

A CULTURAL CENTER  
DESIGNED FOR  
KANSAS STATE UNIVERSITY  
MANHATTAN, KANSAS

by

MICHAEL TUNG-KEN YU

B. Arch., Chung Kung University  
Taiwan, China, 1958

---

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARCHITECTURE

Department of Architecture

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1963

Major Instructor

Frederic A. Condit

LD  
2665  
T4  
1963  
Y94  
C.2  
Document

TABLE OF CONTENTS

INTRODUCTION.....	1
GENERAL CONSIDERATION.....	3
The Site.....	3
The Department of Music.....	4
The Department of Drama.....	8
The Auditorium.....	8
The Little Theater.....	11
GENERAL CONCEPT OF DESIGN.....	12
The Education Center.....	14
The Auditorium.....	15
The Little Theater.....	16
ACOUSTIC CALCULATION.....	18
PRESENTATION.....	38
CONCLUSION.....	55
ACKNOWLEDGMENT.....	56
REFERENCE.....	57

## INTRODUCTION

According to the university statistics, the predicted enrollment of Kansas State University will increase to 12,000 students by the year 1970. To accomodate these students, it will be necessary to provide more and better facilities for studying and recreation.

So far K-State has an auditorium that has a capacity of 1,000 seats and the auditorium was built in the year of 1913. This building is constructed of limestone and wood. It is unfit for public assembly according to modern building codes. In addition, the building is too small for the present student enrollment, the old facilities are outdated and the acoustics are rather poor for the presentation of music, drama, and public speaking.

Recently the University has started planning for a new auditorium. This auditorium should at least have a capacity of one-fourth to one-fifth of the total number students enrolled in the year 1970. It will be used for multiple purposes such as assembly hall, music performances and drama presentations, also for certain incidental meetings.

The project will also include additional facilities for the Department of Music, and the Department of Drama which have the closest relation to this auditorium, so that these departments will have separate facilities for their teaching, research, and administration. This building, however, should be located near to the proposed auditorium.

The Department of Music, now, has separate offices, studios, practice rooms and classrooms in the corners of the present auditorium and Nichols gymnasium. Recently it had fifty-six musical major students and an additional 560 students who attend music classes or practices. This figure is approximately 8% of the total enrollment of the entire university. The Department also cooperates with the city of Manhattan in the presentation of different musical activities for the students and the public as well, such as concerts by well known orchestras and small scale chamber music. By 1970 this Department hopes to double its enrollment and engage in more activities, therefore, they are also anticipating the need for more space.

At present the Department of Drama is a sub-department of the Department of Speech in the College of Arts and Science. Therefore they do not have any spaces and rooms of their own. Due to the fact that the Drama Department is a very active department on the campus, (They usually present two to three plays for the student's practices each month), this department shall have a large and a small stage for this variety of needs. These stages should be built separately from the main hall containing the working shop and studios for generally practice and teaching purposes.

As mentioned above, these two departments have similar needs for classrooms, library and certain rehearsal rooms. In order to be effective and save space, it is better to house

these two departments in one single building.

Because the auditorium is too big to be used for the routine practices and experiments of these two departments, a proposed little theater is to be built which will provide for small assemblies and rehearsals. This little theater will be a great benefit to both departments, and one assumes it will be frequently used.

This cultural center will form an important feature on the campus of The Kansas State University.

#### GENERAL CONSIDERATIONS

##### THE SITE

The proposed site is located at the south-east corner of the campus, and is on the east side of the present All Faith Chapel. It is also close to the sub-community center of Aggieville as shown in the drawing. (page 40, 41)

This area is bounded on the East, South, and North respectively by Manhattan Avenue, Anderson Avenue, and Vattier Drive. According to the city's future plan, 14th Street will be connected with Vattier Drive, and Anderson Avenue will be directly connected with Blumont at 14th Street as a main traffic highway. The length of the streets along each side of the project are:

Anderson Avenue	380 ft.
Manhattan Avenue	535 ft.
Vattier Drive	440 ft.

### 14th Street Extension 595 ft.

The total area is about 390,000 sq. ft. which includes the Anderson-Bluemont road space.

The elevation is 1034 feet above sea level at the north-west corner of the site, and slope down to 1030 feet at the south-east corner, contour line about 4 feet difference.

The site is two miles away from the downtown area, going through Bluemont Avenue and through 14th Street and Poyntz Avenue. It is three blocks from the city park and one block from the Aggieville shopping center. North Manhattan Avenue is connected to State Highway 13 which also leads to Olsburg and Tuttle Creek State Park. Anderson Avenue, on the other hand, leads to Highway 24 and 40, which leads to Topeka, Lawrence and Kansas City going east, and leads to Ogden, Junction City, Abilene, and Salina going west.

## THE DEPARTMENT OF MUSIC

### A. The Room Requirements

#### 1. Rehearsal Rooms

- a. One rehearsal room, capacity for 150 persons.
- b. One band and orchestra room, capacity for 120 persons.
- c. One all purpose rehearsal room, for 100 persons.

#### 2. The Studios (practice)

- a. Piano studio.
- b. Voice and instrumental studios.
- c. Five studio-offices.
- d. Organ studio.

3. Practice Room
    - a. Small practice room.
    - b. Large practice room.
    - c. Organ practice rooms.
  4. Four class rooms
  5. Main office room
  6. Library
  7. Mechanical room
  8. Transformer room
  9. Other rooms
    - a. Poyer.
    - b. Toilets. (Gentlemen, Ladies)
    - c. Telephone booth.
    - d. Janitor.
    - e. Corridors.
    - f. Storages, thus as band storage, band uniform storage, library storage.
    - g. Locker space room for 200 persons near the practice and rehearsal rooms.
  10. Shops: Repair shops and storage
- B. The Study of the Rooms of Music Department
1. General Rehearsal Room:
    - a. Permanent stage of 3' levels above floor.
    - b. Ceiling should be 15'-0" to 18'-0" high.
    - c. A storage area (about 12' x 20') located adjacent to choral room, totally closed.

- d. Another storage room for choral library.
- e. An exit to auditorium.
- 2. Band and Orchestra Rehearsal Room
  - a. It should have a storage of about 600 sq. ft.
  - b. Moveable risers.
  - c. Recessed percussion storage.
  - d. An exit to outside or auditorium.
- 3. All Purpose Rehearsal Room. This room will be used for
  - a. Combined choral and instrumental group.
  - b. Small auditorium.
  - c. Music appreciation lecture.
  - d. Student recitals.
  - e. Wind and string classes.
  - f. Must have a stage.

General Consideration of all Rehearsal Rooms

- a. Ample storage area.
  - b. Outside exits convenient to auditorium.
  - c. Near library and repair area.
  - d. Located on the ground floor.
  - e. Higher space, about 15 feet high.
  - f. Persons should be installed in areas near the rehearsal rooms.
4. The Studios
- a. Door large enough to move in grand piano.
  - b. Built in shelves and storage.
  - c. Sound proof.
  - d. Built-in blackboard.



5. The Practice Rooms

- a. All in one area and near studio and classrooms.
- b. Sound proof.
- c. Built-in shelf.
- d. Full length mirror in each room.
- e. Suggest ceiling 9'.
- f. Locker space and locker benefit.

6. The Classrooms

- a. Ceiling 12'-0" high. (Rough low for screen)
- b. Blackboard on three sides.
- c. Back wall constructed to contain storage cabinets.

7. The main office should include:

- a. Counter and reception area.
- b. Ticket office.
- c. Closet for clothes.
- d. Rest room.

8. Storages to be used for storage of department supplies,  
and musical reproducing and for other storage use

9. Miscellaneous

The general requirements

- a. With exception of main office, no wall should be parallel with any other wall.
- b. Cooling and heating systems for whole building.
- c. All rooms should have proper acoustical treatment.
- d. Faculty rest room in addition to public rest rooms should be provided.

- e. Floor surface should be tile-covered to permit movement of heavy instruments.
- f. All rooms must be sound proof so that sound cannot be transmitted to other rooms.
- g. All office studios and classrooms should be equipped with audience spaces and chairs.

#### THE ROOMS AND SPACES OF DEPARTMENT OF DRAMA

Most rooms will be like Department of Music.

- 1. Main office.
- 2. Dean's office.
- 3. Offices.
- 4. Classroom.
- 5. Studios.
- 6. Staff Lounge.
- 7. Library.
- 8. Two rehearsal rooms.
- 9. Telephone booth and janitor's quarters.

#### THE AUDITORIUM

Front of house area:

- 1. Lobby area should have direct access to:
  - a. Audience chambers.
  - b. Ticket, show window and information booth.
  - c. Rest room.
  - d. Coat check service.
  - e. Bar and refreshment.

- f. Telephone booth (public)
2. Toilet (rest room) and facilities will be dictated by code.
3. A refreshment bar where soft drinks and coffee can be obtained.
4. Public telephone booth should be provided so the box office phone is clear for business.

The requirement of the large Auditorium Audience Chamber:

1. The treatment should be functional, comfortable, and aesthetic. The decorations should not be over-powering or ostentatious. Everything should focus on the area where the entertainment is to take place----the stage.
2. Seating: The seats should be comfortable, provide ample space for the increasing size of the human race. Adequate leg room and passage space between seats; assume the gross area (including aisles) at about seven sq. ft. per seat. A continental or modified continental arrangement of seating should be observed. Aisles at the extreme outer edges of the seating are desirable. The first row of seats is as close to the stage as possible.

#### Stage Orientation and Access

1. Direct access to front of house and stage without going through audience.
2. Outside loading dock and door (8' x 12') directly onto stage (or storage shop). Doors should be at side or side rear.

3. Direct accessibility to shop-opening size capable of taking a full size stage weapon.
4. As close to the dressing room as possible.
5. All stage control curtain, light, etc. on the same side of the stage, preferably on the right side of the stage.

#### Stage

1. Requirement of stage (proscenium).
  - a. A 48' x 28' acting area should be floored with pine and unfinished.
  - b. Above acting area should be entirely trapped by 4' x 8' removed sections.
  - c. Acting area should start at house curtain line.
  - d. Apron should be of soft wood.
2. Requirement of front stage elevator. (the orchestra pit)
  - a. At least the width of proscenium opening.
  - b. Should accomodate 40 musicians and their instruments.
  - c. Motor control worm gear.
  - d. This space sometimes can be used for:
    - i. stage extension
    - ii. extra seating
    - iii. orchestra pit
    - iiii. basement loading

#### Green room: Actors gathering area

1. Space requirement 40' x 50'.
2. Comfortable lounge furniture.
3. Small kitchenette to prepare coffee, etc.

Dressing room: Two large rooms 20' x 40' (one for ladies and one for gentlemen).

1. Dressing table, mirrors, and lights along one of 10' walls.
2. Stools for tables.
3. Near costume room and costume shop.

Small Dressing Rooms

Projection Booths

Designing for good sound control and projection.

### THE LITTLE THEATER

This proposed little theater will have an area about one fourth the size of the auditorium mentioned above and will have a seating capacity of 500 persons, except for the area of the rooms which will be similar to the ones in the auditorium. This theater being a place for the students' experimental and practice uses, the facilities of the chambers and stage must be easy to re-arrange to fit the different occasions.

In relation to the audience, the stage must be able to adapt for the following basic types:

Proscenium: The contemporary proscenium Baroque Theatre is a performing area at one end of the theater, which the audience watches through the picture frame of the proscenium arch. So the performing area and Chamber area are separated. The trouble with this form is that there is no intimate relationship between the actor and the audience.

Arena: This form has a central stage area surrounded on all sides by audience. Both audience and actor areas are in the same room. This is based on the round plan of the early amphitheater. This arrangement may have large numbers of spectators in closest proximity to the actor. But some spectators find the absence of all scenic background and the substituted wall of faces disturbing.

Apron: The pure apron theater is a combination of the axial and round plans. The main performing area projects into the audience, which surrounds three sides and permits the actor to come into intimate proximity with the spectators. Behind the performing area can be set some scenic background. So the stage area is open, no picture frame separates audience, and both are in the same room. This open stage theater was used in the old Greek and Shakespearean plays.

Caliper: One stage form which seems to be a product of the modern theater, reverses the arena concept of the audience surrounding the stage. It has a side stage, which extends out to surround the audience.

#### GENERAL CONCEPT OF DESIGN

The designer had several primary ideas in mind as a general planning consideration for the design of proposed cultural center.

These are some fundamental considerations which relate to the design:

First will be the function, which the design object can have to create the biggest effects. The two different functions are namely for the people who use the facilities for general teaching, practice, and presentation, and for the audience who attend meetings and performances. So the designer thought that the functional consideration will effect the whole planning, chiefly in two ways: First, in the relation buildings to each other and to the lot. Second, in the design of the means of communication between them.

Secondly, the acoustics is another important factor in the design. It controls the most part in this project. The acoustics not only restrict the space and shape of the design, but also determines the materials which will be used in the interior design. The acoustical effects, like acoustic image and the optimum reverberation time, will be carefully taken into consideration.

The designer thought that the project will create a place for highly cultural life, also that the design objectives are to create a spacious and serene atmosphere, which the people will enjoy. The whole composition will have some kind of unity which gives balance, harmony, continuity and climaxes. Too much unity also creates monotony. So the best features may often be emphasized through some contrast.

All of these fundamental considerations are much under the designer's control. It is also through his careful exercise of this control and play of his creative imagination that he de-

signed the cultural center's auditorium, educational center and the little theater. We will find that the precision and whiteness of the concrete forms have some kinds of unity, but also have some sharp contrast between each other. (pages 42, 43, 44)

### THE EDUCATION CENTER

The education center is the nucleus of the whole design. This Y-shaped building will be developed according to the acoustic principle which provide the best advantage for good sound characteristics. The designer used a simple column and beam structure which gives wide open floor areas. Subdivision will be made in accordance with the requirement of individual Departments and to provide flexibility and accessibility. These are the main determining factors of the design.

The main entrance, lobby, and three big rehearsal rooms which provide for a large number of uses, are located on the first floor, and the basic shape of these is designed to give the best sound effects. The stairs and the elevator are in the center of the floor for easy vertical transportation. The second floor houses the Departments' offices, class rooms, the library, and the shop. The non-parallel walls avoid the flatter. The shop which is two stories high, can be used as a place for the drama-set for both the auditorium and little theater. The practice center is in the third floor. Most practice rooms and studios are located in this floor.

The roof of this building uses fold-plate units. The



columns carry the loads to the foundation.

The concrete floor covering may be of rubber, carpet, or terrazzo tile for different places as shown in the acoustical calculation sheets. The front wall will be covered with mosaic mural, while concrete block screen wall will be constructed at the south-east and north-east side as sun breakers and as an architectural feature. (pages 44, 45, 46, 47)

#### THE AUDITORIUM

The Auditorium is the largest building in the group. This circular shaped building is divided into two parts by the cylindrical stagehouse. The front circle is the space for public audience, and the presentation space is in the smaller back circle.

The audience chamber is the center of the public service area, and surrounded by the outer ring of utility spaces, such as the lobby, lounge, rest rooms and refreshment centers.

The seating area is on a sloped floor, which is elevated for the purposes of good sight and sound wave receiver. The side walls and the ceiling are broken so that the best sound reflection and diffraction will be obtained. This diffusion was also needed to prevent the possible blur and echo from the side walls. Wood slat screens will be constructed on the side walls for the purpose of preventing blur and echo. The back wall is designed in a zig-zagged form. The back wall and side wall behind the screen is of plaster material which is necessary for

the absorption of sound.

The ventilating equipment, columns and ducts are placed in the pipe space between the walls which separates the chamber and intermission lounge, lobby.

For the purposes of circulation and intermission, the designer thought the circular intermission area etc, which surrounds the chamber, was the best answer. The space divided by the entrance lobby, lounges, which connected the inside and outside areas. The rest rooms and refreshment counter are easy to approach. The exterior walls are all made by aluminum, glass panels, and with concrete block sun screens.

The presentation space which includes the revolving stage, green room, and wagon storages is located at the back part of the theater. The large opening of the stage is adjustable, such that it may be closed or opened if the circumstances so demand. The acoustical reverbration time of this area and stage house which is the same as the auditorium was also carefully calculated. Above the green room are six dressing rooms of different sizes.

The roof of this building is of thin shell concrete slab curved upward in the outside part, and the dome is over the chamber which gives more volume to the room. The horizontal structure of stage house gives a kind of sensual delight and balance. (pages 44, 48, 49, 50, 51)

#### THE LITTLE THEATER

This round theater is different from the auditorium. It

is smaller and more efficient, and also an attractive sculptured piece among the group.

The seating area is an elliptical shape and the curvature of the walls gives a very pleasing shape. The V'd wall provides acoustical diffusion. Between the walls are the utility space for ducts and pipes. The lobby and lounge, which are on the same side, are not only a connection of the chamber, entrance, green room and the outside, but also a place for intermission use. The floor windows have nice view of the court which can be used for intermission. The landscaping and sculpture are used to enhance the space and to create more intimate close-up views of planting and surrounding areas.

The revolving stage with the elevated orchestra pit, are another special feature in this theater. This easy changeable installation may satisfy any kind of stage presentation forms as previously mentioned.

The stage and orchestra trap, dress rooms, mechanical room and some areas are located in the basement.

The thin shell roof construction gives a high light for the group design. It makes this small piece of sculpture like a bright star. The light weight concrete cap supported by columns with compression beam in the bottom and tension ring on top, contains the stage house, the light box, and plenty of room for the air-conditioning ducts. (pages 44, 52, 53, 54)

## THE ACOUSTICAL CALCULATION

Now the designer is going to calculate the optimum reverberation time for the rehearsal rooms, little theater and auditorium. In determining this optimum reverberation time versus frequency characteristic for these rooms, the designer shall assume that the room's shape and the distribution of absorptive and reflective surfaces, are such as to give proper diffusion of sound, thus proper uniformity and smoothness of decay. So that the rooms reverberation time is optimum over a large frequency scale we will calculate it for 128, 512, and 2048 cycles. The calculation in the following sheets will be based on the tables by Knudsen, in his book of Acoustical Design for Architecture, also adapted from the book of Acoustics for the Architect by Burris-Meyer & Goodfriend and Perkin's book of Acoustics Noise and Building.

### SEARCH OF ELEVATION OF AUDITORIUM FLOOR

The distance that does not need raise.

$$s = \frac{r}{h} H + r$$

where:  $s$  = the distance that does not need raise

$r$  = the distance between rows

$h$  = the raise between = 0.39'  $rr = 4.7"$

$H$  = the height of the sound source

$$s = \frac{r}{h} H + r = \frac{2.6}{0.39} \times 5.6 + 2.6 = 37.3 + 2.6 = 39.9' \pm 10'$$

The raise after 40' will use the following formula.

$$h_n = h_{n-1} + h = \frac{r(H - h_{n-1})}{s + (n-1)r}$$

where:  $n$  = the row begins 40'

$h_n$  = the raise of the row  $n$

$h$  = the dis. elev. of hearer between two rows = 4.7"

$s$  = need not elev.

$r$  = horizontal dis. between = 2.6'

$H$  = elev. of source

$h_1 = +0.03'$

$h_5 = +0.053'$

$h_{10} = +1.16'$

$h_{15} = +2.47'$

$h_{20} = +3.97'$

$h_{25} = +5.00'$

$h_{30} = +7.88'$

$h_{35} = +10.06'$

$h_{40} = +12.07'$

$h_{45} = +15.02'$

## AUDITORIUM

1. Floor	14060 sq. ft.		
2. Wall	7464 sq. ft.		
3. Ceiling	14476 sq. ft.		
4. Opening	2160 sq. ft.		
5. Surface	30156 sq. ft.		
6. Volume	392161 cu. ft.		
7. Volume/Person	196 cu. ft./p		
8. @72° F. 50% Relative Humidity			
9. Sound Amplification Needed			
10. Opt. Reverb. Time	128	512	2048
11. x $[-2.30 \log_{10}(1-\bar{\alpha})]$	$1.39 \times 1.44 = 2.00$	1.39	1.39
$t_{60} = (0.49 \times V)/SX$			
$X_1 = \frac{0.49 \times 392161}{30156 \times t_{60}}$	.252	.363	.363
$\bar{\alpha}$	.223	.304	.304
12. Total Abs. Area Req.	0510	11599	11599
13.	$S_{\bar{\alpha}}$		

	Materials	Area	Coef.	Area	Coef.	Area	Coef.	Area
14.	Materials							
15.	Unupholstered Chair 2000 x 1/3	666	.3	199.0	.3	199.0	.3	199.8
16.	Auditors in Unupholstered Chair 3000 x 2/3	1334	.2	2668	.3	4002	.35	4667
17.	Air at 75% relative humidity	V = 392161					0.0005	196.00
18.	Orchestra Player	60	4	240	5.5	330	8	480
19.	Ceiling Plaster. Sand Finish on Metal Lath	14476	0.04	576	0.06	868	0.04	576
20.	Proscenium Opening	2126	.3	648	.4	864	.5	1080
21.	Wall Wainscot 5' high, Pine	2430	.1	243	.1	243	.08	194
	Pine Louver (3006)/2	1953	.1	195.3	.1	159.3	.08	156.3
	Absorb-A-Tone Type IV-A Wall	3906	.53	2304.5	.90	3515.4	.75	2924.2
	Back Wall Panel of 1/8" Hardboard	928	.9	825.2	.25	232	.1	92.8
22.	Carpet Cardinal Batala. on con. 7/16"	2740	.12	328	.28	767.2	.21	575
23.	Floor Linoleum on concrete	11323	.02	226.4	.03	339	.04	453

24.	Door & Casing	588	.07	41.1	.07	41.1
25.	Total Abs. Area			8495.3		11635.2
26.	Check					
	$\bar{x} = S\bar{\sigma}/S$			.2222		.304
	$x = -2.3 \log_{10}(1-d)$			.2521		.3632
	$t_{60}$		1.99		1.388	1.387
	% of error		0.05%		0.014%	0.021%



AUDITORIUM STAGE HOUSE

[illegible]

13.	Side Wall Plywood	1482	.1	148	.1	148	.02	118.5
14.	Door & Casing	238	.3	71.4	.1	23.8	.1	23.8
15.	Opening	2160	.3	648	.4	864	.5	1060
16.	Drum Set Printed Canvas Set 3000 sq ft	1070 yd	.14	150	.55	588	.70	749
17.	Total Act. Abs. Area	(10)+(11) +((...)+(16)		2064.9		2253.9		2450
18.	Additional Req.			1276		2245.1		2049
19.	Use Fiberglass TW-F Wool 2" on Wall		.55-0.01 .54	1276 0.54 =2360	.99-.02 .97	2245.1 .97 =2320	.91-.02 0.86 =2300	2049 0.86 =2300
20.	Average Req. Area (2360+2320+2300) = 2327	Use 2330						
21.	Add'l Abs. Area	2330	.54	1259	.97	2260	.89	2065
22.	Total Abs. Area			3323.9		4513.9		4515
23.	New Reb. Time $\bar{x} =$		(3323.9)/15338 .2230	(4513.9)/15338 .294			4515/15338 .2941	

	x $t_{60}$			
24. Error %		$.2530$ $1.992$ $(2.00 - 1.99^2) / 2.00\%$ $= 0.04\%$ O.K.	$.3400$ $1.441$ $(1.39 - 1.44) / 1.39 \cdot 100\%$ $= 0.36\%$ O.K.	$.3402$ $1.440$ $(1.39 - 1.44) / 1.39 \times 100\%$ $= 0.359\%$ O.K.

# REHEARSAL RM.

150 Persons

1.	Floor					1264 sq. ft.
2.	Walls					1804 sq. ft.
3.	Ceiling					1574 sq. ft.
4.	Surface	(1)+(2)+(3) = S				4642 sq. ft.
5.	Volume					18240 cu. ft.
		128		512		2048
6.	Opt. Reverb. Time	$t_{60}$		1.25		1.25
7.	$x = (0.045V)/St_{60}$	-2.3 log(1- $\bar{x}$ )		.154		.154
8.	$\bar{x} =$			.142		.142
9.	$S \bar{x}$	478		656		656
Materials		Area	Abs. Coef.	Abs. Area	Abs. Coef.	Abs. Area
10.	Unupholstered Chair 150 x 1/3= 50	50	.3	15	.3	15
11.	Auditors in Unuphol- stered Chair 150 x 2/3=100		2.5	250	3.5	400

12.	Stage Floor Pine	324	.1	32.4	.1	32.4	.08	25.9
13.	Door & Casing	88	.07	6.1	.07	6.1	.07	6.1
14.	Floor Linoleum	960	.02	19.2	.03	28.8	.04	38.4
15.	Wall Plaster, Sand Finish	1236	.04	49.4	.06	64.1	.04	49.4
16.	Ceiling Plaster on Metal	1574	.04	62.9	.06	94.4	.06	94.4
17.	Back Wall Danish Acoustical Materials STFI	480	.13	62.5	.15	72.1	.09	43.2
18.	Total Act. Abs. Area			497.5		662.9		672.4
19.	Check Absorption $\bar{\alpha}$ $\bar{x}$ $t_{60}$		.107 .112 1.72		.141 .153 1.26		.145 .157 1.23	
20.	Try Error %		(1.77-1.72)/1.77 x100% =0.70%		(1.25-1.26)/1.25 x100% =0.00%		(1.25-1.23)/1.25 x100% = .16%	
							All The Errors Are Allowable.	

BAND REHEARSAL

120 Persons

1.	Wall					1959 sq. ft.
2.	Floor					1264 sq. ft.
3.	Ceiling					1318 sq. ft.
4.	Volume	V				16172 cu. ft.
5.	Surface	S				4541
			120	512	2048	
6.	$t_{60}$		1.74	1.23	1.23	
7.	$x$		1.00	.142	.142	
8.	$\bar{x}$		.095	.132	.132	
9.	$S^2$		431.3	599.4	599.4	
			Abs.	Abs.	Abs.	
10.	Materials	Area	Coef.	Area	Coef.	Area
11.	Stage Floor Pine	270	.1	27	.00	21.6
12.	Door & Casing Wood Doors	80	.07	6.1	.07	6.1

13.	Ceiling Plaster, Sand Finish on Metal	1310	.04	56.7	.06	84	.04	56.7
14.	Wall Plaster	1871	.04	74.8	.06	112.2	.04	74.8
15.	Floor Carpet	1094	.04	43.7	.04	43.7	.04	43.7
16.	Chairs Unoccupied 120x1/3 = 40	2	80	3	120	3	120	
17.	Persons With Chair 120x2/3 = 80	2	160	3	240	3.5	280	
18.	Total Act. Area		420.3		633.0		602.9	
19.	Check $\bar{x} = S\# / S$ $x =$ $t_{60} =$ Errors %		.0945 .059 1.764 (1.77-1.764)/1.77 x100% = 0.33%		.139 .15 1.16 (1.23-1.16)/1.23 x100% = 5.7%		.1321 .1415 1.232 1.23-1.267/1.23 x100% = 0.16%	

REHEARSAL ROOM  
Education Center

1.	Floor Area	(7540' Stage)					3949 sq. ft.
2.	Walls						3398 sq. ft.
3.	Ceiling						4192 sq. ft.
4.	Surface (1)+(2)+(3)	S					11536 sq. ft.
5.	Volume						79890 cu. ft.
6.	Volume/Person = 79890/450						177 c.f./p.
7.	Opt. Reverb. Time	$t_{60}$	128	512		2048	
8.	$t_{60} = (0.049xV)/S[-2.30 \log_{10}(1-\bar{\alpha})]$ $x = (0.049xV)/S t_{60}$		$1.44 \times 1.41 = 2.02$	1.41		1.41	
9.	$\bar{\alpha}$		.175	.241		.241	
			.161	.214		.214	
10.	Total Sq. Ft. Abs. Area Req. $S \bar{\alpha}$		1860	2470		2470	
11.	Materials	Area	Abs. Coef.	Abs. Area	Abs. Coef.	Abs. Area	
	Unoccupied Seats 450 x 1/3	150	2.0	300	3.0	450	450



12.	Occupied Seats 450 x 2/3	300	2.5	750	3.0	900	3.5	1050
13.	Carpet in Aisle	937	.1	93.9	.25	234	.3	286
14.	Rubber Flooring on Concrete Floor	2506	.02	50.1	.1	250	.1	250
15.	Stage Floor Oregon Pine	504	.09	45.36	.06	40.32	.1	50.4
16.	Wall Plywood 5/16"	2342	.11	257.1	.12	281.0	.10	234.2
17.	Door & Casing	196	.3	58.8	.1	19.6	.1	19.6
18.	Ceiling, Plaster	3556	.04	142.2	.06	213.3	.04	142.2
19.	Ceiling on Stage Plasterboard Suspended with Large Air Space	634	.2	126.8	.1	63.4	.04	25.36
20.	Miscellaneous (Light, Piano, Etc.)							
21.	Total Abs. Surface			1844.3		2480.6		2537.8
22.	% Error of Reverberation  = (Act. Abs. Units)/(Total S)  $x = [-2.30 \log_{10}(1-x)]$ $t_{60} = \frac{0.04CV}{Sx}$		$\frac{1844.3}{11536}$ =.1599			$\frac{2480.6}{11536}$ =.215		$\frac{2537.8}{11536}$ =.22
			0.174			0.242		0.240
			1.95			1.403		1.37

% Error	$\frac{(2.02-1.95)}{2.02}$ <p>3.46%</p>	$\frac{(1.41-1.403)}{1.41}$ <p>0.5%</p>	$\frac{(1.41-1.37)}{1.41}$ <p>2.05%</p>
---------	---	---	---

# LITTLE THEATRE

1.	Floor					3700 sq. ft.
2.	Wall					4816 sq. ft.
3.	Ceiling					4449 sq. ft.
4.	Surface	(1)+(2)+(3)	(S)			12945 sq. ft.
5.	Volume		(V)			85268 cu. ft.
				128	512	2048
6.	Opt. Reverb. Time	$t_{60}$			1.42	1.42
7.	$x = -2.3 \log_{10}(1-\bar{\alpha})$			1.42x1.42 = 2.01		
8.	$\bar{\alpha}$			.160	.227	.227
				.147	.202	.202
9.	Total Abs. Area Req.	$S \bar{\alpha}$		1905	2670	2670
	Materials			Abs. Coef.	Abs. Area	Abs. Area
10.	Unupholstered Chair 540 x 1/3 = 180			.3	54	54
11.	Auditors in Unupholstered Chair 540 x 2/3 = 360			2.9	104.8	1656
12.	Proscenium Opening	1332		.3	399.6	666

13.	Doors & Casing	168	.3	50.4	.1	16.8	.1	16.8
14.	Wall Concrete Block Painted	3316	.01	33.1	.01	33.1	.02	66.2
15.	Floor Carpet, Rubber on Concrete	3780	.04	151	.00	302.4	.03	113.4
16.	Ceiling Plaster Lime Sand Finish, on Metal Lath 3/4"	4449	.04	177.9	.06	266.9	.04	177.9
17.	Total Abs. Area			1914.0		2726.0		2705.9
18.	Check $\bar{x}$ $x = -2.3 \log_{10}(1-\bar{\alpha})$ $t_{60} =$ Error		.1478 .165 1.96 $\frac{2.01-1.96}{2.01}$ $\times 100\%$ $= 2.49\%$	.210 .236 1.37 $\frac{1.42-1.37}{1.42}$ $\times 100\%$ $= 3.52\%$	.208 .233 1.385 $\frac{1.42-1.385}{1.42}$ $\times 100\%$ $= 2.47\%$			

# LITTLE THEATRE

## Stage House

1.	Opt. Reverb. Time as Chamber Part	128	512	2040
		2.01	1.42	1.42
2.	Data			
	Floor Area			1708 sq. ft.
	Wall			5586 sq. ft.
	Ceiling			1962 sq. ft.
	Surface			8703 sq. ft.
	Volume			78500 cu. ft.
3.	$x = -2.3 \log(1-\sigma)$	.220	.311	.311
4.		.198	.268	.268
5.	S	1720	2329	2329
	Materials	Abs.	Abs.	Abs.
		Coef.	Coef.	Coef.
		Area	Area	Area
6.	Floor Wood Sheeting Pine	.1	.1	.03
		170.8	170.8	136
7.	Proscenium Opening	.3	.4	.5
		346.5	462	577.5

8.	Ceiling Cement Unpainted	1962	.01	19.6	.01	19.6	.02	39.2
9.	Wall Concrete Unpainted	3086	.01	30.8	.01	30.8	.02	61.7
10.	Back Wall Plaster	2510	.04	100.4	.06	150.2	.04	100.4
11.	Draperies Two Sets	900 yd	0.14	126	0.55	495	0.70	630
12.	Total Act. Areas			794.1		1328.4		1544.8
13.	Additional Req.			925.9		1000.1 1/3		784.2
	Use Flintkote Acous- tical Tile 1/4" Per- forated, Painted		$\begin{matrix} 0.62 \\ (-0.1) \\ = 0.01 \end{matrix}$	$\begin{matrix} 925.9 \\ 0.01 \\ = 1615 \end{matrix}$	$\begin{matrix} 0.63 \\ (-0.1) \\ = 0.62 \end{matrix}$	$\begin{matrix} 1000.3 \\ 0.62 \\ = 1610 \end{matrix}$	$\begin{matrix} 0.4 + \\ (0.14-0.2) \\ = 0.45 \end{matrix}$	$\begin{matrix} 784.2 \\ 0.45 \\ 1670 \end{matrix}$
			$\frac{1615 + 1610 + 1670}{3}$					
				= 1632				
	Use 1632 sq. ft.			990		1010		735
14.	After Addt'l Abs. Area			1784.1		2338.4		2279.8
15.	Check							
	$\alpha =$		.204		.2681			.262
	$x =$		.228		.3112			.304
	$t_{60} =$		1.95		1.422			1.45

Error =	$\frac{2.01-1.65}{2.01}$ $\times 100\%$ $=+2.90\%$	$\frac{1.42-1.422}{1.42}$ $\times 100\%$ $= -0.14\%$	$\frac{1.42-1.45}{1.42}$ $\times 100\%$ $= -2.11\%$
---------	--	--	---

## PRESENTATION

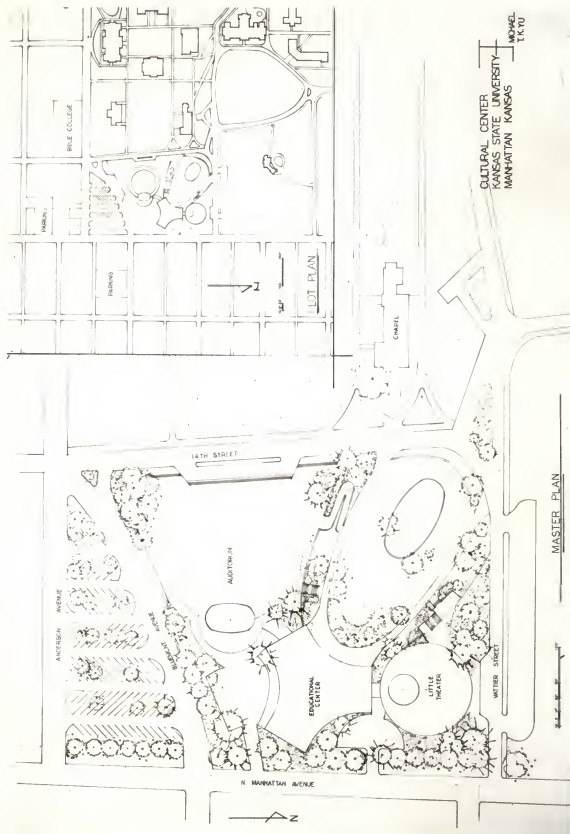


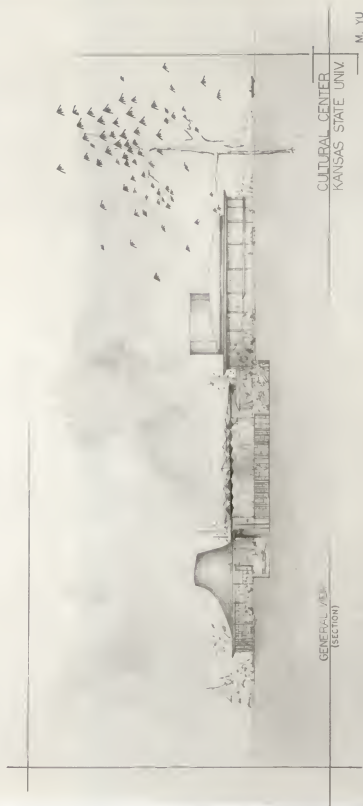
A CULTURAL CENTER  
KANSAS STATE UNIVERSITY, MANHATTAN, KANS.

MICHAEL TUNG-KEN YU DESIGNER

SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENT FOR THE DEGREE  
MASTER OF ARCHITECTURE  
KANSAS STATE UNIVERSITY







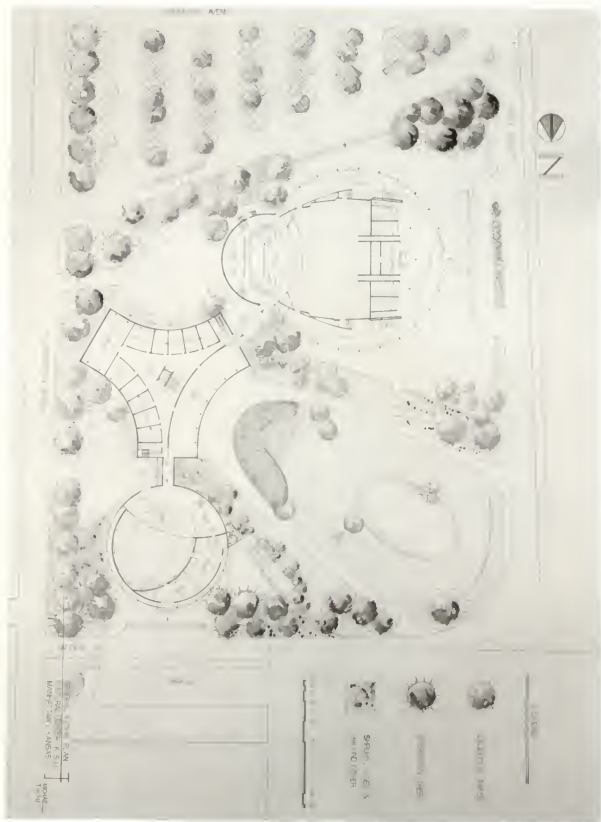
1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

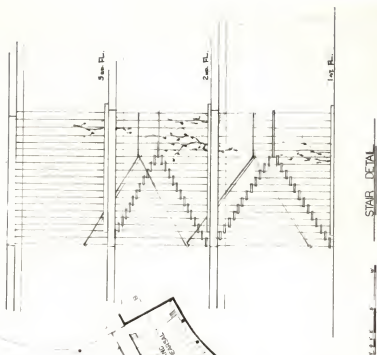


REPLY

12



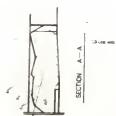




FIRST FLOOR PLAN

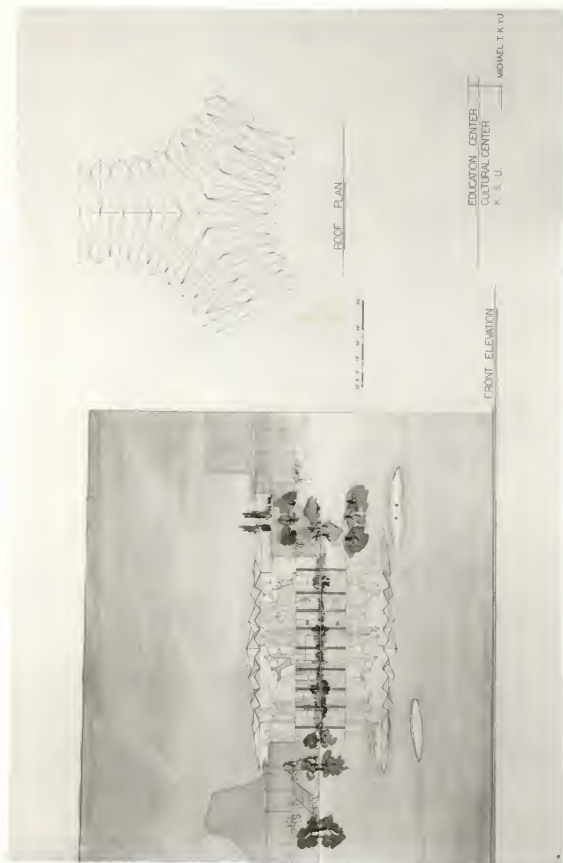
EDUCATION CENTER  
CULTURAL CENTER  
KANSAS STATE UNIV.

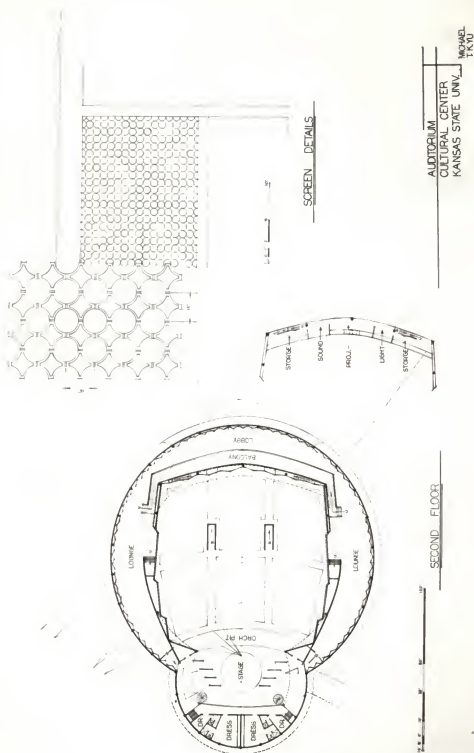
MICHAEL T. K. YU













ASTORIA  
OCEAN CENTER  
K X U M



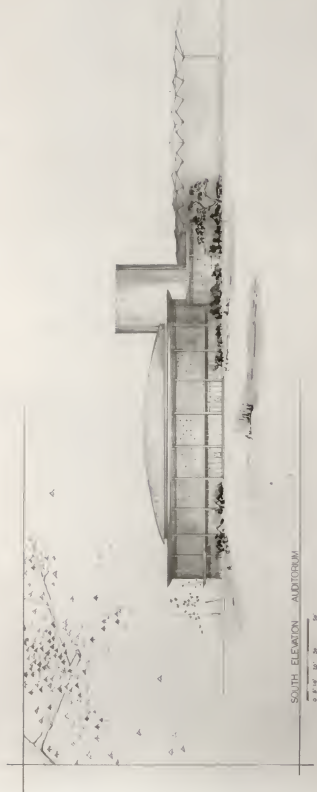
SECTION

SECTION



SECTION







FRONT ELEVATION LITTLE THEATER

LITTLE THEATER	
CULTURAL CENTER	
K. S. U.	MICHAEL YU

STAGE FORMS



PERFORMANCE



ARENA



ARENA

PERFORMANCE  
WITH LOU-CHEN-BAI

CAULDRON



ARENA

LITTLE THEATER  
CULTURAL CENTER K.S.U. MODEL NO.



LITTLE THEATER  
EDUCATION CENTER K S U  
MANHATTAN KANSAS

MICHAEL WU



0 10 20 30 40

SECTION



0 10 20 30 40



## CONCLUSION

This thesis is the study of a university cultural center. The goal of the project is to provide for the best advantage of good sound effects through the use of good acoustics which will be beneficial for cultural and recreational purposes of university professors, students as well as people from the nearby counties.

The designer has used his ability to understand the natural advantages of the acoustics, the characteristics of the academic system and its needs, and created his own ideas and imagination in seeking a solution that will provide a pleasing architectural and acoustical environment.

## ACKNOWLEDGEMENT

The author wishes to take this opportunity to express his deepest appreciation and acknowledgement to Professor Theodore A. Chadwick of the Department of Architecture, for his encouragement in the supervision of this work.

## REFERENCE

## Books:

- Bode, Paul.  
Kinos  
Verlag geurg. D.W. Callwey, München, 1957.
- Burris-Meyer, Harold & Cole, Edward C.  
Theater and Auditorium. Reinhold, New York, 1949.
- Burris-Meyer and Goodfriend.  
Acoustic for Architect. Reinhold, New York, 1958.
- Groupius, Walter.  
Scope of Total Architecture. New York, Harper, 1955.
- Knudsen, Verne and Harris, Cyril M.  
Acoustical Designing in Architecture. New York: John Wiley and Sons Inc. 1962.
- Papadaki, Stamo  
Oscar Niemeyer Work in Progress. New York: Reinhold Publishing Corp. 1956.
- Papadaki, Stamo  
LeCorbusier - Architect, Painter, Writer. New York: Reinhold Publishing Corp, 1950.
- Parkin, Acoustic, noise and building, 1958.
- Theil, Hans, W.  
Saalbau  
Verlag, George, D.W. Callwey, München. 1959
- Wright, Frank Lloyd.  
An American Architecture. New York: Horizon Press, 1953.
- Zevi, Bruno  
Architecture as Space. New York: Horizon Press, 1957.

## Magazines:

- Architecture Forum  
97. 103-11 April 1952.  
97. 146-49 Oct. 1952  
97. 114-15 Dec. 1952  
108. 124-7 April 1958  
109. 11 July 1958  
109. 104-9 Oct. 1958  
112. 86-107 June 1960

## Architecture Record

123. 177-20 Feb. 1958  
 125. 157-72 Mar. 1959  
 126. 198-20 Oct. 1959  
 129. 107-22 Feb. 1961

## Architecture Progressive

- National Cultural Control 40:103 Sept. 1959.  
 School March, 1960.

## A.I.A. Journal Aug. 1961

- J 33 74-5 Jan. 1960  
 J 35 70-1 April 1961

## Royal Architectural Institute of Canada Journal

- U. 37:11 The O'Keefe Center for the Performing Arts,  
 Toronto.

## Unpublished Materials:

Lu, Paul C.K.

- A Lake Union and University Park Design for K.S.U., A  
 Thesis, K.S.U., 1962.

Ru, J.C.

- Civic Center, K.C. Mo., 1980, A Thesis, K.S.U. 1961.

A CULTURE CENTER DESIGN  
FOR KANSAS STATE UNIVERSITY  
MANHATTAN, KANSAS

by

MICHAEL TUNG-KEN YU

B. Arch., Cheng-Kung University  
Taiwan, China, 1953

---

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARCHITECTURE

Department of Architecture

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1963

The proposed cultural center design is primarily an exercise of space relation. The space arrangement of the physical structure must satisfy not only the functions of the buildings, but also must create an atmosphere of the containment. Arranging this building group is an imaginative exercise of the greatest complexity. There are numerous factors to control, both practical and aesthetic, which are:

1. The establishment of a functional relationship throughout the composition, in addition to maintaining a simple and effective means of communication.
2. The recognition of acoustical requirements in the architectural design.
3. The study of unity and harmony of the group as a whole and of continuity between its varied parts.
4. Academic requirements combined with public usage.

The planning of the larger area requires a uniform concept to hold together the individual parts and to make them function as architecture. The general concept and individual details demanded equal attention. The demands of acoustics and use influenced the design. All of these fundamental considerations are part of the designer's obligation. It is through the recognition of this obligation and careful exercise of design principles that he will control the design of the cultural center.

The education center is a three story building. This Y-shaped building was derived from acoustical considerations such as diffusion, diffraction, and sound isolation and insula-

tion. The main entrance, lobby and three rehearsal rooms are located on the first floor. The second floor contains the offices, class rooms, the library and the shop, with exits to the auditorium and the little theater, and the loading dock. Most of the practice rooms and studios are located on the third floor. The elevator core and stair-case are in the center of the plan to assure concentration and efficient locations of the vertical transportation. The poured in place fold-plate roof provides both a center of interest and good diffusion in rooms below.

The auditorium envelope is circular in form. The shape of the auditorium, however, was dictated by acoustical requirements. It is surrounded by the intermission and transition area acting as a sound barrier, where the lobby, lounges, refreshment area and rest rooms are located. The proscenium stage is the core of the presentation area, and related to the green room, dressing rooms, and stage house. The hollow blocks on the outside walls are used as sun-screen and also as horizontal balance of huge stage house.

The little theater is designed for experimental use. The stage and setting can be changed for different performances. The circular-shaped plan and thin shell roof provide balance for the composition.

The view and circulation of people in the whole center is also a major consideration in the site development. Circulation around the sunken garden provides a landscape element that ties

all the buildings together and adds to the cultural atmosphere of the center.

In summary, the designer has used his ability to understand, and to analyze the acoustical needs and the characteristics of the people and their cultural needs; the consideration of the aesthetic, by creating imaginative, functional forms in seeking a solution that will provide a pleasing architectural and acoustical environment.