TECHNOLOGICAL STUDIES AND STAGE MODEL OF THE NEW KANSAS STATE UNIVERSITY AUDITORIUM

by

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PART I: THEATRE ACOUSTICS

ARCHITECTURAL CONSIDERATIONS

From the audience's point of view, visibility and audibility are the two basic physical problems an architect must solve in building a theatre. If a member of the audience can not see the performance, there is no need for him to merely warm a seat in the auditorium. Likewise, being unable to hear the performance can be a frustrating experience. Theatre acoustics has been one of the largest unsolvable problems facing the theatre architect for many years. Today, practically every theatre being build has an acoustical consultant, but this does not insure the theatre client of acceptable acoustics. As Cole points out, ". . . in spite of much research, results are somewhat unpredictable."[1] In lieu of being unable to know what will be suited for a theatre,

> Various publications show that the acoustical defects in auditoriums are practically all traceable to reflected sound--echoes, excessive reverberation, interference, resonances, and imperfect articulation.[2]

Acoustics concerns itself with the reflection and absorption of sound. The principal factor of reflected sound is reverberation. "Reverberation can be defined as a series of multiple echoes so closely spaced as to merge into a continuous sound."[3] Wallace

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[1]Wendell Cole, "Some Contemporary Trends in Theatre Architecture," _Educational Theatre Journal_, VII (March 1955), p. 18.

[2]F. R. Watson, Acoustics of Buildings (New York, 1941), p. 51.

[3]George I. Smith, "Acoustics and the Theatre," _Theatre Catalog_, XIII (1955-1956), p. 37.

Clement Sabine first experimented with reverberation control while working on the correction of auditoriums. His experiments led to the absorption power of carpets, curtains, upholstered seats, and the scientific formula $T=0.05V/as$ for measuring the reverberation of a room.

> T=the time taken for sound in a room to decay to one-millionth of its initial value. V=volume of the room in cubic feet. The factor 0.05 involves a 60 db (decibel) decay of the sound. 'as' is the total absorption value of the room, 'a' being the average absorption coefficient, and 's' being the total area in square feet of all surfaces of the room. The value of 'as' is found by taking the sum of the absorption values of different materials in the room. $as=a_1s_1$(plaster) + a_2s_2(wood) + a_3s_3(carpet) + etc.[4]

In short, the reverberation time is directly proportional to the volume of the room and inversely proportional to the absorption coefficient of the room.

The suggested reverberation for a large music hall is 2.32 seconds, and that for a theatre is approximately 1.5 seconds. In conjunction with this theory, acoustical engineers have narrowed further to basic architectural demands for reflected sound control of an auditorium. Acoustically, the length of the auditorium should not be greater than twice the width due to sound reflection difficulties arising between side wall surfaces. When the ratio of width to length is less than 1:1.4, the structure produced neglects the architectural consideration for sightlines and the acoustical consideration for sound distribution. Large back walls should be avoided. Architectural considerations are: 1) sightlines, 2) width of light beam and projection angle, and 3) general appearance.

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[4] Watson, p. 37

Additional acoustical considerations are: 4) ceiling height dimensions proportional to the horizontal proportions, 5) optimum cubic-foot volume per seat required for the given design. The inclination of the seats, inclination of the upper seat level, and the height of the projection room must be considered when determining the ceiling height since they affect the total ceiling height of the auditorium. One advantage resulting from proper control of ceiling height and structural volume is the

> . . . excessive power output [is] not required to compensate for high energy losses frequently caused by use of acoustical materials on walls and ceiling surfaces.[5]

The shape of the wall is another important consideration. Concave walls offer an obvious unwanted concentration of sound. Straight or plane walls are better than concave, but convex walls can be used more effectively for reduction of echoes. By using a ramification of the convex wall to solve the problem of echoes

> . . . and still retain a 'live' auditorium, (S. Charles) Lee created a back wall design for the La Reina, Van Nuys, California that has met every measuring test by acoustical engineers and is now recommended. A series of angular panels treated with acoustical plaster, and of such size and direction as to make cross tones impossible to cause sound distortion, this wall has produced sound of the highest degree of perfection.[6]

The function of this arrangement of the back wall was to direct the reflected sound. At the Purdue Music Hall, architect Walter Scholer designed the back wall in "stepped" plane sections. Sound absorp-

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[5]Arnold Farber, "Ben Schlanger . . . Theories and Practices," Theatre Catalog, XI (1953-1954), p. xv.

[6]Paul J. Green Halgh, "The Work of S. Charles Lee," Theatre Catalog, VII (1949-1950), p. 30.

tion on this wall was provided by rock wool two inches thick, backed with an air space, and faced with perforated transite. Two balconies served further to break up the expanse of the back wall.

George I. Smith, in his article "Acoustics and the Theatre", listed four generalized rules of avoidance in acoustical design. They are as follows: 1) Real walls with uniform curvature centering at a point on stage are apt to produce echoes at the front of the auditorium. Curved seats can also produce echoes if the center of curvature is incorrectly centered. 2) Side walls and that portion of the ceiling located down front of the auditorium should reflect at glancing angles to the sides and the rear of the auditorium. This calls for splayed walls and the ceiling sloping upward from the arch. 3) Extended walls or ceiling surfaces should not have centers or axes of curvature centered on stage or near any of the audience. These centers act as spotlight reflectors. 4) Average ceiling heights should be determined from the number of seats so that the volume of the auditorium in cubic feet does not exceed two hundred times the number of seats.[7]

[7]Smith, p. 38.

ACOUSTICAL MATERIALS

Acoustical problems arise from short-cuts as well as from oversight and lack of understanding. Beginning with acoustical planning can be economical as well as time saving. In solving the problem of poor acoustics in the Cleveland Public Auditorium, engineers found that 37,000 square feet of the auditorium's walls, ceiling, and floor needed acoustical treatment to shorten the reverberation time to an acceptable time period.

Special acoustical materials are now being commonly used to eliminate reverberation on the ceiling, back wall, and side walls. "The fundamental purpose of acoustical materials is to reduce either the average sound-pressure level or the reverberation time in a room or both."[8] The quality that offers these materials their desirability is called porosity. The more porous materials offer the best acoustical advantage. Sound waves enter porous materials through their perforations, and friction causes the waves to dissipate in their struggle to escape from the fibrous maze of the interior.

The two general groups of materials are the prefabricated units and the job assembly units. Both are available with or without surface perforations. Breaking down these two groups, there are the soft materials such as hairfelt, which is superseded by rock wool; and asbestos, which is fireproof, vermin proof, and more attractive. Porous tiles and acoustical plasters are classi-

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[8] Noise Reduction, ed. Leo L. Beranek (New York 1960), p. 384.

fied as hard materials. Of these two, acoustical plasters are more advantageous because they will lend themselves to architectural design more readily than porous tiles. The major disadvantage of acoustical plasters is that their absorbing capacity depends on the skill of the workmen installing them. Acoustical plaster efficiency is generally less than other products because if painted, special instructions must be followed to avoid clogging of the pores. However, plasters and sprayed-on materials have an economic advantage.

When planning an auditorium, the architect is concerned with the entry of outside sounds into the theatre as well as the projection of sound within the theatre. The prevention of outside sounds entering the theatre makes sound insulation another important aspect of acoustics. Theatre walls usually contain a special sound-soaking material to keep outside sounds outside, and non-acoustical materials such as glass are avoided. Three important precautions in sound insulation are:

1. Fill all cracks or openings in construction
2. In double construction maintain maximum structural separation and insolation, and
3. provide an impervious layer as light concrete block.[9]

Several colleges and universities have experimented with acoustics in their theatres. At the University of Oregon, a high grade of acoustic plaster was specified for the walls. The contractor, however, applied the plaster in the cheapest possible way rather than the correct way. This theatre has been found, unfor-

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[9] "Acoustical Materials Review," prepared by the Acoustical Materials Association, Theatre Catalogue, VIII (1955-1956), p. 40.

tunately, to have little or no acoustical value. Benedicta Arts Center at the College of Saint Benedict, Saint Joseph, Minnesota, eliminated the need for an orchestra shell on stage by providing a twenty-ton isolation door between the auditorium and stage house. Acoustical "clouds" were hung in the ceiling and concealed in the walls were absorptive burlap draperies for acoustical adjustment. The room ". . . can be 'tuned' acoustically by operating push button sound absorptive burlap draperies behind the wall battens."[10] Loretto Hilton Center at Webster College, Webster Groves, Missouri incorporated sound proof moveable walls for their multi-purpose theatre. The rear wall was treated with acoustical plaster. The side walls can be moved to change the acoustics from absorptive for the spoken word to reverberant for music. George C. Izenour was the consultant for the moveable walls, lighting, and special equipment design. Warner Concert Hall at Oberlin College, Ohio uses adjustable curtains on rear and side walls to cover the walls when more absorption is desired. At the University of Illinois auditorium,

> The hairfelt with muslin covering used originally was removed because the installation was dirty and unsightly, and it had become a fire hazard. Rock wool replaced the hairfelt on the curved side walls, where it also was covered with completely perforated celotex.[11]

Muslin covering has been almost completely disregarded acoustically because it catches dirt easily, and when its pores become clogged

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[10] "Theater and Auditoriums: Building Types" (anon. rev.), Architectural Record, CXXXVI (December 1964), p. 119.

[11] Watson, p. 82-83.

with dust particles, the material is useless. The rock wool and celotex implemented at the University of Illinois not only provided a better physical appearance, but provided an improvement in absorption.

Architects often become so concerned with proper acoustics for the audience that they neglect acoustics on the stage. Experiments have shown that performers prefer conditions in which they can hear themselves. In one experiment conducted at the University of Illinois, a band was asked to play in a gymnasium. The musicians found it difficult to perform because they were unable to hear the other musicians as well as themselves. The band was then placed under a 12' X 14' reflector. When the reflector was seven feet above the band, the band members could hear themselves, and tones became more natural and less blurred. Listeners seated further away said the tempo of the music could be followed more easily when the reflector was used.

ACOUSTICAL ANALYSIS OUTLINE

In dealing with various acoustical aspects of an auditorium, the Acoustical Material Association has prepared an acoustical analysis outline. This outline states that if an auditorium is to have the best acoustical advantage, the architect must 1) determine the volume of the auditorium, 2) calculate total absorption of the empty auditorium in relation to room surfaces and seats, 3) calculate the reverberation time in the empty auditorium, and 4) calculate absorption when the auditorium is filled to 1/2, 2/3, and full audience. When determining the respective reverberation times, he must 5) select acceptable reverberation times, 6) determine the number of units which must be added to give acceptable reverberation time when the auditorium is at its capacity, 7) determine the number of square feet of acoustical treatment which gives required number of additional units, and 8) calculate the reverberation time of the auditorium after treatment for empty, 1/3, 2/3, and full audience.[12]

The latest contribution to the area of acoustics is Dr. Manfred R. Schroeder's discovery of measuring the sound decay of an auditorium. Schroeder, director of Acoustics, Speech, and Mechanics Research Laboratories, a unit of Bell Telephone Laboratories, perfected his discovery after his philharmonic research in which there were excessive echoes and reverberation.

> The single curve obtained with Dr. Schroeder's instrument represents the average of many. A filter end

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[12]Acoustical Materials Association, p. 42.

amplifier feeds the pistol shot or other test signal into the hall being tested. Received in a microphone at another point in the chamber, the sound is analyzed by a computer. A graphic plotter or oscilloscope displays the results.[13]

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[13]Stacy V. Jones, "Sound Decay," Science Digest (January 1968), p. 94.

PART II: KANSAS STATE UNIVERSITY AUDITORIUM

ACOUSTICAL DESCRIPTION

By the fall of 1970 Kansas State University hopefully will open its new auditorium. As an experiment in acoustics, it could prove to be extremely successful. The back wall, including the orchestra and balcony back walls, is to be covered with 3/4 inch metal lath and plaster splayed walls varying in width. The plaster will be painted with two coats of Pratt and Lambert's "Vapex" flat wall finish. The color will be designated by the State Architect. For acoustical adjustments the back wall, including the balcony rear wall, will have two sets of 100% full Saluda Grade Velour curtains on an automatic track.

The side walls are divided into three acoustical sections. The first section is the upper part of the wall that extends from the proscenium wall to the front edge of the balcony. This portion of the wall contains a plaster coating and an expanded mesh metal a few inches in front of the plaster. The plaster wall is treated identically as the back wall. The visible expanded mesh metal will be painted flat diamond, and its properties will be equivalent to Gypsum "Color Rite". Between the mesh metal and the plaster wall will be six sets of Nashua double faced flannel draperies which will be flameproofed by the Texpruf process. These curtains will be operated by a push button panel labeled, "up", "½", and "down". By changing their position, the curtains can be acoustically tuned for this multi-purpose auditorium. The second part of the side walls is that area adjacent to the balcony which extends from the front of the balcony to the rear wall. This will be an acoustical plaster splayed wall. The third part of the side walls is the lower section which will be acoustically treated with a vinyl wall covering, specifically Prince Guard "Presidential". In addition, there will be nine curved acoustical reflecting panels on each side of the auditorium located on the facings of the continental projections.

The most outstanding acoustical feature of the new Kansas State University Auditorium is the adjustable false ceiling. The ceiling is composed of numerous panels. The typical panel consists of ½-inch plywood covered by an expanded metal pattern. Two acoustical panels drop from the ceiling at an approximate 55° angle. On top of the ceiling are three pairs of roll curtains. These curtains are used to dampen the acoustics and are operated by means of a push button panel labeled "up", "½", and "down". This also functions as an acoustical tuning aide. The curtains are Nashua double faced flannel, dyed the color designated by the State Architect and flameproofed by the Texpruf process.

Hinged to the moveable ceiling is the pro-proscenium teaser with three acoustical reflecting panels. The ceiling has four positions, which are concert, opera, drama, and stop. These positions are controlled by a push button panel. In concert position, the ceiling and pro-proscenium teaser are at the "up" limit. For opera, the pro-proscenium moves to an intermediate level. The ceiling moves down and joins the pro-proscenium, and together they move until the ceiling stops at an intermediate level and the pro-

proscenium teaser is at its "down" position. For drama, the pro-proscenium teaser remains at its "down" position, and the ceiling drops to its "down" limit. To return to either of the other positions, the order is reversed. When the ceiling is in drama position the ceiling cuts off the balcony, leaving an orchestra of 939 seats. In concert position, the auditorium seats 1,815 people. In conjunction with the moveable ceiling, the draperies on the walls and above the moveable ceiling can be tuned acoustically to reverberant for musical groups, or less reverberant for drama production.

MULTI-PURPOSE THEATRE

Theatre can no longer be a static term in architecture. In today's society it must represent a number of environments. The term "auditorium" denotes more than one function, but a theatre building can no longer project the single concept of a proscenium, an arena, a thrust, or an end stage. Multi-purpose theatre is the new trend in combining the theatre and music forms into one architectural structure or into a complex of smaller structures. Intimacy with the audience is the cry of the multi-purpose theatre form. Aesthetic distance is definitely important, but it can be maintained psychologically rather than by the antiquated concept of "physical distance".

In an educational theatre, flexible staging is of paramount importance.

> Multiform, or a facility where an arrangement of stage and audience can be made, is a style more suited to the educational phases of the living theatre.[17]

Flexibility will produce an atmosphere in which the theatre student can experience his maximum creative ability. Norman Bel Geddes said in reference to the purpose of educational theatre, ". . . the answer is 'flexible staging'."[18] In reference to arena theatre, Stanley R. McCandless stated, "I believe this type of production should be provided in any new theatre."[19] Sean

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[17] Miller, p. 92.

[18] Norman Bel Geddes, "Theatre Planning: A Symposium", Educational Theatre Journal, II (March 1950), p. 4.

[19] Bel Geddes, p. 7.

Kenny, in reference to experimental staging said, "You must first sow seeds. Then the tree grows. And beware that you don't sell the fruit until the tree is grown."[20] From men like these came a series of staging forms with the concepts of "intimacy" and "theatre for the audience".

Several colleges and universities have effectively combined all three forms of staging into one theatre. At the Loretto Hilton Center, multi-purpose theatre has been accomplished with the aide of three moveable walls and moveable panels around the stage area. This theatre offers theatre-in-the-round, thrust, and proscenium. The University of Miami incorporated the "flexible ring theatre" which accomodates arena, proscenium, and thrust. This is accomplished by a revolving stage 30 feet in diameter. The basic principle is similar to Walter Gropius' totaltheatre concept, which is in direct correlation to flexible staging. Another flexible theatre at Antioch College offers four major features, ". . . moveable seat sections and platform; a coverable pit; an asbestos curtain opening to full width of house; and a traveling crane."[21] The Loeb theatre at Harvard University and the new theatre at Burmingham Southern College are also outstanding examples of the multi-purpose theatre.

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[20]Steven Joseph, ed., Actor and Architect, (Toronto 1964), p. 64.

[21]Miller, p. 93.

Combining all these forms into one theatre plan, however, may result in inadequate conditions for the three types of staging.

> What will result will not be a flexible theatre but a theatre of one dominant form possessing a number of possible but rarely used variations.[22]

Other ideas from modern architects have resulted in the theatre complex, in which several buildings are erected to meet the demands of "intimacy" and "theatre for the audience". The Kronnert Center at the University of Illinois consists of five separate buildings, a music auditorium which seats 2,200, a music theatre seating 1,000, a drama theatre seating 700, an experimental theatre which seats 250, and an outdoor amphitheatre which seats 1,000. To build such centers would seem to be beyond the scope of the ordinary university's finances.

> Theorectically it should be possible to devise an adaptable theatre to please any exponent of each form of stage that is included in its range. Yes, but the expense of doing so would probably be greater than building separate auditorium and stages for each purpose.[23]

It seems only too obvious that any university theatre group needs some form of flexibility whether it be contained in one building or two or three.

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[22] H. D. Albright, William P. Halstead, and Lee Mitchell, Principles of Theatre Art, (New York, 1955), p. 221.

[23] Steven Joseph, New Theatre Forms (London, 1963), p. 92.

PART III: STAGE MODEL

PLANNING THE MODEL

A model theatre brings to mind a delightful toy to be played with and pampered, but those in theatre realize the importance of a workable stage model. Often a scene designer discovers he must alter his scene changes or his design due to unexpected problems. A stage model would allow the scene and lighting designers to pre-plan all scene changes and lighting plots. In addition to being advantageous for a scene designer, a stage model can be used as an aide in instructing students of the theatre.

A model does not have to be elaborate or a novelty item. It should be functional and as accurate as representation will allow. In planning the Kansas State University state model, consideration was given to function, materials, and scale. The initial planning step was to make workable drawings of the stage, including only the basic and necessary components.

Drawing Number 1 shows the floor plan with the positioning of the wagon tracks, tormentor tracks, pull-out panel tracks, orchestra apron, and the proscenium opening width. The wagons will be used for model sets with multiple scenes with regard to quick scene changes. One wagon, there being one on stage left and one on stage right, will be in playing position while the other, "off-stage" is being "set-up". When the scene ends the wagon playing will be moved "off-stage" to its respective side, and the other will be moved into playing position. With wagons included in the model, the scene designer will be able to pre-plan his scene changes.

The tormentors and pull-out panels are used to narrow the width of the proscenium opening from opera position to drama position. With these in the model, they will allow the scene designer to check his sightlines and provide for adequate masking. If the scene designer is testing a scene design the model will bring the model set down to its correct proportions.

The positions of the light bridge, the operating gallery, the lighting gallery, and the cyclorama are important to the scene designer. (See Drawing Number 2) The light bridge has attached to its down stage side the main teaser. As the bridge moves, so goes the teaser. The teaser is important for the checking of sightlines and masking. The operating gallery and the lighting gallery are located 22 feet above the stage floor on stage right and stage left respectively. This is important for the scene designer. He must plan for scenery under 22 feet in order to clear these galleries. The cyclorama functions as a back stage masking and a lighting projection backing. It is located "up-stage" and can be flown "in" and "out". Its location is important to the scene designer so that he can judge clearing distances, masking and its incorporation into his design.

A cross-section of the stage is always helpful to a model builder. This supplies the vertical dimensions of the stage house and the vertical locations of portions included. (See Drawing Number 3)

In building stage models, elevations of included components are beneficial. The components included in the stage model for Kansas State University are: the lighting bridge, the pull-out panels, the teasers, and the tormentors. These elevations enable the builder to have a visual concept of them and their correct dimensions. (See Drawings 4, 5, and 6)

The plan of the grid and operating lines are a necessity to the model. (See Drawing Number 7) The operating lines provide the scene designer with another aide in planning scene changes. Since these lines carry the scenery they are of utmost importance.

After planning and drawing the necessary components of the model, the scale of the model should be determined. Consideration should be given to the finished size of the model. The finished size should be large enough to operate with ease, but small enough to be portable. The scale of the Kansas State University stage model is ½" equals 1'. The final dimensions are 5'6" X 2'4" X 3'2".

MATERIALS

In making a model, the most difficult item to decide upon is the type of material to be used. Durability, weight, costs, and stability are factors to be considered in choosing the material. Materials such as matboard or its equivalent are immediately disqualified due to their lack of stability and durability. Concrete and metals are disqualified because of their weight. Plywood or equal products of stability, durability, weight, and cost seem to be best suited for a model. Plexaglas equals plywood in durability and weight, but it exceeds plywood in usefulness in that it will not warp, and it is sturdier under normal conditions. The cost of plexaglas is considerable more than plywood, but its appearance is far superior to plywood.

Plexaglas is a plastic product which has visual properties similar to glass in its transparent panels. Acrylite, another name for plexaglas, combines the desirable qualities of light weight, shatter resistance, and formability. It is a permanent plastic with resistance to weathering, stains, and chemicals. Acrylite has twice the impace strength of tempered glass and will withstand from 6 to 17 times the impact of double strength glass. It can be sawed, routed, blanked, turned, shaped, tapped, ground, sanded, and polished with conventional wood working tools. Acrylite is designed as a slow burning plastic by Underwriters' Laboratories, Inc.

The best suited material for the "lines" is nylon fishing line. This line is strong, will not weather, and will slip easily through the hook eyes which function as pulleys and head blocks. The battens are 5/16 inch dowel.

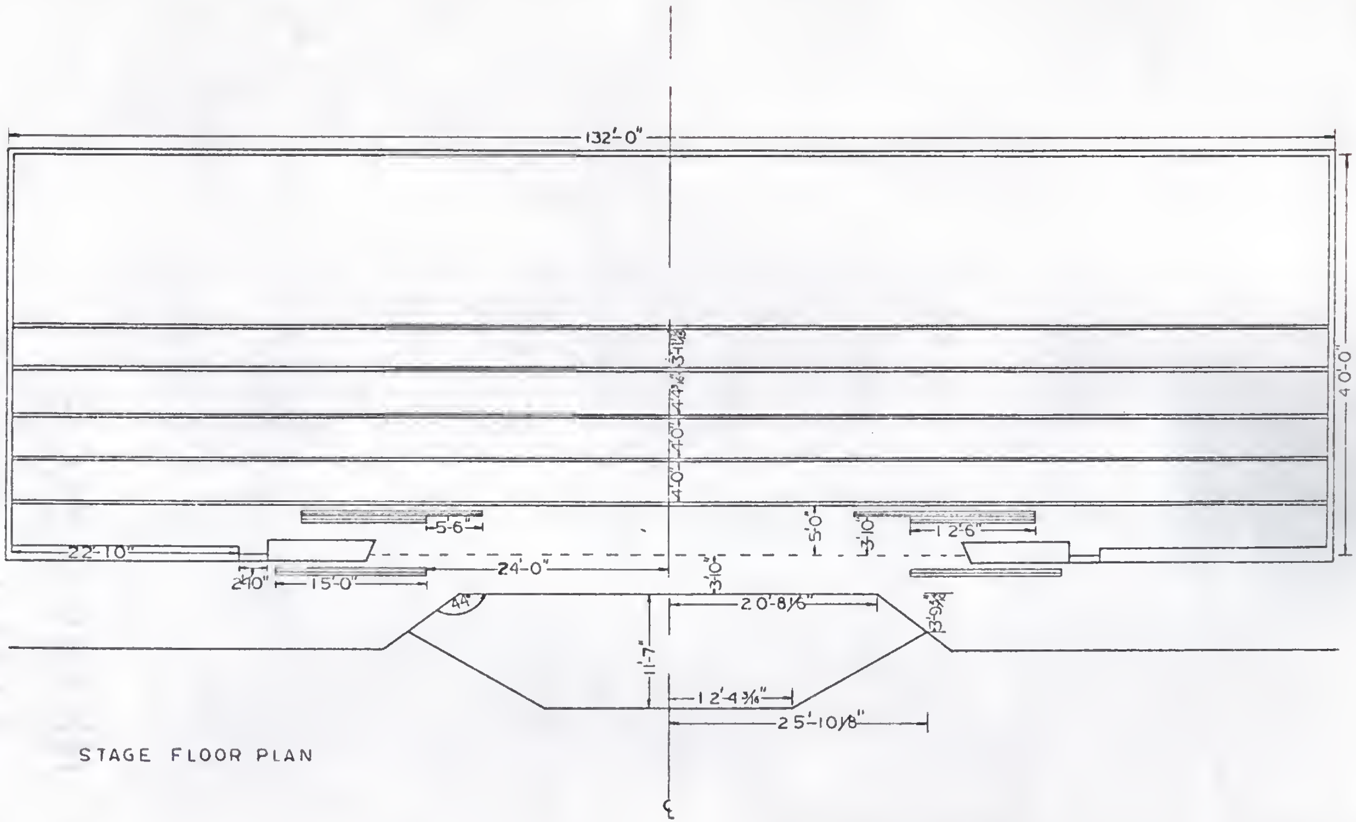
STAGE AND GRID

In building a workable stage model, certain adjustments must be made in order to allow for accessibility to the stage. For example, an exact replica of the new auditorium would not allow for see-through side and back walls. It would not allow access to the stage; therefore, provisions must be made. Often, a model builder will omit either a side or back wall for accessibility. The Kansas State University stage model allows for this by the hinging of the back wall which can be maneuvered up or down. It will, as far as possible, keep everything seen by the audience and the workable parts, strictly to scale. The important dimensions for sightlines are those of the proscenium opening, the pull-out panels, the tormentors, and the teaser.

The space surrounding the proscenium opening is the wing space and "flying" space. Building as closely to scale as possible will allow ample space for "flying" scenery out of sight and for wagon usage.

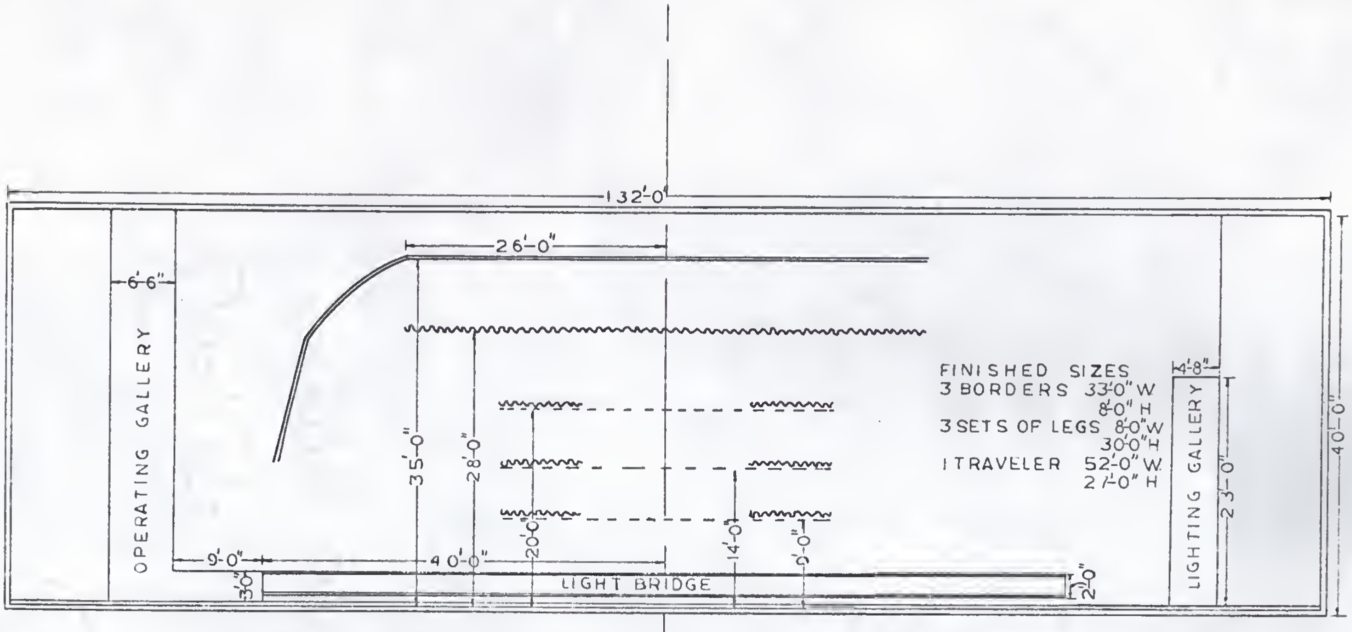
Since the material chosen for the stage model was plexaglas, the model needed little bracing, although this was a consideration for stability. To enclose the area of the stage a special plexaglas solvent was used to dissolve the edges of the plexaglas into one another.

The grid is that part of the stage which houses the "fly" lines which in turn enables scenery to be "flown in" and "flown out". In the model, the grid is loosely framed with hook eyes screwed into the cross-sections. The "fly lines" feed through the hook eyes with one end attached to the batten and the other end running to the operating gallery. At the operating gallery the "fly line" is tied off with hook eyes. The stage counter-weight system has been excluded from the model for purposes of simplicity and operability.



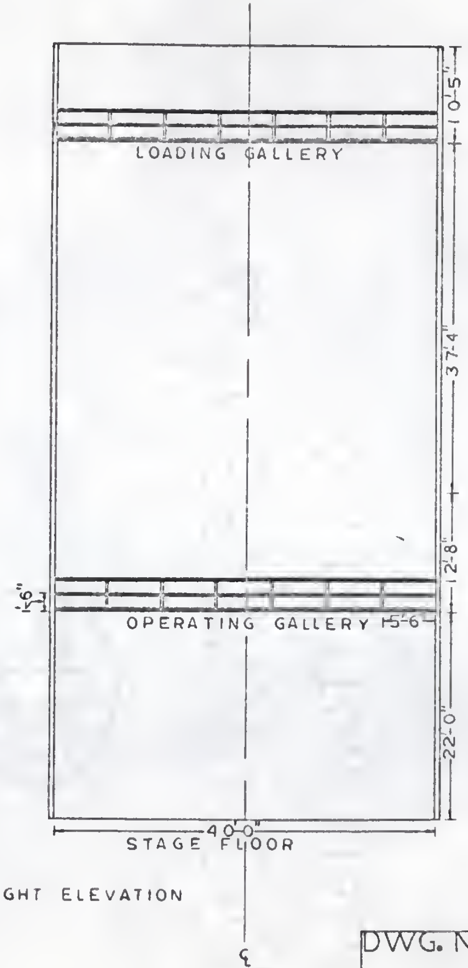
STAGE FLOOR PLAN

DWG. NO.	KANSAS STATE UNIVERSITY AUDITORIUM	
1	DWN. BY: J. ALLRED	DATE:
	CKD: W. D.	SCALE: 1/8" = 1'-0"



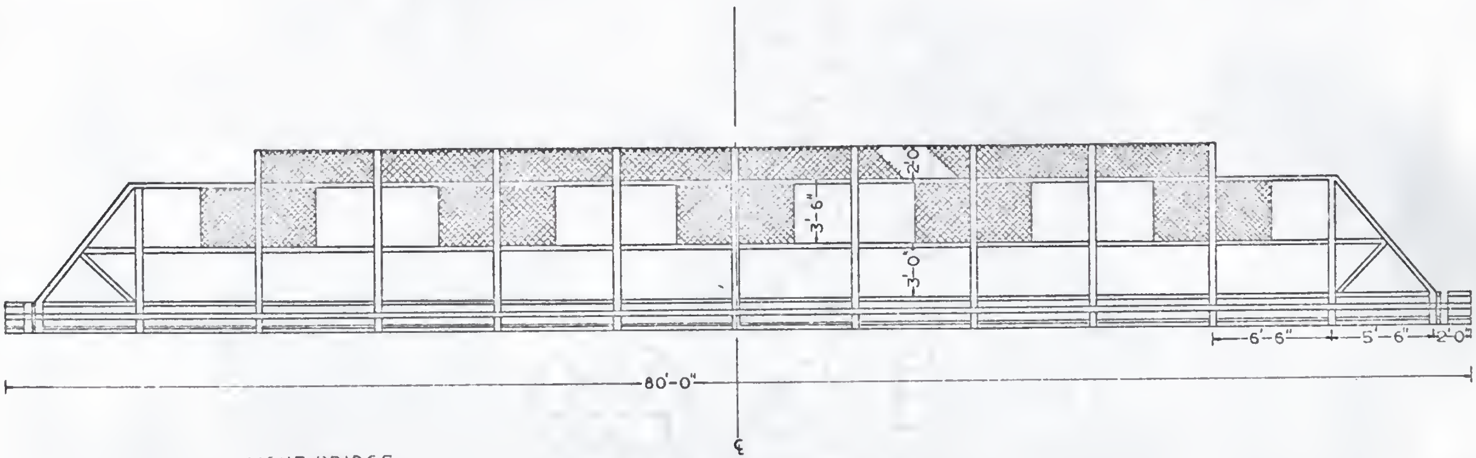
DRAPERY AND GALLERY PLAN

DWG. NO.	KANSAS STATE UNIVERSITY AUDITORIUM	
2	DWN. BY: J. ALLRED CKD: ℓ.Ɗ.	DATE: SCALE: 1/8 = 1'-0"



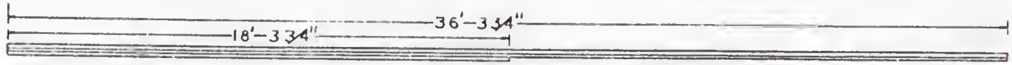
STAGE RIGHT ELEVATION

DWG. NO.	KANSAS STATE UNIVERSITTY AUDITORIUM	
3	DWN.BY: JALLRED CKD: W. D.	DATE: SCALE: 1/8 = 1'-0"

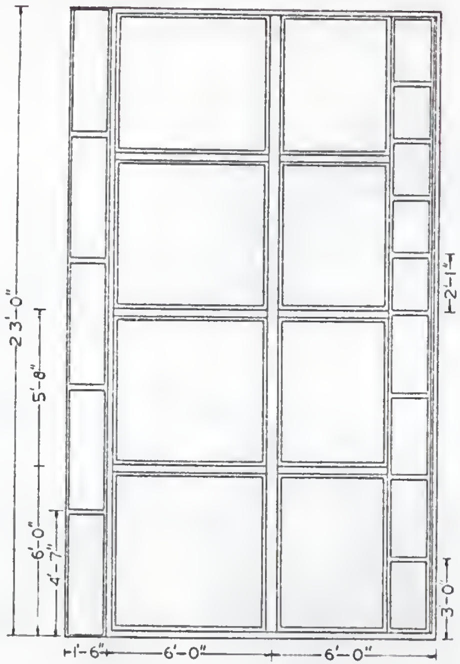


LIGHT BRIDGE

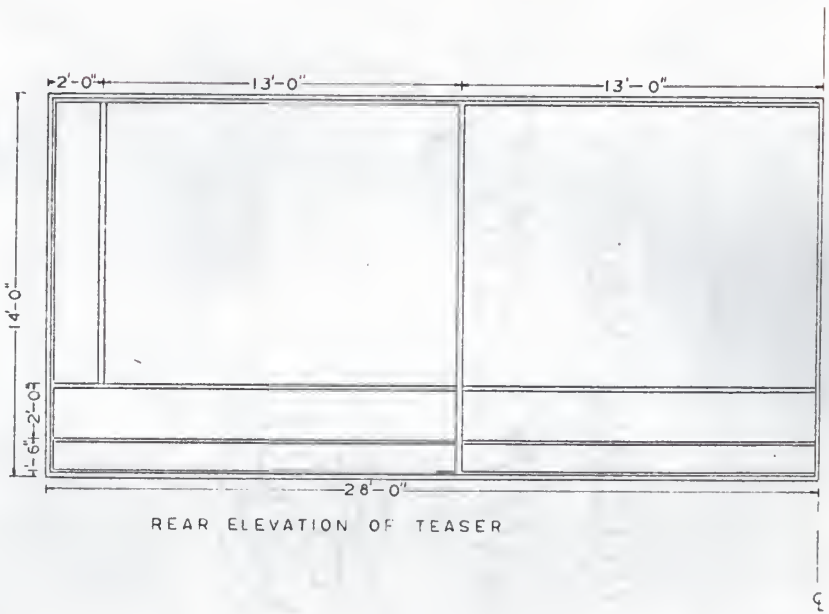
DWG. NO.	KANSAS STATE UNIVERSITY AUDITORIUM	
4	DWN. BY: J. ALLRED	DATE:
	CKD: W. D.	SCALE: 1/4 = 1'-0"



STAGE LEFT TORMENTOR TRACKS

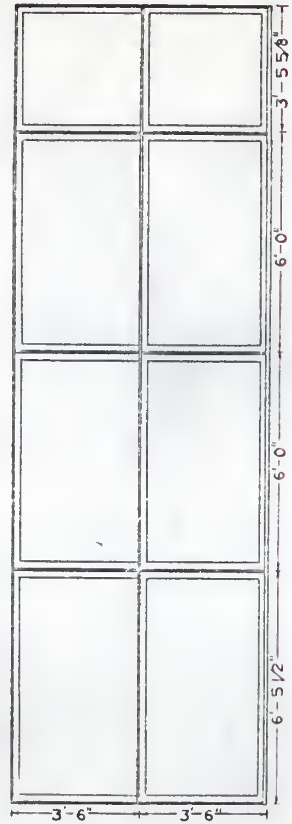


REAR ELEVATION OF STAGE LEFT TORMENTOR



REAR ELEVATION OF TEASER

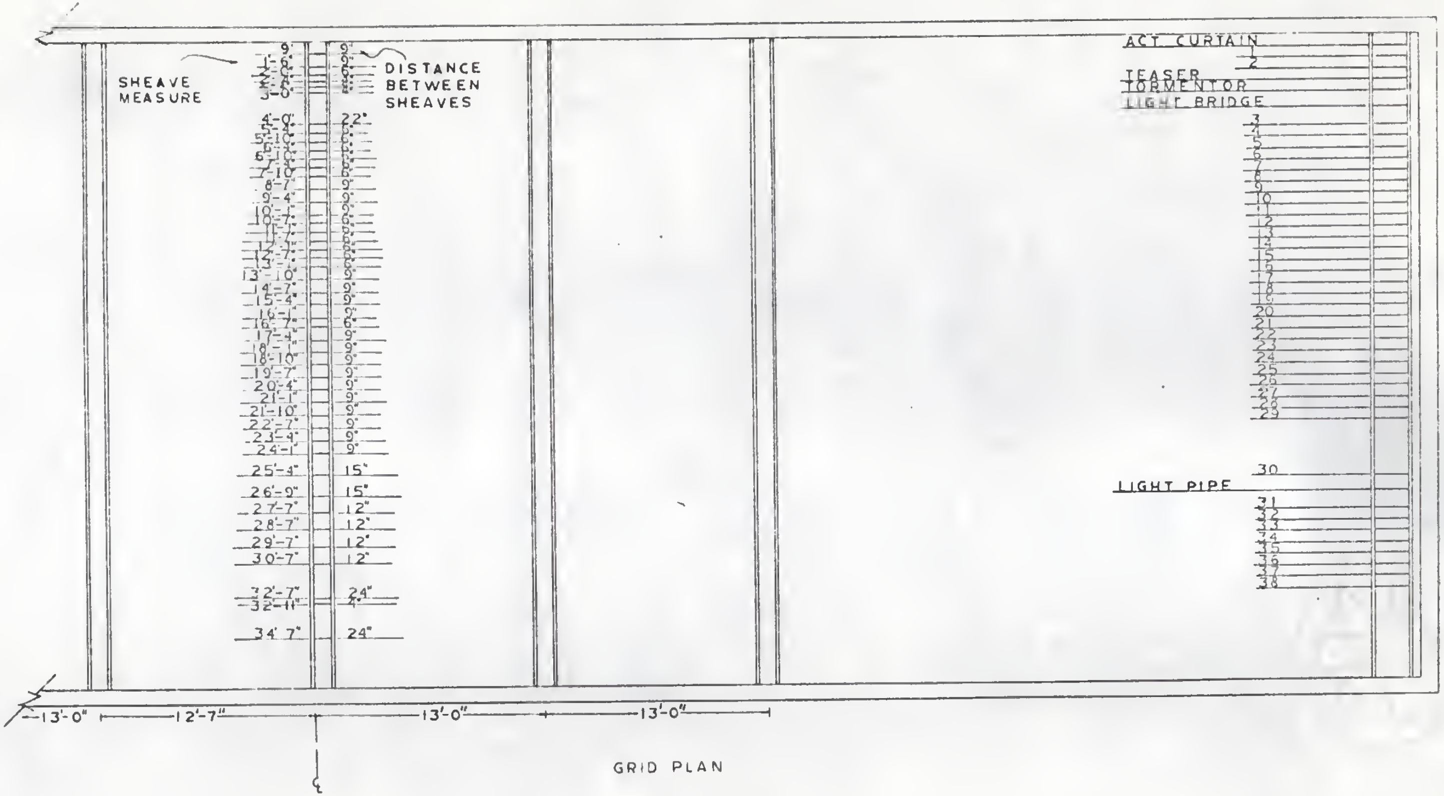
DWG. NO.	KANSAS STATE UNIVERSITY AUDITORIUM	
5	DWN. BY: J ALLRED	DATE:
	CKD: u. D.	SCALE: 3/8"=1'-0"



PULL OUT PANEL AND TRACK

24'0" FROM ℄

DWG. NO.	KANSAS STATE UNIVERSITY AUDITORIUM	
6	DWN. BY: J. ALLRED	DATE:
	CKD: W. D.	SCALE: 1/2" = 1'-0"



GRID PLAN

DWG. NO.	KANSAS STATE UNIVERSITY AUDITORIUM	
7	DWN. BY: J ALLRED	DATE:
	CKD: W.D.	SCALE: 1/4" = 1'-0"

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TECHNOLOGICAL STUDIES AND STAGE MODEL
OF THE NEW KANSAS STATE UNIVERSITY AUDITORIUM

by

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AN ABSTRACT OF A MASTER'S THESIS

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MASTER OF ARTS

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In researching the new Kansas State University Auditorium, primary consideration was given to the acoustical aspects. This was due to the fact that the auditorium offers advanced experimentation in acoustical innovation.

Part I is an elementary study of theatre acoustics. It includes architectural considerations for the planning of acoustics, the two major types of acoustical materials, and an acoustical analysis outline.

Part II is a description of the new auditorium acoustically and in terms of theatre, including multi-purpose theatre with examples of other university theatre arrangements.

Part III is a description of the stage model, its function, and the materials employed in building the model.