

A DESIGN OF FACULTY OF THEATRE ARTS FOR CHULALONGKORN
UNIVERSITY BANGKOK THAILAND

by

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I. INTRODUCTION.

Thailand is an old country with her own lofty culture. The art of old traditional drama has been very popular and has been refined throughout history.

But still the standard of various performances concerning public relation such as: movie art, T.V. shows, radio broadcast and other dramatic performances, are not at a satisfactory level. Mostly, involved persons such as play-writers, stage managers, movie directors, actors and others in the profession learn from experience and work of others in their rank. They were never formally educated in this field.

While training programmes for classical Thai music, drama, and dances are being offered at Krom Silpakorn, westernized communicative arts is still not available. It is therefore necessary to make available this very important form of arts.

Chulalongkorn University, the oldest and most well-known in Thailand, has decided to establish a new institution to be called "Faculty of Theatre Arts". This Faculty of Theatre Arts will be an institute to educate students who wish to be actors or other roles related to this field. It will be a foundation in raising the art of drama and any kind of performances related to public relations to a higher standard than it is known today. A four-year programme leading to the degree Bachelor of Theatre Arts will be offered.

By necessity, the University will need to have a new modern auditorium with a capacity of about 1,000 persons. The present

one is too small and lacks proper facilities. Furthermore it is not well designed. The new auditorium of the new college will be used by students as well as for public activities in order to help operating expenses.

II. AN INTRODUCTION TO THAILAND

GEOGRAPHICAL AND PHYSICAL BACKGROUND OF THAILAND.*

1. Location

Thailand, the land which once was known as Siam, is situated in the Indochinese Peninsula, the heart of tropical Southeast Asia. On the north it is bounded by China and Laos, on the west by Burma, on the south by Malaysia and on the east lie Cambodia and Vietnam.

It is located approximately between the parallels $5^{\circ}37'$ and $20^{\circ}27'$ north latitude, and between the meridians of $97^{\circ}22'$ and $105^{\circ}37'$ east longitude.

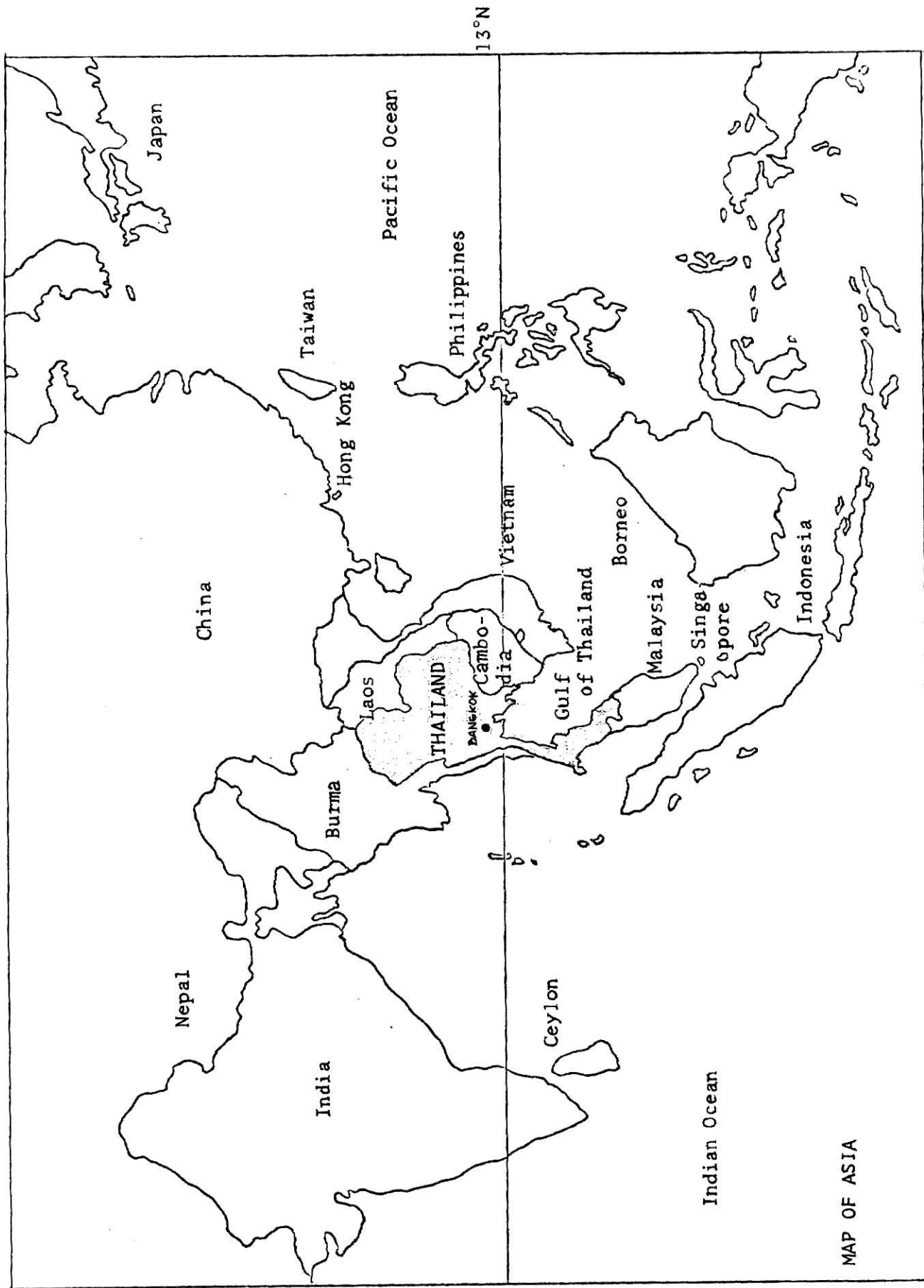
2. The Neighbours

On the Burmese Border there are three mountain ranges, namely, Daenlao, Thanonthongchai and Tenasserim. Four rivers, i.e., Salween, Mae Sai, Moei and Kraburi form the frontier between the two countries.

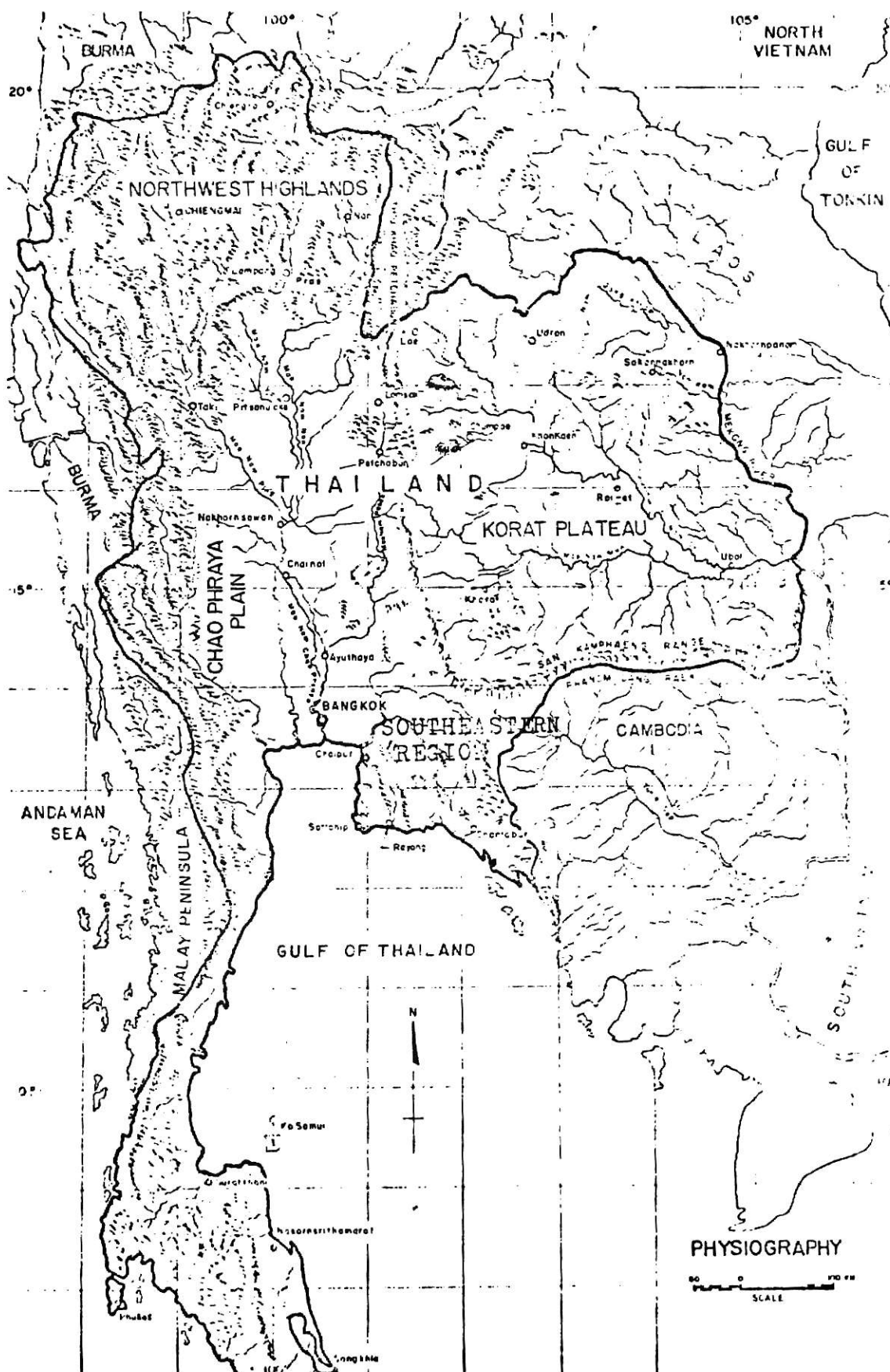
Laos is adjacent to the northeast frontier. It is separated from Thailand by two sections of Mekong River. Maenam Huang, and the ranges of Luang Phrabang and Phu Daenmuang.

Cambodia is in the lower plain southeast of Thailand. Certain parts of the frontier of the two countries lie in the ranges of Dongrak and Banthat.

*Thailand Official Year Book 1969
(Government House Printing Office)



MAP OF ASIA



Malaysia adjoins the south Thai frontier. The range of San Kalakhiri and Maeham Sungai Kolok constitute the boundary for the two nations.

3. Advantages of the Location

Thailand is said to be advantageously located at one of the eastern centres of the world airways. Bangkok Airport today handles an increasing volume of the international air traffic. It should be noted that the airways from four separated continents, i.e., Europe, North America and Australis, also come to unite at Bangkok. It is also interesting to note that all of the mentioned routes are approximate to the great circle lines which are shortest and most economical for air navigation. Topographically, Bangkok is surround by a great expanse of flat rice fields. Here the weather is bright and calm most of the year. The air strip at Bangkok is therefore ideal for safe landing and taking off of the air liners.

It is true that Thailand is not in a perfect location with respect to the ocean trade route, because Bangkok Harbour is over a thousand kilometers away from that route. In spite of a long detour made by all merchant marines calling at Bangkok, the exports of rice, rubber, maize, tin and teak from its harbour give them attractive transportation benefits. (See maps pages 4, 5)

4. Size and Shape

Because Thailand is being mapped at a scale of 1/50,000 it is not possible at the present to give more accurate dimensions of her size than following estimated figures:

South Latitude	5°	40'	north (approx.)
North Latitude	20°	30'	north (approx.)
West Longitude	97°	30'	east (approx.)
East Longitude	105°	45'	east (approx.)
Area	518,000 square km.		
Widest part	750		km.
Longest part	1,620		km.
Narrowest corridor at Prachuap Khiri Khan 10.6 km.			
Narrowest part of the Kra Isthmus			64 km.

The popular visualization of the general outline of Thailand is that it resembles an ancient axe. But to some people it appears as the head of the symbolic white elephant. Khorat Plateau or the Northeast looks like its head while the North is like its crown. The Gulf of Thailand and the South-east are the mouth and the lips. The Southern Peninsula represents the trunk.

5. Topography

The topography of Thailand is characterized by (1) folded mountains which are in the southeastward continuation of the Himalayan System; (2) flat alluvial plains which are intersected by winding rivers and irrigation canals and are flooded during each rainy season; (3) certain amount of undulating country and (4) maritime features such as sandy beaches, mangrove swamps, irregular coastlines, and numerous islands.

For convenience of description, Thailand may be divided into 5 physiographic provinces, namely, the Northern Folded Mountains, the Central Plain, the Khorat Plateau, the South-

east and the Peninsula.

a. The Northern Folded Mountains

This province consists of a series of parallel and longitudinal folded mountains in continuation of the Himalayan System, which runs down through the east of Assam in India, Yunnan Province of China and the Shan State of Burma. This great arc of ranges continues further south through the Peninsular of Thailand and Malaysia.

The strata of sedimentary rocks in the folded mountains were broken lengthwise in many places causing a great mass of magma to force up and fill the gaps. Thus Inthanon and Khun Tan are the two long granitic ranges formed in this way. Between the ridges of these mountains are relatively flat basins, where four major tributaries of Maenam Chao Phya are allowing. These rivers are Mae Ping, Mai Wang, Mae Yom and Mae Nan. The important changwats (provincial centres), such as Chiang Mai, Lampang, Phrae and Nan are situated on these river banks. The alluvial soils of these intermountain basins are fertile for rice cultivation and for growing vegetables, tobacco and various kinds of fruit trees, such as lamyai, lichi and oranges.

The average height of the peaks in this region is about 1,600 meters above mean sea level. Doi Inthanon, towering up to 2,576 meters, the highest peak in the Kingdom, and is about 50 kilometers southwest of Chiang Mai. The plain of Chiang Mai itself is about 300 meters above mean sea level. Doi Suthep, very well known as a touristic spot, and where the

Royal Palace, Phu Phing Ratchanivet is situated, rises to 1,676 meters high, overlooking the city of Chiang Mai from the west.

This northern folded mountain system extends down the western provinces of Tak and Kanchanaburi and ends there. The folding in this part gives rise to the valleys of rivers, such as Mae Moei in Amphoe (district or subdivision of a province) Mae Sot of the Province of Tak, Mae Khwae Noi and Mae Khwae Yai in the Province of Kanchanaburi.

It should be noted that the four rivers: Maenam Ping, Maenam Wang, Maenam Yom, and Maenam Nan, must pass through the narrow gorges before leaving the northern valleys for the central plain. The summer monsoon brings a great deal of moisture from the Indian Ocean. The orographic condition of the northern mountains causes much rainfall. Rapid runoff in the streams accumulates into a big current in these rivers, and if the current cannot be drained through the narrow gorges soon enough, this will result in flood.

The stream gradient of the tributaries of the four major rivers in the north is generally steep. The strong runoff during the wet season brings down a great amount of sediments and deposits them right at the mouths of the streams. This process has built up a string of alluvial fans at the foot of the mountains. These delta fans will increase in size and later join together forming a continuous piedmont plain. The piedmont plains are therefore commonly found on both sides of the alluvial flood plains of these four major rivers. The soils on the

piedmont plains are fertile and are generally utilized for up-land crops.

There are so many limestone hills in this region and they are easily identified by their precipitous features. Doi Chiang Dao, 2,182 meters high, one of the highest limestone mountains, is north of Chiang Mai. A famous cave in this mountain is visited by many tourists from all over the country each year.

Many of the remains of the prehistoric man have been found and excavated from the limestone caves of Changwat Kanchanaburi.

b. The Khorat Plateau

The Khorat Plateau, named after the second name of Changwat Nakhom Ratchasima, consists of two-sided fault and tilt rather than a uniform uplift of the strata of sedimentary rocks. The western tilt causes the ranges of Petchabun and Dong Phrayen to rise up longitudinally with their escarpments facing the central plain on the west. The elevation of the tilted rim of the plateau on this side varies from 130 to 200 meters above mean sea level, while the flat top mountains of Dong Phrayen are generally between 800 to 1,300 meters.

The southern tilt separates the plain of Cambodia from the plateau surface. Thus the two levels of land are traditionally called the Lower Cambodia and the Upper Thailand. The lifted portion forms latitudinal ranges of mountains known as San Kamphaeng and Dong Rak. The steep escarpments of these chains overlook the Cambodian plain in the south. The rim of the plateau on this side averages about 400 meters above mean

sea level, while some of the peaks may rise to about 600 to 700 meters. When one stands on the edge of the escarpment or any high point on the chain of Dong Rak he will see a great expanse of the Cambodian plain, and it seems as he has seen the whole of Cambodia.

Close to the point, where the borders of Cambodia, Thailand and Laos meet at the southeast corner of the plateau, the rim of the escarpment turns northeastward to join with the junction between Mekong River and Maenam (River) Mun.

The land surface on the plateau slopes rather gently eastward towards the Mekong, while it does so fairly abruptly northward towards Maenam Mun. Maenam Chi flows southeast from the ranges of Petchabun to join with Maenam Mun which derives part of its water from Dong Phrayen mountains before uniting itself with Mekong River east of Changwat Ubon Ratchathani. The surface elevation of this Changwat is approximately 50 meters above mean sea level.

The general surface of the plateau is rolling with some studded flat top hills like Khao Yai and Phu Kadung. The tops are generally not horizontal but are sloping in conformity with the tilt which has already been described.

Because of the rolling topography of the region, the drainage pattern is rather dendritic with the general direction of flow toward southeast. The heavy monsoon rain falling over the thin forest covers results in rapid run-off and causes flood almost yearly in Changwat Ubon Ratchathani, which is at the junction of Maenam Mun and Maenam Chi. These two major

rivers and their tributaries on the plateau have built up scattered alluvial lands of various sizes. The largest among them is in Changwat Ubon Ratchathani where rice is the chief crop and its production is highest of the whole northeastern region.

Close to Mekong River the land surface is rather swampy with many lakes, the important one is Nong Han of Sakon Nakorn. The presence of these lakes suggests the horizontality of the strata of sedimentary rocks as well as the shallow water table.

The extent of the plateau consists of sandstone which is the parent material of the sandy soil found on the surface. The aridity of the region with its thirsty soil is traceable to this kind of rock. The underground water can be made available in many places by digging or boring of wells. But the water obtained is either salty or hard and therefore is not palatable or useful domestically. At present there are an increasing number of wells with fresh water, as a result of the government's drive to solve the water problems of the northeast.

Mekong River, which acts as the boundary between the Kingdom of Laos and the Thai Kingdom meanders about in the north and east of the plateau. The section of this river along the frontier varies from 700 to 1,300 meters wide and is either studded with islands or broken up by many impassable rapids. The governments of the countries benefited by this river's system, including the Thai government, are determining to develop its water for agricultural and industrial purposes. Topographical surveys as well as scientific research are being

taken for careful planning.

c. The Southeast

The Southeast, another part of Thailand's rolling country with many high hills in the centre and along the eastern limit, extends from the foot of the San Kamphaeng range towards the south and includes Changwats Prachin Buri, Chon Buri, Rayong, Chanthaburi and Trat.

The area has been much dissected by numerous streams, all flowing in southerly direction; the important ones are Maenam Wen and Maenam Trat. One of the principal peaks in the Chanthaburi chain, Khao Khieo, rising 800 meters high up, is visible from the top of the Golden Mount in Bangkok. Another noted peak is Khao Soidao (literally means reaching for the stars), which towers 1,640 meters above mean sea level.

The southeast region is flanked on the east by a range of hills called Banthat (the ruler), because when looking at a distance far enough the top of the range appears as a straight line. This mountain range forms part of the frontier between Cambodia and Thailand.

Because the mountains in this region are close to the sea, the coastline is therefore much indented and fringed with rocky islands. Ko Chang, the largest island on this coast, and Ko Kut are very well known among tourists for their beautiful beaches and landscapes; the former contains a waterfall. Chon Buri and Rayong also have irregular coastlines with numerous islands not far from the shores; the important one is Ko Si-chang which forms a good shelter for large ocean liners.

The short streams of this region have built up small alluvial basins and deltas along the coast. These are utilized for rice cultivation. The higher grounds and the well drained slopes are occupied by plantations, such as rubber, orchards, sugar cane, cassava and pineapple.

The big river mouths consist of tidal flats and mangrove swamps. Where there is no stream, the coast is generally lined up with beautiful beach and many coconut groves. Thus Chon Buri and Rayong are famous for their sea resorts with delightful weather most of the year.

d. The Central Plain

The Central Plain of Thailand may be divided into two distinct physiographic sub-provinces, the Northern Rolling Plain and the Chao Phya Delta.

The topography of the Northern Rolling Plain has been much lower than the Northern Folded Mountains region; but it is still higher than the Chao Phya Delta. Only three major rivers flow through this rolling plain, namely, Maenam Ping with Maenam Wang already united, Maenam Yom and Maenam Nan. All of these rivers join together at Pak Nam Pho to form Maenam Chao Phya. The junction of these rivers is about the southern limit of the rolling plain. The north-south extent of this rolling topography is about Changwat Nakhon Sawan to Uttaradit, and the east-west extent is approximately from Changwat Kamphaeng Phet to the foot of the Phetchabun range.

The Chao Phya Delta commences south of Nakhon Sawan and extends down to the Gulf of Thailand. The triangular plain is

traversed by two major rivers, Maenam Chao Phya and Maenam Tha Chin, the latter being known by different names as it flows through different changwats down to the gulf. The system of drainage in the Chao Phya Delta is the same as other deltas in many parts of the world, which are braided into many smaller channels, and are too numerous to be represented on the small scale maps. Another river, Maenam Pasak, flows down the valley of the Phetchabun ranges to join with Maenam Chao Phya at Changwat Ayutthaya. Maenam Maeklong on the west and Maenam Bangpakong on the east merely add the sediments to the lower part of the Chao Phya plain, and therefore form parts of this delta.

The flat land of the Chao Phya Delta is generally low and is usually flooded by rain water in the wet season, and this is very useful for rice growing. Bangkok, on the east bank of Maenam Chao Phya, stands only 1.80 meters above mean sea level. The higher ground close to the east and west sides of the delta plain must be aided by irrigation. The Chao Phya Delta is the largest and most fertile plain in the country.

Much silt is transported from the four major tributaries of Maenam Chao Phya in the north down to the Gulf of Thailand. Silting in the gulf has been found to result in a land increase of about a meter and a half a year at the river mouth. Silting is therefore beneficial in one way but a great loss in the other, because a great mass of silt obstructs the navigational channels of the Chao Phya. The pilots have much difficulty in bringing the ships in and out of the Bangkok Harbour. The

Government of Thailand spends a great deal on her annual budget in clearing the silt bar.

As a matter of fact the Chao Phya Delta does not consist of a flat land throughout, but is partly scattered with small isolated hills abruptly rising above the flat plain. These hills are the former islands in the old Gulf of Thailand when it was still as deep as Changwat Chai Nat or beyond. They are now buried by the sediment of clay up to their present bases. Khao Thapkhwai is one of such hills. It is rich with iron ore and is now being mined for the Thai Cement Company's smelting furnace.

e. The Peninsula

The Peninsula covers an area from Ratchaburi to the southern border between Thailand and Malaysia. The general topography is from rolling to mountainous, with a small amount of flat land.

The northern portion from Ratchaburi to Chumphon is flanked on the west by a high mountain range, the Tenasserim, which forms part of the frontier between Thailand and Burma. The east side consists of a long gentle sloping coastline, mostly sandy, touching the Gulf of Thailand. On this coast lies the famous beach, Huahin, which attracts tourists from all over the country and abroad. The streams and rivers here flow down for a short distance to the sea on the east. Maenam Phet is one of the big rivers of the region which has been dammed for irrigation. Numerous limestone hills standing precipitously over the rolling plain give much impression to the landscape of this region.

The massive mountain on the west side attains the height of 1,000 to 1,500 meters. Khao Luangprachuap, for instance, reaches the height of 1,247 meters. Some of the difficult passes leading from Thailand into Burma cross over these ranges; the important one is Jalinga Pass or Chong Singkhon, which connects Prachuap Khiri Khan with the town of Tenasserim.

The southern portion commences from the Isthmus of Kra and extends down to the Malaysian border. It faces the sea on the east. This part of the country is marked by two almost parallel ranges in longitudinal direction, the Phuket and the Nakhon Si Thammarat, while the San Kalakhiri range extends from Chumpen down to Phang Nga, while the Nakhon Si Thammarat range stretches across the peninsula between Surat Thani and Satun.

The rolling country between the Phuket range and the Nakorn Si Thammarat range is studded with isolated peaks rising sheer out of the plain. One massive hill in this region is Khao Phanom Bencha, attaining the height of 1,401 meters, but others are mostly low limestone hills. The highest peak of the Nakhon Si Thammarat range is Khao Luang Nakhon Si Thammarat which rises 1,786 meters above sea level. The frontier range in the south varies in height from 400 meters at both ends to about 1,500 meters in the middle.

The streams and rivers in the southern portion of the Peninsula are generally short and flow down to the seas on both sides; the most important one is Maenam Kraburi, which forms part of the boundary between Thailand and Burma west of Ranong. The others are Ban Don, Tapi, Khirirat and Sungai Kolok; this

last one acts as a portion of the eastern end of the Thai-Malaysian border. Many of the rivers in this region have built up delta lands suitable for rice cultivation. East of Patthalung and north of Songkhla lies a large lake, Thalesap Songkhla. This lake is bordered by a large plain which produces a large quantity of rice for the south.

The western coastline is much indented, because many hills come close to the shore, and physiographically it is a submerged shoreline. The evidence is clearly indicated by the V-shape Maenam Kraburi. Numerous islands are scattered along the western coast; the largest one is the tin rich island of Phuket. This island is also a changwat in the peninsula. The other islands of note are Tarutao, Lanta, Libong, Phrathong and Yaoyai. They are rich also in bird nests and fish. Contrary to the western coast, the eastern side of the peninsula has been uplifted and therefore the shoreline recedes much towards the east, giving rise to a generally smooth curvature along the shore. Some of the evidences indicating the uplift are the marine deposits found in many limestone caves high above the present sea level, and the rocks at the foot of the mountains now on dry land appear to be carved by the action of sea waves.

6. Bangkok*

Bangkok, the capital of Thailand, has a total population

*Thailand Land of the Free (New York Times, February 1965)

of more than 2,000,000. It is a richly decorated modern city, situated on the east bank of the Chao Phya River about 23 miles north of the Gulf of Thailand. Founded in 1782, it serves as center of the nation's cultural, financial, commercial, industrial, and educational life. It is virtually a city of temples, and in regard to tourist interest, it is considered one of the most intriguing beauty spots of the Orient. Because of its unique features of numerous canals, elegant palaces, and colorful temples and shrines, Bangkok is often referred to by westerners as the "Venice of the East." It is one of the major sea ports in Southeast Asia and certainly the principle international air-travel center in the Far East. There are 24 international airlines offering their facilities at Bangkok Airport and 42 companies of 12 nationalities have their ocean liners dock there.

7. Education*

The Thai people have had a written language for 700 years and have, as a result, placed a high premium on literacy during all the following centuries.

The present system of education was established in 1892 with the formation of the Ministry of Education under the Thai government.

In 1921, the first system of compulsory education was

*Reports on Educational Development in 1965-1966
(Ministry of Education of Thailand)

introduced. This required all children between the ages of seven and fourteen to attend school for four years of elementary education in free government schools.

There are six levels in today's educational system in Thailand.

The first is Pre-Primary of Kindergarten Education for children between the ages of three and seven. This requirement is not compulsory, but is rapidly gaining in popularity.

The second is compulsory Elementary Education (Pratom)¹, consisting of four grades for children 7-14 as mentioned above.

Third, Post Primary of Lower secondary Education (Matayom)², consisting of three grades.

Fourth, Secondary Education (Matayom) of three grades, including vocational as well as academic instruction.

Fifth, Pre-University Education, consisting of two years for academic instruction. For educational instruction, this is a three-year course, leading to a certificate in one of the various vocations.

The Sixth and last level is that of University Education.

¹Pratom is the elementary grade in Thailand (Pratom 1-4 are equal to Grades 1-4).

²Matayom is the old secondary system in Thailand (Matayom grades 1-6 are equal to Grades 4-10).

M.S. according to the new amendment of the Secondary System (M.S. grades 1-4 are equal to grades 6-10)

There are eight universities and one college of Education in Thailand, which are the following: Chulalongkorn University, the oldest, Thammasart University, Kasetsart University, Khon Kaen University, Chiang Mai University, Songklanakarin University and the College of Education.

Chulalongkorn University offers courses in Education, Commerce and Accounting, Political Science, Engineering, Architecture, Arts, Public Relation, Economics and the Graduate School.

Thammasart University offers Liberal Arts, Law, Political Science, Economics, Social Administration, Public Administration and Commerce Accountancy and Graduate School.

Kasetsart University offers Agriculture, Animal Husbandry, Forestry, Fisheries, Veterinary Medicine, Economics, Business Administration, Irrigation Engineering and Graduate School.

The University of Medical Sciences includes Medicine and School of Nursing, Dentistry, Pharmacy, Public Health, Tropical Medicine, Medical Technology, Medical Science, and Nursing.

Silpakorn University offers Painting and Sculpture, Architecture, Decorative Arts, and Archaeology.

Khon Kaen University offers Science and Arts, Agriculture, Engineering, and Medicine.

Chiang Mai University offers Arts or Humanities, Teaching Education or Education, Architecture and Fine Arts, Social Sciences, Natural Sciences, Engineering, Medical Sciences, and Agriculture.

Songklanakarin University offers Agriculture, Arts,

Education, Science, Engineering, and Commerce and Accounting.

On April 1, 1961, the new system of education, "The National Education Plan," was set up. It includes Primary Education or Matayom Suksa with a period of five years. The latter is divided into two levels--"Junior" and "Senior".

8. Population^{*}

The total population of Thailand is approximately 33 million with annual growth rate of almost 3%. Between 85% and 90% of the people live in the rural villages. There are only two classified cities: Bangkok and Chiangmai. About 6% of the country's total population lives in this urban area, and its annual growth rate is in excess of 7%. Average population density in Thailand is about 114 persons per square mile. Bangkok is the most populated city whose density is obviously high but fortunately not yet among the highest of the major cities of the world. No specific figure is available at the moment.

The principle minorities are the Chinese, who make up approximately 15% of the population; the Thai-Malays of the Peninsula, forming a little over 3% of the population; and a small number of Vietnamese.

Four out of five Thai are engaged in farming. By 1990, it is estimated that the population of Thailand will be 53,000,000.

^{*}Thailand: Facts and Figures 1966

9. Government*

Thailand is constitutional monarchy with a centralized government. The King is the head of the country. He exercises sovereign power through the three branches of government is organized into 13 ministries, all headed by the prime minister. For local administration, Thailand is divided into 71 provinces (Changwats). Each province consists of districts, communes, and villages, and is ministered by a governor appointed by the minister of the Interior. Local government is controlled and financed by the central government. All officials are appointed except the village headman who is elected by the villagers.

10. Religion*

Buddhism is the established religion of Thailand. The king, though protector of all religions, must be Buddhist. A very large majority of the population of Thailand is Hinayana Buddhist (93.6%). Religion plays an important part of the daily life of the Thai people. More than one thousand wats (temples) are scattered throughout the country.

As for other religions of Thailand, 3.9% of the population is Islamite, 1.7% is Confucian, 0.6% is Christian, and only 3,000 persons are Hindus.

There is, obviously, a close relationship between the monarchy, the government, the educational system and the

*Thailand: Facts and Figures 1966

Buddhist religion. The schools are required by law to set aside regular periods for religious holidays.

11. Language*

Thai is the national and official language. It is influenced by other languages such as Chinese, Khmere, Mon, Pali, and Sanskrit, with Sanskrit being the major source of intellectual and philosophical vocabulary. Linguistically it may be divided into four major dialects: central Thai (official), Northern Thai, Northeastern Thai, and Southern Thai. However, Thai speakers have little difficulty in inter-dialect communication because most know the central official language.

Various Chinese dialects are spoken by the next largest group of people in the country. 800,000 people in the southern most provinces of the Peninsula speak Malay. Other minority languages of Thailand are spoken by the hill tribes of northern Thailand and in the west, along the border of Burma.

English is widely known in Thailand. It is taught in schools to fulfill the compulsory foreign language requirements. Many inhabitants of the main cities speak and understand English. Many people speak French but few speak German.

*Thailand: Facts and Figures 1966

12. Currency*

The Unit of currency is the Bath (or tical), whose smaller denominator is stang (cent). The approximate rate of exchange is maintained at about US \$1.00 to 20.00 bahts for the last twenty years.

13. Economy of Thailand*

Thailand has a prosperous agrarian economy which in 1962 had been growing for a decade at the rate of 5 percent a year. All sectors of the economy with the exception of forestry have shared in this expansion. Along with the gain in total output and an accompanying growth of exports, a significant diversification of economic activity has taken place. The principal exports are, as they have been throughout the modern period, rice, rubber, tin and teak. Rice continues to be the most important single product of the economy, however the largest recent increases in agricultural output have been in other crops, especially rubber, corn, tapioca, fibers and a variety of fruits, vegetables and livestock products. An industrial sector, though small, has expanded rapidly with the establishment of enterprises producing light industrial goods such as textiles, paper, cement, glass and sugar. Tin production has continued at peak levels while communications, transportation and construction have greatly increased their contribution to the national income.

*Thailand: Facts and Figures 1966

14. Climate*

a. Seasons

Thailand, like other southern Asian countries, is dominated by the monsoon, which is essentially seasonal winds blowing from one direction part of the year and the opposite direction the remainder of the year. Three seasons may be recognized in most parts of the country: the rainy season (July-October), in which the strong monsoon rains occur; winter (November-February), the mildest season of the year; and summer (March-June), a hot and humid season when tourism would be at its ebb if no extraordinary attraction is provided. Yearly temperatures normally vary about 35°F. The yearly rainfall is 45 to 55 inches over most of the country with still more in the coastal area.

The monsoonal alternation of wet and dry seasons characteristic of the general area is complicated in Thailand by topography. The basic pattern is determined by the moisture-laden southwest wind which blows in from the sea from about May to October and the dry northeast wind which comes down out of the continental land mass during the rest of the year. Although the two-season cycle prevails over most of the country, the narrow peninsula receives rain almost throughout the year, with the bulk of it falling between October and January. Conditions are similar in the southeast.

*Area Handbook for Thailand 1963

By contrast the western part of the Central Region, and especially the western Khorat Plateau, receives little moisture and may experience actual drought during the dry seasons. Temperatures also vary regionally and with the season, from about 65 degrees F., in the cool months of December, January and aprt of February to as high as 100 degrees F. during the hot months of March, April and May. The cool season occurs when the prevailing winds come over wintry lands to the northeast, and the warm season comes when the skies are cloudless and the sun is gaining in altitude.

Thunderstorms in the afternoon and early evening are common between May and October in the northern areas and between March and November in the south. Toward the end of the dry season and again at the end of the rainy season typhoons of considerable violence sweep across the Indochina peninsula from the south China Sea into Thailand.

b. Prevailing Winds

The prevailing winds of Thailand effect the rains. In the summer and rainy season the winds come across the Indian Ocean from the southeast and southwest, bring the moisture which becomes rain when it meets the cooler air above the land. During winter, winds come from the northeast.

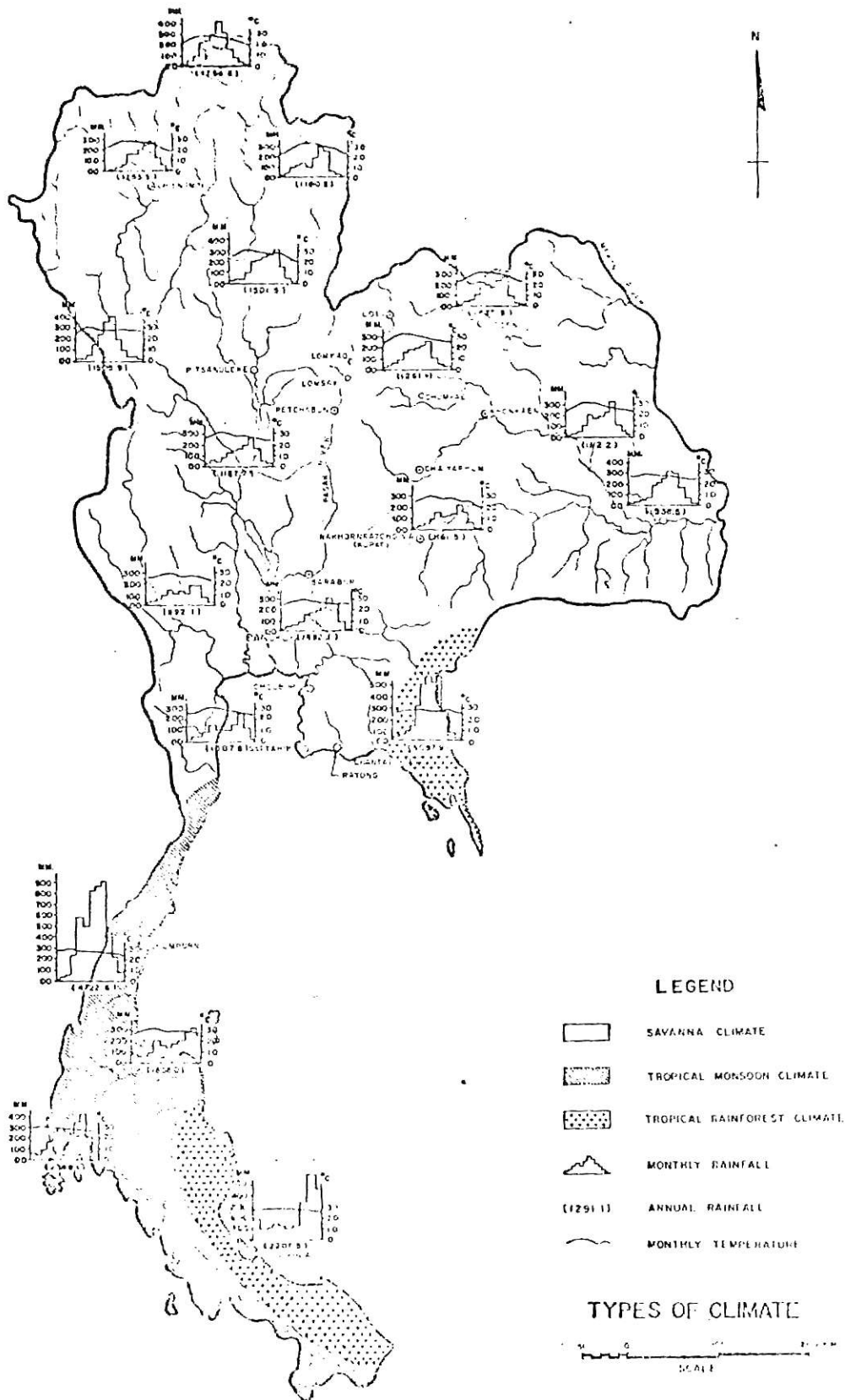
c. Solar Angles

Solar altitude is the vertical angle between the horizontal plane and a line from the sun.

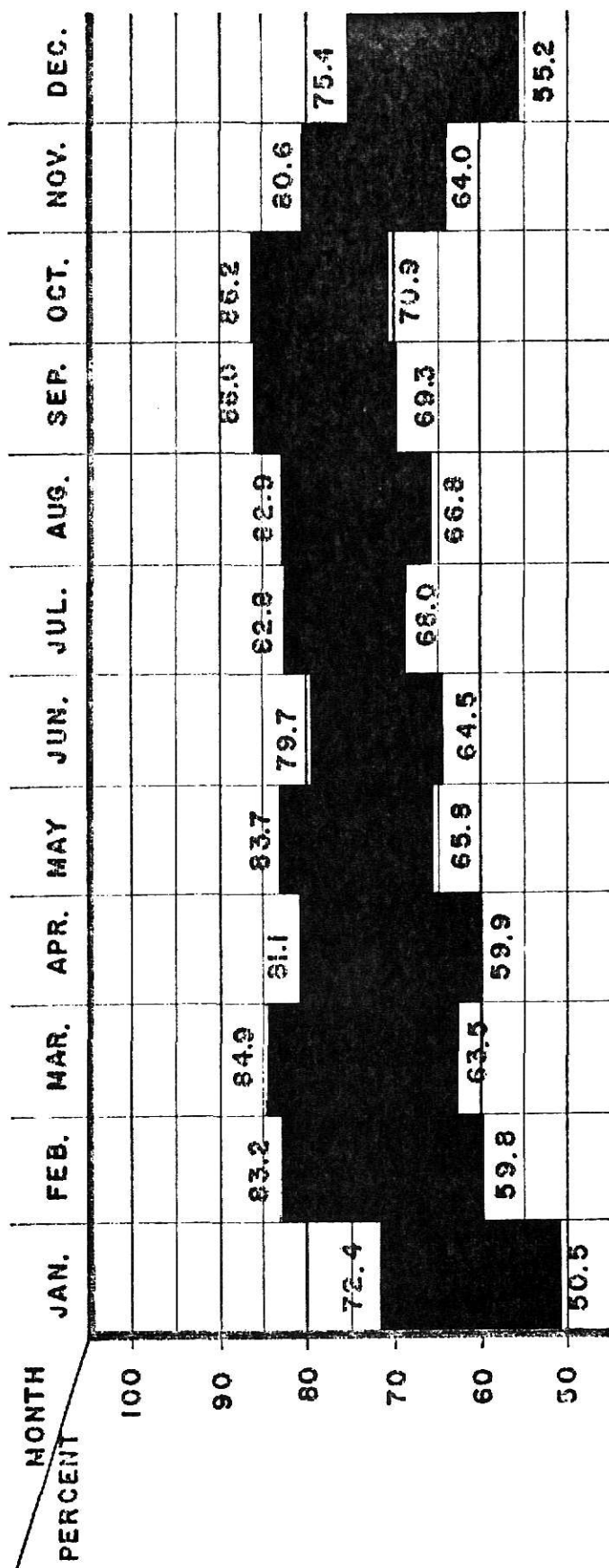
$$\text{Selar altitude in summer} = 90^{\circ} - \text{latitude} - 23\frac{1}{2}^{\circ}$$

$$\text{Solar altitude in winter} = 90^{\circ} + \text{latitude} - 23\frac{1}{2}^{\circ}$$

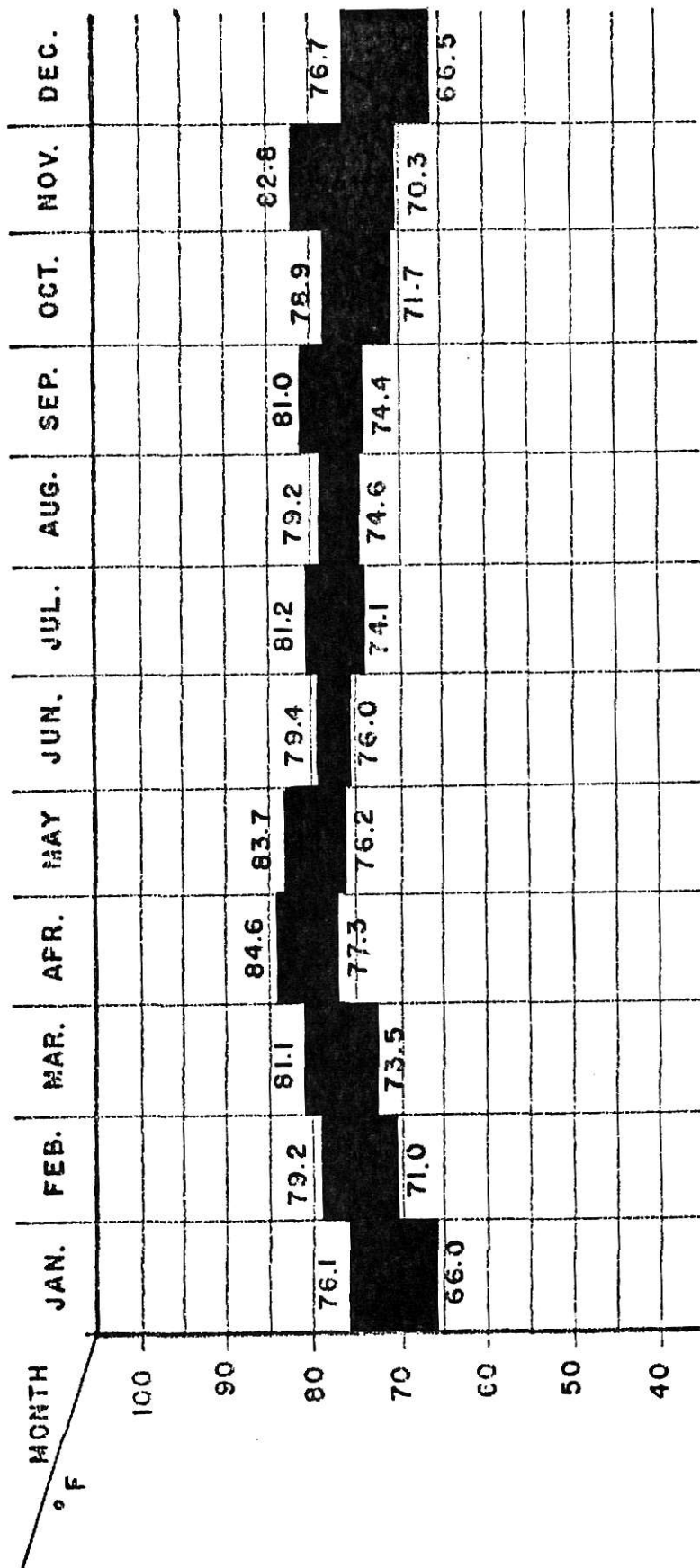
The difference of solar altitudes at summer solstice and winter solstice is very little. The continuity of a year round facility is obviously natural.



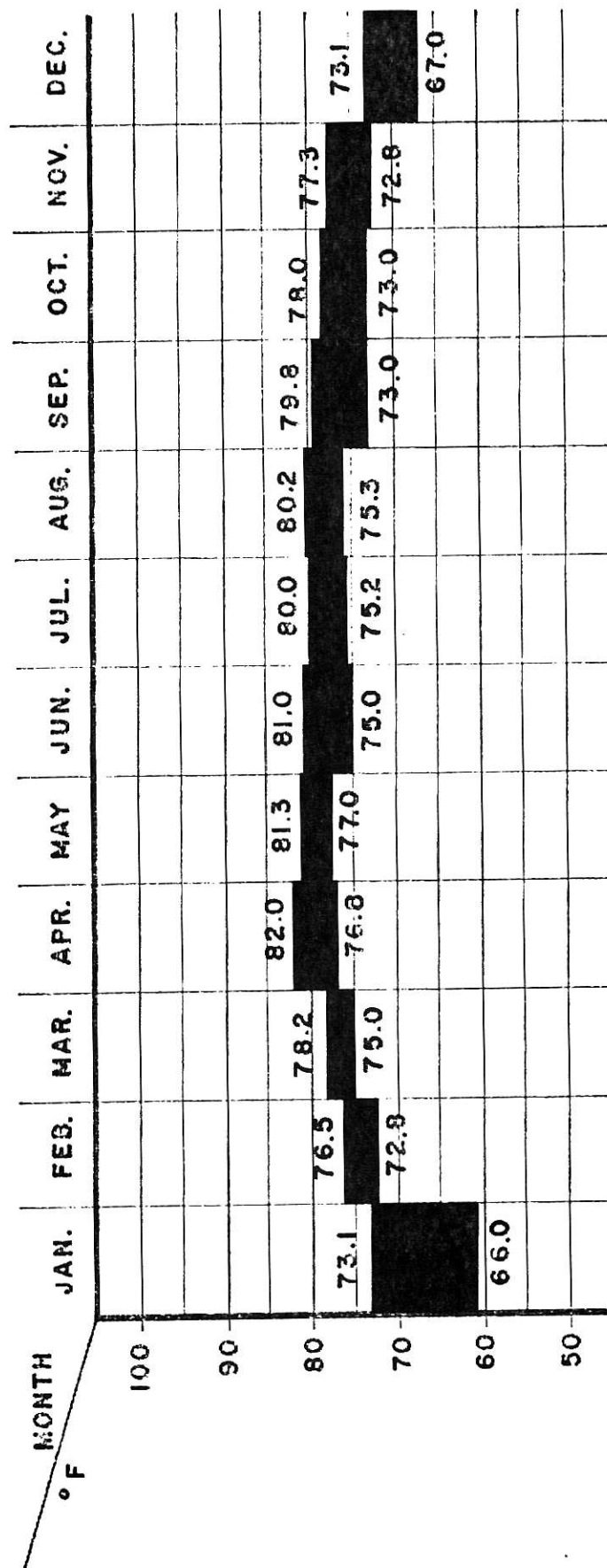




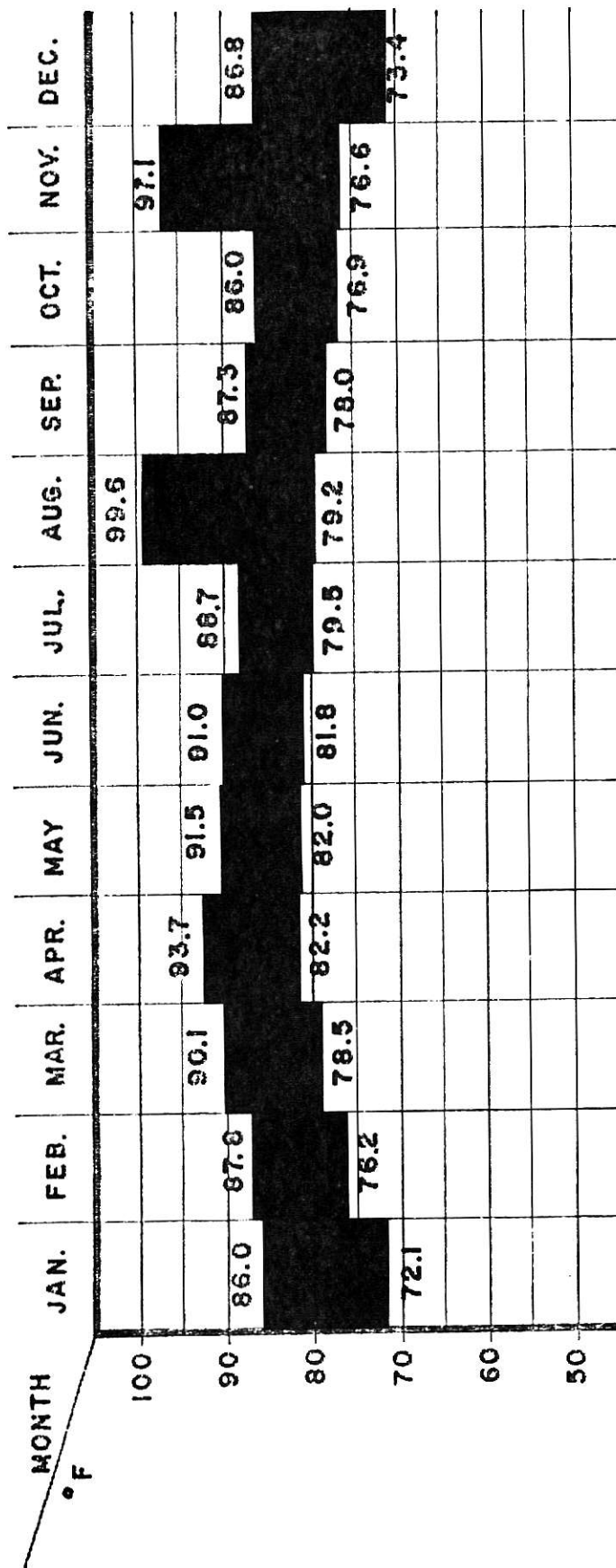
RELATIVE HUMIDITY
AVERAGE MONTHLY



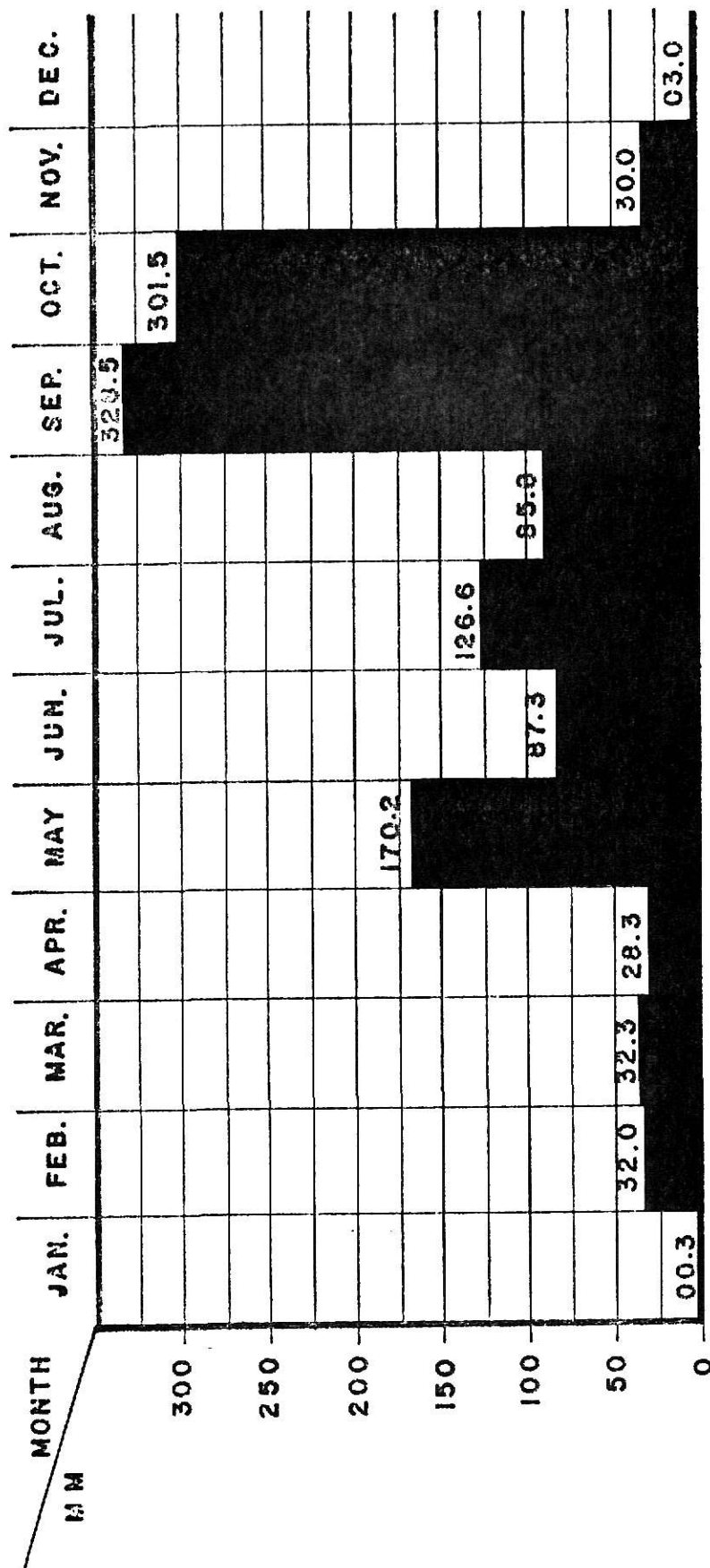
EFFECTIVE TEMPERATURE
AVERAGE MONTHLY



WET BULB TEMPERATURE
AVERAGE MONTHLY



DRY BULB TEMPERATURE
AVERAGE MONTHLY

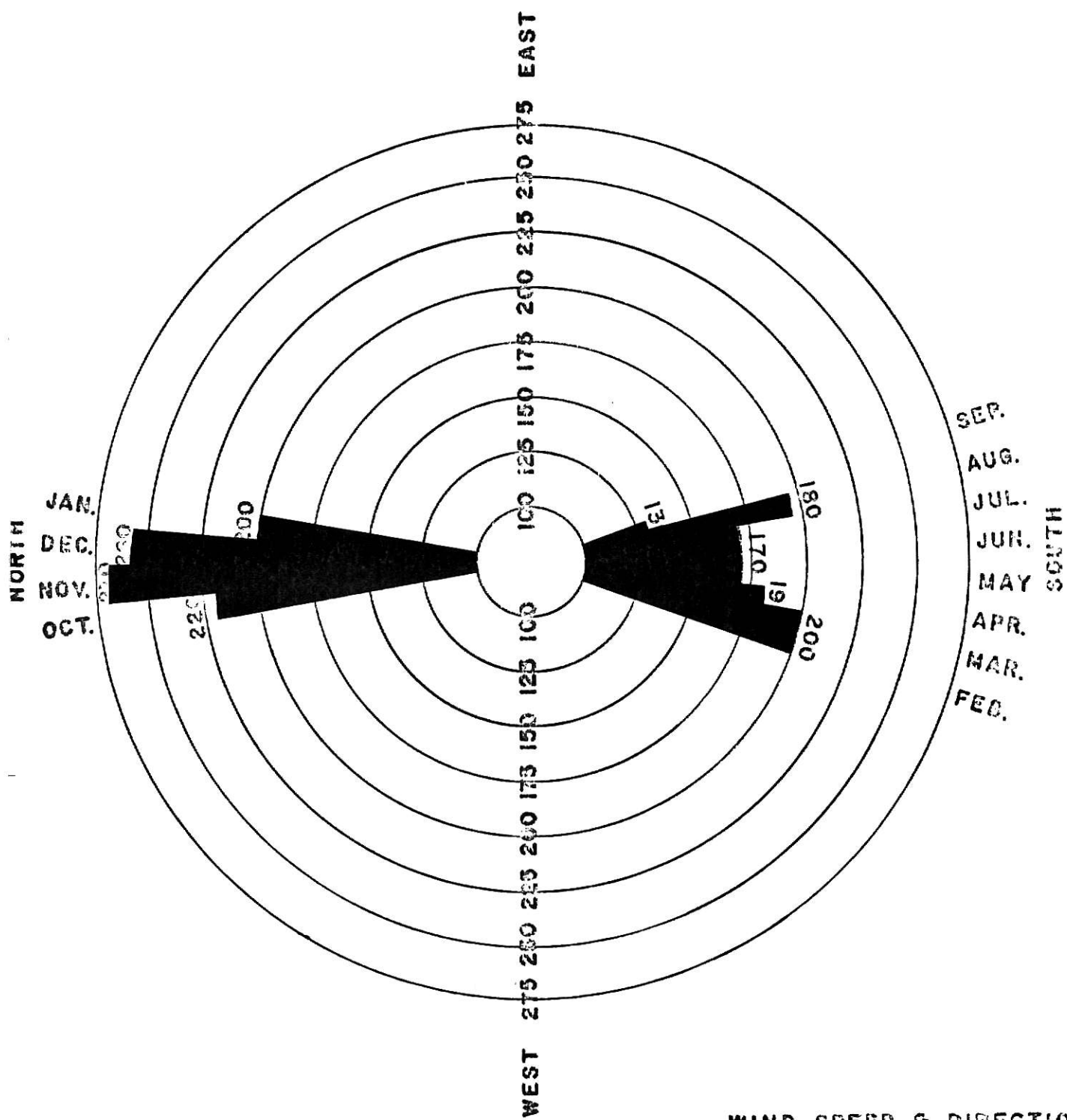


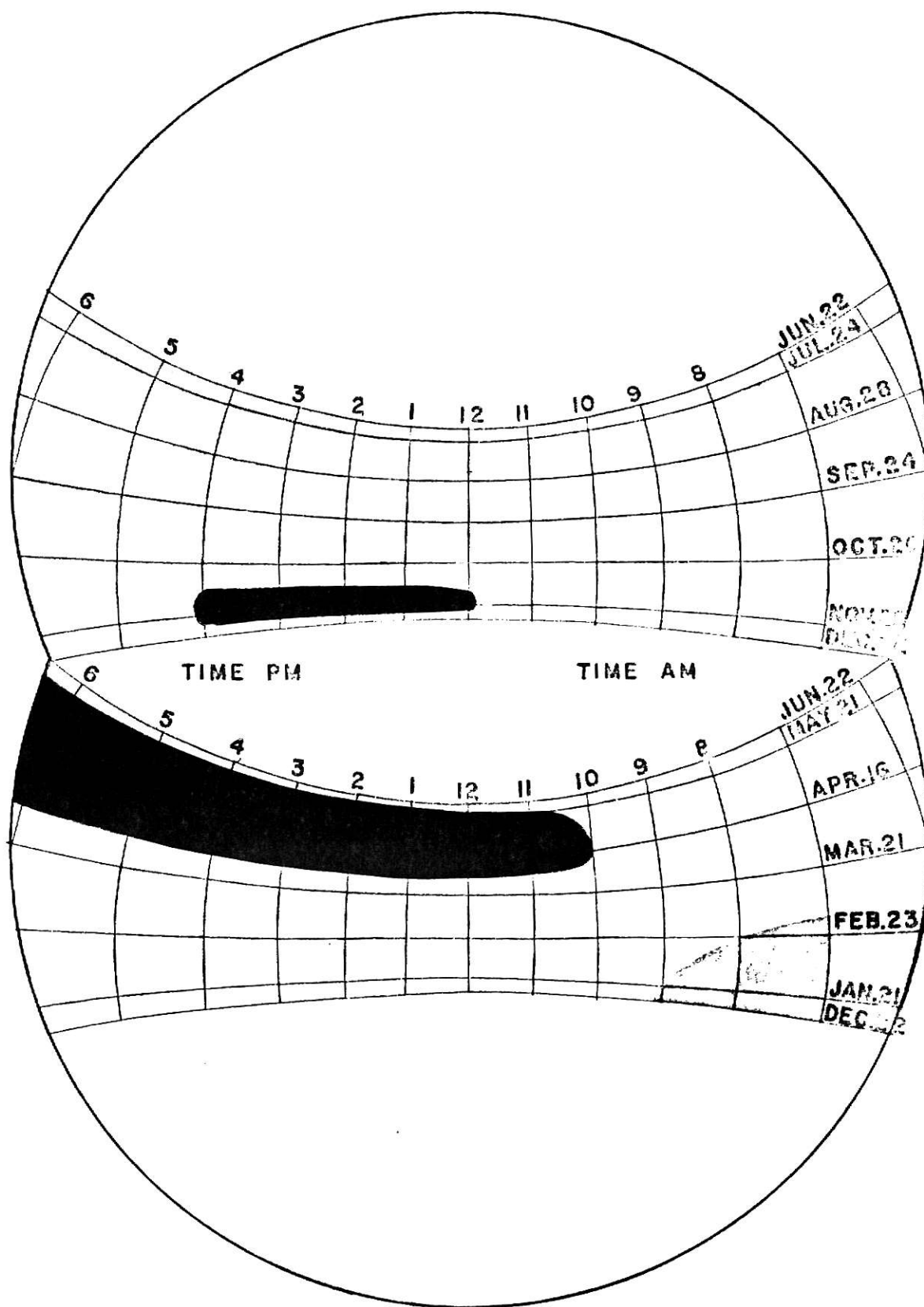
RAIN FALL
AVERAGE NUMBER
OF DAYS OF RAIN PER YEAR

MONTH HOUR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
AM 7.00	66.2	71.2	74.0	77.6	79.5	76.2	74.5	74.5	74.9	71.8	70.8	66.7
8.00	68.8	73.0	75.6	79.2	78.5	77.1	76.0	75.8	76.0	73.2	73.5	68.5
9.00	70.9	74.9	77.4	80.8	80.0	77.8	77.8	76.5	77.9	74.8	76.3	70.9
10.00	72.7	76.7	78.8	81.2	81.2	78.2	79.0	77.9	78.9	76.0	78.6	72.5
11.00	74.1	77.8	79.9	81.2	81.2	78.8	79.8	78.1	79.7	77.0	80.0	74.0
12.00	75.1	78.4	80.3	81.2	81.2	79.0	80.2	78.8	80.0	77.5		75.0
PM 1.00	75.8	78.9	80.6	81.2	81.2	79.2	80.6	79.0	80.7	78.1		78.8
2.00	75.9	79.0	80.9	81.2	81.2	79.5	80.9	79.1	80.3	78.3		76.0
3.00	76.0	79.1	81.0	81.2	81.2	79.4	81.0	79.2	80.3	78.5		77.3
4.00	75.6	78.8	80.6	81.2	81.2	79.2	80.6	78.2	80.2	78.0		75.8
5.00	74.5	78.0	80.0	81.2	81.2	78.9	80.0	77.6	79.7	77.2	80.7	74.6
6.00	73.0	77.0	79.1	81.2	81.2	78.5	79.2	77.0	79.1	76.4	79.0	73.2

EFFECTIVE TEMPERATURE
AT EVERY HOUR FROM SUN RISE TO SUN SET

COOL
CONFORT
HOT





	COLD	(BELOW 71°F)
	COMFORT	(71°F - 81°F)
	HOT	(OVER 81°F)

EFFECTIVE TEMPERATURE

III. FACTORS AFFECTING DESIGN

1. Climate

a. Seasons

There are three seasons in this region: the rainy season (May - November), winter (November - February), and summer (February - April).

The rainy season is the longest season in Thailand. The greatest quantities of rain fall in this area in September and October when the southwest monsoon sweeps in from the Gulf of Thailand and strikes the high mountains.

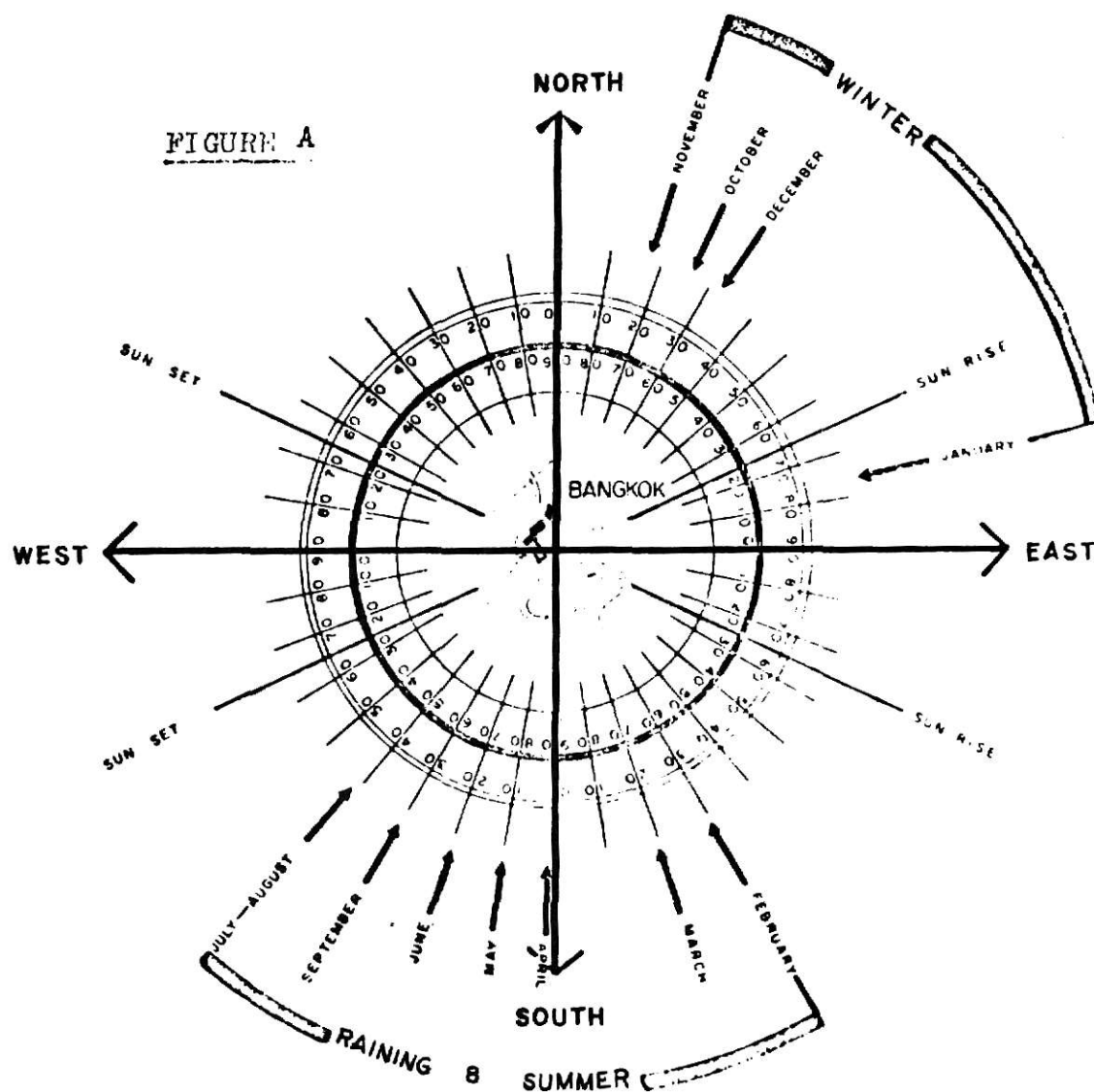
In winter time, the cold weather is mitigated by the northeast monsoon winds which blow warm air from the continent, as well as warm steam from the ocean.

Bangkok itself is located about 25 miles from the ocean. The yearly average temperature in Bangkok is 81.9° F. It is quite hot in summer and not too cold in winter. The average temperature in summer and in the rainy season is 85.4° F. - 90° F., and in the nominal winter, 75.8° F. The total mean rainfall is 50 to 70 inches.

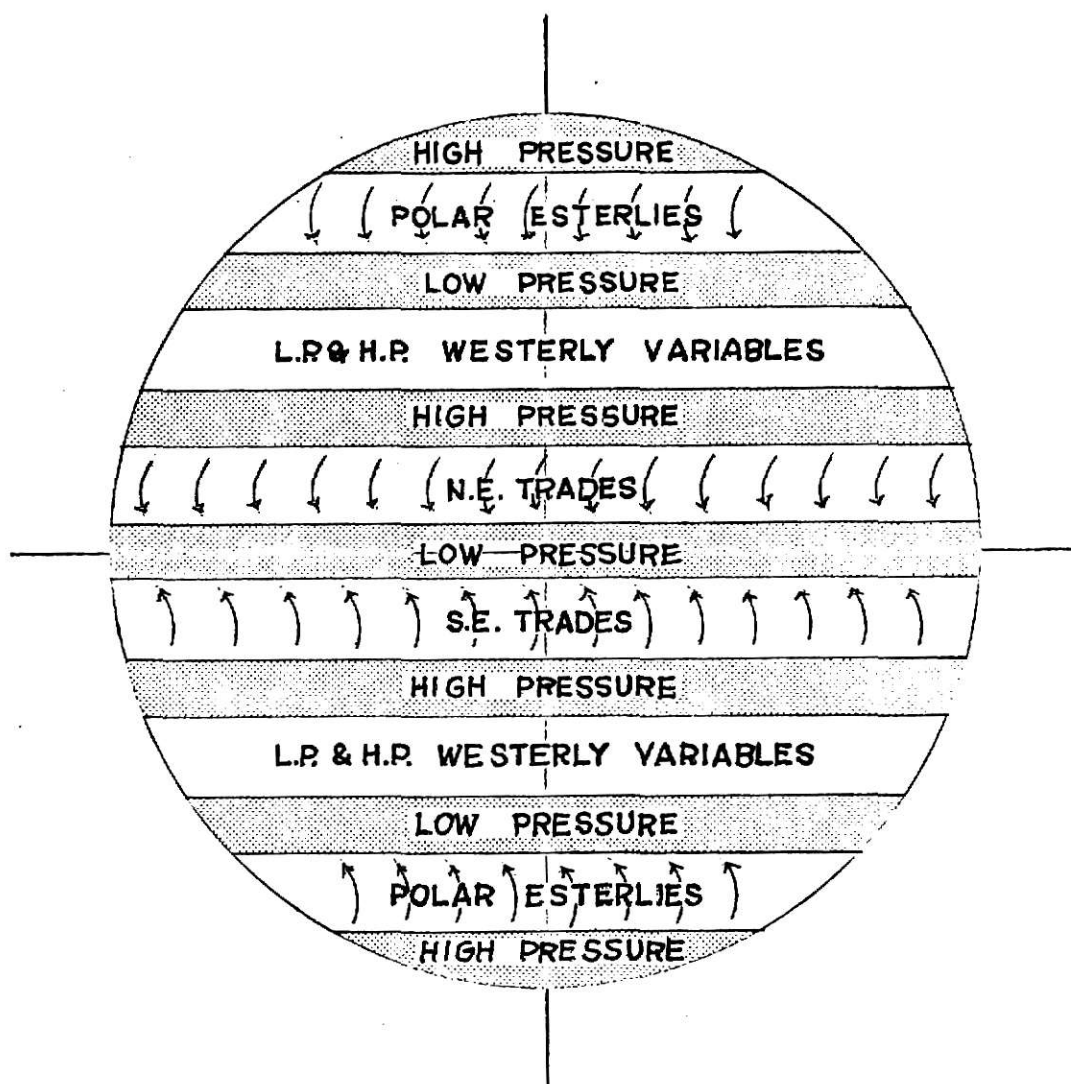
b. Prevailing Winds

Wind is the most useful natural means for ventilating a building in tropical regions. When designing buildings without provision for constant air-conditioning, the buildings should allow for the maximum passage of air. At the coast, the winds blow from the sea to the land during the day and from the land to the sea during the night. The best orientation for catching the cooling and dehumidifying breeze and

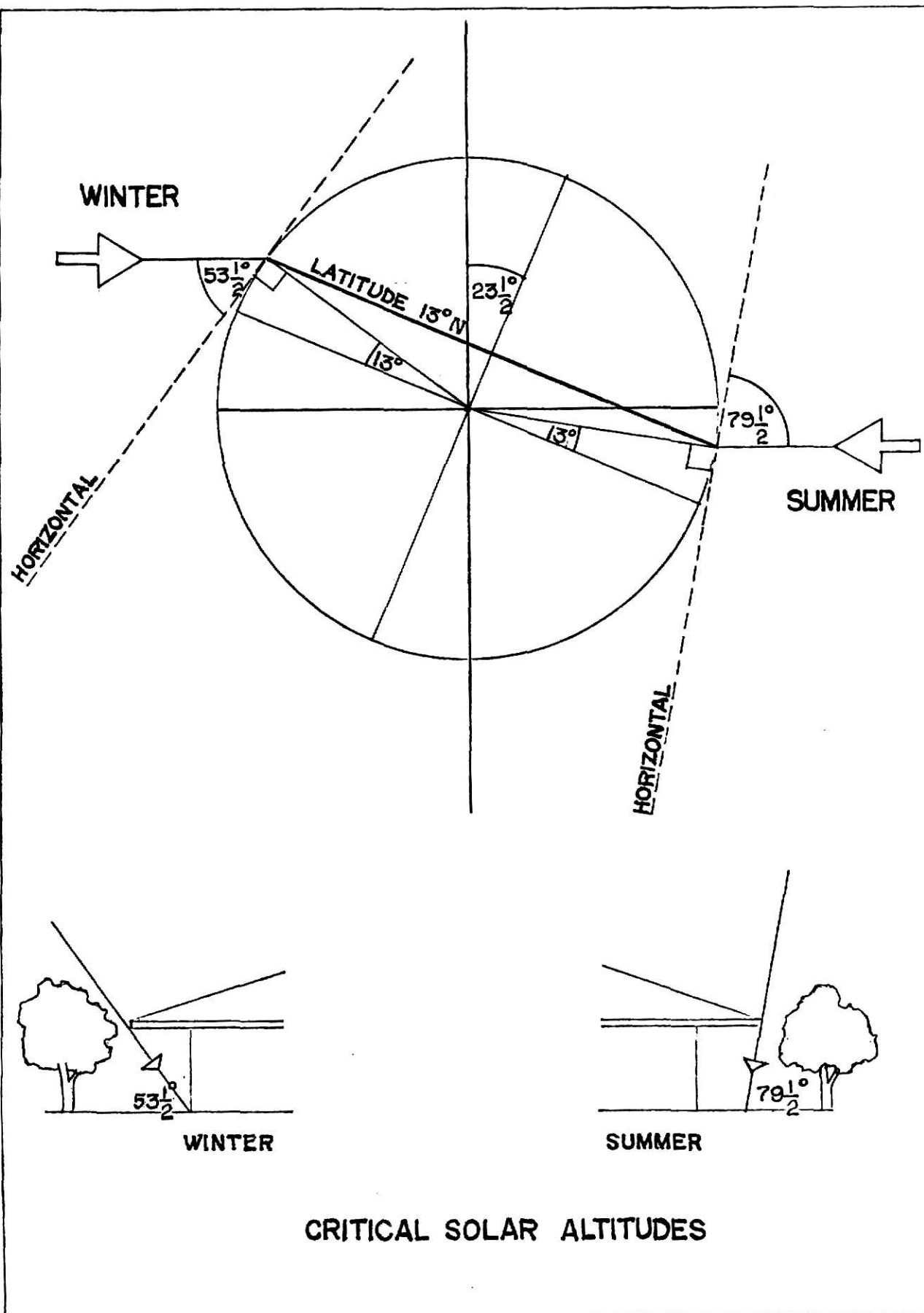
The prevailing winds of Thailand are very complicated and very influential because they control the rains (see figure A). During the winter months the winds come from the northeast. In the summer and rainy season the winds come across the Indian Ocean from the southeast and southwest, bringing with them moisture which is released when it meets by the cooler air above the land.



PREVAILING WIND IN BANGKOK



PLANETARY CIRCULATION OF THE WIND



dispersing the heat, obviously, is to design the buildings with long open sides facing the wind directions.

c. Humidity

The yearly average humidity of Thailand varies little; it is between 75% to 85%. Because of the high temperature and high humidity amidst heavy rainfall, most buildings are built very open with overhangs and sunshades not merely to cut the glare of the sun and its heat from penetrating into interior space, but mainly to protect the interior space against rain and consequent humidity infiltration while at the same time allowing dehumidifying ventilation to go through windows or louvres under the protection of the great overhang.

2. Building Materials

a. Local Materials

Wood. Because of the many huge areas of forests, wood is the general building material being used in Southeast Asia. Almost 60% of the total area of Thailand is covered by woods. These are distributed all over the country with the exception of the Central Plain. Woods are divided into three grades by quality.

Teak (*Tectonia grandis*) is the most valuable timber; it has the highest quality (grade A) among the preferred kinds of woods because it has a beautiful long grain with smooth and fine texture. It rarely shrinks after having been seasoned and is highly resistant to termites. This is one of the factors for its being preferred over other distinguished woods.

Besides, the high oil content of the wood along with its great durability, makes it possible to use teak in direct contact with steel without fear of rust. Teak needs a deep, well-drained soil. It thrives in the foot hills and the lower mountains up to elevations of about 2,000 feet. It is found mostly in the northern part of the country. The richest teak area has 360 mature teak trees to the square mile. At present, though, teak has been cut down rapidly; the supply is not meeting market demands. Its great scarcity affects the price; during the last few years prices have more than doubled. For these reasons, instead of being used for construction work, it is now being used only for furniture and finishing work. Parquet teak floors are commonly used.

Redwood (*Xylia dolabriformis* or *Kerii*) is one of the finest timber; it is grade B. It has long grain and beautiful color. It is popular for use in both construction and furniture. It has little tendency to shrink after having been seasoned. It is used for interior construction members such as beams, floors, and wood panels to show its beautiful grains and color.

Teng, Rang, Maka, and Takhain woods (*Shorea obtusa*, *Pentacme siamensis*, *Afzelia xyclocarpa*, and *Hopea odorata*) are in grade B also. They have short grains and a little white in their texture, and they show little tendency to shrink. They are used only for structure parts such as beams and rough texture. The takhain tree also yields a resin of

high value, the dammer, used in the manufacture of varnishes.

Drabak and Yang woods (*L. Calyculata*, and *Dipterocarpus alatus*) are in Grade C, which is the lowest quality among the woods used in Thailand. The wide range of relative humidity in Thailand causes dimensional changes in these kinds of timbers. They are easily destroyed by termites and moisture; therefore, they are used only for temporary buildings and sometimes as inside members of a wooden partition. They are more widely used as wooden piles because they are cheap and of course more durable in water than in the air.

Bricks. These materials have been used in Thailand for a thousand years. They are made from different kinds of soils and clay combined with a chemical solution and then baked. The standard size is small: 10" long, 5" wide, and $1\frac{1}{2}$ - 2" thick. There are two kinds of bricks in Thailand:

1. B.B.T. (Bang-Boa-Tong) are the initials of the place where the brick is made. They are the best among the bricks used because they can stand much pressure. They have a beautiful color and fine texture. Their principle use is for decorative exterior walls.

2. Morn Bricks are made from low quality soil, mixed with clay, with inferior workmanship. They cannot stand much pressure because they are made to be very light and have many perforations. They are used for light construction work such as walking paths, fences, and one-story walls covered with plaster and other filling purposes.

Sand. This is the major material used in mixing concrete. Only the sand found near fresh-water, rivers, and streams is used in construction. Sand found near salt water is fine grained and high in salt content which will erode steel and weaken concrete. A large quantity of this sand is from Ratchaburi and other locations along the Chao Phraya River.

Stones. These local materials are found in mountainous and coastal areas. They are used in mixing concrete. Beautifully colored and fine textured stones are popularly used for decorative walls and floors.

Aggregates. These inexpensive local materials are also used for decorative walls and outdoor floors.

Concrete. This has become the main building material in Thailand. The first cement factory was established in 1913. At present, there are several large cement factories in the country. In 1966, it was estimated that 1,000 tons of cement were produced a day. In the near future, the estimated cement production will be 3,000 tons daily and 1,200,000 tons annually. The cement industry has developed a large export trade with neighboring countries such as Vietnam, Laos, and Malasia.

Reinforced concrete, because of new techniques in construction methods, and in production, is widely popular. Precast concrete, prestressed concrete, ready mixed concrete, shell concrete structure, floating concrete foundation, and assorted reinforced concrete piles, etc. have been widely used in construction during the past ten years.

Cement blocks. These are made of a mixture of cement and sand. They are quite satisfactory in the tropics for ventilation, sun control, and protection from rain. They are designed to stand much pressure, but they are light in weight. They are easy to join together with cement mortar. Because of their construction they are versatile and economical.

Asbestos cement sheet. This is also produced by cement factories. It is used for ceilings and partitions in the less expensive buildings. It is fire-proof and its acoustical absorption value is high.

Terra-cotta and glazed tiles. These materials have been used for almost 400 years. Terra-cotta tiles are popularly used to cover floors. They are produced in many different shapes and various colors. Glazed tiles have been used as roofing materials on residences and temples. Presently, since new modern materials were introduced, glazed tile has been used more for decorative walls and floors. It is still being used for roofs of temples and of Thai traditional buildings and in decorating furniture as well.

Roofing materials. Terra-cotta and glazed tiles have been used for roofing materials. They are made in 8" x 12" size. The shingles are small and overlapping. They have small spaces between the overlaps through which the rains may overflow under the covering shingles into the buildings if they are not high-pitched in order to drain the rain more quickly. New roofing materials have been introduced on the market to make more practical and economical roof constructions.

These new materials, composed of cement and asbestos, are running length-wise. Their composition and design allows them more lightness and strength than older glazed tiles.

Plywood. Plywood is very popular; it is used for ceilings, partitions, and furnitures. It has different thickness and textures. The most popular kind in use, however, is plywood whose structural thickness is made up by low cost Yangwood while the surfacing is made of teak.

b. Imported Materials

Aluminum products. These materials are popularly used in modern Thai architecture as grills, sun louvers, doors, and window frames because they require less labor. It is susceptible to marine atmosphere, but pure aluminum of "alcad" is most corrosive resistant. Most of the aluminum products are imported from Japan, Taiwan, and the USA. England and Australia are now competing for the market, also.

Iron and steel. Thailand produces some of these building materials. Total production is about 4,500 tons of pig iron and 1,100 tons of steel a year, an amount far from sufficient to meet the country's need.

The Siam Cement Company has operated a small iron and steel work since the end of WW II. The operation is quite uneconomic; fuel appears to be the major problem because there is no coal mine in the country. Thailand imports all her building steel supply from Japan, Belgium, England and Germany.

Glass. The glass industry has only been recently established in Thailand. Because of a lack of skilled labor, the quality of glass has been below standard. Presently, glass is listed as the fourth largest material used in construction in Thailand. Both clear and tinted glass are progressively more widely used.

Resilient tiles. The quality of the resilient flooring tiles made in Thailand is of average quality. Most of the tiles used in construction are imported from Germany, Japan, and the USA.

Steel rods. Reinforced concrete is actively used in construction and promotes highly developed techniques. High tension steel wires for prestressing are as common as ordinary steel bars in construction. Though there are a large quantity of steel rods produced in the country, there is still a need to import. Thailand imports steel rods from Japan and Taiwan at a cost of as much as 5-7 million dollars a year.

Finished materials for flooring. Glazed tiles, mosaic tiles, and polyestered tiles are commonly used for flooring different spaces. Italian marble is popular for commercial and prestigious buildings.

Hardware and sanitary equipment. Both building hardware and sanitary equipment are imported from Belgium, England, Japan and the USA.

Paints. Thai architects try to avoid use of paint because of the necessity for maintenance and repair; however, aluminum

pigmented paints are quite satisfactory in the tropics. Most of the paints are imported from Japan, Germany, and the USA. Polishing oil, wood oil or lacquer which are produced in Thailand are widely used because of good quality and low price.

3. Public Utilities

a. Electricity

Available from the Central Electricity Board, Electricity Organization of Thailand. Standard electricity supply is of the 220 volt, 3 phase, 50 A.C. current. Connection to the main is controlled by the Electricity Department of the Organization.

b. Water Supply

Water supply is by the Water Works Department, Municipality of Bangkok. Charges are based on bulk system.

c. Gas

Gas usually comes in tanks, but it will be available from the mains in the next few years.

d. Refuse Disposal

Refuse disposal are:

1. Combustion in incinerations.
2. Disposal by the Municipal Workers and Cleaning Department. Wrought iron bins of 10 cubic feet (2' x 2' x 2'6") are provided and placed in convenient position for collection by the Department.

e. Sewage

Disposal is controlled by the Water Works Department through septic tanks on each site drainage into the underground water.

4. Municipality of Bangkok Authorities and Building Regulations*

The Municipal Architect: approves proposed building scheme.

The Municipal Sewage Engineer: sewage system and engineering works.

The Municipal surveyor: site surveys, etc., issue certificate of fitness for occupancy.

Building By-Law (Bangkok): Building regulations and requirements.

a. Public Building

"Public Building" means a building used or constructed or adapted to be used as a school, college, hospital, hotel, church...or used or constructed or adapted to be used for any other public purpose.

b. Open Area in Rear of

Public buildings, warehouses abutting a back lane shall have an open space inclusive of half of the back lane equal to 10% of the building area and all such buildings shall be provided with quarters for a watchman and such quarters shall be provided with bathroom and latrine.

c. Detached House Boundaries

For a detached house there shall be at least two meters clear between the building and the boundaries of its plot.

*Thailand: Facts and Figures 1966

(Department of Technical and Economic Cooperation Ministry of National Development, Thailand.)

d. Corridor Width

No corridor shall be constructed less than one and one-half meters wide.

e. Corridor Lighting

All corridors shall be efficiently lighted by openings to the external air.

f. Fire Escape

Every building used for manufacturing, trade purposes, or public assemblies shall be provided on every story with separate and adequate means of escape in case of fire as the Municipal Commissioners may direct.

g. Buildings of Iron or Glass

Buildings known as frame buildings or buildings made wholly or partly of glass, iron or other material not provided for in these By-Laws shall be subject to the approval of the Municipal Commissioners in each particular case. Plans and specifications and calculations shall be submitted.

h. Projection of Footings

The projection at the widest part of the footings of every wall on each side of such wall shall be at least equal to one-half of the thickness of such wall at its base unless an adjoining wall exists, in which case the projection may be omitted where that wall abutts.

i. Width of Offset of Footings

The diminution of the footings shall be in regular offsets or in one offset at the top of the footings and the height

from the bottem of the footings to the base of the wall shall be at least equal to two-thirds of the thickness of the wall at its base, the lowest footing to be at least two courses high. No one course offset shall project more than 70 centimeters beyond the course above it.

j. Every Building to Have a Separate Approach

Every building not abutting on a street shall have a right of way for an approach from the street open to the sky and at least 6 meters in width.

k. Thickness of Walls in Public Buildings

Every wall of a public building shall be constructed of the following thicknesses:

1. In buildings 7 meters high or under, the thickness of the wall shall be 30 centimeters throughout.
2. In buildings from 7-12 meters high, the thickness of wall shall be 40 centimeters for the first story, 30 centimeters all above.

l. Height of Story

No story of public building shall be less than 3 meters and shall be over 6 meters high without the permission in writing of the Municipal Commissioners who may in every such case prescribe to what extent the walls shall be increased in thickness or otherwise strengthened.

m. Thickness of Cross Walls

The thickness of every internal cross wall shall be at least two-third of the thickness prescribed for an external or

party wall of the same height and length, provided that if such cross wall supports a load the whole of such cross wall shall be of the thickness prescribed for an external or party wall and all cross walls shall be bounded to the main walls to which they abut.

n. Walls, Openings In

Every building having an extent of opening in any external wall which is greater than one-half of the vertical face or elevation of that wall or of the story in which the opening is left, shall be constructed with such piers of brick or other supports of incombustible material and so disposed as to be sufficient to carry to the superstructure.

o. Reinforced Walls

Approved reinforcement properly tarred and sanded and bedded in cement or other suitable bondings shall be built in the walls where required by the Municipal Building Surveyor.

<u>For a floor intend to be used for purpose of</u>	<u>Equivalent dead load in kilograms per sq. m.</u>
Classrooms in school buildings	500
Offices	450
Churches	500
Lecture rooms	500
Public assembly	500
Workshops	500
Domestic buildings	300

p. Staircase Not Less Than 1 Meter Clear Width

Every main staircase shall be not less than 1 meter clear

width with not more than 17.5 centimeters risers and not less than 20 centimeters going.

q. Handrails and Exits

All staircases shall have proper handrails and balusters, and shall be situated in such portion of a building as will reasonably afford the best means of exit in case of fire and shall be adequately lighted.

r. Building 20 Meters Deep to Have Two Staircases

All buildings 20 meters or more in depth abutting on a street shall have at least one staircase in addition to the main staircase not less than 1 meter wide, from uppermost floor to the ground floor.

s. Staircases to be Enclosed by Brick Walls

The floor of every lobby, corridor passage and landing and every flight of stairs and all supports of such floor and flight of stairs in every public building and business premises shall be constructed of incombustible and fire-resisting material.

t. Gable to be Vented

All external gables shall be provided with sufficient openings to promote circulation of air.

u. Room, Ventilation of

No room in any building shall be a greater depth than 12 meters unless it is sufficiently lighted laterally, or at both ends, by one or more openings free of any obstruction and communication directly with the external air. Where one air-well is provided, it shall not be less than 12 square meter for

three story buildings, but in such case no single airwell shall have a less area than 5 square meters, of unobstructed daylight.

v. Area or Rooms

No room, used as a bed room, cubicles excepted, shall be of less than 14 square meters or less than 2.40 meters wide and when not cross ventilated not less than 16 square meters in area.

w. Width of Buildings

No domestic building shall have a less width than 4.80 meters in the clear, such width shall be measured at ground floor level between walls of any shop house or terrace house. For corner sites 3.50 meters in the clear.

x. Height of Stories

No ground floor story shall be constructed of less than the following height measured vertically from floor to ceiling.

1. In buildings other than outbuildings, 3 meters.

2. In outbuilding consisting of:

a. Rooms other than bathrooms or latrines,
2.50 meters.

b. Bathrooms or latrines or both, 2.20 meters.

On upper story shall hereafter be constructed so as to be less than 2.50 meters in height measured vertically from floor to ceiling.

y. Height of Buildings

The height of any building, measured to the top of the wall plate above the center of the street, not being a domestic

building in a business or office area abutting on a street, may not exceed in height one and one-half times the width of the street except with the sanction of the Municipal Commissioners.

The decision of the Municipal Commissioners as to whether an area is a dwelling house area or office area shall be final.

IV. DESIGN CONSIDERATION FOR TROPICAL ENVIRONMENT

Climate is one of the most important factors affecting design in the tropical areas. For building design purposes, warm climate may be classified as: warm humid, intermediate, hot-dry, and cooler-upland. They are sometimes divided merely into hot-humid or hot-dry. The elements which create distinct climates are: the direct radiation of the sun together with a variable proportion from the sky; humidity, temperature, pressure and movement of the air; and clouds and rain. The climate of Thailand is classified as hot-humid.

The problem of design for warm climates is different from that of the cool climates. Buildings when occupied perform two thermal functions. They provide shelter from the harsher features of climate: rain, wind, glare, and radiation. They also impede the dispersal of heat developed inside them. In a cool climate both functions are useful, but in a warm climate, people need buildings to shelter themselves against the harsh elements and buildings which, at the same time, do not hinder the rapid dispersal of heat from inside. As a matter of fact, it is not so much the heat that bothers people. It is the subjective feeling of warmth due to a combination of static heat and humidity when air movement is lacking that is uncomfortable.

Among the factors which cause tropical climates to vary are wind, rainfall, the relationship of land to water, the height above the sea level, and the presence and absence of vegetation.

With some understanding of climatic conditions it is

possible to secure a comfortable environment. Aside from the choice of location, orientation is the first consideration in planning. North and south sides of the buildings need much less protection from the sun than the east and west sides; therefore the best orientation for reducing the solar heat gain in the building is to plan its long axis east-west whenever possible. In some cases, the architect may have to consider orientating of buildings for the sake of shading or breezing. If screens are provided to protect the building against sunlight, they must not create darkness inside, and they must not obstruct the breeze, which is so desirable in hot-humid areas. The quality of the moving air will be cooled by the presence of vegetation. At the same time planting is helpful in the functional and aesthetic development of the land.

Buildings in Thailand should be thoroughly ventilated and shaded against the sun and the monsoon rain. Horizontal or vertical louvers (fixed or movable), overhangs, canopies, and varandahs must be liberally adopted. They will allow for cross ventilation through windows, which may remain open even when it is raining. Windows facing west should be avoided whenever possible.

The reduction of solar radiation in a roof is most desirable because it is the area of the buildings most exposed to the sun. The problem is to reduce the penetration of solar heat and to prevent it radiating into the buildings at night. The solution is to produce low temperatures in the ceiling slab and to disperse excess heat rapidly. This may be achieved

by double roofs with a space for air passing through between them. High ceilings do not effectinglly reduce the heat in the building when compared with the cost of increasing wall area.

Ventilation is of the prime importance in hot-humid climates. Discomfort arises mainly from high humidity, hot temperature, and the sun glare. Solar radiation caused from pavings surrounding the building may be effectively decreased by the use of proper materials and landscape treatment of grass and vegetation. Inside ventilation of building may be facilitated by the careful positioning of lower and upper openings which together function on the principle of the stack effect. This stack effect is causing the warm humid air to move up and out of the building while the lower cooler air is evaporating moisture that tends to collect on the skin in a humid climate.

V. MATERIALS AND METHODS OF CONSTRUCTION

The factors which effect the selection of materials are availability, cost, requirement of building regulations, the ability of the materials to stand up to prevailing climatic conditions, and the standard of workmanship. As communications and transportation improve in Thailand, the range and choice of building materials increase. Since the cost of imported materials, due to shipping, insurance, and custom charges is high, there is a marked tendency towards the protection of local materials. This is evident in the case of cement, with resulting greater use of concrete products. The cost of buildings in Thailand is based on the rates of labor cost, both for construction and manufacturing of materials, which is usually low in most tropical countries such as Thailand. The cost of building, however, should not be estimated exclusively on the basis of its initial cost. The cost of maintaining its integrity while exposed to harsh conditions is also a vital factor for consideration.

The standard of workmanship affects the performance of any material. Many imported materials or components may require special skills in fixing. Supervision may be needed to guide inexperienced labor.

High temperatures in Thailand can cause fundamental changes in organic materials such as paints, plastics, bitumen, and rubber causing deterioration. Temperature fluctuations can cause thermal movement resulting in cracking, distortion, or discoloration. Prolonged high humidity promotes mold or

algae growth. Wide daily range in relative humidity causes dimensional changes in timber. Although Thailand, like other tropical areas, has less atmospheric pollution; there are other factors to contend with such as the problem of termites, sea-salt in the atmosphere of maritime areas which promote the corrosion of metals and degrade paint films, and of expansive clay soils on which a method of tied and combined foundation on piles may be needed.

VI. DESIGN CONCEPT

While the "Faculty of Theatre Arts" is part of the University, the character of the building should intergrate with the rest of the campus. However, as a school of drama art, it certainly needs to express the spirit of creativity and artistry, yet not sacrificing the functional simplicity.

The auditorium should stand out and express a warm and welcome feeling. It serves a multitude of functions, both for the academic and the public activities. Design for this complex needs to take all these factors into consideration. At the same time, it is necessary to be sensitive to both the design and the function. By careful combination of aesthetics and functional facilities, we have attempted to achieve an ideal design solution.

The basic considerations of the lay-out design is based on the proper orientation of the building and the functional aspects. The site is divided into two main parts. One is to serve students and faculties of the college, and another is to serve public. The public space or the auditorium area should be located where the public, students and faculties from other departments can get to easily. So it is located in the south-west corner of the site. The six-story classroom building is planned with its long axis east-west, in order to obtain as much natural ventilation as possible, and at the same time gaining least solar heat from the west and east. The auditorium and the classroom building are joined by the dressing room building

to create unity and serve the proper function as well.

(See working drawings pages 106-115)

1. Courses Offered in Faculty of Theatre Arts

Introduction to Theatre.

Consideration of the basic elements of theatre; aesthetics, dramatic literature, theatre technology, and producing organizations.

Stage Movement.

An investigation of the techniques of movement in dramatic and musical productions. Major emphasis is placed on practical application.

Fundamentals of Acting.

Theory and practice of acting with emphasis on voice building, stage movement, and oral interpretation of dramatic literature.

Fundamentals of Technical Production.

An introduction to the technical problems of theatre production, including planning, painting, and mounting scenery as well as other aspects of backstage organization.

Fundamentals of Costuming for Theatre.

A lecture-laboratory course covering the principles and techniques of construction and design of stage costuming.

Techniques of Makeup.

Techniques of makeup for stage, movies, and television.

Fundamentals of Playwriting.

Theoretical study and practical application of fundamentals of playwriting with regard to plot, characters, and production.

Oral Interpretation of Literature.

Techniques of reading from the printed page, selecting portions from various forms of literature, including narrative poetry, essay, lyric, sonnet, non-fictional prose, scenes from plays, and selected short stories.

Opera Workshop.

Principles and techniques of operatic and musical theatre production, with emphasis on class rehearsal and performance of selected scenes from opera and musical drama; brief survey of the history of opera.

Fundamentals of Directing.

Study of the principles and techniques of directing for the theatre.

History of the Theatre.

A survey of the development of the theatre from ancient times to the present day.

Creative Dramatics.

Study of techniques for the training and development of creative imagination of plays.

The Art of the Film.

Theory techniques of the film as an art.

Aesthetics of the Theatre.

Principal emphasis on theoretical problems of dramatic art.

Scene Design.

Principles and styles of design for the stage, utilizing sketches, diagrams, plates, and models.

Stage Lighting.

History and techniques of lighting for the stage and television.

Advance Technical Production.

A lecture-laboratory course in advance technical theatre problems of organization, planning, and execution of scenery, costumes and lighting.

Seminar in Theatre.

Special problems in theatre research.

General Music.

Elementary instruction in the theory of music.

A study of musical materials, forms, and styles that will enable the listener to enjoy music more fully.

Physical Education

General out-door exercises.

English.

Study of English as a second language.

Economics.

Basic facts, principles, and problems of economics.

General Psychology.

Development, structure and functioning of human groups; societal and cultural patterns; the nature of sociological inquiry. Lecture discussion and independent study.

Sociology.

An introduction to the study of behavior, with emphasis in human behavior. A survey of the methods, data, and principles of psychology.

Introduction to Philosophy.

An introduction to the main problems of philosophy based on the study of selected writings of important philosophers, both classical and contemporary.

2. Building Elements**a. Administration Section**

1. General office
2. Information counter
3. Account & Financial
4. Student record
5. Public relation
6. Lounge for non-teaching staffs

- 7. First aid
- b. Exhibition room
- c. Cafeteria
 - 1. Dinning area
 - 2. Kitchen
 - 3. Storage
- d. Conference room
- e. General storage
- f. Toilets
- g. Dean's office
 - 1. Office
 - 2. Secretary section
 - 3. Reception room
- h. Staffs' offices
- i. Lecture rooms for 50 persons each
- j. Tutorial rooms for 12 persons each
- k. Library: include music-library
- l. Design studios
- m. Sound lab
- n. Staffs' lounge
- o. Student commette room
- p. Workshop
- q. Movie and T.V. Studio
 - 1. Dark room
 - 2. Films storage
 - 3. storage

4. Dressing room & Toilet
5. Control room
6. Practicing space
7. Watching gallery
- r. Auditorium for 1000 persons
 1. Stage
 2. House
 3. Lobby
 4. Balcony
 5. Public space
 6. Toilets
 7. Refreshment area
 8. Ticket booths
 9. Storage
 10. Mechanical room

3. Study of Elements of the Auditorium Section.*

- a. Back stage vestibule: minimum 50 sq.ft., shape variable.
Equipment: time clock or other in-out indicator,
buletin board, telephone booth.
Location: central to all backstage department.
- b. Doorman's booth: minimum 30 sq.ft., shape variable.
Equipment: counter, mail box, small desk, key rack.

*Theatres and Auditoriums: Second Edition
(Burris Meyer and Cole)

Location: adjacent stage vestibule to control all traffic to backstage part of building.

- c. **Dressing room:** minimum 16 sq.ft. per person

Equipment: clothes and costume hangers 2 linear feet of rod per person, 2 linear of shoe rack per person, no doors in cabinets, make-up table 30" wide per person, 15" deep, mirror 18" wide person, well diffused light, no shadows, 25 fc. minimum on face before mirror. Full-length mirrors: one in each star's dressing room, one per eight persons in each chorus room, one in corridor on way to stage. One lavatory in each small dressing room, one per four persons in large dressing rooms.

Location: near stage but not necessarily adjoining stage.

- d. **Make-up room:** minimum 100 sq.ft.

Equipment: make-up tables or benches, chairs on two sides. 25 fc. general light on faces.

Location: adjoining dressing rooms.

- e. **Toilets:** use concentrated into short periods of time before show, and during intermissions.

Minimum one toilet per six persons.

- f. **Greenroom:** minimum 300 sq.ft. Stage manager checks cast, assembles choruses. Directors talk to cast. Actor's social room.

Equipment: lounge furniture, tables, smoking accessories, card table set, full length mirror. Call system outlet, telephone outlet, monitor system loud-speaker.

Location: near stage, same level.

- g. Stage anteroom: alternate to greenroom, minimum 150 sq. ft.

Equipment: chairs or benches.

Location: adjoining stage near proscenium. Same use as greenroom but stripped off lounge aspects. Strictly business. Actors are responsible for re-entrances. Must stay where they can hear show.

- h. Quick change dressing room: minimum 50 sq.ft. per actor.
Space for dresser to help actor.

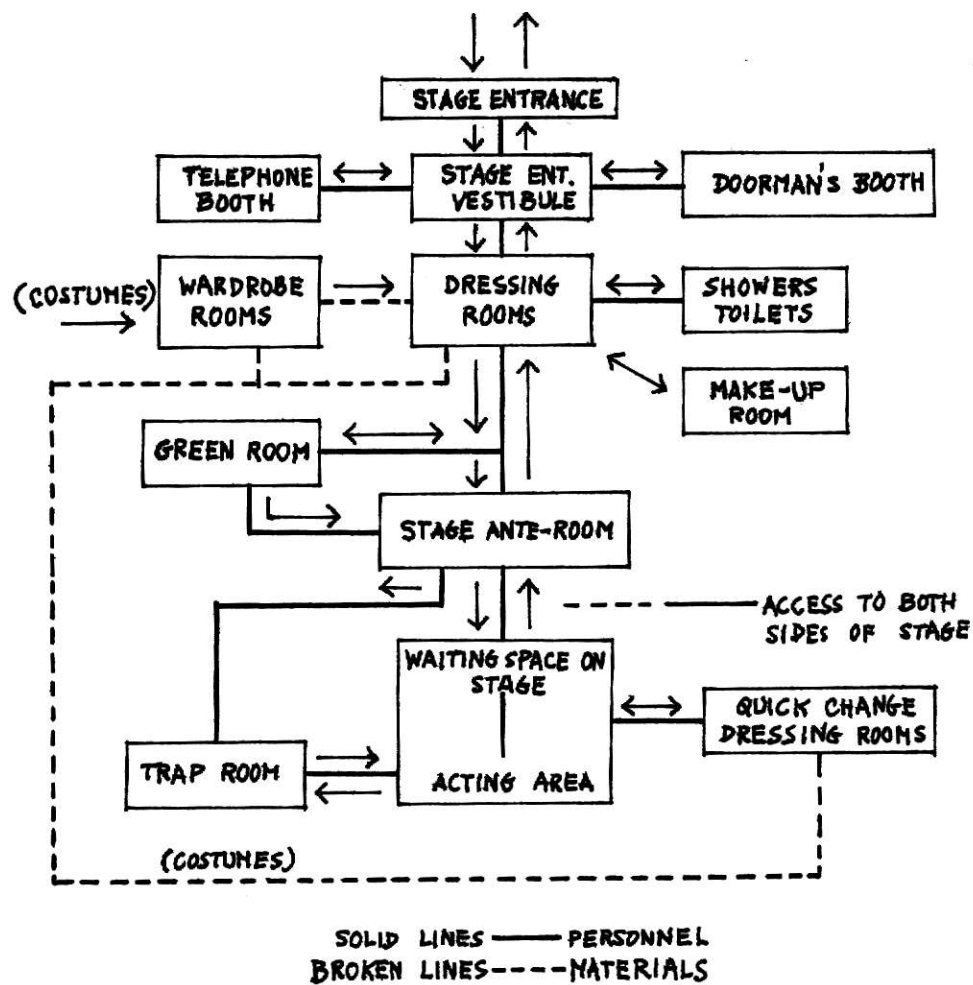
Equipment: same as other dressing room.

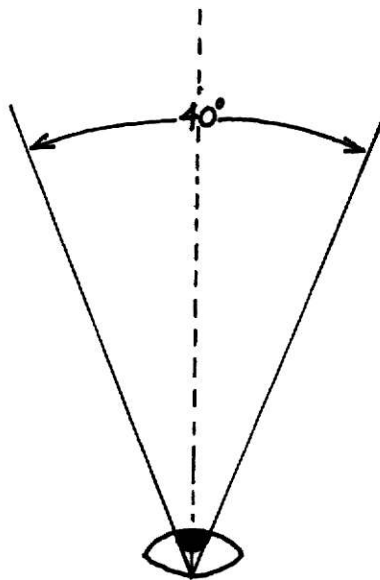
Location: immediately adjoining stage.

- i. Showers: one adjoining each star's dressing room, one for six actors. Peak load immediately following performance; body make-up may necessitate baths by entire company.

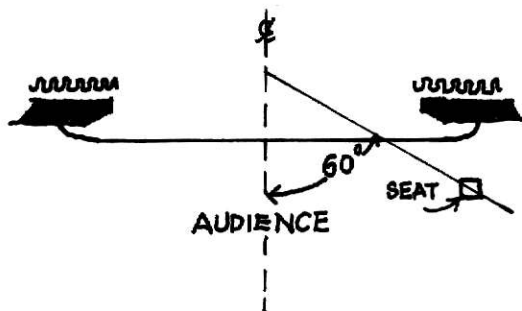
- j. Reception room: adjoining stars' dressing rooms for private entertainment of guests apart from the general bustle of the greenroom. Comfortable furniture and pleasing decoration.

FLOW CHART FOR ACTORS IN THE THEATRE

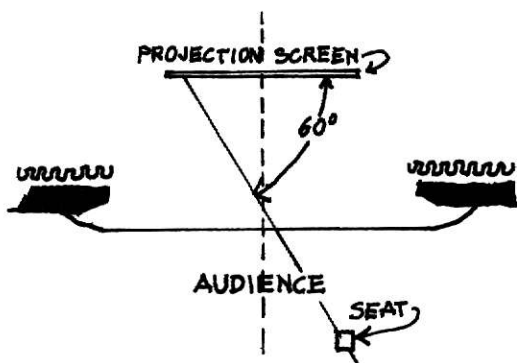


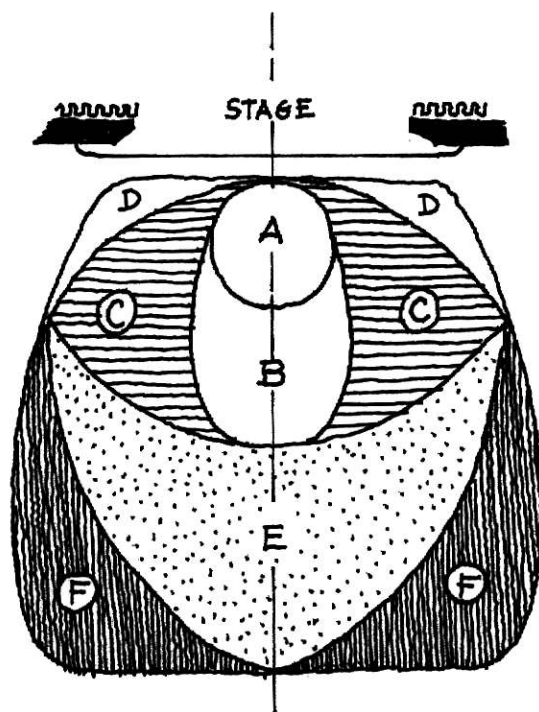


The horizontal angle of polychromatic vision (no eye movement) is approximately 40° .

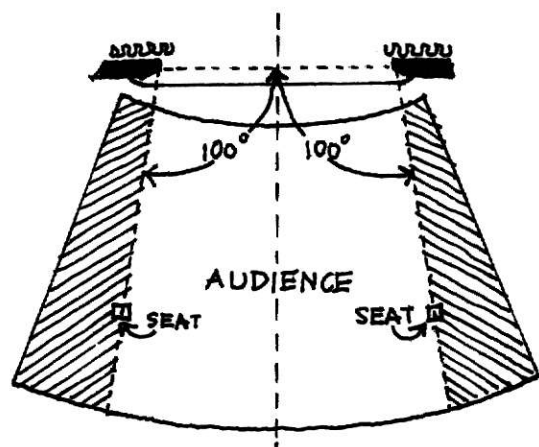


The horizontal angle to the center line at which objects onstage, upstage of the curtain, cease to bear the intended relationship to other objects onstage and to the background is approximately 60° . The horizontal angle to the projection screen at which distortion on the screen becomes substantially intolerable is 60° .

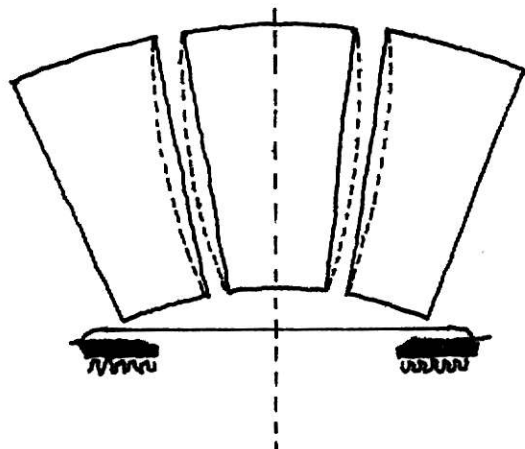




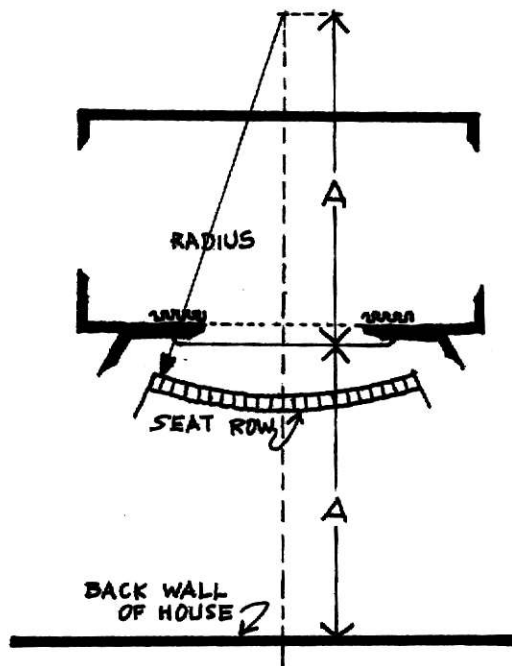
Based on the ability to recognize shapes and confirmed by sequential seat selection of unreserved seats, the order of desirability of location is: A. front center, except when the picture screen is close to the front row; B. middle center; C. middle side; E. rear center; F. rear side.



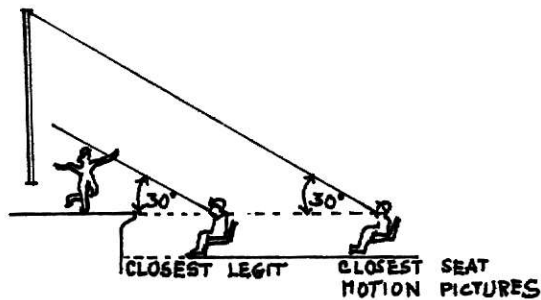
Audiences will not choose locations beyond a line approximately 100° to the curtain at the proscenium. The shaded areas contain undesirable seats.



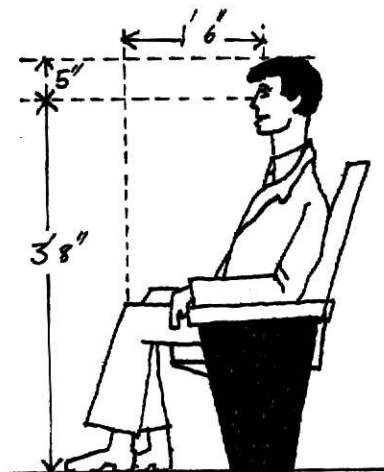
Straight radial aisles are better than aisles which curve or bend.



Location of center of
curvature of rows of seats.



Maximum angle determines
location of closest seats.



Basic dimensions for
plotting floor slope.

- k. Musicians' room: (musical instruments storage) minimum
300 sq.ft.

Equipment: lockers or clothes racks, chairs, music
cabinets, telephone and call system outlets.

Location: basement level near pit and stage. Large
instruments usually kept in pit.

Passage: direct to orchestra pit. Large door to
allow carrying instruments.

- j. Orchestra pit: 10 sq.ft. per musician plus 100 sq.ft.
for grand piano and 50 sq.ft. for tympani.
Width from stage figured on a per man
basis. Depth should keep musicians
below audience sightline to stage.
Conductor must see stage. Singers and
orchestra must see conductor.

Elevating orchestra pit floor:-

1-features orchestra as part of per-
formance

2-adds floor for chairs if brought to
auditorium level.

3-makes forestage when desired

Portable steps or platforms may be set
over orchestra pit.

- m. First aid room: minimum 50 sq.ft.

Equipment: surgical table, stools, chairs, first aid
cabinet, sink, hot water.

- n. Loading platform: Width to accommodate two vans. Avoid change of level inside. Use ramps outside to adjust to grade.
- o. Receiving space: Minimum 200 sq.ft., 20' high.
- p. Trap room: an actor ascending or descending stairs through a stage trap must have a landing at the bottom of the stairs which is beyond the edge of the trap. Therefore the walls of the trap room (the room beyond stage) must be located at least 4 feet beyond the perimeter of trapped area of the stage.

Limits of vertical travel of trap elevators:

The upward limit of travel of trap elevators relates to their scenic uses. There is potential value in being able to create a second-story scenic effect by means of elevators. This would call for a rise of 9 to 10 feet.

This downward limit may be set at the level at which an actor may step off a disappearance trap or staircase and clear the stage floor over his head. This calls for a sinkage of about 7 feet.

- q. Rehearsal room: minimum size: acting area of same size and if possible of same shape, as that of theatre for which show is being

prepared, plus narrow strip of off stage space for actors, plus generous space for director, stage manager, and author on one long side. Washable floor without carpet, glareless general illumination minimum about 15 fc. at floor level. Acoustic good for voice.

Equipment: 24 study chairs. Three small sturdy tables, an assortment of strong standard household furniture (no upholstered pieces and no special pieces). Levels, ramps and platforms as they are to be in performance.

Rehearsal of musicians requires:

Orchestra pit, or rehearsal studio large enough to permit arrangement of instruments as in pit.

Some music rehearsals must be held in the theatre for acoustic reasons.

r. Dance practice room (studio):

The same as rehearsal room, plus one mirror wall, wall bars on other walls, hard-wood floor, piano.

s. Supply room:

Materials consist largely of cloth in bolts, sewing materials, small supplies, pattern paper in rolls. Deep shelves for bulk materials. Shallow shelves for sewing

materials. Some mothproof storage space for woolens, felts and furs.

t. Costume shop:

Pattern Drafting table. Minimum 3' x 6' with working space all around it. Hard surface. Clean area.

u. Dye shop:

Storage for dyestuffs. Closed cabinet with shelves. Space for demijohns of acid. Small chemist's table with balance and weights.

v. Fitting room:

Minimum 100 sq.ft. Podium, 3' x 3' x 10' high. Full length mirror. Small cabinet for fitting supplies.

u. Design studio:

Drafting tables, model building bench and equipment, reference files and bookshelves, cabinets for filing sketches and drawings. Cabinets for storage of building materials.

4. Landscape

Since the design-proposition will be in a high density area and the site itself will have a major part in influencing the lay-out of the design, there will not be much that can be done in landscape.

However, pleasant environments such as plants, trees, green areas, water and sculptures will be used wherever possible. These things are instrumental in dealing with solar heat and glare as well as creating shades and perhaps coziness in outdoor space.

The site will be raised from the street-level and the surface water from rain will be drained by the drainage gutters along the streets.

5. Materials

The consideration in selecting materials used in the design will be based on availability, durability, structural compatibility and ease of maintenance. Concrete will be used in this design because of its durability and structural types used. High quality woods will be used for decorative works and furniture. It is considered economical to use local materials.

Some of the imported materials such as hardwares and sanitary equipments will be used to insure the quality standard at international level. Other imported materials, which are easily maintained, will be used in this design as well. Corrosion resistant materials will be used in the design, exclusively.

6. Structural Compatibility

Reinforced concrete will be used the most in the structure of this design since it is durable for the tropical climate, and is highly resistant to fire. Simple post and lintel reinforced concrete construction will be used in most of the design.

Cantilivers will be aptly adopted to provide protection from the hot sunlight and the rain and to reduce the bending moment of the interior beams, while the technique of prestressing concrete will be utilized to further the reduction in size of the structural members. Waffle slab will be used in some long span parts to reduce the depth of beams. Space frame roof-structure will be used in the wide span auditorium.

VII. ENVIROMENTAL TECHNOLOGY

1. Lighting

Lighting integrates with the design elements of architecture. It illuminates the space, expresses structure, and enhances surface characteristics. In the interest of aesthetics, lighting should be designed to harmonize with architecture and to define function in a revealing manner.

Both natural light and artificial light will be used together in this design. Because of psychological and economical reasons, natural light will be predominantly used wherever possible. The problem of glare from natural light can be solved by using screen and overhangs. Trees and shrubs may help, of course.

2. Air Conditioning

In this tropical area, heating is not needed, but air cooling is considered a necessity for comfort, health and quietness from outside noises. Besides cooling the rooms, air conditioning controls the gentle movement of the air and eliminates smoke, bacteria, fumes, odors, and excessive moisture.

For cooling economy, the design of the buildings should be so oriented that most of the wall areas would face north and south to absorb the least of solar heat. So are the six story classroom building and the auditorium of this design placed. Overhangs and sun breakers should be liberally adopted in order to reduce the cooling load.

Two types of air-conditioning systems will be used in

this college: the central air-conditioning system in the auditorium, dressing room section and movie & T.V. studio and window units system in some other room.

3. Acoustical Study*

a. Introduction

Architectural acoustics are basically concerned with two objectives:

- the provision of good hearing conditions within a space, by controlling the direction, impact, and duration of sound waves, and
- the provision of a satisfactory acoustical environment by raising barriers against unwanted sounds, originating outside the space.

b. Basic Properties of Sound

When a vocalist is producing a tone on a stage, the vibration of his vocal cords generates sound waves, which travel through the air in the form of very small changes in atmospheric pressure, alternately above and below the static pressure. The average deviation in atmospheric pressure above or below the static value, due to a sound wave, is called the sound pressure. This sound pressure, by vibrating the ear drum, produces the sensation of hearing, and essentially determines the loudness of the sound.

*The Use of Architectural Acoustical Materials, Theory and Practice (Acoustical Materials Association)

The sound waves travel outward in all directions from the vocalist's mouth in much the same manner that water waves spread outward on the surface of the pool from a point at which a stone is dropped. As the sound wave progresses, the sound pressure diminishes in proportion to the distance from the source, in the same manner that the water wave dies out as it spreads. Since sound pressure determines loudness, this effect explains the familiar experience of a sound outdoors becoming fainter as one moves away from the source.

In addition to pressure, sound waves have the important attribute of frequency. This is defined as the number of times per second that the sound pressure alternates above and below the ambient atmospheric pressure. Each complete alternation is called a cycle, and frequency is expressed in cycle per second (cps). The extreme range of frequencies which the ear can perceive is approximately 20 to 20,000 cps, although the upper limit decreases considerably with advancing age. The efficiency of acoustical materials varies with frequency, as do the loudness of the ear and the performance of microphones and loudspeakers.

Sound waves travel through the air at a constant speed of 1125 feet per second. If an auditorium is 100 feet long, it will take about 1/10 second for the sound to reach the back row from the stage.

c. Direct Sound

Since sound travels in all directions from the source, the sound waves originating at the vocalist's mouth will strike

the ears of every member of the audience. Each auditor will therefore hear that segment of the sound wave which travels in a direct line from the source to the ear. This is termed direct sound.

d. Reflected Sound

The sound originating on the stage travels not only to the ears of the audience but also to the interior surfaces of the auditorium. When a sound wave strikes a surface, its direction of travel is changed by reflection in the same manner as that of a ball bounced from a hard surface. This is shown in Fig. on page 91, illustrating the physical law that the angle of incidence equals the angle of reflection. If the reflecting surface is plane, the reflected wave will spread outward in its new direction of travel along exactly the same paths that would occur if the source had been behind the surface at the same perpendicular distance as the real source in front of it. This apparent source is called a sound image. The plotting of a sound image behind each plane surface is a useful short-cut in tracing the reflection of sound waves in the acoustic design of an auditorium.

In addition to the direct sound, an auditor will receive segments of the original sound wave which have been reflected at least once before reaching his ears. The reflected path is always longer than the direct path, resulting in a greater reduction in loudness due to distance. All reflected sound loses some of its energy at each reflection.

e. Absorption of Sound

A sound wave in being reflected by a surface always loses part of its energy. This loss of energy is termed sound absorption. The fraction of the energy of the incident sound which is absorbed during reflection is called the sound absorption coefficient of the reflecting surface. Hard, massive, non-porous interior finish surfaces, such as plaster, masonry, glass, wood, concrete, etc., absorb generally less than 5 percent of the energy of incident sound waves and reflect 95 percent or more. Porous materials which permit penetration of sound waves, or soft materials which yield under incident sound pressure, are capable of absorbing much larger amount of sound energy, and may have coefficients approaching 1.00. Such materials include carpets, drapes, upholstered seats and furniture, the clothing of an audience, and acoustical materials.

4. Acoustical design of Auditoriums*

From the acoustical standpoint, an auditorium is any room intended for listening to speech or music. It may be a concert hall, a theater, a lecture room etc. In all cases the primary acoustical requirement is that speech be understood easily and without distraction throughout the room and that music, when presented, be heard under pleasing acoustical conditions. In general, there are four factors which must be considered in the

*The Use of Architectural Acoustical Materials, Theory and Practice (Acoustical Materials Association)

acoustical design of a room in order to meet the above basic requirements as an auditorium, namely

1. loudness
2. noise control
3. first reflections, and
4. reverberation

a. Loudness

The first of these considerations, loudness, is important chiefly in the understanding of speech. The loudness of a speaker's voice as heard at a listener's position not too close to the speaker will depend on both the speaker's sound power output and on the room absorption will generally increase the size of the room. A speaker will naturally try to raise his voice power in large room to compensate for the loss in loudness due to size and absorption, but his ability to do this is limited. It is necessary, therefore, and has become standard practice, to provide speech amplification systems in large rooms.

However, in auditorium, some kinds of shows such as dramas and concerts amplification systems cannot be used. Therefore, the proper design of size, shape, volume and acoustical treatments of interior space is required. This will be discussed later.

b. Noise

Background noise may be a source of serious distraction in listening to music. It may arise from many sources, such as

outside street traffic, railways and aircraft, disturbance from adjoining rooms, ventilation noise, structure-borne vibration from mechanical equipment, and noise made by the audience itself. These sources may be controlled by various means, some of which depend on proper planning and site location of the building, and the use of adequate sound and vibration isolating construction. Acoustical materials are useful principally in the quieting of adjacent areas such as foyers and lobbies, and, in the form of duct liners, for minimizing ventilating noise.

c. First Reflections

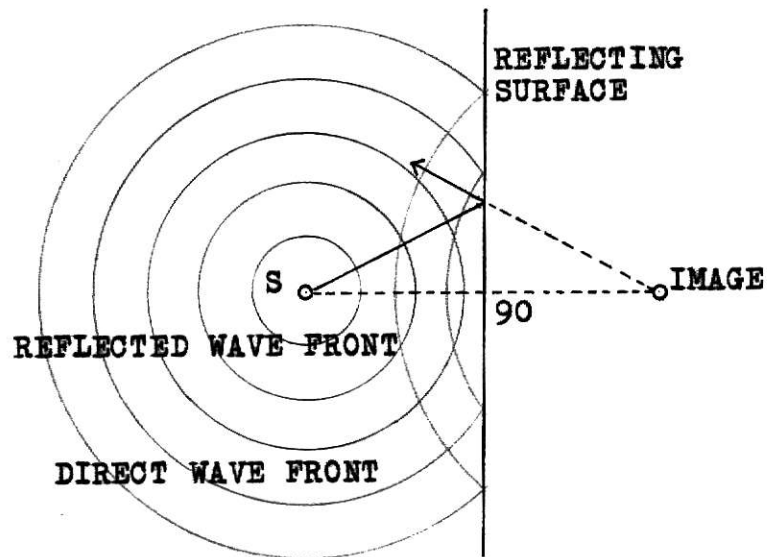
The control of first reflections is again important in connection with speech intelligibility, and also has an influence on musical quality. In the case of a sustained tone, the ear cannot distinguish these first reflections, and they are heard only as the beginning of the general reverberation. The syllables of speech, however, are of such short duration that the first reflections can be more readily sensed as distinct from either the direct sound or from later reflections. The relative prominence of these first reflections is due to the fact that they have lost less energy both by distance and by absorption than those part of the sound which arrive at the ear after many reflections.

d. Reinforcing Reflections and Room Shaping

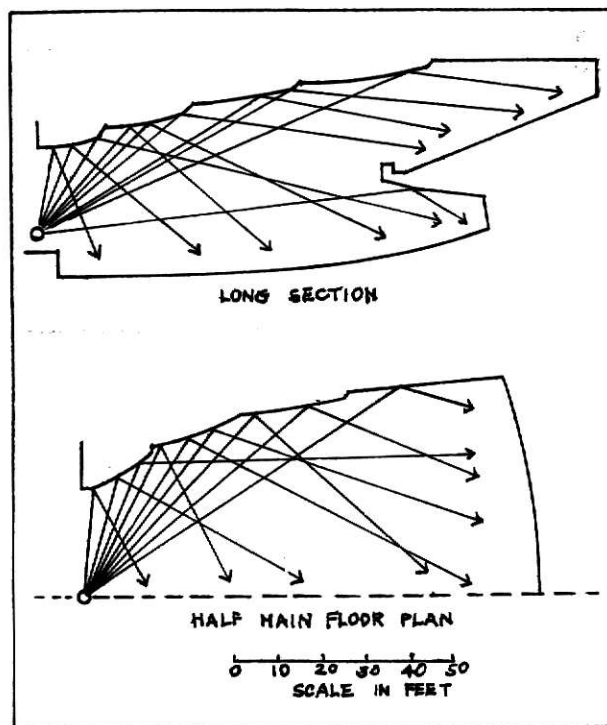
It has been found experimentally that reflections which arrive the ear within an interval of 0.05 second later than

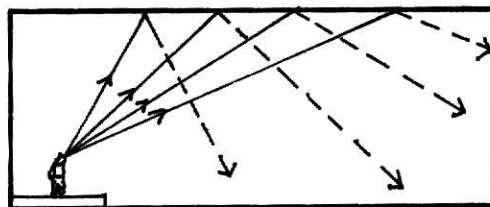
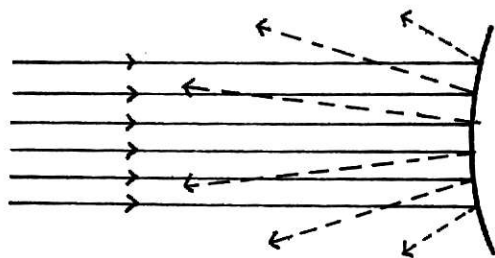
the direct sound tend to reinforce the sound of individual speech syllables, while all later reflections have a blurring or interfering effect on the speech sounds which reduces clarity and intelligibility. The time interval of 0.05 second corresponds to a difference in path length between direct and reflected sound of about 50 feet. It is therefore possible, and is considered good practice in auditorium design, to arrange the room surfaces so that as much reflected sound as possible arrives at each seat by a path length not more than 50 feet longer than that of the direct sound, and also to suppress first reflections which arrive after path delays of more than 50 feet. This reinforcement by first reflections is particularly helpful in auditoriums where loudness of speech without amplification is marginal, as for example in the use of large theater for dramatic presentations.

For maximum effectiveness, the room surfaces which are utilized for reinforcement should provide reflected paths which are as short as possible in relation to the direct path, and are as closely adjacent as possible to the direct path, so that the reflected sound arrives at the ear from nearly the same direction. This calls in general for ceiling not too high near the stage, and for side walls which slope inward toward the stage, as shown in Fig. on pages 91 and 92. It should be noted that this special shaping is effective only in moderately sized auditoriums, seating roughly 500 to 2,000 people. In smaller rooms the first reflections are all naturally short enough in

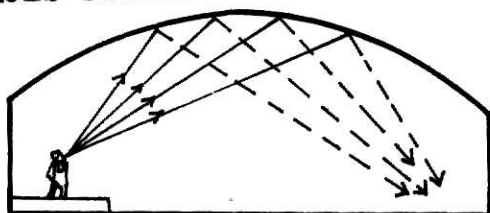
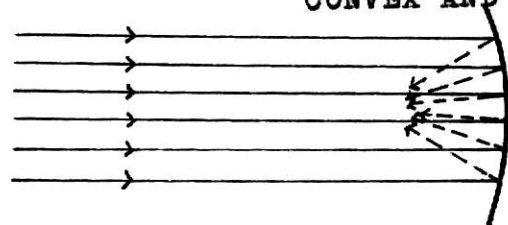


**AUDITORIUM DESIGNED FOR MAXIMUM REINFORCEMENT OF
DIRECT SOUND BY REFLECTED SOUND**

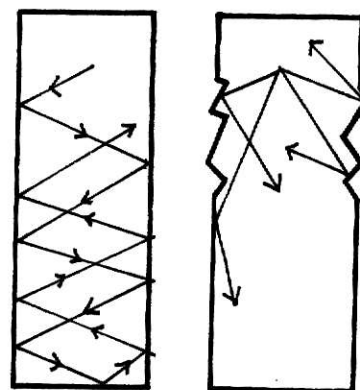
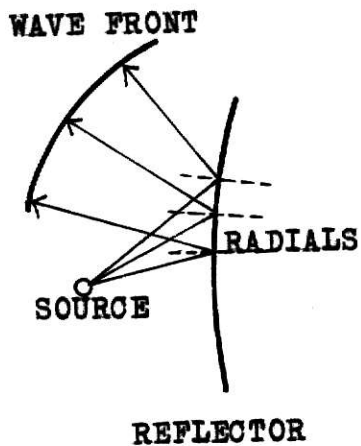
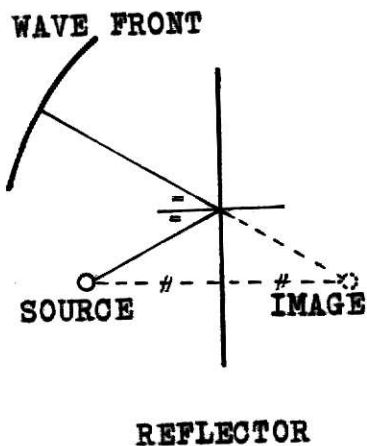




CONVEX AND FLAT SURFACES DISPERSE SOUND



CONCAVE SURFACES CAUSE FOCUSING (BAD)



Long parallel unbroken walls produce flutter effect. Splayed surfaces correct this.

relation to the direct sound that special shaping for reinforcement is not necessary, and in much larger rooms it is difficult to provide short path differences to all part of the seating area.

The effect of significant amounts of reinforcing reflection on musical performances is to impart a "close-up" or "intimate" quality to the sound, and to enable the ear to localize the direction of the source quite accurately. Delayed reflections, especially if they arrive from widely divergent directions give a more diffused, non-directional quality to the musical sound. These differences audible quite apart from differences in overall reverberation time. In fact, it is possible to choose from a fairly wide variety of acoustical conditions in varying pattern of first reflections, and it is sometimes found that the most distant seats have the most intimate acoustics.

e. Reverberation

The sound waves which are already originated in a room will continue to travel back and forth between the room surfaces, and as these waves successively pass a listener's ear, he will hear them as a continuation of the sound after it was stopped at the source. The sound waves, however, lose energy by absorption at each successive reflection, and since this energy is no longer supplied by the source, the sound will be heard to die out more or less gradually. This prolongation and diminishing of the loudness of sound after the source has

stopped, due to continued multiple reflection, is termed reverberation.

If sound dies out very slowly, a room is described "live" or "excessively reverberant", and if it dies out very rapidly, a room is called "dead".

Reverberation is one of the most important factors which govern hearing conditions in auditoriums, and it also has an important bearing on the "noisiness" of working areas. Of especial importance is its effect on the understanding of speech. If sound dies out very slowly in an auditorium used for speaking, the prolongation of each speech sound causes an overlapping and confusion of successive words or syllables which may render intelligibility extremely difficult or impossible. A similar effect is noted in music, where the sustaining effect of reverberation, if excessive, produces a blurring and lack of definition of melody and harmony. This is observed most strikingly when rapid organ music is played in a large, highly reverberant church. In rooms where quiet surroundings are required, reverberation is annoying because it prolongs distracting noises.

f. Reverberation time

The amount of reverberation in a room is measured by its reverberation time. This is defined as the number of seconds required for the energy of the reflected sound in the room to die out to one millionth of the value it had at the moment the source was cut off. The reverberation time is a basic acous-

tical property of a room which depends only on its dimensions and the absorbing properties of its surfaces and contents. It is essentially the same throughout the room, regardless of the position of either the source of the listener. The reverberation time corresponds roughly to the number of seconds which a sound of "average" initial loudness can be heard by a person with normal hearing acuity before it dies out to inaudibility under complete quiet conditions. This may vary typically from a fraction of a second in a very dead room to the order of 5 to 15 seconds in a very live room.

g. Effect of Reverberation Time on Speech and Music

Experimental studies on speech intelligibility have shown that for reverberation times longer than about 2 seconds, the understanding of speech becomes increasingly difficult or impossible. As the reverberation time is lowered below 2 seconds, intelligibility and clarity of hearing steadily improve. With a reverberation time of about 1 second, hearing conditions for speech approach the ideal, and further lowering of the reverberation time produces no substantial improvement. It is also found that lower of the reverberation of time can to some degree compensate for other adverse conditions, such as inadequate loudness or interfering noise.

Since hearing conditions for music are more a matter of taste and traditional than of intelligibility, acceptable reverberation times cannot be specified as precisely as for speech. There is actually a wide range of reverberation time

which are considered acceptable for music of a given type and for a music room of a given size. However, the average requirements for performed music may be placed roughly within the following ranges:

Chamber music	1 to 1½ seconds
Orchestral, choral average church music	1½ to 2 seconds
Large organ, liturgical choir	2 seconds or higher

Exception to these ranges are of course frequently made, as in the case of a piano or instrumental solo recital being performed in a large concert hall whose reverberation time may be designed primarily for symphony orchestra.

Rehearsal rooms, such as school band rooms, due to their comparatively small size and the need for critical listening by the conductor, have been found most satisfactory when the reverberation time is between about 0.8 and 1.0 seconds.

h. Calculation of Reverberation Time

The reverberation time depends on the cubic volume of the room and on its total absorption, and is given by the formular:-

$$T = \frac{0.049 V}{S a}$$

where T = reverberation time in seconds,

V = volume of room in cubic feet, and

Sa = area of each surface x its absorption coefficient
= room absorption in sabins

VIII. THE ACOUSTICAL DESIGN OF THIS PARTICULAR AUDITORIUM IS
BASED ON THESE FOLLOWING CONSIDERATIONS:-

1. Factors Influencing Hearing Conditions

The environment of the auditorium should provide good hearing conditions.

a. The control of background noise by using adequate sound and vibration isolating construction should be carefully designed.

b. The desired sounds must be sufficiently loud.

c. The sound must be well distributed through the room to give a desirable degree of acoustic uniformity, and to avoid disturbing echoes and focusing.

d. The reverberation time must be long enough to give proper blending of sounds and yet be short enough so that there is no excessive overlapping and confusion.

2. Sound Absorption and Reflection

The quality of hearing as applied to sounds originating within a room itself, is governed by the size and shape of the room, the location and volume of the sound, and the reflection characteristics of the materials in the room.

In designing this auditorium for good hearing, the objective is to so dispose the reflective and absorptive materials within the room that all occupants will receive as nearly as possible an agreeable volume of sound.

Plaster on metal lath will be used as the reflective material on the ceiling. The shapes and positions of the ceiling panels are carefully designed in order to reinforce sound

to the rear seats.

The side walls are non-parallel in order to avoid fluttering echoes. Non-parallel side walls, converging in the direction of the sound source are always preferable to parallel walls. They improve sound dispersion and tend to reduce the reverberation period. Wood screen on poured concrete will be used along the side walls to reflect the sound.

The back wall or the surface behind the audience and facing the sound source is absorptive, to minimize the rebound of sound energy which causes repetition of the first hearing.

3. Echo and Blur

Whenever the distance difference between the reflected sound and the sound source is greater than 65 feet or .06 second apart, the reflected sound will interfere with the sound source, creating an echo. If the distance difference were to be between 50 and 65 feet, the resulting overlapping of sound will be a blur. Both the blur and echo tend to cut down the clarity in articulation, as well as clarity in music, and are therefore considered undesirable.

The auditorium for the University is designed to avoid echoes and blurs by careful measurement of the sound-source and audience relationship creating by each reflecting surface and by keeping this distance difference described above to below 50 feet in each case. This check is shown in drawing on page 110

4. Sound Foci

Sound foci is a condition created by concave surfaces, in

which sound energy reflected from each of such surfaces tends to focus in definite points. In the design of this auditorium, no concave wall in the back of the auditorium are used, therefore avoiding sound foci: the basically concave wall in the back of the auditorium are broken into smaller portions of flat surfaces, each having characteristics similar in dimension to those of long wavelengths.

5. Flutter

Flutter is created by two parallel surfaces reflecting sound energy from one wall to another continuously until the energy eventually dies down. (See fig. page 92) This process is disturbing in space where clarity of the source of sound is required. In rooms where windows, doors and objects on the walls, diffusion alleviates problems create by flutter. In the auditorium where sound clarity is the major consideration, however, parallel walls should be avoided whenever possible. In this auditorium, design for diffusion and avoiding of parallel walls avoid any possible flutter.

6. Room Resonance

In general, a room resonance is the normal mode of a room giving certain frequencies and stronger vibrations to a generated sound source. The dimensions of each room will determine its resonant frequencies. Proper absorption and sound diffusion surfaces, however, will minimize sound pressure built up and will smooth out sound resonance throughout the entire frequency range.

7. Reverberation Time

Reverberation time is already described in the previous chapter.

There are basically two determinants for the optimum reverberation time; the volume of the room and the amount of sound absorption in the room. For example, if we keep a given optimum reverberation time as a constant, the room volume and the amount of absorption will be two variables directly related to each other. This relationship is best described in the mentioned formular:

$$T = \frac{0.49}{S} \frac{V}{a} *$$

where the reverberation time is in seconds, while V represents the volume of the room, and Sa represents the units of absorption in the room.

The auditorium in this proposal. is designed for multi-purpose uses such as speeches, plays, music, dramas, operas and movies. According to past studies made by authorities in acoustical design, the desirable reverberation time in such an auditorium should be 1.3 seconds for medium and 1.885 seconds for low frequencies. More detailed calculations are listed in the following pages.

*Knudsen and Harris

8. Auditorium Acoustical Design

	Sq. Meters	Sq. Feet
1. Floor 28 m. x 27 m.	756	8127
2. Walls (27 x 10 x 2) + (28 x 5)	680	7310
3. Ceiling 28 x 27	756	8127
4. Openings	50	537.50
5. Surfacing	2242	24101.50
Volume 756 x 9	6804 m ³ .	240181.00 ft ³ .
Volume / person		230.00 ft ³ .
Total seats	$\frac{240181}{230} = 1044$ seats approximately.	

Required Absorption

$$\text{From } T = \frac{0.049 V}{S a}$$

assume $T = 1.1885$ for 125 cps. sound frequencies

$$V = 240181 \text{ ft}^3.$$

$$S = 24101.5 \text{ sq.ft.}$$

$$a = \frac{0.049 \times 240181}{24101.5 \times 1.1885}$$

$$= 0.26$$

$$S a = 24101.5 \times 0.26 = 6266.39 \text{ sabins}$$

when $T = 1.3$

$$a = \frac{0.049 \times 240181}{24101.5 \times 1.3}$$

$$= 0.37$$

$$S a = 24101.5 \times 0.37$$

$$= 8917.37 \text{ sabins}$$

	For Sound Frequencies in cps.		
	125	500	2000
Optimum reverberation time	1.885	1.30	1.30
Total absorption required S a	6266.39	8917.37	8917.37

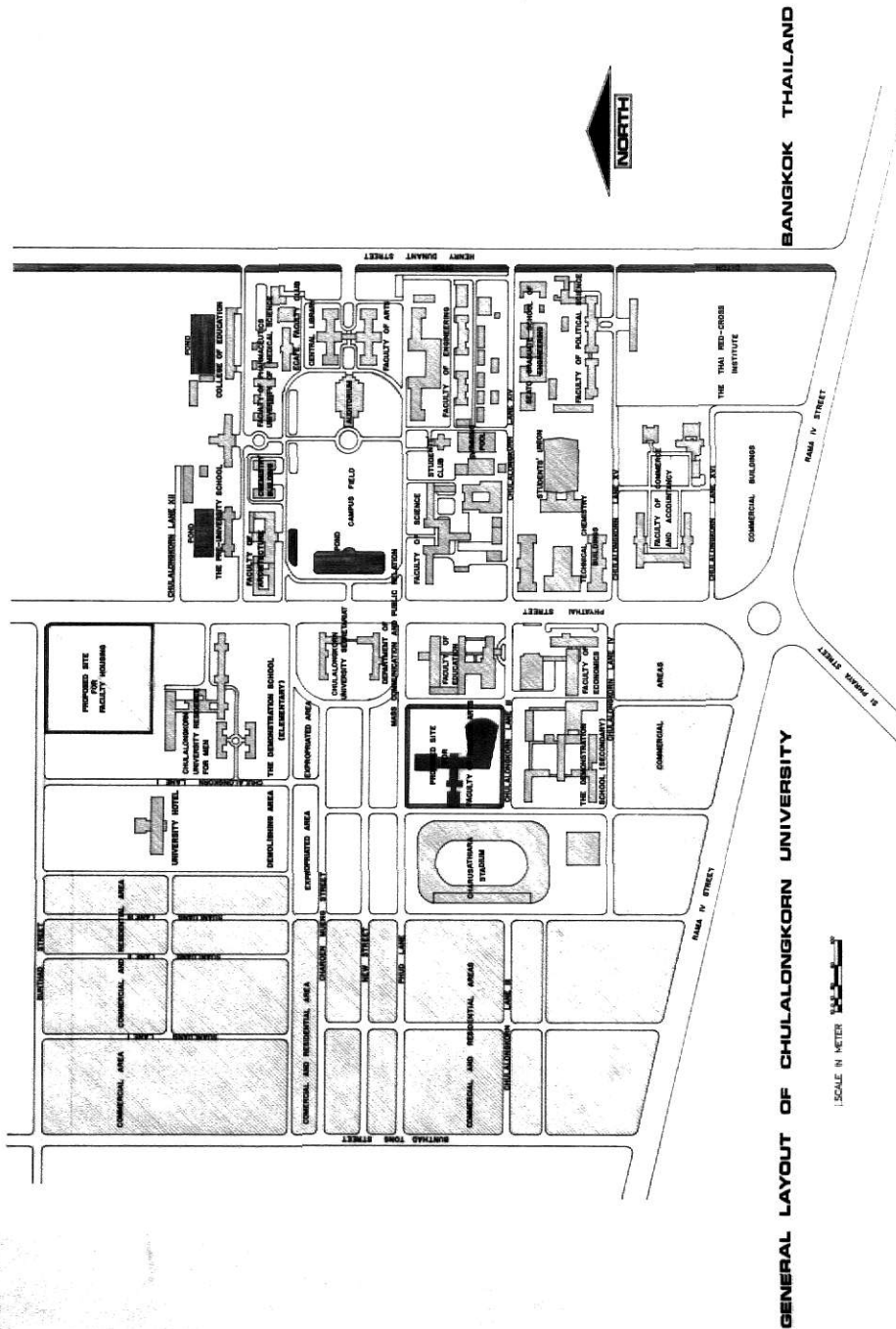
ABSORPTION BY SURFACES

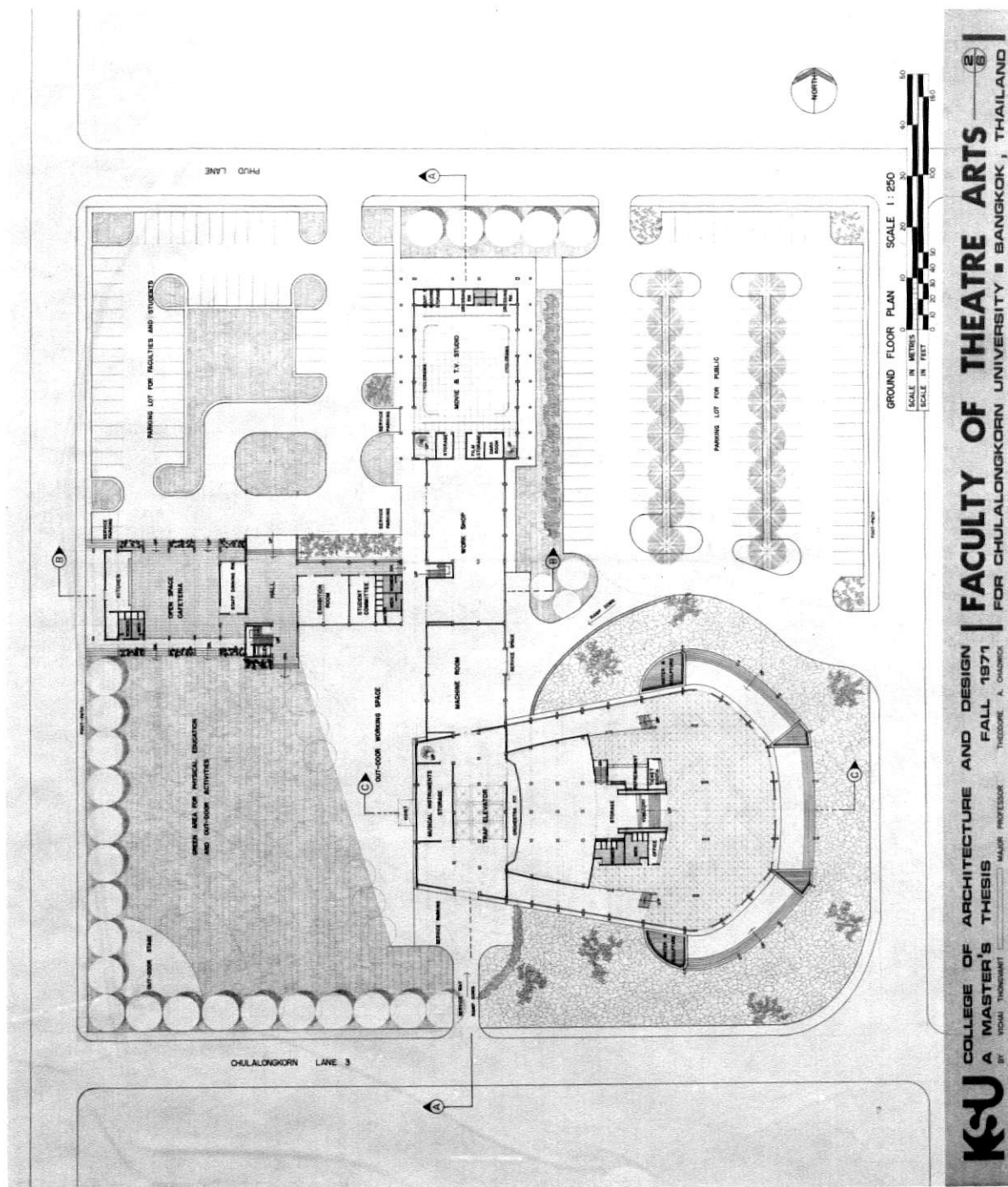
Absorption materials	area/ sq.ft.	125 cps. coef.	units	500 cps. coef.	units	2000 cps. coef.	units
<u>Floor</u>							
Audience, seated in upholstered seats, per sq.ft. of floor area. (2/3)	5418	.60	3250.80	.90	4876.20	.93	5038.74
Unoccupied cloth-covered upholstered seats, per sq.ft. of floor area. (1/3)	2709	.50	1354.50	.80	2167.20	.82	2221.38
Carpet, on concrete. 7/16"	1800	.12	216.00	.24	432.00	.24	432.00
<u>Ceiling</u>							
Plaster on metal lath 3/4" thick	6000	.15	900.00	.06	360.00	.04	240.00
<u>Wall</u>							
Wood screen on poured concrete, unpainted	4100	.01	41.00	.02	82.00	.02	82.00
Wood veneer	2810	.11	309.10	.15	421.50	.10	281.00
<u>Door</u>							
Wooden doors	537.50	.10	53.75	.05	26.88	.04	21.50
Air 75% relative hum.	240181 ft. ³	--	--	--	--	.0025	600.45
TOTAL ABSORPTION			6125.15		8355.78		8917.17
ADDED ABS. REQ'D.			141.24		561.51		0.27

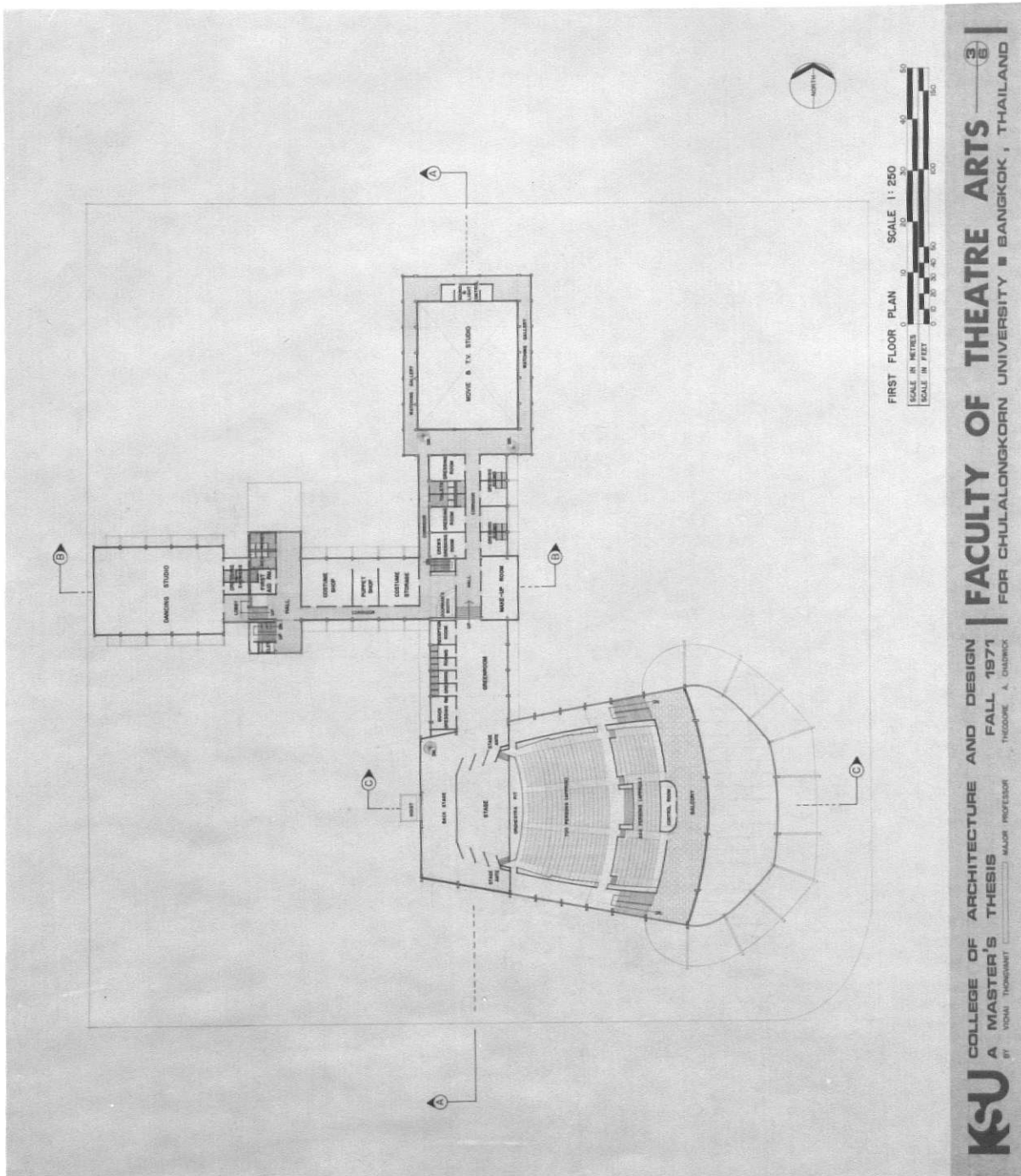
METERS TO FEET CONVERSION TABLE

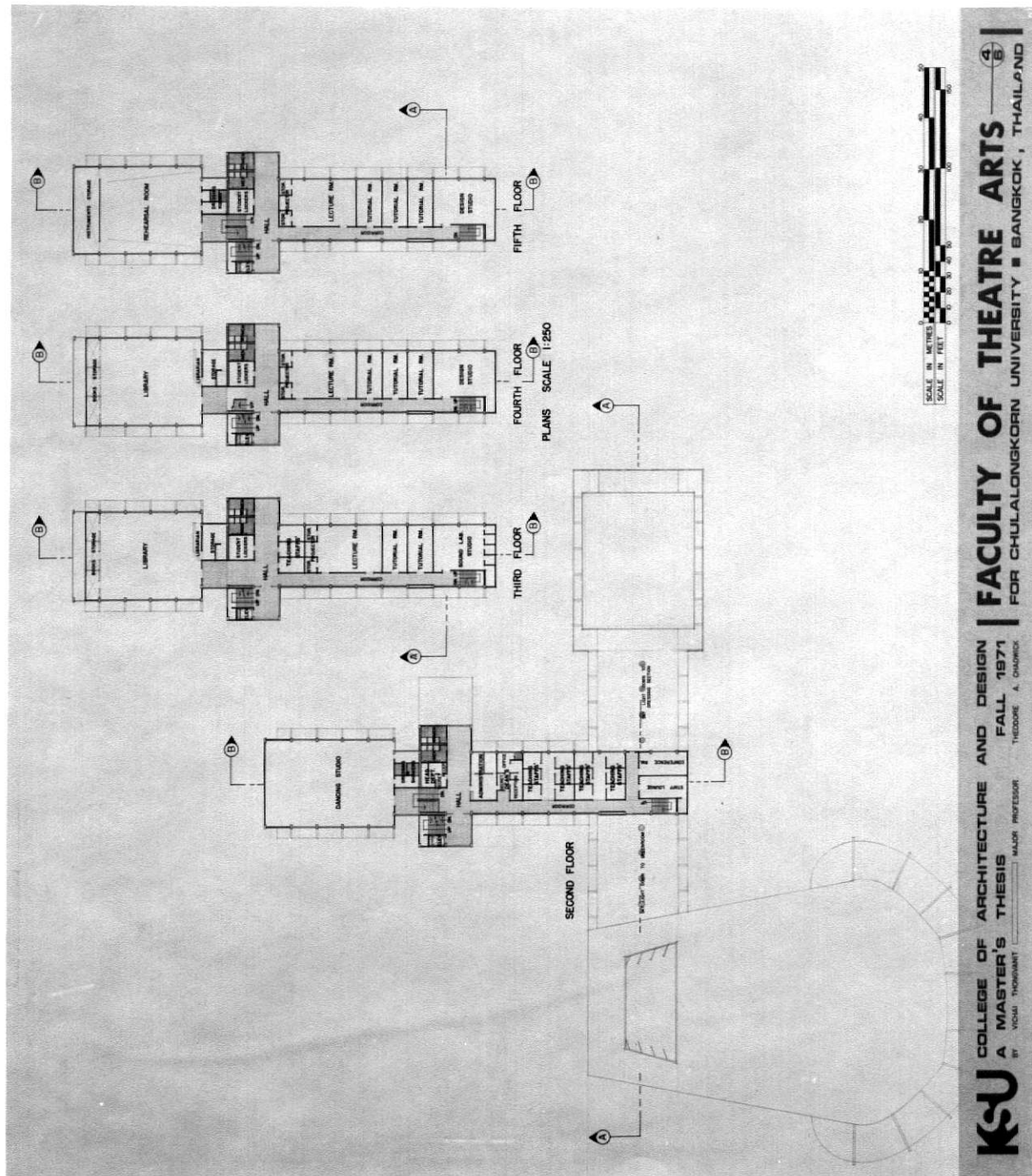
61 METERS	=	200 FEET
1 METER	=	3 FT. and 3.36 in.
.305 METER	=	1 FOOT
13 SQ. METER	=	140 SQ. FEET
1 SQ. METER	=	10.75 SQ. FEET
.0928 SQ. METER	=	1 SQ. FOOT
85 CUB. METERS	=	3,000 CUB. FEET
1 CUB. METER	=	35.3 CUB. FEET
.0283 CUB. METER	=	1 CUB. FOOT

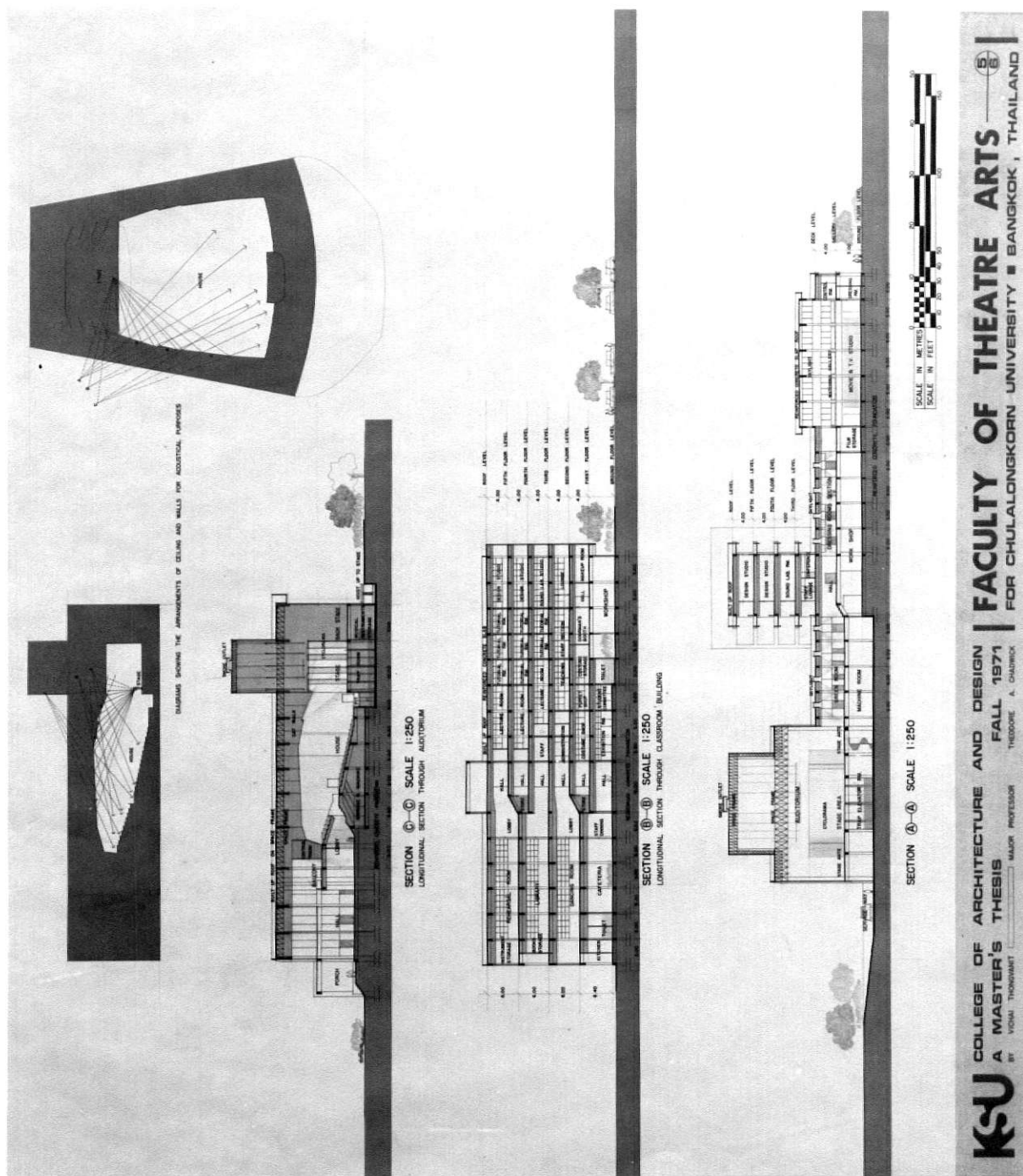
IX. PRESENTATIONS

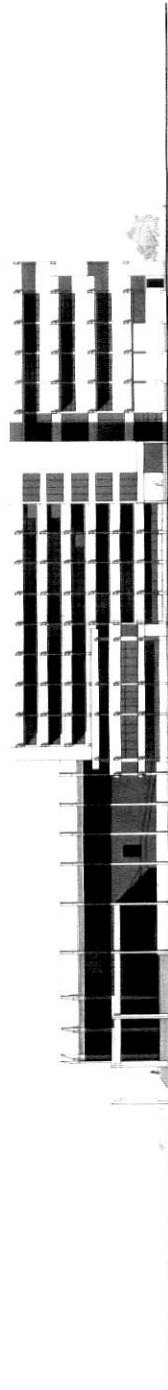




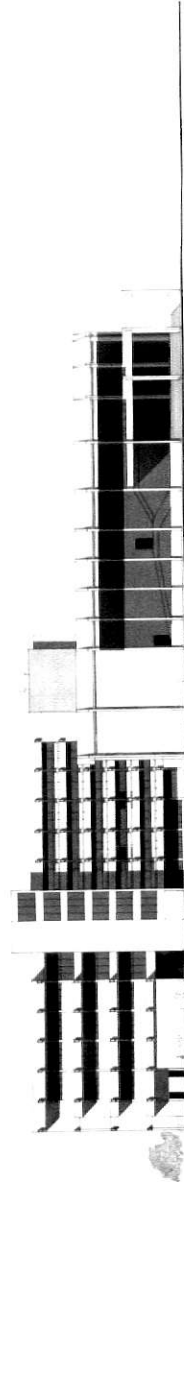




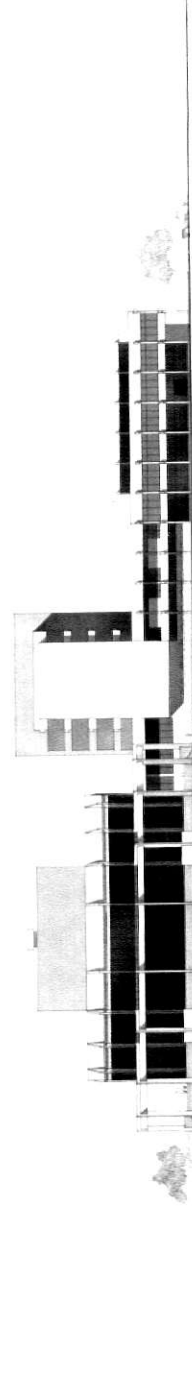




SOUTH ELEVATION SCALE 1:250



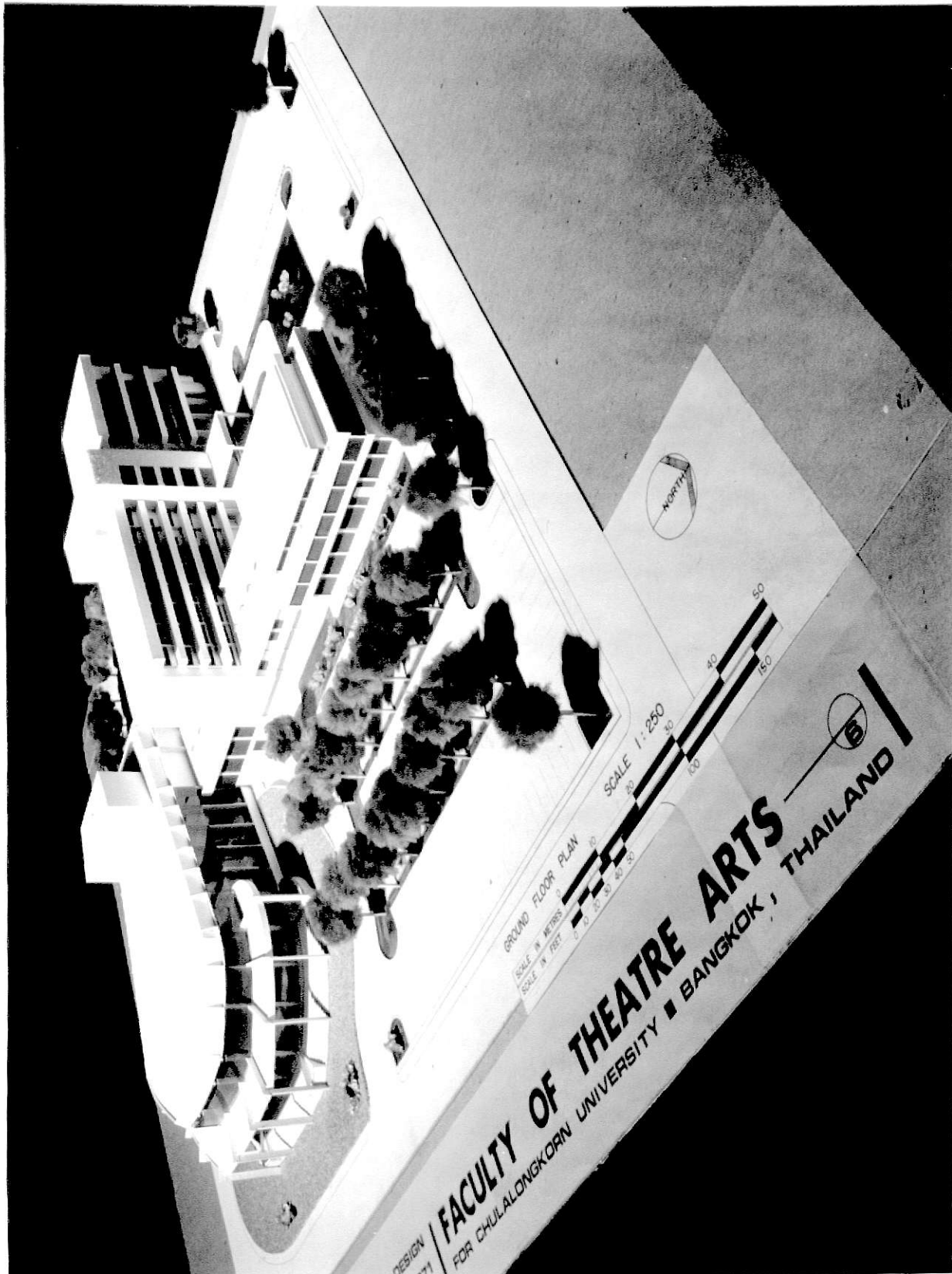
NORTH ELEVATION SCALE 1:250

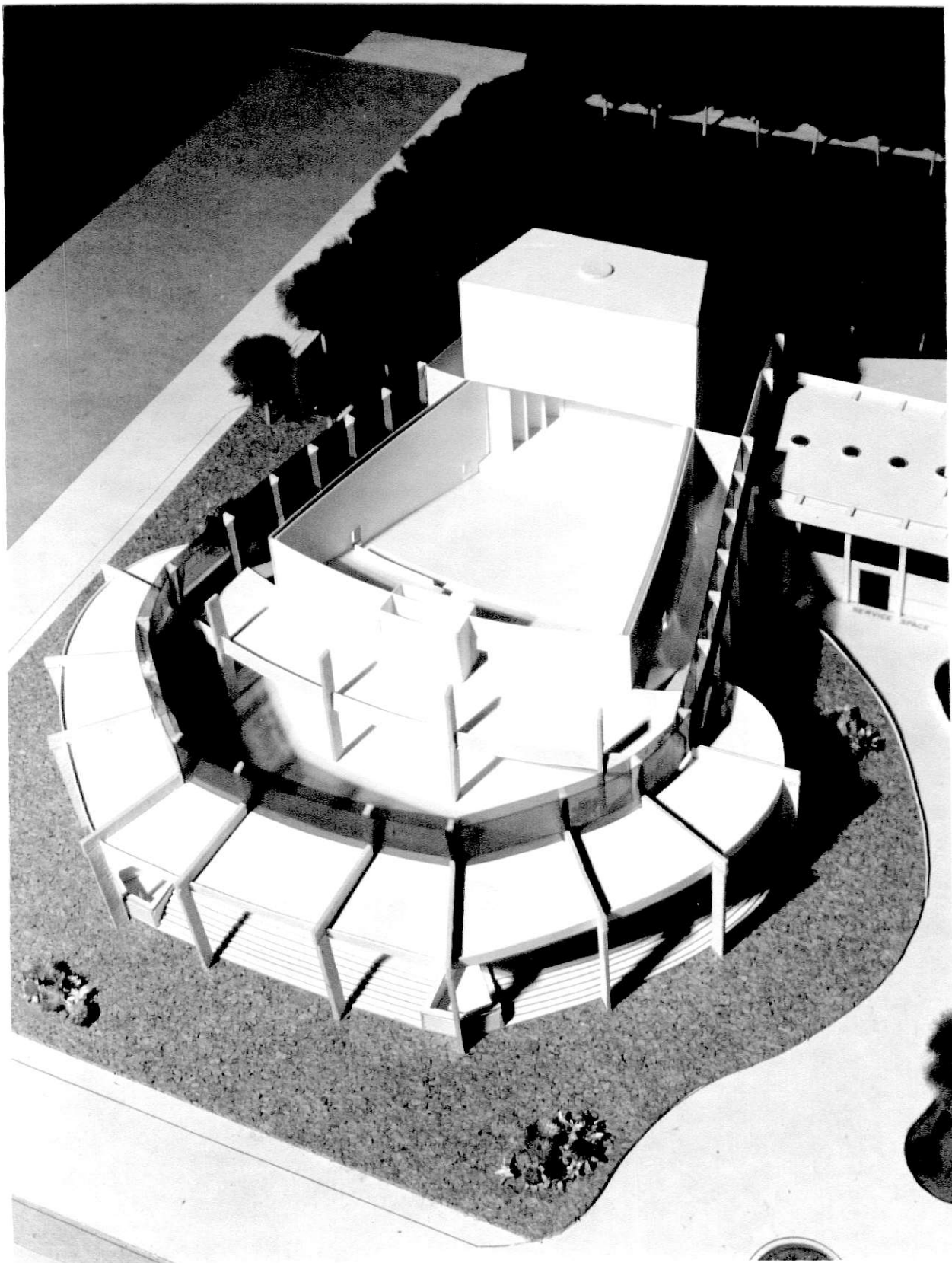


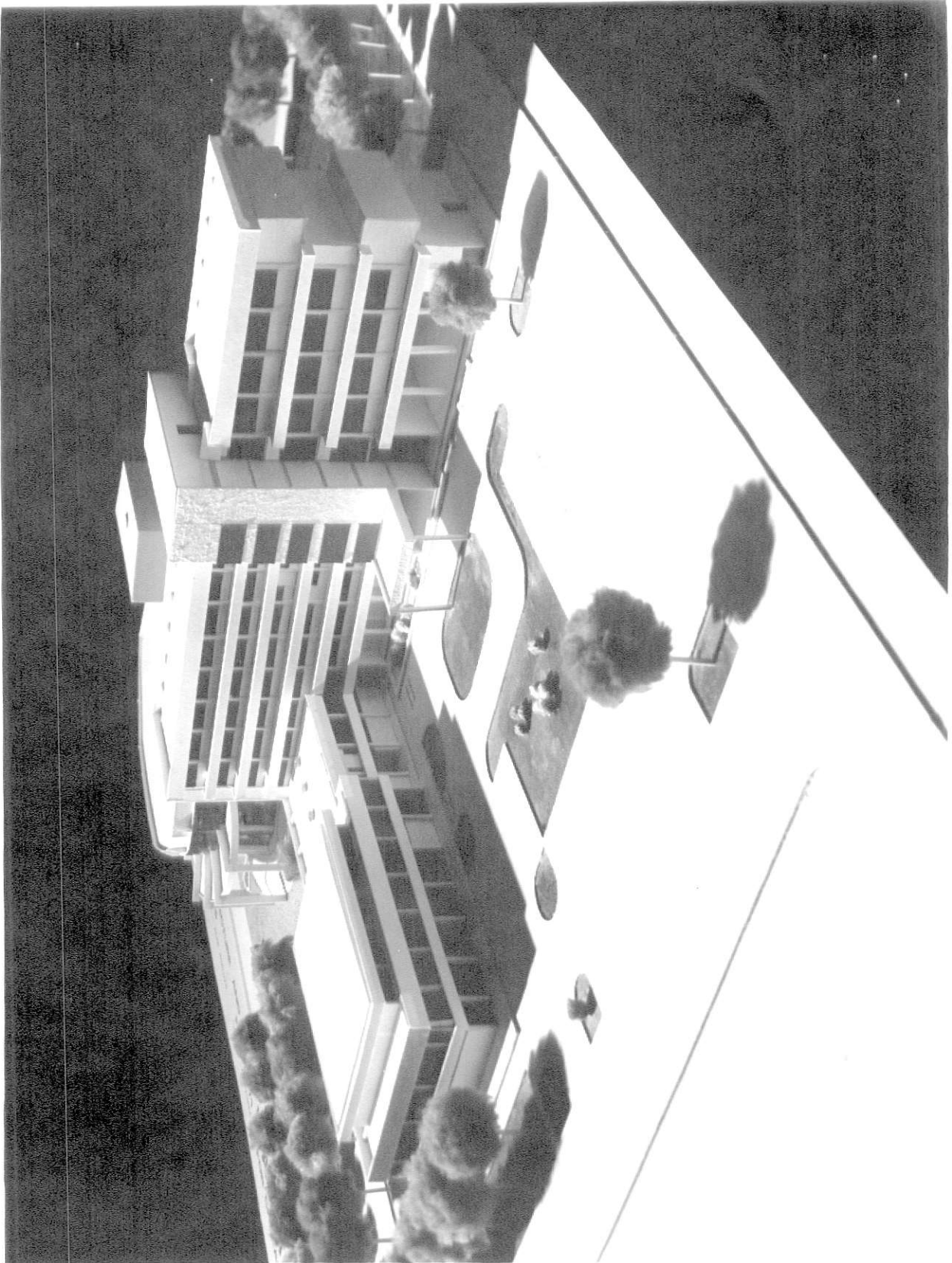
EAST ELEVATION SCALE 1:250

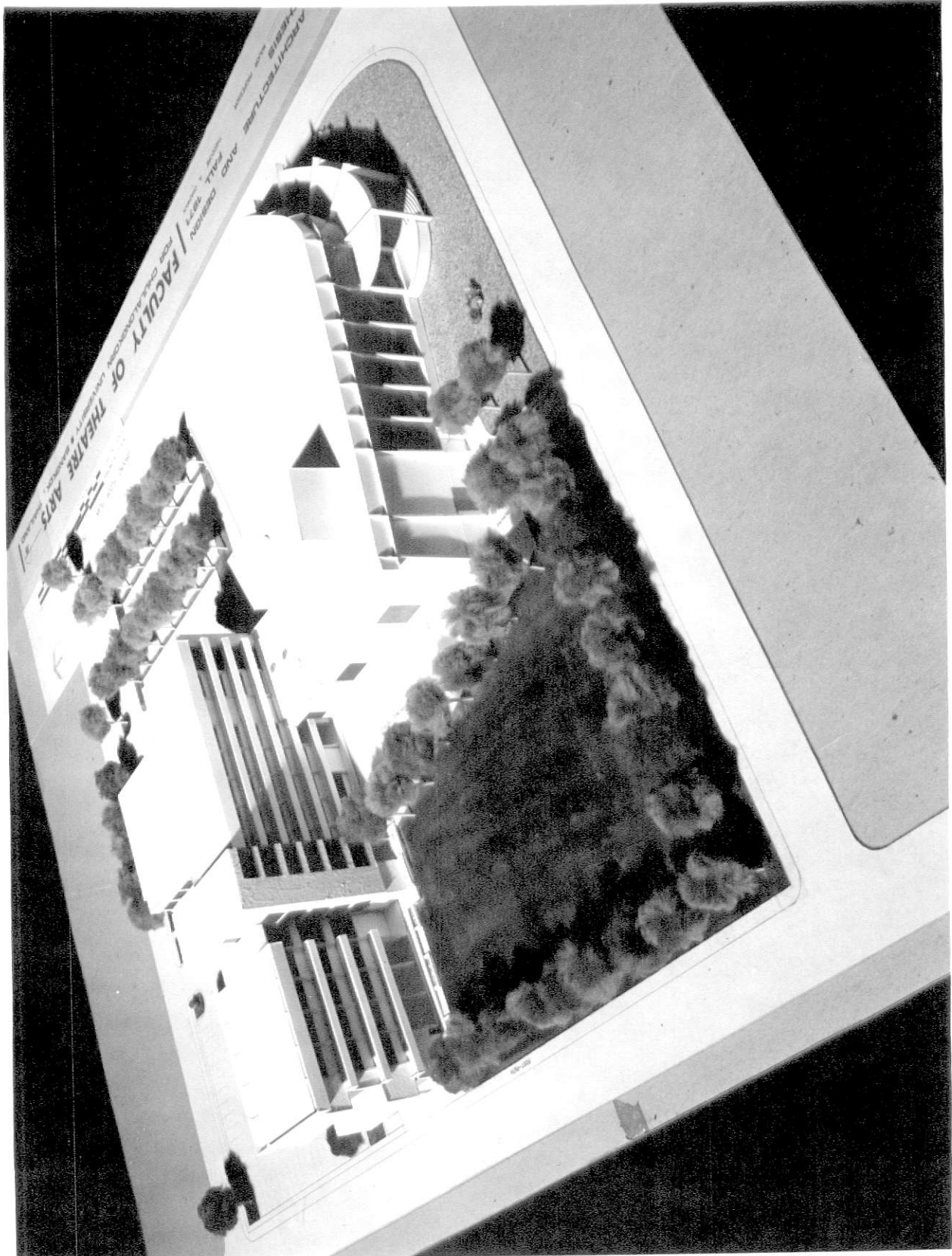


KSU COLLEGE OF ARCHITECTURE AND DESIGN FALL 1971
 A MASTER'S THESIS BY VIGOR THORNDYKE MAJOR PROFESSOR
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A DESIGN OF FACULTY OF THEATRE ARTS FOR CHULALONGKORN
UNIVERSITY BANGKOK THAILAND

by

VICHAI THONGVANIT

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KANSAS STATE UNIVERSITY

Manhattan, Kansas

1971

XII. ABSTRACT

Art, in general, is a form of communication and is a necessity as a means of creating understanding at all human levels. The new "Faculty of Theatre Arts" will be instrumental in helping all people; Thai and non-Thai, to understand the culture and heritage of the country. Furthermore, it will facilitate the need of those interested in arts to reach a higher level of artistic skill.

Major considerations for this design are concentrated in the functional aspects, the aesthetics, the simple but significant characteristics and the cost factors of the building, hoping that, this preliminary design might be of help to the University as the project moves into its final phases.