ELECTRONIC MUSIC CENTER

ARCHITECTURAL THESIS
BY DAVID MCEOWEN
VOLUME 1

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Professor Paul Laseau - Architectural Design
Professor C. Daniel Woodfin - Architectural Design
Professor Stan Geda - Landscape design
Professor Robert Koester - Architectural Design
Professor Tony Costello - Architectural Design
Graduate Assistant Jack Wells - Architectural Design
Dr. Cleve Scott - Technical Advisor
INTRODUCTION
Electronic music is any music that uses electronically generated sound or sound modified by electronic means, sometimes accompanied by live voice or musical instruments, performed live or delivered through speakers. In the past 20 years the field of electronic music has established itself at the forefront of contemporary music. It has been explored by serious classical composers and at the same time, the techniques and equipment of electronic music have been exploited by musicians of all types of music, from pop to rock to jazz. With the development of this field into one of the major areas of modern music, the inclusion of electronic music theory into the music school curriculum has become essential.

For my thesis project I have elected to design an Electronic Music Center for Ball State University. The center has as its purpose the composition, research, and performance of electronic music and provides facilities for bio-medical/musical and acoustical research. The building program calls for a 55,000 square foot facility consisting of a 500 seat acoustically adjustable auditorium, six specialized recording studios, classroom spaces, a music library, and faculty/administrative offices.
A critical issue in the development of the design of this facility was the critical acoustical requirements of the auditorium and studio spaces. Both control of sound inside the space and isolation of that space from exterior noise were significant design constraints. A second issue affecting the design of the facility was that of the kind of image that a building of such unique functions should project. The development of the appropriate building image as expressed in formal vocabulary, materials, colors, and juxtaposition of building elements was a major design issue throughout the project.

This thesis project then has presented me with a challenging array of problems with which to deal. In addition to the traditional architectural concerns of programming, site analysis, schematic design, and design development, the technical problems of acoustical control and the philosophic aspect of the appropriate imagery have given this thesis project an added depth and excitement. The project has been, I feel, a valid exercise in developing my skills as a designer.
The design of any educational building should have as its main concern the ease of functioning of its academic activities, and the physical, social and psychological well being of the students, faculty and staff. The students must be free to pursue their composition, recording, or performance without distraction and in an atmosphere that is non-fatiguing or under stimulating. The facility should feel comfortable, spacious and warm, a place where the composer can relax and concentrate on his creative activity.

Composition, like any creative activity, is a personal thing, and the building must respect the need of personal privacy on the part of the composer. However, creative endeavors also thrive on the criticism and feedback of ones peers. The composer should have a range of choice in the degree of privacy in which he works, private, semi-private or group. The building should as much as possible allow for and encourage the development of responsibility on the part of the student and the realization of his full potential. The physical environment should reflect a feeling of trust, intellectual openness and freedom conducive to the development of creativity in this field.
The essence of electronic music is new, fresh conceptualization traveling beyond the bounds of traditional music. It does this through the use of advanced electronic technology and sophisticated recording techniques. The studio building should reflect this essence in its forms, materials and methods of construction.

The building should encourage a feeling of "esprit de corps" among the students, faculty, and staff. They should have a pride in their facility and their activities in it. The development of this attitude will assist in the establishment of an identity of the studio as an important and vital aspect of the entire music school. The significance of this area of music should be expressed in the building forms and siting.
The unique functional demands of this building required that the traditional design approach and philosophy be reevaluated and that a new architectural aesthetic be developed. The basic questions of what are the appropriate forms for a building housing such abstract and rationalistic functions as the composition of electronic music, and what is the nature of the theatrical/musical experience, had to be dealt with.

Electronic Music is a very abstract, conceptual type art form, dealing with mathematical, geometrical relationships between the sounds and the tones used to produce the music. The building forms should reflect this abstraction, this geometric nature of the functions. For this reason simple, abstracted, geometric forms were used as the basic building vocabulary.

Additionally, the nature of the theatrical/musical event as an illusionary experience was explored. Any musical performance is an excursion into the fantasy world of the composer. The concert goers as they approach and enter the concert hall should be prepared for the illusionary world they will experience within. The areas around the hall (approach) and the support areas
within the hall (lobby, entrance) should present a surrealistic environment, utilizing elements of surprize, shock, fear, intimidation, disorientation and awe to effect a transition between the real world and the fantasy world of the performance. Specific techniques for accomplishing this are the use of optical illusions, juxtaposition of incongruous building elements, distortion of scale, the development of tension in formal relationships, the use of pure abstract forms, and the exploitation of the aweing power of symmetry. All these techniques were explored in the development of the design of this building.
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PROGRAM
Undergraduate students with Electronic music electives
Theory and composition majors
Graduate students in Theory and Composition
Doctoral Fellows
Visiting artists
Music appreciation classes
Faculty
Technical staff
Maintenance staff
Visiting educators
General public (concerts)
## ACTIVITIES

<table>
<thead>
<tr>
<th>Category</th>
<th>Sq. Ft.</th>
</tr>
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<tbody>
<tr>
<td><strong>Academic</strong></td>
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<td>2 Lecture/Demonstration @ 600</td>
<td>1200</td>
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<tr>
<td>3 Seminar @ 150</td>
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<tr>
<td>Library</td>
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<td>Lounge</td>
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<td><strong>Research Offices</strong></td>
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<td>6 Doctoral Fellows @ 150</td>
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<tr>
<td>Visiting Artist</td>
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<td><strong>Studios</strong></td>
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<td>Main Analog</td>
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<tr>
<td>2 Recording Studios @ 600</td>
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<td>Bio-Medical</td>
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<td>2 Training Studios @ 150</td>
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Academic

Lecture/Demonstration

I. Description - Here will occure the introduction of basic electronic music techniques, history of the field, demonstrations of small portable equipment.

II. Number of People - 1 Faculty
   15-20 Students

III. Equipment - Should have adequate electrical outlets for portable equipment (turntable, tape recorders, amps, speakers). Closed circuit television to the main studio and wired to the main studio to recieve output from equipment housed there.

IV. Heating/Ventilating/Lighting/Acoustical Needs
Should be isolated from exterior sounds and soundproof in itself. Natural lighting, ventilation and views are appropriate. Some storage area for equipment is needed. Security for equipment is essential.
   Fresh air - 12 CFM/Person
   Lighting - General 70 fc
   Demonstrations 70 fc
   Required fire exits - 2

V. Special Needs - A cheerful, bright, stimulative atmosphere is desirable.

Library

I. Includes stacks, record tape storage, check out desk, reading area, listening booths, librarian's office. Place for quiet study, reading, research, listening to tapes/records, browsing.

II. Should accomidate 10 - 15 students at one time, librarian and assistant.
III. Tables, chairs, storage, play back equipment, listening booths.

IV. Acoustical isolation (from noise sources) is essential. Natural lighting, ventilation and views are appropriate although care must be taken so that study areas are not in direct sunlight.

- Fresh air - 12 CFM/person
- Lighting - Reading 70 fc
- Stacks 30 fc
- Check out 70 fc
- Humidity - 45-55% (never above 60%)
- Temperature - 75-76°
- Required fire exits - 2

V. It is very important for the individual to be able to establish his own territory and maintain his privacy, acoustically and visually. A bright, stimulative atmosphere should prevail.

Lounge

I. To be used by students and faculty for relaxation, socialization and refreshments. Students will come here to get away from the pressures of the academic routine. The design should encourage social interaction, casual group get togethers, discussions, etc.

II. 20 - 30 people

III. Vending machines, comfortable chairs, tables.

IV. Should relate directly to the outside. Natural lighting and views are essential to the creation of a relaxing atmosphere. Natural ventilation is also appropriate. Because this is a fairly active area, it should be acoustically and visually isolated from other parts of the facility.

- Fresh air - 12 CFM/person
- Lighting - 30 fc
- Required fire exits - 2
V. The individual should have the option of quiet personal meditation or interaction with his peers. The environment should respect this and allow for the appropriate territoriality and privacy to be established.

Research Offices

6 Doctoral Fellows

I. Office space for graduate students pursuing special research. In this area will be reviewing articles and books, writing, listening to tapes and records, reviewing compositions, and meeting with faculty and students for discussions.

II. 2-3 people

III. Desk, chair, filing cabinets, turntable, tape, etc., chairs for visitors. Should be wired to the main studio to receive outside input from equipment there.

IV. Natural lighting and ventilation are appropriate. Should be in relatively quiet area.
   Fresh air - 15-20CFM/person
   Lighting - 100fc
   Required fire exits - 2

V. The graduate student must be allowed the option of isolation (privacy) so that he may conduct his own research, and also accessibility to those who desire his help, or to whom he wishes to speak. To this end he must be able to establish a definite territory and to indicate whether that territory is to be violated or not. His own office space must be readily personalized.

Visiting Artist

I. The artist will be reading, writing, reviewing compositions, composing, meeting
with students and faculty for discussions and listening to tapes and records.

II. 3-4 people

III. Desk, chair files, shelves, storage, chairs for visitors, tables, turntable etc., provisions for computer terminal, wired to main studio for output.

IV. Natural lighting, ventilation and views are appropriate. Should be in quiet area.
   Fresh air - 15-20 CFM/person
   Lighting - 100fc
   Required fire exits - 2

V. The visiting artist will need the option of privacy versus accessibility. He must be able to establish his privacy when he so desires. The office should be spacious and comfortable.

Studios

Main analog

I. In this studio the major most intricate compositions will be produced. The composer will in this space generate sounds using various electronic devices, modify these sounds then record the sounds into a pattern he has predetermined. Often live acoustical instruments will be used as sound sources. These instruments, if convenient, will be located and recorded in the main studio itself. Larger instruments or ensembles will be recorded in the recording studio. This means that these two studios be visually connected as well as electronically.

II. 1-2 composers
   1 faculty
   2-3 supporting musicians

III. 6 sine wave generators
   1 white noise generator
   1 pulse generator
   1 reverb unit
   1 variable pass band filter
1 ring modulator
1 amplitude filter
1 frequency shifter
1 voltage controlled synthesizer
1 envelope shaper
5-6 microphones
1 mixing console
1 patch board
4 2 track recorders
1 4 track recorder
5 tape splicers
4 loud speakers
1 grand piano
percussion instruments

The studio equipment should be modularly assembled so that different pieces of equipment may be patched through the main console to other studios in the facility, enabling output from the main studio equipment to be used in other studios directly. All equipment in the studio will be connected to the main mixing console which will feed output to the tape recorders or speakers or both. Connections to the main BSU computer are also required.

IV. Acoustic isolation is a absolute necessity. A STC number of 56 or more is necessary for studio construction and a NC Curve of 15 is the maximum limit for sound within the space. The interior acoustics should be relatively dead.

- Fresh air - 15 CPM/person
- Lighting - 70 fc
- Humidity - 50% ± 5%
- Temperature - 70° ± 3°
- Required fire exits - 2

V. As composing demands concentration the facility should allow for privacy when it is desired. The studios should be accessible for faculty assistance when needed, and be acoustically isolated from each other and other areas of the facility.
From time to time in any activity diversions are needed to provide relief from the intensity of the work. The composer must be allowed the option of interaction with his peers, by visiting other studios, other parts of the building or opening up his studio to visitors. The studio environment itself should not be barren or harsh, but warm, comfortable, with enough visual variety so as not to be monotonous. It should be bright enough however so as to not be sedative.

Recording Studio

I. Consists of the recording area and the control room. The recording area is the area in which medium to large size ensembles will record. Should be acoustically moderately live. Should be directly visible to the control room.

The control room is where the engineer operates all the recording equipment and monitors the performance. Visual and verbal cues are given the performers in the recording area from the control room. Should be acoustically isolated from the recording area.

II. 2-10 musicians in the recording area 1-2 engineers in the control room.

III. 6-7 microphones, music stands, chairs (in studio). Two tape recorders, 1 mixing board, 1 patch board, monitor speakers (control room.)

IV. Acoustic isolation is imperative. Must be basically a live space but have the capacity for adjustment of the reverberation time for varying performances.

- Fresh air - 15 CPM
- Lighting - 70 fc
- Required fire exits - 2

V. Privacy is important for concentration but the recording area should have the capacity to be visually in contact with the main studio space.

A comfortable, and relaxing atmosphere should be generated, not sterile and barren.
Bio-medical Studio

I. In this area human subjects are examined as to their vital signs; heart beat, brain waves, resperation, skin conductance. Information generated here is recorded in the control room. Biological responses to certain musical stimuli will be examined as will the physical state of being during musical performance. Investigations will also be made into the physical perceptions of sound.

II. 1-2 subjects
1-2 researchers.

III. Examination table, chairs, piano, examination equipment.

IV. Must be wired to the control room so that vital signs may be monitored. Acoustical and visual isolation from exterior areas is critical.
- Fresh air - 15 CFM/person
- Lighting - 70 fc
- Required fire exits - 2

V. Privacy for the subject to be examined is very important. The atmosphere should be as relaxing as possible so that the subject will feel at ease and realistic readings can be made.

Training Studio

I. For the development of basic skills, not requiring the variety of equipment present in the main studio. Students here will develop basic techniques of sound generation, modification and recording and splicing. Individual instruction form the professor will occur here.

II. 1 composer
1 instructor
III. Synthesizer
   2 tape recorders
   Splicing block
   Mixing board
   Speakers
   The studio must be wired directly to the modual components of the main studio so that their output can be used in the training studios.

IV. Acoustical privacy is essential. Natural ventilation and lighting is appropriate only if isolation is maintained.
   Fresh air - 15 CFM/person
   Lighting - 70 fc
   Required fire exits - 2

V. The studio must be private but easily accessible from and to the faculty area.

Administration/Faculty

Director's Office

I. The director deals with the coordination of various aspects of the center, as well as administrative and teaching duties. In his office he will read, do paper work, review scores, listen to tapes/records, talk with students and other visitors.

II. Director
   2-3 guests

III. Tape recorder, turntable, amp, 4 speakers, space for computer terminal, style M Steinway piano, built in bookshelves, chair, table, storage space, visitors chairs and table, filing cabinets.

IV. Should be in quiet area. Natural lighting, ventilation and views are appropriate.
   Fresh air 15-25 CFM
   Lighting - 100fc
   Required fire exits - 2
V. The director should have access to and be accessible from the studio space. However he should have the option of privacy when he desires it. The atmosphere should be relaxed and dignified.

Faculty offices

I. Faculty will prepare lectures, read, review student work, listen to tapes/records, write.

II. 1 faculty
    1-2 visitors

III. Desk and chair, outlet for computer terminal, wired to main studio for output, amp, turntable etc.

IV. Should be in quiet area.
    Fresh air - 15-25 CFM/person
    Lighting - 100fc
    Required fire exits - 2

V. Should be available to students but private when needed. Comfortable and cheerful in mood.

Secretary

I. Serves all faculty and director. Does typing, filing, makes appointments, controls visitor flow.

II. 1 secretary.

III. Desk and chair, filing cabinets.

IV. Should be in quiet area. Care should be taken that noise generated by the secretary is not disturbing to the faculty or other parts of the facility. Natural lighting, ventilation, and views are appropriate.
    Fresh air - 15-25 CFM/person
    Lighting - 100fc
    Required fire exits - 2

V. A cheerful atmosphere is desirable.
Conference

I. Small to medium sized meetings occur here. Small presentations and demonstrations will be made and group discussions will take place. Should be serviced and circulation controlled by the secretary. A small area for making coffee and serving refreshments should be available in the room or immediately adjoining it.

II. 8-9 people

III. Table and chairs, chalk board, demonstration area, turntable etc., wired to main studio.

IV. Acoustically and visually private.
Natural lighting and ventilation are appropriate.
Fresh air - 30-50 CFM/person
Lighting - 100fc
Required fire exits - 2

V. Should be relaxed and comfortable in atmosphere.

Performance

I. This facility will be used for experimental purposes, (for developing new techniques and ideas) and the presentation of major works in concert. The typical audience-performer relationship is not appropriate. The audience is not a static observer/listener, but must be involved and surrounded by the performance. Sound direction must be completely variable about the audience. Lighting must be completely variable and include not only the "stage" but also the audience. There must be the provision for changing scenes during the performance and for having multiple scenes appear simultaneously. Back projection and multiple screening must also be available. The space must be completely adjustable acoustically in terms of reverberation time and the dispersal of sound within the space. The volume and configuration of the space itself must be variable. The space must be electrically connected to the
to the main studio so that equipment there may be heard in the hall. Outlets for the operation of portable equipment must also be provided.

II. Seating for 500
   Stage space for 30 musicians

III. Seats, lighting tracks, acoustical modifiers, mixing board, storage.

IV. Absolute acoustical isolation is essential. Because all of the aspects of the interior environment are to be controlled, natural lighting, ventilation and views are not appropriate.
   Fresh air - 7-8 CFM/person
   Lighting Intermission - 10 fc
   Performance - .1 fc
   Foyer - 10 fc
   Lobby - 10 fc
   Required fire exits - 2

V. Atmosphere must be completely variable through the use of lighting, acoustics, scale of space, color. Configuration of stage(s) and audience must be highly variable.

Staff

Technical director

I. Should have space for keeping records on all equipment. Should be situated so as to be able to supervise shop use.

II. 1 director
    1 visitor

III. Desk, chair, filing cabinet, bookshelves.

IV. Natural lighting, ventilation and views are appropriate.
Fresh air - 15-25 CFM/person
Lighting - 100fc
Required fire exits - 2

V. No special needs

Repair area

I. Here will be stored a small technical library, spare parts and tools. Small portable components will be brought to this area to be repaired. Major components will be serviced in the studio and space should be allowed for this. This area will also be used to design specific pieces of equipment needed in the studio. Small group discussions may also take place in this area.

II. 2-3 technicians

III. Storage for parts, tools, counter space, testing equipment.

IV. Should have adequate lighting for small detail work. Views to the outside are appropriate.

Fresh Air - 15-25 CFM/person
Lighting - 100fc
Required fire exits - 2

V. A clean efficient atmosphere is desirable.
## Matrix

|---------|----------|-------------|--------------|-----------|---------|--------|--------------|------------|---------|-----------|-------|

### Relationship Indicators

- No Relationship
- Far
- Near
- Adjacent
- Co-exist
GOALS

The building should act as a terminus to the axis defined by Emens Auditorium, University Hall, and Bracken Library.

The act of approaching and entering the building should be a transition from the real world to the illusionary world of the musical performance.

The building should express in its overall scheme, form, materials, and landscaping the highly abstract, geometric and rational nature of the music produced within.
SITE ANALYSIS
Ball State University was selected as the location for this project because of its convenience, its proximity to several large universities with electronic music programs, and because there already existed at Ball State an active and growing electronic music program in need of larger facilities. It was decided that specific site selection would be in accordance with the 1968 Perkins and Will master plan for University growth. The plan provided for an inner and outer loop system for vehicular traffic, the creation of a pedestrian spine through the center of campus, and proposed the location of future parking facilities and educational buildings.

Three potential sites were selected in the area designated for future academic expansion. All three were evaluated according to the following criteria:

1. Proximity to the music school
2. Sound isolation
3. Access from the inner loop
4. Prominent location
5. Sensuous qualities of the site

The southern most site (#3) was found to be the most advantageous. In addition to its close proximity to the music school, its relative isolation from potential noise sources, and its easy access from the inner loop,
this site presented the advantage of being located at the end of a "cultural axis" developing in the center of campus, bound by Emens Auditorium and the music school, Bracken Library, and University Hall, a moderate sized concert hall. The potential to make the Electronic Music Center a part of this cultural complex was seen as an exciting possibility.

The site itself is extremely flat and is currently used as a central campus parking lot. Its boundaries consist of the Teachers College to the south, the proposed inner loop to the west and a moderately wooded open field to the north. This area is designated in the master plan for future academic expansion. The eastern boundary fronts on the main north/south pedestrian axis of the campus.

The soil at the site is Elount silt loam, having a seasonal water table with 0-2% slope. Utilities are supplied from the eastern boundary of the site.
PROTOTYPE ANALYSIS
The Institute for Research and Coordination in Acoustics and Music (IRCAM) is the musical research component of the new Georges Pompidou Art Center in Paris. The IRCAM is a completely separate facility from the main Arts Center and is located underground beneath the plaza adjacent to the main structure. The building consists of approximately 100,000 square feet and is divided into 4 acoustical zones.

The first zone is a non-acoustically critical main circulation and mechanical distribution spine that connects all 5 floors to the surface and acts as a buffer from exterior noises. Located next to this section is another non-critical zone consisting of administrative offices, library, and conference rooms. This zone again acts as a buffer to the third zone, this one acoustically critical, consisting of the studios and laboratory spaces. It is in these spaces that the majority of the acoustical/musical research takes place. The fourth zone, also critical acoustically, is the 400 seat acoustical research concert hall. This "studio" is 5000 square feet in area and 60 feet high, with movable ceiling, floors, and walls to allow for variation in acoustical and visual qualities. It is used for research purposes and public performances of electronic music.
PLAN
ZONING BY FUNCTION

MECHANICAL
CIRCULATION
OFFICE
LAB
PERFORMANCE
STUDIOS
SECTION

ZONING PUBLIC TO PRIVATE

CIRCULATION

SEMI PUBLIC

SEMI PRIVATE

PRIVATE

MECH.
ACOUSTICAL RESEARCH
STC - Sound Transmission Class

The Sound Transmission class of any construction (walls, ceiling, etc.) is the measure of that construction's ability to stop sound. The higher the STC rating, the more efficient the wall is at preventing sound transmission.

NC Curve - Noise Criteria Curve

The Noise Criteria Curve of any space is the highest sound pressure level permissible in that space before disruption of the activity in that space occurs. The curve specifies dB levels over a continuous frequency spectrum from 20-20,000 Hertz. The higher the number, the louder the permissible noise level in that space.

IIC - Impact Insulation Class

The Impact Insulation class rating of any construction is the measure of that construction's ability to retard the transmission of impact noise to an adjoining space. Similar to the STC ratings for airborne sound, the higher the number, the more resistive the construction is to impact noise transmission.

RT - Reverberation Time

The reverberation time of any space is the time required for the sound pressure level in that space
to decay 60 dB after the sound source is shut off. The RT varies with the frequency of the sound, the volume of the room, the absorption factor of the air and the amount of absorption provided by room surfaces and occupants.
## REQUIREMENTS

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<tr>
<th>Location</th>
<th>NC</th>
<th>STC</th>
<th>IIC</th>
<th>RT</th>
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<td>Studios</td>
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Studios

The area of a recording studio is determined by the room required to comfortably fit the performers, instruments and furniture into the space. Fifteen to twenty square feet of floor space per musician is required in a small studio, while 20-40 square feet per musician is required in a large one.

The volume of any studio is also dependent on the number of performers. It is essential that a adequate level of loudness be maintained in a studio, but not so much as to overload the equipment. As the loudness of an ensemble is directly related to its size, so studio size must be related to the number of performers who use it. The formula expressing this relationship is:

Volume of studio=21(No. of Players)+55

Mankovsky has found however that this formula results in studios that are too small because it fails to take into account the necessity of placing the microphones a minimum distance from the performers. He has found that a volume roughly 3 times the figure given by the formula is more adequate. The formula then reads

V=3((21)N+55).
Finding the correct proportion between studio height, length and width is also a critical aspect of studio design. It is not desirable to have the basic dimensions of the studio of equal length. This reduces floor area and lowers the ratio between surface area (S) and room volume (V) to its lowest point. (This means that the mean number of sound reflections off walls is reduced, thereby making the sound field less uniform.) Great differences in basic studio dimensions is also undesirable because the odd shaped rooms created are difficult to mic, and also because the possibility of echos is increased. Optimum dimensional proportions are shown in the following table:

<table>
<thead>
<tr>
<th>Studio type</th>
<th>Height</th>
<th>Width</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>1</td>
<td>1.25</td>
<td>1.60</td>
</tr>
<tr>
<td>Medium</td>
<td>1</td>
<td>1.50</td>
<td>2.50</td>
</tr>
<tr>
<td>With relatively low ceiling</td>
<td>1</td>
<td>2.50</td>
<td>3.20</td>
</tr>
<tr>
<td>With unusual length relative to width</td>
<td>1</td>
<td>1.25</td>
<td>3.20</td>
</tr>
</tbody>
</table>

Doelle, p.116

The shape of recording studios is also of great importance. Rectangular rooms with their paralle walls lead to standing waves which can muddy sound. Trapazoidal and non-rectangular shapes are used then for studio spaces. Walls are usually skewed at an angle of about 10°, and walls and ceilings are often inclined at an angle of 5°.
Mankovsky suggests that these guidelines be followed in the design of sound studios:

<table>
<thead>
<tr>
<th>Type of studio</th>
<th>Floor area m²</th>
<th>Height m</th>
<th>Volume m³</th>
<th>Number of performers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Television talks studio</td>
<td>12-15</td>
<td>2.8-3.2</td>
<td>34-48</td>
<td>1-2</td>
</tr>
<tr>
<td>Film speech studios and radio studios</td>
<td>15-25</td>
<td>3.2-3.5</td>
<td>48-90</td>
<td>1-2</td>
</tr>
<tr>
<td>TV presentation studios</td>
<td>50-80</td>
<td>4-5</td>
<td>200-400</td>
<td>10-15</td>
</tr>
<tr>
<td>Radio chamber music studio</td>
<td>50-80</td>
<td>3.4-5</td>
<td>200-360</td>
<td>10-15</td>
</tr>
<tr>
<td>Small radio concert studio</td>
<td>150-200</td>
<td>6-7</td>
<td>900-1400</td>
<td>25-40</td>
</tr>
<tr>
<td>Small music film studio</td>
<td>150</td>
<td>6.5-7</td>
<td>1000</td>
<td>25-30</td>
</tr>
<tr>
<td>Orchestra recording studio</td>
<td>450-600</td>
<td>9-9.5</td>
<td>4000-5700</td>
<td>75-100</td>
</tr>
<tr>
<td>Large radio concert studio</td>
<td>400-450</td>
<td>10-11</td>
<td>4000-5000</td>
<td>115-140</td>
</tr>
<tr>
<td>Large studio for recording orchestra and choir</td>
<td>720</td>
<td>10</td>
<td>7200</td>
<td>120</td>
</tr>
<tr>
<td>Small TV studio</td>
<td>100</td>
<td>5-6</td>
<td>600</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>6</td>
<td>900</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>7</td>
<td>1400</td>
<td>50</td>
</tr>
<tr>
<td>Large TV studio</td>
<td>300</td>
<td>8</td>
<td>2400</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>450</td>
<td>10</td>
<td>4500</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>11</td>
<td>6600</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>1000</td>
<td>15</td>
<td>15000</td>
<td>400</td>
</tr>
<tr>
<td>Sync. shooting stage</td>
<td>500-2000</td>
<td>10-18</td>
<td>5000-35000</td>
<td>—</td>
</tr>
</tbody>
</table>

Mankovsky, p. 385
Auditoriums

The proper size of an auditorium is one of the most critical aspects of its design, and should be related directly to the number of people in the audience. Floor area should be held to a minimum (to shorten the distance direct and reflected sounds must travel). Yerges suggests that for optimum response to a wide variety of sources, a room's dimensional proportions should approach $1:\sqrt{2} :\sqrt{3}$ (Height, width, length). Height may be determined by the following formula:

$$RT = \frac{H}{20}$$

where $RT$ is the reverberation time selected for the space, and $H$ is the optimum height.

Doelle suggests this relationship between volume and audience capacity for achieving proper acoustics:

<table>
<thead>
<tr>
<th>Type of auditorium</th>
<th>Volume per audience seat, cu ft (cu m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rooms for speech</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>(2.3)</td>
</tr>
<tr>
<td>Concert halls</td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>(6.2)</td>
</tr>
<tr>
<td>Opera houses</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>(4.5)</td>
</tr>
<tr>
<td>Roman Catholic churches</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>(5.7)</td>
</tr>
<tr>
<td>Protestant churches and synagogues</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>(5.1)</td>
</tr>
<tr>
<td>Multipurpose auditoriums</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>(5.1)</td>
</tr>
<tr>
<td>Motion-picture theaters</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>(2.8)</td>
</tr>
</tbody>
</table>

Doelle, p.52
Site analysis and 3 concepts

Good that sound isolation played a significant part in site selection.

Be conscious of the technical problems of building a below grade amphitheater (drainage).

Good use of the building to block sound reaching amphitheater.

Consider potential for expansion.

Consider energy conservation.

Need more careful consideration of hierarchy of campus circulation.
Schematic design

The theme of illusion in architecture will be extremely difficult to carry out successfully.

Site development in front of the building is weak. The axis is perhaps too restrictive an element. The massing at the end of the axis is not great enough to terminate it.
PRESENTATIONS
Preliminary design development

No longer dealing with 3 elements as a form.

a fourth element, the lobby has become a significant formal element.

Elevation development will be very critical.

Are windowless buildings appropriate for offices.

Some relief is needed. Consider a atrium.

Must carefully consider how to enter the pristine cube forms.
Final design development

Sections are well developed.

Sequence of movement is good.

The move to a symmetrical plan seems to have cleaned up the plan organization.

HVAC for a totally enclosed building (underground) must be carefully worked out.
FINAL
PRESENTATION
Programming and Design Process


Laseau, Paul. *Graphic Problem Solving*.


White, Edward T. *Introduction to Architectural Programming*. Architectural Media, PO Box 4664, Tucson Arizona. 1972

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Architectural Record. March 1977 p. 115-130


Architectural Record. Dec. 1964 p. 140-1

High Fidelity Magazine April 1977 p. 80-84

Journal of Aesthetics and Art Criticism. v. 31 no. 4 p. 567-8


Studio International. April 1970. p. 177-8

Final 404 presentation

The theme of illusion in architecture will be extremely difficult to carry out successfully.

Site development in front of the building is weak. The axis is perhaps too restrictive an element. The Massing at the end of the axis is not great enough to terminate it.
405 PRESENTATIONS AND JURY COMMENTS
Mid term 405 (Preliminary design development)

No longer dealing with 3 cubes only formally. A fourth element, the lobby, has become a significant formal element.

Elevation development will be very critical. Are windowless buildings appropriate for Offices. Some relief is needed. Possible Atrium.

Must carefully consider how to enter the pristine cube forms.
Final 405 Presentation (Final Design Development)

Sections are well developed.
Sequence of movement is good.
The move to a symmetrical plan seems to have cleaned up the plan organization.

HVAC for a totally enclosed building (underground) must be worked out.