CE-86	Digital Level	4
118	CE-96	Pressure measurement Bench	1
119	CE-98	Pitot Tubes	1
120	RB-01	Sieve Set	2
121	RB-02	Sedimentation Test Set	2
122	RB-03	Plastic Index Liquid Limit Test Set	2
123	RB-04	Compaction Test Equipment Set	1
124	RB-05	CBR Testing Equipment	1
125	RB-06	Field CBR Testing Equipment	1
126	RB-07	Field Density Test Set	2
127	RB-08	Specific Gravity Test Set	2
128	RB-09	Aggregate Test Set	1
129	RB-11	Alkali test set	1
130	RB-12	Thin Film Oven	1
131	RB-13	Penetration of Bituminous	2
132	RB-14	Flash & Fire Point Tester	1
133	RB-15	Ductivity Apparatus	1
134	RB-16	Distillation of Cut-Back Asphalt (Bituminous) Products	2
135	RB-17	Travelling Beam Device	1
136	RB-18	Benkelman Beam	1
137	RB-19	Core Drill for Asphalt	1
138	RB-20	Aluminum Staff	9
139	RB-21	Auto-Leveling	2
140	RB-22	Total Station	1
141	RB-23	Theodolite	4
142	RB-25	Hand GPS	2
143	RB-26	Ecocenter	2
144	RB-27	RTK	2
145	RB-34	Soil Investigation Drilling Machine	1
146	RB-38	Sonic Integrity Test (SIT)	2
147	RB-39	Ground Penetrating Radar (GPR)	2
148	RB-40	Dynamic Pile Load Test System	1
149	RB-41	Road Surface Friction Coefficient Test Equipment	1
150	RB-42	Road Roughness Tester	1
151	TL-01	Desktop Computer	10
152	TL-02	Printer	1

Item No.	Request No.	Name of Equipment	Quantity
153	TL-04	Laser Speed Gun	5
154	TL-05	Vehicle Emissions Testing System	2
155	TL-06	Portable Axle Weigh Pads	2
156	TL-07	Handy GPS	3
157	TL-08	Digital Noise Meter for Noise Level Testing	5
158	TL-09	Roadside Alcohol Testing Devices market segmentation	10
159	TL-14	RFID Reader and printer	2
160	TL-15	Barcode Scanner and printer	6
161	EL-08	Coil winding tester	1
162	EL-09	Variable DC voltage source (For transformer resistor testing)	1
163	EL-10	Variable AC voltage source (For transformer testing)	1
164	EL-11	Contact resistance tester	1
165	EL-12	Relay tester (For protection)	1
166	EL-13	Transformer turn ratio meter	1
167	EL-16	Field Intensisty Meter	8
168	EL-17	Electric Circuit Trainer	4
169	EL-21	3 Phase AC Motor Trainer	1
170	EL-27	High Voltage Receiving Equipment Trainer	1
171	EL-34	Electronics Circuit Trainer	2
172	EL-35	Logic Circuit Trainer	2
173	EL-37	PLC Trainer and conveyer system	5
174	EL-38	SCADA trainer	2
175	EL-39	Sensor Trainer	2
176	EL-40	Home Appliance Set for Training	2
177	EL-41	Microprocessor Trainer	5
178	EL-42	Relay Circuit Trainer	2
179	EL-43	Electrical Protection trainer (Substation and transmission line)	2
180	EL-48	Portable power meter	1
181	EL-49	Handy tachometer	5
182	EL-50	Lux meter	2
183	EL-51	Safety and continuity of elcirical power supply	1
184	EL-52	Hybrid renewable energy : Photovoltaic & Wind generator	1
185	ER-01	Logic Circuit Training kit	5
186	ER-02	Pulse Circuit training Kit	5
187	ER-06	IC Trainer with IC Set	5
188	ER-11	Operation Amplifier Trainer Set	10
189	ER-12	AD/DA Conversion Trainer Set	10
190	ER-13	Optical Transmission Trainer Set	5
191	ER-14	Satellite Communications Training System	1
192	ER-16	HMI Trainer	1
193	ER-19	Profinet IO Trainer	3
194	ER-21	Inverter Control Trainer	1
195	ER-28	Builging Electric Installation System Trainer	2
196	ER-29	Trainer for High-pass/Low-pass, Bandpass/Bandstop, Band Filters, Series and Parallel Resonant Circuits	10
197	ER-30	Trainer for 2nd and 4th Order Low-pass and High-pass Filters, 2nd Order Band-pass and Band-stop Filters	10
198	ER-32	Radar technology Trainer	3
199	ER-33	Information and Communication Technology training equipment	5
200	ER-35	PBX System Trainer	3
201	ER-36	WLAN Bridgelink Radio Trainer	3
202	ER-37	Antenna System Trainer	3
203	ER-40	Microwave System Trainer	3
204	ER-46	Basic Protocal Trainer	10

Annex 4

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or 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. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the 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 necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant 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 an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take 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 executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) 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 feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

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 to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) 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 to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the

Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

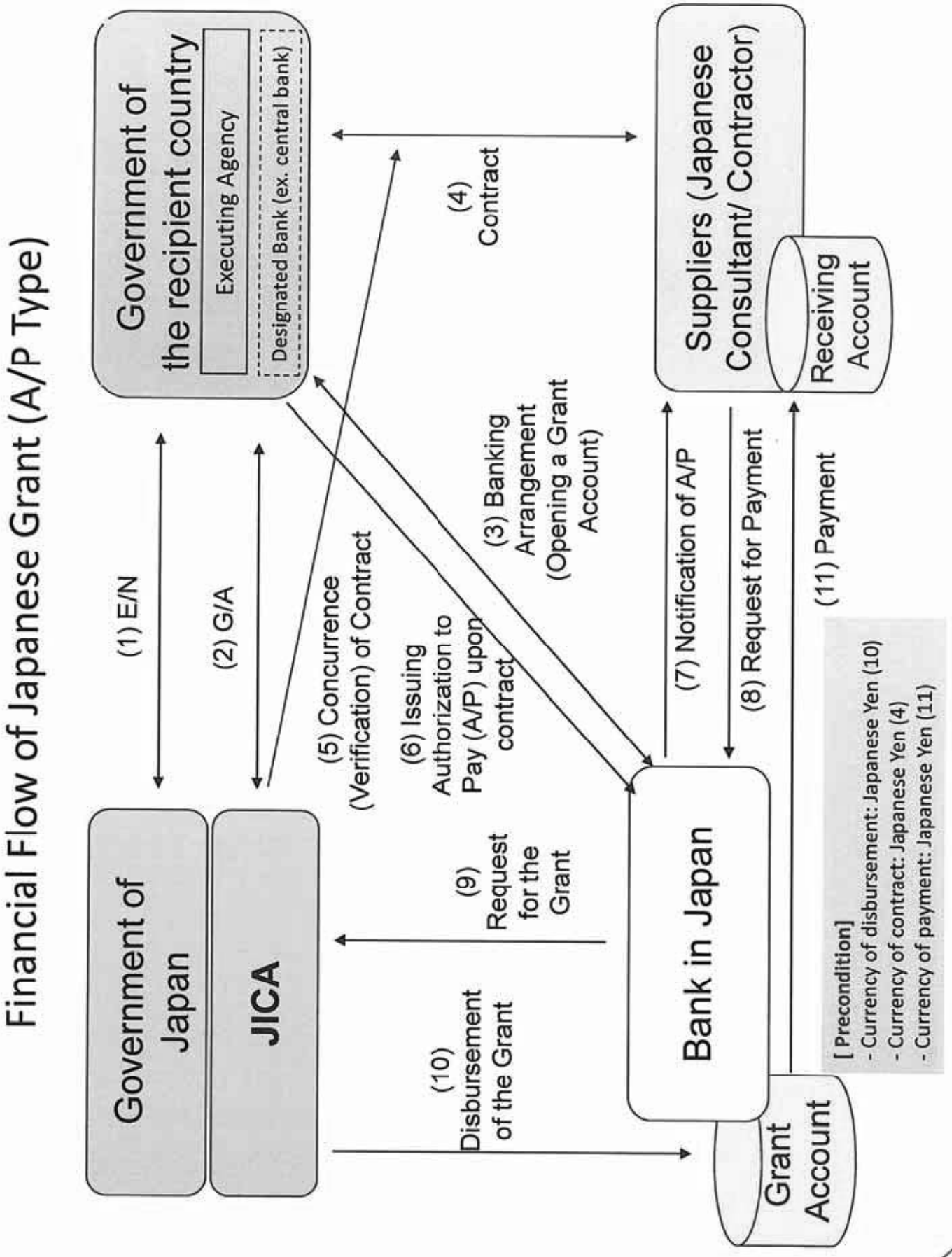
PROCEDURES OF JAPANESE GRANT

Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

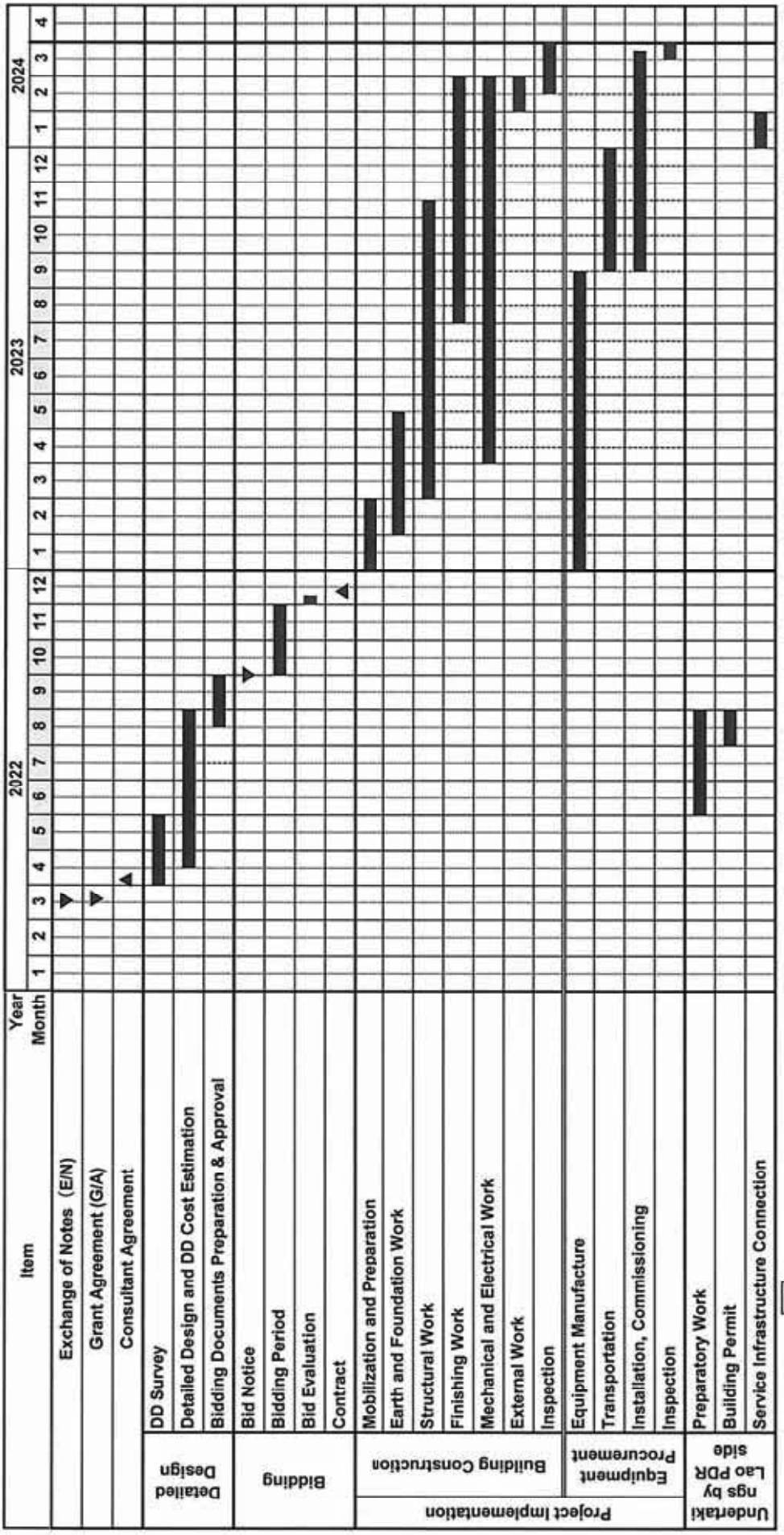
notes:

1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.


Financial Flow of Japanese Grant (A/P Type)
Government of the recipient country
Executing Agency
Designated Bank (ex. central bank)
Suppliers (Japanese Consultant/ Contractor)
Receiving Account
Government of Japan
JICA
Bank in Japan
Grant Account
(1) E/N
(2) G/A
(3) Banking Arrangement (Opening a Grant Account)
(4) Contract
(5) Concurrence (Verification) of Contract
(6) Issuing Authorization to Pay (A/P) upon contract
(7) Notification of A/P
(8) Request for Payment
(9) Request for the Grant
(10) Disbursement of the Grant
(11) Payment
[Precondition]
- Currency of disbursement: Japanese Yen (10)
- Currency of contract: Japanese Yen (4)
- Currency of payment: Japanese Yen (11)

Project Implementation Schedule (Provisional)



The Preparatory Survey on the Project for Improvement of Facility and Labcratory Equipment in the Faculty of Engineering, National University of Laos

Annex 6

Major Undertakings to be taken by the Government of the Lao PDR

1. Specific obligations of the Government of the Lao PDR which will not be funded with the Grant

(1) Before the Bidding

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To sign the banking arrangement (B/A) with a bank in Japan (the Agent Bank) to open bank account for the Grant	within 1 month after the signing of the G/A	BOL/MOF NUOL	--	
2	To issue A/P to the Agent Bank for the payment to the consultant	within 1 month after the signing of the contract(s)	BOL/MOF NUOL	2,400 USD	
3	To bear the following commissions to the Agent Bank for the banking services based upon B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	NUOL		
	2) Payment commission for A/P	every payment	NUOL		
4	To secure and clear the following land within the campus of Faculty of Engineering (FEN), National University of Laos (NUOL) 1) Construction area for CESD (approx. 2,000m²). 2) Construction area for Laboratory Blocks (approx. 3,000m²). 3) Two lots of areas for temporary facilities (approx. 2,000m² + 1,800m²)	before notice of the bidding documents	NUOL	--	
5	To obtain the building permit	before commencement of the construction	NUOL	1,000 USD	
6	To clear the sites by conducting the following preparatory works. 1) Demolition of structural and underground obstacles. For CESD • Rerouting the existing electrical/telephone cables including relocation of a pole. For Laboratory Blocks • Demolition of the existing guard house and concrete platform behind the guard house (including underground structure). • Rerouting the existing underground service line (if any). • Rerouting the existing electrical/telephone cables including relocation of poles. 2) Removal of trees. 3) Rerouting (or lifting) the existing loose electrical/telephone cables around the east gate. 4) Removal of temporary facilities (fence, sheds, etc.) of the contractor for the 4FL classroom building.	before notice of the bidding documents	NUOL	9,600 USD	
7	To secure alternative facilities to accommodate functions of the existing civil engineering building (A3 building), which will be closed during the construction period, and to move the existing furniture and equipment in A3 building (except the ones not in use and/or difficult to move) to the alternative building.	before notice of the bidding documents	NUOL	1,000 USD	
8	To submit Project Monitoring Report (with the result of Detailed Design)	before preparation of the bidding documents	NUOL	--	

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to the Agent Bank for the payment to the supplier and the contractor	within 1 month after the signing of the contract(s)	BOL/MOF NUOL	16,600 USD	
2	To bear the following commissions to the Agent Bank for the banking services based upon the B/A		BOL/MOF NUOL		
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	NUOL		
	2) Payment commission for A/P	every payment	NUOL		
3	To ensure prompt customs clearance and to assist the Contractor/ Supplier with internal transportation in the country of the Recipient	during the Project	NUOL	--	
4	To accord Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work	during the Project	NUOL (MOES) MPI	--	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted–	during the Project	NUOL (MOES) MPI MOF	--	
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	NUOL	--	
7	To notify JICA promptly of any incident or accident, which has, or is likely to have, a significant adverse effect on the environment, the affected communities, the public or workers.	during the construction	NUOL	--	
8	To submit Project Monitoring Report	every month	NUOL	--	
	To submit Project Monitoring Report (final) (including as-built drawings, equipment list, photographs, etc.)	within 1 month after issuance of Certificate of Completion for the works under the contract(s)	NUOL	--	
9	To submit a report concerning completion of the Project	within 6 months after completion of the Project	NUOL	--	
10	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)	2 months before completion of the construction	NUOL	25,000 USD	
	1) Electricity New electrical power connection from the EDL MV service line.				
	2) Water Supply New water supply connection from the water main.				
	3) Drainage New sewage connection for: • water from septic tank for Laboratory Blocks • water used for concrete test and rainwater for Laboratory Blocks. • water from septic tank and rainwater for CESD.				
	4) Telecommunication New optical cable connection.				
11	Installation of the existing equipment, etc. upon the completion of construction work. 1) Installation of 40 computers to Computer Room (2) in CESD. 2) Reinstallation of furniture and equipment to A3 building.	Upon completion of the construction	NUOL	2,000 USD	
12	To ensure the safety of persons engaged in the implementation of the Project	during the Project	NUOL in	--	

			cooperation with MPS (Ministry of Public Security)		
13	To take necessary measures for safety of the Project site, if required (measures for safety) 1) maintaining the safety of workers and the general public by thorough implementation of safety measures and immediate action in the case of accident 2) traffic control around the site(s) and on transportation routes of construction materials 3)installation of fences around the site(s)	during the construction	NUOL	--	

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	After completion of the construction	NUOL	51,700 USD per year	

This part is closed due to the confidentiality.

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Executing Agency	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Line Ministry	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

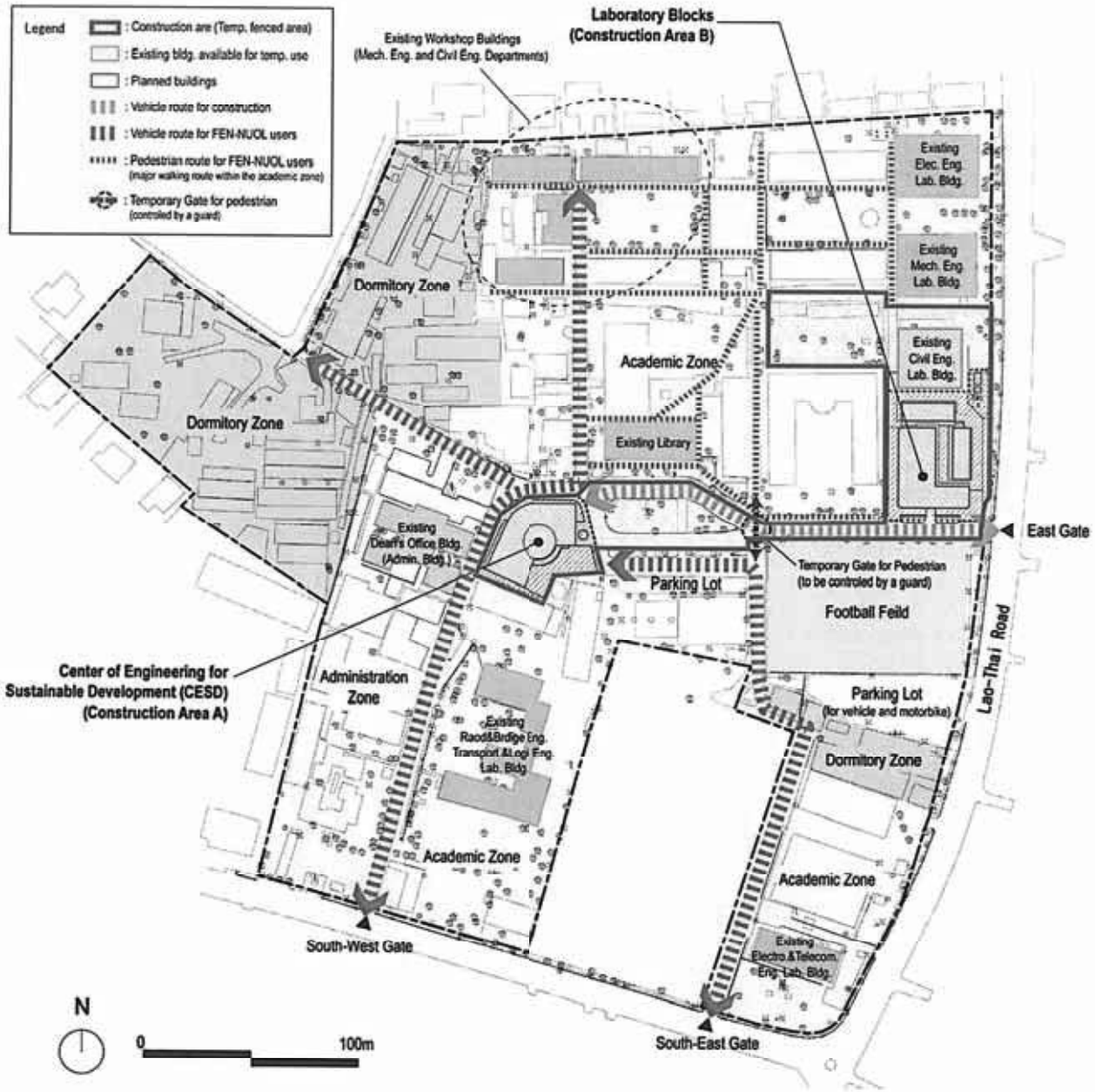
(3) Summary of Discussion with Contractor (if necessary)

-
-
-

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

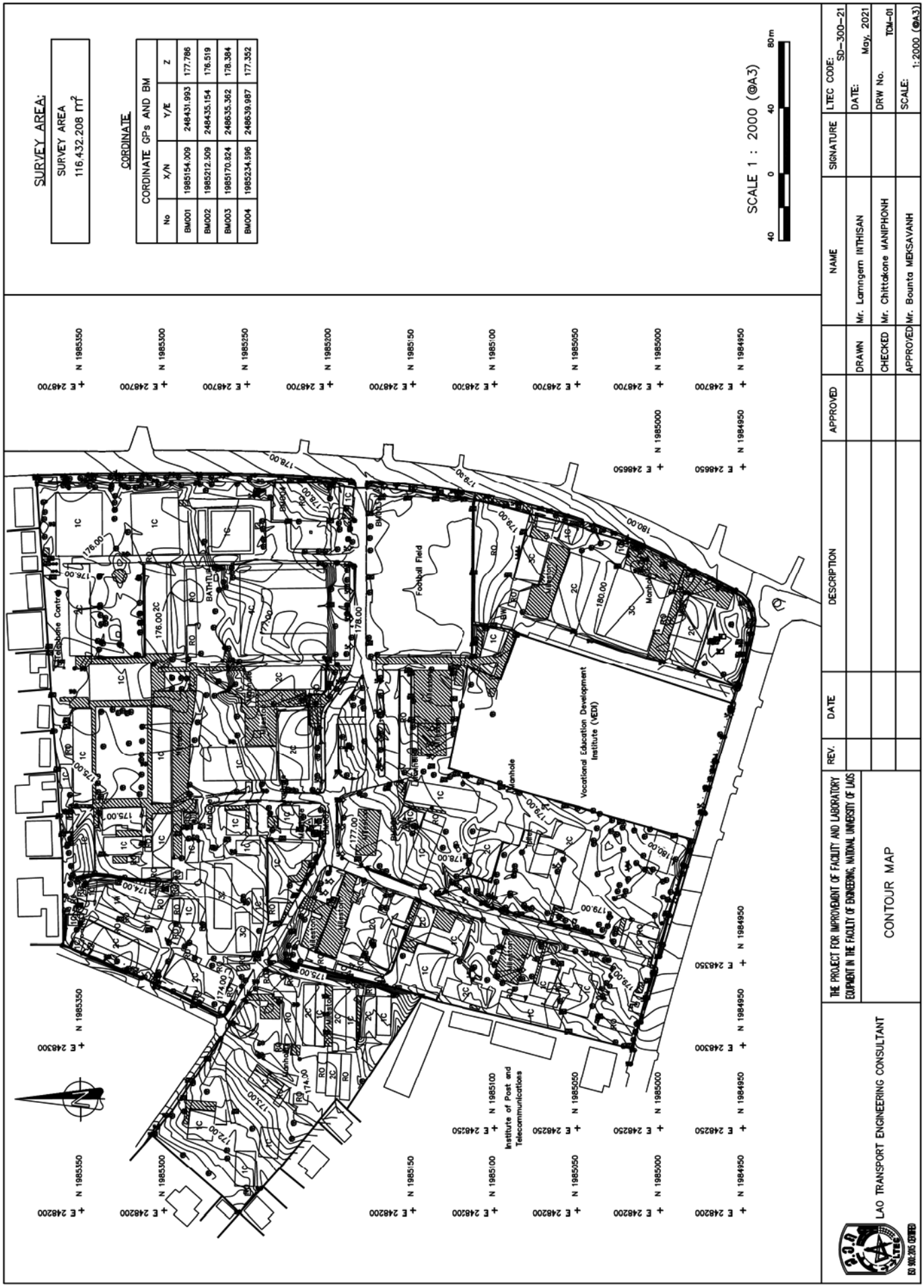
Annex 8



Temporary Plan during Construction Period (Provisional)

Appendix 5. Other Relevant Data

5-1. Surveyed Map

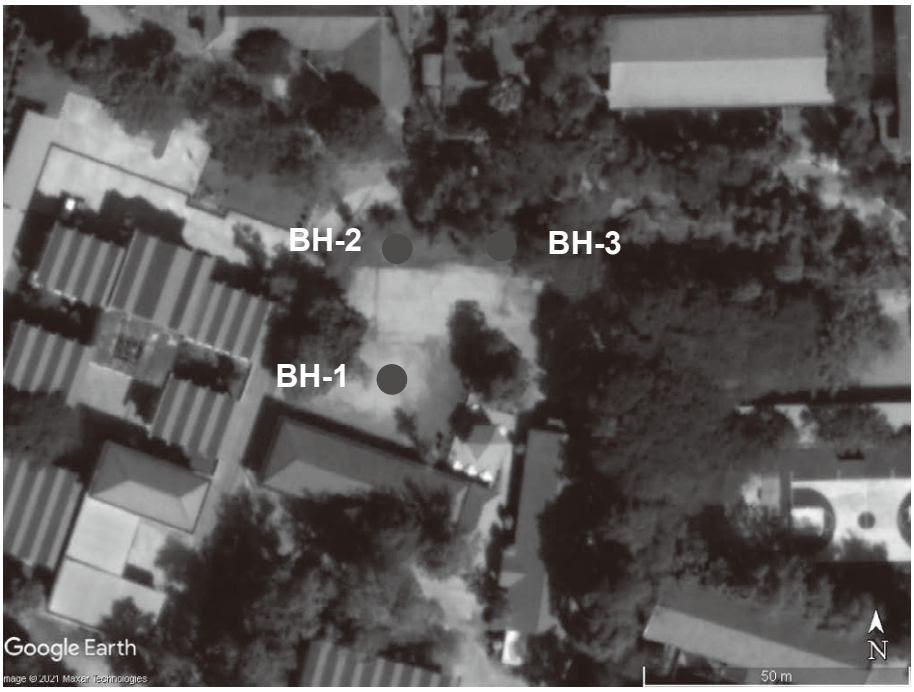

SURVEY AREA:
SURVEY AREA
116,432.208 m²
CORDINATE
CORDINATE GPs AND BM
No | X/N | Y/E | Z
BM001 | 1985154.009 | 248431.993 | 177.786
BM002 | 1985212.509 | 248435.154 | 176.519
BM003 | 1985170.824 | 248635.362 | 178.384
BM004 | 1985234.596 | 248639.987 | 177.352
SCALE 1 : 2000 (@A3)
40 0 40 80m
Vocational Education Development Institute (VEDI)
Institute of Post and Telecommunications
Football Field
Manhole
THE PROJECT FOR IMPROVEMENT OF FACILITY AND LABORATORY EQUIPMENT IN THE FACULTY OF ENGINEERING, NATIONAL UNIVERSITY OF LAOS
CONTOUR MAP
LAO TRANSPORT ENGINEERING CONSULTANT
REV. DATE DESCRIPTION APPROVED
DRAWN Mr. Lamngern INTHISAN
CHECKED Mr. Chittakone VANIPHONH
APPROVED Mr. Bounta MEKSAVANH
SIGNATURE
LTEC CODE: SD-300-21
DATE: May, 2021
DRW No. TCM-01
SCALE: 1:2000 (@A3)

5-2. Outcome of Soil Investigation

1. DRILLING AND STANDARD PENETRATION TEST (SPT))

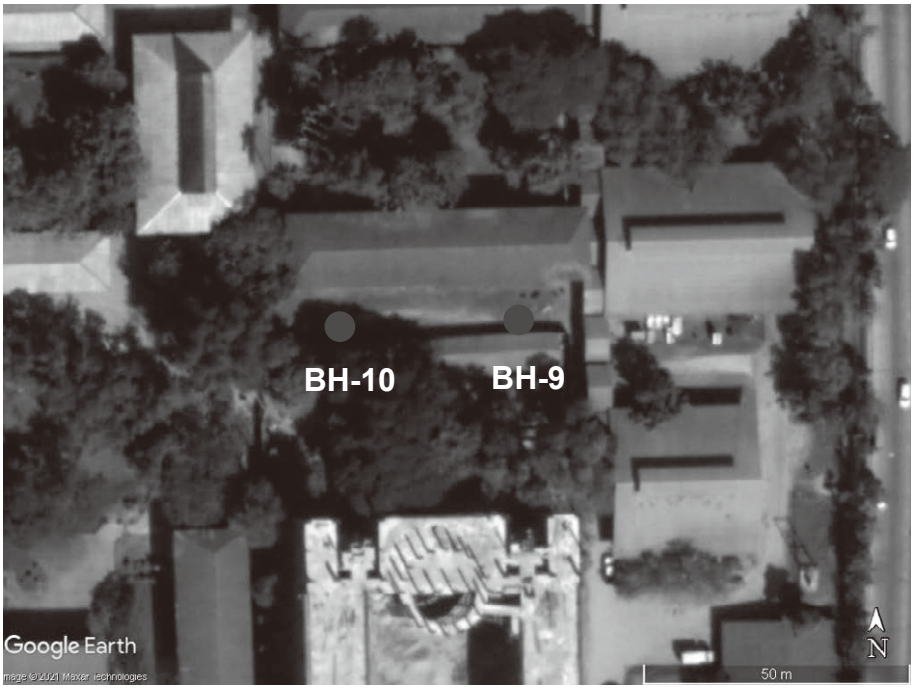
DRILLING LOCATIONS

Test Area: Area A, B and C



Area-A : ● 3 locations of drilling (3 boreholes)

Area-B : ● 5 locations of drilling (5 boreholes)



Area-C : ● 2 locations of drilling (2 boreholes)

BORING LOG

ASTM METHOD, D-1586

Project: Soil investigation is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Village, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary — Hole No : BH-1 — Angle From Horizontal : 90 degree
Drill Started : 27, April, 2021 — Total Depth : 14.00 — Depth of Casting : 0.00 (m)
Drill Finished: 27, April, 2021 — Elevation (m) : — Depth of GWL None : 3.65 (m) — Sheet : 1/1
Co-ordinate : N: E: — Logged By : Bounpasert — Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60	3 13 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m, Stiff, Sandy silt some gravel, Low plastic, brown (ML)	1,00		WO / SS	1		13		1.4	2.0
1,00-2,00m, Stiff, Sandy lean clay with gravel, Medium plastic,Gray (CL)	2,00		WO / SS	2		14		1.5	
2,00-3,00m, Stiff, Sandy lean clay with gravel, Medium plastic,Gray (CL)	3,00		WO / SS	3		19		2.1	
3,00-4,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	4,00		WO / SS	4		17		1.9	
4,00-5,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	5,00		WO / SS	5		17		1.9	
5,00-6,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	6,00		WO / SS	6		13		1.4	1.9
6,00-7,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	7,00		WO / SS	7		13		1.4	1.9
7,00-8,00m, Stiff, Sandy lean clay gravel, Medium plastic, Yellow (CL)	8,00		WO / SS	8		24		2.6	
8,00-9,00m, Very Stiff, Sandy lean clay gravel, Medium plastic, Yellow (CL)	9,00		WO / SS	9		42		4.6	
9,00-10,0m, VeryStiff, Sandy fat clay some gravel, High plastic, Red (CH)	10,0		WO / SS	10		53		5.8	
10,0-11,0m, Stiff, Sandy fat clay High plastic, Red (CH)	11,0		WO / SS	11		51		5.6	
11,0-12,0m, Very Stiff, Sandy fat clay High plastic, Red (CH)	12,0		WO / SS	12		52		5.7	
12,0-13,0m, Very Stiff, Sandy fat clay High plastic, Red (CH)	13,0		WO / SS	13		54		5.9	
13,0-14,00m, Very Stiff, Sandy fat clay High plastic, Red (CH)	14,0		WO / SS	14		56		6.1	
END OF HOLE AT 14,00 m	15,0								
	16,0								
	17,0								
	18,0								

SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stiff	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	> 400					

Degree of Hardness	Remark				Symbol	
1 = Very Soft Rock	SS : Split Spoon	ST : Shelby Tube			PL : Plastic limit	
2 = Soft Rock	ST : Shelby Tube	R : Rought surface Fracture			Wn : Water Content	
3 = Medium Hard Rock	WO : Wash Out	20 : Dip Angle of Fracture or Joint			LL : Liquit limit	
4 = Hard Rock	C : Core				NP : Non Plastic	
5 = Very Hard Rock	P : Planar				SPT N-Value	

BORING LOG

ASTM METHOD, D-1586

Project: soil investigation is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Vilage, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary — Hole No : BH-2 — Angle From Horizontal : 90 degree
Drill Started : 27, April, 2021 — Total Depth : 17.00 — Depth of Casting : 0.00 (m)
Drill Finished: 27, April, 2021 — Elevation (m) : — Depth of GWL None : 4.20 (m) — Sheet : 1/1
Co-ordinate : N: E: — Logged By : Bounpasert — Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60 80	3 13 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m, Stiff, Sandy silt Low plastic, brown (ML)	1,00		WO / SS	1		12		1.3	
1,00-2,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Gray (CL)	2,00		WO / SS	2		13		1.4	
2,00-3,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	3,00		WO / SS	3		19		2.1	2.0
3,00-4,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	4,00		WO / SS	4		16		1.8	1.9
4,00-5,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	5,00		WO / SS	5		19		2.1	1.9
5,00-6,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	6,00		WO / SS	6		11		1.2	1.8
6,00-7,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	7,00		WO / SS	7		13		1.4	2.0
7,00-8,00m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	8,00		WO / SS	8		15		1.6	1.9
8,00-9,00m, Very Stiff, Sandy lean clay some gravel, Medium plastic, Yellow	9,00		WO / SS	9		20		2.2	1.9
9,00-10,0m, Stiff, Sandy lean clay some gravel, Medium plastic, Yellow (CL)	10,0		WO / SS	10		32		3.5	1.9
10,0-11,0m, Very Stiff, Sandy fat clay High plastic, Red (CH)	11,0		WO / SS	11		32		3.5	
11,0-12,0m, Very Stiff, Sandy fat clay High plastic, Red (CH)	12,0		WO / SS	12		53		5.8	
12,0-13,0m, Very Stiff, Sandy fat clay High plastic, Red (CH)	13,0		WO / SS	13		51		5.6	
13,0-14,00m, Very Stiff, Sandy fat clay High plastic, Red (CH)	14,0		WO / SS	14		50		5.5	
14,0-15,00m, Very Stiff, Sandy fat clay High plastic, Red (CH)	15,0		WO / SS	15		53		5.8	
15,0-16,00m, Very Stiff, Sandy fat clay High plastic, Red (CH)	16,0		WO / SS	16		55		6.0	
16,0-17,00m, Very Stiff, Sandy fat clay High plastic, Red (CH)	17,0		WO / SS	17		59		6.5	
END OF HOLE AT 17,00 m	18,0								

SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stiff	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	> 400					

Degree of Hardness	Remark				Symbol	
1 = Very Soft Rock	SS : Split Spoon	ST : Shelby Tube			PL : Plastic limit	
2 = Soft Rock	ST : Shelby Tube	R : Rought surface Fracture			Wn : Water Content	
3 = Medium Hard Rock	WO : Wash Out	20 : Dip Angle of Fracture or Joint			LL : Liquit limit	
4 = Hard Rock	C : Core				NP : Non Plastic	
5 = Very Hard Rock	P : Panar				SPT N-Value	

BORING LOG

ASTM METHOD, D-1586

Project: soil investigation is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Village, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary | Hole No : BH-3 | Angle From Horizontal : 90 degree
Drill Started : 29, April, 2021 | Total Depth : 15.00 | Depth of Casting : 0.00 (m)
Drill Finished: 30, April, 2021 | Elevation (m) : | Depth of GWL None : 0.00 (m) | Sheet : 1/1
Co-ordinate : N: E: | Logged By : Bounpasert | Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60	3 13 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m,Stiff,Sandy lean clay some gravel, Medium plastic,Brown (CL)	1,00		WO / SS	1		6		0.7	1.9
1,00-2,00m,Stiff,Sandy silt some gravel, Not plastic,Brown (ML)	2,00		WO / SS	2		8		0.9	
2,00-3,00m, Stiff, Sandy silt with gravel, Not plastic,Brown (ML)	3,00		WO / SS	3		11		1.2	
3,00-4,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Yellow (CL)	4,00		WO / SS	4		12		1.3	1.9
4,00-5,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Yellow (CL)	5,00		WO / SS	5		13		1.4	2.0
5,00-6,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Yellow (CL)	6,00		WO / SS	6		15		1.6	2.0
6,00-7,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Yellow (CL)	7,00		WO / SS	7		13		1.4	1.9
7,00-8,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Yellow (CL)	8,00		WO / SS	8		14		1.5	2.1
8,00-9,00m,Very Stiff,Sandy lean clay some gravel,Medium plastic,Yellow	9,00		WO / SS	9		24		2.6	2.0
9,00-10,0m,Very Stiff,Sandy lean clay some gravel,Medium plastic, Yellow	10,0		WO / SS	10		50		5.5	
10,0-11,0m, Very Stiff,Sandy lean clay some gravel,Medium plastic,Red(CL)	11,0		WO / SS	11		50		5.5	
11,0-12,0m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	12,0		WO / SS	12		51		5.6	
12,0-13,0m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	13,0		WO / SS	13		51		5.6	
13,0-14,00m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	14,0		WO / SS	14		53		5.8	
14,0-15,00m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	15,0		WO / SS	15		50		6.1	
END OF HOLE AT 15,00 m	16,0								
	17,0								
	18,0								

SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stiff	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	>400					

Degree of Hardness	Remark				Symbol	
1 = Very Soft Rock	SS :	Spilt Spoon	ST :	Shelby Tube	PL:	Plastic limit
2 = Soft Rock	ST :	Shelby Tube	R :	Rought surface Fracture	Wn:	Water Content
3 = Medium Hard Rock	WO :	Wash Out	20 :	Dip Angle of Fracture or Joint	LL:	Liquit limit
4 = Hard Rock	C :	Core			NP:	Non Plastic
5 = Very Hard Rock	P :	Planar				SPT N-Value

BORING LOG

ASTM METHOD, D-1586

Project: soil investigatiin is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Village, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary | Hole No : BH-4 | Angle From Horizontal : 90 degree
Drill Started : 30, April, 2021 | Total Depth : 12.00 | Depth of Casting : 0.00 (m)
Drill Finished: 30, Aoril, 2021 | Elevation (m) : | Depth of GWL None : 2.10 (m) | Sheet : 1/1
Co-ordinate : N: E: | Legged By : Bounpasert | Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60	3 11 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m,Stiff,Sandy silt with gravel Not plastic,Brown (ML)	1,00		WO / SS	1		33		3.6	
1,00-2,00m,Stiff,Sandy silt with gravel Not plastic,Brown (ML)	2,00		WO / SS	2		36		3.9	
2,00-3,00m, Stiff, Sandy silt with gravel Not plastic,Brown (ML)	3,00		WO / SS	3		33		3.6	
3,00-4,00m,Stiff,Sandy lean clay with gravel,Medium plastic,Brown (CL)	4,00		WO / SS	4		30		3.3	
4,00-5,00m,Stiff,Sandy lean clay with gravel,Medium plastic,Brown (CL)	5,00		WO / SS	5		34		3.7	
5,00-6,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Brown (CL)	6,00		WO / SS	6		40		4.4	2.2
6,00-7,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Red (CL)	7,00		WO / SS	7		40		4.4	
7,00-8,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Red (CL)	8,00		WO / SS	8		50		5.5	
8,00-9,00m,Very Stiff,Sandy lean clay some gravel,Medium plastic,Red(CL)	9,00		WO / SS	9		51		5.6	
9,00-10,0m,Very Stiff,Sandy lean clay some gravel,Medium plastic,Red(CL)	10,0		WO / SS	10		55		6.0	
10,0-11,0m, Very Stiff,Sandy fat clay some gravel,High plastic,Red(CH)	11,0		WO / SS	11		54		5.9	
11,0-12,0m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	12,0		WO / SS	12		56		6.1	
END OF HOLE AT 12,00 m	13,0								
	14,0								
	15,0								
	16,0								
	17,0								
	18,0								

SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stiff	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	>400					

Degree of Hardness	Remark				Symbol	
1 = Very Soft Rock	SS :	Spilt Spoon	ST :	Shelby Tube	PL:	Plastic limit
2 = Soft Rock	ST :	Shelby Tube	R :	Rought surface Fracture	Wn:	Water Content
3 = Medium Hard Rock	WO :	Wash Out	20 :	Dip Angle of Fracture or Joint	LL:	Liquit limit
4 = Hard Rock	C :	Core			NP:	Non Plastic
5 = Very Hard Rock	P :	Planar				SPT N-Value

BORING LOG

ASTM METHOD, D-1586

Project: soil investigation is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Village, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary — Hole No : BH-5 — Angle From Horizontal : 90 degree
Drill Started : 1, May, 2021 — Total Depth : 12.00 — Depth of Casting : 0.00 (m)
Drill Finished: 1, May, 2021 — Elevation (m) : — Depth of GWL None : 2.43 (m) — Sheet : 1/1
Co-ordinate : N: E: — Logged By : Bounpasert — Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60	3 13 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m,Loose,Silty sand some gravel, Not plastic, Brown (SM)	1,00		WO / SS	1		9		1.0	
1,00-2,00m,Loose,Sandy silt with gravel, Not plastic, Brown (SM)	2,00		WO / SS	2		4		0.4	
2,00-3,00m, Medium donse, Sandy silt with gravel, Not plastic,Brown (ML)	3,00		WO / SS	3		18		2.0	
3,00-4,00m,Stiff,Sandy lean clay with gravel,Medium plastic,Brown (CL)	4,00		WO / SS	4		11		1.2	1.9
4,00-5,00m,Stiff,Sandy lean clay with gravel,Medium plastic,Brown (CL)	5,00		WO / SS	5		20		2.2	1.9
5,00-6,00m,Stiff,Sandy lean clay with gravel,Medium plastic,Brown (CL)	6,00		WO / SS	6		31		3.4	2.1
6,00-7,00m,Stiff,Sandy lean clay with gravel,Medium plastic,Brown (CL)	7,00		WO / SS	7		38		4.2	2.2
7,00-8,00m,Very Stiff,Sandy fat clay with gravel,Medium plastic,Red(CH)	8,00		WO / SS	8		51		5.6	
8,00-9,00m,Very Stiff,Sandy fat clay with gravel,Medium plastic,Red(CH)	9,00		WO / SS	9		50		5.5	
9,00-10,0m,Very Stiff,Sandy fat clay with gravel,Medium plastic,Red(CH)	10,0		WO / SS	10		50		5.5	
10,0-11,0m, Very Stiff,Sandy fat clay some gravel,High plastic,Red(CH)	11,0		WO / SS	11		51		5.6	
11,0-12,0m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	12,0		WO / SS	12		51		5.6	
END OF HOLE AT 12,00 m	13,0								
	14,0								
	15,0								
	16,0								
	17,0								
	18,0								

SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stiff	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	> 400					

Degree of Hardness	Remark				Symbol	
1 = Very Soft Rock	SS : Spilt Spoon	ST : Shelby Tube			PL : Plastic limit	
2 = Soft Rock	ST : Shelby Tube	R : Rought surface Fracture			Wn : Water Content	
3 = Medium Hard Rock	WO : Wash Out	20 : Dip Angle of Fracture or Joint			LL : Liquit limit	
4 = Hard Rock	C : Core				NP : Non Plastic	
5 = Very Hard Rock	P : Planar				SPT N-Value	

BORING LOG

ASTM METHOD, D-1586

Project: soil investigation is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Village, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary — Hole No : BH-6 (B) — Angle From Horizontal : 90 degree
Drill Started : 1, May, 2021 — Total Depth : 15.00 — Depth of Casting : 0.00 (m)
Drill Finished: 2, May, 2021 — Elevation (m) : — Depth of GWL None : 2.03 (m) — Sheet : 1/1
Co-ordinate : N: E: — Logged By : Bounpasert — Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60	3 13 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m,Very stiff,Sandy silt some gravel, Not plastic, Brown (ML)	1,00		WO / SS	1		31		3.4	
1,00-2,00m, Dense,Silty gravel with sand, Not plastic, Brown (GM)	2,00		WO / SS	2		41		4.5	
2,00-3,00m, Dense, Silty gravel with sand, Not plastic,Brown (GM)	3,00		WO / SS	3		19		2.1	
3,00-4,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Yellow (CL)	4,00		WO / SS	4		22		2.4	2.0
4,00-5,00m,Stiff,Sandy lean clay some gravel,Medium plastic,Yellow (CL)	5,00		WO / SS	5		14		1.5	1.8
5,00-6,00m,Stiff,Sandy lean clay with gravel,Medium plastic,Brown (CL)	6,00		WO / SS	6		29		3.2	2.0
6,00-7,00m,Stiff,Sandy lean clay with gravel,Medium plastic,Brown (CL)	7,00		WO / SS	7		32		3.5	2.1
7,00-8,00m,Very stiff,Sancy fat clay gravel,Medium plastic,Red (CH)	8,00		WO / SS	8		34		3.7	
8,00-9,00m,Very Stiff,Sandy fat clay with gravel,Medium plastic,Red(CH)	9,00		WO / SS	9		45		4.9	
9,00-10,0m,Very Stiff,Sandy fat clay with gravel,Medium plastic,Red(CH)	10,0		WO / SS	10		45		4.9	
10,0-11,0m, Very Stiff,Sandy fat clay some gravel,High plastic,Red(CH)	11,0		WO / SS	11		51		5.6	
11,0-12,0m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	12,0		WO / SS	12		53		5.8	
12,0-13,0m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	13,0		WO / SS	13		50		5.5	
13,0-14,0m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	14,0		WO / SS	14		53		5.8	
14,0-15,0m, Very Stiff, Sandy fat clay some gravel,High plastic, Red (CH)	15,0		WO / SS	15		52		5.7	
END OF HOLE AT 15,00 m	16,0								
	17,0								
	18,0								

SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stiff	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	> 100					

Degree of Hardness	Remark				Symbol	
1 = Very Soft Rock	SS : Spilt Spoon	ST : Shelby Tube			PL : Plastic limit	
2 = Soft Rock	ST : Shelby Tube	R : Rought surface Fracture			Wn : Water Content	
3 = Medium Hard Rock	WO : Wash Out	20 : Dip Angle of Fracture or Joint			LL : Liquit limit	
4 = Hard Rock	C : Core				NP : Non Plastic	
5 = Very Hard Rock	P : Panar				SPT N-Value	

BORING LOG

ASTM METHOD, D-1586

Project: soil investigation is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Village, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary — Hole No : BH-7 (B) — Angle From Horizontal : 90 degree
Drill Started : 2, May, 2021 — Total Depth : 13.00 — Depth of Casting : 0.00 (m)
Drill Finished: 2, May, 2021 — Elevation (m) : — Depth of GWL None : 2.10 (m) — Sheet : 1/1
Co-ordinate : N: E: — Logged By : Bounpasert — Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60	3 11 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m,Medium dense,Silty sand			WO			0			
with gravel, Not plastic, Brown (SM)	1,00		SS	1		15		1.6	
1,00-2,00m,Medium dense,Silty sand			WO						
with gravel, Not plastic, Brown (SM)	2,00		SS	2		21		2.3	
2,00-3,00m,Medium dense,Silty sand			WO						
with gravel, Not plastic, Brown (SM)	3,00		SS	3		20		2.2	
3,00-4,00m,Loose,Silty gravel with			WO						
sand, Not plastic,Brown (GM)	4,00		SS	4		16		1.8	
4,00-5,00m,Stiff,Sandy lean clay with			WO						
gravel,Medium plastic,Brown (CL)	5,00		SS	5		17		1.9	C 1.9
5,00-6,00m,Medium dense,Silty sand			WO						
with gravel, Not plastic,Brown (SM)	6,00		SS	6		27		3.0	
6,00-7,00m,Stiff,Sandy lean clay some			WO						
gravel,Medium plastic,Brown (CL)	7,00		SS	7		38		4.2	C 2.1
7,00-8,00m,Very stiff,Sandy silt with			WO						
gravel, Not plastic,Red (ML)	8,00		SS	8		41		4.5	
8,00-9,00m,Very Stiff,Sandy lean clay			WO						
some gravel,Medium plastic,Red(CL)	9,00		SS	9		50		5.5	
9,00-10,0m,Very Stiff,Sandy lean clay			WO						
some gravel,Medium plastic,Red(CL)	10,0		SS	10		51		5.6	
10,0-11,0m, Very Stiff,Sandy lean clay			WO						
some gravel,Medium plastic,Red(CL)	11,0		SS	11		50		5.5	
11,0-12,0m, Very Stiff, Sandy lean clay			WO						
some gravel,Medium plastic,Red(CL)	12,0		SS	12		54		5.9	
12,0-13,0m, Very Stiff, Sandy lean clay			WO						
some gravel,Medium plastic,Red(CL)	13,0		SS	13		54		5.9	
END OF HOLE AT 12,00 m	14,0								
	15,0								
	16,0								
	17,0								
	18,0								

SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stiff	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	> 400					

Degree of Hardness	Remark		Symbol	
1 = Very Soft Rock	SS : Spilt Spoon	ST : Shelby Tube	PL :	Plastic limit
2 = Soft Rock	ST : Shelby Tube	R : Rought surface Fracture	Wn :	Water Content
3 = Medium Hard Rock	WO : Wash Out	20 : Dip Angle of Fracture or Joint	LL :	Liquil limit
4 = Hard Rock	C : Core		NP :	Non Plastic
5 = Very Hard Rock	P : Planar			SPT N-Value

BORING LOG

ASTM METHOD, D-1586

Project: soil investigation is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Village, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary — Hole No : BH-8 (B) — Angle From Horizontal : 90 degree
Drill Started : 2, May, 2021 — Total Depth : 14.00 — Depth of Casting : 0.00 (m)
Drill Finished: 2, May, 2021 — Elevation (m) : — Depth of GWL None : 2.35 (m) — Sheet : 1/1
Co-ordinate : N: E: — Logged By : Bounpasert — Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60	3 13 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m,Medium dense,Silty sand			WO			0			
some gravel, Not plastic, Brown (SM)	1,00		SS	1		13		1.4	
1,00-2,00m,Medium dense,Silty sand			WO						
with gravel, Not plastic, Brown (SM)	2,00		SS	2		52		5.7	
2,00-3,00m,Medium dense,Sandy silt			WO						
with gravel, Not plastic, Brown (ML)	3,00		SS	3		46		5.0	
3,00-4,00m,Loose,Silty sand with			WO						
gravel, Not plastic,Brown (SM)	4,00		SS	4		37		4.1	
4,00-5,00m,Stiff,Silt sand with			WO						
gravel, Not plastic,Brown (SM)	5,00		SS	5		18		2.0	
5,00-6,00m,Medium dense,Silty sand			WO						
with gravel, Not plastic,Brown (ML)	6,00		SS	6		22		2.4	
6,00-7,00m,Dense,Silty gravel with			WO						
sand,Not plastic, Brown (GM)	7,00		SS	7		30		3.3	
7,00-8,00m, Very stiff, Sandy silt			WO						
Not plastic,Red (ML)	8,00		SS	8		35		3.8	C 2.1
8,00-9,00m, Very stiff, Sandy silt			WO						
Not plastic,Red (ML)	9,00		SS	9		48		5.3	
9,00-10,0m, Very stiff, Sandy silt			WO						
Not plastic,Red (ML)	10,0		SS	10		52		5.7	
10,0-11,0m, Very stiff, Sandy silt			WO						
Not plastic,Red (ML)	11,0		SS	11		51		5.6	
11,0-12,0m, Very stiff, Sandy silt			WO						
Not plastic,Red (ML)	12,0		SS	12		52		5.7	
12,0-13,0m,Very stiff, Sandy silt			WO						
Not plastic,Red (ML)	13,0		SS	13		51		5.6	
13,0-14,0m, Very stiff, Sandy silt			WO						
Not plastic,Red (ML)	14,0		SS	14		53		5.8	
END OF HOLE AT 14,00 m	15,0								
	16,0								
	17,0								
	18,0								

SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stiff	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	> 100					

Degree of Hardness	Remark		Symbol	
1 = Very Soft Rock	SS : Spilt Spoon	ST : Shelby Tube	PL :	Plastic limit
2 = Soft Rock	ST : Shelby Tube	R : Rought surface Fracture	Wn :	Water Content
3 = Medium Hard Rock	WO : Wash Out	20 : Dip Angle of Fracture or Joint	LL :	Liquil limit
4 = Hard Rock	C : Core		NP :	Non Plastic
5 = Very Hard Rock	P : Panar			SPT N-Value

BORING LOG

ASTM METHOD, D-1586

Project: soil investigation is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Village, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary — Hole No : BH-9 (C) — Angle From Horizontal : 90 degree
Drill Started : 3, May, 2021 — Total Depth : 13.00 — Depth of Casting : 0.00 (m)
Drill Finished: 3, May, 2021 — Elevation (n) : — Depth of GWL None : 1.10 (m) — Sheet : 1/1
Co-ordinate : N : E : — Logged By : Bounpasert — Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60	3 13 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m, Stiff, Sandy silt Not plastic, Brown (ML)	1,00		WO / SS	1		0 / 10		1.1	
1,00-2,00m,Medium dense,Silty sand with gravel, Not plastic, Brown (SM)	2,00	o o	WO / SS	2		15		1.6	
2,00-3,00m,Medium dense,Silty sand with gravel, Not plastic, Brown (SM)	3,00	o o	WO / SS	3		20		2.2	
3,00-4,00m,Medium dense,Silty sand with gravel, Not plastic, Brown (SM)	4,00	o o	WO / SS	4		29		3.2	
4,00-5,00m,Dense,Silt sand with gravel, Not plastic,Brown (SM)	5,00	o o	WO / SS	5		32		3.5	
5,00-6,00m, Stiff, Sandy lean clay Medium plastic,Red (CL)	6,00		WO / SS	6		24		2.6	C 2.0
6,00-7,00m,Very stiff, Sandy lean clay Medium plastic,Red (CL)	7,00		WO / SS	7		33		3.6	C 2.1
7,00-8,00m, Very stiff, Sandy lean clay Medium plastic,Red (CL)	8,00		WO / SS	8		38		4.2	C 2.1
8,00-9,00m, Very stiff, Sandy lean clay Medium plastic,Red (CL)	9,00		WO / SS	9		45		4.9	
9,00-10,0m, Very stiff, Sandy lean clay Medium plastic,Red (CL)	10,0		WO / SS	10		50		5.5	
10,0-11,0m, Very stiff, Sandy lean clay Medium plastic,Red (CL)	11,0		WO / SS	11		52		5.7	
11,0-12,0m, Very stiff, Sandy lean clay Medium plastic,Red (CL)	12,0		WO / SS	12		53		5.8	
12,0-13,0m,Very stiff, Sandy lean clay Medium plastic,Red (CL)	13,0		WO / SS	13		55		6.0	
13,0-14,0m, Very stiff, Sandy lean clay Medium plastic,Red (CL)	14,0		WO / SS	14					
END OF HOLE AT 14,00 m	15,0								
	16,0								
	17,0								
	18,0								

SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stiff	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	> 400					

Degree of Hardness	Remark				Symbol	
1 = Very Soft Rock	SS : Spilt Spoon	ST : Shelby Tube			PL:	Plastic limit
2 = Soft Rock	ST : Shelby Tube	R : Rought surface Fracture			Wn:	Water Content
3 = Medium Hard Rock	WO : Wash Out	20 : Dip Angle of Fracture or Joint			LL:	Liquit limit
4 = Hard Rock	C : Core				NP:	Non Plastic
5 = Very Hard Rock	P : Planar				SPT N-Value	

BORING LOG

ASTM METHOD, D-1586

Project: soil investigation is the Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sokpalouang Village, Sisattanak District, Vientiane Capital
Drill Method : Direc Rotary — Hole No : BH-10 (C) — Angle From Horizontal : 90 degree
Drill Started : 3, May, 2021 — Total Depth : 12.00 — Depth of Casting : 0.00 (m)
Drill Finished: 3, May, 2021 — Elevation (m) : — Depth of GWL None : 1.10 (m) — Sheet : 1/1
Co-ordinate : N : E : — Logged By : Bounpasert — Loged Date : 18, May, 2021

Soil Description	Depth (m)	Symbol	Drill Method	Sampling	Recovery	SPT N-Value (blows / ft)	Water content, LL, PL (%)	Unconfined compressive strength q_u (KG/Cm^2)	Unit Wegth g/Cm^3
	0,00					0 20 40 60	3 13 23 33 43 53	0 3 6 9 12	0 5 10 15 20
0,00-1,00m, Stiff, Sandy silt some gravel, Low plastic, Brown (ML)	1,00	o	WO / SS	1		0 / 17		1.9	C 1.9
1,00-2,00m,Medium dense,Silty sand with gravel, Not plastic, Brown (SM)	2,00	o o	WO / SS	2		21		2.3	
2,00-3,00m,Medium dense,Silty sand with gravel, Not plastic, Brown (SM)	3,00	o o	WO / SS	3		26		2.8	
3,00-4,00m,Medium dense,Silty sand with gravel, Not plastic, Brown (SM)	4,00	o o	WO / SS	4		17		1.9	
4,00-5,00m,Stiff, Sandy silt Not plastic,Brown (ML)	5,00		WO / SS	5		16		1.8	C 1.8
5,00-6,00m, Dense, Silty sand with gravel , Not plastic,Red (SM)	6,00		WO / SS	6		24		2.6	
6,00-7,00m,Dense, Silty sand with gravel , Not plastic,Red (SM)	7,00		WO / SS	7		40		4.4	
7,00-8,00m, Very stiff, Sandy silt Not plastic,Brown (ML)	8,00		WO / SS	8		50		5.5	
8,00-9,00m, Very stiff, Sandy silt Not plastic,Brown (ML)	9,00		WO / SS	9		50		5.5	
9,00-10,0m, Very stiff, Sandy silt Not plastic,Brown (ML)	10,0		WO / SS	10		52		5.7	
10,0-11,0m,Very stiff, Sandy silt Not plastic,Brown (ML)	11,0		WO / SS	11		53		5.8	
11,0-12,0m, Very stiff, Sandy silt Not plastic,Brown (ML)	12,0		WO / SS	12		53		5.8	
END OF HOLE AT 12,00 m	13,0								
	14,0								
	15,0								
	16,0								
	17,0								
	18,0								

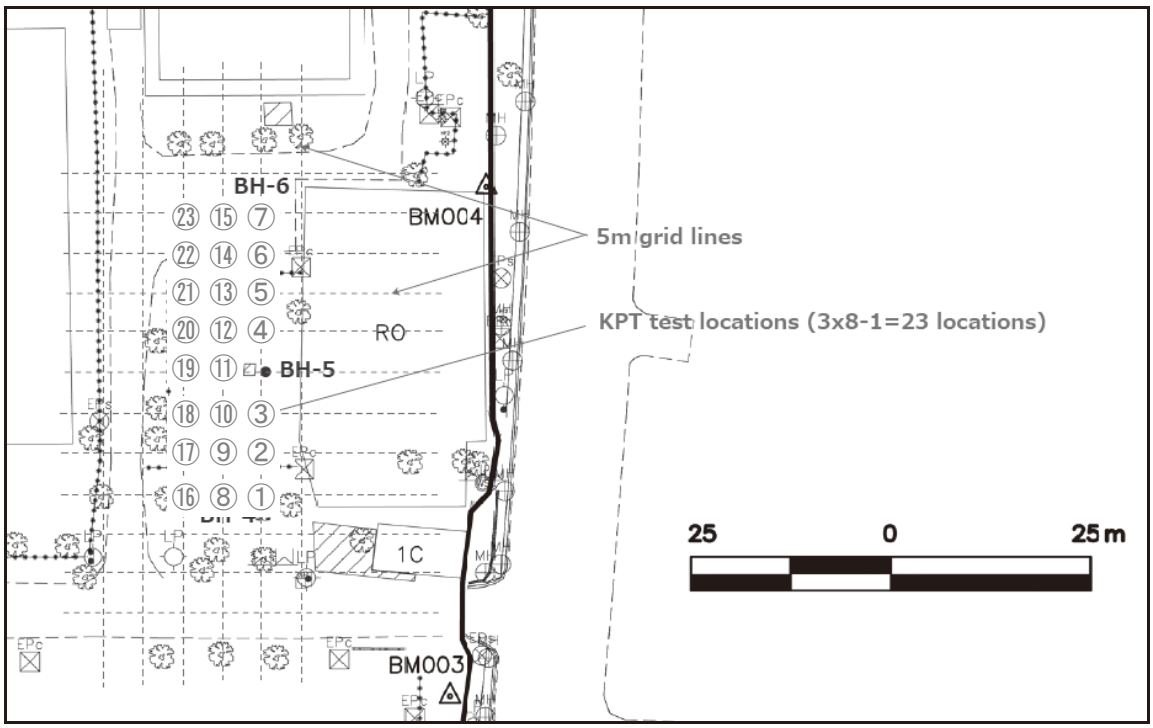
SPT (CLAY)	Unconfined Compressive Strength , q_u (KN/m^2)	SPT (SAND)	Approximate relative density , Dr (%)	Approximate relative angle of friction of soil, ϕ (deg)	Wet density, γ_{wet} T/m^3	Wet density, γ_{wet} KN/m^3
0 - 2 = Very Soft	0 - 25	0 - 5 = Very Loose	0 - 5	26 - 30	1.1 - 1.6	11 - 16
2 - 5 = Soft	25 - 50	5 -10 = Loose	5 - 30	28 - 35	1.4 - 1.8	14 - 18
5 -10 = Medium Stiff	50 - 100	10 -30 = Medium Dens	30 - 60	35 - 42	1.7 - 2.0	17 - 20
10 -20 = Stiff	100 - 200	30 -50 = Dense	60 - 95	38 - 46	1.7 - 2.2	17 - 22
20 -30 = Very Stif	200 -400	>50 = Very Dense	95 - 100		2.0 - 2.3	20 - 23
> 30 = Hard	>400					

Degree of Hardness	Remark				Symbol	
1 = Very Soft Rock	SS : Spilt Spoon	ST : Shelby Tube			PL:	Plastic limit
2 = Soft Rock	ST : Shelby Tube	R : Rought surface Fracture			Wn:	Water Content
3 = Medium Hard Rock	WO : Wash Out	20 : Dip Angle of Fracture or Joint			LL:	Liquit limit
4 = Hard Rock	C : Core				NP:	Non Plastic
5 = Very Hard Rock	P : Planar				SPT N-Value	

2. SOUNDING TEST (Kunzelstab Penetration Test (KPT) Method)

TEST LOCATIONS

Test Area: Area B



Sounding Test Locations in Area B

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-1/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Loose, Brown		0.20	19	17.00			0.86
		0.40	13	14.00			0.67
		0.60	31	23.00			1.24
		0.80	34	24.50			1.34
		1.00	27	21.00			1.12
Sandy silt Medium, Brown		1.20	26	20.50			1.08
		1.40	36	26.60			1.40
		1.60	68	41.50			2.43
		1.80	67	41.00			2.40
		2.00	65	40.00			2.33
Sandy silt Medium, Brown		2.20	56	35.50			2.04
		2.40	80	47.50			2.81
		2.60	105	60.00			3.61
		2.80	105	60.00			3.61
		3.00	108	61.50			3.71
Sandy silt Dense, Brown		3.20	95	54.75			3.28
		3.40	101	57.75			3.47
		3.60	101	57.75			3.47
		3.80	98	55.25			3.37
		4.00	110	62.50			3.77
Sandy silt Dense, Brown		4.20	115	65.00			3.93
		4.40	113	64.00			3.87
		4.60	120	67.50			4.09
		4.80	116	65.50			4.03
		5.00	113	64.00			3.87
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.71

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-1/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	116	65.50			3.96
		5.40	112	63.50			3.84
		5.60	119	67.00			4.06
		5.80	115	65.00			3.93
Sandy silt Dense, Brown		6.00	128	71.50			4.35
		6.20	130	72.50			4.41
		6.40	135	75.00			4.57
		6.60	133	74.00			4.51
		6.80	133	74.00			4.51
Sandy silt Dense, Brown		7.00	130	72.50			4.41
		7.20	135	75.00			4.57
		7.40	137	76.00			4.64
		7.60	132	73.50			4.48
		7.80	146	80.50			4.92
		8.00	158	86.50			5.31
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					4.43

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-2/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	13	14.00			0.67
		0.40	17	16.00			0.80
		0.60	43	29.00			1.63
		0.80	71	43.00			2.52
		1.00	91	53.00			3.16
Sandy silt Medium, Brown		1.20	102	58.50			3.52
		1.40	115	65.00			3.93
		1.60	112	63.50			3.84
		1.80	130	72.50			4.41
		2.00	128	71.50			4.35
Sandy silt Medium, Brown		2.20	114	64.50			3.90
		2.40	125	70.00			4.25
		2.60	125	70.00			4.25
		2.80	125	70.00			4.25
		3.00	128	71.50			4.35
Sandy silt Dense, Brown		3.20	125	70.00			4.25
		3.40	121	68.00			4.12
		3.60	126	70.50			4.28
		3.80	124	69.50			4.22
		4.00	128	71.50			4.35
Sandy silt Dense, Brown		4.20	125	70.00			4.25
		4.40	126	70.50			4.28
		4.60	134	74.50			4.54
		4.80	132	73.50			4.48
		5.00	133	74.00			4.51
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					3.72

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-2/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	136	75.50			4.60
		5.40	134	74.50			4.54
		5.60	135	75.00			4.57
		5.80	135	75.00			4.57
Sandy silt Dense, Brown		6.00	139	77.00			4.70
		6.20	135	74.00			4.51
		6.40	128	71.50			4.35
		6.60	134	74.50			4.54
		6.80	135	75.00			4.57
Sandy silt Dense, Brown		7.00	130	72.50			4.41
		7.20	132	73.50			4.48
		7.40	137	76.00			4.64
		7.60	139	77.00			4.70
		7.80	144	79.50			4.86
		8.00	147	81.00			4.96
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					4.60

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-3/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm 0 20 40 60 80 100 120 140 160	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Loose, Brown		0.20	11	13.00			0.60
		0.40	20	17.50			0.89
		0.60	27	21.00			1.12
		0.80	40	27.50			1.53
		1.00	41	28.00			1.56
Sandy silt Medium, Brown		1.20	52	33.50			1.92
		1.40	55	35.00			2.01
		1.60	75	45.00			2.65
		1.80	81	48.00			2.84
		2.00	106	60.50			3.64
Sandy silt Dense, Brown		2.20	112	63.50			3.84
		2.40	114	64.50			3.90
		2.60	115	65.00			3.93
		2.80	85	50.00			2.97
		3.00	88	51.50			3.07
Sandy silt Medium, Brown		3.20	82	48.50			2.88
		3.40	84	49.50			2.94
		3.60	88	51.50			3.07
		3.80	94	54.50			3.26
		4.00	98	56.50			3.39
Sandy silt Medium, Brown		4.20	92	53.50			3.20
		4.40	94	54.50			3.26
		4.60	94	54.50			3.26
		4.80	97	56.00			3.36
		5.00	91	53.00			3.16
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.73

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-3/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm 0 20 40 60 80 100 120 140 160	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	96	55.50			3.32
		5.40	94	54.50			3.26
		5.60	93	54.00			3.23
		5.80	95	55.00			3.29
		6.00	99	57.00			3.42
Sandy silt Dense, Brown		6.20	101	58.00			3.48
		6.40	107	61.00			3.68
		6.60	104	59.50			3.58
		6.80	115	65.00			3.93
		7.00	118	66.50			4.03
Sandy silt Dense, Brown		7.20	116	65.50			3.96
		7.40	117	66.00			4.00
		7.60	120	67.50			4.09
		7.80	127	71.00			4.32
		8.00	124	69.50			4.22
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.72

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-4/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm 0 20 40 60 80 100 120 140 160	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	15	15.00			0.73
		0.40	112	63.50			3.84
		0.60	100	57.50			3.45
		0.80	73	44.00			2.59
		1.00	66	40.50			2.36
Sandy silt Medium, Brown		1.20	66	40.50			2.36
		1.40	47	30.75			1.74
		1.60	57	36.00			2.08
		1.80	60	37.50			2.17
		2.00	65	39.75			2.32
Sandy silt Medium, Brown		2.20	83	48.75			2.89
		2.40	83	48.75			2.89
		2.60	53	33.75			1.93
		2.80	75	45.00			2.65
		3.00	59	36.75			2.12
Sandy silt Medium, Brown		3.20	69	42.00			2.46
		3.40	59	36.75			2.12
		3.60	65	39.75			2.32
		3.80	60	37.50			2.17
		4.00	58	36.50			2.11
Sandy silt Medium, Brown		4.20	48	31.50			1.79
		4.40	42	28.50			1.60
		4.60	50	32.25			1.84
		4.80	37	26.00			1.44
		5.00	62	38.25			2.22
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.25

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-4/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm 0 20 40 60 80 100 120 140 160	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	88	51.50			3.07
		5.40	81	48.00			2.84
		5.60	99	57.00			3.42
		5.80	95	55.00			3.29
		6.00	101	58.00			3.48
Sandy silt Dense, Brown		6.20	111	63.00			3.84
		6.40	108	61.50			3.71
		6.60	104	59.50			3.58
		6.80	115	65.00			3.93
		7.00	117	66.00			4.00
Sandy silt Dense, Brown		7.20	115	65.00			3.93
		7.40	112	63.50			3.84
		7.60	111	63.00			3.80
		7.80	111	63.00			3.80
		8.00	114	64.50			3.90
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.63

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-5/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
		0.20	20	17.50			0.89
		0.40	67	41.00			2.40
Sandy silt		0.60	64	39.50			2.30
Medium, Brown		0.80	66	40.50			2.36
		1.00	46	30.50			1.72
		1.20	54	34.50			1.98
Sandy silt		1.40	46	30.50			1.72
Medium, Brown		1.60	64	39.50			2.30
		1.80	86	50.50			3.06
		2.00	61	38.00			2.26
		2.20	66	40.50			2.36
Sandy silt		2.40	67	41.00			2.40
Medium, Brown		2.60	81	48.00			2.84
		2.80	75	45.00			2.65
		3.00	75	45.00			2.65
		3.20	58	36.50			2.11
Sandy silt		3.40	73	44.00			2.59
Medium, Brown		3.60	54	34.50			1.98
		3.80	55	35.00			2.01
		4.00	52	33.50			1.92
		4.20	51	33.00			1.88
Sandy silt		4.40	42	28.50			1.60
Medium, Brown		4.60	49	32.00			1.82
		4.80	55	35.00			2.01
		5.00	61	38.00			2.20
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.16

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-5/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
		5.20	88	51.50			3.07
		5.40	101	58.00			3.48
Sandy silt		5.60	99	57.00			3.42
Dense, Brown		5.80	95	55.00			3.29
		6.00	101	58.00			3.48
		6.20	111	63.00			3.80
Sandy silt		6.40	108	61.50			3.71
Dense, Brown		6.60	104	59.50			3.58
		6.80	115	65.00			3.93
		7.00	117	66.00			4.00
		7.20	115	65.00			3.93
Sandy silt		7.40	112	63.50			3.84
Dense, Brown		7.60	111	63.00			3.80
		7.80	111	63.00			3.80
		8.00	114	64.50			3.90
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.67

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-6/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
		0.20	36	25.50			1.40
		0.40	66	40.50			2.36
Sandy silt		0.60	69	42.00			2.46
Medium, Brown		0.80	75	45.00			2.65
		1.00	54	34.50			1.98
		1.20	48	31.50			1.79
		1.40	33	24.00			1.31
Sandy silt		1.60	90	52.50			3.13
Medium, Brown		1.80	81	48.00			2.84
		2.00	66	40.50			2.36
		2.20	63	39.00			2.27
		2.40	78	46.50			2.75
Sandy silt		2.60	96	55.50			3.32
Medium, Brown		2.80	90	52.50			3.13
		3.00	76	45.50			2.68
		3.20	72	43.50			2.56
		3.40	60	37.50			2.17
Sandy silt		3.60	66	40.50			2.36
Medium, Brown		3.80	60	37.50			2.17
		4.00	64	39.50			2.30
		4.20	66	40.50			2.36
		4.40	66	40.50			2.36
Sandy silt		4.60	70	42.50			2.49
Medium, Brown		4.80	72	43.50			2.56
		5.00	66	40.50			2.36
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.41

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-6/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
		5.20	76	45.50			2.68
		5.40	101	58.00			3.48
Sandy silt		5.60	94	54.50			3.26
Medium, Brown		5.80	96	55.50			3.32
		6.00	97	56.00			3.36
		6.20	101	58.00			3.48
		6.40	104	59.50			3.58
Sandy silt		6.60	98	56.50			3.39
Dense, Brown		6.80	96	55.50			3.32
		7.00	97	56.00			3.36
		7.20	102	58.50			3.52
		7.40	107	61.00			3.68
Sandy silt		7.60	104	59.50			3.58
Dense, Brown		7.80	101	58.00			3.48
		8.00	109	62.00			3.74
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.42

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-7/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	51	33.00			1.88
		0.40	57	36.00			2.08
		0.60	39	27.00			1.50
		0.80	21	18.00			0.92
		1.00	31	23.00			1.24
Sandy silt Medium, Brown		1.20	22.5	18.75			0.97
		1.40	57	36.00			2.08
		1.60	39	27.00			1.50
		1.80	58.5	36.75			2.12
		2.00	67.5	41.25			2.41
Sandy silt Medium, Brown		2.20	102	58.50			3.52
		2.40	82	48.50			2.88
		2.60	92	53.50			3.20
		2.80	90	52.50			3.13
		3.00	60	37.50			2.17
Sandy silt Medium, Brown		3.20	66	40.50			2.36
		3.40	60	37.50			2.17
		3.60	64	39.50			2.30
		3.80	66	40.50			2.36
		4.00	70	42.50			2.49
Sandy silt Medium, Brown		4.20	66	40.50			2.36
		4.40	66	40.50			2.36
		4.60	60	37.50			2.17
		4.80	62	38.50			2.24
		5.00	66	40.50			2.36
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.19

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-7/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	69	42.00			2.46
		5.40	72	43.50			2.56
		5.60	84	49.50			2.94
		5.80	83	49.00			2.91
		6.00	82	48.50			2.88
Sandy silt Dense, Brown		6.20	91	53.00			3.16
		6.40	94	54.50			3.26
		6.60	98	56.50			3.39
		6.80	94	54.50			3.26
		7.00	90	54.00			3.23
Sandy silt Dense, Brown		7.20	108	61.50			3.71
		7.40	111	63.00			3.80
		7.60	109	62.00			3.74
		7.80	122	68.50			4.16
		8.00	121	68.00			4.12
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.30

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-8/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	27	21.00			1.12
		0.40	30	22.50			1.21
		0.60	18	16.50			0.83
		0.80	21	18.00			0.92
		1.00	34	24.50			1.34
Sandy silt Medium, Brown		1.20	26	20.50			1.08
		1.40	25	20.00			1.05
		1.60	23	19.00			0.99
		1.80	54	34.50			1.98
		2.00	73	44.00			2.59
Sandy silt Medium, Brown		2.20	72	43.50			2.56
		2.40	76	45.50			2.68
		2.60	75	45.00			2.65
		2.80	77	46.00			2.72
		3.00	76	45.50			2.68
Sandy silt Medium, Brown		3.20	89	52.00			3.10
		3.40	83	49.00			2.91
		3.60	99	57.00			3.42
		3.80	89	52.00			3.10
		4.00	92	53.50			3.20
Sandy silt Medium, Brown		4.20	98	56.50			3.39
		4.40	98	56.50			3.39
		4.60	96	55.50			3.32
		4.80	92	53.50			3.20
		5.00	98	56.50			3.39
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.35

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-8/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	107	61.00			3.68
		5.40	110	62.50			3.77
		5.60	106	60.00			3.61
		5.80	113	64.00			3.87
		6.00	116	65.50			3.96
Sandy silt Dense, Brown		6.20	115	65.00			3.93
		6.40	115	65.00			3.93
		6.60	117	66.00			4.00
		6.80	118	66.50			4.03
		7.00	116	65.50			3.96
Sandy silt Dense, Brown		7.20	114	64.50			3.90
		7.40	129	72.00			4.38
		7.60	135	75.00			4.57
		7.80	139	77.00			4.70
		8.00	148	81.50			4.99
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					4.09

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-9/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Loose, Brown		0.20	14	14.50			0.70
		0.40	26	20.50			1.08
		0.60	22	18.50			0.96
		0.80	25	20.00			1.05
		1.00	21	18.00			0.92
Sandy silt Loose, Brown		1.20	28	21.50			1.15
		1.40	21	16.00			0.92
		1.60	26	20.50			1.06
		1.80	20	17.50			0.89
		2.00	21	18.00			0.92
Sandy silt Medium, Brown		2.20	26	20.50			1.08
		2.40	32	23.50			1.28
		2.60	35	25.00			1.37
		2.80	35	25.00			1.37
		3.00	38	25.50			1.47
Sandy silt Medium, Brown		3.20	38	25.50			1.47
		3.40	45	30.00			1.69
		3.60	58	35.50			2.11
		3.80	56	35.50			2.04
		4.00	59	37.00			2.14
Sandy silt Medium, Brown		4.20	55	35.00			2.01
		4.40	64	39.50			2.30
		4.60	66	40.50			2.36
		4.80	72	43.50			2.56
		5.00	78	46.50			2.75
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					1.51

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-9/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	88	51.50			3.07
		5.40	81	48.00			2.84
		5.60	83	49.00			2.91
		5.80	83	49.00			2.91
		6.00	85	50.00			2.97
Sandy silt Dense, Brown		6.20	98	56.50			3.39
		6.40	101	58.00			3.48
		6.60	111	63.00			3.80
		6.80	115	65.00			3.93
		7.00	126	70.50			4.28
Sandy silt Dense, Brown		7.20	124	69.50			4.22
		7.40	125	70.00			4.25
		7.60	131	73.00			4.44
		7.80	129	72.00			4.38
		8.00	133	74.00			4.51
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.69

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-10/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Loose, Brown		0.20	9	12.00			0.54
		0.40	5	10.00			0.41
		0.60	42	28.50			1.69
		0.80	19	17.00			0.86
		1.00	19	17.00			0.86
Sandy silt Medium, Brown		1.20	45	30.00			1.69
		1.40	28	21.50			1.15
		1.60	20	17.50			0.89
		1.80	17	16.00			0.80
		2.00	33	24.00			1.31
Sandy silt Medium, Brown		2.20	36	25.50			1.40
		2.40	39	27.00			1.50
		2.60	44	29.50			1.66
		2.80	39	27.00			1.50
		3.00	40	27.50			1.53
Sandy silt Medium, Brown		3.20	42	28.50			1.60
		3.40	39	27.00			1.50
		3.60	35	25.00			1.37
		3.80	31	23.00			1.24
		4.00	25	20.00			1.05
Sandy silt Medium, Brown		4.20	26	20.50			1.08
		4.40	28	21.50			1.15
		4.60	66	40.50			2.36
		4.80	79	47.00			2.78
		5.00	74	44.50			2.62
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					1.38

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-10/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	75	45.00			2.65
		5.40	88	51.50			3.07
		5.60	86	50.50			3.00
		5.80	93	54.00			3.23
		6.00	94	54.50			3.26
		6.20	88	51.50			3.09
Sandy silt Dense, Brown		6.40	102	58.50			3.52
		6.60	108	61.50			3.71
		6.80	104	59.50			3.58
		7.00	106	60.50			3.64
		7.20	114	64.50			3.90
Sandy silt Dense, Brown		7.40	115	65.00			3.93
		7.60	129	72.00			4.38
		7.80	144	79.50			4.86
		8.00	153	84.00			5.15
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.68

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City
KPT-No: KPT-11/1
Date: 16, June, 2021
Coordinates N: E:
Method: DIN 4094 (Swedish Geotechnical Institute)
Ground Elv :

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Loose, Brown		0.20	9	12.00			0.54
		0.40	55	35.00			2.01
		0.60	40	27.50			1.53
		0.80	24	19.50			1.02
		1.00	17	16.00			0.80
Sandy silt Medium, Brown		1.20	23	19.00			0.99
		1.40	30	22.50			1.21
		1.60	37	26.00			1.44
		1.80	41	28.00			1.56
		2.00	35	25.00			1.37
Sandy silt Medium, Brown		2.20	47	31.00			1.76
		2.40	41	28.00			1.56
		2.60	39	27.00			1.50
		2.80	75	45.00			2.65
		3.00	44	29.50			1.66
Sandy silt Medium, Brown		3.20	36	25.50			1.40
		3.40	34	24.50			1.34
		3.60	35	25.00			1.37
		3.80	25	20.00			1.05
		4.00	26	20.50			1.08
Sandy silt Medium, Brown		4.20	30	22.50			1.21
		4.40	24	19.50			1.02
		4.60	64	39.50			2.30
		4.80	67	41.00			2.40
		5.00	64	39.50			2.30
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					1.48

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City
KPT-No: KPT-11/2
Date: 16, June, 2021
Coordinates N: E:
Method: DIN 4094 (Swedish Geotechnical Institute)
Ground Elv :

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	67	41.00			2.40
		5.40	68	41.50			2.43
		5.60	68	41.50			2.43
		5.80	71	43.00			2.52
		6.00	73	44.00			2.59
Sandy silt Medium, Brown		6.20	77	46.00			2.72
		6.40	79	47.00			2.78
		6.60	85	50.00			2.97
		6.80	84	49.50			2.94
		7.00	86	50.50			3.00
Sandy silt Dense, brown		7.20	98	56.50			3.39
		7.40	96	55.50			3.32
		7.60	111	63.00			3.80
		7.80	115	65.00			3.93
		8.00	115	65.00			3.93
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.01

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City
KPT-No: KPT-12/1
Date: 16, June, 2021
Coordinates N: E:
Method: DIN 4094 (Swedish Geotechnical Institute)
Ground Elv :

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Loose, Brown		0.20	20	17.50			0.89
		0.40	34	24.50			1.34
		0.60	35	25.00			1.37
		0.80	18	16.50			0.83
		1.00	7	11.00			0.48
Sandy silt Loose, Brown		1.20	8	11.50			0.51
		1.40	17	16.00			0.80
		1.60	22	18.50			0.96
		1.80	26	20.50			1.06
		2.00	37	25.00			1.44
Sandy silt Medium, Brown		2.20	52	33.50			1.92
		2.40	65	40.00			2.33
		2.60	60	37.50			2.17
		2.80	63	39.00			2.27
		3.00	40	27.50			1.53
Sandy silt Medium, Brown		3.20	35	25.00			1.37
		3.40	35	25.00			1.37
		3.60	41	28.00			1.56
		3.80	30	22.50			1.21
		4.00	35	25.00			1.37
Sandy silt Medium, Brown		4.20	39	27.00			1.50
		4.40	44	29.50			1.66
		4.60	44	29.50			1.56
		4.80	46	30.50			1.72
		5.00	54	34.50			1.98
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					1.41

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City
KPT-No: KPT-12/2
Date: 16, June, 2021
Coordinates N: E:
Method: DIN 4094 (Swedish Geotechnical Institute)
Ground Elv :

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium dense		5.20	56	36.50			2.04
		5.40	64	39.50			2.30
		5.60	64	39.50			2.30
		5.80	72	43.50			2.56
		6.00	83	49.00			2.91
Sandy silt Medium dense		6.20	86	50.00			2.97
		6.40	89	52.00			3.10
		6.60	85	50.00			2.97
		6.80	94	54.50			3.26
		7.00	96	55.50			3.32
Sandy silt Dense, Brown		7.20	98	56.50			3.39
		7.40	96	55.50			3.32
		7.60	102	58.50			3.52
		7.80	106	61.50			3.71
		8.00	104	59.50			3.58
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.02

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-13/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	17	16.00			0.80
		0.40	42	28.50			1.60
		0.60	12	13.50			0.64
		0.80	25	20.00			1.05
		1.00	28	21.50			1.15
Sandy silt Medium, Brown		1.20	42	28.50			1.60
		1.40	19	17.00			0.86
		1.60	35	25.00			1.37
		1.80	45	30.00			1.69
		2.00	38	25.50			1.47
Sandy silt Medium, Brown		2.20	50	32.50			1.85
		2.40	46	30.50			1.72
		2.60	36	25.50			1.40
		2.80	48	31.50			1.79
		3.00	48	31.50			1.79
Sandy silt Medium, Brown		3.20	51	33.00			1.88
		3.40	49	32.00			1.82
		3.60	47	31.00			1.76
		3.80	40	27.50			1.53
		4.00	39	27.00			1.50
Sandy silt Medium, Brown		4.20	32	23.50			1.28
		4.40	37	26.00			1.44
		4.60	34	24.50			1.34
		4.80	38	26.50			1.47
		5.00	39	27.00			1.50
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					1.45

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-13/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	65	40.00			2.33
		5.40	64	39.50			2.30
		5.60	68	41.50			2.43
		5.80	62	38.50			2.24
Sandy silt Medium, Brown		6.00	74	44.50			2.62
		6.20	75	45.00			2.65
		6.40	88	51.50			3.07
		6.60	84	49.50			2.94
		6.80	99	57.00			3.42
Sandy silt Dense, Brown		7.00	95	55.00			3.29
		7.20	98	56.50			3.39
		7.40	93	54.00			3.23
		7.60	108	61.50			3.71
		7.80	107	61.00			3.68
		8.00	108	61.50			3.71
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.00

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-14/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	30	22.50			1.21
		0.40	24	19.50			1.02
		0.60	18	16.50			0.83
		0.80	60	37.50			2.17
		1.00	66	40.50			2.36
Sandy silt Medium, Brown		1.20	60	37.50			2.17
		1.40	40	27.50			1.53
		1.60	36	25.50			1.40
		1.80	54	34.50			1.98
		2.00	30	22.50			1.21
Sandy silt Medium, Brown		2.20	63	39.00			2.27
		2.40	39	27.00			1.50
		2.60	39	27.00			1.50
		2.80	39	27.00			1.50
		3.00	59	37.00			2.14
Sandy silt Medium, Brown		3.20	64	39.50			2.30
		3.40	70	42.50			2.49
		3.60	68	41.50			2.43
		3.80	64	39.50			2.30
		4.00	74	44.50			2.62
Sandy silt Medium, Brown		4.20	76	45.50			2.68
		4.40	66	40.50			2.36
		4.60	71	43.00			2.52
		4.80	75	45.00			2.65
		5.00	76	45.50			2.68
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					1.99

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-14/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	78	46.50			2.25
		5.40	81	48.00			2.84
		5.60	85	50.00			2.97
		5.80	96	55.50			3.32
		6.00	97	56.00			3.36
Sandy silt Dense, Brown		6.20	111	63.00			3.90
		6.40	108	61.50			3.71
		6.60	108	61.50			3.71
		6.80	104	59.50			3.58
		7.00	106	60.50			3.64
Sandy silt Dense, Brown		7.20	103	59.00			3.55
		7.40	105	60.00			3.61
		7.60	105	60.00			3.61
		7.80	107	61.00			3.68
		8.00	103	59.00			3.55
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.45

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-15/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	27	21.00			1.12
		0.40	30	22.50			1.21
		0.60	54	34.50			1.98
		0.80	43	29.00			1.63
		1.00	34	24.50			1.34
Sandy silt Medium, Brown		1.20	46	30.50			1.72
		1.40	45	30.00			1.69
		1.60	69	42.00			2.46
		1.80	66	40.50			2.36
		2.00	42	28.50			1.60
Sandy silt Medium, Brown		2.20	54	34.50			1.98
		2.40	60	37.50			2.17
		2.60	51	33.00			1.88
		2.80	72	43.50			2.48
		3.00	50	32.50			1.85
Sandy silt Medium, Brown		3.20	56	35.50			2.04
		3.40	70	42.50			2.49
		3.60	74	44.50			2.62
		3.80	76	45.50			2.68
		4.00	80	47.50			2.81
Sandy silt Medium, Brown		4.20	76	45.50			2.68
		4.40	66	40.50			2.36
		4.60	60	37.50			2.17
		4.80	42	28.50			1.60
		5.00	46	30.50			1.72
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.03

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-15/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	58	35.50			2.11
		5.40	71	43.00			2.52
		5.60	77	46.00			2.72
		5.80	90	52.50			3.13
		6.00	94	54.50			3.25
Sandy silt Dense, Brown		6.20	105	60.00			3.61
		6.40	102	58.50			3.52
		6.60	105	62.00			3.74
		6.80	115	65.00			3.93
		7.00	114	64.50			3.90
Sandy silt Dense, Brown		7.20	114	64.50			3.90
		7.40	116	65.50			3.96
		7.60	114	64.50			3.90
		7.80	114	64.50			3.90
		8.00	115	65.00			3.93
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.47

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-16/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	27	21.00			1.12
		0.40	30	22.50			1.21
		0.60	18	16.50			0.83
		0.80	21	18.00			0.92
		1.00	34	24.50			1.34
Sandy silt Medium, Brown		1.20	26	20.50			1.08
		1.40	25	20.00			1.05
		1.60	23	19.00			0.99
		1.80	30	22.50			1.21
		2.00	36	25.50			1.40
Sandy silt Medium, Brown		2.20	44	29.50			1.66
		2.40	48	31.50			1.79
		2.60	58	36.50			2.11
		2.80	105	60.00			3.61
		3.00	103	59.00			3.55
Sandy silt Dense, Brown		3.20	111	63.00			3.80
		3.40	115	65.00			3.93
		3.60	112	63.50			3.84
		3.80	108	61.50			3.71
		4.00	109	62.00			3.74
Sandy silt Dense, Brown		4.20	116	65.50			3.96
		4.40	114	64.50			3.90
		4.60	116	65.50			3.96
		4.80	113	64.00			3.87
		5.00	117	66.00			4.00
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.50

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-16/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	116	65.50			3.96
		5.40	121	68.00			4.12
		5.60	116	65.50			3.96
		5.80	122	68.50			4.16
		6.00	124	69.50			4.22
Sandy silt Dense, Brown		6.20	126	70.00			4.25
		6.40	129	72.00			4.38
		6.60	129	72.00			4.38
		6.80	128	71.50			4.35
		7.00	129	72.00			4.38
Sandy silt Dense, Brown		7.20	131	73.00			4.44
		7.40	133	74.00			4.51
		7.60	134	74.50			4.54
		7.80	137	76.00			4.64
		8.00	143	79.00			4.83
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					4.34

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-17/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm 0 20 40 60 80 100 120 140 160	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	6	10.50			0.44
		0.40	12	13.50			0.64
		0.60	25	20.00			1.05
		0.80	66	40.50			2.36
		1.00	74	44.50			2.62
Sandy silt Medium, Brown		1.20	56	35.50			2.04
		1.40	68	39.50			2.11
		1.60	62	38.50			2.24
		1.80	75	45.00			2.65
		2.00	74	44.50			2.62
Sandy silt Medium, Brown		2.20	74	44.50			2.62
		2.40	78	46.50			2.75
		2.60	82	48.50			2.88
		2.80	88	51.50			3.07
		3.00	94	54.50			3.26
Sandy silt Dense, Brown		3.20	91	53.00			3.16
		3.40	95	55.00			3.29
		3.60	99	57.00			3.42
		3.80	94	54.50			3.26
		4.00	93	54.00			3.23
Sandy silt Dense, Brown		4.20	98	56.50			3.39
		4.40	107	61.00			3.68
		4.60	103	59.00			3.55
		4.80	105	60.00			3.61
		5.00	111	63.00			3.80
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.71

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-17/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm 0 20 40 60 80 100 120 140 160	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	115	65.00			3.93
		5.40	118	66.50			4.03
		5.60	119	67.00			4.06
		5.80	124	69.50			4.22
		6.00	126	70.50			4.28
Sandy silt Dense, Brown		6.20	131	73.00			4.44
		6.40	128	71.50			4.35
		6.60	132	73.50			4.48
		6.80	125	70.00			4.26
		7.00	127	71.00			4.32
Sandy silt Dense, Brown		7.20	136	75.00			4.57
		7.40	139	77.00			4.70
		7.60	141	78.00			4.76
		7.80	155	85.00			5.21
		8.00	154	84.50			5.18
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					4.45

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-18/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm 0 20 40 60 80 100 120 140 160	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	7	11.00			0.48
		0.40	6	10.50			0.44
		0.60	41	28.00			1.56
		0.80	35	25.00			1.37
		1.00	52	33.50			1.92
Sandy silt Dense, Brown		1.20	90	52.50			3.13
		1.40	116	65.50			3.96
		1.60	105	60.00			3.61
		1.80	92	53.50			3.20
		2.00	95	55.00			3.29
Sandy silt Dense, Brown		2.20	96	55.50			3.32
		2.40	95	55.00			3.29
		2.60	100	57.50			3.45
		2.80	105	60.00			3.61
		3.00	104	59.50			3.58
Sandy silt Dense, Brown		3.20	101	58.00			3.48
		3.40	113	64.00			3.87
		3.60	111	63.00			3.80
		3.80	102	58.50			3.52
		4.00	105	60.00			3.61
Sandy silt Dense, Brown		4.20	104	59.50			3.58
		4.40	109	62.00			3.74
		4.60	112	63.50			3.84
		4.80	117	66.00			4.00
		5.00	113	64.00			3.87
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					3.10

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-18/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm 0 20 40 60 80 100 120 140 160	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	112	63.50			3.84
		5.40	111	63.00			3.80
		5.60	118	66.50			4.03
		5.80	122	68.50			4.16
		6.00	121	68.00			4.12
Sandy silt Dense, Brown		6.20	126	70.50			4.25
		6.40	124	69.50			4.22
		6.60	125	70.00			4.25
		6.80	126	72.00			4.36
		7.00	133	74.00			4.51
Sandy silt Dense, Brown		7.20	132	73.50			4.48
		7.40	134	74.50			4.54
		7.60	133	74.00			4.51
		7.80	146	80.50			4.92
		8.00	160	87.50			5.37
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					4.36

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-19/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Loose, Brown		0.20	10	12.50			0.57
		0.40	29	22.00			1.18
		0.60	12	13.50			0.64
		0.80	34	24.50			1.34
		1.00	29	22.00			1.18
Sandy silt Medium, Brown		1.20	26	20.50			1.08
		1.40	27	21.00			1.12
		1.60	31	23.00			1.24
		1.80	28	21.50			1.15
		2.00	41	28.00			1.56
Sandy silt Medium, Brown		2.20	45	30.00			1.69
		2.40	70	42.50			2.49
		2.60	47	31.00			1.76
		2.80	72	43.50			2.56
		3.00	60	37.50			2.17
Sandy silt Medium, Brown		3.20	48	31.50			1.79
		3.40	63	39.00			2.27
		3.60	52	33.50			1.92
		3.80	55	35.00			2.01
		4.00	47	31.00			1.76
Sandy silt Medium, Brown		4.20	44	29.50			1.66
		4.40	38	26.50			1.47
		4.60	67	41.00			2.40
		4.80	64	39.50			2.30
		5.00	72	43.50			2.56
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					1.57

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-19/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Dense, Brown		5.20	84	49.50			2.94
		5.40	82	48.50			2.88
		5.60	88	51.50			3.07
		5.80	91	53.00			3.16
		6.00	94	54.50			3.26
		6.20	92	53.50			3.20
		6.40	99	57.00			3.42
		6.60	95	55.00			3.29
		6.80	111	63.00			3.80
		7.00	104	59.50			3.58
		7.20	114	64.50			3.90
		7.40	116	65.50			3.96
		7.60	118	66.50			4.03
		7.80	116	65.50			3.96
		8.00	133	74.00			4.51
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.53

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-20/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	26	20.50			1.08
		0.40	23	19.00			0.99
		0.60	27	21.00			1.12
		0.80	32	23.50			1.26
		1.00	27	21.00			1.12
Sandy silt Medium, Brown		1.20	30	22.50			1.21
		1.40	26	20.50			1.08
		1.60	23	19.00			0.99
		1.80	38	26.50			1.47
		2.00	28	21.50			1.15
Sandy silt Medium, Brown		2.20	35	25.00			1.37
		2.40	38	26.50			1.47
		2.60	44	29.50			1.66
		2.80	50	32.50			1.85
		3.00	72	43.50			2.56
Sandy silt Medium, Brown		3.20	63	39.00			2.27
		3.40	67	41.00			2.40
		3.60	67	41.00			2.40
		3.80	55	35.00			2.01
		4.00	45	30.00			1.69
Sandy silt Medium, Brown		4.20	39	27.00			1.50
		4.40	29	22.00			1.18
		4.60	35	25.00			1.37
		4.80	34	24.50			1.34
		5.00	64	39.50			2.30
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					1.55

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-20/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :

Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	66	46.50			2.36
		5.40	68	41.50			2.43
		5.60	71	43.00			2.52
		5.80	75	45.00			2.65
		6.00	79	47.00			2.78
		6.20	86	63.60			3.13
Sandy silt Dense, Brown		6.40	95	55.00			3.29
		6.60	99	57.00			3.42
		6.80	106	62.00			3.74
		7.00	102	58.50			3.52
		7.20	107	61.00			3.68
Sandy silt Dense, Brown		7.40	113	64.00			3.87
		7.60	118	66.50			4.03
		7.80	118	66.50			4.03
		8.00	119	67.00			4.06
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.30

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-21/1
Date: 13, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	13	14.00			0.67
		0.40	15	15.00			0.73
		0.60	42	26.50			1.60
		0.80	60	37.50			2.17
		1.00	75	45.00			2.65
Sandy silt Medium, Brown		1.20	35	25.50			1.40
		1.40	29	22.00			1.18
		1.60	39	26.50			1.47
		1.80	31	23.00			1.24
		2.00	62	38.50			2.24
Sandy silt Medium, Brown		2.20	60	37.50			2.17
		2.40	39	27.00			1.50
		2.60	32	23.50			1.28
		2.80	62	38.50			2.24
		3.00	47	31.00			1.76
Sandy silt Medium, Brown		3.20	39	27.00			1.50
		3.40	48	31.50			1.79
		3.60	48	31.50			1.79
		3.80	45	30.00			1.69
		4.00	44	29.50			1.66
Sandy silt Medium, Brown		4.20	43	28.00			1.63
		4.40	32	23.50			1.28
		4.60	45	30.00			1.69
		4.80	44	29.50			1.66
		5.00	58	36.50			2.11
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					1.64

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-21/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	66	40.50			2.36
		5.40	68	41.50			2.43
		5.60	77	46.00			2.72
		5.80	84	49.50			2.94
		6.00	88	51.50			3.07
Sandy silt Medium, Brown		6.20	91	53.00			3.16
		6.40	94	54.50			3.26
		6.60	92	53.50			3.20
		6.80	104	58.50			3.58
		7.00	105	60.00			3.61
Sandy silt Dense, Brown		7.20	107	61.00			3.68
		7.40	111	63.00			3.80
		7.60	111	63.00			3.80
		7.80	109	62.00			3.74
		8.00	112	63.50			3.84
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.60					3.28

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-22/1
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Loose, Brown		0.20	10	12.50			0.57
		0.40	6	10.50			0.44
		0.60	5	10.00			0.41
		0.80	20	17.50			0.89
		1.00	30	22.50			1.21
Sandy silt Medium, Brown		1.20	24	19.50			1.02
		1.40	27	21.00			1.12
		1.60	36	25.50			1.40
		1.80	71	43.00			2.52
		2.00	73	44.00			2.59
Sandy silt Medium, Brown		2.20	73	44.00			2.59
		2.40	77	46.00			2.72
		2.60	73	44.00			2.59
		2.80	71	43.00			2.52
		3.00	70	42.50			2.49
Sandy silt Medium, Brown		3.20	76	45.50			2.68
		3.40	70	42.50			2.49
		3.60	74	44.50			2.62
		3.80	76	45.50			2.68
		4.00	74	44.50			2.62
Sandy silt Medium, Brown		4.20	76	45.50			2.68
		4.40	76	45.50			2.68
		4.60	80	47.50			2.81
		4.80	72	43.50			2.56
		5.00	76	45.50			2.68
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.06

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-22/2
Date: 16, June, 2021
Coordinates N: E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	89	52.00			3.50
		5.40	91	53.00			3.16
		5.60	87	51.00			3.04
		5.80	93	54.00			3.23
		6.00	92	53.50			3.20
Sandy silt Dense, Brown		6.20	101	58.00			3.50
		6.40	104	59.50			3.58
		6.60	106	61.50			3.71
		6.80	105	60.00			3.61
		7.00	105	60.00			3.61
Sandy silt Dense, Brown		7.20	104	58.50			3.58
		7.40	106	60.50			3.64
		7.60	114	64.50			3.90
		7.80	107	61.00			3.68
		8.00	108	61.50			3.71
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.48

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capital City

KPT-No: KPT-23/1
Date: 16, June, 2021
Coordinates N : E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		0.20	71	43.00			2.52
		0.40	93	54.00			3.23
		0.60	71	43.00			2.52
		0.80	45	30.00			1.69
		1.00	51	33.00			1.88
Sandy silt Medium, Brown		1.20	66	40.50			2.36
		1.40	100	57.50			3.45
		1.60	61	38.00			2.20
		1.80	50	32.50			1.85
		2.00	42	28.50			1.60
Sandy silt Medium, Brown		2.20	38	28.50			1.47
		2.40	37	25.00			1.44
		2.60	43	29.00			1.63
		2.80	45	30.00			1.69
		3.00	43	29.00			1.63
Sandy silt Medium, Brown		3.20	60	37.50			2.17
		3.40	65	40.00			2.33
		3.60	67	41.00			2.40
		3.80	66	40.50			2.36
		4.00	70	42.50			2.49
Sandy silt Medium, Brown		4.20	86	50.50			3.00
		4.40	88	51.50			3.07
		4.60	86	50.50			3.00
		4.80	82	48.50			2.88
		5.00	73	44.00			2.59
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
0.00		5.00					2.30

Kunzelstab Penetration Test

Project : Faculty of Engineering campus of National University of Laos (FEN-NUOL campus)
Submitted by : Namsok Survey-Design and Construction Co., Ltd
Location : Sok pa luang Village, Sisatanak District, Vientiane Capitol City

KPT-No: KPT-23/2
Date: 16, June, 2021
Coordinates N : E:
Ground Elv :
Method: DIN 4094 (Swedish Geotechnical Institute)

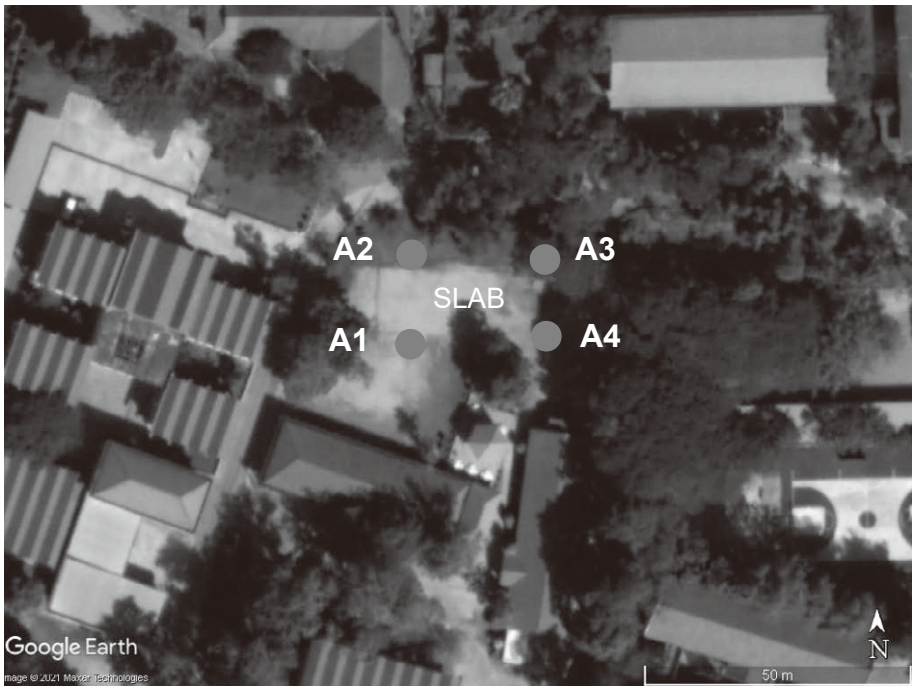
Description of Soil	Symbol	Depth (m)	Blow/20 Cm N	Blow/20 Cm N'	Blow per 20 cm (0 20 40 60 80 100 120 140 160)	Ultimate Bearing Capacity for Clay,Qu (Kg/cm²)	Ultimate Bearing Capacity for Sand, Qu (Kg/cm²)
Sandy silt Medium, Brown		5.20	79	47.00			2.78
		5.40	90	52.50			3.13
		5.60	85	50.00			2.97
		5.80	90	52.50			3.13
		6.00	96	55.50			3.32
Sandy silt Dense, Brown		6.20	95	55.00			3.29
		6.40	99	57.00			3.42
		6.60	99	57.00			3.42
		6.80	94	54.50			3.26
		7.00	98	56.50			3.39
Sandy silt Dense, Brown		7.20	94	54.50			3.26
		7.40	94	54.50			3.26
		7.60	124	69.50			4.22
		7.80	128	71.50			4.35
		8.00	135	75.00			4.57
		8.20					
		8.40					
		8.60					
		8.80					
		9.00					
		9.20					
		9.40					
		9.60					
		9.80					
		10.00					
From Depth		To Depth				Average Allowable Ultimate Bearing Capacity for Clay	Average Allowable Ultimate Bearing Capacity for Sand
5.20		8.00					3.45

5-3. Outcome of Underground Structure Survey

UNDERGROUND STRUCTURE SURVEY

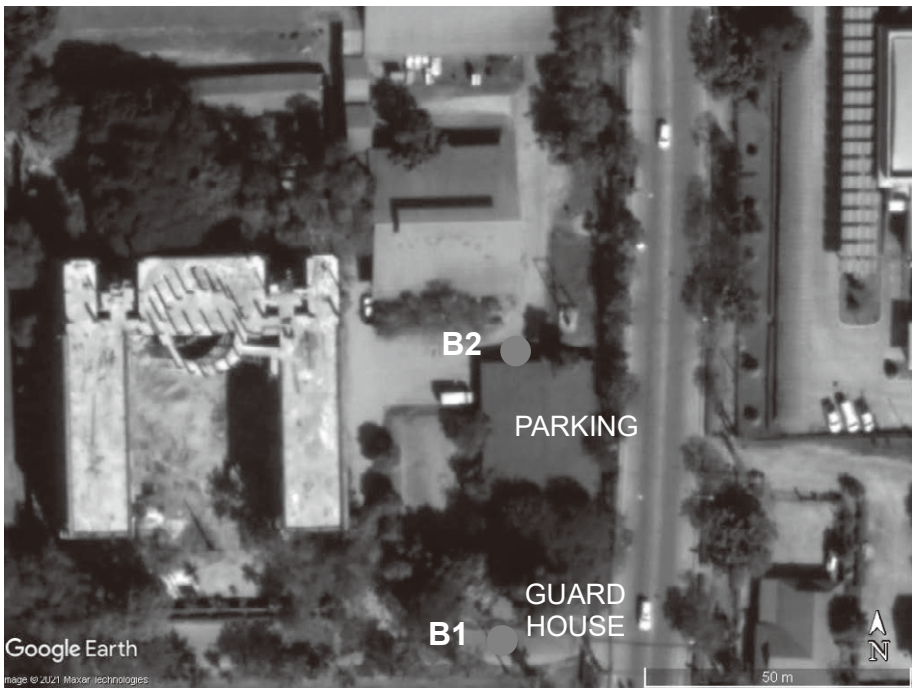
SURVEY LOCATIONS

Test Area: Area A, B and C

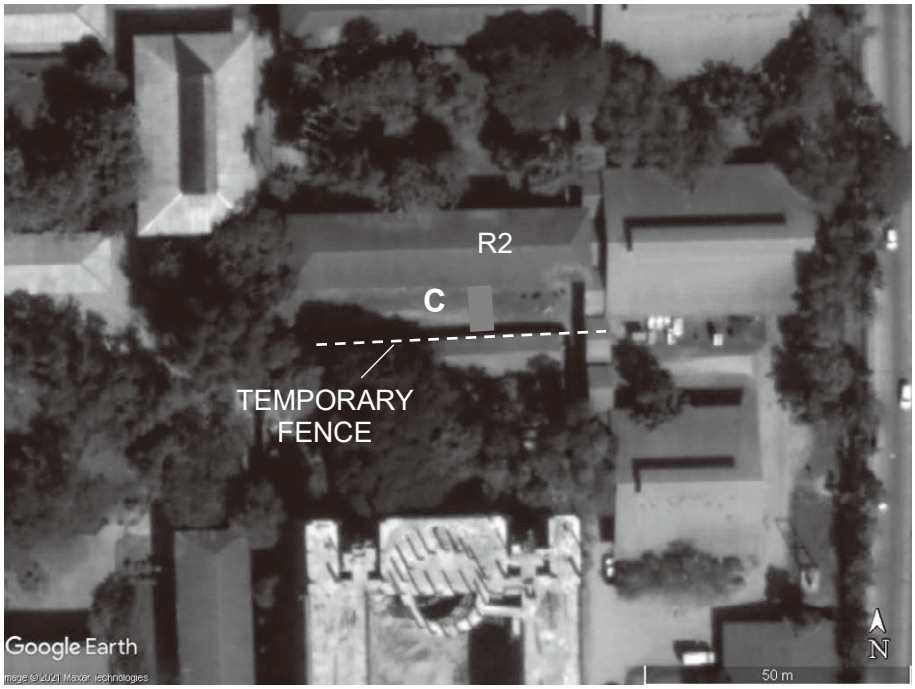


Area-A : ● 4 points (4 corners of the existing concrete slab)

Depth of Trial Digging: 1.0m deep each



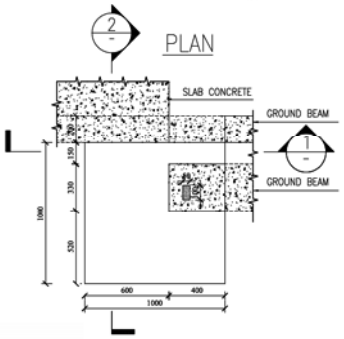
Area-B : ● **2 points**
(1 corner of the existing guard house and 1 corner of the existing bike parking)
Depth of Trial Digging: 1.0m deep each



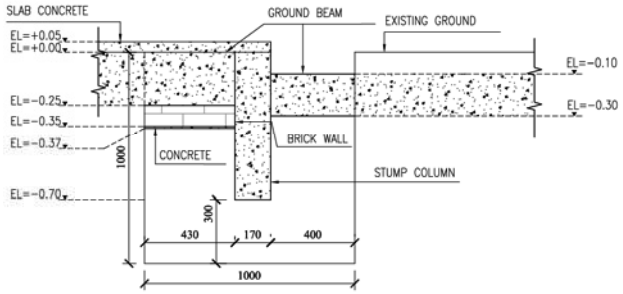
Area-C : Location: ■ **1 point**
(1m x 12m =12m2 between R2 building and temporary fence)
Depth of Trial Digging: 0.5m deep

INSTALL TEMPORARY FENCE

UNDERGROUND STRUCTURE SURVEY No.A1



SECTION 1



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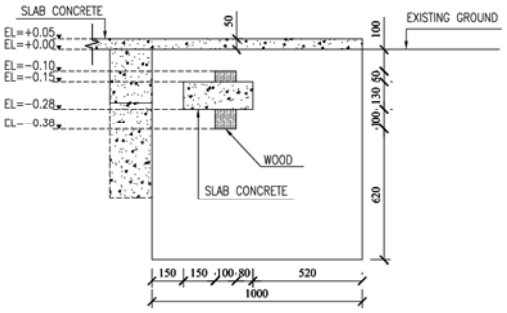
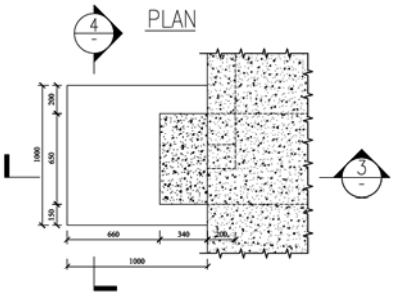


NAMSOK SURVEY - DESIGN AND CONSTRUCTION CO.,LTD Tanmixay Village, Xaythany District Vientiane Capital Lao PDR Tel: (+856-20) 58889655 / 56088000 Email: namsok.sdc@gmail.com	LABORATORY UNDERGROUND STRUCTURE SURVEY	Name	Signature	Code: NS-0015/21
		Drawn by: Khamphone BOUAKEOMALA		Scale: —
	A1	Check by: Xaimisouk SOUDTHIVONG		Date: 10/05/2021
				Sheet No - A-003

INSTALL TEMPORARY FENCE

UNDERGROUND STRUCTURE SURVEY No.A1



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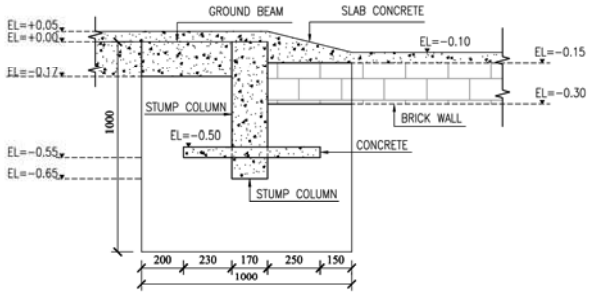
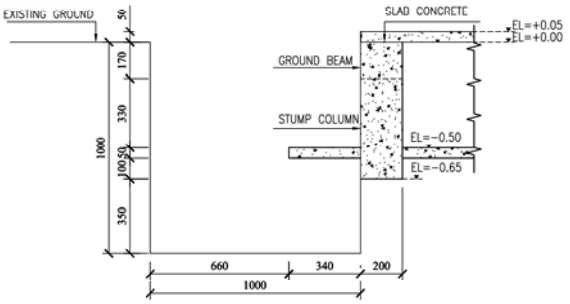


SECTION 3



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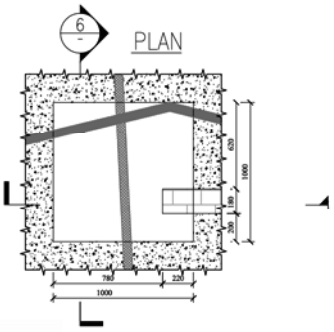
		Drawn by: Khamphone BOUAKEOMALA		Scale: —
	A2	Check by: Xaimisouk SOUDTHIVONG		Date: 10/05/2021
				Sheet No - A-004

INSTALL TEMPORARY FENCE

UNDERGROUND STRUCTURE SURVEY No.A1



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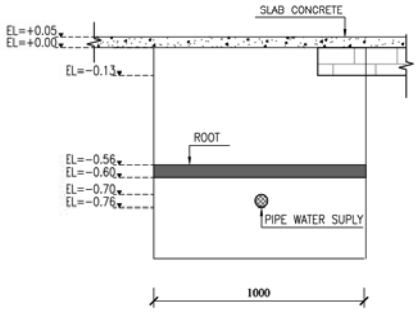

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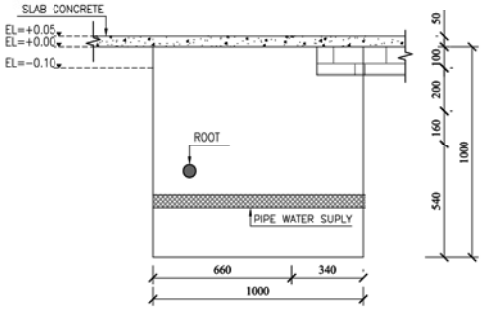

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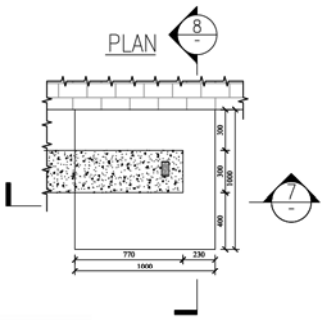
		Drawn by:	Khamphone BOUAKEOMALA		Scale: —
	A3	Check by:	Xaimisouk SOUDTHIVONG		Date: 10/05/2021
					Sheet No - A-005

INSTALL TEMPORARY FENCE

UNDERGROUND STRUCTURE SURVEY No.A1



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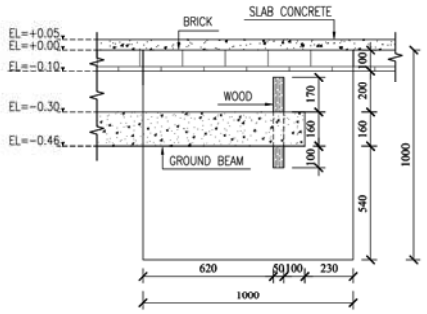

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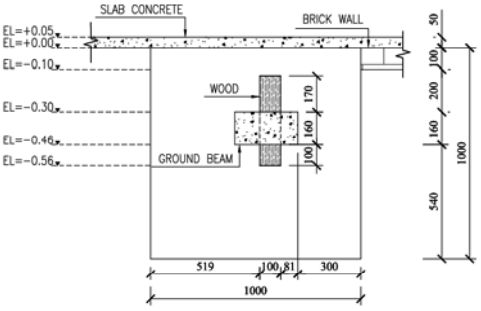

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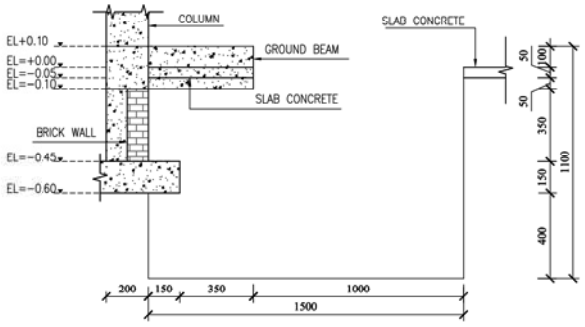
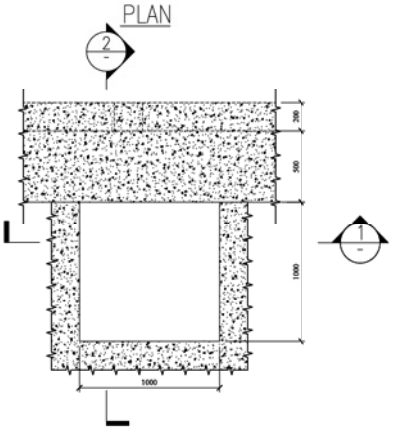
		Drawn by:	Khamphone BOUAKEOMALA		Scale: —
	A4	Check by:	Xaimisouk SOUDTHIVONG		Date: 10/05/2021
					Sheet No - A-006

INSTALL TEMPORARY FENCE

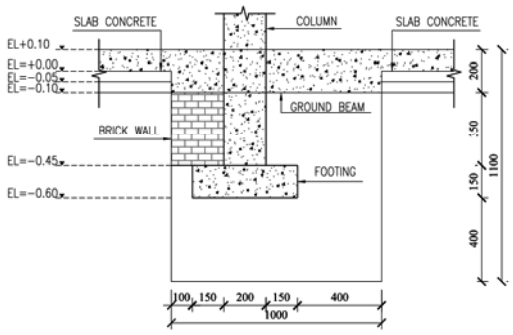
UNDERGROUND STRUCTURE SURVEY No.B2



PLAN



SECTION 1



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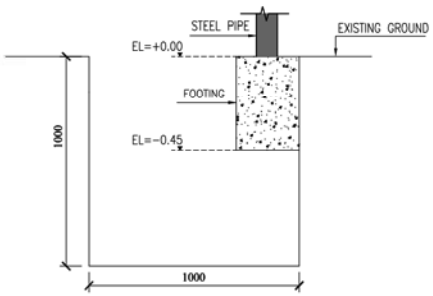
		Drawn by: Khamphone BOUAKEOMALA		Scale: —
	B1	Check by: Xaimisouk SOUDTHIVONG		Date: 24/05/2021
				Sheet No - B-003

INSTALL TEMPORARY FENCE

UNDERGROUND STRUCTURE SURVEY No.B2

SECTION 4



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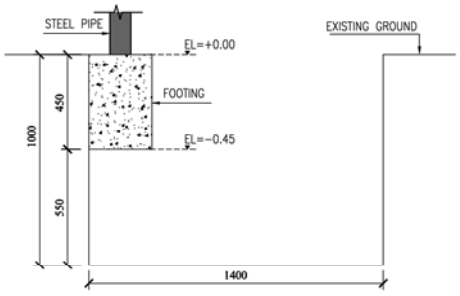
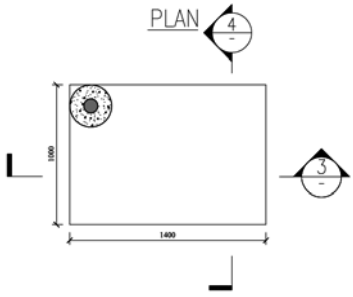


PLAN



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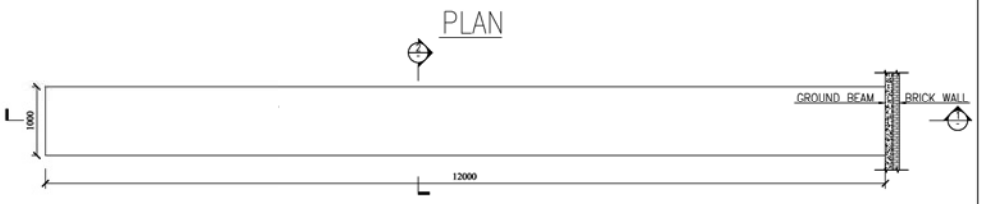
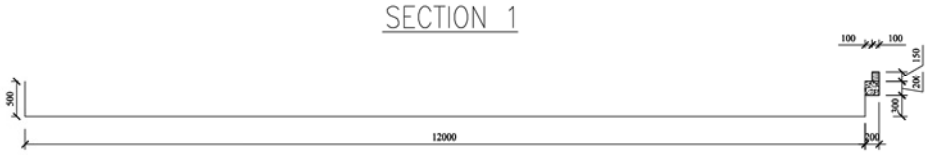
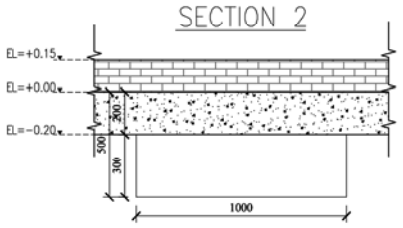
		Drawn by: Khamphone BOUAKEOMALA		Scale: —
	B2	Check by: Xaimisouk SOUDTHIVONG		Date: 24/05/2021
				Sheet No - B-004

INSTALL TEMPORARY FENCE

UNDERGROUND STRUCTURE SURVEY No.C







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		Drawn by:	Khamphone BOUAKEOMALA		Scale: —
	C	Check by:	Xaimisouk SOUDTHIVONG		Date: 24/05/2021
					Sheet No - C-003