

**ARCHITECTURAL DESIGN METHOD OF THE KING MONGKUT'S
INSTITUTE OF TECHNOLOGY LADKRABANG'S
FIRST AUDITORIUM COMPLEX (1974)**



**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENT FOR THE DEGREE OF
MASTER OF ARCHITECTURE PROGRAM IN INTERIOR ARCHITECTURE
FACULTY OF ARCHITECTURE
KING MONKUT'S INSTITUTE OF TECHNOLOGY LADKRABANG
2021**

KMITL-2021-AR-M-003-019

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Thesis	Architectural Design Method of the King Mongkut's Institute of Technology Ladkrabang's First Auditorium Complex (1974)
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Program	Interior Architecture
Year	2021
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ABSTRACT

This research study examines the King Mongkut's Institute of Technology Ladkrabang (KMITL) first auditorium complex. The construction of this auditorium complex was funded by the Japanese government, designed by *Kume Architects-Engineers*, and was completed in 1974 also by the Japanese construction company, *Takenaka Corporation*. The main research questions seek to inquire 1) environmental factors, influencing the design of the KMITL first auditorium complex, 2) design techniques *Kume Architects-Engineers* used in the design of the first auditorium complex in response to the environmental factors, as well as to 3) whether these aforementioned techniques are unique to this project or related to the other work of *Kume Architects-Engineers* in Thailand built during the time period. Qualitative paradigm is main approach of research method. The main data sources include archival records, the architectural drawings, data from field research, including direct observation and artifactual measurement, with supplementary the interview with KMITL executives and personnel. The results indicate that external factors affecting the first auditorium complex design included the location, which covers the soft, muddy ground that prone to flooding during the south-east monsoons, high humidity, and strong heat from sun radiation of the tropical climate. With these considerations in mind, *Kume Architect-Engineer* solved the problems by creating architecture that responsive to the climate and environmental constraints such as orienting the building toward east-west axis, placing, windows on south and north to obtain natural ventilation with efficient shading design, and ingenious detail design of the wall to reduce humidity retention while providing heat insulation. It is found that design elements such as double roof layers, extended use of eaves and shading, internal court, grid and module system were common, using of local building materials were the common features across the *Kume Architects-Engineers* projects between the 1970s – 1980s in Thailand.

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ACKNOWLEDGEMENTS

I would like to thank to my academic and thesis advisor, Associate professor Toru IRIE, for providing guidance and feedback throughout this project. Thanks also to Associate professor Piyarat Nanta. for working with me, and for her support, encouragement, and patience. Without her guidance and persistent help, this research study would not have been possible.

To Professor Nubuyuki OGURA and Associate professor Haruno KINJO for the kindness and valuable advice.

I am also deeply grateful to Ms. Rin NAKAGAWA along with all friends in Associate professor IRIE's lab. Their helps have made my time in Okinawa joyful, and filled with great experience.

I would also like to thank my committee members of the University of the Ryukyu and King Mongkut Institute of Technology Ladkrabang for their invaluable comments and suggestions. Lastly, I would like to thank my family for supporting and everything.

Vorrakan Pienroj

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CHAPTER 1

INTRODUCTION

The main goal of this study is to examine *Kume Architects-Engineers* design methods including the environmental factors influencing the architectural design as well as the ingenuity of the Japanese architect in the design of the King Mongkut's Institute of Technology Ladkrabang first auditorium complex in the tropical country such as Thailand. As a complementary to the main investigation, this research seeks to understand whether there are design signature common characteristics across the six case studies and the first auditorium complex.

The structure of this thesis is composed of five parts. The first chapter is the introduction which will provide an overview of this research including research background, rationale, objectives of the study, definition of terms, and the diagram of research study process. The next part, Chapter Two, presents and analyze six case studies of *Kume Architects-Engineers*' design works of public buildings in Thailand during the early 1970s to the late 1980s through field survey and the Japan International Cooperation Agency (JICA) records. Then, the case study research design employing mixed data collecting methods is described in Chapter Three. Chapter Four, the main thesis of this study, illustrates the background, the socio-cultural context of Thailand during the conception of the KMITL first auditorium complex project in the 1970s as well as the environmental factors influencing the first auditorium complex architectural design, the specific and uniqueness of the design element of the projects. The report is concluded by discussing and comparing architectural characteristics and environmental constraints, which constitute the design considerations of the first auditorium complex projects against the six cases to reveal whether there are design signature common characteristics across the work of *Kume Architects-Engineers* in Thailand during the aforementioned period.

1.1 Background

Between the 1970s-1980s, the Japanese government provided financial aids and cooperation to help propelling the growth of developing countries including Thailand

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to help produce highly skill and knowledgeable workforce with the aim to drive the country from the existing agrarian to industrial base economy, to overcoming the poverty, and contribute to the country increase Gross Domestic Income (GDP), to move toward the goal of being a developed nation. Necessary to the production of these new workforces, were education and training facilities. As such, through JICA, the construction of several educational and training facilities across Thailand were commenced during the 1970s-1980s. These include the King Mongkut's Institute of Technology Ladkrabang (KMITL)'s first auditorium complex project (1974), the Asian Institute of Technology (AIT) Library (1974), Central Laboratory Facilities at Kasetsart University's Kamphaengsaen Campus (1978), The Youth Welfare Center (1979), the Ministry of Commerce's Trade Training Center (1982), King Mongkut's Institute of Technology Ladkrabang's Lecture Room Building Complex (1983), and The Establishment of the Environmental Research and Training Center (1989).

The establishment of King Mongkut's Institute of Technology Ladkrabang (KMITL) was possible through the Japanese aids in both the financial support and human resources development aspects. In 1971, after KMITL was relocated from the campus in Nonthaburi Province to Ladkrabang District, Bangkok, the Japanese government offered to assist in the construction of the facilities within the new campus, by providing a total of 953.2 million yen.

According to Araki (2016), the first installment of 163.2 million yen was granted in 1971, at the outset of KMITL campus construction, which covered the construction of a laboratory, gymnasium, first auditorium. The second installation of 790 million yen were granted in 1974 at the completion year of the first auditorium complex and other training facilities, including the deficit from the first part (due to the depreciation of the Japanese yen currency) and the purchase of experimental equipment to be installed in the laboratory.

Central to this research is the King Mongkut's Institute of Technology Ladkrabang (KMITL)'s first auditorium complex designed by *Kume Architects-Engineers*, and built and completed also by Japanese construction company *Takenaka Corporation* in 1974. Although KMITL currently has two auditoriums, the first auditorium that was funded by the Japanese government and designed by Japanese architectural firm is still considered an outstanding example of architecture and construction technology. Unfortunately, none of systematic document, such as JICA

report or other research investigation on the design process of architectural design features of this building has been found.

In this light, this research study aims at examining the factors influencing the architectural design, and the specific and unique architectural design features of the KMITL first auditorium complex that was built in 1974. It should also be noted that the word ‘first auditorium complex’ throughout this study will refer to the first auditorium, memorial hall and library project of King Mongkut’s Institute of Technology Ladkrabang unless otherwise noted.

1.2 Rationale

Both traditional and contemporary Japanese architectures have been known for the aesthetic quality as well as the unique design approaches, and have become inspiration for architects and designers all over the world. Unsurprisingly, numbers of research studies been dedicated to investigate the design process and factors influencing Japanese architectural design.

The works of Japanese architects have not been limited within the boundary of the temperate climate of Japan, but have been spread all over the world by either the direct commissions or went hand in hand with the financial aids from the Japanese government. However, the one of the most interesting aspects of the Japanese architecture abroad is not only about the aesthetic dimension of the design, but also on the ingenuity of the architects. As such, the design methods as well as the conditions influencing the design of Japanese architecture abroad, and—especially the originality of the design solutions, the architects implemented to meet the specific condition suitable for the needs of occupants of other regions.

Similarly, the KMITL first auditorium complex by *Kume Architects-Engineers*, should deserves the attention of architectural researcher (Fig. 1.1). There is a large difference in temperature, precipitation, and humidity between Japan and Thailand's environment. Thus, how the architects implemented and adapt the knowledge base from temperate zone of Japan to fits the constraints of local milieu and people merit special interests in architectural history, building design as well as environmental technology.

The KMITL first auditorium complex has been considered the old time-honored architecture constructed in the first period of the establishment of KMITL, and has been

regarded as one of the iconic buildings on the campus. It had even been used as many movies and music video sets during 1990s, and has been used as an inspiration to set design scheme for the later building designs around the campus. Recently, to serve to the contemporary needs of its users, KMITL has enacted series of renovation projects that might alter the original design, and structure of the first auditorium complex. Therefore, it is important to systematically study and examine the design techniques of this architecture before the original building and its design has been lost.



Fig. 1.1 The KMITL first auditorium complex
(Source: the author)

This study will increase knowledge of architecture for both academics and students likewise. It will help local, This especially to understand Japanese architects' ingenious design solutions as well as serving to supplement of the historical information related to the establishment of King Mongkut's Institute of Technology Ladkrabang.

1.3 Research Questions

1. What were environmental factors, specific to the tropical zone of Thailand, influencing the 1974 KMITL first auditorium complex design?
2. What were the design techniques that *Kume Architects-Engineers* implemented the 1974 KMITL first auditorium complex?
3. Were the techniques used in the 1974 KMITL first auditorium complex design unique to this project or related to the other work of *Kume Architects-Engineers* in Thailand of the same period?

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1.4 Research Objective

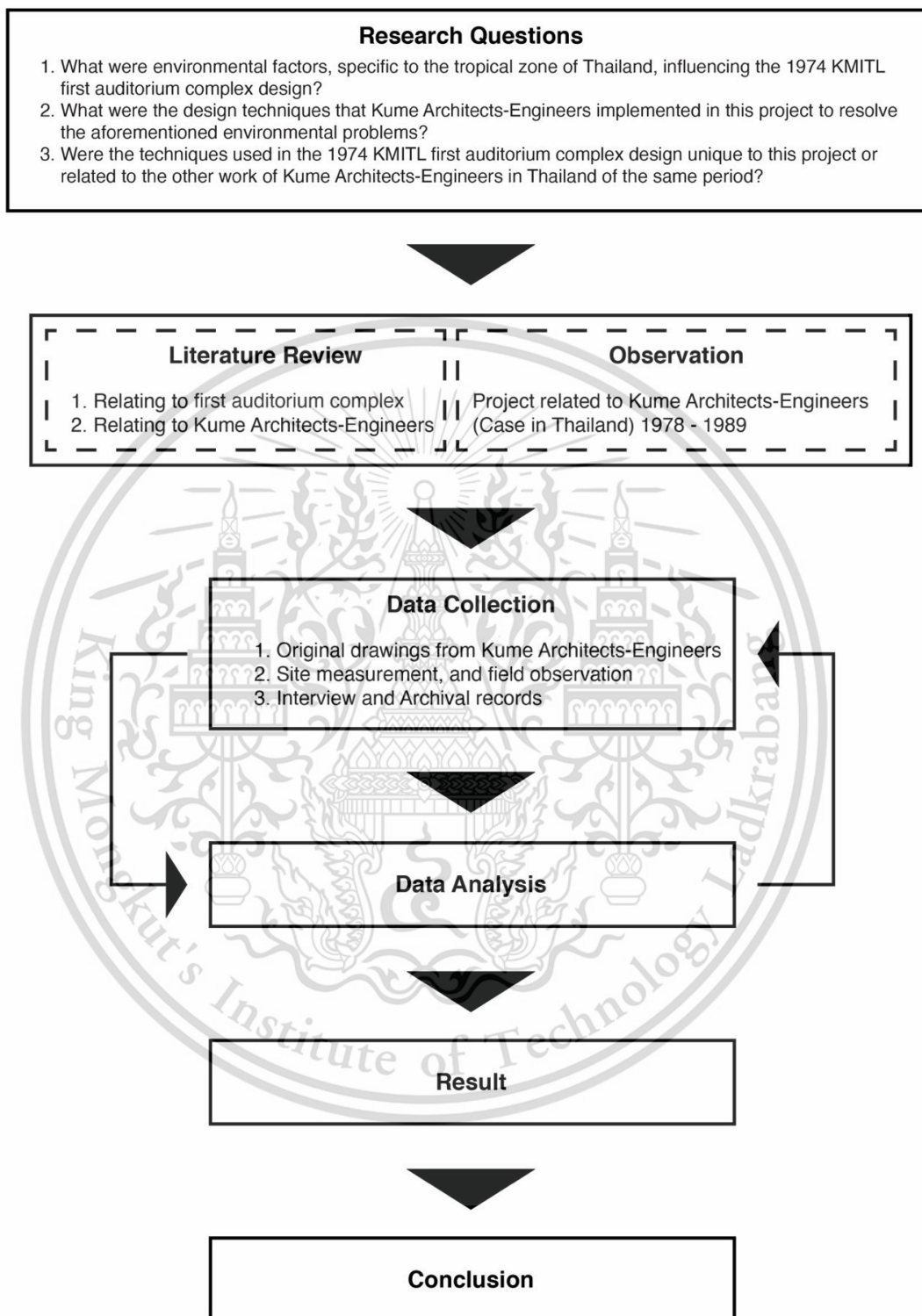
This study aims to:

1. investigate environmental factors, specific to the tropical zone of Thailand, influencing the 1974 KMITL first auditorium complex design.
2. investigate design techniques that *Kume Architects-Engineers* implemented the 1974 KMITL first auditorium complex.
3. discern were the techniques used in the 1974 KMITL first auditorium complex design unique to this project or related to the other work of *Kume Architects-Engineers* in Thailand of the same period?
4. systematically document the history of the first KMITL first auditorium complex.

1.5 Definition of Terms

1. 'Environmental Factors' refers to environmental factors are external to the building and can positively or negatively influence a building, function, or structure.
2. 'Design technique' refers to creates a plan, building layout, specific or unique design elements of the architecture.

Diagram of Research Design



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CHAPTER 2

LITERATURE REVIEW

This chapter consists of a review of six *Kume Architects-Engineers'* architectural design in Thailand from the Japan International Cooperation Agency (JICA) records from the period between 1978 – 1989. These records were part of the feasibility studies, prior to the actual construction process (Fig. 2.1).

The projects reviewed include various type of buildings either for the use of general public such as the Youth Welfare Center, or educational facilities such as the Asian Institute of Technology (AIT) Library, the KMITL Lecture halls in the university or to support research and development such as the Central Laboratory at Kasetsart University (KU) Kamphaengsaen Campus, and the Natural Resources and Environment Research Center, and the government training center such as the Ministry of Commerce Trade Training Center. Structure of the review are arranged in a logical order, which starts from the project background, the environmental and other external factors that might influence the project's architectural design, and its unique and specific design elements.

2.1 Framework

The framework used in the reviews, as well as the analysis of this study, is drawn from 1) Library & Media Buidling, Asian Institute of Technology (AIT), 2) the Central Laboratory & Greenhouse Complex of Kasetsart University (KU) Kamphaengsaen Campus, 3) the Youth Welfare Center Project, 4) the Trade Training Center for the Ministry of Commerce, 5) the Lecture Room Building for KMITL and 6) The Environmental Research & Training Center, which were designed by Kume Architects-Engineers's in Thailand between the year 1978-1979, and the preliminary of site observation by the author with the architectural construction drawing (or blueprint). The structure used in organizing and analyzing the literature on the previous work of Kume Architects-Engineers can be grouped as 1) Environmental factor influencing the Architecture design, and 2) Specific and unique design Element.

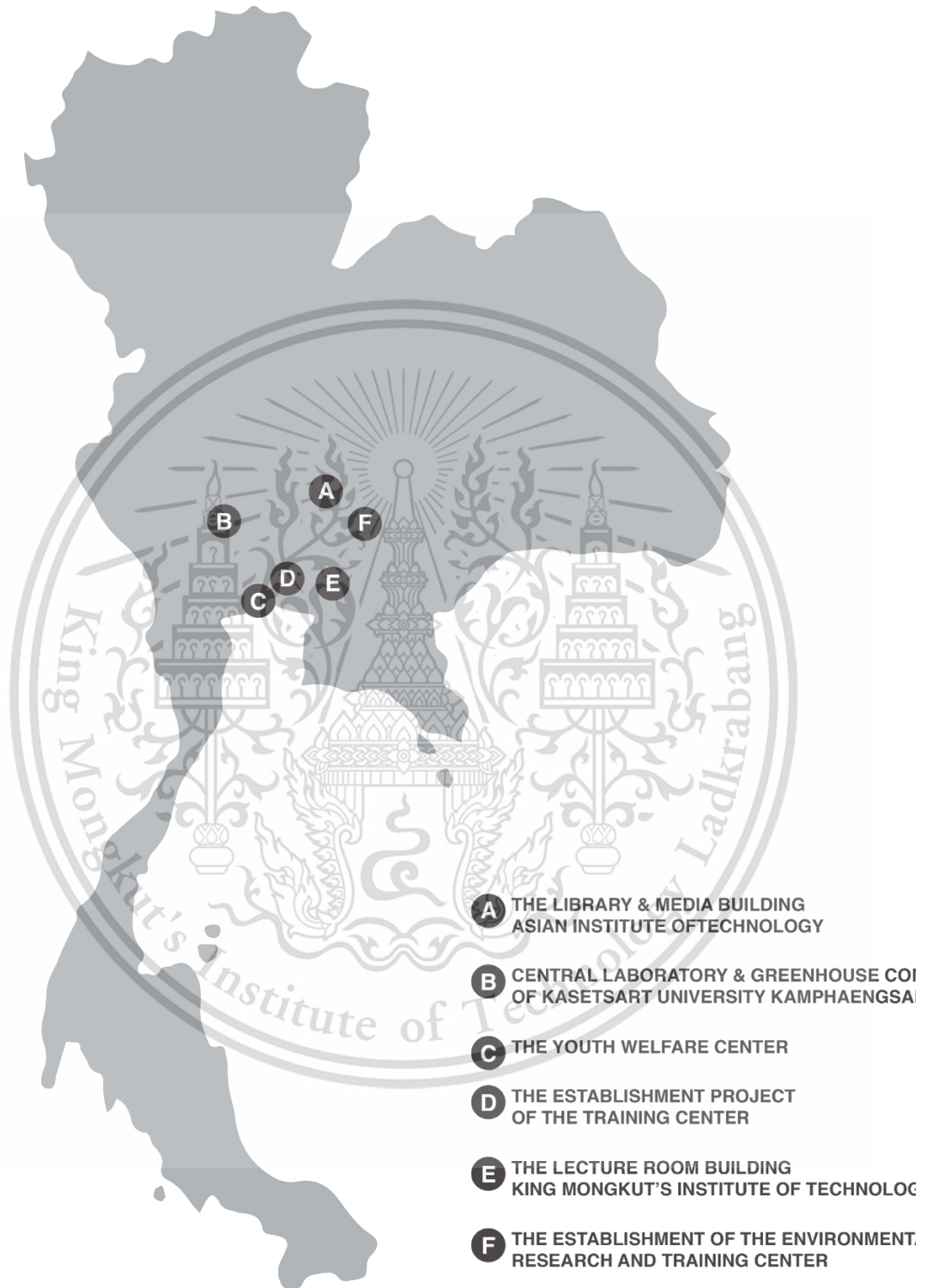


Fig. 2.1 Project related to Kume Architects-Engineers in Thailand.

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2.2 Architecture Design by *Kume Architects-Engineers* in Thailand

2.2.1 *The Library & Media Building Asian Institute of Technology (AIT) (1978)*

2.2.1.1 *Background*

Asian Institute of Technology (AIT) was found in 1959 as the Southeast Asia Treaty Organization (SEATO) Graduate School of Engineering. In November 1967, the Institute became an entirely dependent international non-profit educational organization with its present title under the Charter of the Asian Institute of Technology, granted as individual registration by the Chulalongkorn University campus. In February 1973, it moved to the present location in Rangsit District 40 kilometers. North of Bangkok (Fig. 2.2), approximately 400 acres of land was provided by the Royal Thai Government. The completion of the administration, academic buildings, laboratories, dining hall, and dormitory buildings in the first phase facilities extension plan inaugurated the renewed activities. Then, the Japanese Government had been rendering assistance since 1969 by dispatching professors and sharing scholarship funds and donation equipment and materials, and in 1974, constructed the AIT Center building for a total cost amounting to ¥870 million.



Fig. 2.2 Location Asian Institute of Technology

(Source: Japan International Cooperation, 1978. “Preliminary design of The Library & Media Building Asian Institute of Technology”, Japan International Cooperation Agency Library, p.2)

2.2.1.2 Environmental factor Influencing the Architecture design

Thailand is located out of any seismic zone designated in the world. The country had little experience of having the earthquake. As for wind pressure, the data show that the yearly average of wind velocity was about 2.0 m/sec. Moreover, the maximum wind velocity ever recorded was 28.3 m/sec. Thus, horizontal forces to act on the building is extremely small as compared with those in Japan.

2.2.1.3 Specific and unique design Element

2.2.1.3.1 Building Layout

The facilities are planned to be composed of three main sections: The Library to perform the main function, the RDC, which function relevant information seamless and the LMC of provide services for audio-visual aids devices. The functional relation to other facilities in the campus (Fig. 2.3).

The plan of the library was designed with the intention to limit the elevation of building to an as low level as two-stories in consideration of the balance with the campus and ground condition of the site and also to realize clear functional flows by studying separation of functions on the horizontal more as well as the relations to each other (Fig. 2.4). In order to make up for lengthy flow caused by the low-rise, to prevent overflows from crossing and to keep the Reading & Collection Section, Technical Service officer and LMC clearly separate from each other, the courtyard is provided in the center so as to enable the function flows to run around in a loop (Fig. 2.5). This layout has also taken into consideration for minimizing the operation costs in that by providing the courtyard, it attempted to save artificial lighting cost by making use of natural light, some of the rooms can depend on natural ventilation, and it would even be possible to get a comfortable condition indoors without air-conditioning during the hours when it is easy to get by at relatively low temperature.

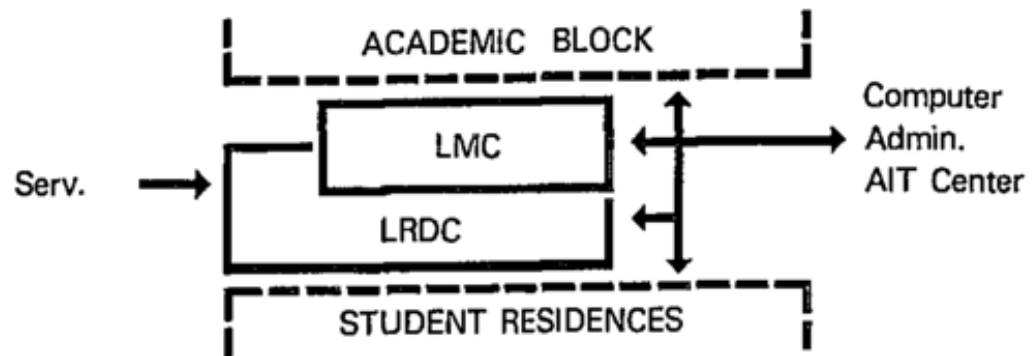


Fig. 2.3 The functional relation to other facilities in the campus

(Source: Japan International Cooperation, 1978. "Preliminary design of The Library & Media Building Asian Institute of Technology", Japan International Cooperation Agency Library, p.48)

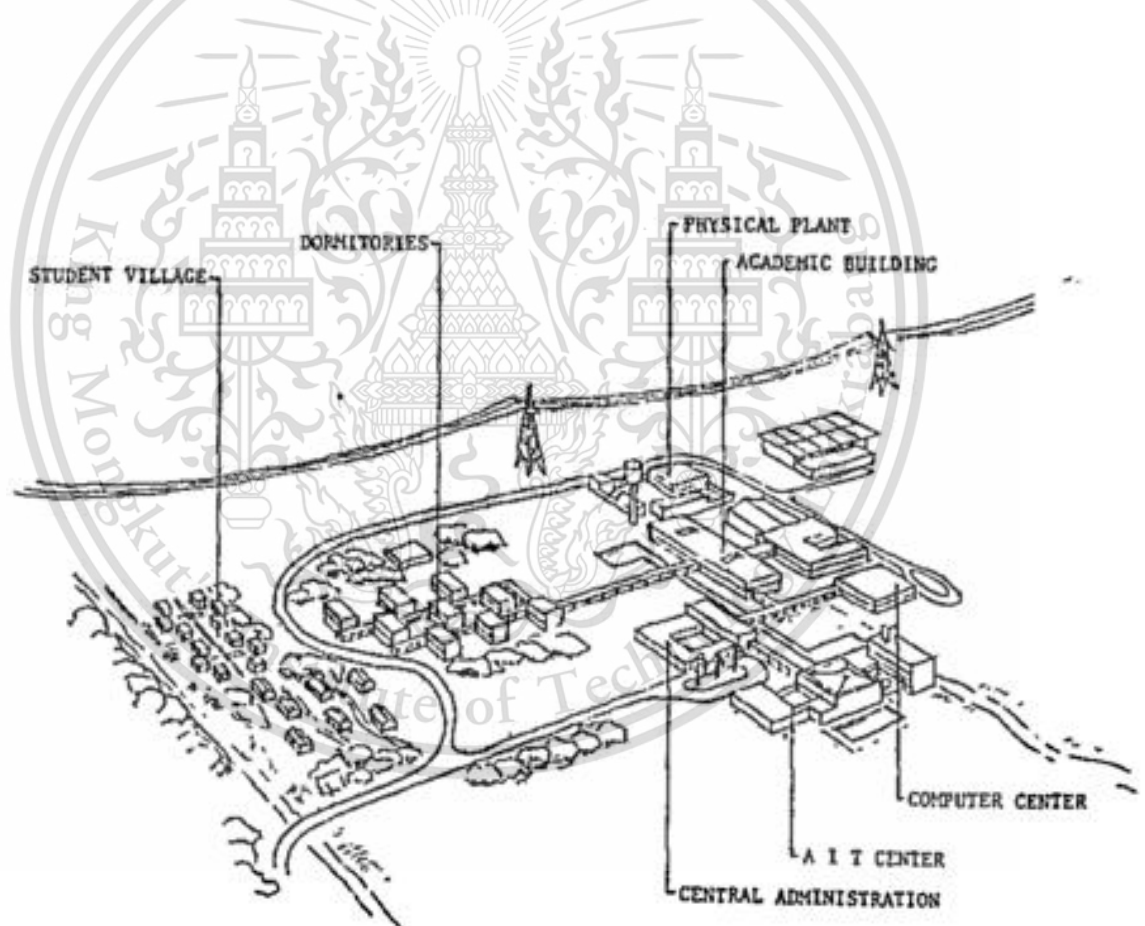


Fig. 2.4 The campus and ground condition of the site AIT

(Source: Japan International Cooperation, 1978. "Preliminary design of The Library & Media Building Asian Institute of Technology", Japan International Cooperation Agency Library, p.8)

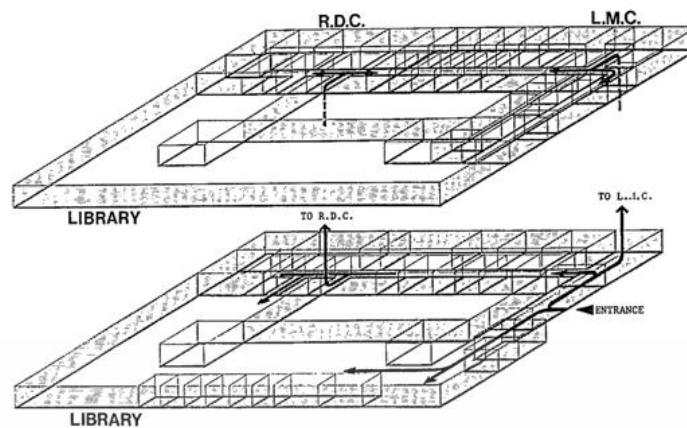


Fig. 2.5 Diagram of Library & Media Building AIT.

(Source: Japan International Cooperation, 1978. "Preliminary design of The Library & Media Building Asian Institute of Technology", Japan International Cooperation Agency Library, p.56)

The modular system is employed for the planning, with the module unit identical to the 8 m x 8 m grid covering the entire campus area in an attempt to keep uniformity and harmony with other building blocks. At the same time, the modularity is intended to affect the coordinated layout within the Library building, the book stack, and the covered arrangement (Fig. 2.6).

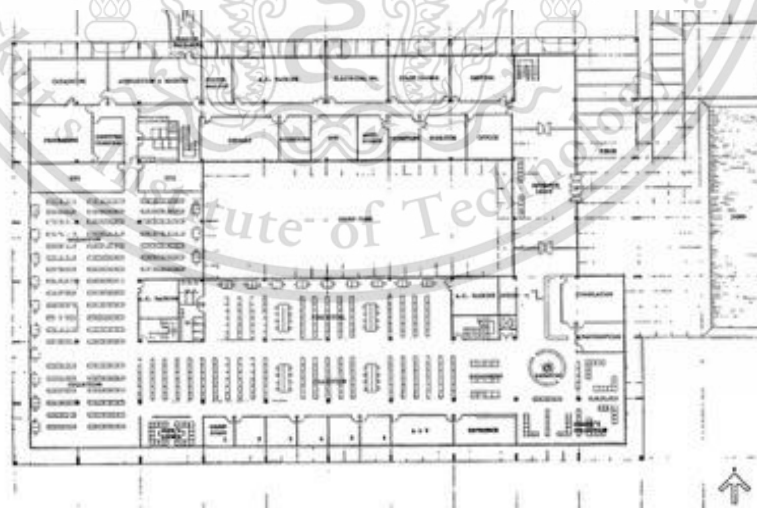


Fig. 2.6 Floor Plan first of Library & Media Building AIT.

(Source: Japan International Cooperation, 1978. "Preliminary design of The Library & Media Building Asian Institute of Technology", Japan International Cooperation Agency Library, p.54)

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2.2.1.3.2 Climate Design

1) The roof is the element greatly affected by sunlight and precipitation. Due consideration should be given to strong sunlight and heavy rain. For reinforced concrete buildings, the heat insulation method is to shingle an asbestos roof over the concrete roof slab, thereby preventing heat radiation from entering the interior space of the building, making use of the air space beneath the asbestos roof for a heat-insulating layer.

2) Exterior walls are also susceptible to the effects of sunlight. However, the use of materials with a high overall heat transmission resistance and providing with eaves and louvers serve successfully to avoid much solar radiation. The Academic Building of AIT was designed to draw back exterior walls and to have canopies, eaves fitted around the building (Fig. 2.7).



Fig. 2.7 Exterior walls of Library & Media Building AIT

(Source: the author)

2.2.1.3.3 Material

Based on local materials and taking into consideration the problems involved in maintenance, it is the policy to utilize local materials as much as possible. The materials for use in this project are as follows:

1) The roof uses a shingle of corrugated asbestos cement is installed over the concrete roof slab for heat-insulating purposes.

2) Wall construction techniques of the reinforced concrete wall are found generally under-developed. The materials are stacked to form walls such as brick and

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block are in everyday use for wall construction. While the movable partition is planned to be applied to some partition walls for flexibility in plans.

3) Floor PVC tile and polished terrazzo are employed for use in the general areas, while the carpet is provided depending on the requirement of specific rooms for sound absorption.


Summary

Asian Institute of Technology (AIT) was found in 1959 as the SEATO Graduate School of Engineering. In February 1973, it moved to the present location in Rangsit District 40 kilometers. North of Bangkok, approximately 400 acres of land was provided by the Royal Thai Government. Then, the Japanese Government had been rendering assistance since 1969.

The facilities are planned to be composed of three main sections.

The plan of the library was designed with the intention to limit the elevation of building to an as low level as two-stories in consideration of the balance with the campus, ground condition of the site and the modular system is employed for the planning, with the module unit identical to the 8 m x 8 m grid covering the entire campus area in an attempt to keep uniformity and harmony with other building blocks. The roof making use of the air space beneath the asbestos roof for a heat-insulating layer. Exterior walls use materials with a high overall heat transmission resistance, and providing eaves and louvers successfully avoids much solar radiation. In part of material based on local materials and taking into consideration the problems involved in the maintenance (Table 2.1).

Table 2.1 Summary of Asian Institute of Technology (AIT)

Study					Specific and unique design Element				
Environmental factor influencing The Architecture design									
Heavy rain	Strong sunlight	Seasonal Winds	Flooding	Hight Density Land use	Building Layout	Climate Design	Supplementary Design Requirements	Local material	Import material
●	●	●	N/A	N/A	 <ul style="list-style-type: none"> - Use courtyard to enable the function flows to run around in a loop - 8x8 Grid module 	<ul style="list-style-type: none"> - Double layers roof - Eaves, louvers, and canopies around the building - Courtyard to provide natural light and ventilation 	<ul style="list-style-type: none"> - Two stories to balance with the campus and ground condition of the site and to be unifrom with other building blocks 	●	N/A

Source: the author (2021)

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2.2.2 Central Laboratory & Greenroom Complex of Kasetsart University (KU)

Kamphaengsaen (1978)

2.2.2.1 Background

Kasetsart University (KU), Kamphaengsaen Campus is located in a vast area of 3,000 acres in Kamphaeng Saen's district in Nakhon Pathom Province (Fig. 2.8). This KU campus of Kasetsart University was established in 1978 to extend the agricultural sciences and other disciplines of education to Thailand's rural area. Like other higher education institutions, it is an educational and research institution, with the following objectives as approved by the KU Council: to provide and promote higher education, to conduct research, to provide academic services to society, to propagate and nourish national arts and culture, and to take part in national development. As for the relations between Thailand and Japan, the loan to be obtained from the International Bank for Construction and Development would be limited to education-related facilities, and sufficient funds for research, extension, and training are not likely nor expected. Accordingly, a request has been made to the Government of Japan to explore options for cooperation in these facilities' construction. An official request for assistance has followed this informal sounding-out.

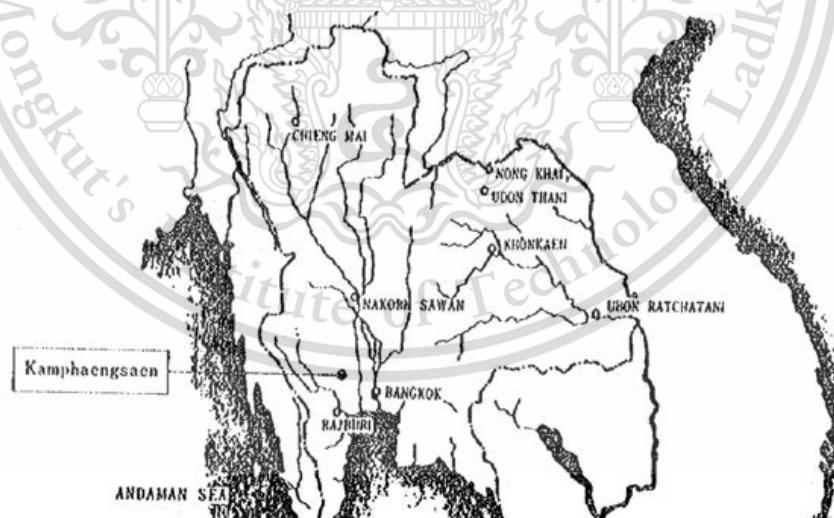


Fig. 2.8 Location Kasetsart University, Kamphaeng Saen Campus

(Source: Japan International Cooperation, 1978. "Preliminary design for Central Laboratory & Greenhouse Complex of Kasetsart University Kamphaengsaen Campus in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.8)

2.2.2.2 Environmental factor influencing the Architecture design

Environmental factor influencing the Architecture design of Central Laboratory & Greenroom Complex of Kasetsart University Kamphaengsaen, climate conditions in the region and nature of the facility, under hot and humid climate conditions, or impact of sunlight, wind, and rain on the buildings

2.2.2.3 Specific and unique design Element

2.2.2.3.1 Building Layout

Base on the concept, zoning, flow lines, and axial lines are as follows (Fig. 2.9). Each of the buildings is positioned on the outer side of the loop from the general corridor, considering their functional and organic relationships.

In the sections where the structures connect to the public corridor, common spaces such as offices and display rooms for each of the laboratory buildings will be situated to facilitate administration. The connecting passages for each of the buildings open onto the parking areas to provide direct access to any necessary services from the outside (Fig. 2.10). In the case of this building, the minimum unit is set at 3.5m x 7.0m, with highly functional spaces being planned using basic modules of 7.0m x 7.0m (Fig. 2.11).

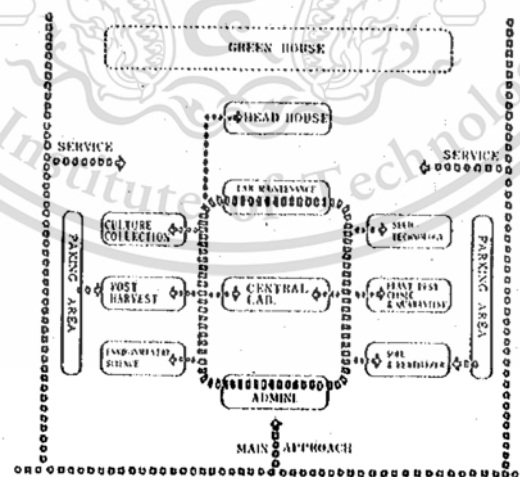


Fig. 2.9 Concept, zoning, flow lines, and axial lines

(Source: Japan International Cooperation, 1978. "Preliminary design for Central Laboratory & Greenhouse Complex of Kasetsart University Kamphaengsaen Campus in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.28)

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Fig. 2.10 Central Laboratory & Greenroom Complex of KU

(Source: the author)

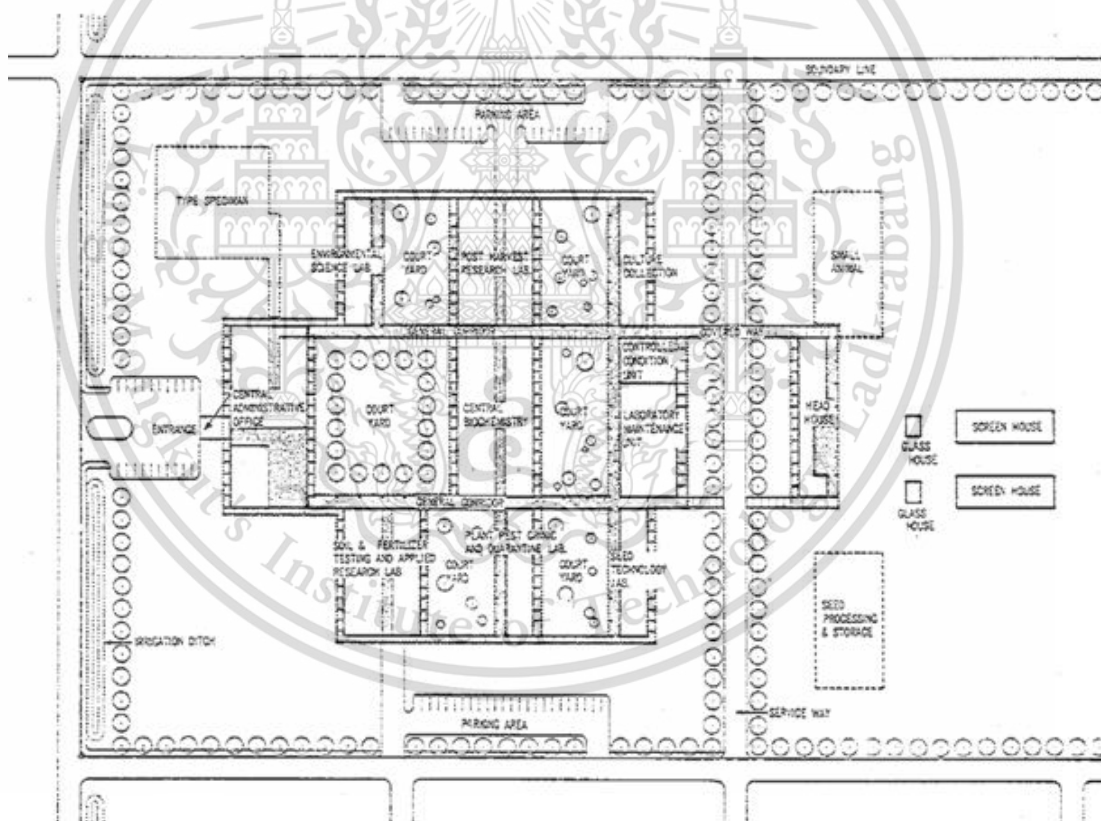


Fig. 2.11 Lay Out Plan Central Laboratory & Greenroom Complex

(Source: Japan International Cooperation, 1978. "Preliminary design for Central Laboratory & Greenhouse Complex of Kasetsart University Kamphaengsaen Campus in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.59)

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2.2.2.3.2 Climate Design

1) The entire roof structure of Central Laboratory & Greenroom Complex is made of reinforced concrete, roof truss, and cover with the asbestos cement sheet. Also, in the case of a high, multi-stored building with large room capacities, the effects of radiation heat are not so adverse. Because the heat is not readily transmitted to the lower parts of the rooms, with sufficient ventilation of the vicinity air near the roofs is carried out (Fig. 2.12).



Fig. 2.12 Lay Out Plan Central Laboratory & Greenroom Complex

(Source: the author)

2) The exterior wall is also susceptible to the effects of solar radiation. However in such means as using materials of high overall heat transmission resistance plus the fitting of eaves and louvers (vertical louvers and horizontal louvers) are used, it is possible to avoid much solar radiation. Also, in Thailand, it is possible to obtain the draft by the seasonal south-north winds throughout the year. Therefore, from the standpoint of planning for natural ventilation, the building shall be built, taking into consideration of this wind direction and providing large openings in this direction for the facilitation of wind pass through. For fitting at the openings, wooden, steel, or aluminum, windows and doors are produced in Thailand.

3) Floor levels, during the rainy season, there is a considerable amount of precipitation in Thailand. However, the floor levels should be set at a relatively high level, just in this case.

2.2.2.3.3 Materials

1) The roof covering materials, roof tiles are suitable. These materials easy to transport and manufactured in large quantities in the area.

2) Reinforced concrete wall construction techniques are, generally, not very high, and materials that are stacked to form a wall, such as Mhon bricks are used. Mhon brick is a local material (Table 2.2), that is easy to find and inexpensive, as well as easy to maintain after the project was finished. The uniqueness of Mhon brick is from a hole in the middle of the block that create air insulation. Mhon brick, comes in variety of size, is made from clay shaped into a block and fired in a kiln. A high concentration of iron oxide in the clay creates a rusty iron color and strenght suitable to be used as a construction material in Thailand. Mhon bricks can be used freely, and the frames decided without any need to worry about joint plans. In the case of plastered walls, a washed terrazzo finish for the exterior walls would be suitable, this type of finish is popular in Thailand. The local laborers are experienced in such work, and artistry is satisfactory. Also, its cost is relatively low. Therefore it is used as a standard exterior wall finishing procedure.

3) The floors of the offices and laboratories of these buildings, bearing in mind the fact that they will need scrubbing with water. So the floor of this building use materials as ceramic tiles, precast terrazzo, polished terrazzo, and vinyl sheets.

Table 2.2 Specification of Mhon brick.

Information	Unit
Volume (cm. ³)	0.60
Density (kg/m ³)	1615 - 1650
Thermal Transfer (Watt/m ²)	30 - 45
Conductivity – K value (W/m.K)	0.473
Resistivity – R value (m ² K/W)	0.15
Thermal Capacity (j/kg.K)	800-1000
Compression resistance (kg./cm ²)	35 kg./cm ²
Sound protection (dB)	36 - 40
Fire resistance (hour)	0.5 - 2

Source: bricklampang.wordpress.com (2015, September 29)

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Summary

Kasetsart University, Kamphaeng Saen Campus is located in an area of 3,000 acres in the district of Kamphaengsaen in Nakhon Pathom Province. This KU's campus was established in 1979 to extend the agricultural sciences and other disciplines of education to the rural area of Thailand.

Each of the buildings is positioned on the outer side of the loop from the general corridor. In the case of this building, the minimum unit is set at 3.5m x 7.0m, with highly functional spaces being planned using basic modules of 7.0m x 7.0m. In this hot and humid region, solar radiation, rainfall, and ventilation requirements will be significant in building design. In part of material based on local materials (Table 2.3).

Table 2.3 Summary of Central Laboratory & Greenroom Complex of Kasetsart University Kamphaengsaen campus.

Study										
Environmental factor Influencing The Architecture design					Specific and unique design Element					
Heavy rain	Strong sunlight	Seasonal Winds	Flooding	High Density Land use	Floor Plate Diagram	Building Layout	Climate Design	Supplementary Design Requirements	Local material	Import material
●	●	●	N/A	N/A		<ul style="list-style-type: none"> - Loop structure to connect passage from each building to the public corridor - 7 x7 Grid module 	<ul style="list-style-type: none"> - Double layers roof - Eaves, louvers, and canopies around the building - Seasonal wind to create draft - High floor to prevent flooding 	N/A	●	N/A

Source: the author (2021)

2.2.3 *The Youth Welfare Center project in the Kingdom of Thailand (1979)*

2.2.3.1 *Background*

As a result of the rapid increase of the population in Bangkok Metropolis, particularly of the younger generation, about 60% of the total population of 5 million in Bangkok is under 25 years; within these years, poverty, domestic discord, and crime have become critical social problems in this city.

To solve these problems, it is essential to develop the spirit of mutual assistance among the citizens, especially among the youth, through social activities, symposiums, meetings, lectures, and sports activities in their leisure hours out of work or after school, and it is also essential to develop their personalities through these cultural activities including simple vocational training. Various counseling services are also required for those who are young and in an unstable mental state.

This Center was planned in commemoration of the Bicentennial Anniversary of the Chakri Dynasty to provide a public facility that young people and other citizens can access freely and where they can strengthen the sense of social solidarity through cultural and sports activities. In 1979, a contract was signed between the Japanese and Thai governments to build a The Youth Welfare Center for Thailand (Fig. 2.13). In celebrating the 200th anniversary of Rattanakosin, the Japanese government intends to build an institution as a memorial and give it as a gift to Thailand. The project site of this center is located in Din Daeng, Phaya Thai District, northeast of the Bangkok Metropolis.



Fig. 2.13 The Youth Welfare Center project in the Kingdom of Thailand
(Source: the author)

2.2.3.2 Environmental factor influencing the Architecture design

According to JICA's report (1979), "local meteorological conditions are necessary actors in designing building elements. In this hot and humid region, solar radiation, rainfall, and ventilation requirements will be significant in building design, and suitable measures must be taken against these factors."

2.2.3.3 Specific and unique design Element

2.2.3.3.1 Building Layout

The main facility of this Center consists of a gymnasium with a stage, the grandstand of the main stadium, student activity rooms, an auditorium, a library, administration offices (Fig. 2.14-2.15). The stadium is located directly to the east side of the main building with the rear elevation curving around the open space creating a warm and unique to welcoming approach to the Youth Welfare Center.

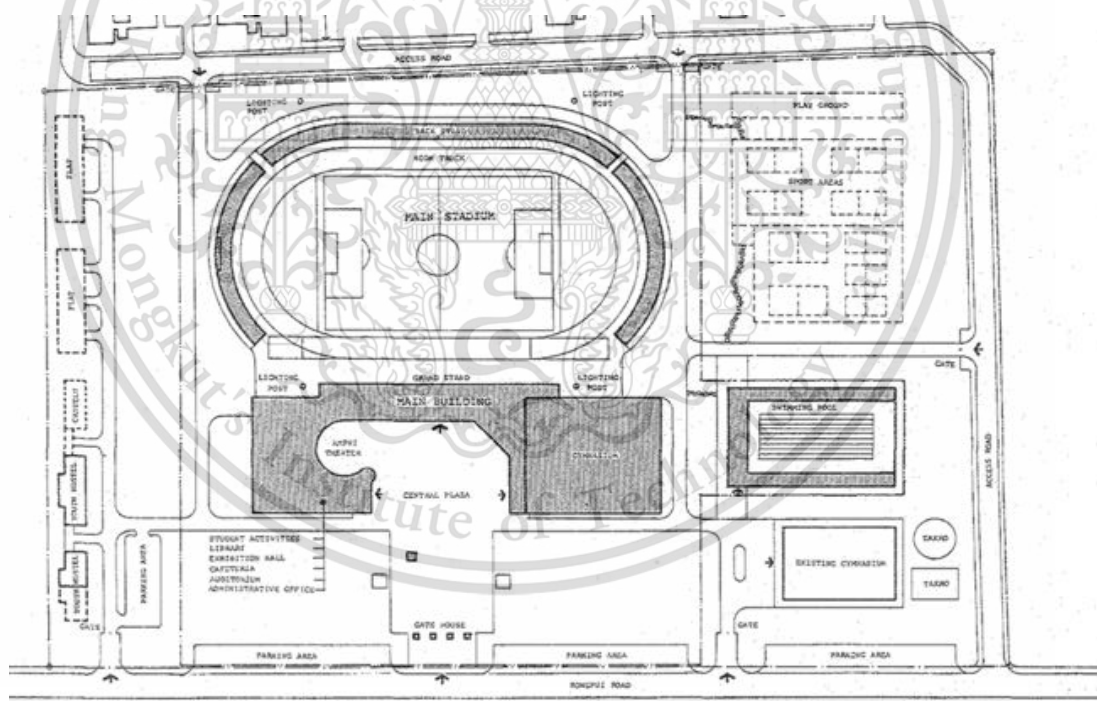


Fig. 2.14 Building Layout (The Youth Welfare Center)

(Source: Japan International Cooperation, 1979. "Basic Design For The Youth Welfare Center Project in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.23)

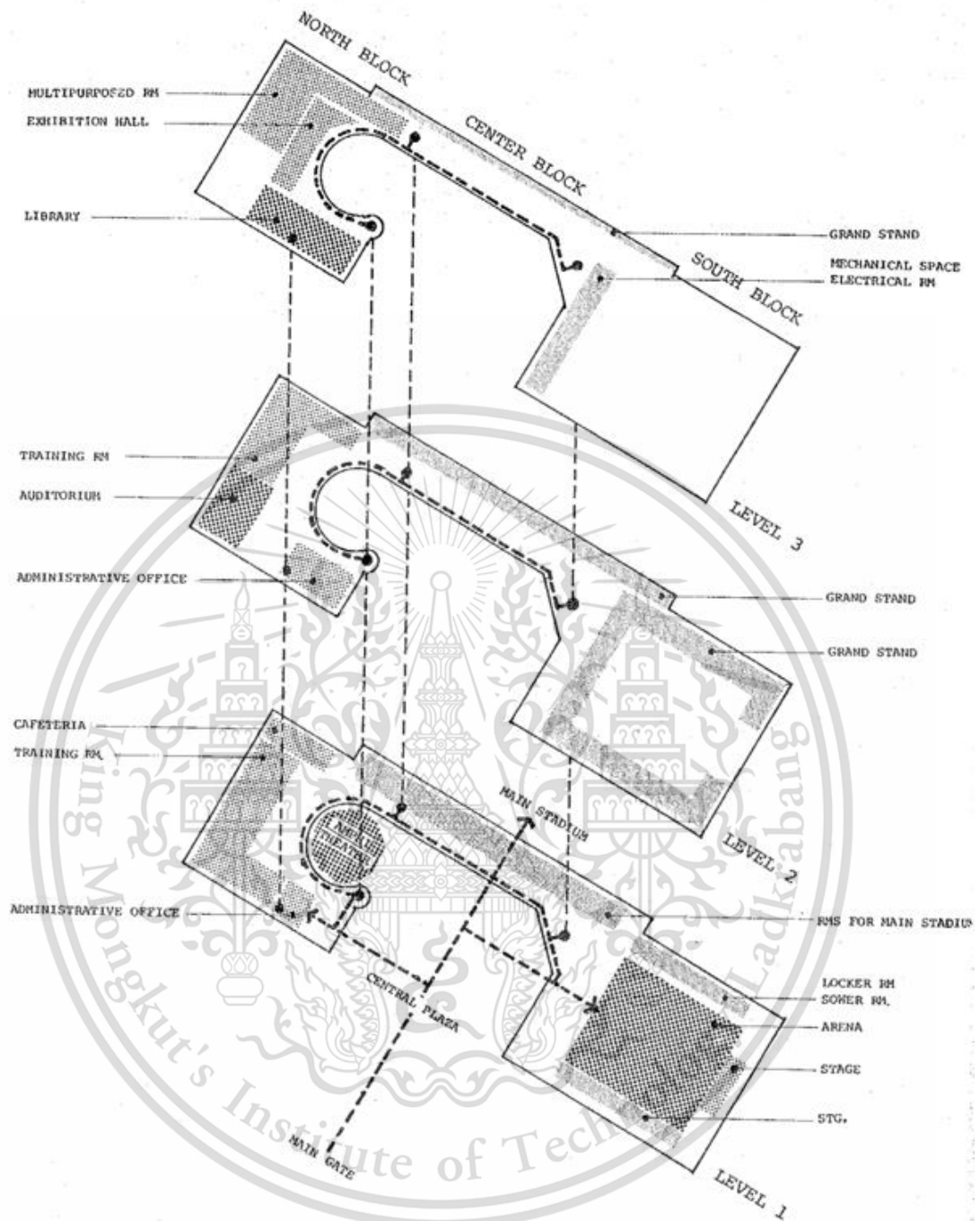


Fig. 2.15 Diagram of Main Building (The Youth Welfare Center)

(Source: Japan International Cooperation, 1979. "Basic Design For The Youth Welfare Center Project in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.8)

2.2.3.3.2 Climate Design

1) Roofs are the element most affected by solar radiation. Adequate heat-insulating layers design to use between the roofs.

2) Exterior walls are also affected by solar radiation. Eaves and louvers must be provided to minimize its effect. There are seasonal winds in Thailand throughout the year. The best use of this natural benefit, openings as large as possible, will be provided in buildings to facilitate natural ventilation.

3) The floor level design to sufficiently high to avoid flooding during the rainy season.

2.2.3.3.3 Materials

The structure is mainly reinforced concrete frame with a concrete block wall. The roof of the gymnasium will be of steel framework (Table 2.4).

Table 2.4 Materials of The Youth Welfare Center

Exterior finish materials		
No.	Information	Materials
01.	Roof	Resin waterproofing, elongated Alvanized iron sheet roofing (backed with insulating materials)
02.	Wall	Washed terrazzo
03.	Fitting	Aluminum, steel, partly wood
Interior finish materials		
No.	Information	Materials
01.	Floor (General office) (Corridor, Lobby) (Auditorium, Library) (Gymnasium)	Vinyl asbestos tile sheet Polished terrazzo Carpet Synthetic resin flooring
02.	Wall	The paint finish on cement plaster, Acoustic board
03.	Celling	Acoustic panel, acoustic spray covering


Source: Japan International Cooperation, 1979. "Basic Design For The Youth Welfare Center Project in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.15.

Summary

The Thai Japanese Youth Welfare Center was planned in commemoration of the Bicentennial Anniversary of the Chakri Dynasty to provide a public facility that young people and other citizens can access freely and strengthen the sense of social solidarity through cultural and sports activities. in 1979. This center's project site is located in Din Daeng, Phaya Thai District, northeast of the Bangkok Metropolis.

In part of *Climate Design*, environmental conditions are necessary to designing building elements in this hot and humid region. Eventhough its structure is mainly made of reinforce concrete frame with concrete block wall and steel frame roof, Sustainable design measures have been taken to handle strong solar radiation, high level of rainfall and humidity (Table 2.5).

Table 2.5 Summary of The Youth Welfare Center project in the Kingdom of Thailand

Study						
Environmental factor Influencing The Architecture design					Specific and unique design Element	
Heavy rain	Strong sunlight	Seasonal Winds	Flooding	High Density Land use	Floor Plate Diagram	Supplementary Design Requirements
●	●	●	N/A	N/A	 <p>Building Layout</p> <ul style="list-style-type: none"> - Open space in the center and in the front 	<p>Climate Design</p> <ul style="list-style-type: none"> - Double layers roof - Eaves, louvers, and canopies around the building - Seasonal wind to create draft - High floor to prevent flooding
						N/A

Source: the author (2021)

2.2.4 *The Trade Training Center of Thailand (1982)*

2.2.4.1 *Background*

At the request of the Government of the Kingdom of Thailand for the grant cooperation to contribute to the establishment of the Trade Training Center, the Government of Japan had dispatched the preliminary survey team for this project, from 6 - 14 of January 1982, to plan the effective implementation of technical cooperation and grant assistance. The establishment of the Center aims to obtain personnel well-versed in the international trade business and practice through training activities, facilitate the improvement of the quality of Thailand's major export products, and promote pervasion of the products by exhibition activities (Fig. 2.16). Thereby, it is expected that the deficit of international payment in Thailand will be eliminated.

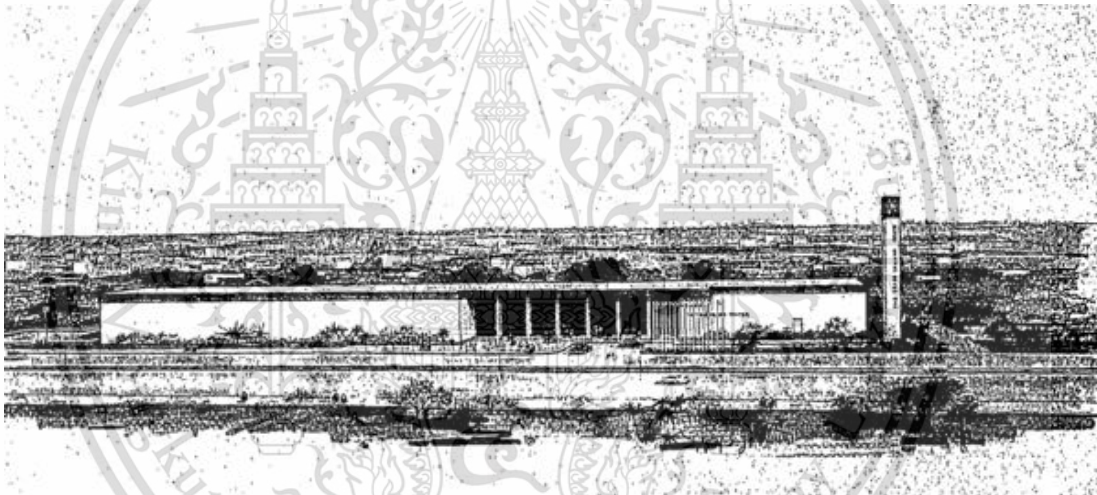


Fig. 2.16 The Establishment Project of The Training Center

(Source: Japan International Cooperation, 1982. "Basic Design Study on The Establishment Project of The Trade Training Center in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.2)

2.2.4.2 *Environmental factor influencing the Architecture design*

Local meteorological conditions and interior environments are critical factors in designing building elements. This hot and humid region, solar radiation, rainfall, and natural ventilation have a strong influence on building design.

2.2.4.3 Specific and unique design Element

2.2.4.3.1 Building Layout

According to Japan International Cooperation Agency, (1982), the objectives, the activities of the Center are classified as follows:

- 1). Trade Training Activity
- 2). Standard 6 Quality Control Activity
- 3). Exhibition Activity

The building is laid out at the south side of the site to retain an ongoing relationship with the office building of the DCR. The multi-purpose is located on the north part of the building directly adjacent to the outdoor exhibition area, of which open space is left to cope with a possibility for future expansion of the building (Fig. 2.17).

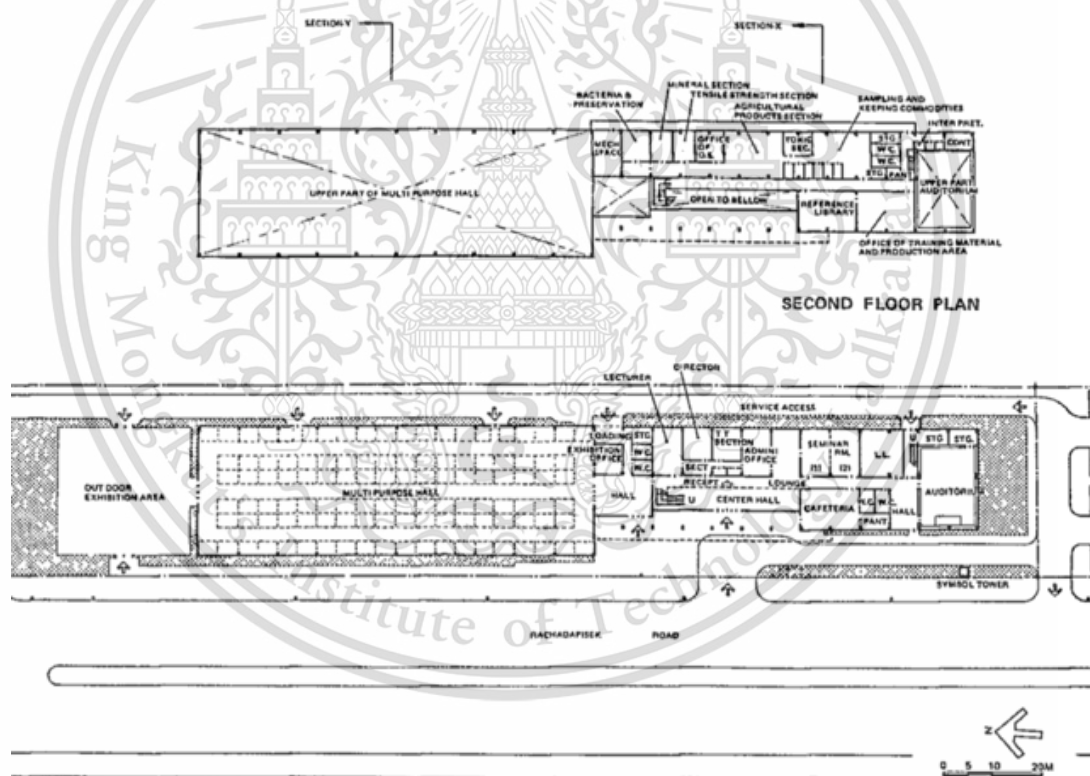


Fig. 2.17 First and Second Floor Plan of the Training Center

(Source: Japan International Cooperation, 1982. “Basic Design Study on The Establishment Project of The Trade Training Center in The Kingdom of Thailand”, Japan International Cooperation Agency Library, p.34)

2.2.4.3.2 Climate Design

1) The roof is the building element that is most affected by solar radiation and rainfalls. Durable waterproofing against active solar radiation and heavy rainfalls and adequate heat-insulating layers against radiation heat must be provided on and between roof and interior. In the case of reinforced concrete structure in Thailand, corrugated asbestos cement covering on roof slab is the general and rational way to protect interior space from radiating heat, making good use of the air-space between the cover and concrete slab as insulating layers.

2) Exterior walls are also affected by solar radiation. It is essential to provide eaves and louvers as well as to use materials with a more excellent total resistance of heat transmission to minimize the effect of solar radiation.

3) Floor levels, a designing ground level should be carefully studied to avoid flooding.

2.2.4.3.3 Materials

As far as there is no problem with availability, local materials should be used for the construction considering the maintenance and construction costs. The main structure is a reinforced concrete frame with Mhon brick or concrete block wall (Table 2.6).

Table 2.6 Materials of The Establishment Project of The Training Center.

Exterior finish materials		
No.	Information	Materials
01.	Roof	Flat roof with waterproofing covered by asbestos cement sheet, with insulation material backing
02.	Wall	Paint spray on mortra
03.	Fitting	Aluminum, steel, partly wood
Interior finish materials		
No.	Information	Materials
01.	Floor (Entrance hall, Corridor) (General offices) (Auditorium, Library) (Multi-purpose hall)	Tiles and polished, Terrazzo Vinyl tiles Carpet Floor coating material
02.	Wall	Cement plaster, paint ,finish Acoustic board (especially Auditorium)
03.	Celling	Paint finish on board, Acoustic board

Source: Japan International Cooperation, 1982. "Basic Design Study on The Establishment Project of The Trade Training Center in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.19.

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Summary

At the request of the Government of the Kingdom of Thailand for the grant cooperation to contribute to the establishment of the Trade Training Center, the Government of Japan had dispatched the preliminary survey team for this project, from 6 - 14 of January 1982, to plan the effective implementation of technical cooperation and grant assistance.

Local meteorological conditions and interior environments are critical factors in designing building elements. In this hot and humid region, solar radiation, rainfall, and natural ventilation strongly influence building design. The roof is the building element that is most affected by solar radiation and rainfalls. Durable waterproofing against active solar radiation and heavy rainfalls and adequate heat-insulating layers against radiation heat must be provided on and between roof and interior. Exterior walls are also affected by solar radiation. It is essential to provide eaves and louvers and use materials with a more excellent total resistance of heat transmission to minimize the effect of solar radiation and Floor levels; a designing ground level should be carefully studied to avoid flooding. As far as there is no problem with availability, local materials should be used to consider the maintenance and construction costs (Table 2.7).

Table 2.7 Summary of The Establishment Project of The Training Center of Thailand

Study					Specific and unique design Element				
Environmental factor Influencing The Architecture design									
Heavy rain	Strong sunlight	Seasonal Winds	Flooding	High Density Land use	Building Layout	Climate Design	Supplementary Design Requirements	Local material	Import material
●	●	●	●	N/A	Floor Plate Diagram  <ul style="list-style-type: none"> - Leave open space for future expansion 	<ul style="list-style-type: none"> - Double layers roof - Eaves, louvers, and canopies around the building - Seasonal wind to create draft 	<ul style="list-style-type: none"> - Retain relationship with office building around the site 	●	N/A

Source: the author (2021)

2.2.5 *The Lecture Room Building King Mongkut`s Institute of Technology (1983)*

2.2.5.1 *Background*

KMITL has based eventful incipient stage for about ten years after its foundation and is entering the improvement and development stage. In response to the semi-industrialization policy for stabilizing the national economy as a part of the 5th National Social/ Economic 5 years. The plan drawn out by the Government of Thailand, which aims to educate a maximum number of competent engineers promptly, KMITL is under the separation of front North Bangkok and Thonburi campus and transformation to a new national university. Also, many faculties will be increased to 8 from 4 at present during the 6th National Plan period (1986 - 1990).

2.2.5.2 *Environmental factor influencing the Architecture design*

In the architectural element plan, climate conditions in the region and nature of facility maintenance and administration plan after the completion will be determinant factors. Under hot and humid climate conditions, or impact of sunlight, wind, and rain on the buildings.

2.2.5.3 *Specific and unique design Element*

2.2.5.3.1 *Building Layout*

The objective of the KMITL Lecture Room Building Facilities, Construction Scheme, is to construct the following facilities, which constitute the core of the new national university and its eight faculties (Fig. 2.18).

It is based on a guideline on educational development in national development plan:

- 1) General Lecture rooms/laboratory building to conduct general requirements and basic technical courses for freshman and sophomore year students in 8 faculties of the university.
- 2) Central administration building required for administration and management of the new national university system.
- 3) Information service course material production center for instructors and students.
- 4) Student's hall and dormitory for the welfare and convenience of students.

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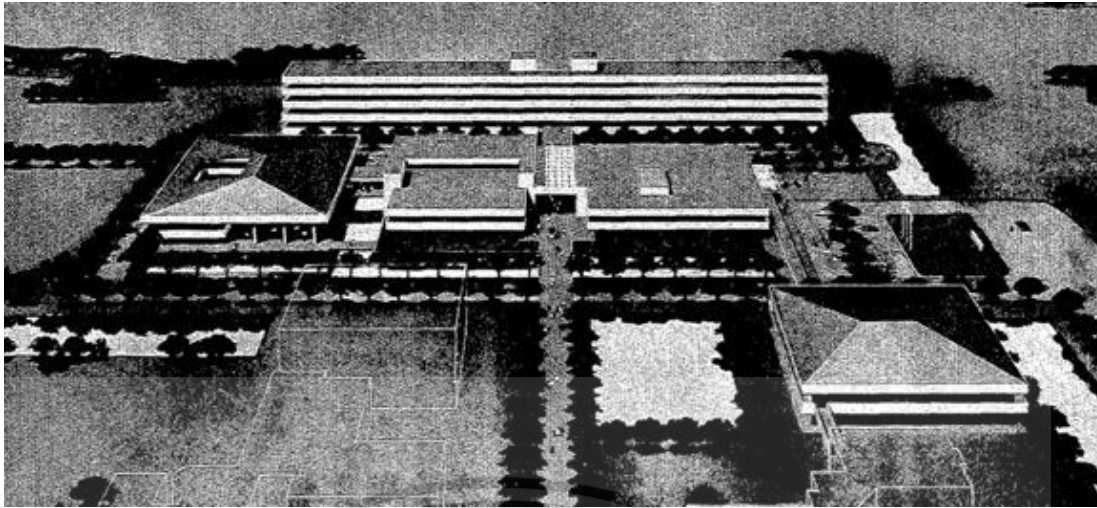


Fig. 2.18 KMITL Lecture Room Building

(Source: Japan International Cooperation, (1983). “Basic Design Study on The Construction of The Lecture Room Building King Mongkut’s Institute of Technology in The Kingdom of Thailand”, Japan International Cooperation Agency Library, p.3)

The layout plan will be drawn out following the fundamental design principle and the following items are taken into consideration as determining factors in planning (Fig. 2.19).

- 1) Conceptualization of characteristic appearance
- 2) A relatively high density of land use
- 3) The building’s appearance for entering traffic from the north side in the future
- 4) The simple layout of the building
- 5) Easy access from the main road
- 6) Securing a route from the railroad station
- 7) Way to connect the building with existing office buildings

At the first stage of planning, the following two conceptual designs, Alternative A and B, are prepared for comparison.

A specific feature of Alternative A is found in the layout of the buildings, which spirals around a square counter-clockwise to create an atmosphere full of variety, combining the buildings and the square. Three lecture and laboratory buildings of five stories are laid out along their diagonal axis to generate a gentle impression on the whole premises.

On the other hand, Alternative B is a feature in the parallel arrangement of the buildings, such as Lecture Laboratory Buildings and Information Service Center, on both sides of an axis perpendicular to the north-south bound the main road of the campus, separating two rows of buildings 25m apart. The central part will be provided with a mall-type shaded promenade. As a result, the buildings will be arranged in a compact, high-density fashion to create a compelling and symbolic impression as a whole. Based on the above features, Alternative B is selected to satisfy a set of determining factors listed for earners.

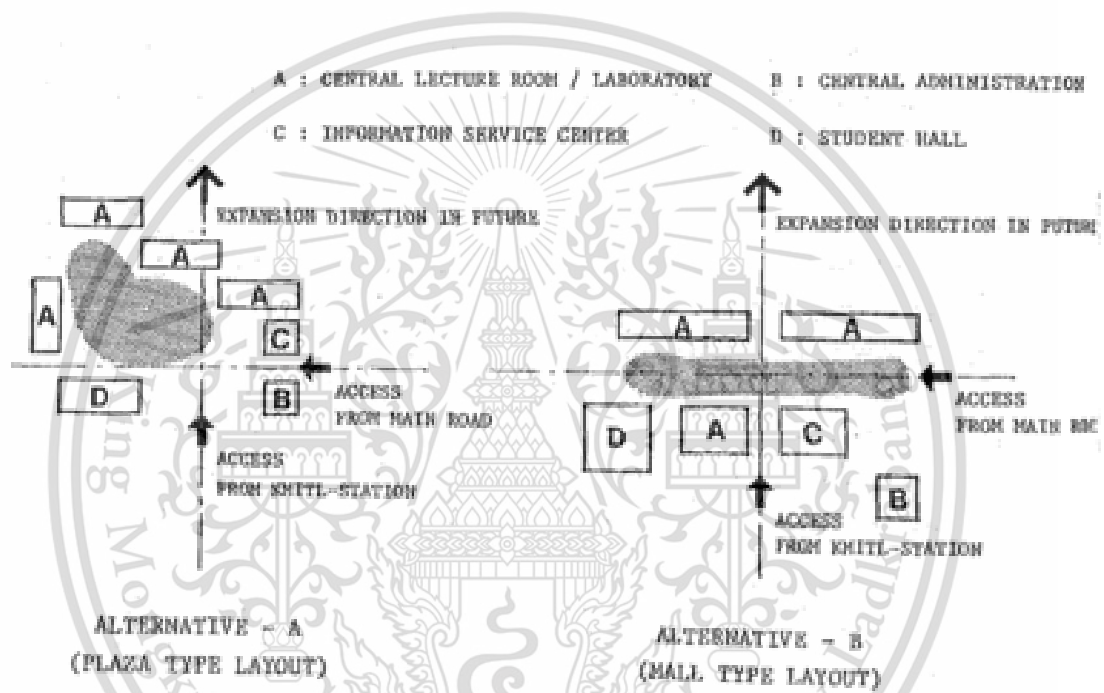


Fig. 2.19 Conceptual diagram, Alternative A and B (KMITL Lecture Room Building)

(Source: Japan International Cooperation, (1983). "Basic Design Study on The Construction of The Lecture Room Building King Mongkut's Institute of Technology in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.52)

2.2.5.3.2 Climate Design

1) As the roof is subject to the enormous impact of sunlight and rain, maintenance-free and durability factors should receive close attention. Roof structure frequently observed in a region is a slant roof of the corrugated asbestos sheet on wooden shed structure built on top of reinforced concrete buildings, to reduce the construction cost.

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2) External wall in consideration of the annual dominant wind direction and sunshine condition, the buildings are principally designed of east-west orientation on their lengthwise with windows on the south and north side to employ natural ventilation. No openings are installed on the east and west side, but hollow space in the form of a double wall is provided for insulation. Eaves or sunshades are installed for shading at the openings on the south and north side.

3) Since the open corridors are installed in most parts, rainfall is blown into the corridors during a gale. Thus detail of the entrances to the rooms will be required to have a design which prevents rainwater. Determination of floor level on the ground floor should be based on the highest water level in the past. In the existing campus facilities, the floor level is lifted of 1.0 m above the railroad floor level to avoid the possible flooding.

2.2.5.3.3 *Materials*

In the educational facility, the materials should be selected to create a functional and durable space for the use of a significant number of people. Simultaneously, the materials should be selected to shorten the construction period, reduce construction costs, and minimize operation and maintenance costs (Table 2.8).

Table 2.8 Materials of The Lecture Room Building of KMITL.


Structural Material (for major structure)		
No.	Information	Materials
01.	Pillar, Beam, Floor and Stair	Rainforce concreat
02.	Wall	Concreat block and Brick
Exterior finish materials		
No.	Information	Materials
01.	Roof	Double-layer structure to employ insulation material
02.	External finish	Washed aggregate, hollow brick or paint
03.	Fixture	stainless steel, aluminum, or steel
04.	Eave	Concrete panel, metal, or asbestos cement board
Interior finish materials		
No.	Information	Materials
01.	Class room : Floor	Cement mortar trowelled
	: Wall	Paint
	: Ceiling	Sound absorptive sheet
02.	Laboratory R. : Floor	Cement mortar or tile
	: Wall	Paint
	: Ceiling	Sound absorptive sheet
03.	Production R. : Floor	Felt Carpet
	: Wall	Sound absorptive sheet
	: Ceiling	Sound absorptive sheet
04.	Meeting R. : Floor	Felt Carpet
	: Wall	Paint or vinyl paper
	: Ceiling	Sound absorptive sheet
05.	Hall : Floor	Terrazzo or mortar
	: Wall	Paint
	: Ceiling	Paint
06.	Office : Floor	Vinyl tile or Felt carpet
	: Wall	Paint or vinyl paper
	: Ceiling	Paint

Source: Japan International Cooperation, (1983). "Basic Design Study on The Construction of The Lecture Room Building King Mongkut's Institute of Technology in The Kingdom of Thailand", Japan International Cooperation Agency Library, pp.61-62.

Summary

The architectural element plan of the KMITL Lecture Halls, climate conditions in the region and the nature of facility maintenance and administration plan after the completion were be determinant design. Hot and humid climate conditions, along with the impact of sunlight, wind, and rain on the buildings were thoroughly taken into consideration. Simultaneously, the maintenance-free structure were introduced to each design element where possible to minimize the operation and maintenance cost of the facilities. The materials were selected base on a functional and durable space for the use of a significant number of people. As well as construction and cost efficiency shorten the construction period (Table 2.9).

Table 2.9 Summary of the Lecture Room Building of KMITL.

Study										
Environmental factor Influencing The Architecture design					Specific and unique design Element					
Heavy rain	Strong sunlight	Seasonal Winds	Flooding	Hight Density Land use	Floor Plate Diagram	Building Layout	Climate Design	Supplementary Design Requirements	Local material	Import material
●	●	●	●	●		<ul style="list-style-type: none"> - Mall Lay out - Design to connect existing Office, Railroad - Cronrol furture traffic - Hight Density Land use 	<ul style="list-style-type: none"> - Double layers roof - Double wall on east west Elevation 	<ul style="list-style-type: none"> - Administration plan after completion - Matainance and Durability - 1.0 M raised floor to prevent flooding 	●	●

Source: the author (2021)

2.2.6 *The Environmental Research and Training Center (1989)*

2.2.6.1 *Background*

The population of metropolitan Bangkok has been rapidly increasing due to the inflow of farmers who have lost their jobs in local areas and the shift of workers from local areas to the manufacturing industry in Bangkok, extremely worsening Bangkok's urban functions with the expansion of slum quarters, serious traffic jams and the deterioration of public services.

The Environmental Research and Training Center (ERTC) is an agency under the Department of Environmental Quality Promotion which is under the Ministry of Natural Resources and Environment established with the cooperation between the Thai government and the Japanese government (Fig. 2.20). With the aim to promote, support and carry out research and development of suitable technology for pollution prevention and control including the conservation and management of natural resources and the environment as well as having a mission to transfer technology for natural resource and environmental management for government officials, private individuals and private organizations both in the central and provincial areas and since the environmental research and training center operated on March 20, 1992. Environmental Research and Training Center play an important role in supporting the Thai government in driving the country towards sustainable development and for the better quality of life of the people.



Fig. 2.20 Environmental Research and Training Center

(Source: the author)

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2.2.6.2 *Environmental factor influencing the Architecture design*

The ERTC building, climatic conditions are similar to those of the Bangkok metropolitan area and are characterized by high temperatures and humidity and high level of solar radiation.

The building is located in Khlong Luang District is part of the Chao Phraya rivers and is suffering from conspicuous land subsidence. Therefore, measures dealing with the land subsidence should be taken not only in the pictorial planning and general site preparation work. As rainwater in northern Thailand flows south in the months during and after the rainy season, increasing the District's canal water level measures to prevent damage to the ERTC facilities due to flooding were examined.

2.2.6.3 *Specific and unique design Element*

2.2.6.3.1 *Building Layout*

The ERTC building compound will largely consist of three main blocks, including research, training, and environmental monitoring, in addition to the administrative and the dormitory blocks. The facility layout is located along the east-west axis with an entrance hall at the center of the building. The training and administrative blocks is located to the east of the entrance hall. In contrast, the research and environmental monitoring blocks, which are closely connected, is located to the west of the entrance hall. The canteen and dormitory blocks will be located beyond the courtyard at the far side of the main entrance to maintain privacy.

Instead of central corridors that cannot provide adequate natural ventilation and lighting, side corridors is adopted, aiming at low-cost air conditioning, ventilation, and lighting with little dependence on equipment. Although the total corridor length is rather long due to the adoption of side corridors, a gallery around the courtyard provide quick access between blocks. The provision of a courtyard secures natural ventilation and privacy for each block, while all the blocks located on one side of the courtyard will be connected through the entrance hall, nine cores will also be introduced so that any location within the building is visible. Such common facilities are stairs, lavatories, and storages, which will be located at these cores for easy access and use (Fig. 2.21).

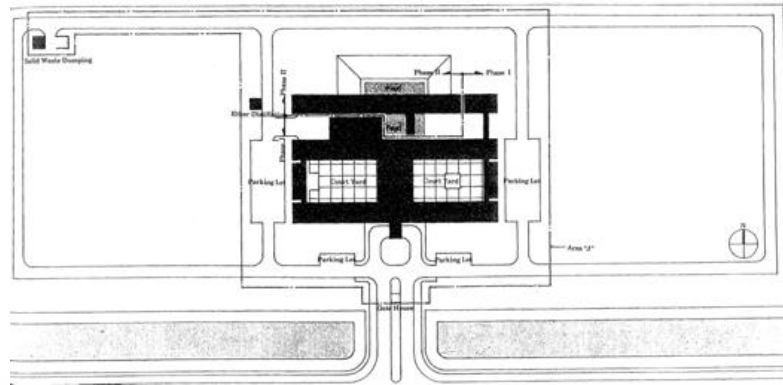


Fig. 2.21 Floor Plate Diagram of The Training Center

(Source: Japan International Cooperation, (1989). “Basic Design Study Report on The Establishment of The Environment Research and Training Center in Kingdom hailand”, Japan International Cooperation Agency Library, p.137)

2.2.6.3.2 Climate Design

Wide eaves will be introduced around the building to protect it from the intense sunshine and torrential rain, which are characteristics of a tropical climate. The building is consist of three stories to shorten the construction period and to reduce the volume of foundation and piling work (Fig. 2.22). The height of the first floor is be 1.5m above the level of the banking prepared by the Thai side to protect the building and essential equipment from possible flooding.

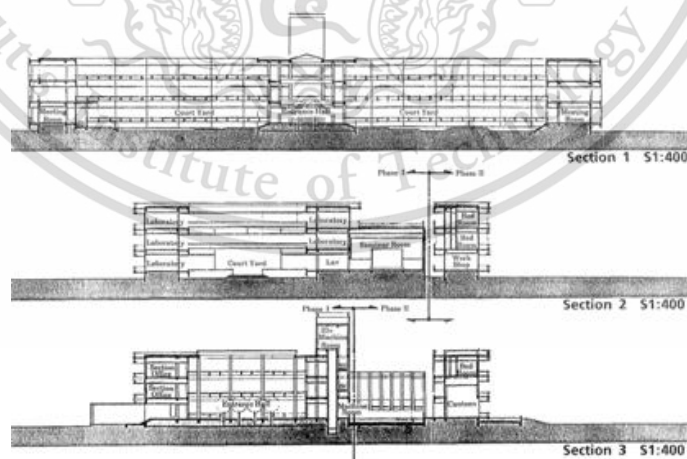


Fig. 2.22 Section Environmental Research and Training Center

(Source: Japan International Cooperation, (1989). “Basic Design Study Report on The Establishment of The Environment Research and Training Center in Kingdom hailand”, Japan International Cooperation Agency Library, p.142)

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2.2.6.3.3 Materials

Exterior Finishing washed terrazzo, which are traditionally used in Thailand and almost maintenance-free, will be used for the exterior finish. Therefore, paint should be carefully selected, and the painting of large areas should be avoided. The roof is covered by concrete slabs and then coated with mortar gave waterproofing. A tilted roof covered with asbestos slates are placed above the mortar waterproofing to improve heat insulation and waterproofing.

Interior Finishing of the rooms have been classified into the following groups based on their requirements to select the most suitable interior finishing materials (Table 2.10).

Table 2.10 Materials of Environmental Research and Training Center (ERTC)

Group A /Group B /Group C /Group D /Group E /Group F /Group G			
Group A :	Public spaces (entrance hall, canteen, corridors) Requiring durable materials that are easy to maintain.		
Group B :	Offices and section offices, requiring a Standard finish which is durable and economical.		
Group C :	Laboratories, requiring a finish with superior resistance to chemicals and easy maintenance in view of maintaining a sanitary environment.		
Group D :	Bedrooms and other rooms requiring comfort.		
Group E :	The seminar room and the audiovisual room require superior acoustic absorption.		
Group F :	Machine room and practice rooms, requiring durability and workability.		
Group G :	Lavatories and kitchen, requiring easy cleaning in view of the use of water.		
The following materials have been selected for each of the above groups			
Group	Floor	Wall	Ceiling
A	Washed aggregate and polished terrazzo in parts	Washed terrazzo	The paint finish on mortar
B	Vinyl paint	Vinyl paint	Rockwool board
C	Epoxy paint	Vinyl paint	M-type bar (lattice ceiling), paint finish
D	Parquet floor	Vinyl paint	The paint finish on gypsum board
E	Parquet floor	Acoustic board	Rockwool board
F	Hard Mortar finish	Vinyl paint	The paint finish on concrete
G	Ceramic tiles	Vinyl paint	The paint finish on waterproof board

Source: Japan International Cooperation, (1989). "Basic Design Study Report on The Establishment of The Environment Research and Training Center in Kingdom Thailand", Japan International Cooperation Agency Library, p.131.

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Summary

Environmental Research and Training Center (ERTC) is an agency under the Department of Environmental Quality Promotion, under the Ministry of Natural Resources and Environment established with the cooperation between the Thai government and the Japanese government. The environmental research and training center operated on March 20, 1992. The ERTC is largely consist of three main blocks, including research, training, and environmental monitoring, in addition to the administrative and the dormitory blocks.

The ERTC building was design with wide eaves around the building to protect it from the intense sunshine and torrential rain, which are characteristics of a tropical climate. The first floor's height is roused 1.5m above the level of the banking prepared by the Thai side to protect the building and essential equipment from possible flooding (Table 2.11).

Table 2.11 Summary of Environmental Research and Training Center (ERTC)

Study					Specific and unique design Element				
Environmental factor Influencing The Architecture design									
Heavy rain	Strong sunlight	Seasonal Winds	Flooding	Hight Density Land use	Building Layout	Climate Design	Supplementary Design Requirements	Local material	Import material
●	●	●	N/A	N/A	Floor Plate Diagram  <ul style="list-style-type: none"> - Gallery around courtyard - Site corridors as cores to connect facilities to entrance hall 	<ul style="list-style-type: none"> - Double layers roof - Side corridor to provide natural ventilation - Wide eaves 	<ul style="list-style-type: none"> - Shorten the construction period - Reduce the volume of foundation - Piling work - 1.5 M raised floor to prevent flooding - The painting of large areas should be avoided 	●	N/A

Source: the author (2021)

Summary

Kume Architects-Engineers designed the buildings. Most of the construction is in Bangkok, a joint project between Thailand and the Japanese during the year 1978-1989 were designed by *Kume Architects-Engineers*. These constructions of the buildings as well as the government of related furnishing items were funded by the Japanese government.

The design of *Kume Architects-Engineers* may be seen as a combination of functional and environmental. The architects' design embrace important considerations entailed: 1.) environmental factor of local climate. There included solar radiation, rainfall, and natural ventilation. 2.) ease of maintenance and operation by using local materials. A summary of the categorical analysis by using the framework is tabulated below (Table 2.12).

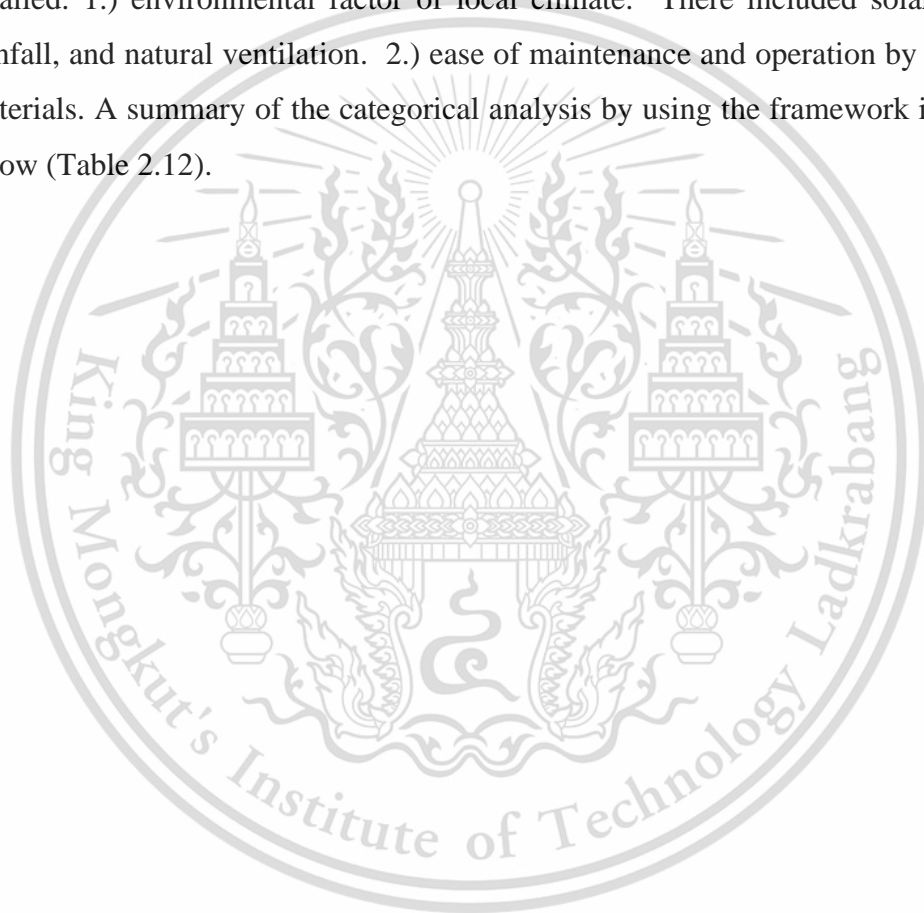








Table 12 Previous studies of Kume Architects-Engineers as categorized by the research framework

Study								
Specific and unique design Element								
Project related to Kume Architects-Engineers	Previous Study	Project	Building Layout	Climate Design	Supplementary Design Requirements	Local material	Import material	
		THE LIBRARY & MEDIA BUILDING ASIAN INSTITUTE OF TECHNOLOGY Year 1978	 <small>Floor Plate Diagram not to scale</small>	<ul style="list-style-type: none"> - Use courtyard to enable the function flows to run around in a loop - 8x8 Grid module 	<ul style="list-style-type: none"> - Double layers roof - Eaves, louvers, and canopies around the building - Courtyard to provide natural light and ventilation 	- Two stories to balance with the campus and ground condition of the site and to be uniform with other building blocks	●	
		CENTRAL LABORATORY & GREENHOUSE COMPLEX OF KASETSART UNIVERSITY KAMPHAENSAEN Year 1978		<ul style="list-style-type: none"> - Loop structure to connect passage from each building to the public corridor - 7 x7 Grid module 	<ul style="list-style-type: none"> - Double layers roof - High floor to prevent flooding - Eaves, louvers, and canopies around the building - Seasonal wind to create draft 	N/A	●	
		THE YOUTH WELFARE CENTER PROJECT IN THE KINGDOM OF THAILAND Year 1979		<ul style="list-style-type: none"> - Open space in the center and in the front 	<ul style="list-style-type: none"> - Double layers roof - High floor to prevent flooding - Eaves, louvers, and canopies around the building - Seasonal wind to create draft 	N/A	●	
		THE ESTABLISHMENT PROJECT OF THE TRAINING CENTER Year 1982		<ul style="list-style-type: none"> - Leave open space for future expansion 	<ul style="list-style-type: none"> - Double layers roof - Eaves, louvers, and canopies around the building - Seasonal wind to create draft 	- Retain relationship with office building around the site	●	
		THE LECTURE ROOM BUILDING KING MONGKUT'S INSTITUTE OF TECHNOLOGY Year 1983		<ul style="list-style-type: none"> - Mall Lay out - High Density Land use - Design to connect existing office, railroad - Control future traffic 	<ul style="list-style-type: none"> - Double layers roof - Double wall on east west Elevation 	<ul style="list-style-type: none"> - Administration plan after completion - Maintenance and Durability - 1.0 M raised floor to prevent flooding 	●	●
		THE ESTABLISHMENT OF THE ENVIRONMENTAL RESEARCH AND TRAINING CENTER Year 1989		<ul style="list-style-type: none"> - Gallery around courtyard - Site corridors as cores to connect facilities to entrance hall 	<ul style="list-style-type: none"> - Double layers roof - Wide eaves - Side corridor to provide natural ventilation 	<ul style="list-style-type: none"> - Shorten the construction period - Reduce the volume of foundation - Piling work - 1.5 M raised floor to prevent flooding - The painting of large areas should be avoided 	●	

Source: the author (2021)

2.3 Review of Research Methodology

The aim of this section is to review the relevant research design method (see: Table 2.13). The review topics range from 1) Research Paradigm, 2) Research Design, 3) Data Collection and Analysis, and 4) Informants and Recruitment Techniques. The purpose of this review is to critically assess the research design and techniques appropriate for investigating architectural elements within the research framework for this study.

2.3.1 *Research Paradigm*

The studies of design method, particularly of iconic architecture, usually proceed retrospectively. In most cases, the research attempts to understand multiple factors that influence the background, inspiration, thought process, and work pattern of the architect of interest. The paradigm that lends itself to the exploration of such a pluralistic worldview is of the naturalistic stance. Most of the research studies in this review are based on the naturalistic paradigm or have naturalistic combined with quantitative techniques.

2.3.2 *Research Design*

For all of the research studies reviewed, the research design can be categorized as historical research as they investigate and compile past occurrences. Case study research is also found to be useful for studying the work of an iconic person, as evident in the studies.

Table 13 Review of Methodology

	Article's title	Year	Authors	Paradigm	Research Design	Data collection				
						Interview	Drawing	Photographi	Archival	Field
Literature review related to design methods	STUDY ON THE CHARACTERISTIC OF MIES VAN DER ROHE'S DESIGN PROCESS OF EARLY 1930'S HOUSES	2002	Juan Rufino CASTILLO, Toshimasa SUGIMOTO	Qualitative	Historical		●	●		●
	EARLY DAYS OF THE MODERN INFFLUENCE AT SILPAKORN SCHOOL OF ARCHITECTURE	2008	Rerde POTIWANAKUL	Qualitative	Historical Case study	●	●	●	●	●
	EARLY MODERN ARCHITECTURE IN EAST AFRICA AND ITS ADAPTATION TO THE CLIMATE	1986	Nobuyuki OGURA	Qualitative	Historical		●	●	●	
	CULTURAL SIGNIFICANCE IDENTIFICATION OF MODERN ARCHITECTURAL HERITAGE	2017	Waeovichian ABHICHARTVORAPAN, Kenji WATANABE	Qualitative	Historical Case study	●	●	●	●	●
	ARCHITECTURAL DESIGN METHODS FOR THE TROPICAL CLIMATE BY JUNZO SAKAKURA IN CASE OF A VOCATIONAL SCHOOL PROJECT IN LADKRABANG, THAILAND	2019	Junichi SAWAKI	Qualitative	Historical Case study	●	●	●	●	●

Source: the author (2021)

CHAPTER 3

RESEARCH METHODOLOGY

This research intends to compile and analyze the contemporary architectural design by Kume Architects-Engineers in Thailand during the 1970s. This chapter presents the research design for the investigation of Kume Architects-Engineers' design method in the first auditorium complex of King Mongkut's Institute of Technology Ladkrabang in Thailand. Also, the data were collected through the study of documents that provide historical information about the first auditorium complex, its significance and architectural interpretation, and the interview of auditorium staff.

3.1 The Main Case Study

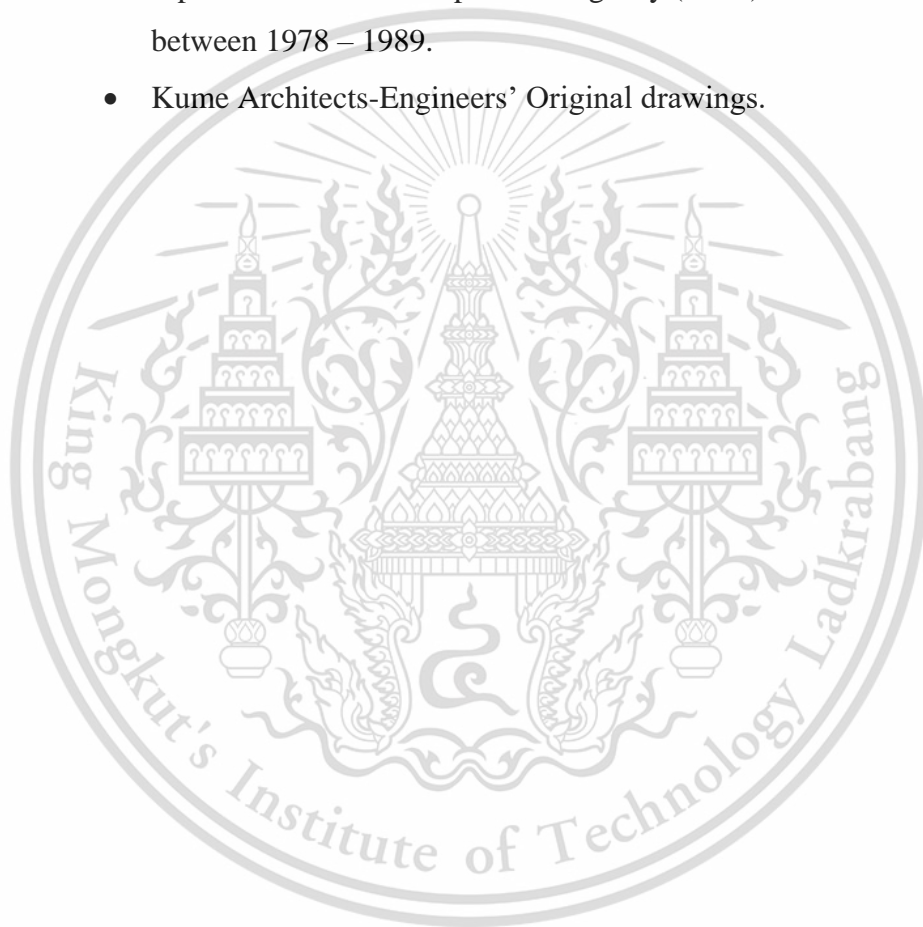
The main case study in this investigation is the first auditorium complex in King Mongkut's Institute of Technology Ladkrabang (KMITL). It was constructed right after the institute had been relocated to Ladkrabang in 1971 with the funding & support from the Japanese government.

3.2 Research Design

The previous chapter states that historical research and case studies have often been used in the design method. Thus, this paper also adopts this qualitative paradigm using a case study approach. The main data sources studies include archival records, such as the architectural drawings, initial photographs taken during the construction, and architectural journals with supplementary data from field research, including observation, the interview from twelve personnel that are related to the first auditorium complex building, and artifactual measurement, as presented below. The first auditorium complex of King Mongkut's Institute of Technology Ladkrabang:

- Site measurement, and field observation
- Interviews
 - Krisda Indrasthitya, Associate professor. Date of interviews: September 10, 2018

- Rattanarama Puangpet, Associate professor. Date of interviews: October 12, 2018
 - Somsak Thamwetwithi, Professor. Date of interviews: November 24, 2018
 - Prakit Tangtisanon, Associate professor. Date of interviews: January 24, 2019
- Archival records
- Japan International Cooperation Agency (JICA) records from the period between 1978 – 1989.
 - Kume Architects-Engineers' Original drawings.



Sources of data used for the analysis are shown as follows (Fig. 3.1).

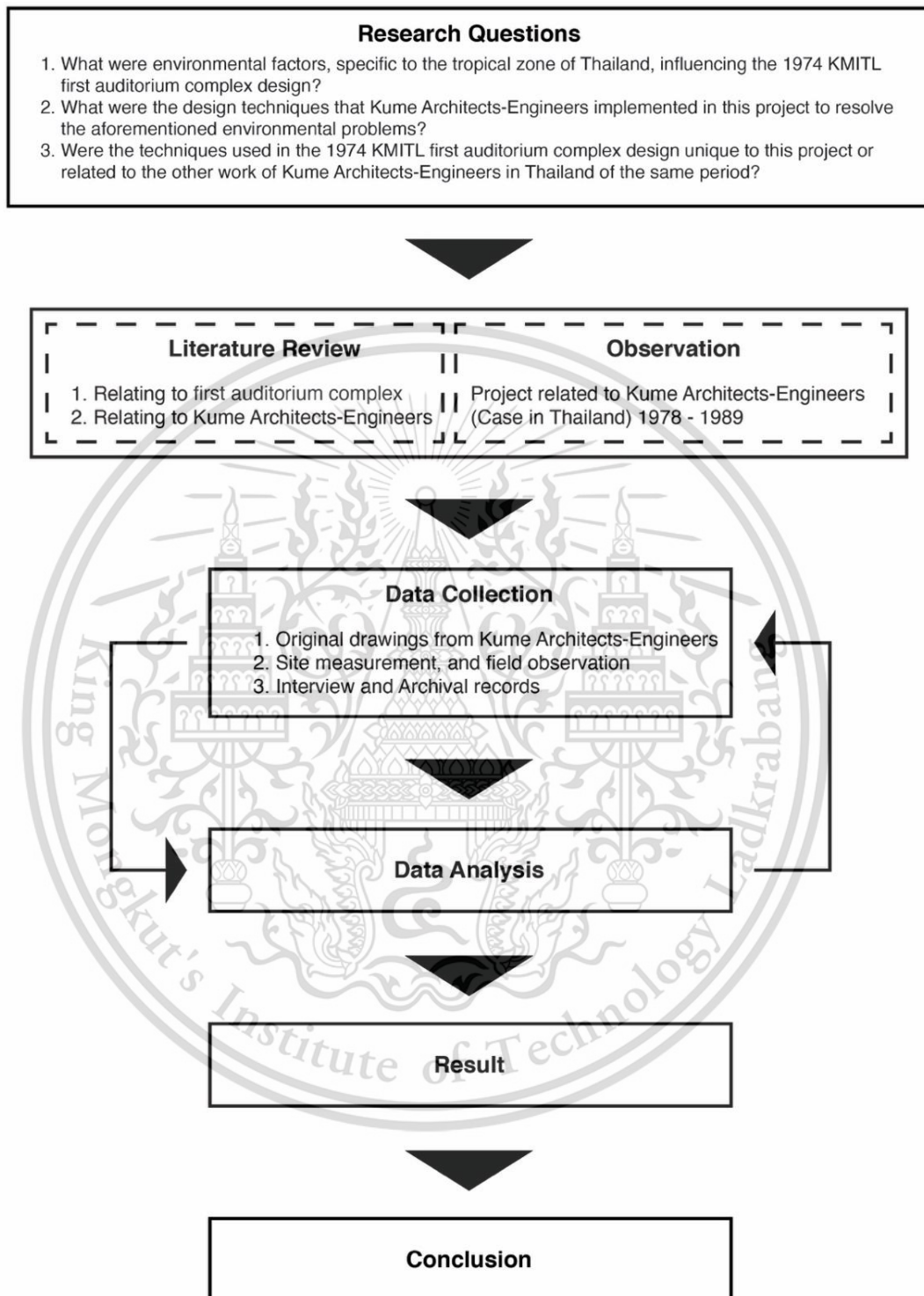


Fig. 3.1 Diagram of Research Design
(Source: the author)

CHAPTER 4

RESULTS

This chapter presents *Kume Architects-Engineers* design methods including the environmental factors influencing the architectural design in the design of the King Mongkut's Institute of Technology Ladkrabang (KMITL) first auditorium complex. In addition to the main investigation, The common characteristics across the six case studies and the first auditorium complex project are discussed.

To set the stage for understanding the KMITL first auditorium complex design and its history, this chapter begins by illustrating the Thailand socio-cultural scene of the early 1970s that lead to the conception of the project. Further, the relation between KMITL and the Japanese organization that provide aids and funding are also described. Based on the data gathered through the field survey, interviews and archival study, the KMITL first auditorium complex architectural characteristic is then analyzed with focuses on the environmental factors that served as external forces shaping the design consideration as well as building specific and unique design elements, which includes building layout and floorplate, climate design, materials selection and criteria as well other supplementary attributes.

4.1 Background Information

4.1.1 *The Socio-economics Context of Thailand during the 1970s*

Up until the 1970s, Thailand continued steady but piecemeal economic growth, establishing its economy's basic structure depending mostly on the agriculture production (Fig. 4.1). The country as result, the agricultural labor occupied 70 percent of the country's entire workforce. However, the economic growth were slowing down in the late 70s due to stagnant agricultural production caused by unfavorable weather worsening international trade balance, and a high inflation rate resulting from sudden rise of oil prices.

To avoid the undesirable impacts from this economic downturn, Thailand needed to shift from its former agrarian economic base and moved toward a semi-industrial economy. This led to an important mission for the government sector to

promote technical education in order to produce competent engineers to supply the country is plan for an upcoming industrial society.

Along with the aforementioned task, the Government was obligated to expand the educational facility, provided improved and efficient equipment and resources for basic research and training as well as higher education institutions such as universities and various technical schools. However, such programs' implementation faces difficulty because of a chronic shortage of budget.



Fig. 4.1 The economy's a basic structure of Thailand

(Source: https://en.wikipedia.org/wiki/1970s_peasant_revolution_in_Thailand)

4.1.2 History of King Mongkut's Institute of Technology Ladkrabang (KMITL)

KMITL began as the Nonthaburi Telecommunication Training Center on August 24, 1960, with academic cooperation from the Government of Japan. Later in 1964, under the Colombo Plan, the training center became the Nonthaburi Institute of Telecommunications.

As specified by the 1971 King Mongkut's Institute of Technology Act, KMITL was originated by combining three technical colleges (Fig. 4.2). Namely the Nonthaburi Institute of Telecommunications, the North Bangkok Technical College, and the Thonburi Technical College. In the same year, the Nonthaburi Institute of Telecommunications, or known as King Mongkut's Institute of Technology at Nonthaburi Campus, was relocated to the district of Ladkrabang in Bangkok.

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The Nonthaburi Institute of Telecommunications became the Faculty of Engineering in 1972. In the same year, the College of Design and Construction located at the Bangplad district was transformed into the Faculty of Architecture adding the new discipline to KMITL. The new campus was named the ‘*Chao Khun Taharn Ladkrabang*’ campus.

Among the three campuses that constitute the King Mongkut’s Institute of Technology, the Ladkrabang Campus was the only engineering college in Thailand recognized for its long standing academic cooperation and support from the Japanese government and private institution.

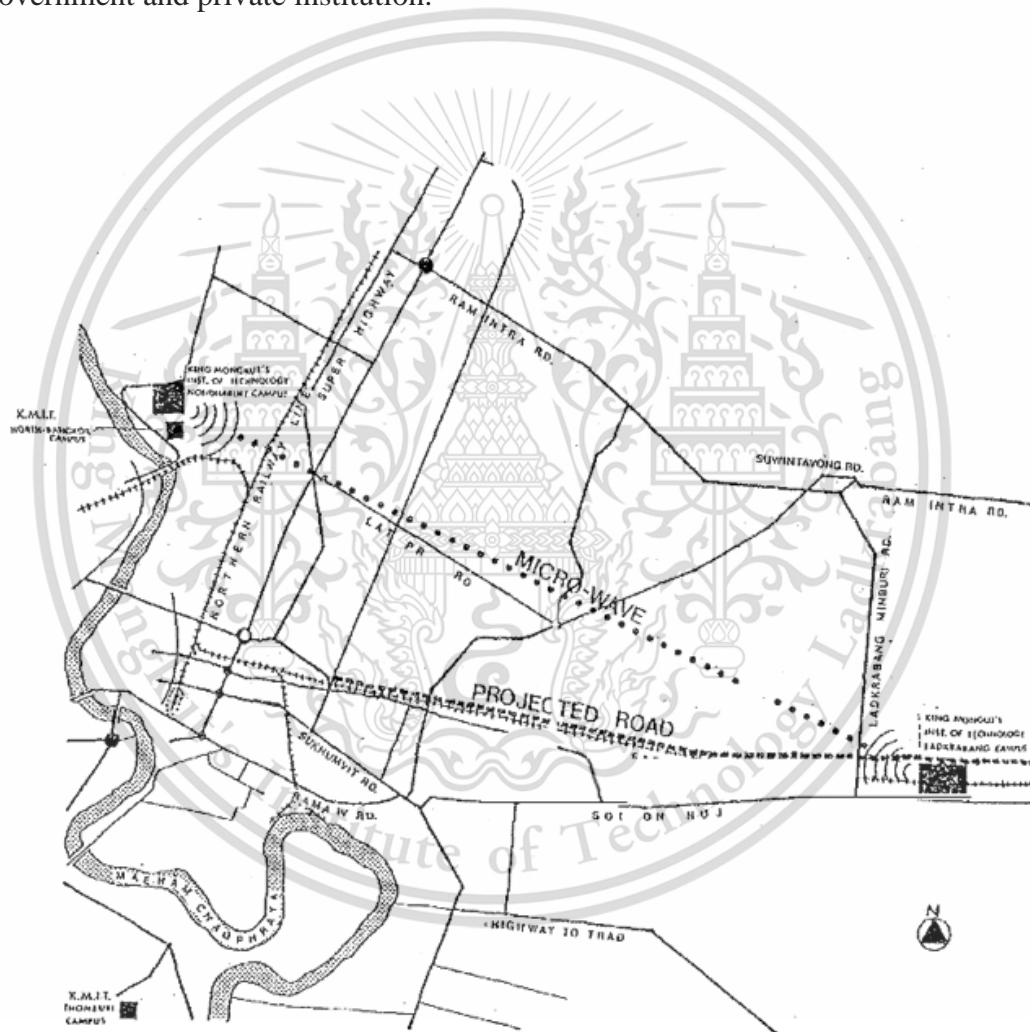


Fig. 4.2 Location of Three Campus of KMITL

(Source: Japan International Cooperation, (1983). “Basic Design Study on The Construction of The Lecture Room Building King Mongkut’s Institute of Technology in The Kingdom of Thailand”, Japan International Cooperation Agency Library, p.18)

The financial assistance from the Japanese government for the construction of KMITL campus in 1973 consisted of two installments. The record showed that the government of Japan provided 163.2 million yen as the first installment of grant aid to cover the construction of a telecommunication laboratory building, a library, a memorial hall, an auditorium (capacity 1600 people), a gymnasium. Due to the yen appreciation and rise in construction expenses, 790 million yen was stipulated as the second installment of grant aid in June 1974.

A decade later, KMITL received the second phase of grant aid of 3.69 billion yen, from the Japanese government to expand its campus, including classrooms, an information center, an administration office, a cafeteria, and student dormitories in 1983. The development of the KMITL campus during the period of 1970s-1980s are shown in (Fig. 4.3).

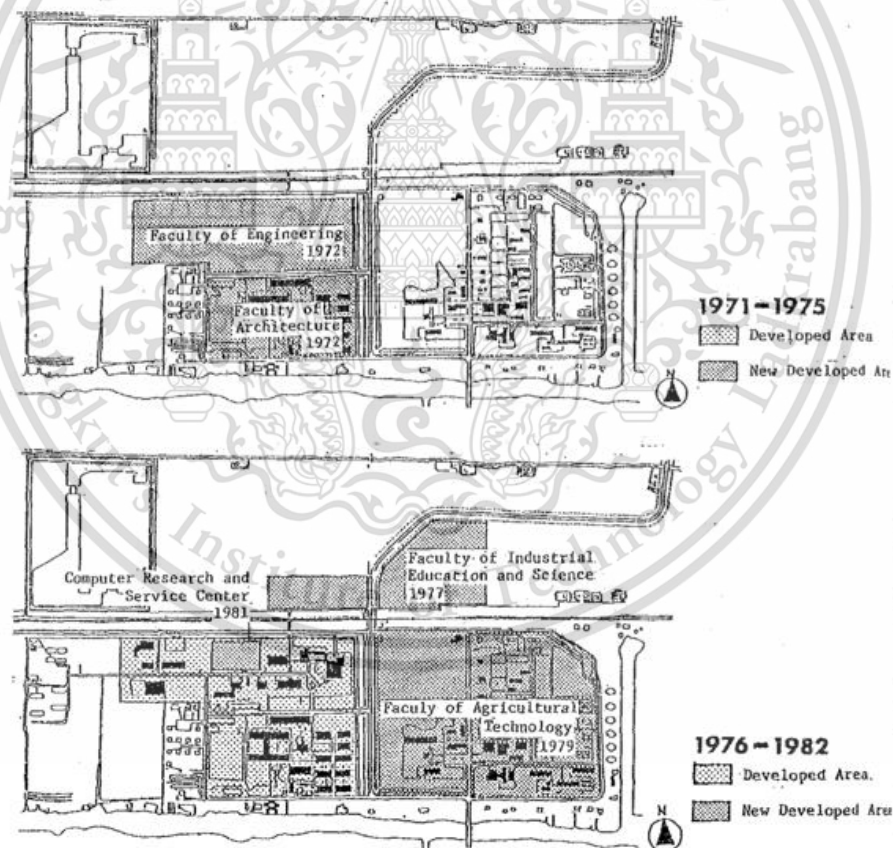


Fig. 4.3 Developed Progress of KMITL

(Source: Japan International Cooperation, (1983). "Basic Design Study on The Construction of The Lecture Room Building King Mongkut's Institute of Technology in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.24)

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In summary events in history of KMITL are listed as follows : (Table 4.1).

Table 4.1 Event in history of KMITL

Years	Event
1959	File study by the Government of Japan for technical
1961	Opening of Nondhaburi Telecommunication Training Center
1964	Raise of the status to Nondhaburi Telecommunication College
1969	Cabinet approved to merging of Nonthaburi Telecommunic action College, North Bangkok Technical School, and Thonburi Technical School, and to establishing of advanced course
1970	Established as King Mongkut's Institute of Technology on merging of three schools, and which were named as KMITL Nondhaburi, North Bangkok, and Thonburi campus
1972	Decided to relocate Nondhaburi campus to Ladkrabang Establishing the faculty of architecture by merging with the existing architectural school
1975	Completion of the facilities for the faculty of engineering, under grant aid by the Government of Japan.
1976	Use of Nondhaburi campus as the Faculty of engineering of KMITL Ladkrabang
1977	Establishing the faculty of industrial education and science
1979	Establishing of the faculty of agricultural technology by merging with an agricultural school
1983	Cabinet approval to raise 3 KMITL campuses to the status of independent national university

Source: Japan International Cooperation, (1983). "Basic Design Study on The Construction of The Lecture Room Building King Mongkut's Institute of Technology in The Kingdom of Thailand", Japan International Cooperation Agency Library, p.19

4.1.3 The Location and Site Characteristics

KMITL is located on the land granted by the family of former nobleman who served in the reign of King Rama the V. The entire campus, with a land area of around 120 hectare was located a side of the former irrigation canal called ‘Klong Prawet,’ to the north of On Nuj Street, approximately 30 km east of a central Bangkok. The campus is divided by the Thai National Railway Eastern, a line connecting Bangkok (Fig. 4.4). Diagonally to railway, the campus is cut across by the Chalongkrung road dividing the site into four quadrants. During the early 1970s, the north side of the campus, the highway number 7 (or as known as the Motorway) was still in the planning phase. This highway would be extended in the north-south direction center road and perpendicular to the railroad and will provide access to the institute. This building has two main entrances to the first auditorium complex (Fig. 4.5 – Fig. 4.6).

The natural environment of Ladkrabang is closed to the Chao Phraya river. The site is a vast open land, exposed to strong sunlight, and seasonal wind. It is almost at the sea level, and has a high underground water table contributing to the soft muddy ground, suitable for cultivating rice and freshwater fisheries, which was evident throughout the area. Situated in the middle of wetland and flanked by the canal, Ladkrabang is prone to seasonal flooding during the monsoon season of July to October. Thus, this flooding had become one of the main consideration for the design of the facilities within the KMITL campus (Fig. 4.7).



Fig. 4.4 Proposed of KMITL (1970)

(Source: Source: KMITL archives)

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Fig. 4.5 Proposed of KMITL (2021)

(Source: the author, an edit from google mapping)

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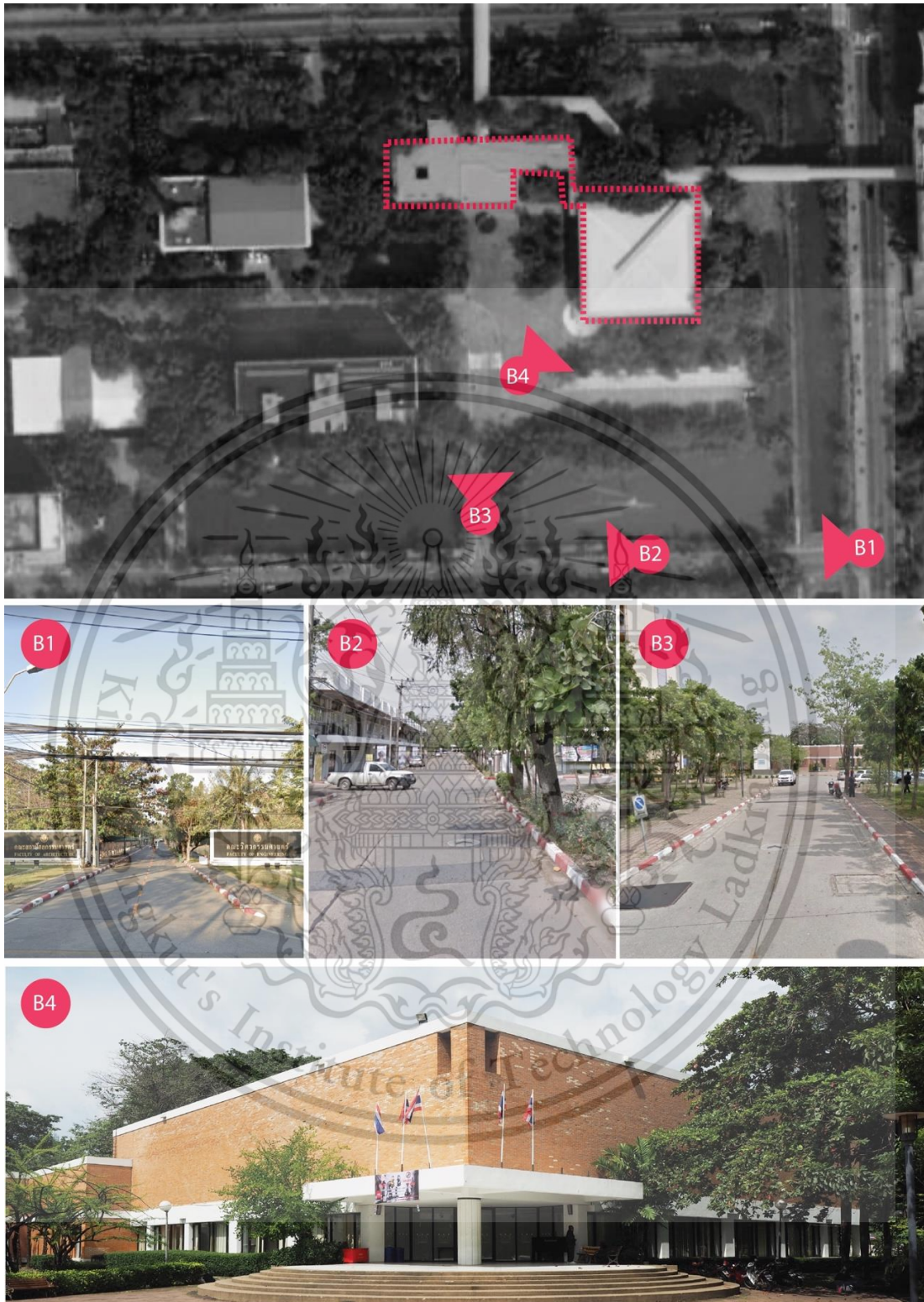


Fig. 4.6 Proposed of KMITL (2021)

(Source: the author, an edit from google mapping)

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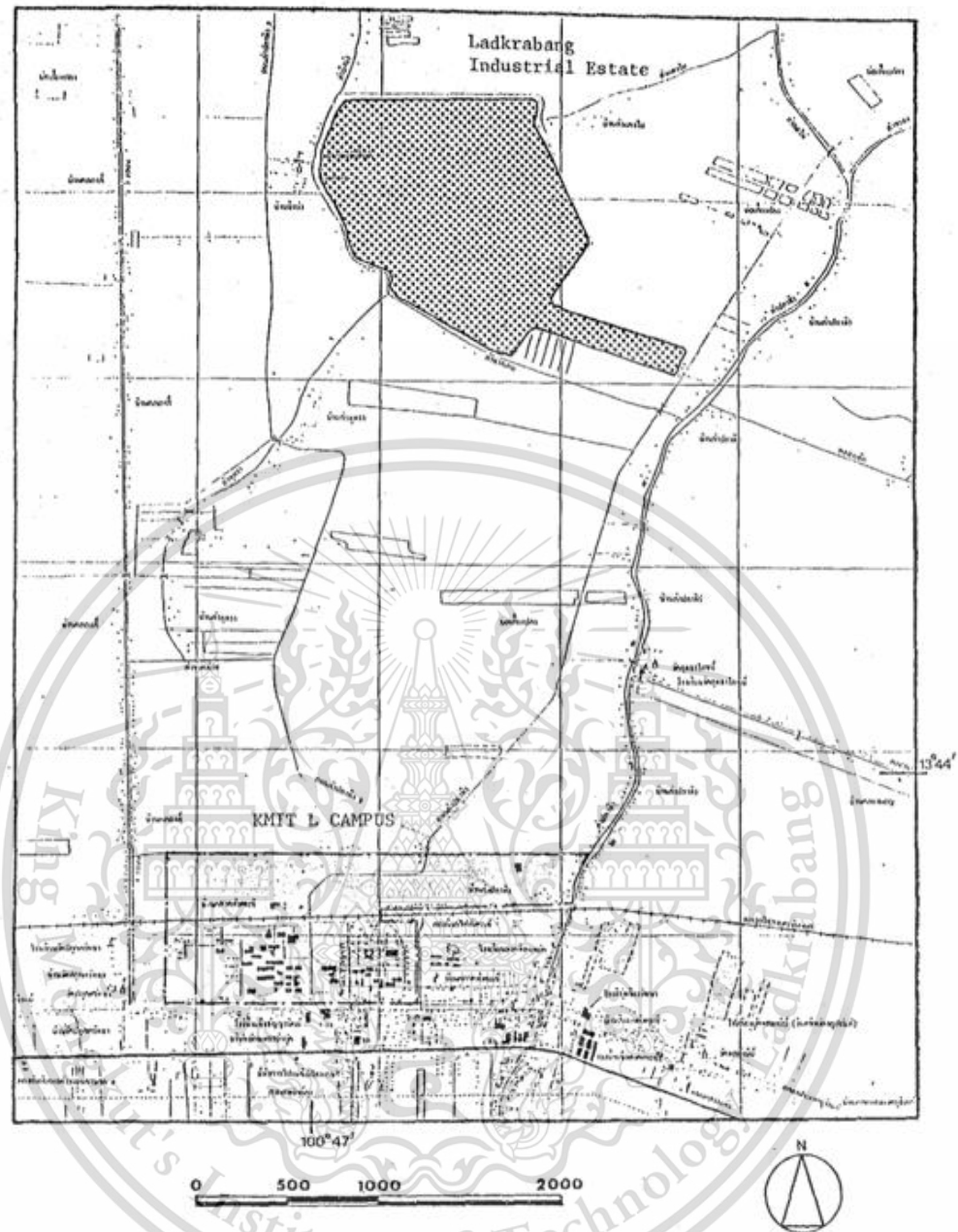


Fig. 4.7 Proposed of KMITL (1970)

(Source: Source: KMITL archives)

4.1.4 The KMITL first auditorium complex

As mentioned earlier, the economic slowdown in the late 70s posed the financial difficulties for Thailand. Despite such struggle, the Thai government attempted to launch a project to construct the first auditorium complex for KMITL to serve as part of a main facilities in the university and as a training center.

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The first auditorium complex was constructed in 1974, and the members of KMITL have considered it as an outstanding in architecture and construction technology designed and made possible by the aids from Japan¹. Thamwetwithi (2018), mentioned that *“the construction of the KMITL first auditorium complex was possible by the Japanese government financial support. And all the materials and equipment used in the construction were imported from Japan.”*

The first auditorium complex has also been regarded as meaningful place associated with KMITL history and good memories. As noted by Rattanarama (2018), *“The first auditorium complex is regarded as a representative of the historical and valuable buildings of King Mongkut's Institute of Technology Ladkrabang.”* The building has been associated with good memories of King Bhumibol Adulyadej (King Rama IX) and Her Majesty Queen Sirikit that graciously came to the ceremony to commemorate the construction's completion (Fig. 4.8) and visited the first Ladkrabang exhibition on June 16, 1976. (Boonpal, 2003) *“This first auditorium complex represents the institute in terms of being an emotional, mental center for students and personnel within the institute in the past. This is because the building has continuously been used for holding meetings, place for various activities regularly. Also, the construction of the first auditorium complex was supported by Japan...Professors from Japan had come to take post at KMITL to train the institute’s.”*



Fig. 4.8 The first auditorium complex in 1974

(Source: KMITL archives)

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4.2 Environmental factors influencing the first auditorium complex Architectural design

The suburb of Bangkok is under hot and humid climate conditions of annual average temperature of 28.5°C, and average relative humidity of 74.7%, with a dry season and the rainy season (May - October), which brings daily shower for 1-2 hours. Predominant wind direction is constantly south from February to September, and North East from October to January. In the feasibility study and design phase, JICA (1983) record indicated that in order to handle heat and strong sunlight, efficient shading design and structural elements, that promoted natural ventilation should be employed in the design of the first auditorium complex.

Suvarnabhumi airport was one of the largest transportation and logistics hub located south of the KMITL campus. Suvarnabhumi airport completed in 2006, the plan to build this airport, in its current location, had been underway and included in considerations to regulate the building design within Ladkrabang district since 1960. These impacts on the building regulations such as controlled building height, and on the well-being of the occupants such as noise pollution and its effect. Concerning with future traffic growth and the possibilities of having an international airport in the vicinity, the facilities (Fig. 4.9), were equipped with a soundproof structure to shield the noise from the future airport in the southern part of Ladkrabang.

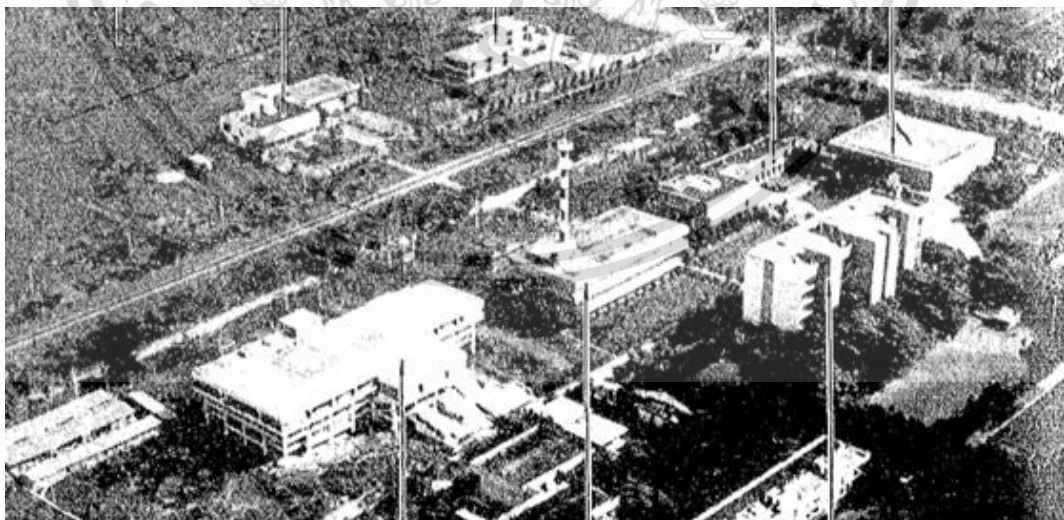


Fig. 4.9 The facilities of KMITL in 1974

(Source: Source: KMITL archives)

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4.3 Specific and Unique Design Elements

4.3.1 Building layout

With the total floor area of 2,076.8 square meter (Fig. 4.10), The first section of the *auditorium* (1,549.9m²) consists of foyer, the main hall, two special function rooms for VIPs guests, storages, washrooms, and mechanical rooms. The second section of the memorial hall and library (526.9m²) consisting of the main hall, lecture room, meeting room, storage, lavatory, library, office, bookstack room, copy room and reading room. These functions have fully served as the meeting place for students and KMITL staffs for almost half of a century since the mid 1970s.

This building is a skeleton framed structure typically used for the construction of multi-story buildings. It incorporates a network, or system, of columns and connecting beams which support the building's interior floors and exterior walls and carries all loads to the foundations (Fig. 4.11-4.12). The grid and modular system with the module unit of 6 m x 6 m found in the entire Auditorium (Fig. 4.13).

The principal function within the auditorium, the main hall, houses a large staging area with seven hundred audience bleacher seats. The large floor in front of the stage can be arranged for all dimension enabling the possibility for being venue for myriad activities such as collaborative meeting , academic seminars, orientation, performing arts, concerts, lectures for further study, medical examination and use in the last experience of student life, graduation rehearsal to name a few (Fig. 4.14 – 4.15).

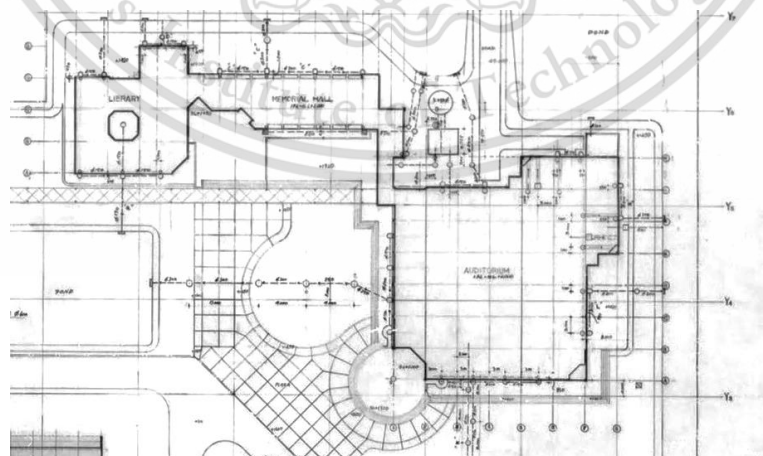


Fig. 4.10 Original drawing of First auditorium complex

(Source: Kume Sekkei 1974)

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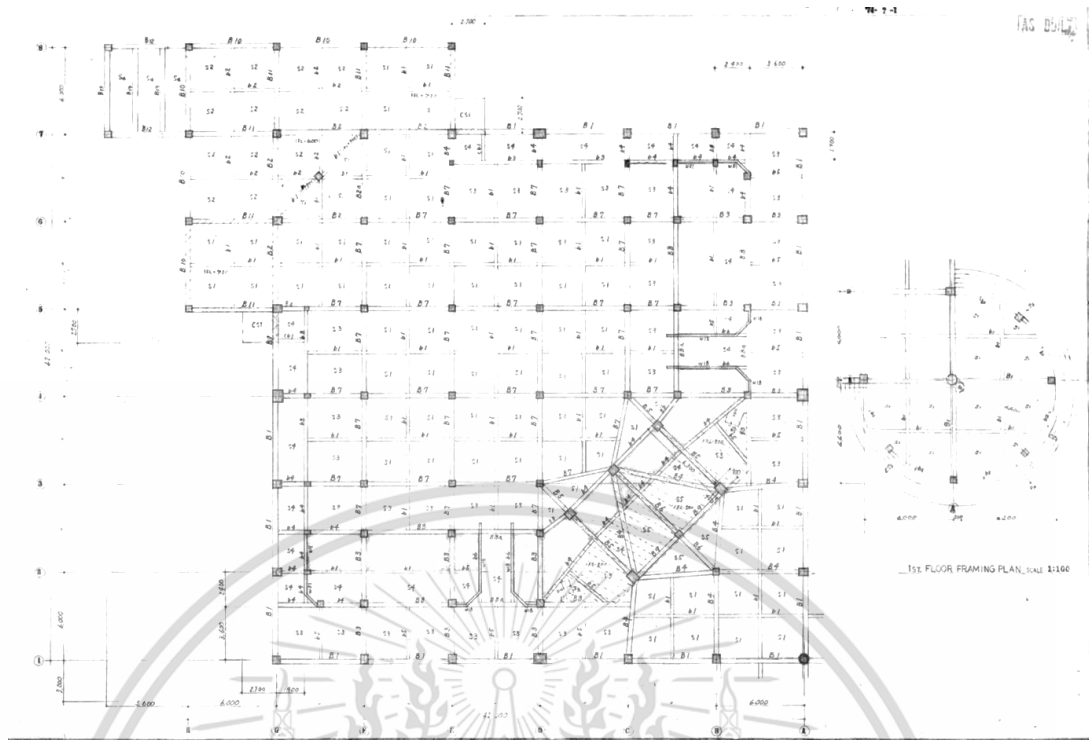


Fig. 4.11 Original drawing of First floor framing Lay-out plan of First auditorium complex

(Source: Kume Sekkei 1974)

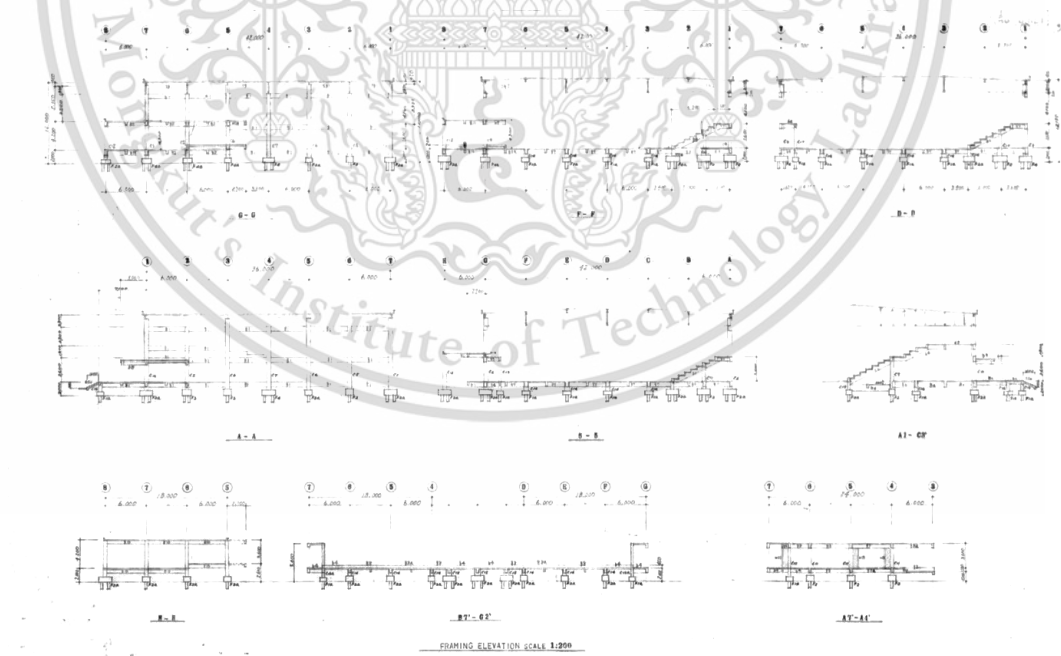


Fig. 4.12 Original drawing of Framing Elevation of First auditorium complex

(Source: Kume Sekkei 1974)

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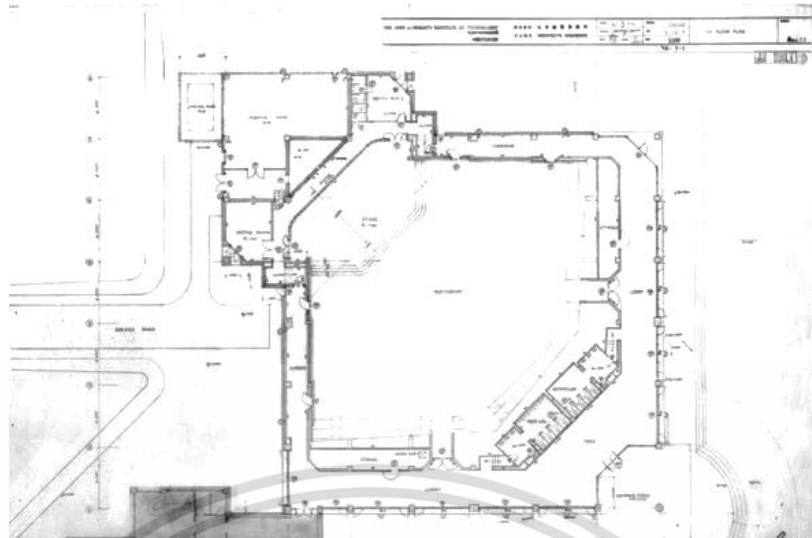


Fig. 4.13 Original drawing of auditorium (First Layout Plan)

(Source: Kume Sekkei 1974)



Fig. 4.14 A meeting place for students and personnel, KMITL

(Source: KMITL archives)



Fig. 4.15 The last experience of student life, graduation rehearsal, KMITL

(Source: KMITL archives)

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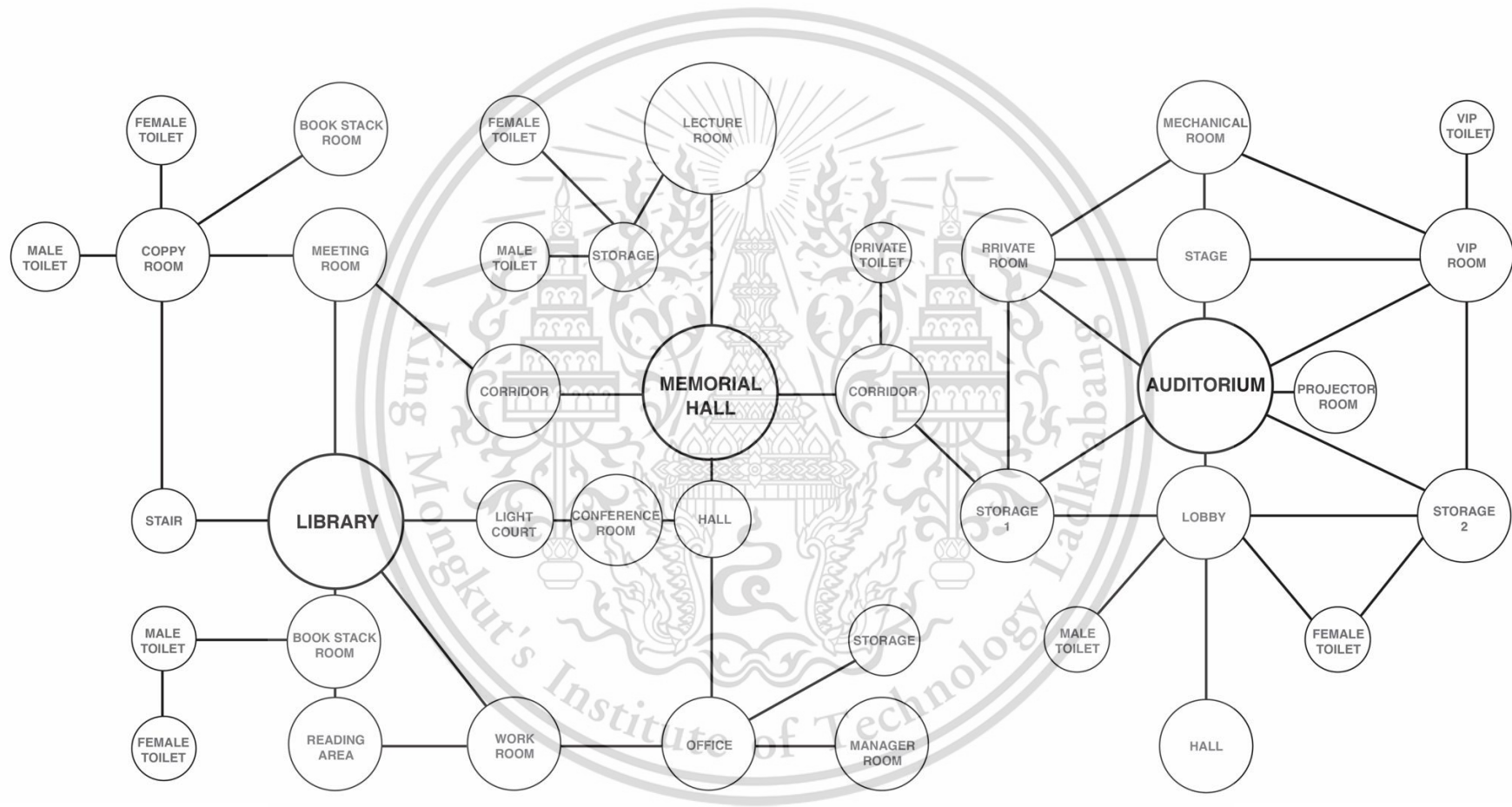


Fig. 4.16 Bubble Diagram of first auditorium, memorial hall and library

4.3.2 Climate Design

The Two seasonal winds are the main consideration for ventilation of architectural design. In Thailand. The north-easterly wind, between November and March, brings cooler temperatures and generally less humidity and less chance of rainfall (Fig. 4.17). Another is the southwest monsoon between June and September that brings monsoons, and along with them humidity from the Indian Ocean.

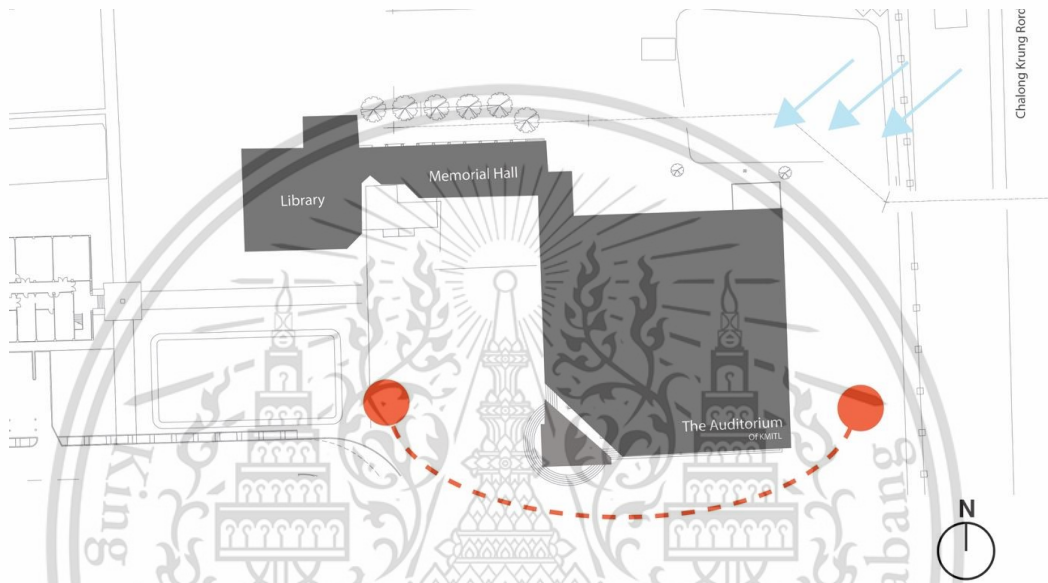


Fig. 4.17 Site analysis

According to the Ministry of Energy, Thailand received solar radiations include both direct and diffuse radiations. Peak density of direct radiation in Thailand usually escalates from January and reaches the peak in April before descending to the bottom in December.

The first auditorium complex layout was conceived with the understanding of these tropical climate conditions, and using design ingenuity to create design solutions to such constraints. The west and south elevation are galleries with side opening that expose the corridor flanking the main hall to natural light and ventilation (Fig.4.18). This results in a very comfortable indoor temperature even without the use of air-conditioning. To cope with excess humid that might retain in the building structure, the architect added series of small squares for ventilation. Conway (2016) a ventilated cavity wall works on the simple premise of letting air into and out of the wall cavity through weep vents strategically. This connection promotes drying of the wall assembly

as moisture is dissipated to the exterior through vents in the brick wall. Venting of the wall cavity in wet climates creamware resilient wallet with less moisture-related issues such as spalling, cracking, or staining. In some cases, the introduction of wall cavity venting to an existing unventilated cavity wall has helped alleviate or eliminate chronic efflorescence since salt-saturated moisture does not have time to form in abundance or migrate to the surface the brick wall. (Fig. 4.19- 4.20). From the survey of a ventilated cavity wall, it was found that inside the humidity was 31Rh and outside the humidity was 30Rh (Fig. 4.21).

The large plain of the auditorium's roof is an element that positively affected by intense sunlight of the equator (Fig. 4.22). The heat radiate from the rooftop would lead to high temperature and the large amount of power consumption for air-conditioning. Thus, the design measure must be taken to solve this problem. With this in mind, double roof layers of concrete roof slab covered with asbestos corrugate shingles with gap for ventilation were used to provide air insulation to reduce direct radiation (Fig. 4.23).

Since the construction site of the auditorium covered the wetland with poor soil condition, the settlements around the buildings must be prepared to handle floods, and storm water drainage. Determinant floor level on the ground floor was based on the past highest water level (Fig. 4.24- 4.27). As such the auditorium main floor was set to 1.5 m above the ground.



Fig. 4.18 Corridor of The auditorium

(Source: the author)

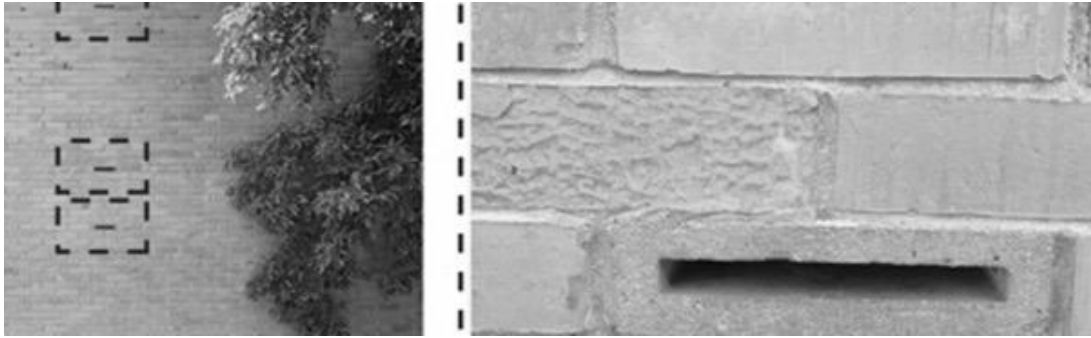


Fig. 4.19 Small squares for ventilation

(Source: the author)

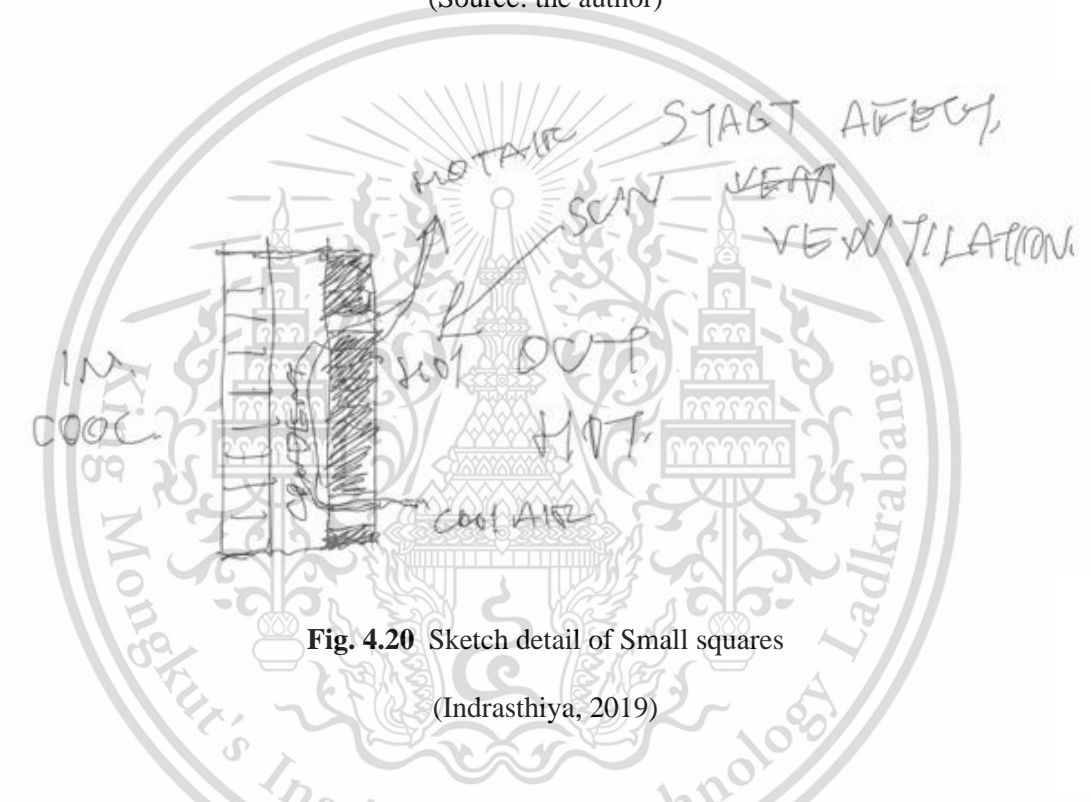


Fig. 4.20 Sketch detail of Small squares

(Indrasthiya, 2019)



Fig. 4.21 Ventilated cavity wall (inside and outside the humidity)

(Source: the author)

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Fig. 4.22 Two-story roof design

(Source: the author)

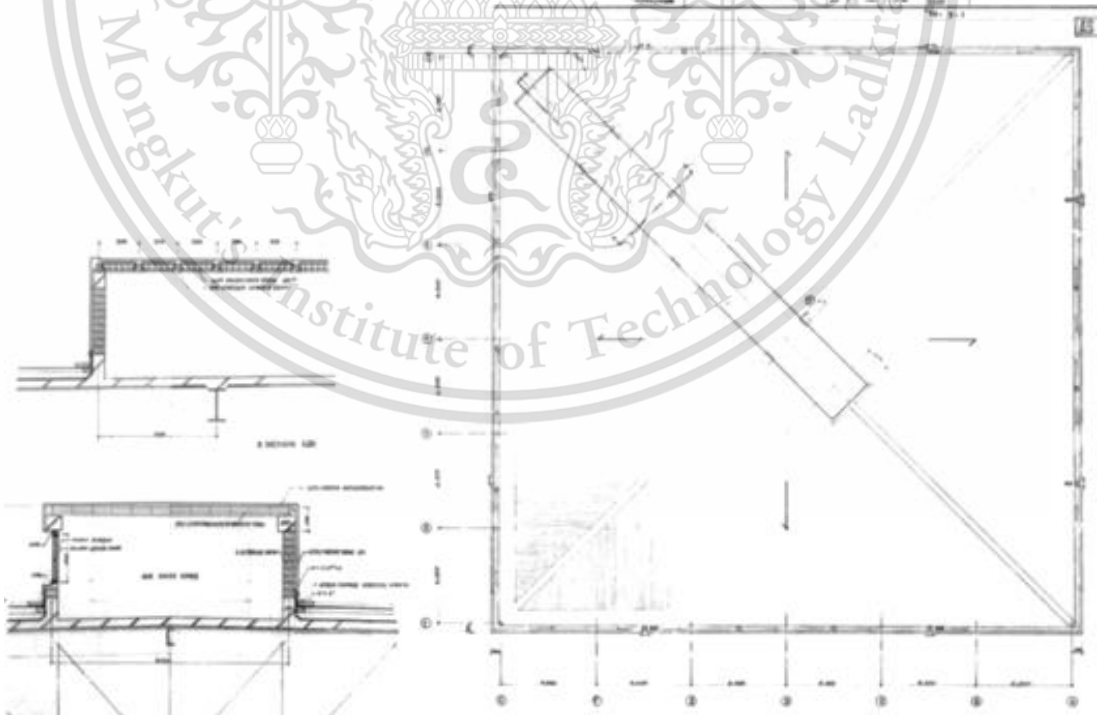


Fig. 4.23 Original drawing (Roof design)

(Source: Kume Sekkei, 1974)

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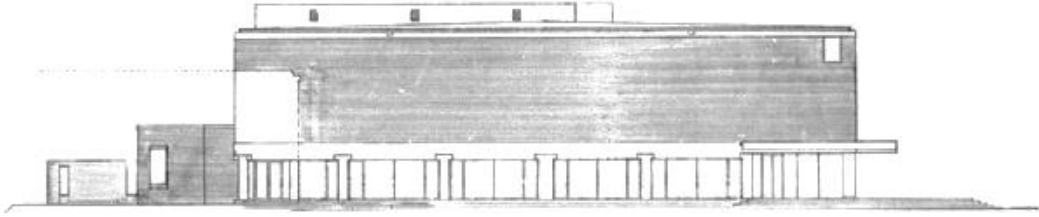


Fig. 4.24 Original drawing (West Side Elevation)

(Source: Kume Sekkei, 1974)

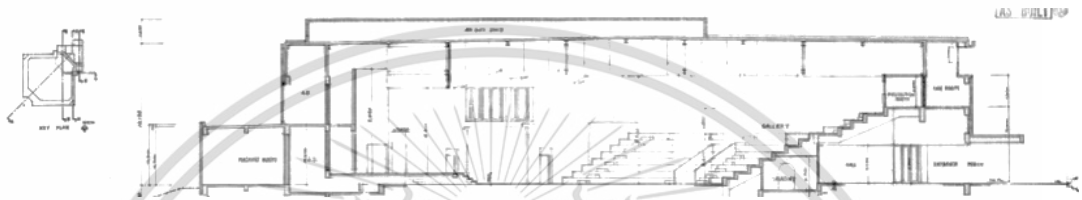


Fig. 4.25 Original drawing (Section A)

(Source: Kume Sekkei, 1974)

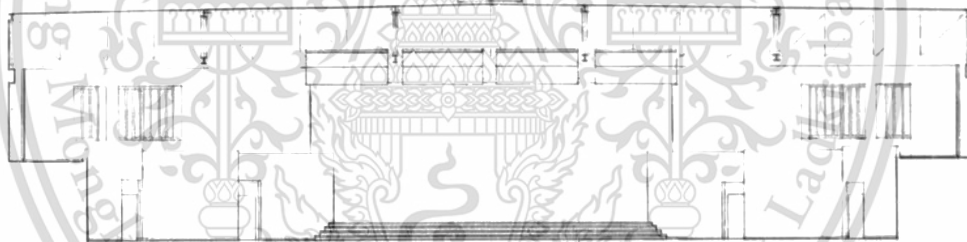


Fig. 4.26 Original drawing (Side A)

(Source: Kume Sekkei, 1974)

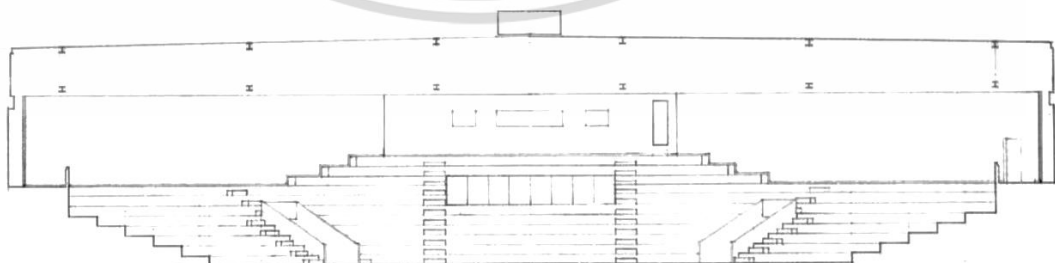


Fig. 4.27 Original drawing (Side B)

(Source: Kume Sekkei, 1974)

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4.3.3 Material

The selection of materials used in the project were based on several aspects such as availability of local materials, expertise and knowledge of the local construction contractor, construction techniques and cost, as well as ease administration and efficiency of maintenance after the project was finished. Similar to other JICA's project, information from the interview also indicated that the first auditorium complex project intended to utilize local materials as much as possible.

The building is a wide span structure in a rectangle shape covered with two-story, long-lifted bricklayer walls. The building's color is a natural color exposed aggregate with white cut edges. The first auditorium complex structure will be the steel framework, and double brick walls are to prevent aircraft noise. The flooring using terrazzo, which is traditionally used in Thailand and almost maintenance-free (Fig. 4.28). Materials within the interior of the main hall, such as wood flooring, carpet, acoustic panels and fabrics, were selected based on acoustic as well as aesthetic qualities.

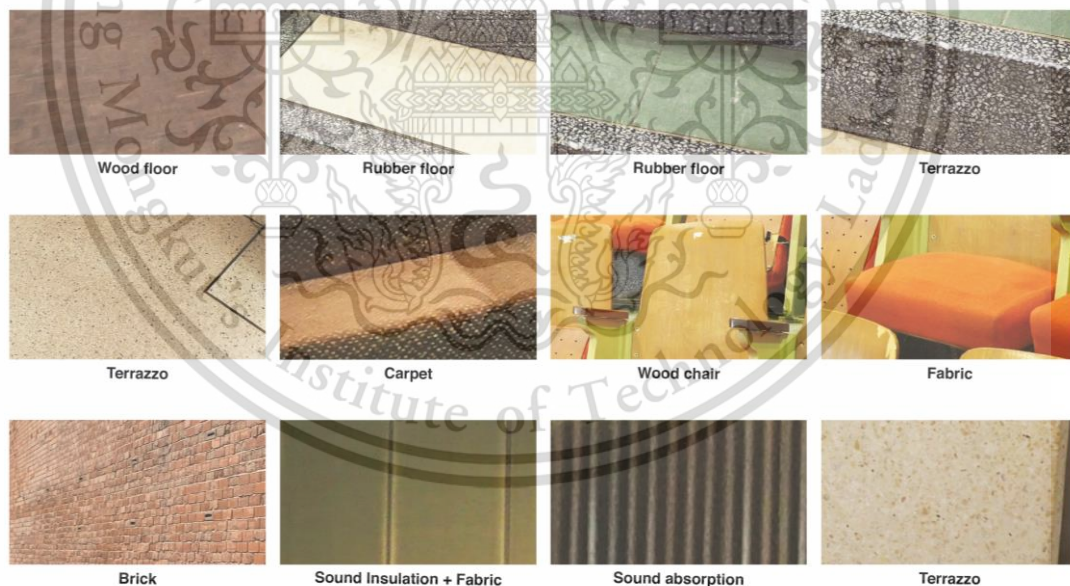


Fig. 4.28 Materials used in the construction of the Auditorium

(Source: the author)


Summary

KMITL first auditorium complex project was conceived in the early 1970s with aids from the Japanese government through the Japanese International Cooperation Agency (JICA) as part of the attempt to provide educational facilities to promote technical education for the future industrial society. Along with the funding, the first auditorium complex was designed by Japanese firm *Kume Architect-Engineer* who had been commissioned for JICA the projects during the 1970s and 1980s.

The external factors affecting the first auditorium complex design included the location, which covers the soft muddy ground that prone to flooding during the south-east monsoons, high humidity, and strong heat from sun radiation of the tropical climate. With these considerations, *Kume Architect-Engineer* solved the problems by creating architecture that responds to the climate and environmental constraints.

The layout placed the building toward east-west orientation on their lengthwise with windows on south and north to employ natural ventilation couple with the use of efficient shading design, and ingenious detail design of the wall to reduce humidity retention while providing heat insulation. Materials selection were based on the availability in the local area, expertise of the construction labors, ease of maintenance and administration after the completion of the project. These durable and easy to procure materials included terrazzo, aggregate surface, vinyl tiles, and Mohn bricks (Table 4.2).

Table 4.2 Summary of the first auditorium complex

Study					Specific and unique design Element		
Environmental factor Influencing The Architecture design							
Heavy rain	Strong sunlight	Seasonal Winds	Flooding	Hight Density Land use	Building Layout	Climate Design	Supplementary Design Requirements
●	●	●	●	N/A	Floor Plate Diagram  <ul style="list-style-type: none"> - Functional flows on the horizontal - 6x6 Grid module 	<ul style="list-style-type: none"> - Double layers roof - Double wall - High floor to prevent flooding risk 	<ul style="list-style-type: none"> - 1.0 M raised floor to prevent flooding - Maitainance and Durability

Source: the author (2021)

CHAPTER 5

CONCLUSION & DISCUSSION

This chapter summarizes the findings of this research and discuss the results with previous research related to *Kume Architects-Engineers* works in Thailand during the 1970s-1980s by focusing on two major aspects including environmental factors influencing the architectural design, and specific design elements. It concluded with the limitations of the study, and further studies recommendation.

CONCLUSIONS

The results of this study indicate that the external factors affecting the first auditorium complex design included its location in the wetland that prone to flooding during the June - October monsoons season. Other tropical climate conditions that posed constraints for the architectural design are high humidity, and strong heat from sun radiation.

It was evident that, in designing the KMITL first auditorium complex, *Kume Architects-Engineers* created specific and unique design element with the aforementioned factors in mind. The buildings are principally designed of east-west orientation on their lengthwise with windows on south and north to employ natural ventilation. The building layout plan employed a modular system of 6 m x 6 m grid for efficient spatial organization as well as corresponded to the limitation of construction materials during that period. The floor level is lifted off the fin above the railroad floor level to avoid the possible flooding. The use of a two layers roofing—corrugate shingles over the concrete slab to ventilation, and double as heat insulation for the strong solar radiation. The walls and other construction materials in the projects were selected based on their availability in the local area as well as ease of maintenance and administration after the project completion.

DISCUSSION

Among other *Kume Architects-Engineers* work in Thailand during the 1970s-1980s, it is safe to say that the design commonalties are found among these work

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including the first auditorium complex. This might be due to the careful studies, of the architects on the external factors such as meteorological conditions of the tropical zone such as heavy rain, high humidity, strong sunlight, seasonal winds, and flooding. Information from JICA records, from the preliminary design studies, also indicated that seismic activity and severe storms were not the problematics in this area, which did not cause a limitation for the structural design of these projects (Table 5.1).

Grid and modular and modular systems were found across some projects; the 6 m x 6 m in the first auditorium complex, 7 m x 7 m. The use of a central focus within the enclosure of the group of buildings was evident in several projects such as the 1978 MIT Library, the 1978 Central Laboratory at Kasetsart University Kampeangsaen campus, and the 1989 Environmental Research and Training Center. However, this feature was not employed in the KMITL first auditorium complex.

All but one, the KMITL Lecture Hall project, were low-rise. The raised level of ground, ranging from 1.0 – 1.5 m, were found only in the area prone to flooding such as two of the projects located in the Ladkrabang area—the KMITL first auditorium complex and the successor project the 1983 Lecture Halls. This feature was also found in the ETRC, the Trade Training Center as well as the KU's Central lab projects. To cope with a severe heat and humidity of the above the equator location, design features such as double-layered roofs to help increase ventilation while double as heat insulation for the strong solar radiation were found across all cases reviewed as well as the first auditorium complex. The use of extended eaves and shading were found in *Kume Architects-Engineers* later projects. A double wall was used as an acoustic barrier as well as a shield from solar heat radiation. This feature was found on the east-west elevation of the Lecture Room Building of KMITL, and the first auditorium complex of KMITL project. Moreover, the first auditorium complex of the KMITL project has interesting detail design such as small holes on the wall were added to help release the humidity retained in the building.

Finally, materials selection was similar across all projects. Speculatively, this was due to the availability of the materials in the local area, expertise of the construction laborers, ease of maintenance and administration after the completion of the project. These durable and easy-to-procure materials included terrazzo, aggregate surface, vinyl tiles, and Mohn bricks (Table 5.2).

Study							
Environmental factor Influencing The Architecture design							
Project related to Kume Architects-Engineers	Previous Study	Project	Heavy rain	Strong sunlight	Seasonal Winds	Flooding	Hight Density Land use
		THE LIBRARY & MEDIA BUILDING ASIAN INSTITUTE OF TECHNOLOGY Year 1978	●	●	●	N/A	N/A
		CENTRAL LABORATORY & GREENHOUSE COMPLEX OF KASETSART UNIVERSITY KAMPHAENSAEN Year 1978	●	●	●	N/A	N/A
		THE YOUTH WELFARE CENTER PROJECT IN THE KINGDOM OF THAILAND Year 1979	●	●	●	N/A	N/A
		THE ESTABLISHMENT PROJECT OF THE TRAINING CENTER Year 1982	●	●	●	●	N/A
		THE LECTURE ROOM BUILDING KING MONGKUT'S INSTITUTE OF TECHNOLOGY Year 1983	●	●	●	●	●
		THE ESTABLISHMENT OF THE ENVIRONMENTAL RESEARCH AND TRAINING CENTER Year 1989	●	●	●	N/A	N/A
	Result of This Paper	THE AUDITORIUM MEMORIAL HALL AND LIBRARY OF KING MONGKUT'S INSTITUTE OF TECHNOLOGY Year 1974	●	●	●	●	N/A


Study								
Specific and unique design Element								
Project related to Kume Architects-Engineers	Previous Study	Project	Building Layout	Climate Design	Supplementary Design Requirements	Local material	Import material	
		THE LIBRARY & MEDIA BUILDING ASIAN INSTITUTE OF TECHNOLOGY Year 1978	 <small>Floor Plate Diagram not to scale</small>	<ul style="list-style-type: none"> - Use courtyard to enable the function flows to run around in a loop - 8x8 Grid module 	<ul style="list-style-type: none"> - Double layers roof - Eaves, louvers, and canopies around the building - Courtyard to provide natural light and ventilation 	- Two stories to balance with the campus and ground condition of the site and to be uniform with other building blocks	●	
		CENTRAL LABORATORY & GREENHOUSE COMPLEX OF KASETSART UNIVERSITY KAMPHAENSAEN Year 1978		<ul style="list-style-type: none"> - Loop structure to connect passage from each building to the public corridor - 7 X7 Grid module 	<ul style="list-style-type: none"> - Double layers roof - High floor to prevent flooding - Eaves, louvers, and canopies around the building - Seasonal wind to create draft 	N/A	●	
		THE YOUTH WELFARE CENTER PROJECT IN THE KINGDOM OF THAILAND Year 1979		<ul style="list-style-type: none"> - Open space in the center and in the front 	<ul style="list-style-type: none"> - Double layers roof - High floor to prevent flooding - Eaves, louvers, and canopies around the building - Seasonal wind to create draft 	N/A	●	
		THE ESTABLISHMENT PROJECT OF THE TRAINING CENTER Year 1982		<ul style="list-style-type: none"> - Leave open space for future expansion 	<ul style="list-style-type: none"> - Double layers roof - Eaves, louvers, and canopies around the building - Seasonal wind to create draft 	- Retain relationship with office building around the site	●	
		THE LECTURE ROOM BUILDING KING MONGKUT'S INSTITUTE OF TECHNOLOGY Year 1983		<ul style="list-style-type: none"> - Mall Lay out - Hight Density Land use - Design to connect existing office, railroad - Control future traffic 	<ul style="list-style-type: none"> - Double layers roof - Double wall on east west Elevation 	<ul style="list-style-type: none"> - Administration plan after completion - Maitainance and Durability - 1.0 M raised floor to prevent flooding 	●	●
		THE ESTABLISHMENT OF THE ENVIRONMENTAL RESEARCH AND TRAINING CENTER Year 1989		<ul style="list-style-type: none"> - Gallery around courtyard - Site corridors as cores to connect facilities to entrance hall 	<ul style="list-style-type: none"> - Double layers roof - Wide eaves - Side corridor to provide natural ventilation 	<ul style="list-style-type: none"> - Shorten the construction period - Reduce the volume of foundation - Piling work - 1.5 M raised floor to prevent flooding - The painting of large areas should be avoided 	●	
	THE AUDITORIUM MEMORIAL HALL AND LIBRARY OF KING MONGKUT'S INSTITUTE OF TECHNOLOGY Year 1974		<ul style="list-style-type: none"> - Functional flows on the horizontal - 6x6 Grid module 	<ul style="list-style-type: none"> - Double layers roof - Double wall - High floor to prevent flooding risk 	<ul style="list-style-type: none"> - 1.0 M raised floor to prevent flooding - Maitainance and Durability 	●		

Design Technic Implementation Guidelines

The First Auditorium design Strengths includes the use of Natural ventilation grid module, double wall, double roof, simple shape, local materials and the last the large floor in front, architect Kume Sekkai's decision to use these technics in the design of this auditorium is very appropriate of the tropical building that enteral energy efficiency while mentioning user comfort (Table 5.3).

Weaknesses of First Auditorium Complex, This building does not provide the universal design feature and design base on minimum of human scale (Table 5.4). Perhaps these features were not coincided the required building norm at the time of the construction.

Table 5.3 Strengths of First Auditorium Complex.

Building	Environmental Factor	Specific and Unique Design Element
First Auditorium Complex	- Natural ventilation	<ul style="list-style-type: none"> - Grid module - Double wall and Roof - Simple shape - Local Metersials - The large floor in front of the stage can be the arrangement for all dimension enabling the possibility
		

Source: the author (2021)

Table 5.4 Weaknesses of First Auditorium Complex.

Building	Environmental Factor	Specific and Unique Design Element
First Auditorium Complex	-	<ul style="list-style-type: none"> - not responding to Universal Design - Minimum of Human scale

Source: the author (2021)

Limitation of the study

This research investigation depended on the multiple sources of information. One important source for secure in-depth information is an interview method. However, for the project that was completed almost fifty years ago, only a few informants were available to provide the information. And if so, it was quite challenging for them to recollect detail account of the design and construction process. In addition, formal records from involving agency, such as the Japan International Cooperation Agency (JICA) preliminary study that would further enhance the understanding of this project could not be found. Thus, the analysis of the results in this study were derived from the triangulation of the field survey, piecemeal records from KMITL's archive, original drawings from *Kume Architects-Engineers*, and interviews of KMITL personnel as supplementary information.

Further study

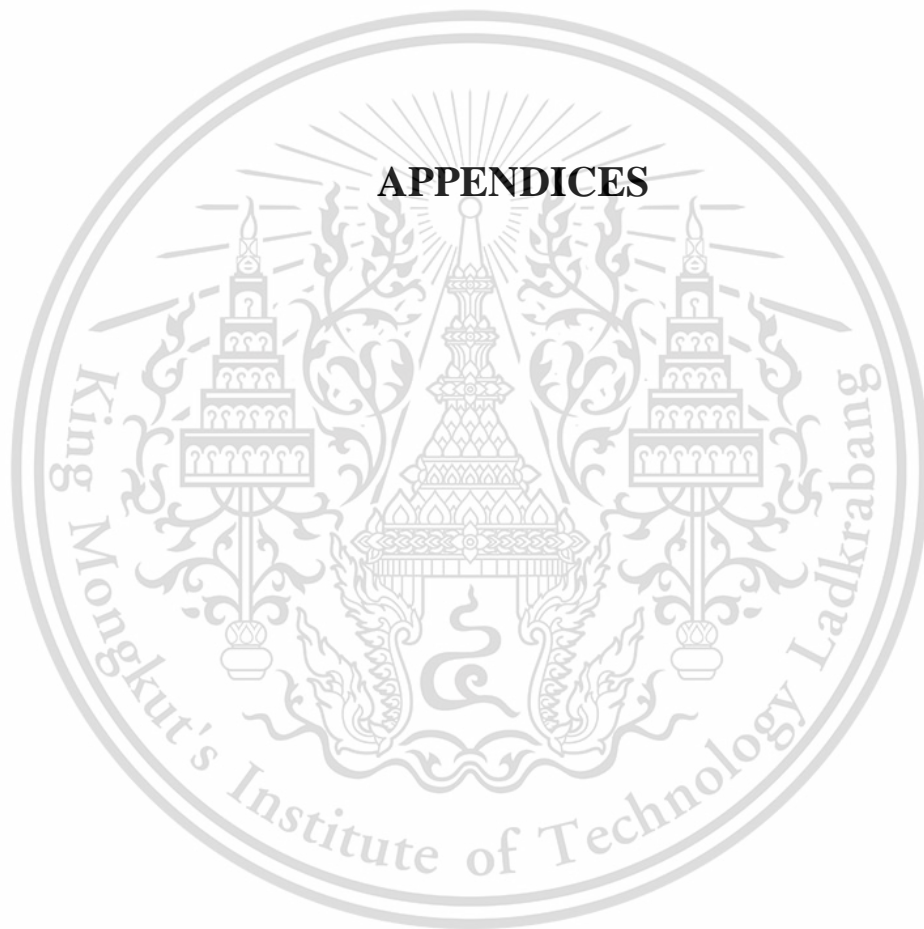
This research examined the unique architectural design features of the 1974 KMITL first auditorium complex and factors influencing these attributes. King Mongkut's Institute of Technology Ladkrabang main office issues a policy to renovate this auditorium in 2021. The renovation will focus on the repairs of the building systems and equipment as well as replacing the old worn-out materials of the building interior. However, it is likely that some materials will not be available, and KMITL will have to find the substitutes closest to the original ones, which might jeopardize the design integrity of This auditorium complex. Thus, it is important to further investigate and record the material used in the first auditorium complex, and search for the comparable materials for future replacement. In addition, the study of Japanese architects' ideas for energy-saving building system in the Japanese design buildings in Thailand should also be further explored. Many attributes, different from the ones used by local architects, are very useful and energy efficient.

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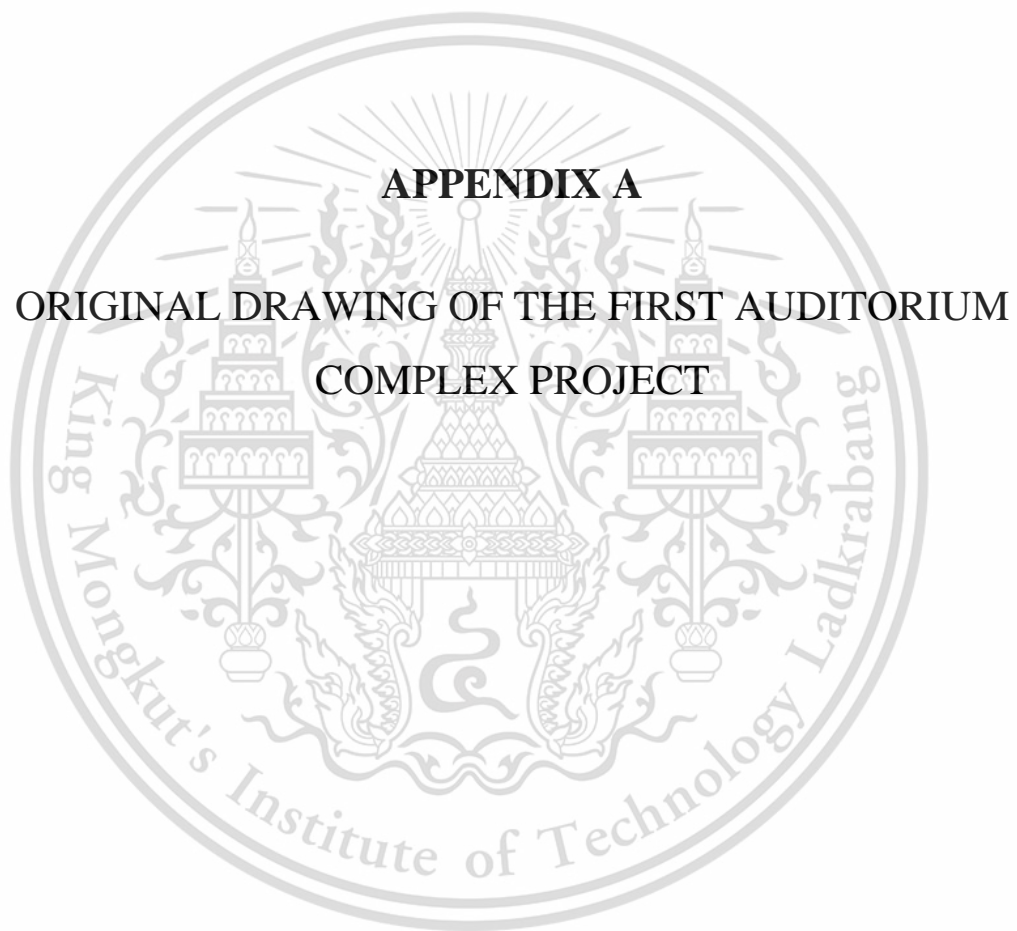
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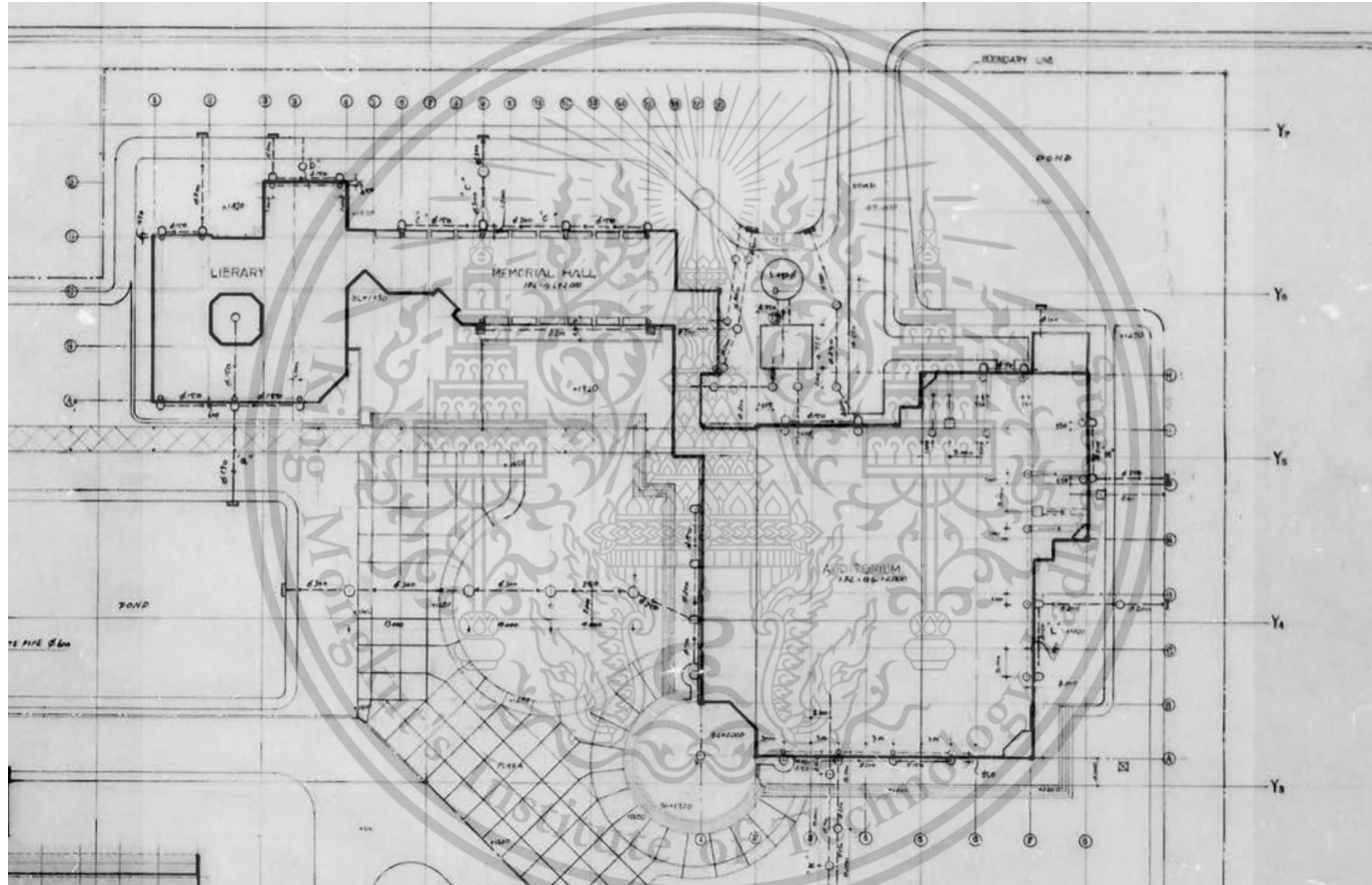


Fig. A.1 Original drawing of The auditorium complex
(Source: Kume Sekkei, 1974)

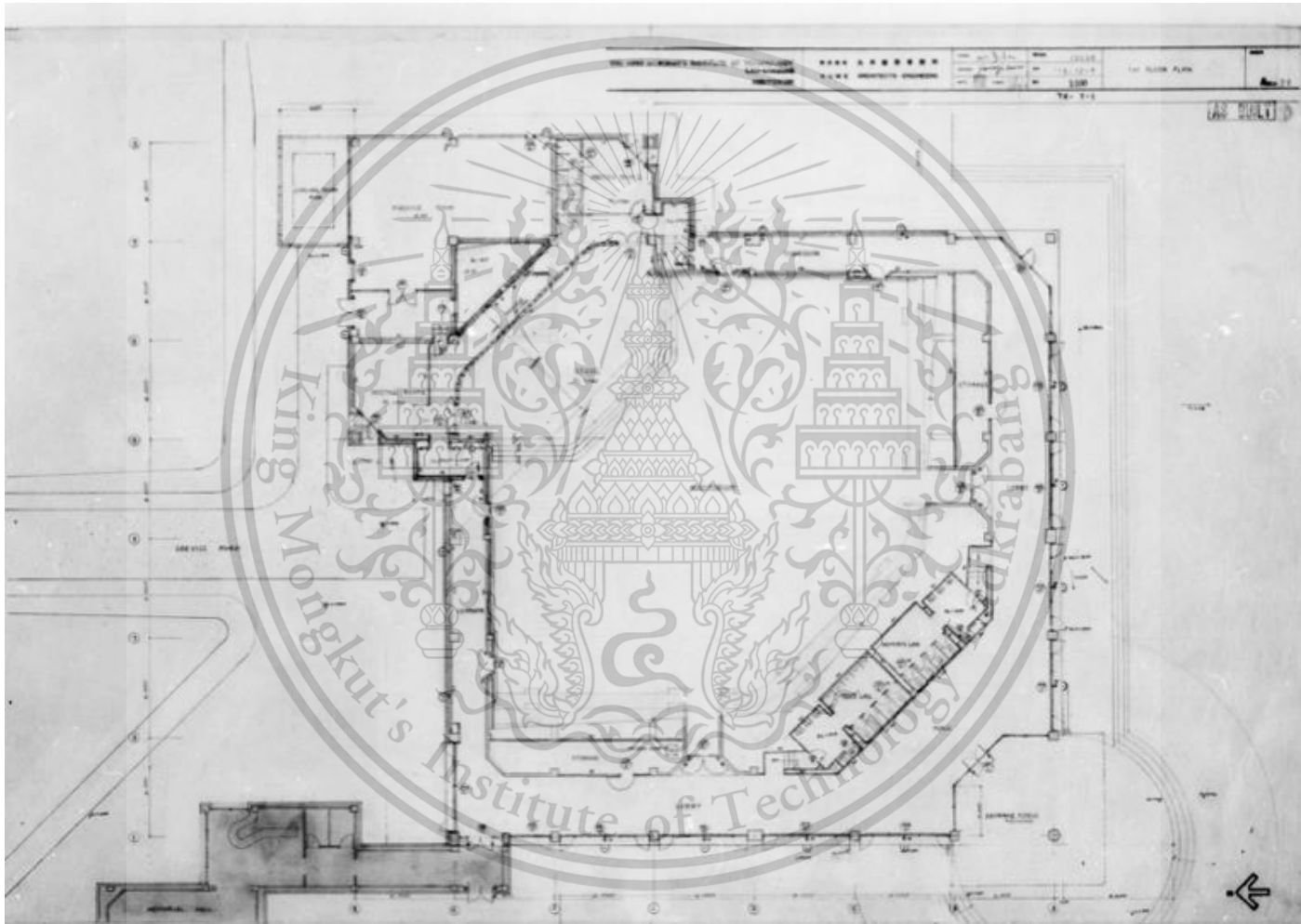


Fig. A.2 Original drawing of The auditorium (1st Layout Plan)
(Source: Kume Sekkei, 1974)

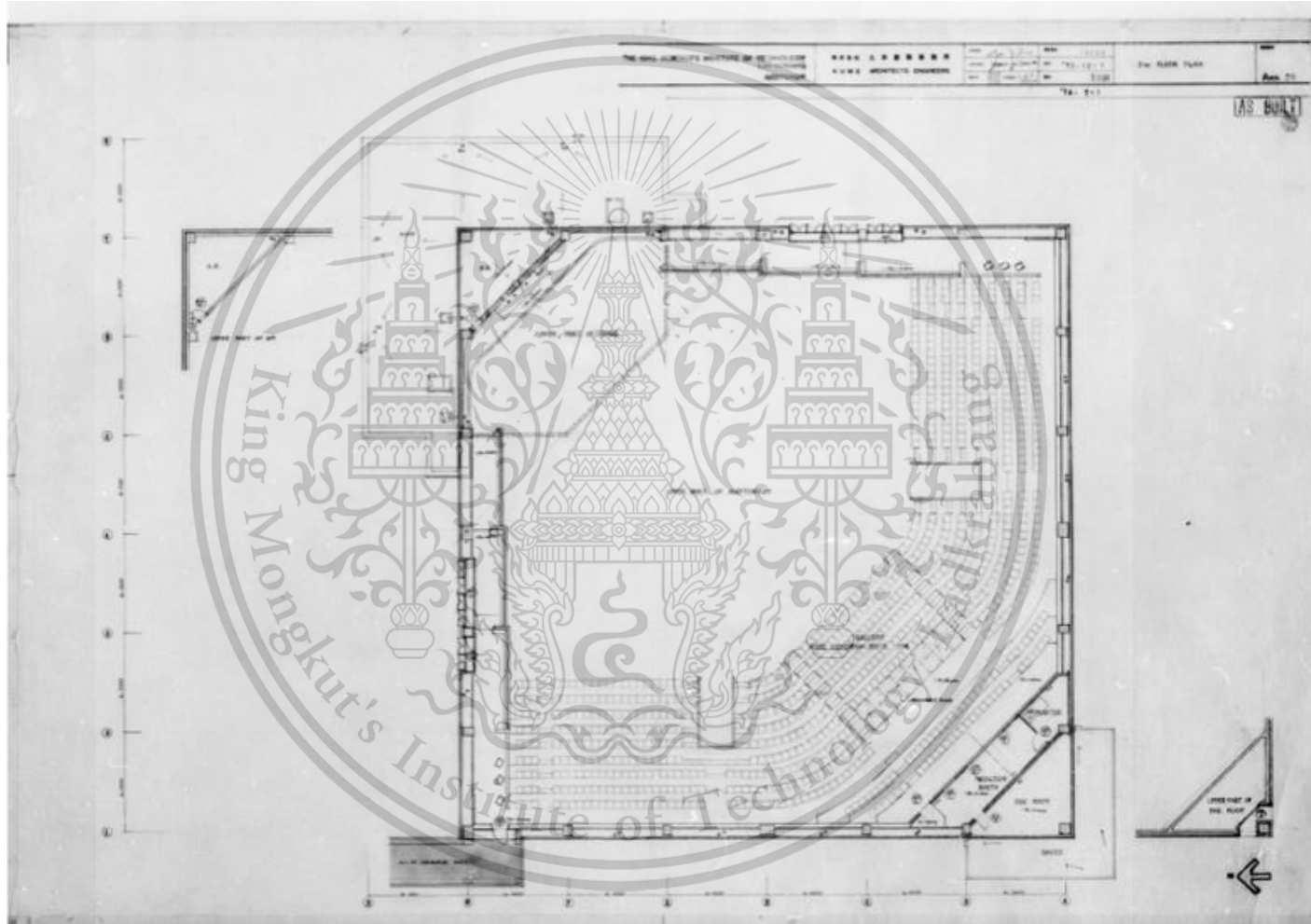


Fig. A.3 Original drawing of The auditorium (2nd Layout Plan)
(Source: Kume Sekkei, 1974)

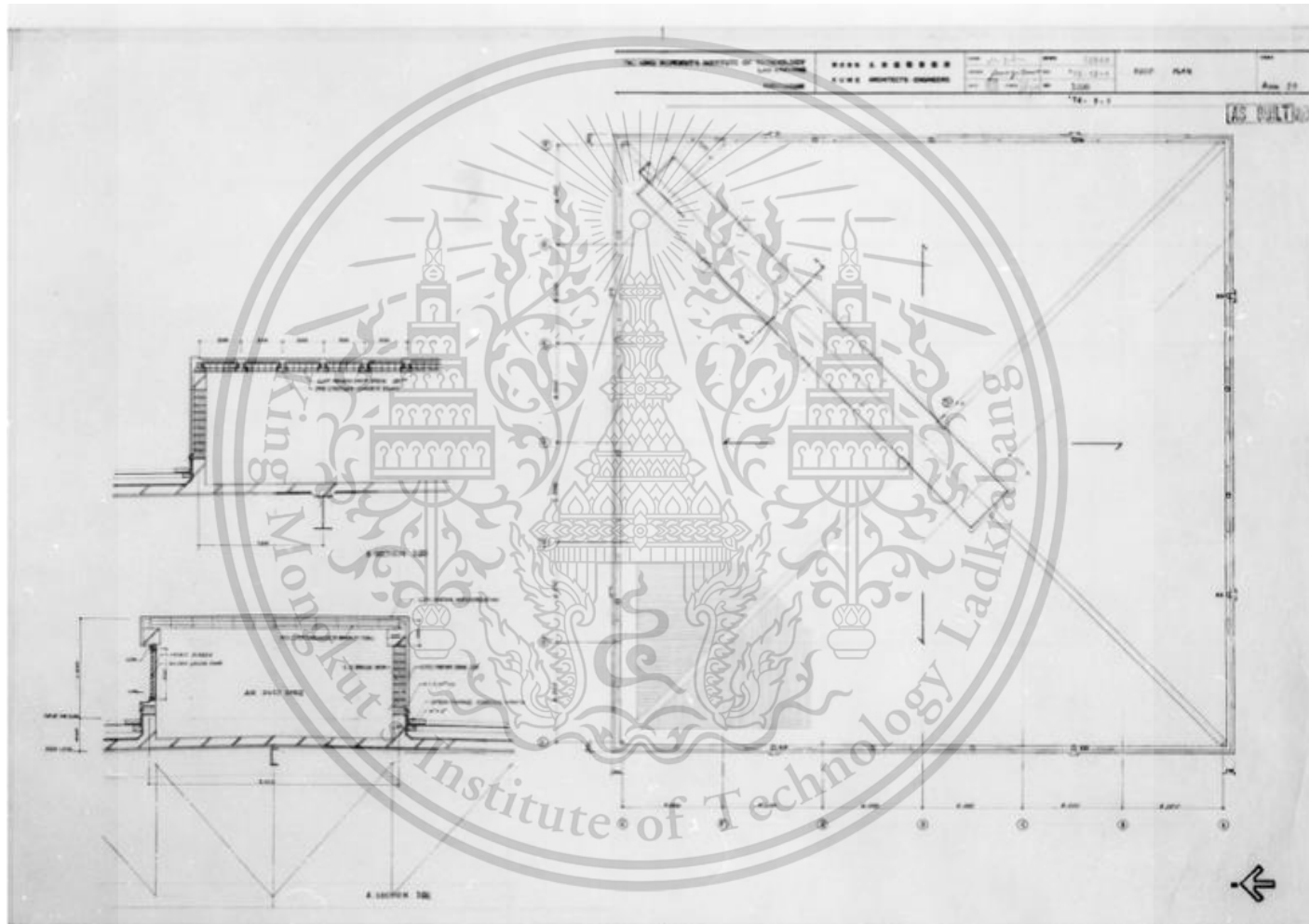


Fig. A.4 Original drawing of The auditorium (Roof Detail)
 (Source: Kume Sekkei, 1974)

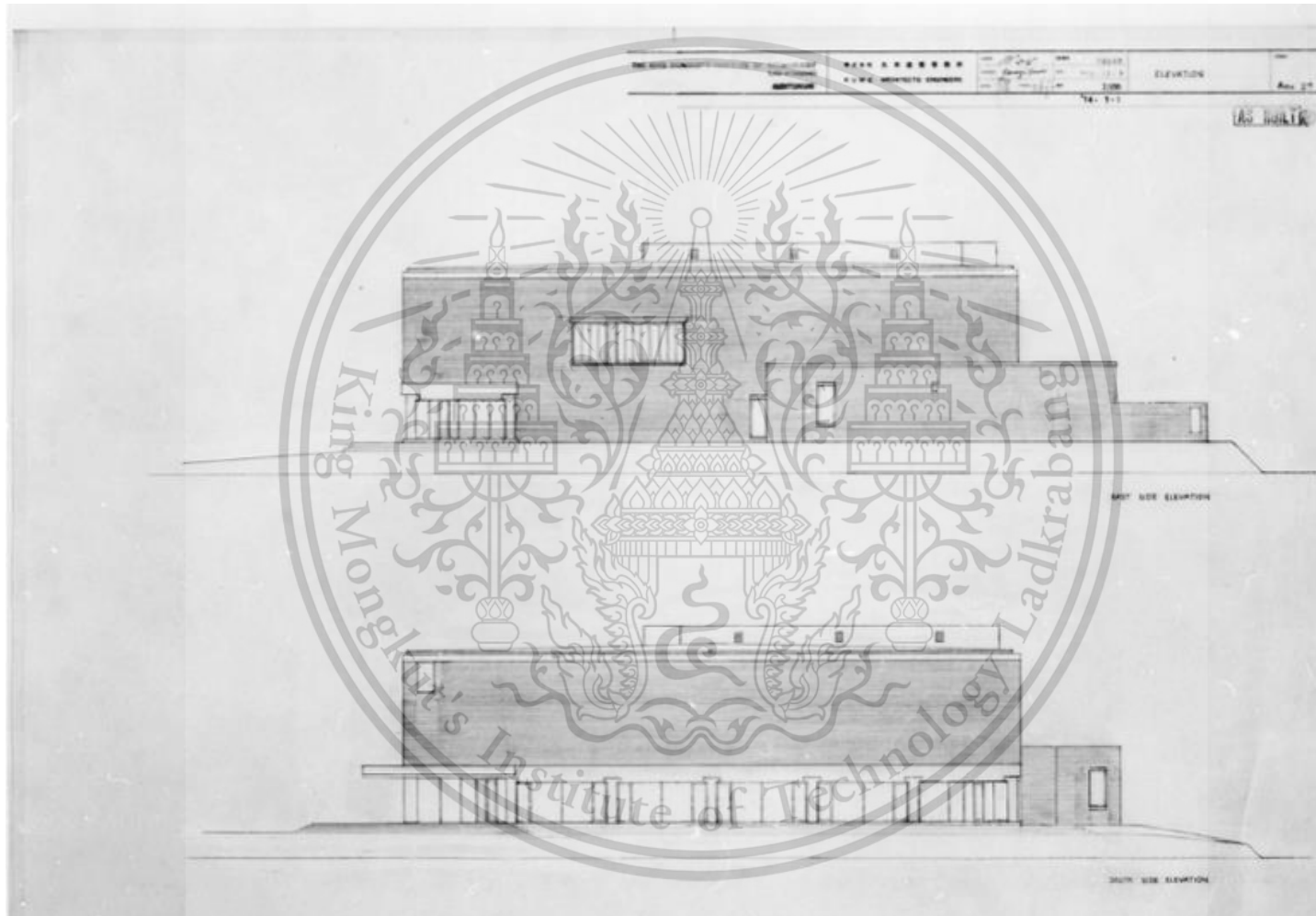


Fig. A.5 Original drawing of The auditorium (Elevation east and south side)
(Source: Kume Sekkei, 1974)

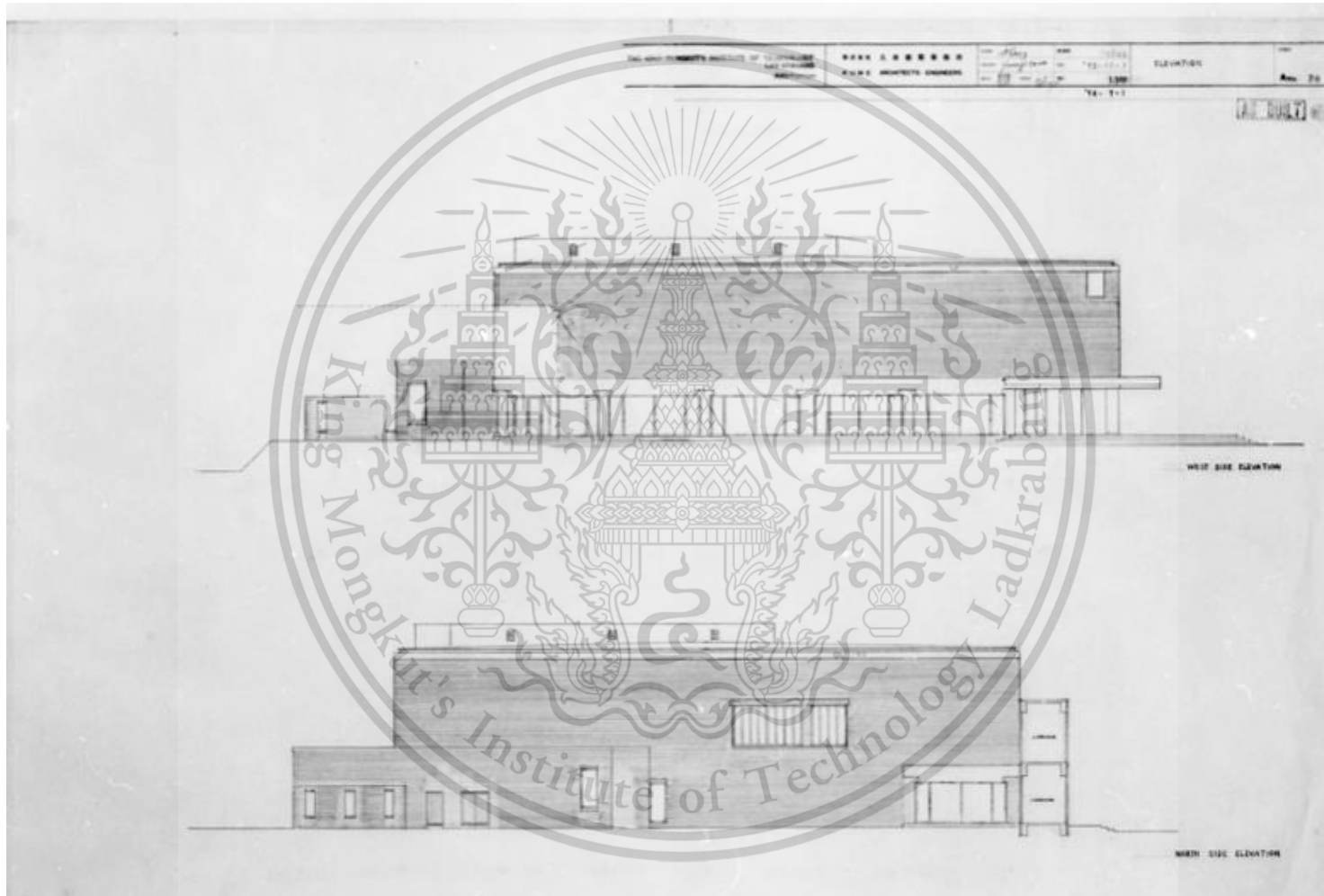


Fig. A.6 Original drawing of The auditorium (Elevation north and west side)
 (Source: Kume Sekkei, 1974)

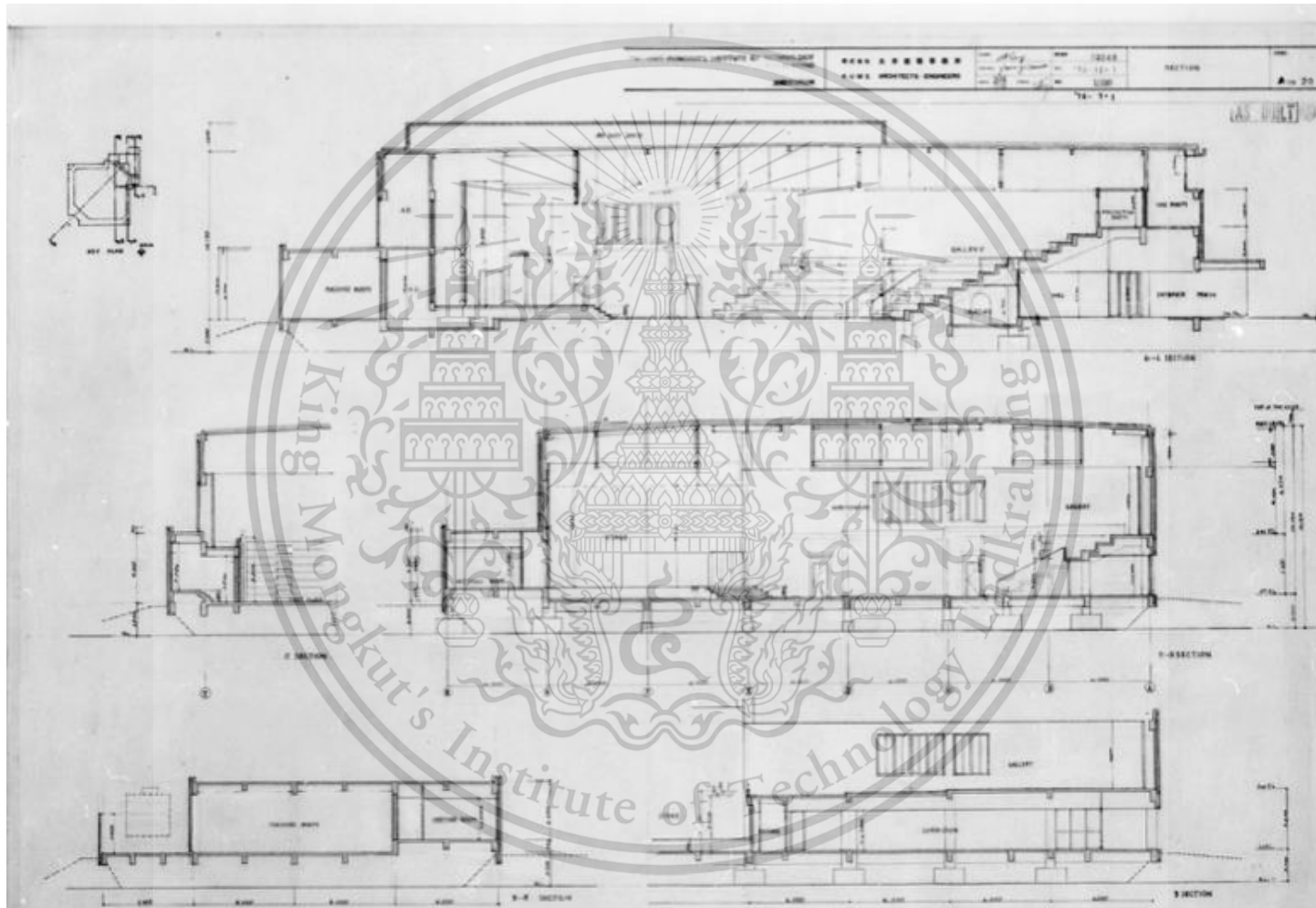


Fig. A.7 Original drawing of The auditorium (Section A, B, C, and D)
 (Source: Kume Sekkei, 1974)

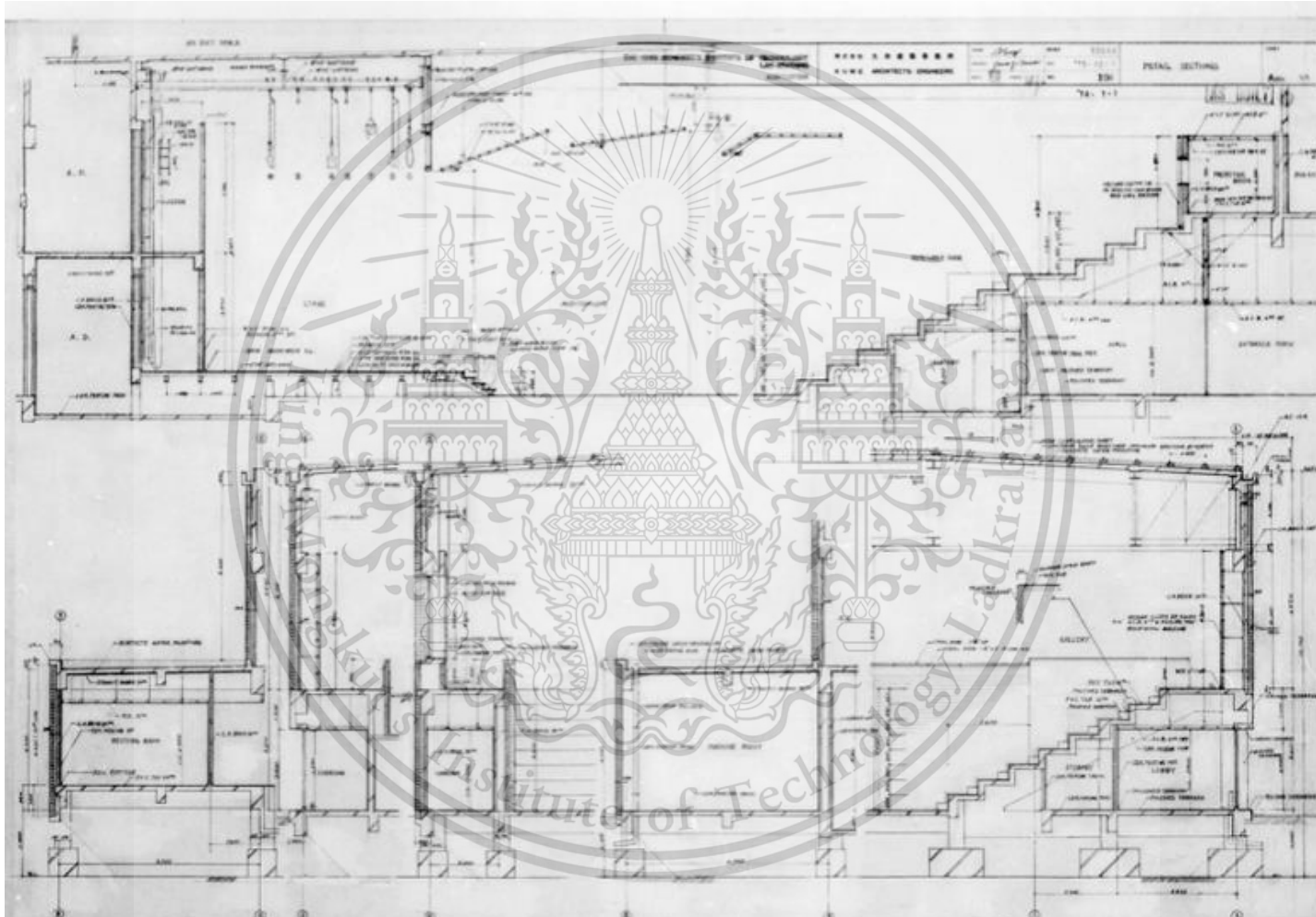


Fig. A.8 Original drawing of The auditorium (detail Section)
 (Source: Kume Sekkei, 1974)

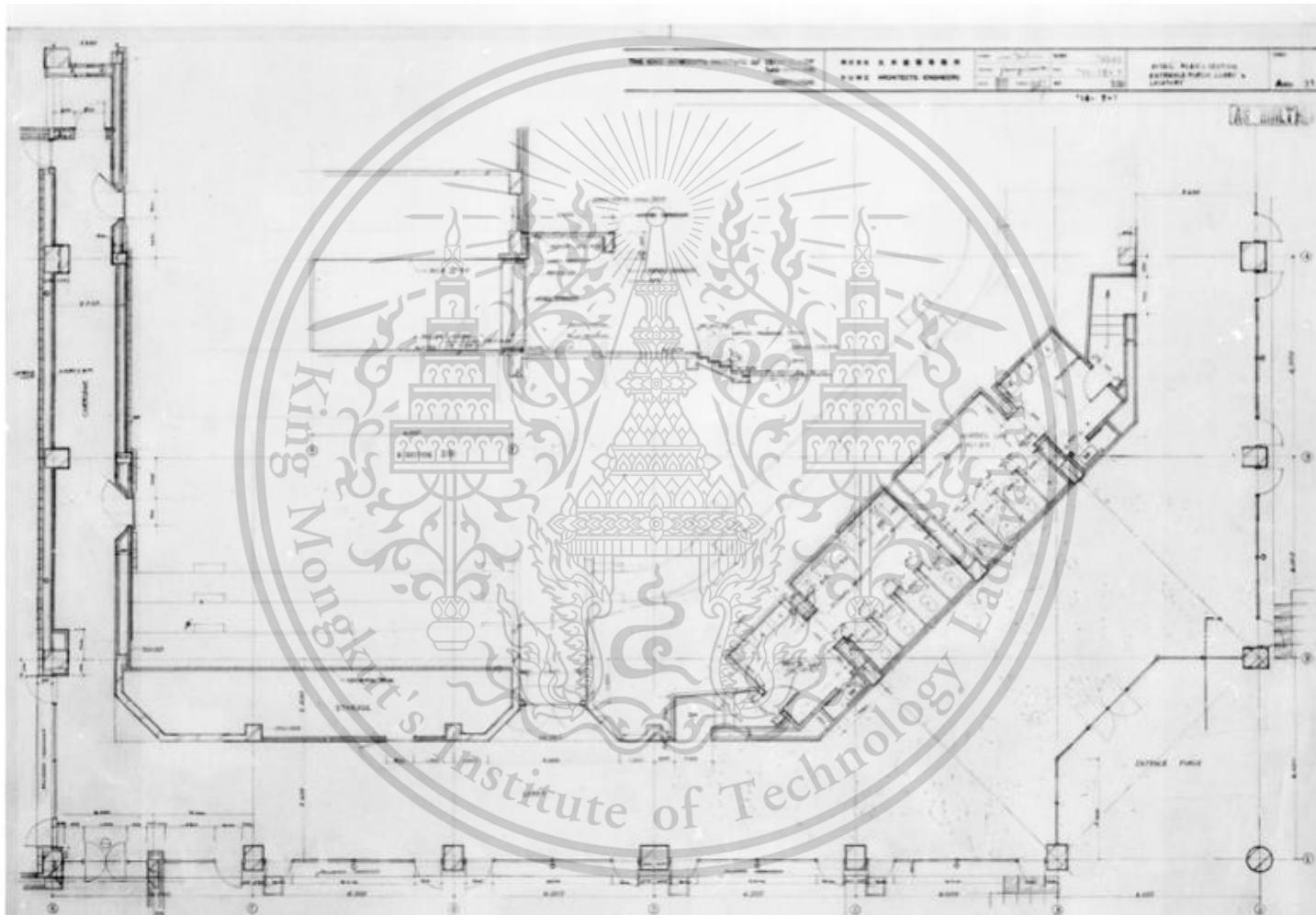


Fig. A.9 Original drawing of The auditorium (detail Section of entrance)
 (Source: Kume Sekkei, 1974)

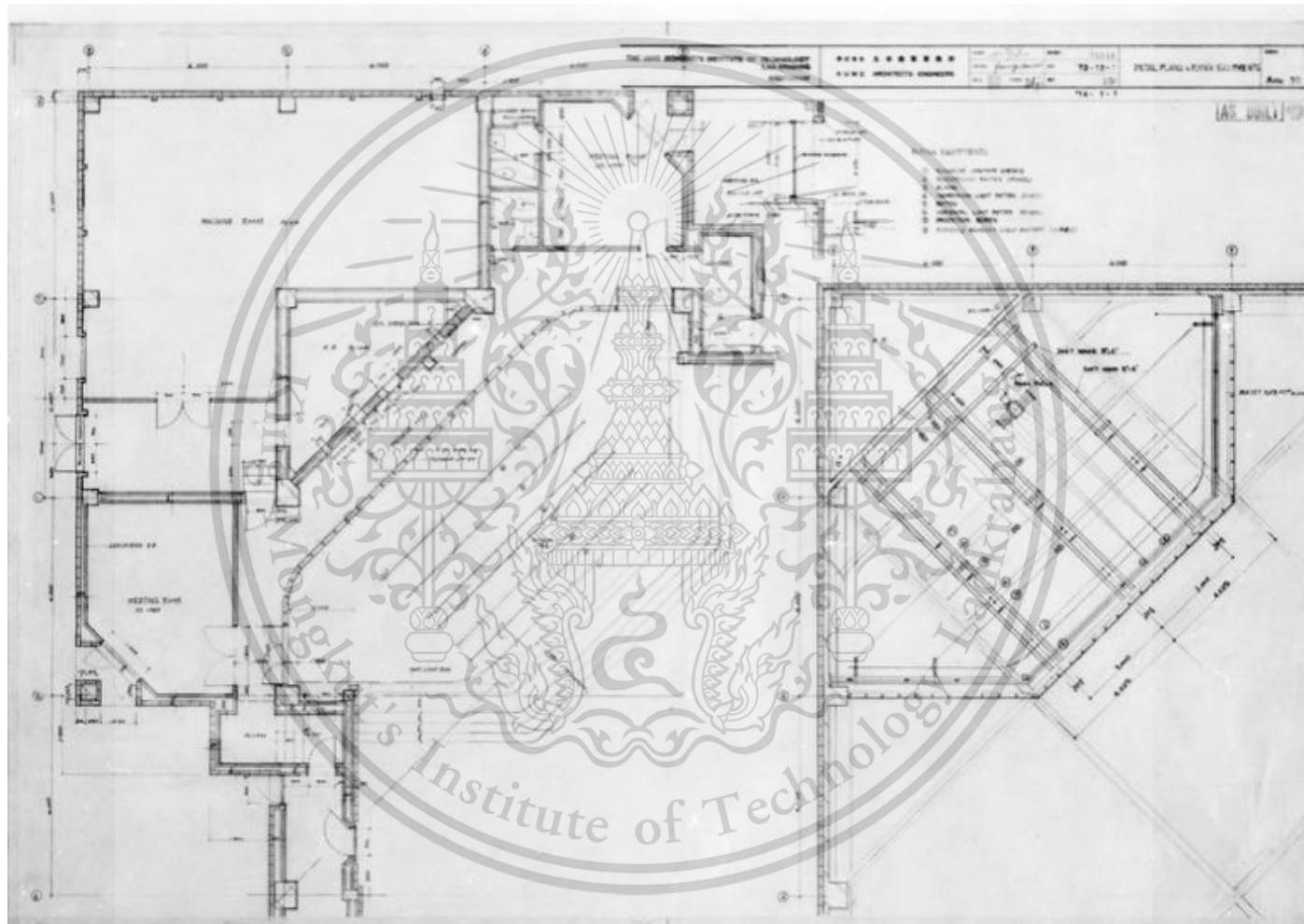


Fig. A.10 Original drawing of The auditorium (detail plan of equipment)
 (Source: Kume Sekkei, 1974)

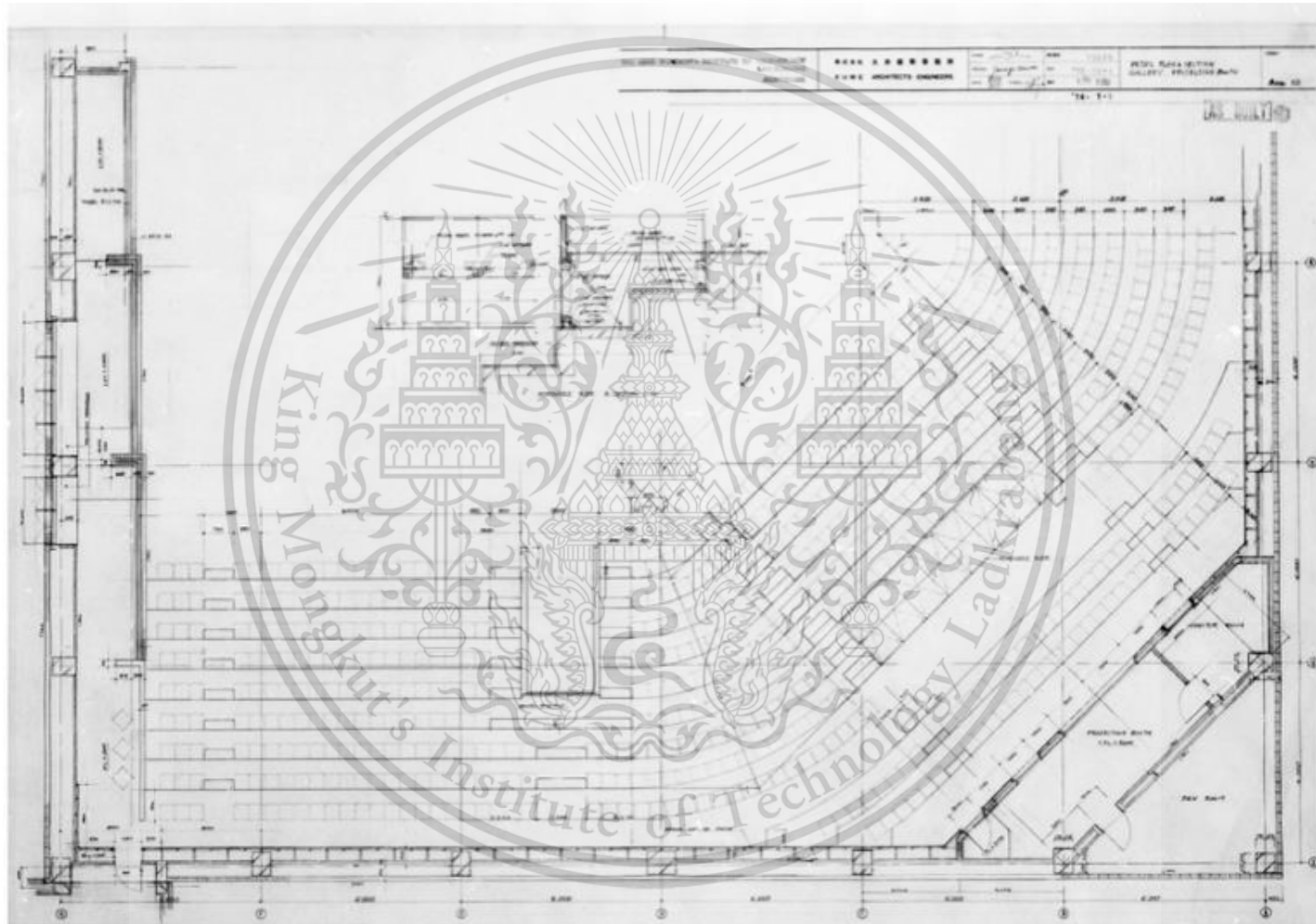


Fig. A.11 Original drawing of The auditorium (detail plan of gallery, projection room)
(Source: Kume Sekkei, 1974)

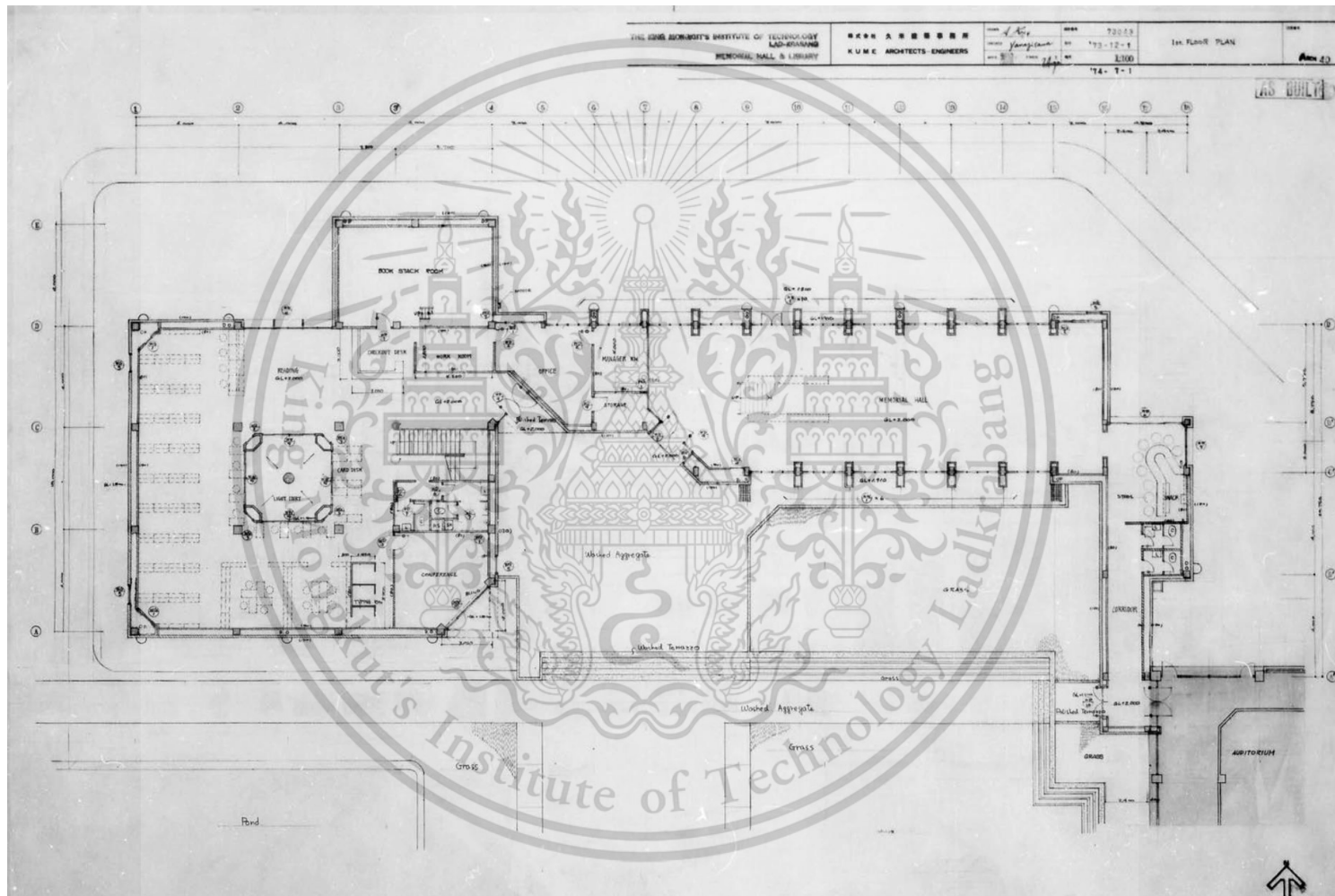


Fig. A.12 Original drawing of The memorial hall and library (1st Layout Plan)
(Source: Kume Sekkei, 1974)

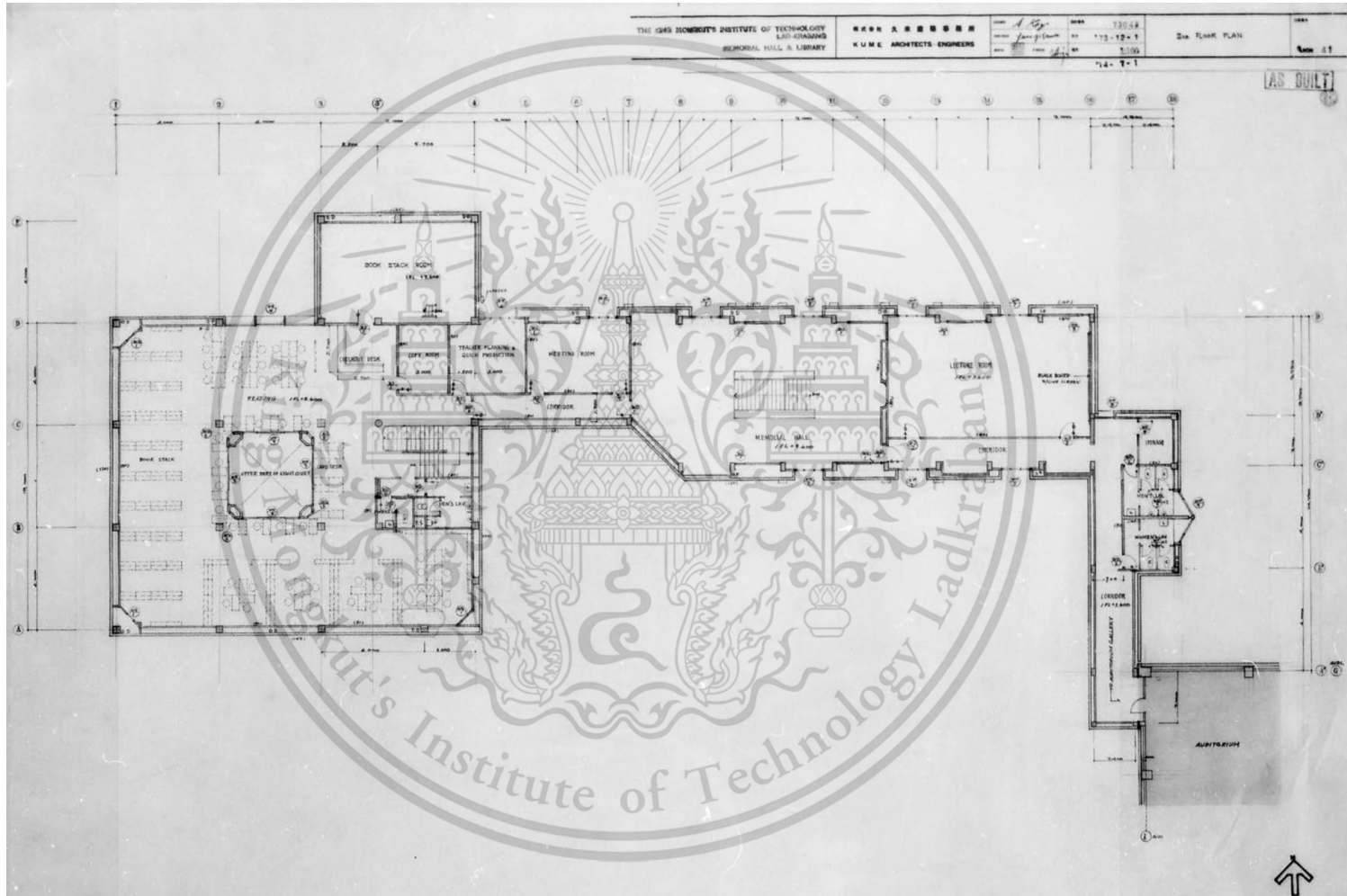


Fig. A.13 Original drawing of The memorial hall and library (2rd Layout Plan)
(Source: Kume Sekkei, 1974)

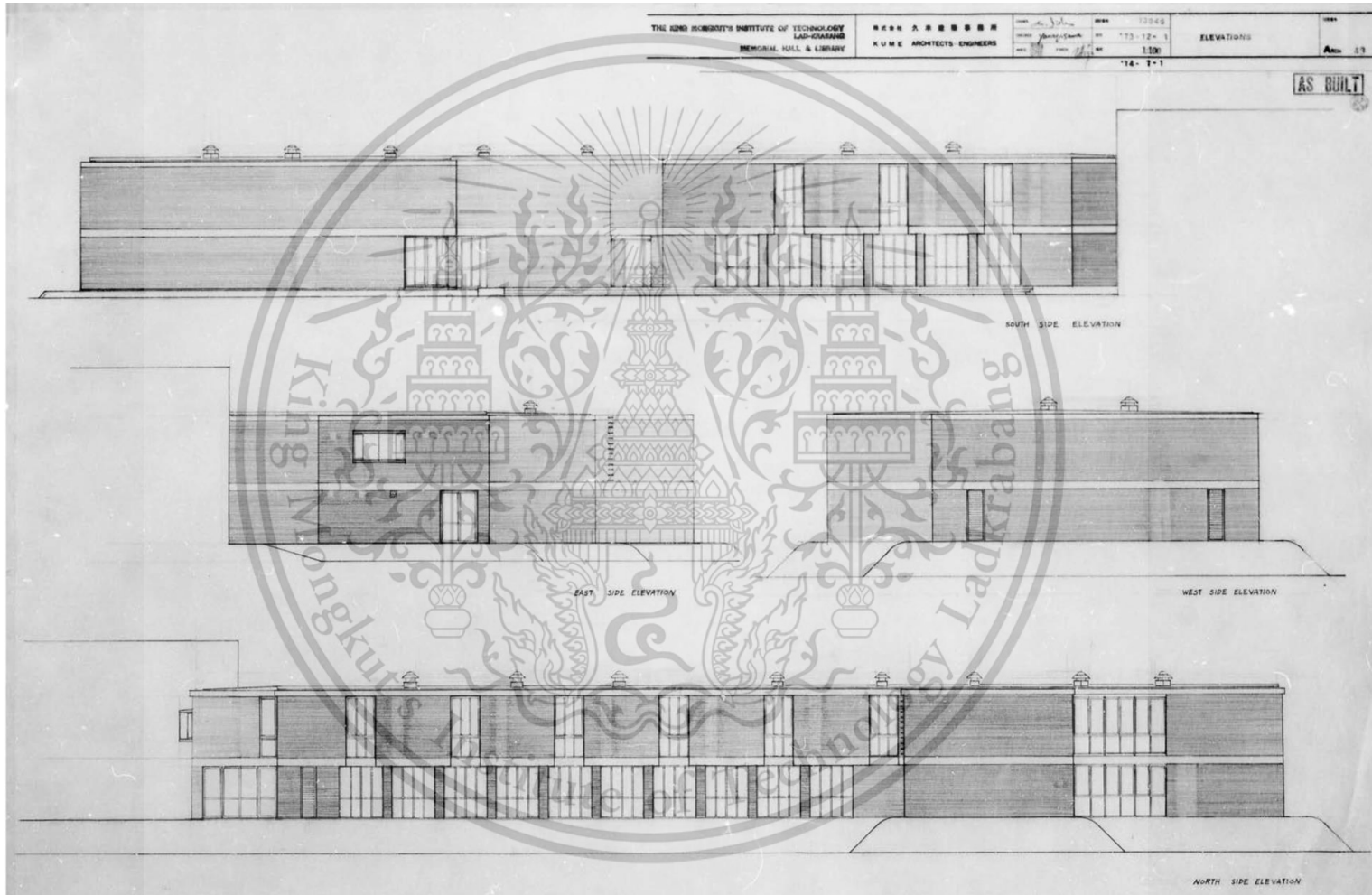


Fig. A.14 Original drawing of The memorial hall and library (Elevation)
(Source: Kume Sekkei, 1974)

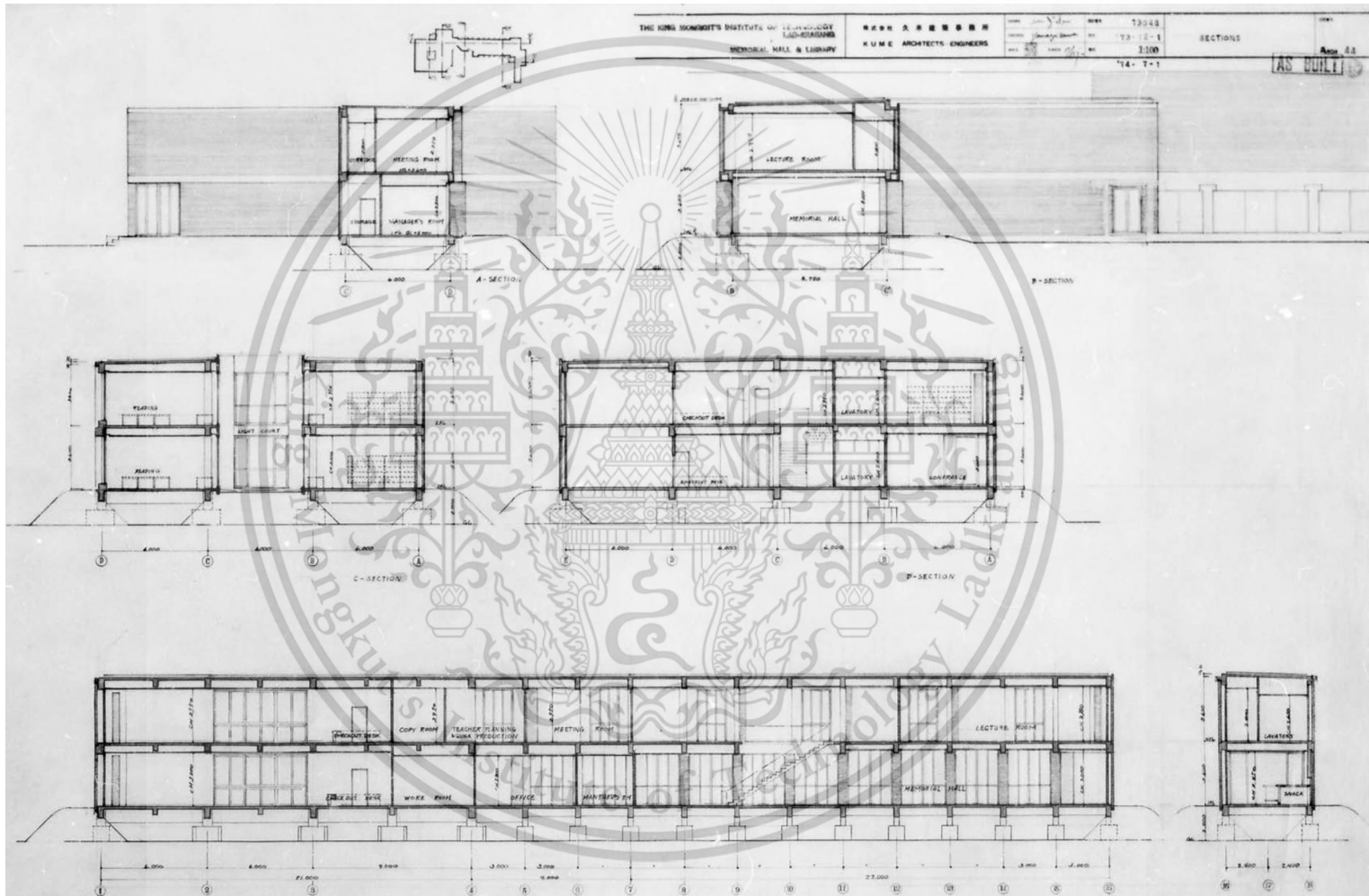


Fig. A.15 Original drawing of The memorial hall and library (Section)
(Source: Kume Sekkei, 1974)

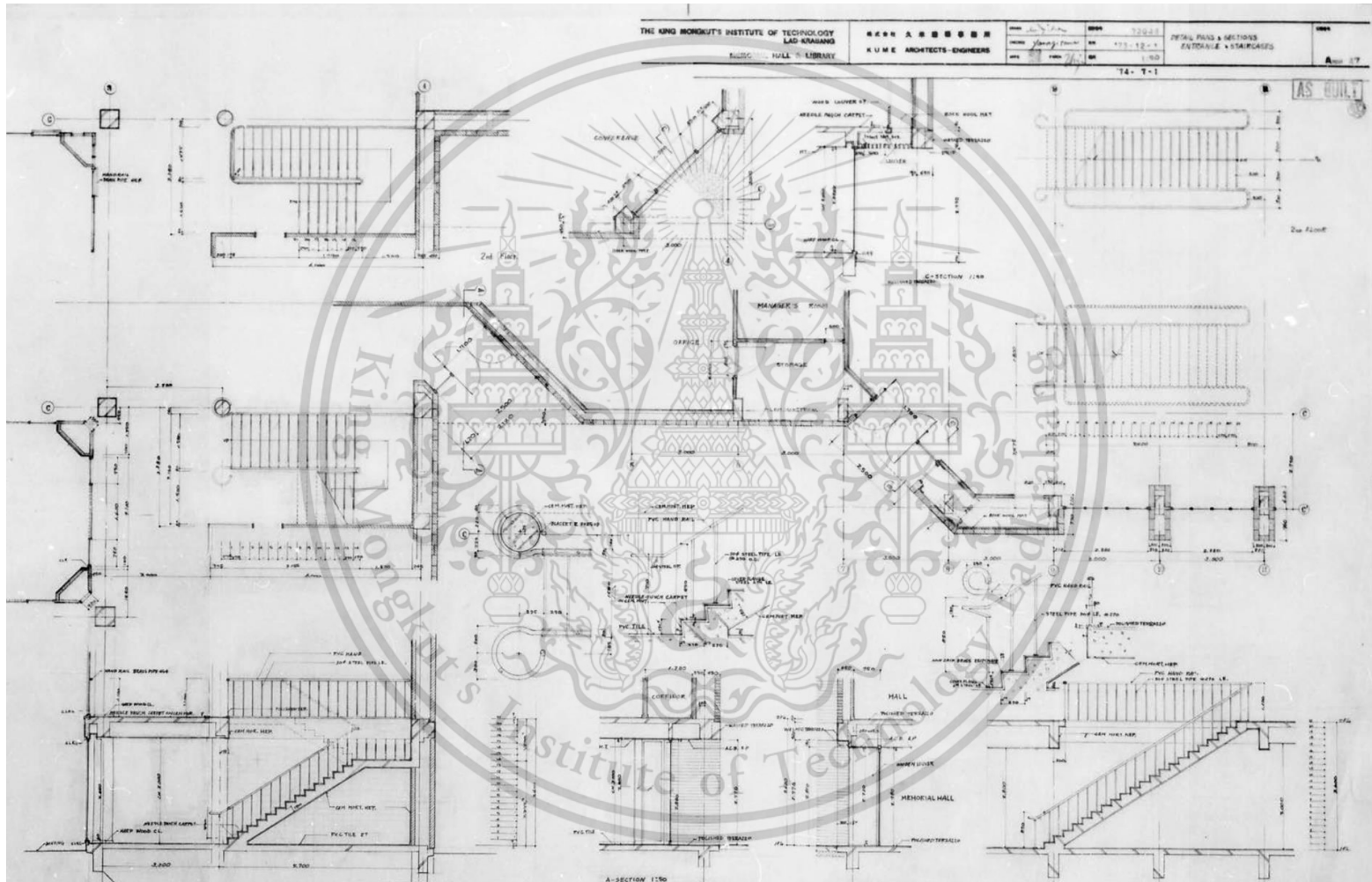
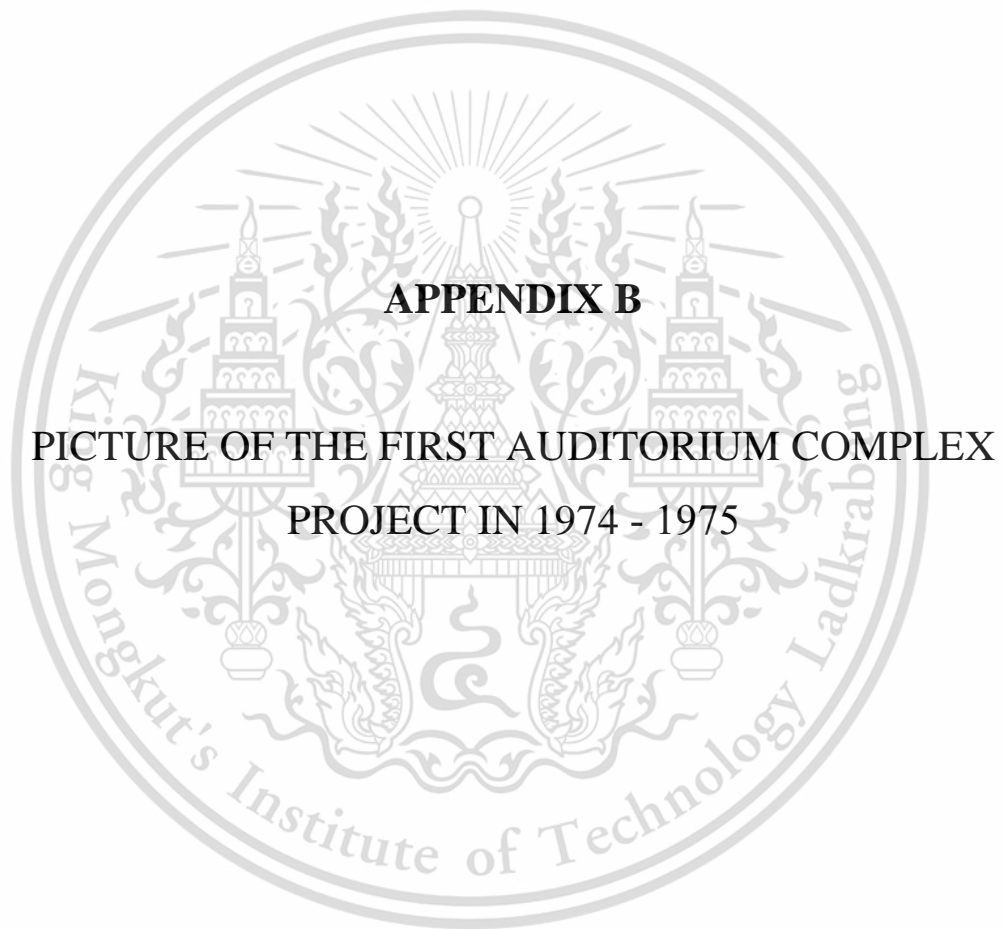


Fig. A.16 Original drawing of The memorial hall and library (Detail and section Entrance)
(Source: Kume Sekkei, 1974)



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Fig. B.1 The Auditorium Complex in 1974 (๓๐17-๐๐1)
(Source: KMITL archives)



Fig. B.2 The Auditorium Complex in 1974 (ทอ17-002)

(Source: KMITL archives)

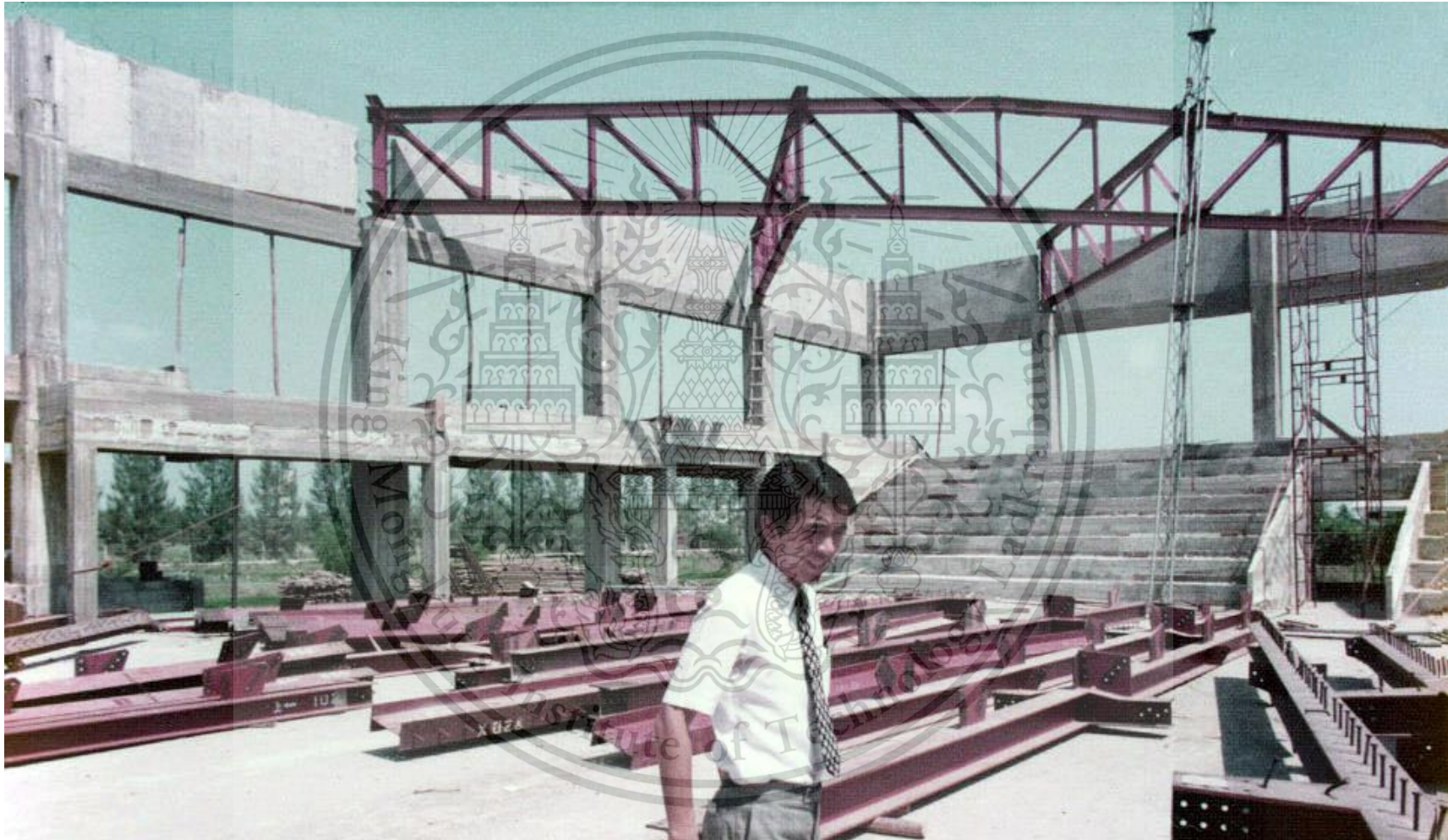


Fig. B.3 The Auditorium Complex in 1974 (๓๐17-003)
(Source: KMITL archives)

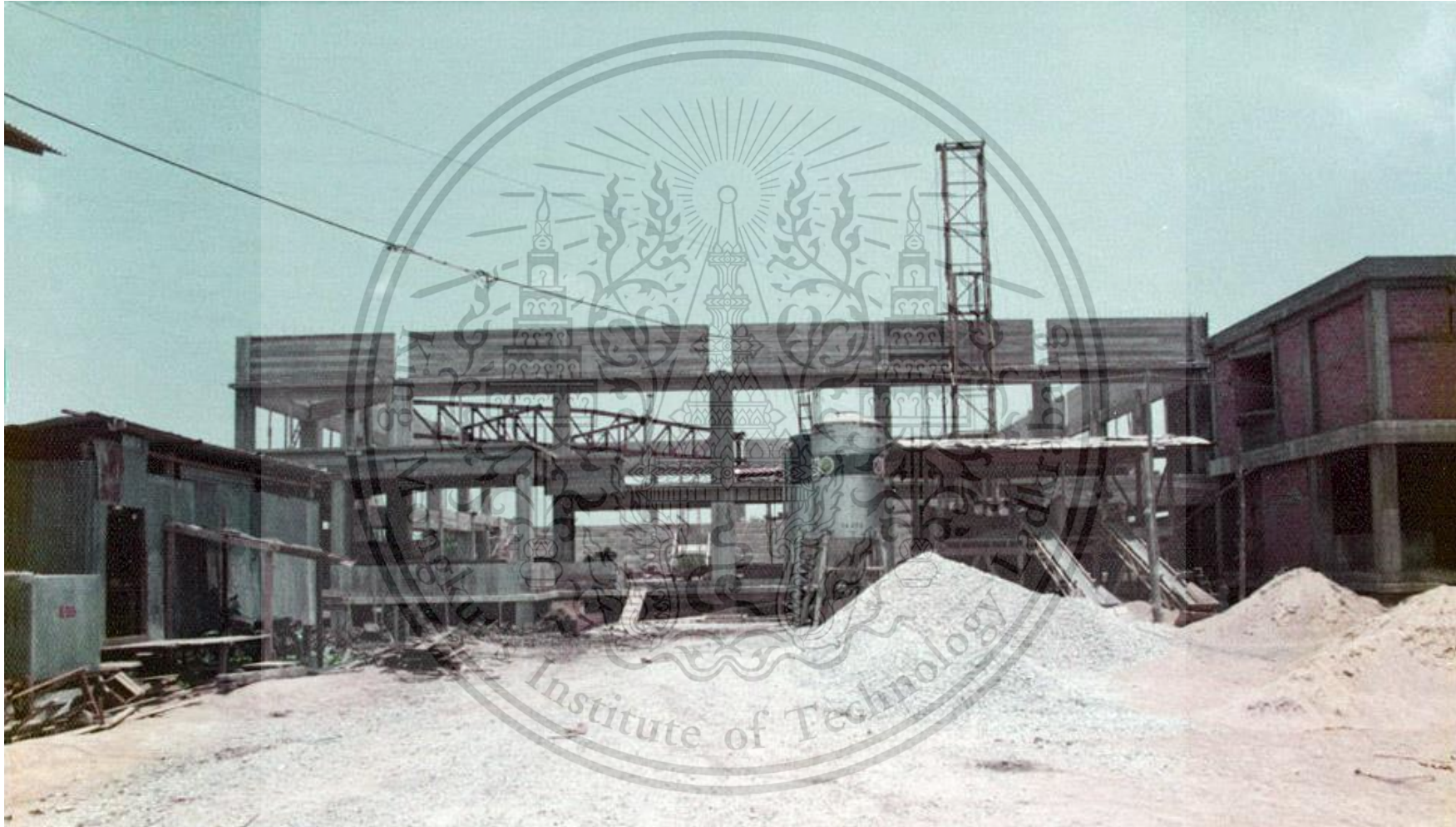


Fig. B.4 The Auditorium Complex in 1974 (ร017-004)
(Source: KMITL archives)



Fig. B.5 The Auditorium Complex in 1974 (๓๐17-๐๐5)
(Source: KMITL archives)



Fig. B.6 The Auditorium Complex in 1974 (ก๑17-006)
(Source: KMITL archives)



Fig. B.7 The Auditorium Complex in 1974 (๓๐17-๐๐7)

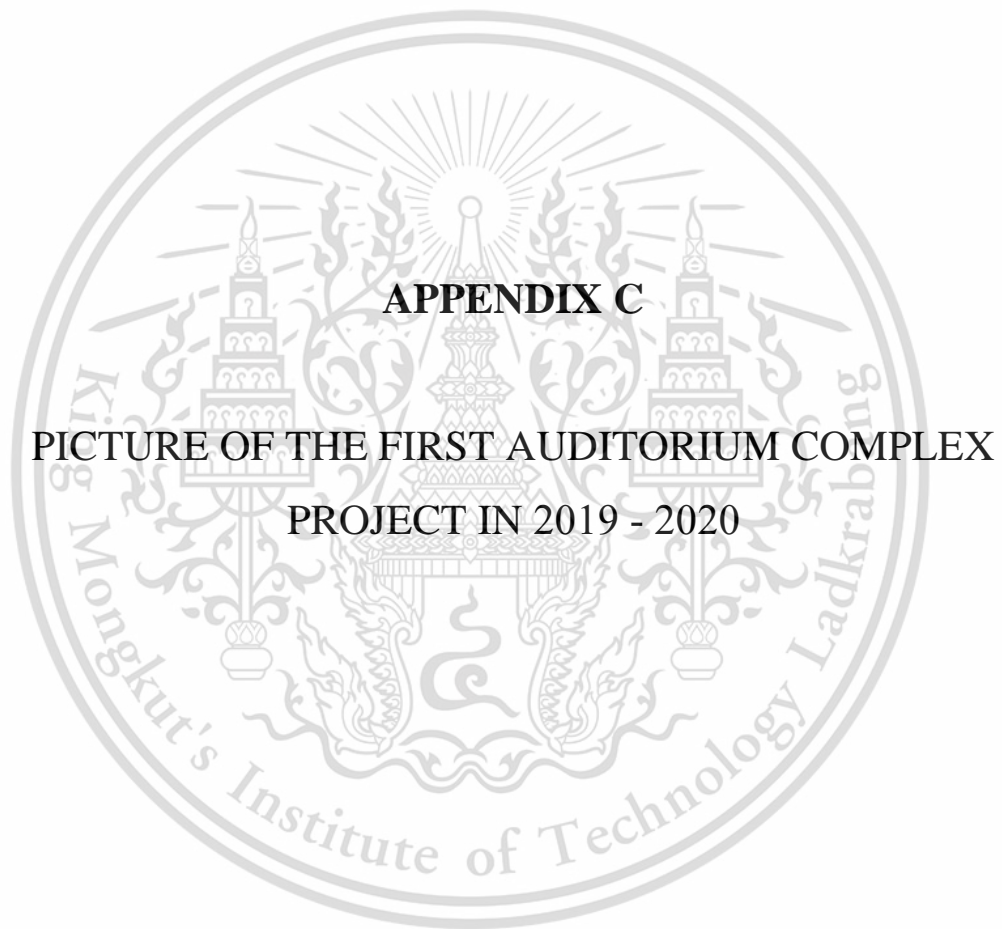
(Source: KMITL archives)



Fig. B.8 The Auditorium Complex in 1974 (๓๐17-๐๐8)
(Source: KMITL archives)



Fig. B.9 The Auditorium Complex in 1974 (๓๐17-009)
(Source: KMITL archives)



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Fig. C.1 Top View of The Auditorium Complex in 2019
(Source: Tiapisap, 2019)



Fig. C.2 The Entrance of The Auditorium Complex in 2019
(Source: the author)



Fig. C.3 Inside of The Auditorium Complex in 2019
(Source: the author)

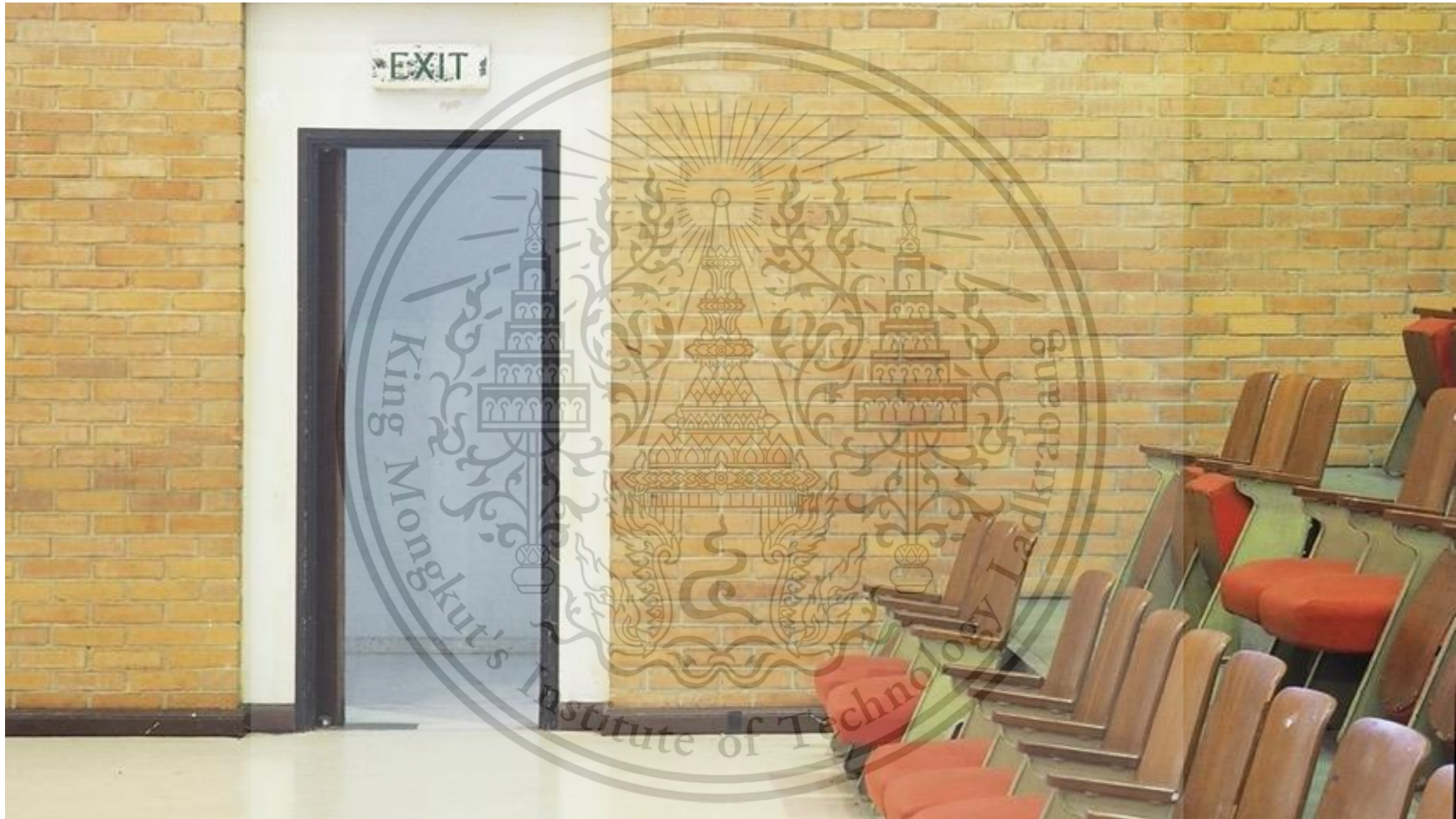


Fig. C.4 Inside of The Auditorium Complex in 2019
(Source: the author)



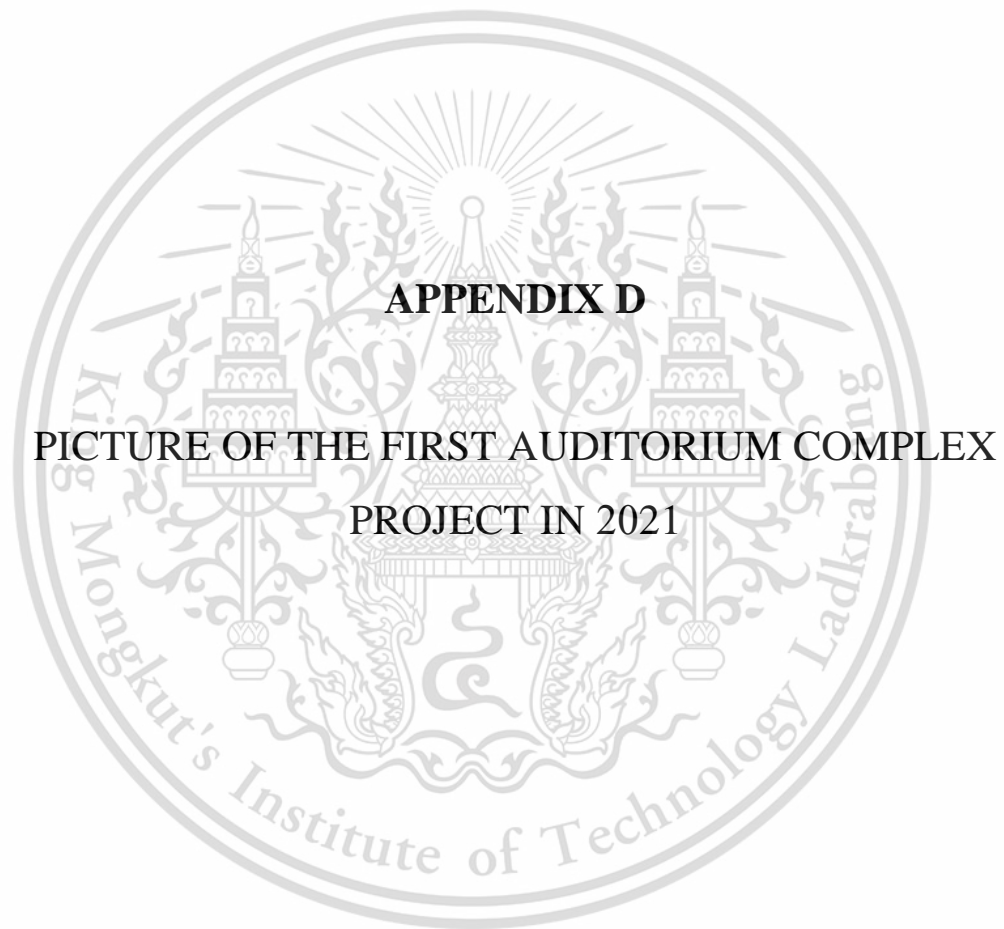
Fig. C.5 Inside of The Auditorium Complex in 2019
(Source: the author)



Fig. C.6 Inside of The Auditorium Complex in 2020
(Source: the author)



Fig. C.7 Inside of The Auditorium Complex in 2020
(Source: the author)



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Fig. D.1 Entrance of The Auditorium Complex in 2021
(Source: the author)



Fig. D.2 Outside of The Auditorium Complex in 2021
(Source: the author)



Fig. D.3 Inside of The Auditorium Complex in 2021
(Source: the author)



Fig. D.4 Inside of The Auditorium Complex in 2021
(Source: the author)

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