RESORT COMPLEX, SHIHMEN RESERVOIR, TAIWAN

by

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TABLE OF CONTENTS

Page

INTRODUCTION. 1

DESCRIPTION OF TAIWAN 3

I. Topography and population of Taiwan 3

II. Land reform 4

III. Industrial reconstruction 5

IV. Transportation and communication. 6

V. Improvement of the people's livelihood. 7

DESCRIPTION OF SHIH-MEN RESERVOIR 8

I. Main objectives and benefits. 8

II. The natural landscape 9

III. The climate 11

PROJECT REQUIREMENTS. 14

I. Living quarters 14

II. Recreational facilities 15

III. Service and maintenance 19

IV. Sewage disposal 21

ENVIRONMENTAL TECHNOLOGY. 23

I. Acoustics 23

II. Structure 33

III. Air-conditioning. 34

IV. Lighting. 38

PRESENTATION. 44

CONCLUSION. 60

ACKNOWLEDGEMENT 61

BIBLIOGRAPHY. 62

INTRODUCTION

The Government of Taiwan is planning to develop a resort area, located in Shih-men, for recreation and enjoyment of local inhabitants and tourists. Low-rise and high-rise apartments, hotel, shopping center, restaurant, beach complex and control, and marina are the major facilities planned for this area.

This thesis is a study of this recreational complex. It will be referred to as "RESORT COMPLEX."

After the development of industries, transportation, communication, land reform, and improvement of the people's standard of living, the people of Taiwan have extra money and time to spend for varied recreation. The Taiwan Government emphasizes the need of recreational facilities for local citizens as well as for tourists. As Taiwan becomes more accessible to tourists, its fame as a beautified country is spreading throughout the world. Lush, verdant rice crops on the tranquil paddy lands contrast sharply with mighty 10,000 feet mountain peaks, towering primitive forests and exciting mountain gorges spanned by swaying, foot bridges. To enable tourists to enjoy Taiwan's magnificent scenery, amazing engineering achievements have produced roads carved into sheer, rock cliffs. The East-West Cross Island Highway is famous not only for its scenery but also, for its venturesome construction.

There are many beautiful tourist areas in Taiwan, but the most well-known areas are the nine listed below.

		No. of tourists
1.	Yangmingshan	925,000
2.	Sun-moon Lake	850,000
3.	Green Lake	825,000
4.	Cheng-ching Lake	748,000
5.	Shih-men Reservoir	496,000
6.	Peitao	424,000
7.	Yeilio	406,000
8.	Weolie	178,000
9.	Ayli Mountain	50,000

This Shih-men Reservoir area is a most desirable place for the proposed resort complex, for the following reasons:

1. Shih-men Reservoir is located at the beautiful north rim of the Taiwan Central Mountain system, twenty to forty miles from the cities of Taoyuan, Singshu and Taipei, the capital city of Taiwan. There are four million residents in these cities who have the convenience of communication.
2. Shih-men Reservoir is formed by the largest dam in the Far-East, and it is the newest tourist area in Taiwan. The water surface of this reservoir spreads widely providing wonderful recreational facilities. A total number of 1,500,000 or even more tourists will be expected after the whole area is developed.

DESCRIPTION OF TAIWAN

I. Topography and population of Taiwan.

Taiwan lies at longitude 119.138 to 122.625 east; it lies in latitude 21.4525 to 25.3753 north, its area is 380 kilometers by 140. With the Pacific Ocean to the east, the Taiwan Straits to the west and being opposite to the Philippines, and with the Ryukyu Island to the north-west, Taiwan's geographical location is of great importance. It is known as the "unsunken aircraft-carrier." The whole area of Taiwan is 35,961 square kilometers. Two-thirds of it are mountains, with three systems, the Central, Eastern Taiwan and Ta-tueng. Among the sixty-two high mountains reaching above 3,000 meters, Mt. Yu is the highest; it is 3,950 meters above the sealevel. Being surrounded by water, Taiwan has a coast line of 1,566 kilometers in total length. Because of topographical limitations, the rivers have a rapid fall and shorter courses. There are twenty rivers over fifty kilometers in length. With its mild climate all the year around, an abundant rainfall, an industrious and modest people, and rich agricultural products, Taiwan has been called "Treasure." The administrative districts of the whole Province consist of five municipalities, 16 districts, the Yangmingshan administration, 77 towns, 235 rural districts and 3,117 villages. The whole population of Taiwan was about 12,500,000 at the end of 1965, of which 99% are from the mainland, and whose dialects are Fukien and Cantonese, but, owing to wide-spread

education in recent years, their mode of living and customs and habits have become the same as those in the mainland.

II. Land reform.

Sixty per cent of the citizens in Taiwan are farmers, of whom 70 per cent used to be tenants. Under the old tenancy system, the landlord enjoyed the lion's share of the annual harvest; some tenants got less than one-half, some 40 per cent, and others as low as 25 per cent. In line with a dicision to realize Dr. Sun Yat-sen's ideal of "land-to-the-tiller" policy and to better the farmers' livelihood, the Government adopted its land reform policy with great success in 1949. The first stage was the farm rent reduction to 37.5 per cent of the total annual yield of the principal crop. The second stage of land reform in Taiwan was the sale of public lands. The third stage of land reform in Taiwan was the implementation of the land-to-the-tiller program. The results of such programs are the following: 1. increase of cultivation area to 7 per cent; 2. Over 90 per cent of the land can be directly irrigated and displaced; 3. the roadside farm lands are convenient for cultivation and transportation and are economical to use; 4. rise of land value after its redemarcation. It is anticipated that after the completion of this program, not only the most economical and effective management will have been acquired by the farming population but also a vast area of lands (from 15,000 to

21,000 hectares of cultivatable lands) will be available for further utilization.

III. Industrial reconstruction.

The industry of Taiwan acquired a good foundation during the Japanese occupation from 1900 to 1945. However, it suffered great damage during World War II. Since the retrocession of Taiwan to the republic of China, the Government has spared no effort to restore itself to its original position. The first-stage of the four-year plan for Taiwan's economic reconstruction began in 1953. At present, three four-year plans have been accomplished, and the fourth-stage plan is in operation. In spite of the government-operated enterprices of which a part were started by the Japanese, the Chinese Government lays great emphasis on the development of privately owned enterprises. Among the hundreds of industries of Taiwan Province, the more important ones may be briefly stated to be as follows: Textile industry, Fertilizer industry, Metallurgical and Mechanical industry, Rubber goods industry, Sugar industry, Cement industry, Petroleum industry, Ship-building industry, Automobile industry, and Electrical industry. Besides the refineries for agricultural products such as tea, pineapples, tobacco, wine refineries have also made great progress. Medicine and plastic industries, above all are both new and promising. The Government is making great efforts in carrying out the plans for the

acceleration of Taiwan's economic development, and a very bright prospect is in store for the near future.

IV. Transportant and communication.

A. Railways: The total length of the railways in Taiwan is 3,834 kilometers. A total of one-fourth are Provincial; the remainder are managed by productive organizations. The average length is 11 kilometers for every 100 square kilometers; the railroads form a network all over the Island.

B. Highways: The total length of Provincial highways is 16,228 kilometers. During recent years, most highways have been repaired and new bridges have been put in, e.g., the Silo Bridge, the longest in the Far East, has been constructed. In 1956, the East-West Cross-Island Highway was started; and, after three years and ten months of paintaking construction work, it was completed in May, 1960.

C. Airlines: In recent years, the aviation in South-East Asia has increased greatly, both for passengers and cargoes. Because of the location, Taipei plays an important role for the airlines between Manila, Hong Kong and Tokyo. Visitors and business men from all over the world come here for sightseeing and business transactions at an ever increasing rate. Under such circumstances, the new Taipei International Terminal Building was completed in 1962. Right now, there are two Domestic airlines and six international airlines served in this building.

D. Harbors: The three large harbors, Keelung in the north, Kaohsiung in the south, and Hwalien in east (this international harbor was just completed at the end of 1960), are important in foreign trade.

V. Improvement of the People's Livelihood

Liberty, security, and happiness are the government's objectives for all the people of Taiwan. Undoubtedly, the better living standard enjoyed by the people at large surpasses that of its previous stages and has won a considerable respect from the Asiatic nations. The improvement of the people's living standard here is chiefly due to the mutual efforts made by the government and the people. Taiwan's progress has greatly affected the people's standard of living. As a result of the increase of farmers' income and purchasing power to engage in reproduction, their standard of living has been greatly improved. Secondly, the implementations of the three four-year plans for economic reconstruction not only have negated inflation and diminished price fluctuations but also have raised the people's purchasing power and ability to produce. The implementation of direct democracy in local government and the improvement in people's standard of living have resulted in the improvements of education, communication, public health, information, culture, and in other agencies. For instance, the total number of students in Taiwan is 2,269,049, a ratio of 212.2 per 1,000.

The increase of traffic and transportation and innovations in post and tele-communication; the decrease of death rate and increase of birth rate owing to the improvements in medicine; the developments of private-owned broadcasting stations and wide circulation of newspapers, magazines, etc., and, above all, the most interesting item of all, is the increase of marriages from 74,482 in 1947 to 87,872 in 1959, all indicate the marvelous improvement in the peoples' lives in Taiwan.

DESCRIPTION OF SHIH-MEN RESERVOIR

Shih-men reservoir is the first multipurpose water resource development undertaken by the Government of the Republic of China as a part of the overall program to make Free China self-sufficient.

I. The main objectives and benefits.

Irrigation--The reservoir provides irrigation for about 56,000 hectares of rice fields in Taoyuan, Hsinchau and Taipei Counties and makes possible an annual increase of coarse rice production of 80,000 tons.

Power Generation--The power plant provides the Taiwan power system with a dependable peak capacity of 87,400 kilowatts or a maximum peak capacity of 102,000 kilowatts, and an annual energy out put of 216,000,000 kilowatt-hours.

Water Supply--The water plant now provides, in its initial stage, a water supply for domestic and industrial area of about 148,000 inhabitants and in the future it will supply 340,000 people, in Taoyuan County alone.

Tourism Development--The reservoir, a remarkable chain of scenic areas, is one of the most significant tourist centers in Free China.

II. Description of the natural landscape.

The reservoir caused by the dam extends eastward for miles through beautiful, wooded, mountainous land, that is particularly uninhabited. Located high in the Central mountains of Taiwan, the high level of the reservoir will be normally an elevation of 250 meters. The reservoir is about 8.15 square kilometers in area, 16.5 kilometers in length, and 54 kilometers by highway south of Taipei, Free China's capital city. The lake gets widest and is most scenic at Amup'ing; hence this area has been selected as the site for the project located at the central part of the reservoir. The site of this area is relatively flat and wider compared with the characteristics of other areas. The slope of this site is 18% and the area is 12 square kilometers (2/3 is land) approximately. The water surface of this area spreads widely and provides a desirable place and attractive views for (those who enjoy) boating, fishing, swimming, waterskiing and sightseeing. In cooperation with the government and having

Location of Shih-men Dam in Taiwan

the desire to attract tourists to Taiwan, Taiwan has decided to provide facilities for tourists as well as for the local citizens. Because of the beauty of the land, striking views and romanticism, the writer thinks this might be a suitable place for a natural development of a summer resort. Within the site stands a group of Chinese farmhouses. These are native buildings of bricks with tile roofs typical of the type so common throughout the Taiwan countryside. Some feeling has been expressed that these buildings would serve as a good tourist attraction. (See page 44)

III. The climate.

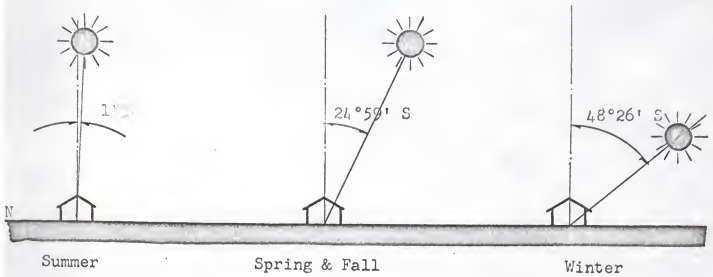
Lying in the Tropic of Cancer in the subtropic zone, Shih-men, like other places in Taiwan, has a mild climate, where snow is rare except in the higher mountain areas. The summer is long and the winter is short. Because of the regular winds from the sea, the marine climate causes any variance in temperature to be only slightly felt. The average rainfall is 1850 millimetres at Shih-men; however, in other places in Taiwan there is an average of 2,500 millimetres. Because Shih-men is located up on the mountains with an elevation of about 800 feet, the average yearly temperature is 20.2° C cooler than that of Taipei; it is 22.2° C on the average. The average velocity of wind is 3.6 meter/sec. Generally speaking, the wind blows from south-west; with the exception of June to August when the direction

is changed from north-east. Average relative humidity is 81%. Rainy days are about 142.9 per year. Average vapor pressure is 760.00 millimetres. Frequent mild earth tremours are felt from place to place; however, destructive earthquakes are relatively rare.

The chart below shows the average temperature, relative humidity, rainfall, and wind velocity of every month from 1958 to 1965.

Month	Temperature in C	Relative humidity	Rainfall in mm	Wind velocity in meter/sec
January	13.0	82%	64.1	3.6
February	12.6	85%	161.6	3.3
March	15.0	85%	191.4	2.7
April	18.5	84%	195.3	2.4
May	22.1	83%	278.8	3.3
June	24.7	82%	362.6	2.7
July	25.9	81%	169.2	2.5
August	25.7	80%	238.2	2.3
September	24.5	80%	91.5	2.5
October	21.7	77%	23.0	3.5
November	19.5	79%	26.8	3.7
December	14.8	78%	42.9	4.0

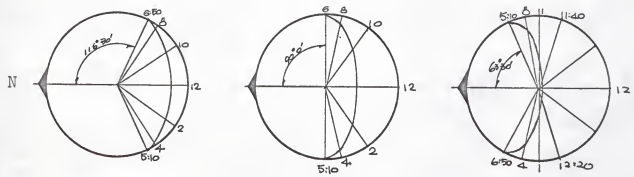
The solar angle is 24°59' south during spring and fall, 1°32' south during summer and 48°26' south during winter at noon. Sketches on the next page show the solar angles of four seasons.



DIAGRAMS OF AZIMUTH AND ALTITUDE OF THE SUN

WINTER Dec 22 FALL Sept 23 March 21 SPRING June 22 SUMMER

25° North Latitude



PROJECT REQUIREMENTS

I. Living Quarters.

A. Apartments.

Two types of apartments--high-rise and low-rise--are provided for different purposes: High-rise apartments make it possible to take advantage of the beautiful scenery of the reservoir and for the people who prefer to live in high-rise apartments. Guests living in this type of building will have to spend a little more than will those living in low-rise apartments, because they are the more expensive in construction and for facilities provided. Low-rise apartments are built not only for developing the landscape by using the width and the beauty of the resort area but also for creating a quiet and peaceful living area which aims to have the characteristics of village living which disappeared from society for a long time.

High-rise for living accomodations for 60 families will provide a 75% parking area.

Room accomodation requirements include: 35%-1 BR. 25%-3 BR. 40%-2 BR. plus living room, kitchen, bath room, and dining room.

Other accomodation requirements include: entrance lobby, lounge, post and information table, laundry space, stairs and elevators. (See pages 47, 48)

Low-rise living accomodations for 100 families provide a maximum height restriction: 3-floors. Room accomodation

provide 80%-3 BR. 20%-2 BR. plus living room, dining room, kitchen, bath room. (See pages 49, 50)

B. Hotel.

It will be first class and meet international standards and provide accomodations of 150 rooms. It is envisioned that this hotel will provide for guests of transient nature, who will stay only a day or two and leave.

Room requirements: 20% single rooms, 75% two-bed rooms, 5% two rooms suites, all rooms must have a bath room and air-conditioning.

Other requirements include an entrance lobby, lounge, cloak room, porters' station, public telephone, public toilet, news stand, office, main desk, manager's office, linen room, employees' lockers and toilets for men and women, major mechanical room, furniture repair room, electric sub-station, telephone room, general purpose supply and repair rooms, gift shop, barber shop, beauty shop, two air-line booking offices, dining room, kitchen, bar, coffee shop. All laundry will be sent to a commercial laundry providing truck pick-up and delivery twice daily. (See pages 55, 56)

II. Recreational Facilities.

A. Convenience shopping.

A market, drug store, bakery, beautyshop, barber shop, sports shop, shoe repair shop, dry cleaning and laundry, and storage space are provided for the whole area.

By using the different sizes of hyperbolic paraboloids in different elevations according to the original contour, a free and interesting space is formed for a shopping center. It looks like a combination of shelters; some of the hyperbolic paraboloids are open; some of them are closed. A wide range of varied goods and many facilities are provided; such as they will offer different kinds of food, sports' equipment, laundry service and shoe repair, respectively. (See page 51)

B. Restaurant.

The restaurant of the resort complex will serve those who are staying at the living quarters and also those who are visiting the resort for only one day. The restaurant building contains not only the service-restaurant but also the cafeteria to meet varied desires of patrons.

The service-restaurant will provide tables for 100 people. A wider range of dishes will be provided and the food will be served by the staff to the customer sitting at a table. This area should be entirely separated from the cafeteria which offers different service and satisfies different requirements. A higher price for food will be charged in the service-restaurant than in the cafeteria. More carefully handled lighting and decoration and a higher standard of service and food will be expected in the restaurant. A dancing area is also provided in this area.

The cafeteria will privide self-service counters to speed up operation and to reduce the cost. About 200 seats will be provided in this area.

Air-conditioning will be provided in the restaurant. Customers in a cool, fresh atmosphere have better appetites.

For a reasonable amount of expansion during the weekend, a wide terrace space should be considered to solve the problem. Besides, the terrace is a nice place to look out upon the lake and to enjoy the scenery.

Other requirements include an entrance lobby, lounge, coat room, office and checking room, a beer and wine storage place, a kitchen (supplied with cold, dry and vegetable store room, a place for preparation, a cooking area), a wash-up, crockery pot wash, storage area, public toilets for men and women, employees' lockers and toilets, storage and a mechanical room and a service area. (See page 52)

C. Marine activities:

1. Allocated beach for swimming.
2. Cabanas: 100 units.
3. Beach complex: public dressing rooms, including showers and toilets for men and women, snack bars, rest area and lounge are the main facilities for this combination of different kinds of hyperbolic paraboloids. A parking area for 80 cars and a bus station are provided about 200 feet from the beach complex. Other facilities include kitchen, service area, rental office and storages. (See pages 53, 54)

4. Beach control: The director's office, control office, life-guard room, first aid room and storage room will be provided. (See page 53)
5. Marina: Because of the prominence of the structure system of hyperbolic paraboloid on the site, well planned buildings of appropriate style, located in carefully arranged and landscaped settings, will add much to the charm of the marina. Plan requirements: lobby, lounge, dining room, kitchen, food storage and preparation, dish-washing and storage, office, men's and women's toilets, showers and lockers, snack bar, cloak room, observation deck, and loading platform. A parking area for 20 cars will also be required. (See pages 54, 59)
6. Repair shop: It is often necessary or desirable that a certain amount of repairing be carried on within the marina. Boat repairing done within the shop generally is of a minor or emergency nature. The repair shop space, in addition to accommodating the boats under repair, should provide for the storage of parts and for necessary power tools and adequate room for the use of special handling of other mobile equipment. A ceiling height of approximately 16 feet is sufficient to accommodate most motor powered boats up to 40 feet in length. (See page 54)

7. Storage shed and parking areas can be used for boat storage during off season. (See page 54)
8. Piers for motor propelled boats and row boats: The selection of the type of pier is a very important element in a marina. This marina will be on a flood control reservoir where the range between high and low water is a great number of feet. Obviously the use of a pier built according to a fixed elevation could cause serious inconvenience, especially during the time of low water. Floating piers will be used in order to solve the problem.

III. Service and Maintenance.

The whole project cannot be considered completed without considering service and maintenance for the entire resort complex.

A relatively large and flat area is needed for the facilities of maintenance. This area is to be located at the north-east area of the resort area, only 1.4 miles from the farthest building which is the marina, but at a higher elevation than that of all of the buildings to provide water pressure. (See page 45)

Several main utilities are provided:

A. Electric sub-station: A input of high voltage electricity from the power plant, 6 miles away

from the maintenance area, will be transferred to low voltage for the electricity used in the complex.

B. Police, fire protection, and storm warning program must be determined and accommodated accordingly.

C. A gas station and parking lot for cars, buses and trucks must be provided.

D. A plant is required for air-conditioning, providing hot water supply, garbage treatment, and so forth. It should also take the responsibilities of building maintenance, like providing paint, a repair room, etc., for the entire area.

E. Water plant for water supply: There are two possibilities for obtaining the water supply for the whole area. One source is ground water, utilizing wells, and the other source is the Shih-men reservoir. After consideration, the ground water will be selected for the source of water supply for the reasons that there will be a lower cost for construction and that a purer quality of the water may be obtained. The construction of wells and the maintenance of such a system will result in a much less expensive program than would the construction, maintenance, and operation of treatment facilities required in the use of surface water. Several wells will be drilled and test drilling will be required in order to provide satisfactory provision of water in quality and in quantity for domestic demands. A drilling

investigation should be made to search out the ground water sources at depth. The use of ground water supplies generally requires treatment for hardness and chlorination. The treated water will flow to every building, and then it will be pumped up to the elevation water tank. A large amount of water will be needed in a short time, when there is a fire. A water tank must be provided for such an emergency.

A tremendous amount of trash and garbage, from thousands of tourists per day, must be picked up and burned to keep the area clean and attractive.

Roads, walks, paths, shelters, pavilions, general landscape features and several parking lots are provided for the interests and demands of the area.

IV. Sewage Disposal.

Shih-men Reservoir is located miles away from the nearest city--Taoyuan. Meanwhile, thousands of tourists will be here on their vacation; hence, how to provide a satisfactory sewage treatment becomes quite important and necessary.

To achieve the goals of providing simple, dependable treatment, economical to operate, easy to maintain, ordor-free and nuisance-free, the factory built "Oxigest"[1] sewage

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[1]A sewage treatment equipment producted by Smith & Loveless Company.

treatment will be selected to solve the special problem of this resort area. The treatment plant is designed specifically for small subdivisions, a mobile home court, motels, shopping centers, apartments, resorts, hospitals, schools and factories in outlying areas without municipal sewer facilities. It would not be economically desirable to pump the sewage a long distance to an existing treatment plant.

The living quarters and the recreational facilities are located some distance away from each other on the north and south side of the bay area separated by part of the reservoir. The restaurant, shopping center, high-rise and low-rise apartments are on the north side while the hotel, marina and beach complex are on the south. Two treatment plants are considered to be able to meet the requirements. One will take care of the sewage from the buildings on the south side, and the other will take care of the other sewage.

Sewage contains both mineral and organic matter in suspension, in colloidal form, and in solution. Proper control in a sewage treatment plant organic material may be converted to a stable and inoffensive state.

The problem is to remove the obvious solids which give the sewage effluent a bad appearance and to convert the remainder of the solids to a stable form, not subject to offensive decomposition and not a potential danger to health.

The effluent--all waste waters, including treated sewage--must ultimately enter the reservoir, so the effluent has to be treated by sedimentation, skimming and bioligical methods.

Since the reservoir exists for providing water supply and tourism development, further treatment will be needed to meet the requirements for marine activities and for domestic and industrial water supply. A solution feed, vacuum type chlorinator will be provided for chlorination of the "Oxigest" sewage treatment plant effluent. The machine will be designed specifically for the use of chlorine gas and special corosion resistant materials shall be used for all parts which come in contact with chlorine gas. It shall be designed for wall mounting and will be furnished completely assembled and ready for operation.

The sewage dumping of this resort area should extend some distance beyond the area even if the effluent is specially treated; several openings are recommended to obtain good distribution through the water.

ENVIRONMENTAL TECHNOLOGY

I. Acoustics.

Acoustics are an attribute of every structure. They constitute one of the essential determining factors in all architectural projects where comfort, auditory communication, or a number of other special requirements must be satisfied. The architect is therefore faced, whether he likes it or not, with the problems of reverberation, diffusion, type and distribution of sound-absorbent acoustic material, and shape of room.

The project, "A RESORT COMPLEX," provides several entirely different kinds of buildings, ranging from apartments to a marina. The lobby of the hotel will be used to illustrate a typical problem in acoustics. This lobby is selected for some detail work in acoustics, including calculations for the proper reverberation time, because it illustrates the use of structural, air-conditioning, furnishings, lighting, and acoustical materials in arriving at a successful interior design. (See pages 57, 58)

A study of the acoustics for the above follows:

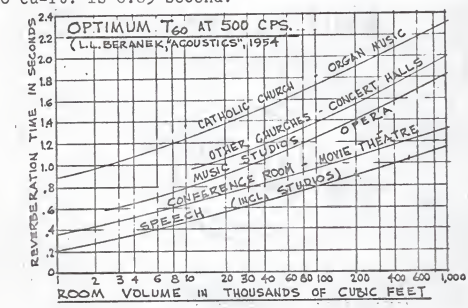
The acoustics for a lobby space of a hotel is somewhat different from the acoustics for an auditorium or for a lecture hall, since the requirements are not the same. For example, the "liveness" is very much appreciated for lecture or music, but it is not desirable for lobby space where private conversations prevail. On the contrary, "deadness" is required to prevent the interference from others. Therefore, the selection of proper sound-absorbing materials to achieve the "deadness" becomes the main acoustical problem.

The ceiling of the lobby space will be rather high, about 20 to 27 feet; hence, it will be quite necessary to treat the side walls acoustically so as to reduce the horizontal reflections (flutter). The higher sound-absorbing materials, such as pierced brick wall and wood wainscot of walnut slats with 3 inches of fiberglas behind are used for the most part on the walls. (See page 57)

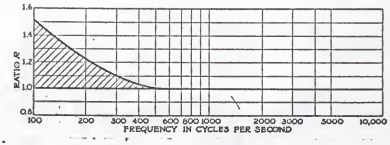
The waffle pattern and the various plans of the hyperbolic paraboloid provide diffusion by deflection at all wave lengths for the reason that the dimensionable characteristic of the above are similar to the variable wave lengths that have been considered for the room.

The control of noise from the outside and from one room to another is accomplished by the use of hard materials, such as concrete blocks, facing bricks and double glass. The heavy curved bearing wall with mosaic on the surface, facing the lobby space, is not only a decorative element but insulates the office space.

The reverberation time of this lobby should not exceed the optimum time of speech for noise reduction purposes, and, for large rooms, noisy rooms, or rooms in which quiet is a prime objective, or the lobby in this building, the reverberation time should be not more than two-thirds to three-fourths of the optimum time for speech. From the figure below, the optimum reverberation time at 500 cycles for speech in a room of 53,500 cu-ft. is 0.85 second.



And from the figure below, the ratio r is 1.45 and 1 for 125 cycles and 2,000 cycles, respectively. The reverberation time at 125 cycles and 2,000 cycles is 1.25 sec. and 0.85 sec. for speech.



But for conversation, the optimum reverberation time should be cut down to two-thirds to three-fourths as mentioned above. So the reverberation time in this lobby should be 0.9 sec., and 0.6 sec., and 0.6 sec., for 125 cycles, 500 cycles, and 2,000 cycles, respectively.

The elevator lobby has a deep recess under the balcony and therefore is a coupled space, and must have a reverberation time similar to that of the main lobby. The untreated elevator lobby acts as a reservoir of sound energy that

continues to return the energy to the main space, thereby prolonging the reverberation in the lobby. Portions of the side walls are treated with very absorptive materials, such as, pierced brick wall and wood wainscot as mentioned before, to provide this necessary reverberation. (See page 57)

From the following calculations, certain amounts of acoustical materials are required for both the main lobby and the coupled space to achieve satisfactory conditions in the hotel lobby.

Acoustical Study in Lobby Space of a Resort Hotel

Main Space:

$Vm = 53,500^{cu.ft.}$

$Sm = 14,000^{sq.ft.}$

$$t = \frac{0.5 \times V}{S(-2.30\log_{10}\frac{1-\bar{a}}{})}$$

A. Required Absorption

	125 cycles	500 cycles	2,000 cycles
Optimum reverberation time in sec.	0.9	0.6	0.6
$-2.3 \log_{10}(1-\bar{a})$	0.215	0.324	0.324
$\bar{a}$	0.193	0.275	0.275
Total sq.ft. units of absorption required = S	2,700	3,850	3,850

B. Absorption Furnished by Surfaces, Chair & People

Absorptive Material	125 Cycles		500 Cycles		2,000 Cycles	
	Abs. Coef.	Abs., in sq.ft. units	Abs. Coef.	Abs., in sq.ft. units	Abs. Coef.	Abs.,in sq.ft. units
Hyperbolic Paraboloid Concrete Unpainted Roof 3,240 sq.ft.	0.1	324	0.2	648	0.2	648
Ceiling 1,100 sq.ft. 1/2in. Gypsum Board on studs	0.29	325	0.06		0.04	44
Glass 1540 sq.ft.	0.18	280	0.04	61	0.02	30
Cork Floor 3,880 sq.ft.	0.04	158	0.05	194	0.07	272
Brick wall 400 sq.ft.	0.02	8	0.03	12	0.05	20
Pierced Brick Wall 1,800 sq.ft.	0.4	720	0.85	1525	0.65	1,170
Wood Wainscot (Slat) 1,500 sq.ft.	0.3	450	0.9	1,350	0.8	1,200
Beam, Col. (Concrete) 540 sq.ft.	0.1	54	0.2	108	0.2	108
People in Seat 10	3.2	32	3.8	38	4.5	45
People 20	3.0	60	4.5	90	5.0	100
Empty Seat 15	2.5	37	3.2	48	3.5	53
Air--per 1,000 cu.ft.	--	--	--	--	2.3	130
Total		2,440		4,140		3,820

Checking Reverberation Time in Main Space

I. 125 Cycles.

$$\bar{\alpha} = \frac{2,440}{14,000} = 0.174$$

Assume $-2.30 \log_{10}(1-\bar{\alpha}) = X$

$X = 0.192$

$$t = \frac{0.5 \times 53,500}{14,000 \times 0.192} = 0.99$$

$0.99 = 0.99 > 0.81$ O. K. (error within 10%)

II. 500 Cycles.

$$\bar{\alpha} = \frac{4,140}{14,000} = 0.296$$

$X = 0.351$

$$t = \frac{0.5 \times 53,500}{14,000 \times 0.351} = 0.55$$

$0.66 > 0.55 > 0.54$ O. K.

III. 2,000 Cycles.

$$\bar{\alpha} = \frac{3,820}{14,000} = 0.271$$

$X = 0.315$

$$t = \frac{0.5 \times 53,500}{14,000 \times 0.315} = 0.61$$

$0.66 > 0.61 > 0.54$ O. K.

Coupled Space:

Vc = 6,800 cu.ft.

Sc = 2,800 sq.ft.

$$t = \frac{0.5 \times V}{S(-2.30 \log_{10} \frac{1-\bar{\alpha}}{\quad})}$$

A. Required Absorption

Optimum reverberation time in sec.	125 cycles 0.9	500 cycles 0.6	2,000 cycles 0.6
$-2.30 \log_{10}(1-\bar{\alpha})$	0.135	0.202	0.202
$\bar{\alpha}$	0.127	0.218	0.218
Total sq.ft. units of absorption required S	360	510	510

B. Absorption Furnished by Surfaces, Chair & People

Absorptive Material	125 Cycles		500 Cycles		2,000 Cycles	
	Abs. Coef.	Abs., in sq.ft. units	Abs. Coef.	Abs., in sq.ft. units	Abs. Coef.	Abs., in sq.ft. units
Ceiling 970 sq.ft. (plaster on metal lath)	0.15	146	0.06	58	0.04	38.8
Carpet. unlined 720 sq.ft.	0.08	57.6	0.15	108	0.25	180
Wood Wainscot (Slats) 120 sq.ft.	0.3	36	0.9	308	0.8	96
Water 250 sq.ft.	0.01	2.5	0.01	2.5	0.02	5
Pierced Brick Wall 100 sq.ft.	0.4	72	0.85	153	0.65	117
Marble 160 sq.ft.	0.01	1.6	0.01	1.6	0.01	1.6
Mosaic 150 sq.ft.	0.01	1.5	0.01	1.5	0.01	1.5
Glass 150 sq.ft.	0.18	26	0.04	6	0.02	3
Door 90 sq.ft.	0.1	9	0.05	4.5	0.04	3.6
People 5	3.0	15	4.5	22.5	5.0	25
People in seat 5	3.2	16	3.8	19	4.5	22.5
Empty seat 5	2.5	12.5	3.2	16	3.5	17.5
Air-per 1,000 cu.ft.	--	--	--	--	2.3	15.6
Total		390.7		500.6		536.9

Checking Reverberation Time in Coupled Space

I. 125 Cycles.

$$t = \frac{0.5 \times 6,800}{2,800(-2.30 \log_{10} \frac{1-\bar{\alpha}}{})}$$

$$\bar{\alpha} = \frac{390.7}{2,800} = 0.139$$

Assume $-2.30 \log_{10} (1-\bar{\alpha}) = X$

$X = 0.15$

$t = 0.815$

$0.99 > 0.815 > 0.81$ O. K.

II. 500 Cycles.

$$\bar{\alpha} = \frac{500.6}{2,800} = 0.181$$

$X = 0.210$

$t = 0.60$

$0.66 > 0.60 > 0.54$ O. K.

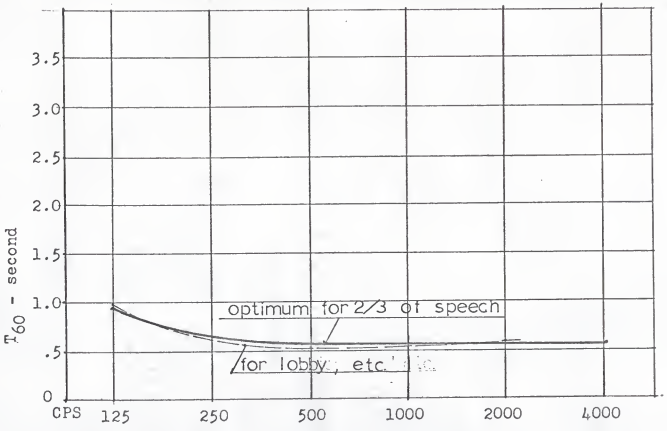
III. 2,000 Cycles.

$$\bar{\alpha} = \frac{536.9}{2,800} = 0.191$$

$X = 0.212$

$t = 0.57$

$0.66 > 0.57 > 0.54$ O. K.



OPTIMUM T_{60} CURVES RE: FREQUENCY

FOR VOLUME =53,500 cu. ft.

HOTEL LOBBY

II. Structure

The rapid growth of interest in one of the newest forms of shell roof construction--the hyperbolic paraboloid--is due largely to its economical use of construction materials, the simplicity of its structural action and to its inherent beauty.

The hyperbolic paraboloid is one of the types of constructions that utilize efficient use of materials by relying on form or shape for strength rather than on mass. Double curvature enables loads to be transferred to supports entirely by direct forces so that all material in the crosssection of the shell is uniformly stressed.

Although intricacies of mathematics obscured and analysis of hyperbolic paraboloids for many years, it will be shown that the underlying statical principles are not difficult to understand or to apply and that the design can be handled as easily as the design of many other types of structures.

Economy in the construction and design of hyperbolic paraboloids allows the architect to depart from the conventional practice of forcing all structures to conform to networks of linear members confined to three perpendicular planes and to make imaginative use of the many graceful shapes that may be developed.

Because of the several reasons mentioned above, all of the recreational facilities will use this structure system.

A variety of roof forms is developed either by use of entire warped surface or combining parts in varies ways. The procedure gives the building certain characteristics that carry through the whole design.

Because of the difference between the living quarters and recreational facilities, the hyperbolic paraboloid is not quite suitable for hotel and apartments, especially for high-rise buildings. This is why the most common and simple structure system--the beam, column, and bearing wall--is used for living quarters.

III. Air-conditioning

It is now well established that air-conditioning is a necessity for human comfort and efficiency, for the proper operation of hospitals, offices, stores, hotels, theaters, and residences and for the successful processing and production of a good quality of manufactured goods. For this reason, the Summer Resort of Shih-men will provide air-conditioning in most of the buildings. Lying in the subtropic zone, this resort area has a mild climate all around the year. Heating is not necessary for the Summer Resort, but air-conditioning is extremely important. The significant elements consist of cooling, dehumidifying, cleaning and circulating air.

The need of air-conditioning arises from the initial temperature and humidity of the air together with the heat,

moisture, and contamination produced by artificial lights, machinery, industrial processes, and occupants. In order to secure comfort, heat, and efficienty, an effort is made to balance the heat losses of the human body and to improve the quality and movement of the air rather than to increase its quantity. Temperature, humidity, and air motion are of nearly equal importance in inducing comfort.

In summer, outdoor air in Taiwan contains more moisture than it does in winter. Comfort in hot weather is much increased by cooling the air and reducing its moisture content. However, a limit should be set upon the difference in temperature between inside and outside air since too great a drop produces an unpleasant shock and sense of chilliness when one enters a room. In summer the relative humidity of outdoor air averages higher than it does in winter, and comfort in hot weather often requires a reduction in air vapor quite as much as a decrease in temperature. Cooling and dehumidifying are accomplished by passing the air through a spray of cold water or over refrigerating coils which reduce the temperature sufficiently to condense out some of the moisture. For cooling and dehumidifying, coils are common instead of water sprays, or they may be combined with water sprays, depending upon the requirements and economics involved. Water sprays are generally designed to produce complete saturation of the air and can be easily controlled for dew-point temperature by a duct thermostat. They also

produce a degree of air cleaning and odor absorption. Coils, on the other hand, provide a simple closed water circuit without pumps and water level controls but are not quite as efficient. Cooled water is usually circulated in the coil. Sometimes a simplification is obtained with direct expansion coils in which the refrigerant itself is expanded into the coil directly from the refrigeration machine. In case of leakage these coils are dangerous and hence are not often used in comfort conditioning. When they are combined in use with spray water the coils are installed in the spray chamber.

That a gentle movement of air produces a refreshing and stimulating effect is a phenomenon that has always been recognized. The movement should not be so violent as to cause draughts but should be at a sufficient rate to preclude stagnant air, which is always depressing. Air may contain large quantities of dust, cinders, soot, smoke, fumes, pollen, grit, bacteria, and odors which when breathed induce discomfort and disease. Air motion and air clearing are also two important procedures in air-conditioning.

The net indoor heat gain through glass involves differing phenomena in the radiation and transmission of heat as received directly from the sun and as received from outdoor convection and radiation. The cost in air-conditioning may be reduced by opening the windows and doors in the south and north directions instead of opening them in west and east

directions in order to avoid heat radiation and transmission directly from the sun. Window shades, venetian blinds, and similar devices keep the sun's rays out and reduce solar radiation. Heat can be reduced by trees and grass; hence trees and grass should be raised not only for landscape but also for reducing the cost in air-conditioning.

Two of the air-conditioning systems that will be used in most of the buildings in this project will be equipped with both central air duct system and the chilled water system. The activity facilities and the lower parts of the hotel and high-rise apartments, which are public spaces, are air-conditioned by the duct system. Several advantages which will be gained are listed below:

1. Low initial cost.
2. Cooling, dehumidifing and ventilation air clearing combined together as a simple unit.
3. An electric heater that provides closed control of humidity as well as winter heating.
4. Evenly distributed room air temperature and humidity can be achieved by proper layout of the duct system, air supply and return grill diffuser.

The chilled water system is quite satisfactory for high-rise buildings. Duct space can be saved, especially for high-rise buildings. The fan coil units can also be controlled easily in each room to meet the different requirements. This system will be provided for guest rooms in hotel and high-rise apartments.

IV. Lighting

Lighting plays a very important role in architecture, it relates to architecture and is architecture, in two ways: first, in the kind and quality of light produced and in how this illuminates the space to reveal the contours and character of the building; secondly, in the design of the light sources themselves and in their integration with the architecture as design elements. The lighting system should work in harmony with and not in opposition to or independent of the architecture.

Two kinds of lighting are included here--natural and artificial lighting. Both are important and should be throughly used.

A. Natural light.

Advantages:

1. Natural light is free.
2. It has psychological advantages.
3. The appearance of objects and spaces under good day lighting conditions are seen in a clarity of form difficult to obtain by artificial means.

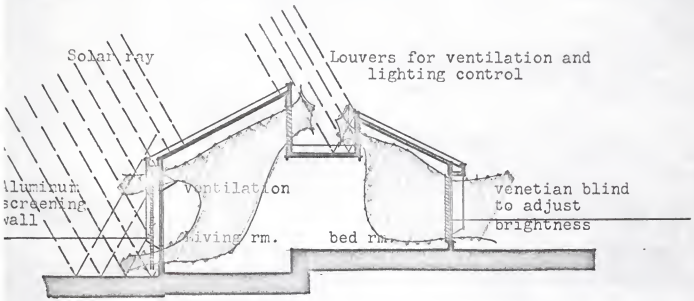
The advantages of day lighting are qualitative, and therefore less easy to enumerate than the disadvantages. They are based upon man's deep-rooted love of the natural environment; on his desire for change and variety during the working day, and on his search for spatial unity; the very intangibility of these bases suggests that it is difficult to estimate

their importance.

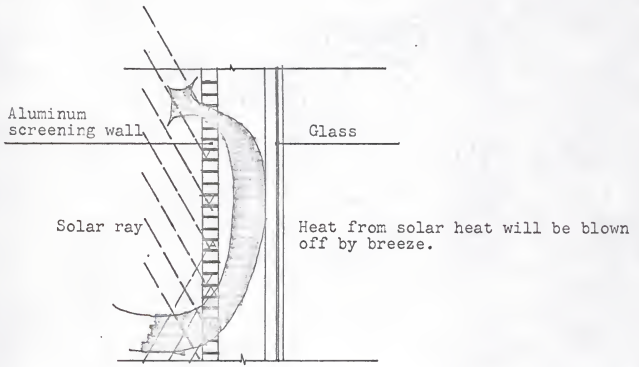
The living quarters of this resort area are to be provided for tourists not only as a place to stay for over night, but also as a place to enjoy nature. Therefore, the treatment of the natural light becomes very important. Several arrangements are carefully considered for the hotel, high-rise and low-rise apartments concerning elimination of the sun glare and to provide adaptable brightness for living and bed rooms.

Zigzag plans are designed for hotel and high-rise apartments not only for adapting the contour but also for taking advantage of natural light. The space north and south of the buildings is entirely open. Balconies in front of the rooms, eliminate the glare. The balcony actually works like a canopy keeping the solar rays out of the room. (See pages 47, 48, 55, 56)

The following sketch shows the special arrangements needed for low-rise apartments. A higher ceiling in a living room admits more natural light than that of the bedroom does. The louvers and aluminum screening wall in livingroom block the solar rays from outside; thus a soft and comfortable atmosphere can be obtained. Louvers and venetian blinds are provided in bedrooms, so that the brightness of the lights can be adjusted. In addition, good ventilation is obtained at the same time. Meanwhile, how to have the minimum solar heat from such a large glass area in livingroom presents a



TYPICAL LOW-RISE APARTMENT SECTION



ALUMINUN SCREENING WALL

serious problem, especially when no air-conditioning is to be provided. How the aluminun screening wall and breeze is shown on the next page will solve the problem.

B. Artificial lighting

William M. C. Lam said, "We also feel that the initiative must come from the architect. Only he can assume the responsibility for the building as a whole--for the lighting no less than for the structure or the space itself. If he knows the principles of lighting well enough to clearly define his lighting objectives in the context of the total building concept, and to clearly convey them to the engineer who will execute them, he need not be cowed by the dicta of the hand books."[1] Only the ways and principles concerning how to light the resort area to give enough light, how to increase mood and atmosphere, how to complement the structure and how to midify the appearance of a space, are going to be discussed here, not the calculations. Engineers will take care of that detail not the architects.

Two lighting systems--general and supplementary--are to be used for the interior. The general system supplies uniform illumination in the area; supplementary lighting supplies illumination of a specific nature, color, or distribution, usually to satisfy a local, specific requirement.

Offices, toilets, laundry, storage rooms, lobby areas, kitchens, locker rooms, mechanical rooms, work shops, barber

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[1]William M.C. Lam. Lighting for Architecture, reprinted from "Architectural Record," F.W. Dodge Corporation, 1961.

and beauty shops, and other areas are illuminated by general lighting system. Only a little supplementary lighting is provided in these rooms. Show windows of these shops are well lit by supplementary lighting.

The majority of the buildings, both living quarters and recreational facilities will be provided with a supplementary lighting system. General lighting is used as a complementary lighting system. As a matter of fact, the combination of general and supplementary lighting illuminates the interior spaces of the buildings. The only difference is which is to be used as a complemental lighting system. Two examples are given below:

1. As mentioned above, the lighting in the lobby is obtained by use of the general lighting system which is the main system, but supplementary lighting has to be used for the counter to supply the need of a different function and to supply a higher level of brightness. (See page 57)

2. Supplementary lighting is used as a main lighting system in the dining area of the restaurant to create special moods and atmosphere which are desirable. Meanwhile, the uniform illumination used on the ceiling, is served by the general system, which makes the total space as a whole feel and appear much more harmonic.

Lighting to complement structure is the other function of light. The main structural system used for recreational facilities is hyperbolic paraboloid, which involves an

interesting use of structure and which is very important in the design concept. The designer plans to enlist light to define and reinforce structure, by silhouetting major structural members or by washing their surfaces with light.

The indirect light placed at the neck of the columns highly emphasizes the ribs of the hyperbolic paraboloid by gradual varied intensity of light--the lower in the brighter, the higher in the darker. (See page 58)

Most architects today still design only for daylight, although there is an increasing awareness of the importance of lighting architecture at night. During the night, the entire building might become a lantern and function as a dramatic focus for its entire surroundings. The silhouette of the main structure members of the hyperbolic paraboloid and the lighted ceiling can be seen through the high windows from outside, so that the structure system can be evident even during nighttime.

The floodlighting and street lighting are designed for the night scenery and traffic convenience. The flood lighting is widely proposed for the basketball courts, the tennis courts, the playlots, the marine activities, and so on. The other important or even more important effect of the flood-lighting is for illumination of the buildings. A reflection of light from the walls of each building gives the resort area a wonderful scenic beauty at night. Street lighting is provided along the road by use of alternate spacing.

RESORT COMPLEX

by

STEPHEN K. H. LI
B.S., Tunghoi University, 1964

A MASTER'S THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE

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MASTER OF ARCHITECTURE

College of Architecture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

Approved by:

T. A. CHADWICK
Major Professor

SHIHMEN RESERVOIR S:1/20,000 N

RESORT COMPLEX

N

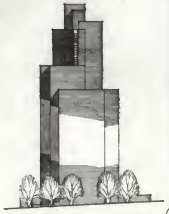
SITE PLAN 1"=150'

RESORT COMPLEX

PERSPECTIVE

HIGH-RISE APARTMENT

HIGH-RISE APARTMENT



EAST ELEVATION

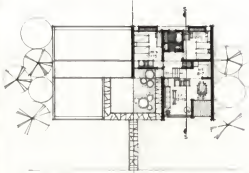
NORTH ELEVATION

SOUTH ELEVATION

WEST ELEVATION

LOW-RISE APARTMENT

2-BD.



ROOF PLAN FLOOR PLAN

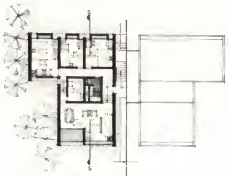
SOUTH ELEVATION

WEST ELEVATION

SECTION S-S

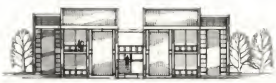
LOW-RISE APARTMENT

3-BD.

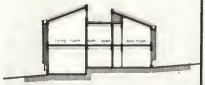


FLOOR PLAN ROOF PLAN

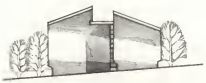
SCALE 1/8"=1'



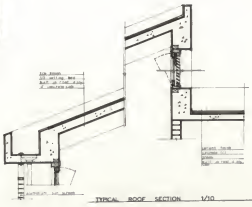
SOUTH ELEVATION



SECTION S-S

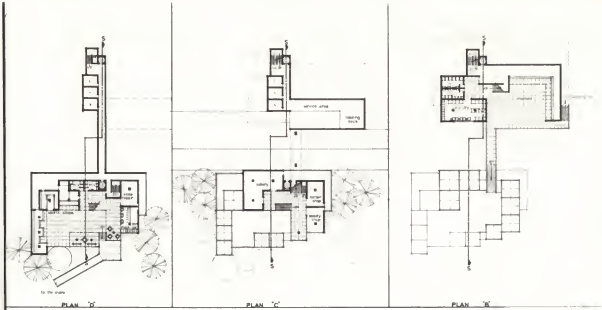


EAST ELEVATION

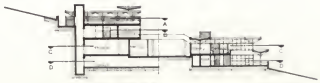


TYPICAL ROOF SECTION 1/10

SHOPPING CENTER

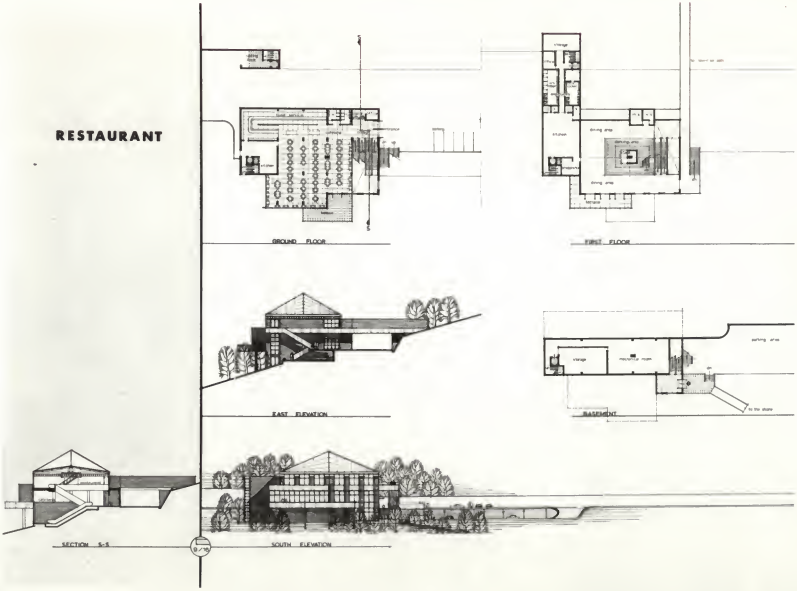



SOUTH ELEVATION

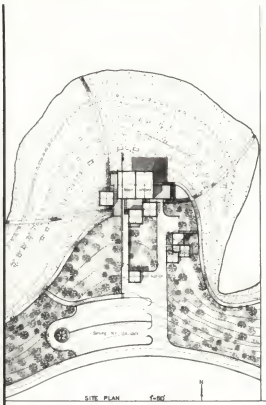

SECTION S-S


PLAN "K"

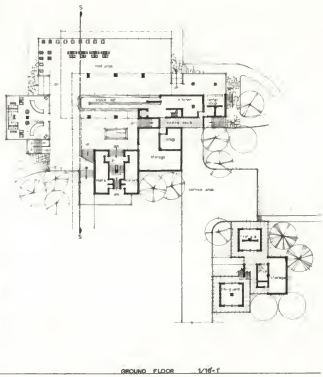
RESTAURANT


GROUND FLOOR
FIRST FLOOR
EAST ELEVATION
BASEMENT
SECTION S-S
SOUTH ELEVATION

BEACH COMPLEX



SITE PLAN 1"=80'

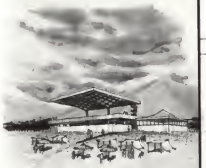


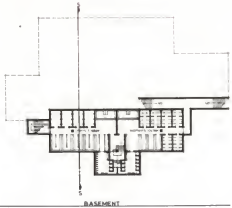
GROUND FLOOR 1/16"=1'

SECTION S-S

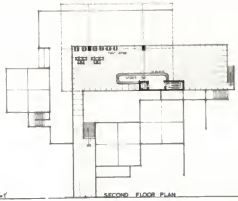
NORTH ELEVATION 1/16"=1'

BEACH COMPLEX



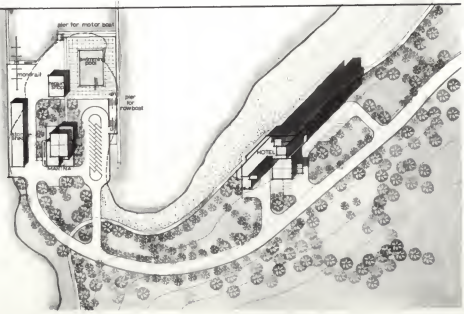


BASEMENT

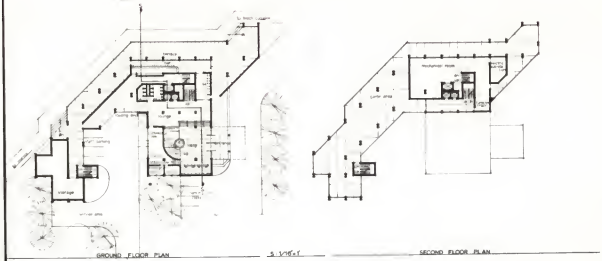


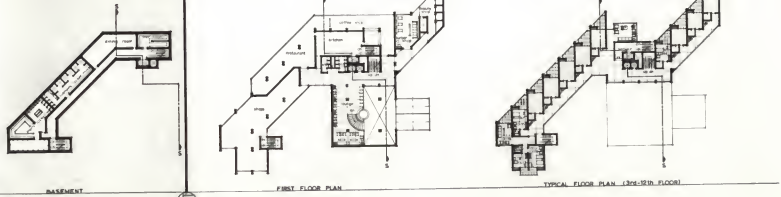
SECOND FLOOR PLAN

MARINA AND HOTEL
SITE PLAN

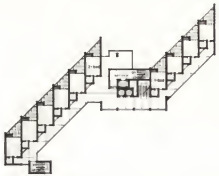


HOTEL


GROUND FLOOR PLAN
SECOND FLOOR PLAN


BASEMENT
FIRST FLOOR PLAN
TYPICAL FLOOR PLAN (3RD-12TH FLOOR)

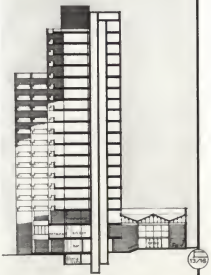
HOTEL



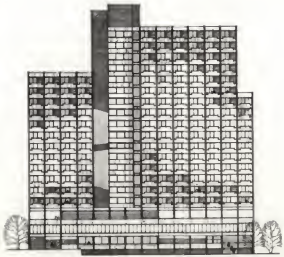
13-34th FLOOR PLAN

1:1/16"

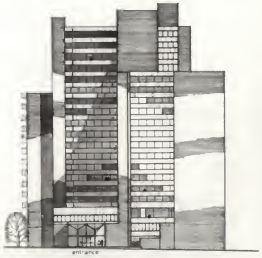
19th-18th FLOOR PLAN



SECTION S-S

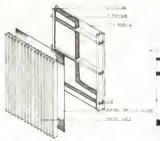


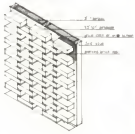
NORTH ELEVATION (beach view)



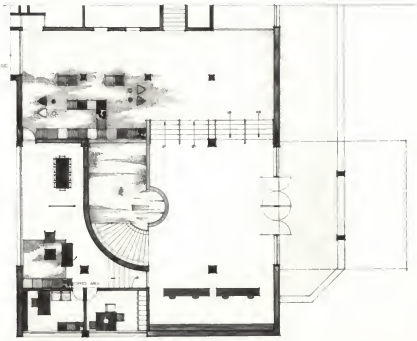
EAST ELEVATION

INTERIOR DESIGN
FOR
HOTEL LOBBY

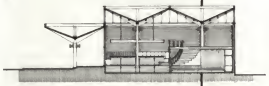




ACOUSTICAL ABSORBER

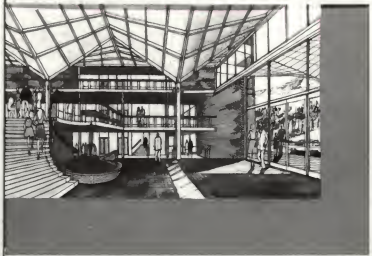


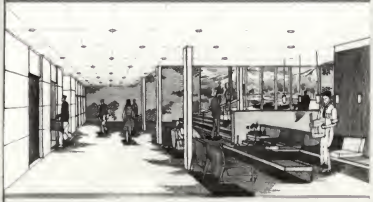
PLAN



SECTION S-S 1/8"-1'

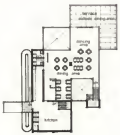
LOBBY DESIGN
FOR
HOTEL





MARINA


to pool
GROUND FLOOR PLAN


FIRST FLOOR PLAN


SOUTH ELEVATION


EAST ELEVATION


SECTION S-S

CONCLUSION

This thesis is the study of a summer resort area in Shih-men. Recreation and enjoyment for the local citizens as well as foreign tourists, are the goals of the project. The designer has tried to use his ability to understand the natural advantages of the site, the character of the people and their needs, plus his own ideas and imagination in seeking a solution that will provide a pleasing architectural and natural environment.

ACKNOWLEDGEMENT

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BIBLIOGRAPHY

Abraben, E., Resort Hotel, Reinhold Pub. Co., N. Y., 1965.

Architectural Record, Motels, Hotels, Restaurants and Bars, F.W. Dodge Corporation, 1960.

Butler, George D., Recreation Areas, The Ronald Press Company, N. Y. second edition.

Campbell, William Giles, Form and Stype in Thesis Writing, Boston, Houghton Mifflin Co.

Chaney, C. A., Marinas, New York, 1961.

Gibberd, Frederick & F. R. S. Yorke, Apartment Building Design, New York, 1958.

Harttrett and Partners, Hotel, Restaurant, Bars, Reinhold Pub. Co., N. Y., 1962.

Knudsen, Vern O. and Cynil M. Harris, Acoustical Designing in Architecture, John Wiley & Sons, Inc., New York, London, Sydney, Eighth Printing, 1965.

Kohler and Luckhardt, Lighting in Architecture, Reinhold Pub. Co., N. Y., 1959.

Lam, William M. C., Lighting for Architecture, reprinted from "Architectural Record", F. W. Dodge Corporation 1960.

Larson, Lesile, Lighting and its Design, Whitney Library of Design, N. Y. 1964.

Phillips, Derek, Lighting in Architecture Design, McGraw-Hill, N. Y. 1964.

Portland Cement Association, Elementary Analysis of Hyperbolic Paraboloid Shells, Chicago, Illinois, 1960.

Smith & Loveless (One of the union tank car companies) Sewage Treatment Equipment, Lenexa, Kansas.

Steel, Ernest W., Water Supply and Sewage, N. Y., 1960.

Taber, Colin, The Shell Builder, Reinhold Pub. Co., N. Y., 1963.

Threlkeld, James L., Thermal Environmental Engineering, Prentice-Hall, Inc., Englewood Cliff, N.J., 1962.

Zeni, Bruno, Architecture as Space, Horizon Press, N.Y., 1957.

RESORT COMPLEX, SHIHMEN RESERVOIR, TAIWAN

by

STEPHEN K. H. LI

B. S., Tunghai University, Taiwan, 1964

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARCHITECTURE

College of Architecture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

This thesis is the study of a combination of recreational facilities and living quarters at Shih-men Reservoir, which is located 40 miles south from Taipei, the Capital city of Taiwan. Recreation and enjoyment for the local inhabitants, visitors, as well as the foreign tourists, is the goal of the project.

The two divisions of the problem are first the recreational facilities and secondly the living quarters. The study of the project leads the author to recommend a trilateral type plot plan for the design.

The living quarters contain a hotel and apartments (both high-rise and low-rise), ranging from 18 stories to 1 story spreading on the both sides of the bay area--Amu'ping. There will be 150 guest rooms and 170 apartments provided for accommodating about 800 tourists.

On the north side of the lake, between high-rise and low-rise apartments, the shopping center will be provided for the daily demands of the whole resort area, providing a food market, laundry, drug store, bakery, beauty shop, barber shop, shoe repair shop, snack bars, and sport shops.

The restaurant will be located at almost the center of the resort area on the north side of the lake. A cafeteria is also provided here to serve various demands.

The south side of the bay area is relatively flat, a situation good for marine activities--swimming and boating. Beach complex and marina are also located here. Like the

shopping center and the restaurant, they consist of a group or only one hyperbolic paraboloid which is poured concrete with a central column and a roof of thin shell construction. These are usually open but sometimes are enclosed or enclosable. Various spaces are created for various uses and for varied sizes of the thin shell construction.

The pedestrian walk paved with gravels, along the lake, plays a very important role in communication for this whole area. A retaining wall is provided for the walk to hold back the gush of the water from the mountains.

In summary, the designer understands that the resort complex is to serve multiple purposes. The relationships of all buildings, the landscape, the character of the land, the technology of environment, and the needs of the people as well as the problems of the architecture itself, should be thoroughly considered and resolved in order to produce a satisfactory design.