PROVINCETOWN: AUDITORIUM FOR MUSIC AND EXPERIMENTAL DRAMA

A thesis submitted in partial fulfillment of the requirements for the degree of Master in Architecture at Massachusetts Institute of Technology

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ABSTRACT

PROVINCETOWN: AUDITORIUM FOR MUSIC AND EXPERIMENTAL DRAMA

"unity: 'the reference of the elements of a ... composition to a single idea' ... the common denominator"

"Venice ... built in spite of the water ... lives because of it"

"this noble material has kept alive the Acropolis"

"Santa Sophia ... the power and majesty of one vast space"

"an auditorium ... interpreting the resolved mechanics"

"the long standing need for a music and arts center in Provincetown"

"a system within which the center may grow"

"describing the topological conditions ... a humid climate"

"a primary stage ... as one large cover ... the hyperboloid"

"the projected scheme ... thirteen similar corrugations ... a plastic conception"

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Submitted for the degree of Master of Architecture in the Department of Architecture on January 17, 1955

..... P R O V I N C E T O W N:

A U D I T O R I U M

for

MUSIC

and

EXPERIMENTAL DRAMA .....

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1. UNITY AND THE COMMON DENOMINATOR

By studying unity as the most significant and essential quality of the great architecture of the past, some thoughts on this subject have evolved as a basis for the design of an auditorium for music and experimental drama for Provincetown, Massachusetts.

Webster defines unity as a "state of being one; a totality of related parts; a complex or systematic whole," but it is his sixth definition which points the way in which unity can be achieved; " the reference of the elements of a literary or artistic composition to a single main idea or point of view." It is this single idea becoming the common denominator, which carries a work to success despite its deficiencies and mistakes. This is not to say that the element selected as the main idea is made so overpowering that the faulty parts are lost in the shuffle, but rather that the strength of this common denominator relates and ties together all of the separate elements so that the defects either reinforce the good parts by contrast or take on new values because of the relationships set up. Furthermore this thesis does not exclude the possibility of several elements unifying the design, but where this is so, one must be dominant.

Despite the inherent dangers of isolating and classifying the components of architecture, it is worthwhile to analyze the different media which play the role of common denominator:

Landscape - the organization of natural elements which surround and/or support architecture. Harvard yard in Cambridge offers an excellent example of how only a roof of trees can unite otherwise insoluble ingredients.

Space - the organization of volumes, proportioned and limited three dimensionally. Despite the unrelatedness of the shops and theatres along Tremont and Boylston Streets to the houses, apartments and hotels along Beacon and Arlington Streets, they compose an harmonious whole because of the special order set up by the Boston Commons and Gardens surrounded by circulation and bordered by openings to smaller spaces.

Geometry - the physical position of parts and the organized form of the whole. Apparently what character and interest one finds in Beacon Street between Arlington Street and Massachusetts Avenue is the result of a similarity in the physical nature of the houses which line its two sides from their bay windows and steps to their dormers and chimney pots.

Structure - the order by which material is put together to enclose space. The structure of the State Street block in Boston continues to unify the diverse functions and mishandled additions, both functionally by creating a flexible system and visually by producing a rhythm continuous throughout.

Material - the physical substance of which architecture is built. The Trinit Church of Boston and its parish house, exemplify how a good, sound material can harmonize an infinity of forms and adjust architecture to an awkward site

These examples were all taken from the Boston area, but the following subjects selected for analysis are cities and buildings which are generally considered among the best efforts of western man to create architecture and to develop city planning.*

Venice is a noiseless, placid, stagnant, crowded, crumbling, dirty city, and it is a fairyland. Probably no other city in the world lives quite so much on its past as an attraction to tourists or shows the effects of museum visitors as does Venice.

* these observations were made at first hand by the writer

It is a city with a history -- a history of a world center, culturally as well as politically; and there are great architectural monuments to prove it Its beauty, however, is not due fundamentally to these monuments but rather to ~~its~~ the water in which it sits. Water makes the city unique, but more important than that, it is the common denominator uniting marble with stucco, the endless maze of irregular passages with the grand simplicity of Piazza San Marco, the warm reds with the cold grays, the classicism of Palazzo Vendramin with the romanticism of Ca d'Oro. How well the Doge's Palace, the Campanile the Library and San Marco exist side by side even though one cannot see the water from which they all spring! The city was built in spite of the water and lives because of it, but no one can say it is an architectural contrivance. Rather each architect accepted it as the common denominator, the grounds on which his work would be related to what existed and what would come to be.

There are no ruins in the world as beautiful as the Acropolis. Located between heaven and earth, surrounded by the donut shaped valley that holds the city of Athens, this essence of the Greek civilization is a product of the best the world had to offer. Though the site planning and positioning of buildings is not well done in this writer's opinion, and though one may criticize its use of stone expressed as wood, as well as other debatable points, the results would be great architecture simply because of the form ~~of~~ or geometry of the buildings. But surpassing this seemingly incomparable quality as the backbone of the entire design is the pure white marble of which everything is built. Surviving the centuries, this noble material has kept alive the Acropolis and has united the dissimilar forms of the original group of architecture and sculpture as well as the broken pediments and pieced columns which exist today. The Parthenon floating classically on its base is at one with the Erechtheion relating itself to the uneven site by actually

following the contours; the rather dead coldness one is likely to imagine from such a degree of purity is never felt. The clean, smooth, soft surface of the stone is irresistible; it is elegant at one foot or one mile and appeal to every sense. Here the common denominator has been selected by architects who knew the material and its potentials.

Santa Sophia comes to mind spontaneously when one thinks of the term unity it illustrates how symbolism of unity in religion can be expressed in architecture. Situated at the summit of a slope this structure and other similar mosques appear as crests of waves rolling across the skyline of the city. Large domes melt into smaller domes as minarets sprout from symmetrical forms. Inside from the doorway of the narthex one sees the power and majesty of one vast space, the common denominator of a multitude of forms, of incongruous materials and colors. There are other spaces, connecting, augmenting, and transitional; and it is the ordering and articulation of these adjacent aisles and galleries as well as the intimate space created under the plane of chandeliers (defining the actual dimensions of the central dome) together with the overwhelming size and importance of the nave which classifies Santa Sophia as the masterpiece of Byzantine architecture.

Two points must be clarified: the common denominator does not actually demand of the other elements subordination in the sense of devaluation, nor is it just a featured attraction; rather it is the servant of every other particle; it is the one element which is so intimately connected to every other element that interrelations become easy and natural. In other words it makes possible freedom -- a freedom which allows concentrated effort to attain the highest ideals or permits complacence to produce the unpretentious. And it is here that the non-intruding quality of an architecture acquires value. Almost every architect unknowingly, if not purposely, creates something in his work which antagonizes the observer or leaves him cold.

Speaking of "unknowingly" and "purposely" leads us to consider just what decisions the Architect has in his hands in dealing with the common denominat Obviously he cannot always select the components he is to work with -- in fac sometimes he may only put together the raw materials given him. This is more true of the part of the program which determines the landscaping, the materia and the space order than it is of that part which governs the geometry, and t structure. But this does not mean that the latter are more valuable as the common denominator; in all probability the Architects for the Acropolis were told to use marble as the builders of Venice accepted the water as a reality. This leads to the question, is the common denominator "something" used "anywa "anything" used "someway," or neither of these? The first implies that the Architect's judgment in selection is his only responsibility, as the second suggests that ingenuity in use is the limit of his field. Neither is adequat the common denominator must be "something" used "someway" whether or not the "something" is chosen by the Architect, and whether or not "someway" is a product of his imagination.

There is one more quality that characterizes the common denominator, and that is permanence. "Yes" must be the answer to two questions: will it last in itself, and is it capable of keeping alive the Architecture it unifies, through the ages?

New Religions, new functions, and new appendices have not destroyed the ~~special~~ spatial quality of Santa Sophia; only a drastic change of the earths form wil drain or flood Venice; and apparently none of the natural elements will ever mar the marble of the Acropolis. Furthermore, ~~the~~ Architecture can be kept alive:

1. by using the common denominator to obtain a three dimensional flexibili capable of adjusting to new functions.

2. by making certain that the original beauty of the common denominator will survive despite the possible disintegration of other elements.

3. by designing (selecting and/or arranging) a common denominator which will assimilate any change or addition gracefully.

These the true common denominator will do automatically. These are the characteristics of great architecture.

An auditorium is one of the most complex of building types, and most of the time the designer is so occupied solving the mechanics that he seldom gets beyond the engineering aspects plastered over with a little architectur On the other hand he may start with an inspired concept which loses its origi meaning because it fails to adjust to the demands of the experts. The Royal Festival Music Hall and the Auditorium for M. I. T. are examples of these pro cedures respectively. Besides the technical problems of providing a large sp structure, an efficient flow pattern, and good hearing and seeing conditions, there are the problems of organizing a large space related to smaller ones, o relating the building as a whole to the site, and of creating the right feeling between audience and performer and between individuals in the audienc Moreover the problem of long-life must be solved since such a project is seldom the product of the public's passing fancy.

Mies van-der Rohe has proposed an auditorium for Mannheim, Germany based o his theory of a universal space, and utilizing the structure as the common de nominator. Frank Lloyd Wright has designed a theatre for Hartford, Connectic composed of such powerful forms that any correction due to technical requirements would hardly be noticeable. Though these two buildings have not been built, the reputation of the work of these two Architects is enough to guarantee that the concepts of these auditoria will survive erection demands.

What better way can Architecture of such complexity be given order, simpl city, and meaning than by creating a common denominator interpreting the resolved mechanics and transcending the deficiencies?

A. BACKGROUND:

Provincetown, more than any other location on Cape Cod, and possibly including the State of Massachusetts as well, has continually generated tremendous enthusiasm and activity in the creative fields of painting, sculpture, music, literature and the drama. Provincetown has provided a sympathetic clime in the past for such people as Susan Glaspell, George Cramm Cook, Hutchins Hapgood, Wilbur Daniel Steele, William Gaston, John Dos Passos Frederic Waugh, Richard Miller, Max Bohm, John Noble, Charles Hawthorne, Eugene O'Neill, Halsall and others. Today, men like Hans Hoffman and Joseph Hawthorne prove its efficacy undimmed.

Sixty years or so has given light to the productive energies of these people, yet during that time nothing has been done to recognize their contribution. The people of Provincetown and other responsible citizens have never given recognition to these activities, except to derive indirectly from them a source of income as a tourist attraction; a situation which does nothing to encourage the continuance of such an enviable history. Beyond the Provincetown Playhouse, grossly inadequate, there is nothing in the way of a permanent place where the creative productivity of the Town may adequately express itself. Certainly no permanent hall wherein concerts may be properly performed or group exhibitions to be shown, or theatre wherein experimental work may be continued, has been found, although the need has continually existed.

In contrast to this apathetic atmosphere, there is no question that the public, the audience, far from losing interest in the cultural aspects , has increased its interest and education to an all time point. This has occurred

in spite of the obstacles that have been strewn in its path by institutions and organizations that should have contributed to the propagation of these art

With the knowledge that audience interest is so tremendous, and can be expected to increase, it is proposed that studies for such a permanent center be made.

INTERESTS:

All creative activity in Provincetown may be said to fall within three categories:

Music

Drama

Visual Arts

(Literature, and its 'performance,' is placed within the category of Drama.

Joseph Hawthorne, the conductor of the Symphony Orchestra in Chattanooga, Tennessee, will direct the musical activities. Samuel Kootz and Phillip Malec represent the men responsible for the visual arts. Charles Moore will direct the drama; his position at Carnegie Institute in Pittsburgh, Pennsylvania. Al of these men have spent many years at Provincetown and have always been very active in their respective fields. Mr. Hawthorne has already been in the process of organizing the Cape Cod Summer Symphony, a group composed of approximately thirty musicians, assembled from outstanding orchestras throughout the country. This group had already performed successfully during the summer of 1941, but its career was short-lived when the war curtailed its activities. Mr. Kootz, director of an important gallery in New York City, has long been associated with the exhibition of the work of outstanding painters. Mr. Moore is also a prominent figure in theatre work at the Cape.

It was Charles W. Hawthorne, father of the present Musical Director, who began what is known as the summer art colony at Provincetown sixty years ago.

The climate was ideal and offered Hawthorne, an important painter of his time, a sympathetic environment for his work. A beautiful and peaceful landscape, with industrious people earning their livelihood as fishermen convinced him of its value as a place for creative thinking. Every summer thereafter thousands continued to find their way to Provincetown for much the same reasons, giving proof to Hawthorne's inspiration. Today, many people find the Cape's clime suitable the year round, but as yet, the major portion of the season's activities is confined to the summer months, and it is within these months, July to September, that the aforementioned activities will be scheduled.

PROPOSALS:

Having recognized the long standing need for a music and arts center in Provincetown wherein creative activity may express itself to an appreciative audience, Mr. Hawthorne, Mr. Moore, Mr. Kootz and Mr. Malecoat have begun discussions with the realization of such a center as their goal. It is understood that such a center, in order to do full justice to the various art that will perform, must meet certain minimum requirements and that the financing may subsequently be larger than could be handled by private individuals. Inasmuch as the Commonwealth of Massachusetts in general, and the Town of Provincetown in particular have long talked of promoting public facilities it has been suggested that this project would fall within the category of State and Local Government sponsorship. A site has been tentatively chose among the Provincelands, which are State owned. It is proposed that the Stat will donate this land for the Center. A second proposal is that the costs of the center be shared by the State and Local Governments as well as perhaps by private organizations and individuals. The operation of the Center is expect to be self supporting.

The following studies are prepared for a two-fold purpose. The first to aid in enlisting the support for such an enterprise, and the second as suggested methods of organizing it, with the realization of the Center as the ultimate objective.

THE CENTER:

Basically, the Center shall house the activities falling within the three categories, Music, Drama and the Visual Arts. Investigation shows that of the three, Visual Arts requires the least attention with respect to physical structure and acoustic considerations. It has also been determined that under optimum conditions each activity should be separately housed inasmuch as each is so highly specialized as to demand many conditions that are not common to all. Thus, a theatre for drama may play to an audience far larger than that required for true chamber music, and a chamber music audience should be smaller than required by a symphony orchestra. This study recognizes this fact, and while the solutions offered here indicate a single housing for all the activities, consideration has been given to providing for optimum conditions should time, money and effort deem it worthwhile.

Therefore, this study has made several decisions which affect the Center. The most important one recognizes the fact that the project by nature is a flexible one, due to many unknowns, and therefor provides for a system within which the Center may grow. Within this system, two solutions are offered. Each one is stated not to be the ultimate solution in terms of satisfying the individual requirements of the three basic activities. The system upon which the two solutions are built is stated to be an optimum one. Thus, each solution offers a single theatre to house all the activities required by the program. The system upon which these are built is in effect the organization of the site structure itself. One of the primary objectives of this study is to indicate such a system wherein all theatres may be built which will at once dictate the basic organization of any such structure, and yet allow the Architect freedom for his own expression.

THEATRE SPACE REQUIREMENTS

A. THE STAGE

1. The proscenium width affects other dimensions

   a. 25' minimum width

   b. height equals 2/3 that of width

   c. height above audience floor equals approximately 3'-4"

   d. Steps at side leading to the audience

   e. Adjustable or removeable proscenium a possibility

2. Width of stage

   a. Preferably equal to full stage both right and left

   b. Minimum: 1/2 full stage right and left

3. Scenery

   a. The Grid System

      1. Cubic footage required equals 450 x proscenium width

   b. Horizontal or transverse Grid System

      1. Allows greater stage space or 4 x stage space of ordinary grid system

4. Depth of Stage

   a. (1-1/4 - 1-1/2) x proscenium (30' - 35') minimum

   b. Fore-stage (Apron) 6' -8'

   c. Additional fore-stage created by removing front seats or pit for removeable stage sections

5. Floor Finish

   a. Fore-stage is of hard wood to curtain line or 2' behind

   b. Stage is of soft wood (pine or fir) long grain laid parallel to curtain. Covered by canvas or linoleum

   c. Stage may be trapped in 3' square sections

C. Side Walls

a. Unplastered

b. Painted to avoid reflections

c. Space on each side for stacking scenery

7. Cyclorama may be:

a. Permanent skydome

b. Plastered back wall

c. Flown stretched canvas

8. Fire Doors

a. Large door to admit scenery, properties to loading platform at stage height

1. Sheltered with roof

2. Masked from light when opened

3. Noiseless

9. Stage Entrance and Circulation

a. Door to auditorium - one left and one right

b. Cross-over stage

c. Act curtain

d. Fire curtain

10. Stage Lighting

a. May be on stage right if at same level

b. Overhead

c. Working space all around

d. Disappearing trough for foot lights

e. Spot lights from side wall or front of auditorium or spot booth

11. Sound Effects

12. Broadcast

a. Control and Soundproofed

B. THE WORKSHOP

1. Construction - Production - Preparation (Scenery building and painting)
   a. Access to stage (sound insulated)
   b. Lights, lockers, workbench, shelves, slop basin, running water, paint frame, paint bridge, storage
   c. Electrical Department
   d. Properties
2. Sufficient height of ceiling approximately 10' minimum
3. Space for platforms, etc.
4. Costume workshop and storage
   a. Damp proof
5. Make-up (Can be separate from dressing rooms)
6. Dressing Rooms
   a. Isolated - noise and light of stage
   b. Number of occupants varies from single, double, triple, etc. to chorus
   c. Storage
   d. Lavatories
   e. Kitchen
7. Green Room - assembly, rehearsal
   a. Between dressing rooms and stage
8. Music Room and Storage
9. Basement
   a. Boiler room
   b. Fuel storage
   c. Refrigeration
   d. Transformer
   e. Contactor room for stage switchboard
   f. Batteries for emergency lighting
   g. Pumps
   h. Incinerator
   i. Air conditioning, heating, ventilating

C. PUBLIC SPACES

1. Location

   a. Accessibility

   b. Exits on several sides

   c. Parking space

2. Circulation - ease of movement criteria

   a. Entrance

      1. Auto and pedestrian

   b. Vestibule

      1. Display

      2. Box office

   c. Lobby or Foyer

   d. Cloak rooms

   e. Men's and Women's rest rooms and lavatories

   f. Manager's office

   g. Usher Rooms and lockers

   h. Phone Booths

   i. Fire Precautions

   j. Maintenance

D. THE HALL

1. Size 6 - 8 square feet per person minimum

2. Shape

   a. Free from uncontrolled light

   b. Sightlines

   c. Accoustics

3. Balcony

4. Orchestra Pit

   a. 16 square feet per player

   b. 12 feet minimum depth

   c. Across entire audience

5. Seating

   a. Continental preferred

   b. Odd number of sections

   c. Rows

      1. Not parallel to curtain

      2. Staggered

   d. Side aisles

   e. Seats

      1. Widths - 19" - 24"

      2. Comfortable and silent

      3. Windscreen behind last row

6. Lighting

   a. Aisles illuminated

   Program reading

   c. Flexible in form and brightness

   d. Directed towards front

7. Exits

ABSTRACTS OF CORRESPONDENCE WITH CLIENTS

Mr. Samuel Kootz
Kootz Gallery
600 Madison Avenue
New York, 22, N.Y.

1. Letter of September 29, 1954

"........As I recall.....there was hope that the project would include a music shed, which could also be used for an experimental theatre. Nothing seemed to be decided, and I believe that someone attached to the Chamber of Commerce up there was to do a series of Interviews with the townspeople and with State officials to secure permission to use the land Hawthorne showed you.....Should it come about, I'd be delighted to see you do the plans....."

2. Letter of October 25, 1954

"I am delighted you have progressed so far with Messrs. Hawthorne and Moore, and hope that the whole project is shaping into reality. Perhaps.....the chamber music should be intergrated, rather than a separate shed. Don't forget that it will be impossible to have full symphonies each week, and that as many people will attend chamber music as well as symphony in a small community such as Provincetown... ...If some of the areas were protected and closed, I would lend work for display there and I am sure that other galleries would co-operate.

Mr. Joseph Hawthorne
Musical Director
The Chattanooga Philharmonic Association, Inc.
Hunter Gallery of Art
Chattanooga 3, Tenn.

1. Letter of November 3, 1954

".....I don't believe this project will have any use during the off season, since we are aiming at attracting the big summer population. July 4th and Labor Day are good terminals for the season. As to conflicts with the dramatic schedule: The first year, most of the rehearsals of the orchestra will take place on the middle of the Cape and probably not until the final two rehearsals will we be---in Provincetown, and therefore on the stage. If the project really "snowballs" by next summer, we would probably use the stage almost daily, in all probability during the mornings.....as to solo and chamber music, there is a good likelihood of there being a half-dozen performances during the summer. I would say that separate rehearsal facilities would not be necessary for the present, but it would be well in the scheme to allow space and the method of making available such practice space. Certainly ballet and choral works are very good possibilities.....as to a Green Room, there should be a small room for the guest soloist and conductor, and a middle size room for the orchestra members...a room where a piano may be housed without undergoing various climatic changes...."

Mr. Charles Moore
Director of Department of Dramatics
Carnegie Institute
Pittsburgh, Pa.

1. Letter of October 4, 1954

"....we are directing our plans toward the eventual financial and cultural expansion of the town as a whole...finding something to bring intelligent, cultured people to Provincetown and giving them enough so that they will be willing to stay...we want the whole thing so be run as a non-profit corporation, if possible....the location must take as much advantage of the Provincetown climate and at the same time be isolated from traffic. This makes a location in the Dunes as almost inevitable.....the town and the state must put up the money and cost is important. As to theatrical requirements, I think they should only be added if they do not detract from the musical requirements.

1. An orchestra pit for musical accompaniment when actors are using the stage.
2. Developement of the overhead portions of the shell to include fly lines for scenery. We do not need the grid system towering above.....just bars which can be raised or lowered to hang scenery, and bars at the front edge of the shell roof upon which to hang lights.
3. An equal space (as much as the stage itself) stage right and stage left.
4. Arrangements for dressing, storage of scenery and costumes.
5. A more highly developed switchboard than would be necessary for concerts alone.
6. Bars and electrical outlets in the shed part for front lighting.
7. A sloping auditorium of 1500 seats.
8. A water system
9. .....provisions for lighting equipment.
10. If the area were to be used as a location for the kind of symphonic drama such as Paul Green's The Common Glory, the four corners of the audience shed would have to be light towers and the electrical equipment would have to be powerful, extensive and flexible.

....it would be a shame to hide the heavens on fine nights, and the auditorium should have some arrangements for stormy night....this particular problem of creating sides and a ceiling which may not be used in fair weather is a tough problem...I would say that the problem is not to make a completely equipped layout which would be equally good for theatre or Music, but rather to make one which is primarily for music and which can be used for drama in a pinch."

Mr. Charles Moore
Director of Department of Dramatics
Carnegie Institute
Pittsburgh, Pa.

2. Letter of October 26, 1954

> "For your purposes, I think it is not feasable to attack the planning with a complete theatre set in mind. That's what I mean when I say the drama would be experimental....I would like to produce new plays in the modern idiom, which would be done on a bare stage. So that no matter what I produce, it could be done on an empty stage which has decent sight lines and a flexible lighting system. Trapping the stage is usually a good thing and inexpensive.. ...all the products would probably be small and done to give performances to plays which we feel have promise in the future development of the art...plays which because of their searching nature, do not have much of a chance in the commercial theatre.

B. THE SITE

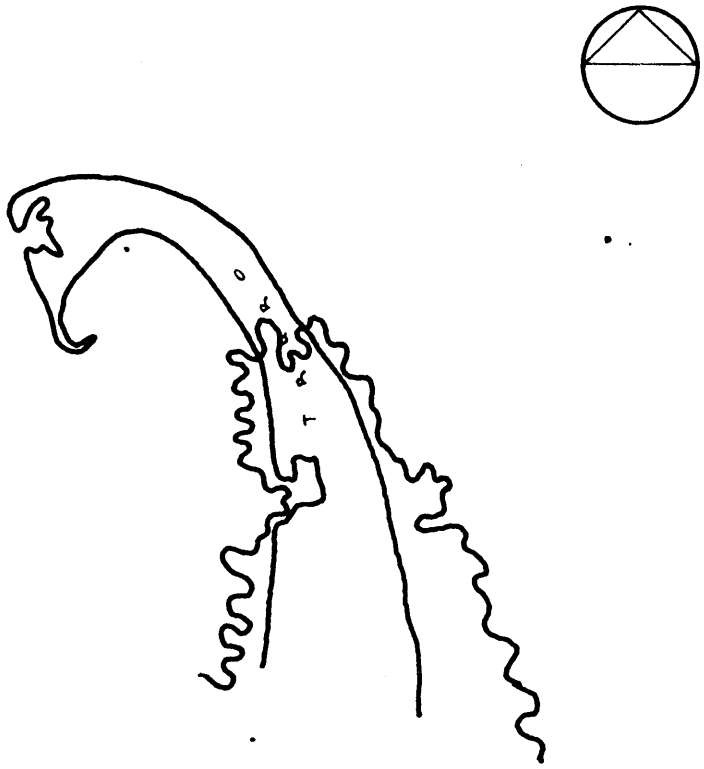
1. TOPOGRAPHY

This summary attempts to make use of scientific data in a generalized manner, with the object of describing the topological conditions of the area selected to build upon. A discussion of the formation of the tip end (Provincetown and the Provincelands) of Cape Cod is necessary in order that we can predict the stability of land.

The Cape itself represents a terminal end or moraine: of the last glacial period, and as such, is founded upon rock deposits, as are the major portions of the New England area. One of the interesting conclusions reached by oceanographers, based upon the fact that some parts of the New England Acadian shoreline presents a rocky beach, and other parts sandy beaches, is that the seas actually came to rest upon our present shores within comparatively recent times. The Cape may have been the result of the washing down into some water body the sands and gravels and rock from the melting glacier itself. At any rate, the terminal of these deposits is said to be found in the abandoned marine cliffs of the Truro Highlands. This is some five miles to the south east of our projected site. (See Drawing)

Due to wave and ocean current action, the original shoreline represented by the much indented line was slowly cut back, that is, on the east and west shores, as the current sought to curl around the projection of the Cape. Thus bars were deposited to the north of Truro Highlands, and this in turn altered the direction and intensity of currents in such a manner as to cause the Truro mainland to be eaten at from both shores, noticeably from the east, and to deposit these sands in the patterns shown by what is Provincetown and the Provincelands today.

That the Cape end is still in the building up process can readily be attest to by the fact that no serious receding of beaches is noticed here, while the



rate of receding at Truro is very noticeable indeed. Two major promulgations can be found at the Cape end; one at Race Point and the other at Long Point, which are growing in the directions indicated by observed ocean currents, that is, from the east, counterclockwise south and southeasterly in the direction of the west or bay shore of Truro. Both of these spits show layers and build-up of sand in this direction.

Conclusion:

The Cape end is comprised of semi-dense, semi-coarse sand with no rock encountered until a depth of over several hundred feet. These sands have been deposited by the action of waves forming visible bars in the direction of ocean currents, upon which were gradually built a succession of dunes, due to the action of wind forces. Observation shows a tendency for these formations to grow, rather than to decrease, contrary to conditions at the Truro Highlands, which has been the source of the sands of the Cape End. Shoals and sand bars formed by this action and found beneath the surface of the water tend to shift considerably due to wave and current action. The exposed surfaces of the Cape End itself, in particular, the high dunes, are also inclined to shift according to wind forces, except in areas where nature or man has provided adequate cover, such as shrub and grass growths. or actual buildings. Comparisons between U. S. Government Topographic Surveys and a more recent aerial survey made by the Harvard Air Research Institute in 1947 show no perceptable changes in the formation of dunes. Therefore, major consideration must be given to stabilizing the movement of the site. Sand, when properly contained, offers a good foundation for building upon. There is usually no problem of frost since water does not tend to accumulate but rather will drain immediately. Properly contained, sand offers a high degree of compressibility for foundations. Moving sand for excavation, for fill, offers no problem.

2. CLIMATE SURVEY

A general analysis of the Massachusetts Bay area, as stated by the Climate Control Series of the AIA bulletins, indicates a humid climate, with fast and heavy showers, a maximum of five thunderstorms a month in the summer. The RH is highest in the cool of the night and lowest in the heat of the day. More than half of the summer has pleasant RH conditions.

Thermal Analysis:

		percent of time				
		May	June	July	August	September
Air Temperatures	85-97	1	1.8	6.6	6.9	1.1
	65-85	18.5	49.8	76.8	75.7	34.8
	45-65	74.9	48.4	16.6	17.4	63.7
Dew Point Temperatures	65-85	0.7	8.1	34.2	35.5	8.6
	45-65	44.2	84.8	64.9	64.1	74.3
	25-45	52.4	7.1	0.9	0.4	17.1

Solar Analysis:

	May	June	July	August	September
Hours Sunshine	267	283	292	270	227
Clear-Partly-Cloudy	9-12-10	10-9-11	9-13-9	11-11-19	12-9-9
Noon Av. Btu's/sq.ft	225	235	235	220	200
Sun Height at Noon	67	71	69	62	51

Precipitation Analysis:

Precipitation	May	June	July	August	September
Most	10.83	9.13	12.38	12.10	11.95
Average	3.41	3.22	3.46	3.93	3.33
Days					
Rain	11	10	10	10	9
Thunder	2	3	5	4	2
Fog	1	1	1	1	2

Wind Analysis

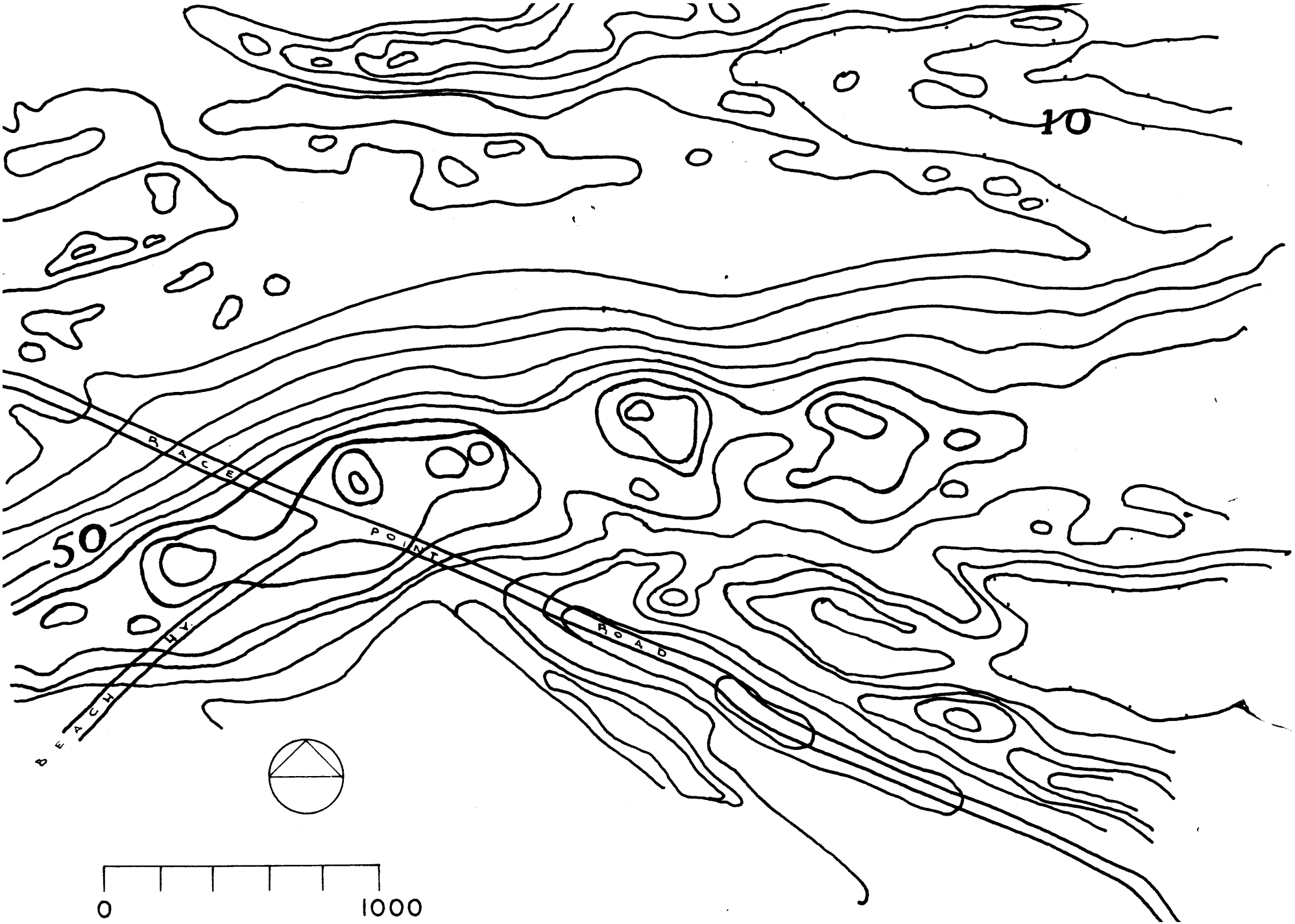
Prevailing breezes moderate to strong in the late afternoon can be expected from the SouthSoutheast in summer. Winter winds originate in the Northeast quarter. Northwest winds bring rain squalls. Easterly winds usually bring moderate breezes to calms, often accompanied by light rain or fog.

The Cape is particularly vulnerable to hurricanes. The South Shore about Woods Hole experiences the brunt of these forces, although Provincetown has often experienced hurricanes in excess of one-hundred miles per hour. These originate in the South, moving in a northerly direction; however hurricanes with "eye" centers sometimes occur and cannot be determined as to direction.

Note: The action of salt air at the Cape on metals is particularly corrosive. Metals therefore require the greatest maintenance. Concrete is the best building material to use.

Conclusion:

Provincetown offers one of the most pleasant climate conditions for vacationers during the summer season.


10
50
PACE POINT ROAD
BEACH BAY
0
1000

DESCRIPTION OF BUILDING SITE

The building site which is to be considered has been chosen for inherent advantages, attributes of land formations, and beauty, also for its proximity to Provincetown, to roads and bus lines, and to highway connections to Boston and other large centers.

Provincetown may be approached by rail, airlines and highways, linking it directly to Boston. The institution of Music and Drama Festivals could easily demand special trains and flights from that city.

The site is an elongated valley, one half mile in width, more than a mile in length, approached from the south at the intersection of Beach Road and Race Point Road, one and one quarter miles from the center of Provincetown. Sand dunes on the south rise to a height of ninety feet above the floor of the valley, while those on the north rise at least half that height. Those on the south have been selected to be built upon, offering a fair approximation of a good seating slope for the auditorium as well as a magnificent panorama of the ocean and dunes while those on the north offer good sound insulation from the noise of the surf on the beaches three-quarters of a mile to the north of the seating slope. Scrub pitch pine and a hardy grass form the only ground cover.

C. BASIC DECISIONS: The Decision to present two solutions within the framework of the original premise:

The decision to investigate two solutions was based upon the recognition of the large number and complexity of questions that arose as the result of reconciling the needs of a client within the framework of the initial premise of this study. Therefore, rather than indicate a complete solution in its highest form, it was necessary to present a succession of stages, beginning with the organization of the site, and the recognition that separate theatres would supply the optimum in performance level.

Inasmuch as certain factors such as audience interest existed in theory, a single auditorium in its simplest form was deemed necessary to begin with. This solution was to answer as many of the clients needs as possible within his present operating budget, to permit an auditorium to grow immediately, based upon the known audience interest. In this form the auditorium will perform symphonic music, chamber music as well as experimental theatre.

The second stage solution represents an effort to relate spatial concept wi structure and accoustics to as high a degree as possible. To do full justice to this problem, it was necessary to isolate these qualities as much as possit from the influence of an immediate budget, if the study was to have value as research. Therefore it projected itself into the far future to the time when an imaginary budget large enough to handle the problem would exist. With it grew the size of the audience. This auditorium would also house the performances of all three functions previously described, but also with the view that it eventually would serve purely as a music auditorium. Unlike the first solution which would be replaced, this solution indicates the final form of the music auditorium.

A. ORDERING THE SITE:

The site offers more in actual size and quality than do any of the other potential elements either implied by the requirements of the program or conditioned by the location of the site. Because of this and the very nature of a permanent project it was decided that the site should be so planned and landscaped as to fulfill all the requirements of a common denominator. By building retaining walls and levels it was possible to order the site so that immediate dimensions were defined, and so that circulation and related functions were organized. Moreover, a system of unity was created which would permit a later addition to be as diverse as a Gothic cathedral or a Geodesic dome. It is the one thing that is common to both solutions.

B. SOLUTIONS:

1. PRIMARY STAGE SOLUTION

a. Proposals:

While this study places the greatest importance and value upon the organization of the site structure as the primary stage, in order that the present client's wishes may be fullly complied with, the design of an auditorium seating approximately fifteen hundred persons, and at least that same amount out of doors, for the purpose of performing works of symphony orchestral work of thirty players, chamber music and experimental theatre may be said to be included within the framework of this primary stage. It is recognized at the outset that optimum conditions demand separate housing for each of these activites and that this entire study, must indicate how this may be accomplished. However, with the limitations of budget, and the unknown quantity of interest that may develope with respect to such a center for Provincetown, it is deemed advisable to divide the developement of the Center into stages, each representing more expenditure of time, money and effort.

Understandably the initial theatre, housing all three activities, having these burdens placed upon it, must accept certain limitations of performance. The greatest of these is the limitation of acoustic quality. The acoustic requirements of theatre and symphonic music and chamber music differ from one another, noticeably in reverberation time. Inasmuch as the client wishes to have a theatre that will play to an outdoor audience as well as an indoor one, it must be said that control of reverberation time must be acknowledged as practically impossible. The acoustic problem is thus resolve to the control of reinforcing sound as it travels out to the audience, both the indoor and the outdoor group, and if possible, the proper "mixing" or balancing of the components of sound waves reaching the ear of the audience.

Observation of existing theatres which play to dutdoor groups as well as to indoor ones show that it is at best a very difficult problem to provide sound at a proper sound intensity level to the outdoor audience without the additional aid of an amplifying system. This study does not proposeto enter this investigation, feeling that this can best be solved by an experienced technician.

Another limitation accepted by this study is that concerning the ability to change the size of the audience and the stage itself according to the nature of the program being offered. The auditorium used as a hall for symphonic music is expected to seat the full fifteen hundred people within and the same amount outside on the sand. Chamber music on the other hand is performed by a few musicians and should be directed to a smaller audience, preferably in the neighborhood of four hundred people. Inasmuch as the necessary reverberation time accorded to chamber music is impossible by virtue of the initial premise, the primary stage solution does not provide for the smaller audience by means of moving wall partitions, as they usually are an extremely complicated feature, or by the creation of a second hall either within or without the considered structure. This was decided in favor of creating a separate hall for chamber music in the future, within the framework of the site-system.

The third limitation is that of the difficulty of reconciling the same equipment to both performances of music and drama. This difficulty is offset by the nature of experimental theatre which will require a minimum of appliances.

The value of this solution is that of a study designed to indicate a direction of further investigation that will be pursued. The study has been made in terms of the organization of space within the framework of the site-system, in terms of the structure and finally in terms of the acoustics.

b. Space Organization:

The approach to the problem of a primary stage auditorium and its inherent limitations led to the decision to relate all the activites within a form of "Universal Space" which would act as one large cover for these activities. This would reduce the complexity of forms arising from the nature of the individual activities considered and would thus be in keeping with its conception as a primary or basis structure. A system of levels in relationship to the general site-system is designed to separate the circulation of the audience and the performers. The shape of the hall is articulated to define the indoor audience and the outdoor audience. Besides relating all the activities beneath the unifying cover, attention has been paid to the creating of interesting and inviting spaces, which describe in themselves the nature of their function. Thus the entrance must be clearly defined. The audience as it approaches the lobby area, the lobby functions and finally the hall itself must feel the direction.

Within the hall itself, the problems both optical and acoustical must be solved. The theory of "presence" has been discussed under "CORRESPONDENCE" and the stage and seating arrangement in this solution has attempted to illustrate this. A wide seating angle of one hundred thirty degrees with respect to the projected stage has been considered which has reduced the depth of seating rows considerably.

c. The Structure:

The Geometry

The mathematical figure known as a hyperboloid has been chosen to describe the structural shape of the cover. In three dimensions the figures that correspond to the conics in the plane are quadric surfaces and one of these quadrics is the 'one sheeted' hyperboloid. It can simply be generated by revolving a hyperbola about its axis. It can also be said to be made up of two families of straight lines, every three lines of the same family are in general position, while each line of one family intersects all the lines of the other family.

It is possible to graphically present such a surface with either a circle or ellipse as a transverse section. At any given distance along a central longitudinal axis from the central section or 'throat' the desired section is drawn. In the case of a circular section, equal divisions are mad along the circumference of the circle and straight lines are drawn connecting points of one section to the other at a frequency decided upon. The frequenc and the selected size of end sections will determine the size of the throat and the rate of the 'shape' of the figure. In the case of a hyperboloid of an elliptical section, the points along the circumference of the ellipse formed by the circle-projection method derived from equal divisions along the circumference of the circle will constitute the same points of reference and the hyperboloid may again be drawn with the same factors governing the size and shape.

The size and shape decided upon is related to the needs of the activitie to be covered. An elliptical section was selected because it offers in section less height for the same diameter, (The major axis in this case.) A plane containing the major axes of all sections has been taken through the figure and is used as the ground level.

Planes askew to the considered sections have been taken at either end of the figure in relation to the areas and volumes required. The circumference of these two planes may be said to describe arches or rings".

The surface described between these two rings is therefore a portion of the hyperboloid figure and may be considered as a form of suspension. In reality, the surface is ruled by an infinite number of lines similar to the ones used to graphically present the figure. If the figure is constructed in its final shape of a suspension system of cables, these will act in tension. If the system is of light steel, rigid members welded to each other, the member running the length of the figure may be said to be in tension, and those circling the girth of the figure to the ground at either side may be said to be in compression. A homogeneous surface, such as a thin shell concrete would assume stresses commensurate to those of the light steel two-way grid system. In all cases, the two outer rings would behave as arches, receiving compressive stresses within their planes and transferring them to the ground.

Materials

This study cannot decide upon any of these systems mentioned above but can only suggest that these are all possibilities worth considering. Each one has advantages and disadvantages which should be considered in proportion to the function it is to perform..

The first system, a pure suspension system, with canvas reinforced by light steel cables acting as a form of tent, would seem to require the least effort in erection. The initial cost would arise in the cutting of the canvas segments to desired shape, and the forming of the webbing and sleeves and sewing this into the final form. In the case of the elliptical section, only four similar patterns occur for each single pattern. As in the case of all large ter this would have to be designed in sections, perhaps in twenty-five foot lengths along the longitudinal axis.

Every joint will need waterproof designing, although the shape does lend itself to good drainage. The big problem encountered here is that encountered in any suspension system. Fluttering can cause the failure of any of the materials involved. In the case of the canvas reinforced by steel cables, this can be considerably offset by certain design. Theoretically this surface represents a minimum one. However, this is dependent upon the ability to maintain the straight line generators as straight lines. This is impossible as all completely flexible materials placed in equalibrium under given forces between two points will tend to fall into a catenary curve. However, another method of placing the steel cable reinforcin is left for investigation. It is possible to connect the vertices of all the diamonds formed by the first method (the straight line generators.) This will result in two series of curved lines or cables, one running the length of the figure, convex with respect to the ground and describing the shape of the figure, and the other, describing the circumference of sections joining any series of vertices across the narrow dimensions of the figure, and concave with respect to the ground. The former family is already lying in its catenary position. The latter act as ties to the ground and can be loosely described as pre-stressing the former.

Additional ties may be necessary where the figure becomes large in its opening as the surface there becomes fairly flat. These can be taken directly to the ground. A test model of canvas without any reinforcing other than the overlapping of canvas segments develops great strength where the curve is most pronounced, that is, at the throat, and has a greater tendency to flutter at the outer, larger extremes.

These problems, as well as those encountered in erecting and maintaining the structure (canvas will shrink when wet and therefore needs adjustment in tension) must be solved.

Once the surface is erected, and provided the fluttering problem can be safely contained, there is the additional problem of the noise resulting from rain falling upon it. While rainstorms are by no means the common order of the day, they do occur and would render a performance intolerable. The possibilities of postponing or cancelling performances must be weighed. Climate control studies indicate a very high percentage of clear summer evenings, which is the expected time of performances. The absence of form work and interior supports, as well as a demountable surface in case of carefully planned outdoor performances make this solution attractive. Lighting could enter from above the canvas surface and enter through it, diffusing itself pleasantly for overall effects. A canvas tent such as this may be presumed to have a life span of three to five years.

Another possibility is that of the light steel two way grid system with perhaps canvas again as the cover. The canvas could be rolled down at any of all sections, providing for many interesting variations of outdoor-indoor relationship. However, the corrosive nature of the salt air would raise serious objections to maintenance problems, metal surfaces requiring frequent coats of paint. As a structural system based upon previous experience, this may be said to have extremely good possibilities. The fact that it a much more permanent structure may raise some questions when considering the possibility of constructing the secondary stage solution of this study in the near future. Over a long period of time, the two way grid system could assume proper proportion as an answer.

A third possibility is the thin concrete shell. This is the best surface with respect to maintenance. However, this requires the most form work of all. In comparison to the secondary stage solution, this bears an even poorer relation. A highly developed method of precasting elements in addition to the thin shell is a variation. The thin shell itself would have to act as a suspension system as well.

d. Conclusion:

Any of these systems, as well as others, or combinations of others, require additional study by qualified experts in structural analysis. An immense amount of calculations, wind tunnel tests and other static tests would have to be made of each, as well as a chart of comparative costs. This study presumes only to indicate an approach to the given problem within the framework of the theory discussed before. At this point other studies of the kind described above will have to be made.

e. Acoustics:

Consideration given to the acoustics of this solution are placed under limitations, as has been previously stated. Having reached the decision to open the auditorium to an outdoor audience meant the elimination of reverberation time being controlled. Therefore the problem resolves itself to properly reinforcing the distributed sound waves and to ensure their proper "mixing".

The shape of the auditorium bears some observations, as well as the materials with which it is to be constructed. As a geometric shape, there will be to some extent a focusing of sound in the auditorium. This will occur providing the surface is relatively smooth to the surface of the hyperboloid figure. However, if this surface is canvas, little or no focusing will occur inasmuch as canvas absorbs practically all the sound and therefore reflects very little. What little will be reflected will generally aid in the reinforcement of sound to the outer audience, much in the same manner as a megaphone or cupped hands act.

In this case additional reinforcement must be provided by means of a shell about the stage area itself. If the auditorium cover is to be constructed as a thin shell of concrete, then reflective qualities will definitely have to be taken into consideration. The "mixing" quality of the surface will have to be further investigated.

As stated before additional methods of maintaining a proper sound intensity level for the outdoor audience may have to be resorted to, such as an amplifing system.

pr: AMED III
"SOLUTION"
"SECONDARY"

2. SECONDARY STAGE SOLUTION

Based on the fact that an open air auditorium does not provide optimum conditions for enjoying the spectacle nor adequate protection from the elements, the projected scheme was designed as an enclosure seating a total of 2500 persons by extending the original seating dish and enlarging the lobby and back stage services. Furthermore, the original multi-purpose requirements were eliminated in favor of a separate structure for chamber music and intimate theatre, so that the main auditorium was designed for music and experimental drama requiring a minimum of stage apparatus. It is also assumed that by enclosing the auditorium the season will be extended from sping into fall.

The seating dish is enlarged taking advantage of the natural slope of the site so that the focal point of sight lines is located at the orchestra pit between the stage level and the main floor; this necessitates stepped aisles throughout. In order to seat 2500 people within the desired visibility limits from the stage, the seating fan is spread one hundred and thirty degrees, this also helps an individual to feel he is more a part of the audience since he is facing other spectators. The transition between the large enclosed space and the outside is accomplished by the circumscribing lobby and lounge area with a low ceiling and small enclosed services. In making the rear wall of the stage convex to planar rather than concave, the stage itself is thrust into the audience as in the Elizabethan theatre. Behind this wall the necessary services, performers quarters, and administration facilities are housed in a simple space that allows complete flexibility in arrangement by a system of modular volumes.

For permanence in the damp, salty atmosphere of Cape Cod, reinforced concrete is used in the form of a folded plate; the thirteen similar corrugations are poured individually on a moving form. The back stage structure is laid out on a diamond pattern to correspond to the connection with the house property and the edge of the retaining wall.

Since the side walls cannot be counted on acoustically for directing sound waves, the ceiling of the hall must do the job alone. Therefore it is generally directional in shape and is broken up for fine diffusion at the stage end and for more directional diffusion at the lobby end. This break-up is accomplished by paneling the ceiling in plywood in the form of pyramida coffers. The volume of the hall is 1,039,400 cubic feet, and the optimum reverberation time is 1.96 seconds at 500 cycles per second. As the chart below indicates, the seats were considered two-thirds full, and the space behind the last row of seats and the openings to the lobby was considered void with an absorption coefficient of 1. in calculating the reverberation time. The ceiling panels are random braced to develope absorption coefficients of .225 for 125 c/s; .247 for 500 c/s; and .253 for 2000 c/s. The design of one ceiling bay including the variable air space, random bracing, and 1/2" and 3/4" plywood is repeated thirteen times.

The air space between the panels and the corrugated concrete roof system is available for service ducts and conduits for air conditioning and electric as is the service tube beneath each aisle. Fresh air is circulated through t ceiling space while stale air is exhausted through aisle system. Both supply and return ducts for the lobby lounge space are provided in the aisle tubes.

By submerging the back stage services below the pedestrian level, the remaining form consists of a single roof enveloping a single space closely related to the platform and retaining walls. Taking advantage of the use of concrete, the general concept is a plastic one organized and disciplined by the functions involved. Thus the external form reflects the plasticity of the site and at the same time is in contrast to it as a very fixed duplicated

form against the everchanging, freeform sandscape of Cape Cod. It is a seashell washed ashore.

locale	material	area sq.ft.	absorption units					
			125 c/s		500 c/s		2000 c/s	
			α	1.6 T = 3.14	α	T = 1.96	α	.9T = 1.76
total required unit				17,000		25,000		27,000
2/3 audience		1680 people	2.	3360	5.	8400	5.5	9240
1/3 empty seats	upholstered	840 seats	1.3	1092	3.	2520	3.4	2856
lobby openings	void	3380	1.	3380	1.	3380	1.	3380
aisles	carpet on concrete	2916	.1	292	.3	875	.5	1458
side walls	concrete	12,240	.01	122	.02	244	.02	244
stage floor	wood	2925	.1	293	.1	293	.1	293
total units				8549		15,712		17,471
remaining units				8451		9288		9529
ceiling and stage rear wall	plywood panels	37,557	.225		.247		.253	

REVERBERATION TIME CALCULATIONS PROJECTED SCHEME pr: AMED
volume 1,039,400 cubic feet Tr = 1.96 seconds 2520 seats

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