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A Student Center for the  
Massachusetts Institute of Technology

Submitted by  
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This report is submitted in partial fulfillment of the requirements for the degree of Bachelor of Architecture.

Hsio Wen Shih

This thesis is dedicated to all my teachers, who have been more patient than I deserved, and particularly to Dean Belluschi, Professor Anderson, Professor Newman, Professor Rapson, and Professor Kennedy.

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## I Introduction

The vacuum left by the passing of the frontier as the focus of the energies of the American people was filled by the expanding industrialism of the late nineteenth century. The widening scope of industrial enterprise and the increasing complexity of industrial processes forced an important role in American society on the technical specialist. Under these circumstances the Massachusetts Institute of Technology was founded and rose to its prominent position among the technical schools of the United States.

From its beginning, education at MIT had one principal aim -- to produce graduates with a high level of competence in their special technical field, men who would be able to do good service in American industry. For this purpose a curriculum was developed to present to all students a basic knowledge of the physical sciences, to introduce them to their field of specialization, and to develop in them the discipline of thought and method that they would need in their future professional work.

A recent re-examination of the MIT curriculum from a broader point of view has pointed out that the single-mindedness of MIT education has drastically and dangerously narrowed its

scope; that the MIT curriculum, by overemphasizing technical studies and neglecting humanistic education, has dulled the capacity of students for satisfaction in personal experience, and limited their sense of responsibility as citizens in a democratic society. This realization has precipitated a reorganization of the curriculum. The results -- the creation of the School of Humanities, and the increasing emphasis on humanistic studies in the curriculum -- must be considered a great step toward a more balanced education at the Institute.

At the end of the second World War, the Institute was flooded by veteran-students studying on the G. I. Bill. With the coming of the veterans, enrollment at the Institute jumped from its pre-war peak of about three thousand students to five thousand. These veteran-students entered the Institute at the age of twenty-two or more, with developed personalities, mature interests, and clear-cut aims. They wanted a good technical education; they had interests in their wives and families, and did not need to try out their wings in student activities. In order to accommodate the increased number of students, the Institute began an extensive program to expand its academic facilities.

Since 1948, the number of veterans entering the Institute has dwindled to insignificance, but the enrollment has remained

around five thousand, and will probably stabilize at between five thousand and five thousand two hundred students. The increase in the enrollment of the Institute and a change in the entering students are posing a new problem for the Institute.

The student entering the Institute today, unlike the veteran-students, is somewhere between sixteen and eighteen years old. He is probably a recent high school or preparatory school graduate, and he is in many ways an unformed human being. He came to Tech, perhaps, because his father was a graduate in the class of '25, or because he always did well in math at high school, or even because he heard that starting pay for MIT graduates is N dollars per year. Very likely he knows only vaguely what he wants to study, for he has only vague notions of what various technical specialists do. Nevertheless, in four years he must leave the Institute and take his position in the world among men, not only as a professional worker, but as a husband and father and as a responsible citizen.

The moral responsibility of the Institute toward the non-professional aspects of a student's education is not less important than its responsibility for his technical training. But while his development in professional work depends on the number of courses he takes, the number of lectures he attends,

in these four years, the other aspects of a student's development, moral, social, aesthetic, spiritual, and political, cannot be formed by any series of lectures in the humanities, no matter how thorough and comprehensive. At best, such a course of lectures can provide a frame of reference for interpreting the thoughts he thinks and the feelings he experiences. But in the end this development can only come out of his own thoughts, his own feelings; and these thoughts and feelings are stimulated and challenged by the experiences of his non-academic life.

The responsibility of the Institute in this aspect of education, then, must be to help students to develop an environment full of activity and event and to encourage students to participate in some of these activities, to stimulate his mind, and his sensibilities.

It is for this reason that a student center -- a center for student activities, is important at MIT. Together with the dormitory or fraternity, the dining hall, and the classroom, it is a part of the educational environment of the Institute. And it is for this reason that MIT's decision to build a center, made shortly after work on the program for the new auditorium began, may in the end prove an even more important decision in the educational policy than even the creation of the School of Humanities.

## II The Background of the Problem

In 1950, the Institute commissioned Eero Saarinen and Associates, of Detroit, Michigan, to design an auditorium and a chapel for the Institute. These buildings were to be built on the eastern end of the West Campus, between Massachusetts Avenue and the future West Campus playing fields.

Mr. Saarinen's early studies proposed the development of a large raised plaza, free of the existing buildings facing Massachusetts Avenue, on which the auditorium and the chapel would be placed. The plaza would be connected to the entrance of Bldg. 7 by a wide bridge, and Massachusetts Avenue was to be depressed to clear the bridge. (See Figure 1.)

At a later stage, the buildings facing Massachusetts Avenue (the Coop, Bexley Hall, and the Henessy Block) were to be removed, and a new building was to be constructed along the east side of the plaza to house the shops which service the Institute. Finally, the design of the plaza would be completed by the construction of a gymnasium and field house along the northern side of the plaza. (See Figure 2)

The construction of the plaza would have eliminated some of the precious parking space on the Institute grounds. Because the parking lots are already inadequate, the proposal was made

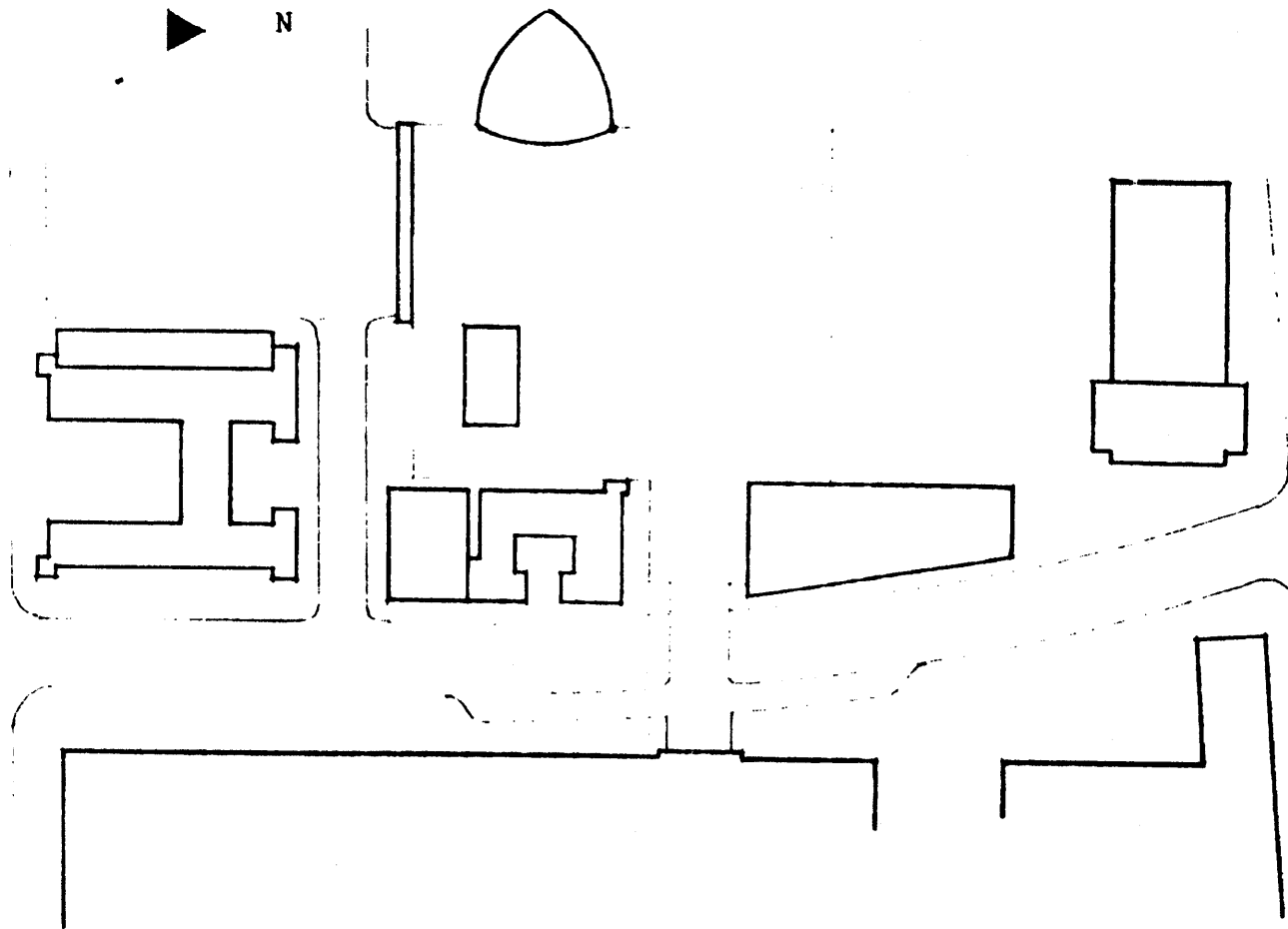


FIGURE I

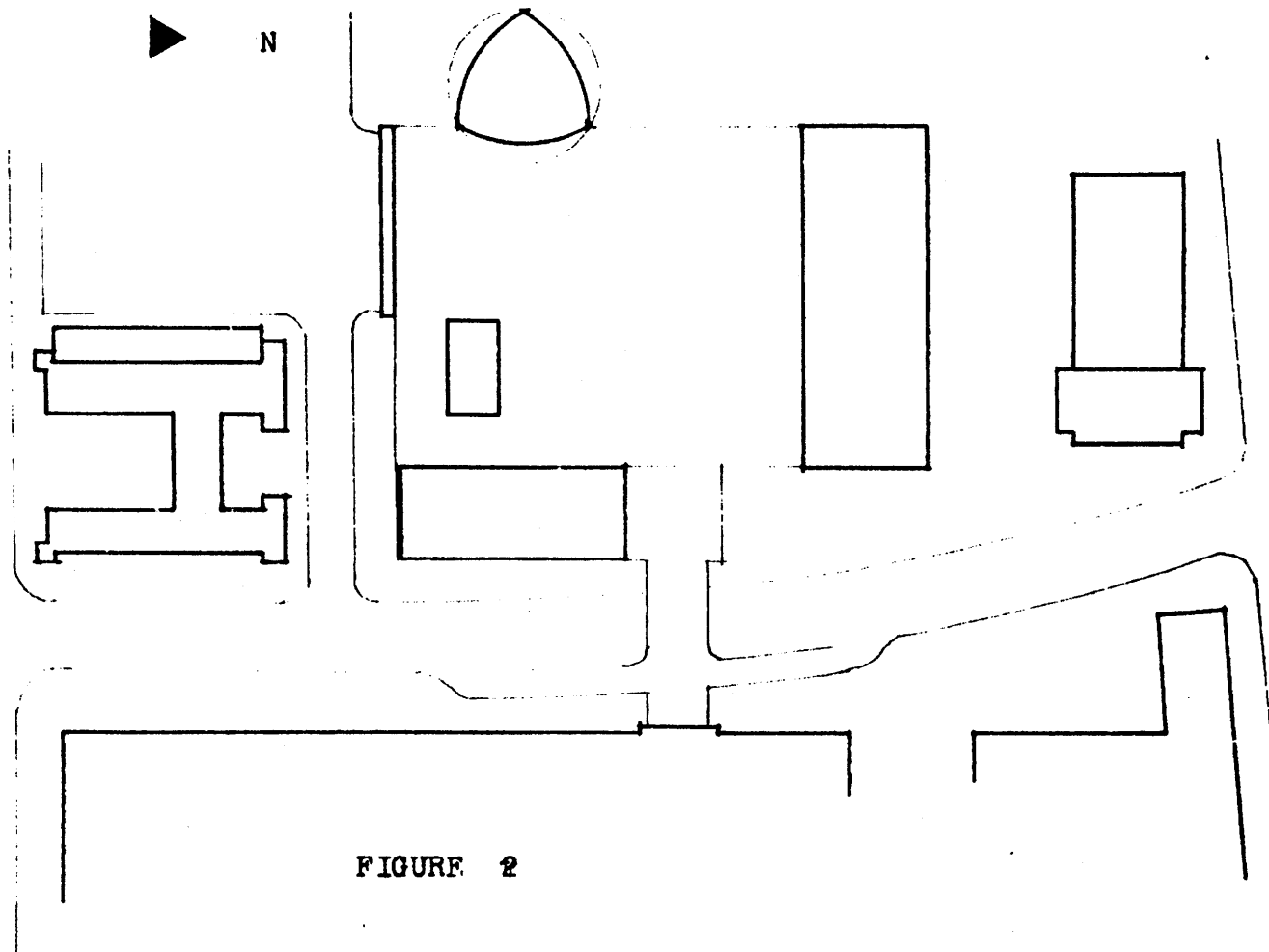


FIGURE 2

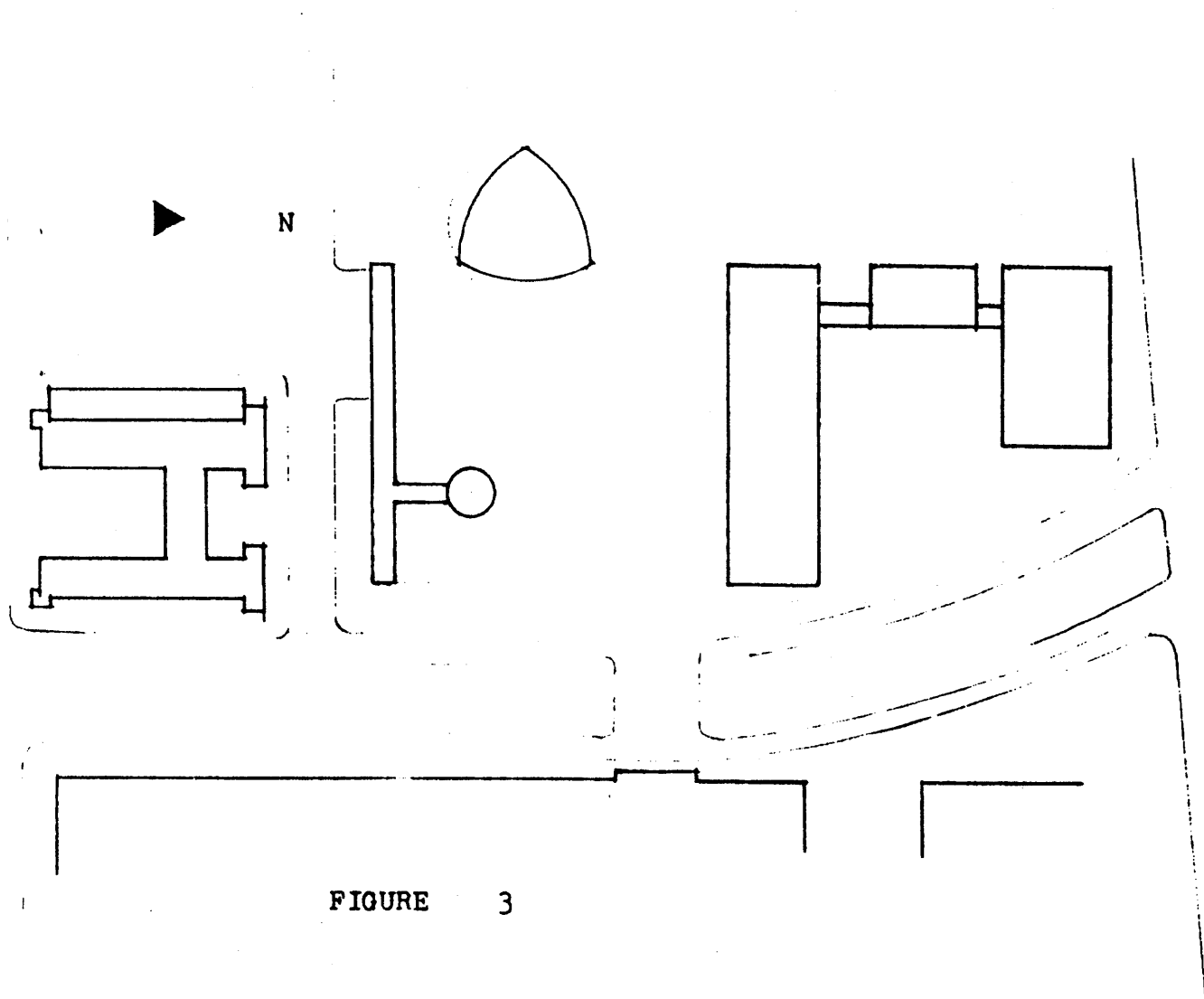


FIGURE 3

that the area under the plaza be excavated to provide an underground parking garage for the use of Institute personnel. This feature was incorporated into Mr. Saarinen's design.

In the fall of 1952, the legislature of the Commonwealth of Massachusetts approved a bill providing for the underpassing of Massachusetts Avenue between the railroad tracks and Memorial Drive, to keep the flow of through traffic along the Avenue free of the disrupting cross-traffic at the railroad crossing and at Vassar Street. The scheme for the underpass proposed by the Institute, with its depressed main traffic lanes and narrow service roads on each side, necessitated the widening of Massachusetts Avenue. In order to widen the street, The Coop, the Henessy Store Block, Bexley Hall, and the front portion of the National Guard Armory would have to be demolished. (See Figure 3)

It became necessary to consider the immediate construction of a building to house the Coop and the other stores which service the Institute, and an area at the north end of Saarinen's plaza was chosen as the site for this building. Although earlier plans had allocated this space for a new gymnasium and field house to be built in the future, the decision was made that, if the rear portion of the Armory could be purchased by the Institute and minor additional facilities, such as lockers, a wrestling room, and a rifle range, could be built between

the proposed store block and the Armory, the construction of completely new athletic facilities could be delayed for many years.

Because the scarcity of land at the Institute forbade the use of this central site for only a one story store block, a number of proposals were advanced for the use of the stories that would be built above the stores. Among these suggestions were an apartment house to replace Baxley Hall, offices for the Institute administration, and a student center.

The location of this site is an ideal one for a student center. In the development plan of the Institute all the area to the east of Massachusetts Avenue is to be used for academic facilities and for graduate student housing. The area to the west of the Avenue will become the center of undergraduate life. Here more dormitories will be built to house the students who now live on East Campus. Land is to be made available to the fraternities to move from Boston to the Cambridge side of the river. Athletic facilities will center on the West Campus, and the auditorium and the chapel will be built on the great plaza, joined to the main entrance of the academic buildings by a broad bridge. On this site the student center would be beside the paths of students going from classrooms to their dormitories, and the presence

of the student center on the plaza would make the plaza a center of activity for the students, who will give life to the plaza with their movements and their voices.

Dean Belluschi, feeling that the design of a student center on this site should be studied, suggested that I undertake it as my thesis for the degree of Bachelor of Architecture. When I began to write the program of the building, Mr. Robert Kimball suggested that I contact the Baker Memorial Committee which was interested in the promotion of a student center at MIT.

The Baker Memorial Committee, a student organization at the Institute, is an undergraduate group formed in the memory of the late Everett Moore Baker, Dean of Students at the Institute. This committee undertakes every year a project in the spirit of Dean Baker. For the year 1952-53, they had decided to undertake the study of a student center at MIT -- what the nature of such a center should be, what kind of facilities it should provide, and how a student center might be realized. This committee had already begun a survey of the requirements of the undergraduate activities in preparation for writing a program for the building. I joined them in this project, and together we completed the survey and wrote a program as a basis for the design of a student center.

### III The Program

#### I The Store Block

The first floor of the building should provide about 20,000 square feet of space for all the shops which serve the students and the staff of the Institute. The building will be built by MIT, and space will be rented to the independently operated shops. These shops are:

The Harvard Cooperative Society, Tech Store	7000 square feet
United States Post Office	5000 square feet
The Harvard Trust Company	3000 square feet
Restaurant	3000 square feet
Tech Record Shop	1000 square feet
Barber Shop	1000 square feet
Laundry and Shoe Repair Shop	1000 square feet
Drugstore	1000 square feet

#### II The Student Center

The Student Center must serve three purposes: it must act as a center for the informal social life of all on campus students, it must provide space and facilities for organized student activities, it must serve as a center for the use of

commuting students during the day. The building must include the following facilities:

A. Entrance Facilities 2900 square feet

1. Lobby 1200 square feet

The lobby should contain a bulletin board and telephone booths. It should provide direct access to the lounge, the snack bar, the game rooms, and to the gym facilities in which dances will be held.

2. Checkroom and Information Booth 500 square feet

The checkroom should contain coat racks and shelves for books and notebooks. It will be used usually for self-checking, but it should be overlooked by the information desk which could serve as a checking counter for special occasions.

3. Lounge 1200 square feet

B. Social Room 3000 square feet

This area should be out of circulation paths to other parts of the building. The space should be somewhat subdivided to give a feeling of intimacy, and should be equipped with tables and chairs. Between classes this should be a place where people come to relax, drink coffee, play cards, or talk in an unhurried atmosphere. At lunch time, this room will be used by commuting students as a lunch room, and a snack bar should be provided to serve sandwiches and drinks

for those who do not bring their lunch. In the evening students on campus can come here to spend a whole evening, or just drop in late for a beer or a frappe, and relax for a while before going to bed.

C. Game Room 3200 square feet

Near the Social Room there should be a room 25 feet wide with ping-pong tables and billiard tables. During the day these facilities would be used mainly by commuting students during free hours or lunch period. During the evening, it would be used by students using the Social Room, or working in one of the organization offices.

D. Bowling Alleys 5000 square feet

The bowling alleys will be used during the evenings. It should be reasonably close to the Social Room. There should be eight alleys with rooms for pin boys and pin storage.

E. Meeting Rooms 3000 square feet

A number of meeting rooms should be provided for meetings of fifteen to fifty persons. Some of these rooms will be used for formal meetings of groups such as the Institute Committee, the Secretariat, and so forth; others will be used for social gatherings of groups like Tau Beta Pi, the Greek student club

Technicon, and for the smokers of the various activities at the beginning of a school year. Since business meetings usually are scheduled between 5 and 7 p.m., and social meetings after 8 p.m., these rooms will be available for the use of commuting students during the day. The large room should be used as a televiewing room, and the smaller rooms can serve as lounges and quiet study rooms.

- |                                        |                      |
|----------------------------------------|----------------------|
| (1) Meeting room for 50 persons        | 1000 square feet     |
| (2) Student government conference room | 500 square feet      |
| (3) Informal meeting room              | 500 square feet      |
| (4) Three small meeting rooms          | 350 square feet each |

Meeting rooms (1) and (3) should be served by a private dining servery connected by dumbwaiter to the restaurant located below in the store block. The three small meeting rooms should each have a kitchenette.

F. Hobby Facilities 7100 square feet

1. The Hobby Shop

a. Wood Shop 1200 square feet

The wood shop should include, in addition to workbenches, two wood lathes, two circular saws, a bandsaw, a jointer, a large surface planer, a belt sander, a drill press, and a painting and finishing room.

b. Machine Shop 1200 square feet

The machine shop should be equipped with five lathes, with

workbenches near by, a bandsaw, two millers and two grinders, three drill presses, and a room for welding equipment.

- c. Electric Shop 300 square feet
- d. Dark Room 300 square feet
- e. Display Workshop 300 square feet

This space will be used for the construction of displays used by publications, LSC, etc., for advertising. It should be equipped with simple woodworking tools, and silk-screen equipment for making posters.

- 2. Tech Model Railroad Club 1000 square feet

This group needs about 700 square feet for track layout, and in addition space of 300 square feet for controls, work-space, and meeting room.

- 3. MIT Astronomical Society 500 square feet

This group needs a space thirty feet long, for the grinding of mirrors, and the testing and construction of telescope assemblies.

- 4. MIT Radio Society (WIMX) 500 square feet

This group needs a shop and workroom of about 250 square feet, and another room of about the same size to be used as a transmitter room.

- 5. Tech Model Aircraft Club 300 square feet

This group needs space for use as a shop to build models and as a meeting room.

6. MIT Flying Club 300 square feet

This group needs an office for business connected with the operation of two club-owned aeroplanes, and a room for small informal meetings.

7. MIT Motor sports Club 400 square feet

This space should be a two car garage with a car lift, equipped with a workbench, and connected by elevator with the hobby shop facilities.

8. MIT Glider Club 400 square feet

This space should be located at grade; it will be used as storage space and maintenance shop for gliders and glider trailers.

9. MIT Outing Club 600 square feet

The outing club room should be located at grade. It will be used as a storing room for outing equipment and as a point of departure for outings.

0. Offices for Student Organizations 5850 square feet

1. Student Government 800 square feet

a. Reception room and

secretaries' office 260 square feet

b. Student working office 300 square feet

c. Finance Committee	120 square feet
d. Public Relations Committee	120 square feet
2. Technology Christian Association	1200 square feet
a. Reception area	100 square feet
b. Book exchange	200 square feet
c. Office	600 square feet
d. Office machine room	120 square feet
e. Storage	80 square feet
f. Movie projection equipment	100 square feet
3. The Tech	1000 square feet
a. News Room	750 square feet
b. Senior Board room	150 square feet
c. Storage	100 square feet
4. Voodoc	750 square feet
a. Work room	600 square feet
b. Senior Board room	150 square feet
5. Technology Engineering News	750 square feet
a. Work room	600 square feet
b. Senior Board room	150 square feet
6. Technique	750 square feet
a. Work room	600 square feet
b. Senior Board room	150 square feet

7. NSA-FSSP	300 square feet
a. Reception room	150 square feet
b. Office	150 square feet
8. Lecture Series Committee	150 square feet
9. Debating Club	150 square feet
H. <u>Music, Drama, and Radio Facilities</u>	<u>2800 square feet</u>
1. Tech Show	1000 square feet
a. Office	300 square feet
b. Rehearsal stage	700 square feet.
2. Combined Music Clubs	900 square feet
a. Office	300 square feet
b. 4 small practice rooms	600 square feet
3. WMIT	900 square feet
a. Office	150 square feet
b. Large studio	300 square feet
c. 2 small studios	200 square feet
d. Control rooms	250 square feet

I. <u>Service Facilities</u>	<u>3000+ square feet</u>
1. Food Service Facilities.	1300 square feet
a. Snack bar	400 square feet
b. Dishwashing	250 square feet
c. Food Storage	250 square feet
d. Garbage and can washing	100 square feet
e. Pantry serving meeting rooms	300 square feet
2. Employee's Facilities	500 square feet
3. General Storage Space	1500 square feet
4. Space for Mechanical Equipment as needed.	

#### IV The Design Problem

Three principle considerations guided the approach to the design of this project. One of these is based on the conviction that if students become gradually familiar with all of the activities that go on in this building, they will be encouraged to take part in those activities which particularly appeal to them. To help them to familiarize themselves with all the activities, to give the feeling that they are always welcome to watch or ask questions, as much of the activities as possible should be made visible. The second consideration concerns the extremely important position that the building will occupy on the Institute grounds. It will complete the development of Saarinen's plaza by closing its northern side. In this location, as an integral part of the architecture of the plaza, its architectural design must capture some of the clarity and the classic simplicity of Saarinen's auditorium. The third, and somewhat less important, consideration is the necessity for providing as much parking space as possible in this area so close to the entrance of building 7.

Saarinen's plaza is 320 feet long (north-south) and 300 feet wide (east-west). In his scheme for the underground parking garage, he divided the 300 foot width into 15-20 foot bays. The second, fifth, eighth, eleventh and fourteenth

bays are used as driveways, and the other bays are used as the actual parking space. In the other direction the bays are 26 feet, and each bay parks three cars. To increase the parking space available, it was decided that this underground garage be extended by adding nine more 26 foot bays toward the north, stopping within 25 feet of the Armory wall. Because the curve of Massachusetts Avenue reduces the width of the site at this section, the extended portion had to be reduced in width by 60 feet or three bays. Of the remaining twelve bays, four are used as roadway, and eight for parking. Despite the narrowing of the site, this extension adds 202 additional parking spaces to the 285 of Saarinen's scheme. To facilitate filling and emptying of the garage, another ramp was added near the corner of Massachusetts Avenue and Vassar Street.

The deck created by the roof of the addition to the underground garage is to be used as additional parking space and for trucking and service access to the store block. At the western end of this deck, the auxiliary athletic spaces can be erected. These facilities should include a small gymnasium, for wrestling and fencing, lockers below, and offices for the athletic association and for coaches.

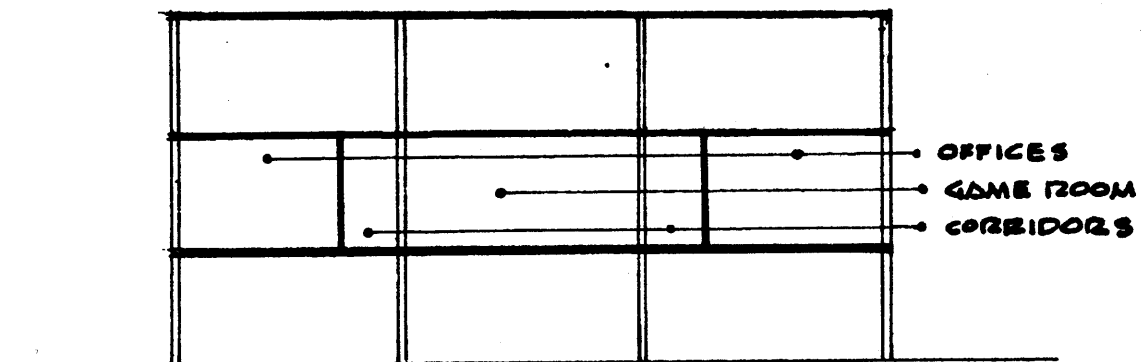
In order to close off the north end of Saarinen's plaza definitely, it was decided that the store block, and along

with it the Student Center, should extend the entire three hundred feet of the plaza. The stores, which must be at plaza level, require a total area of about 20,000 square feet, so the building must be at least 70 feet deep. To follow the column spacing of the parking garage below, the store block was made three bays deep - three hundred feet by seventy-eight feet, or 23,400 square feet.

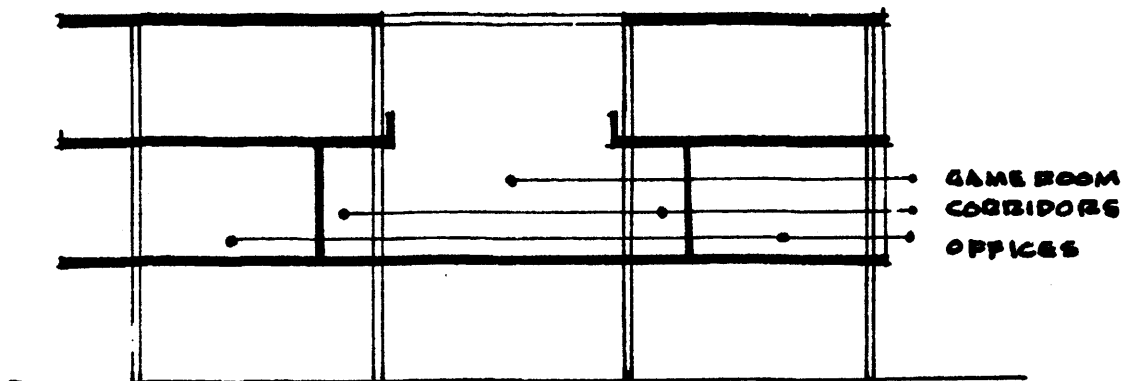
The facilities for the Student Center listed in the program, which does not include space needed for circulation and minor service facilities, amount to almost 40,000 square feet, so if allowances are made for circulation space, the Student Center would occupy two whole floors of 23,400 square feet each.

Now almost half of the space in the Student Center - the offices, the hobby facilities, and the meeting rooms - are relatively small rooms which should have natural light during the day and a view to the out-of-doors. These rooms should not be deeper than 20 or 25 feet from window to the rear wall. If these rooms are placed at the perimeter of the building, there remains a strip thirty-eight feet wide at the center, far too wide to serve as a corridor, and yet hidden away from light and view.

It was decided that this interior space should be used for the ping-pong and billiards room on the first floor of the Student Center. This room would occupy the center bay of 26 feet, and space would be left at each side for corridors leading to the offices.



This scheme had a number of advantages. First, it gave a long room, twenty-six feet wide, as a game room almost ideal for a single row of tables. But more important, if this room were enclosed only in glass, it would open up the interior so that every room would be visible from the center of the building. This scheme seemed to fit so closely with the first objective stated in this section that I decided to carry it one step further, to open it to the second floor, and to light it by a clerestory.



To simplify the circulation to the public portions of the Center the length of the building was divided into three sections. The hundred feet at the western end are occupied by the lounge, the social room, and service facilities on the first floor, and by bowling alleys and mechanical equipment rooms on the second floor. The next twenty foot strip contains the entrance, lobby space, and stairs to the second story. The rest of the building contains the two story game room, the offices of student organizations, and hobby facilities.

The sixty feet at the eastern end of the building, which hold the WFIT studios, music practice rooms, rehearsal stage and WJEX facilities on the first floor and hobby shops on the second floor, presented several rather unusual problems of sound isolation, and the solution is discussed under the section on acoustical considerations.

The main entrance stair from the plaza level rises in the sixth bay from the western end of the building, and divides the store block into two sections, one five bays long and one eight bays long. Rather than enclose the whole bay in which this stair is located, only the stair itself, together with a small vestibule-airlock, and an open passage is provided between Saarinen's plaza and the parking area and athletic facilities on the other side of the building. The five bays of rentable area at the western end of the building, away from Massachusetts Avenue should be used for the bank and post office, and the other section will contain the Co-op, the restaurant, the drug store, the record shop, the barber, the cleaner-shoe repair shop, and the Student Center facilities which must be at grade.

No ballroom was planned in the building because it was expected that dances could be held in the auxiliary gym facilities. To connect the Student Center with these facilities, an enclosed bridge has been planned which will leave the Student Center beside the lounge, and connect directly with the gym on the second story.

To service the kitchen, at one end of the building, and the hobby shops at the other end, and to provide emergency exits in case of fire, an elevator and a stair has been provided near each end of the building. The elevator and the

stair at the east end of the building also connect the ground floor facilities of the Student Center (the auto shop, the cutting club, and the glider club) with the main parts of the building above, and particularly with the hobby shop for machine tool work and welding. This stair and elevator also go down to the basement to the Co-op stockroom, and to the mechanical equipment space.

To differentiate the Student Center clearly from the stores below, the two upper floors of the building are cantilevered beyond the columns for a distance of six feet on the south, east, and west sides, and two feet on the north side. The cantilevered portion is enclosed at the social room, the bowling alleys, the hobby shops, and the music and drama facilities, but at the office areas they are left open as balcony-sunshades. On the first floor, this balcony is connected by a door to the social room, so the balcony can be used for outdoor lunching in the spring and fall. On the second story, the balcony can be used just as a quiet sitting place overlooking the plaza.

## V Acoustical Considerations

Two general sets of acoustical problems must be met in this building -- problems of noise control and problems of room acoustics.

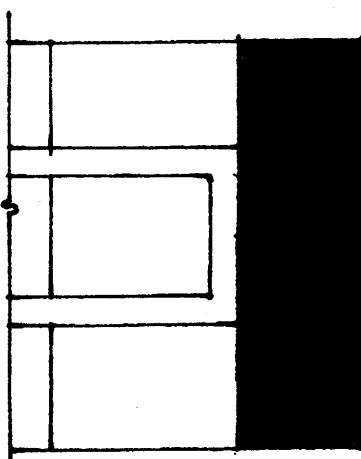
The noise control problems are to provide adequately low background noise levels in the various rooms, and to provide sufficient noise reduction in the walls, ceilings and floors to insure adequate privacy. The noise reduction to be provided between two spaces should not be less than the following values:

between two offices	40 decibels
between office and corridor	40 decibels
between two meeting rooms	45 decibels
between meeting rooms and corridor	45 decibels
between music practice rooms and corridors	45 decibels
between music practice rooms and shops	55 decibels
between radio studio and corridor	55 decibels
between two radio studios	55 decibels

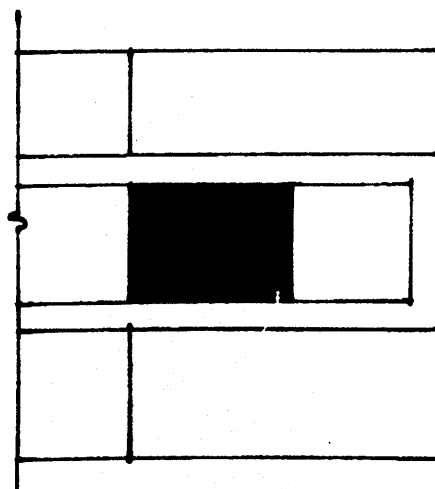
To achieve 40 decibels of noise reduction the partitions should be 4 inches of cinder block plastered on both sides. To achieve 45 decibels of transmission loss, 8 inches of cinder block plastered on both sides must be used. To achieve

55 decibels of noise reduction 2-4 inch leaves of plastered 4 inch cinder block separated by a four inch airspace must be used. The floors for 40 decibels of noise reduction should be the equivalent of 4 inches of concrete. For 45 decibels, the floors must be the equivalent of 4 inches of concrete plus a suspended plaster ceiling. For 55+ decibels, the ceilings must be resiliently hung from the floor slab. The 2 x 4's of the bowling alley floor should be "floated" on rubber-in-shear rails to prevent excessive transmission of impact noise to the social room below.

The three bays at the eastern end of the building presented some particularly difficult problems of sound isolation. On the third floor, this area is occupied by facilities of the hobby shop, while on the second floor the WMIT studios, the rehearsal rooms and practice rooms, and the WIMX facilities are located.

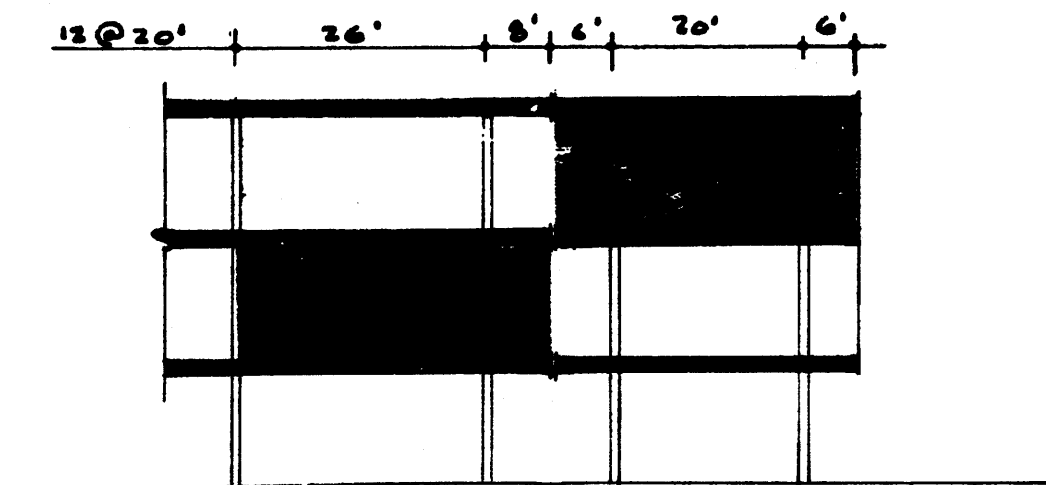


3RD FLOOR



2ND FLOOR

It was especially important that airborne and structure-borne noise from the power tools in the wood and metal shops be prevented from interfering with broadcasting conditions in the studios. The sound level in the shops would run around 95 decibels, and the background levels in the studios should not exceed thirty decibels. In order to achieve the proper degree of noise reduction, it was necessary to create a discontinuity in the structure between the two facilities. To accomplish this, the column spacing is altered in this portion of the building. Instead of three twenty-foot bays with a six foot cantilever at the end, the first bay is twenty feet with a cantilever, of six feet on each side, and the second bay is twenty-six feet, with an eight foot cantilever. The two cantilevers are separated by a mastic filling.



In addition, all of the machinery in the shops should be mounted on resilient rubber-in-shear mounts. The studio floors should be floated to prevent excessive sound transmission from the floor below.

To control noises generated within various spaces, particularly the social room, the lounge, and the bowling alley, ceilings should be covered with perforated acoustic tile. For these spaces no particular consideration of room acoustics is necessary.

A careful study of room acoustics should, however, be made for the radio studios, for the meeting rooms, for the rehearsal stage, and the music practice rooms. The reverberation analysis of three typical rooms are presented here.

#### Reverberation Analysis -- Large Meeting Room

Volume =  $24 \times 40 \times 12 = 12,000$  cubic feet

RT opt. = .65 seconds.

Total Absorption Required = 850 sabines

#### Absorption Existing:

Floor	$25 \times 40 \times .015 = 15$	15
Side walls	$12 \times 25 \times 2 \times .03 = 18$	18
Window	$12 \times 40 \times .1 = 72$	72
Rear wall	$12 \times 40 \times .03 = 15$	15
Ceiling	$25 \times 40 \times .06 = 60$	60
People	$50 \times 4.5 = 225$	<u>225</u>
		405
Additional Absorption Required -		445 sabines

Use a 5 foot strip of absorptive treatment around the edge of the ceiling --  $5 \times 14 \times .85 = 480$  sabines.

Reverberation Analysis -- Small Meeting Room

Volume =  $25 \times 20 \times 12 = 6000$  cubic feet

RT opt. = .56 seconds

Total Absorption Required = 450 sabines

Absorption Existing:

Floor	$25 \times 20 \times .015 = 8$	8
Side walls	$25 \times 12 \times 2 \times .03 = 18$	18
Window	$12 \times 20 \times .1 = 12$	12
Rear wall	$12 \times 20 \times .03 = 4$	4
People	$24 \times 4.5 = 108$	<u>108</u>
		150 sabines
Additional Units Needed		300 sabines

Use a 5 foot strip of absorptive treatment around the edge of the ceiling --  $5 \times 70 \times .85 = 298$  sabines.

Reverberation Analysis -- Large Broadcast Studio

Volume  $300 \text{ sq ft} \times 10 = 3000$  cubic feet

RT opt. = .35 seconds

Total Absorption Required = 350 sabines

## Absorption Existing

Floor	$300 \times .05 = 15$	15
Walls	$70 \times 10 \times .03 = 21$	21
Ceiling	$300 \times .06 = 18$	18
People	$10 \times 4.5 = 45$	<u>45</u>
		99 sabines

Additional Treatment Required = 250 sabines

This treatment should consist of three hundred square feet of Fiberglas 2 inches thick and protected with a slat-type wood facing of at least 50 percent open area. It should be divided into three sections and placed rather randomly both on the ceiling and the walls.

The dimensions of this studio should be so arranged that the normal modes of vibration in different directions do not coincide -- for instance, the room might be 10 feet by 15 feet by 20 feet. In addition, it should have no parallel walls, so that flutter echoes cannot occur.