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# SENIOR HIGH SCHOOL FOR GLASGOW, MONTANA

SUBMITTED TO:
DEPARTMENT OF ARCHITECTURE
MONTANA STATE COLLEGE
FOR ARCHITECTURAL THESIS

SUBMITTED BY:
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MARCH 12, 1962

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Department of Architecture
Montana State College
Bozeman, Montana

Dear Sirs:

I am submitting this study for a new senior high school for Glasgow, Montana as partial fulfillment of the requirements of an undergraduate thesis.

The reasons that I chose a senior high school for Glasgow for my thesis are; Glasgow is my hometown and I am familiar with the needs of this community; during the past four years of my architectural training I have not been exposed to the design of a school, and since schools are such an important percent of an architects' work I feel the need to acquaint myself with the contemporary trends in the field.

The purpose of this study is to analyze the need for the new high school, to choose the site, and to provide a concept and program on which to base further design studies, which will be the second part of the thesis program

Respectfully yours,

Roger Ruppel

Roger Ruppel

1098-17

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ABSTRACT

This study consists of an analysis of the conditions creating a need for the new high school, local conditions, site conditions, economic conditions, aesthetic considerations, and the functions of the building.

Special problems were considered such as; the choice of one of the proposed sites, anaylsis and application of contemporary secondary educational trends, and the study of acoustical problems.

# CONDITIONS CREATING THE NEED FOR THE NEW SENIOR HIGH SCHOOL

## CONDITIONS CREATING A NEED

In the past few years, the high school at Glasgow, Montana, has become much overcrowded. The building that is now being used has a total capacity of about 800 students. This capacity was reached during the 1959-60 school year. During the 1960-61 school year the junior-senior high school was forced to change to a shift system because of the insufficient room for the larger number of students. The present enrollment during the 1961-62 school year has reached 1,150 junior and senior high students. Thus the school program is now operating on an emergency basis.[4]

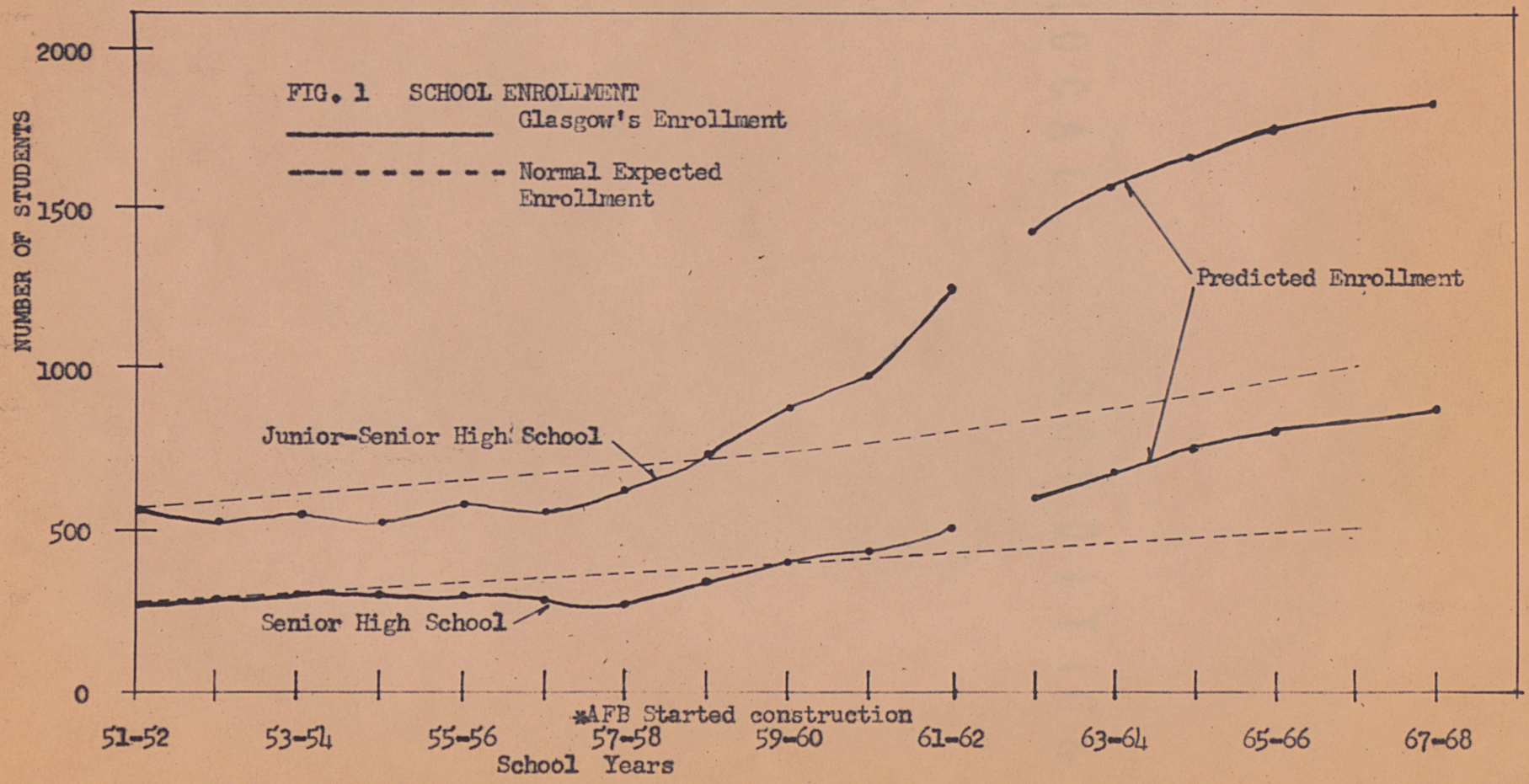
Because of the split shift arrangement the students find themselves with free time during the middle of the day. Many students come by bus and this split system necessitates that these bus students must come and go on the same bus. Since these students can't go home and can't use the school for extra work on hobbies and projects (because of the other shift) they must roam the streets and stores. In talking with the Superintendent he informed me that the merchants have complained about increased shoplifting problems because of excess of students' free time. If a new senior high were built

this problem could be removed.

According to the February, 1961, report of the Bureau of Field Studies and Surveys of the University of Minnesota, the estimated enrollment of the high school by 1965 will be 1760, more than twice the capacity of the school. This figure was based primarily on the current increase of elementary students which will eventually be enrolled in the high school system.

This growth in the school population was not a natural and gradual growth, but due to the number of young families that were drawn to the community as a result of the development of the Glasgow Airforce Base, 16 miles North of Glasgow. The base personnel is expected to contribute about 350 students to the high school system by 1965. The Airforce Base also has caused a permanent increase in the actual population of Glasgow. This occurred because of the need to meet the expanded economic demands of the area. Another contributing factor to the population is the building of a second powerhouse at Fort Peck Dam. Although the construction phase creates a temporary bulge there should be a net increase of personnel to operate the expanded facilities. The students from Fort Peck are also part of the Glasgow High School system.

The high school is organized as a three-year junior and a three-year senior high school in which the student population is divided approximately in half between the junior and senior high schools. This division facilitates an easy transfer of the senior high to a new plant, which is the subject of my thesis. Due to the very recent expansion of the school system to meet the demands of the increased population (three elementary schools and two additions to the high school within ten years) I believe that there is a necessity to create an interest as to the need for a new senior high school.


FIG. 1 SCHOOL ENROLLMENT
Glasgow's Enrollment
Normal Expected Enrollment
Predicted Enrollment
Junior-Senior High School
Senior High School
NUMBER OF STUDENTS
2000
1500
1000
500
0
*AFB Started construction
51-52
53-54
55-56
57-58
59-60
61-62
63-64
65-66
67-68
School Years

# LOCAL CONDITIONS

## LOCAL CONDITIONS

### Geographic Conditions

Glasgow, Montana, is located in the Northeastern corner of the state in the Milk River Valley. Glasgow is the county seat of Valley County, 60 miles from the Canadian Border, 275 miles from Great Falls, Montana, 350 miles North of Billings, Montana, and 120 miles from the North Dakota Border.

Glasgow is at $48.2^0$ latitude, $106.6^0$ longitude. The elevation is 2,208 feet above sea level rising to 2,280 feet in the surrounding bench land.

### Climatic Conditions

The area is subject to extreme climatic changes from $-56^0$ F. to $113^0$ F., a range of 169 degrees.

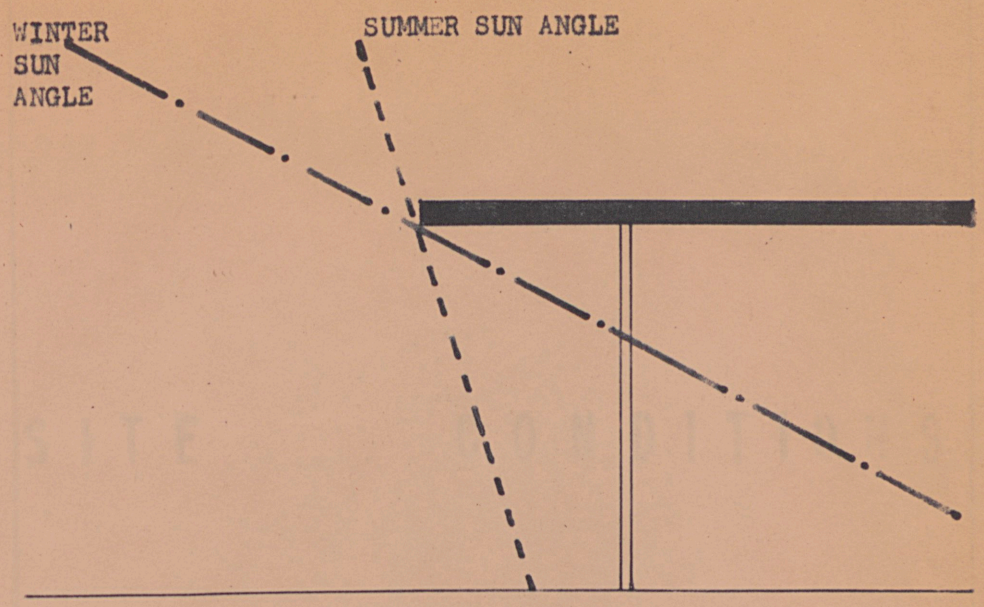
The prevailing wind is from the West. Storm winds may reach a velocity of 50-60 miles an hour.

Page 12 shows the monthly climatic data.

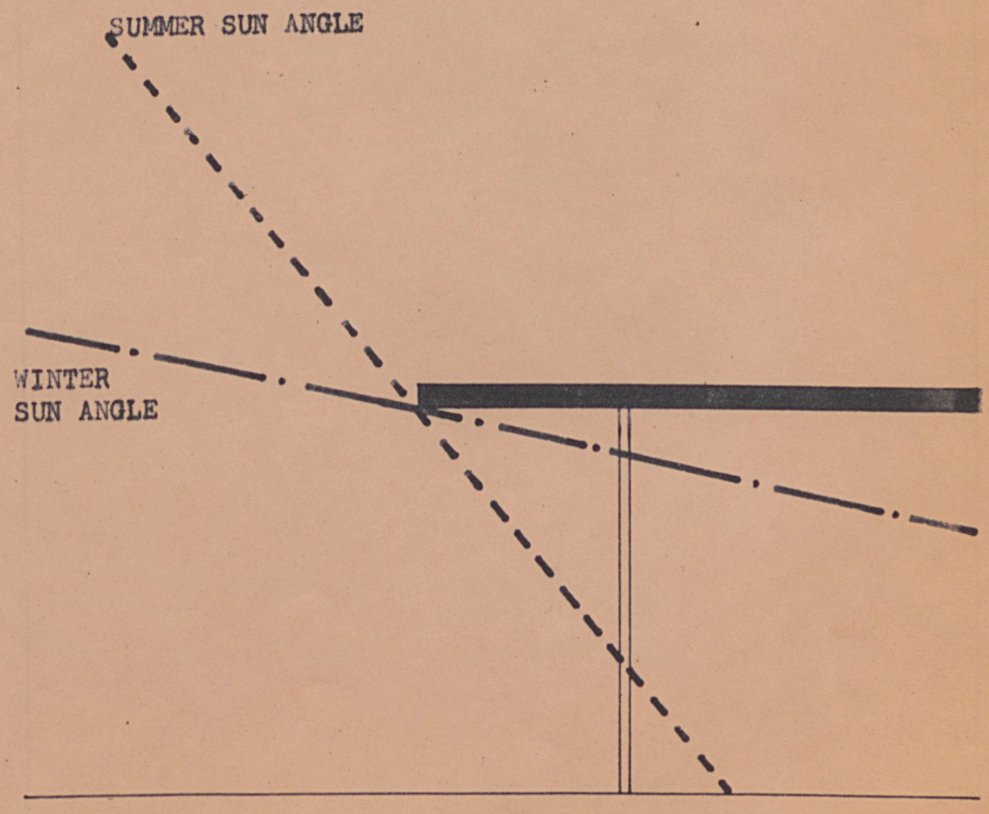
# CLIMATE DATA FOR GLASGOW, MONTANA

| CLIMATE CONDITION | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Snowfall | 5.5 | 4.2 | 6.4 | 2.4 | .1 | - | - | - | .2 | 1.7 | 3.7 | 5.6 | 29.8 |
| Average Percip. | .57 | .46 | .85 | .96 | 2.24 | 2.81 | 1.40 | 1.17 | 1.13 | .76 | .51 | .57 | 13.4 |
| Average Temp. | 8.0 | 11.8 | 24.5 | 44.2 | 54.9 | 63.6 | 70.5 | 68.2 | 56.5 | 43.8 | 27.4 | 14.4 | 40.6 |
| Average Max. Temp | 20.3 | 24.8 | 37.0 | 58.0 | 69.4 | 77.8 | 86.6 | 84.6 | 72.1 | 58.3 | 39.9 | 26.3 | 54.6 |
| Average Min. Temp | -4.2 | -1.2 | 12.0 | 30.4 | 40.4 | 49.4 | 54.4 | 51.8 | 40.9 | 29.2 | 14.8 | 2.4 | 26.7 |
| High Temp. | 62 | 63 | 81 | 90 | 98 | 109 | 113 | 110 | 100 | 89 | 76 | 62 | 113 |
| Low Temp. | -56 | -54 | -45 | -19 | 15 | 24 | 36 | 28 | 14 | -8 | -41 | -47 | -56 |
| Prev'l'g Wind | W. | W. | W. | W. | W. | W. | W. | W. | NW. | W. | W. | W. | W. |

FIGURE 2. SUN ANGLES for GLASGOW




SUN AT TWELVE NOON




SUN AT THREE P. M.

# SITE CONDITIONS

## SITE ANALYSIS

### Choice of Site

There are four proposed sites in consideration for the high school for Glasgow, Montana. Part of my responsibility in the study of the site will be to justify one of the following sites.

Site 1----is adjacent to the fairgrounds.
Site 2----is adjacent to the existing high school on the present athletic fields.
Site 3----is North of town and East of the water tanks.
Site 4----is East of town and near the new East side Elementary School.

My evaluation of the sites was partically based on a theory of Neighborhood Concept and Schools by Clarence Stein.[13] The Neighborhood Concept is organized with a neighborhood as the nucleus as the center of the community. The neighborhood is a circle with a radius of $\frac{1}{2}$ mile. The elementary school forms the center of the neighborhood. Three neighborhoods form a community. At the intersection of the three neighborhoods there should be a high school. The high school should service an area of one mile and be the center for community activites.

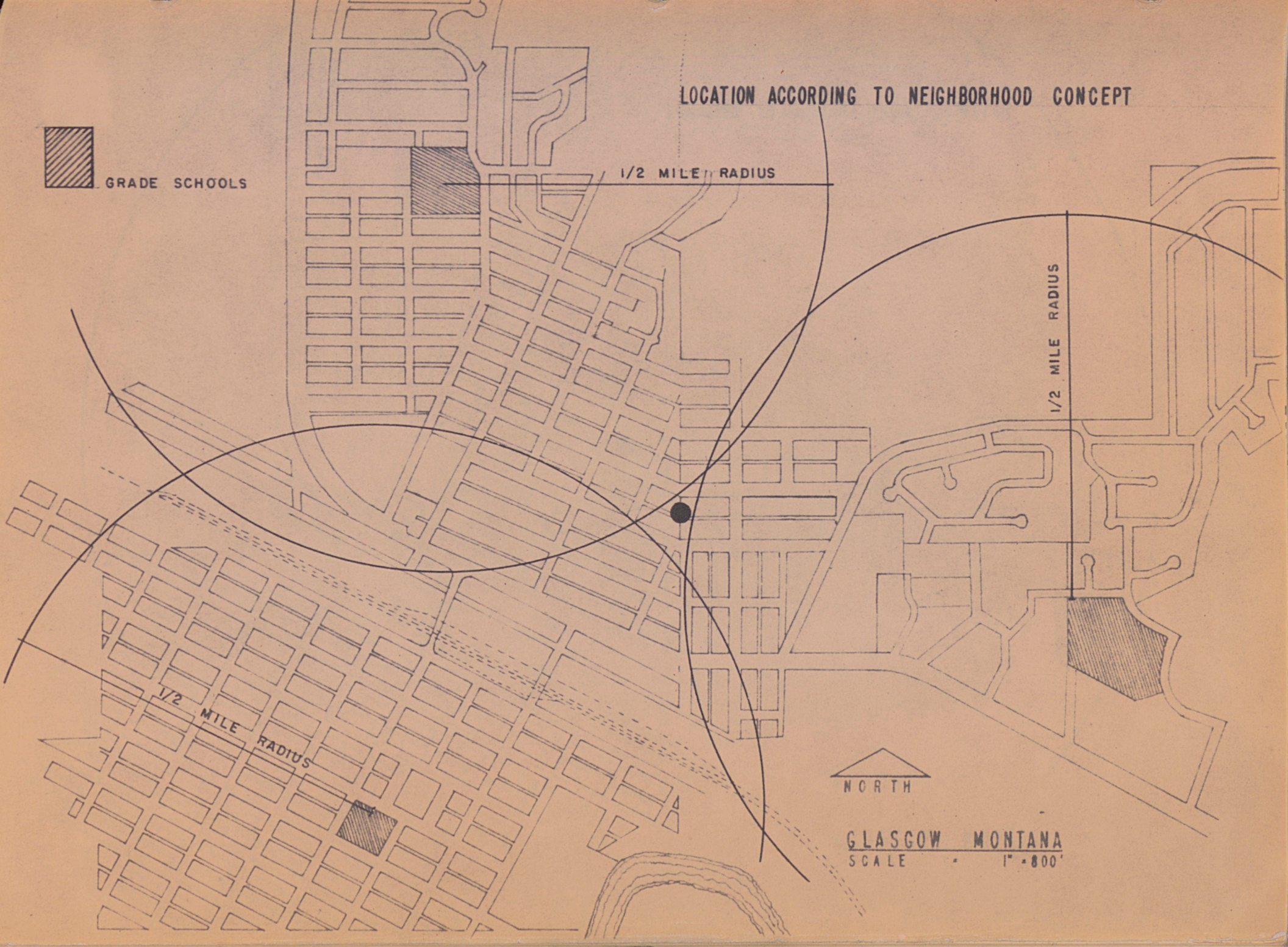
The grade schools in Glasgow are quite well dispersed as evident by figure 3 . Figure 3 shows a favorable location for the high school in accordance with the Neighborhood Concept. Figure 4 shows the central location of a high school as determined by a point equidistant from the perimeter. Figure 5 shows the location as the combination of figures 3 and 4 . It would be impossible to use this hypothetical ideal location because of the present residential use of the area. Figure 5 shows the distance that the proposed site is from the ideal location.

The maximum radius that a high school should service (not including bus transportation) is one mile if it is to follow the Neighborhood Concept. Figure 6 shows radii of one mile from each of the sites and the degree to which the site is able to service the community.

From these studies it appears that sites numbers 2 and 3 fulfill the requirements both in nearness to the most central location and the amount of coverage of the mile radii.

Site number 2 is adjacent to the existing junior-senior high school. If this site were used the present high school athletic fields would have to be moved to some new location.

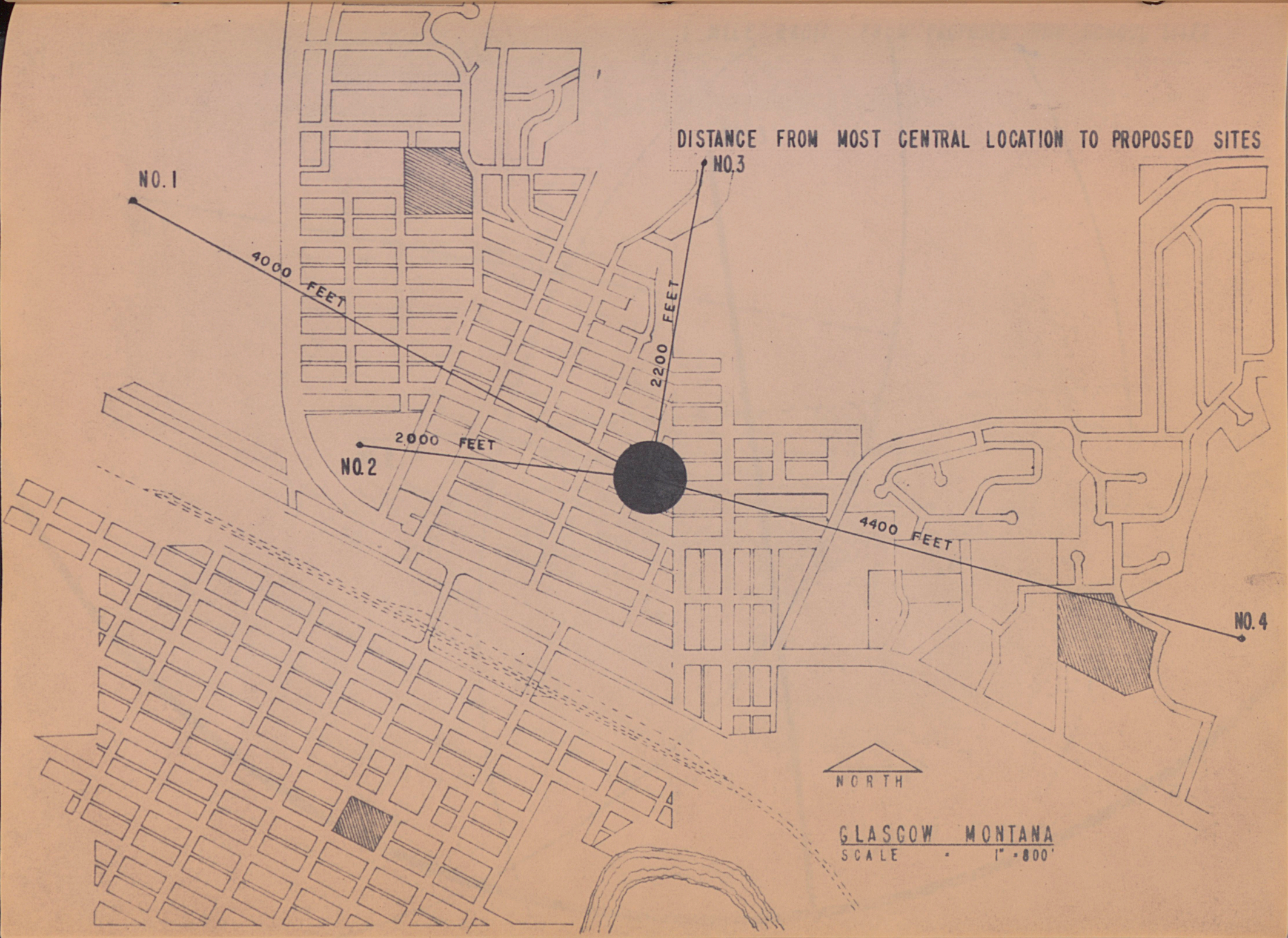
# LOCATION ACCORDING TO NEIGHBORHOOD CONCEPT

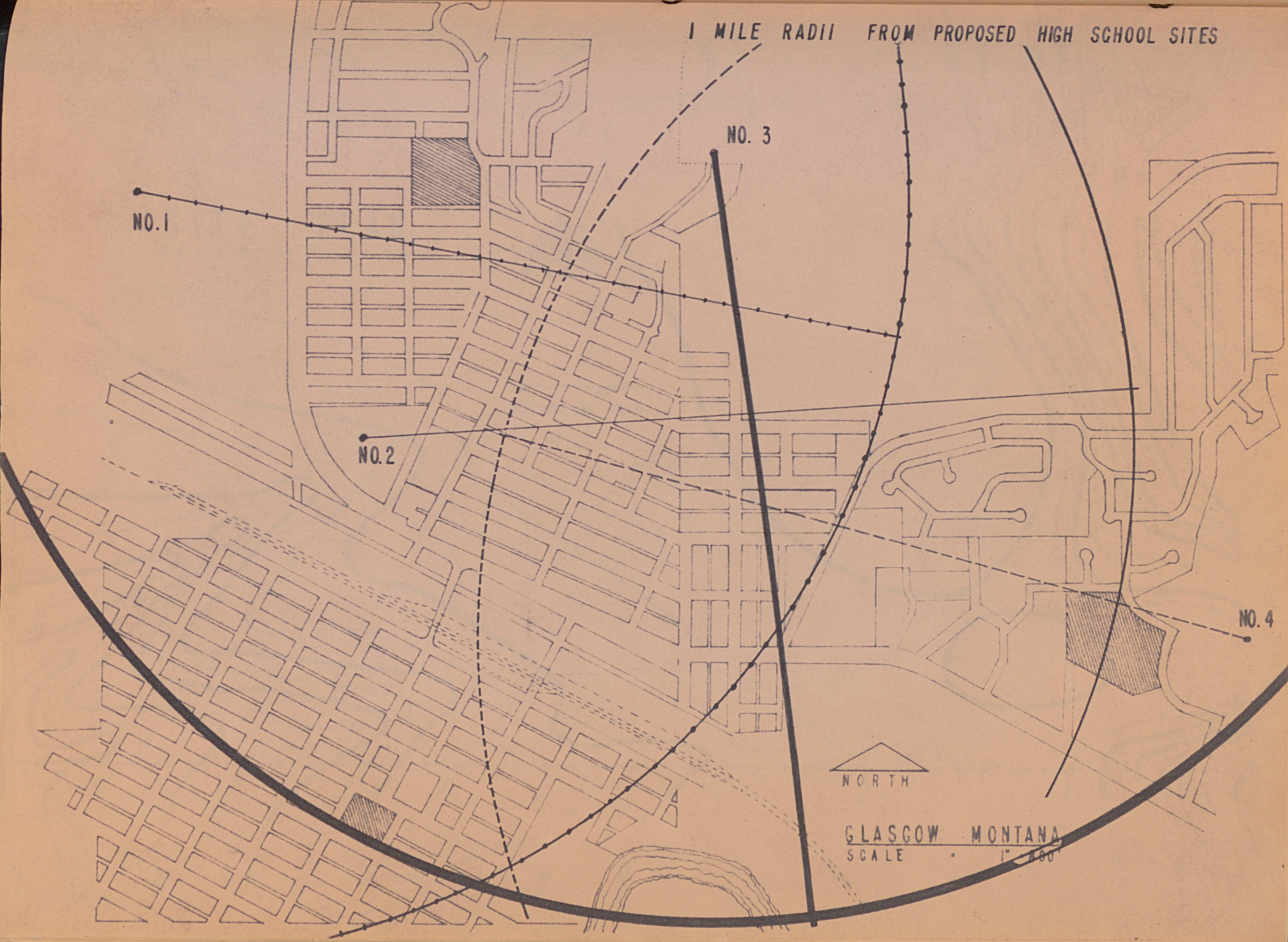


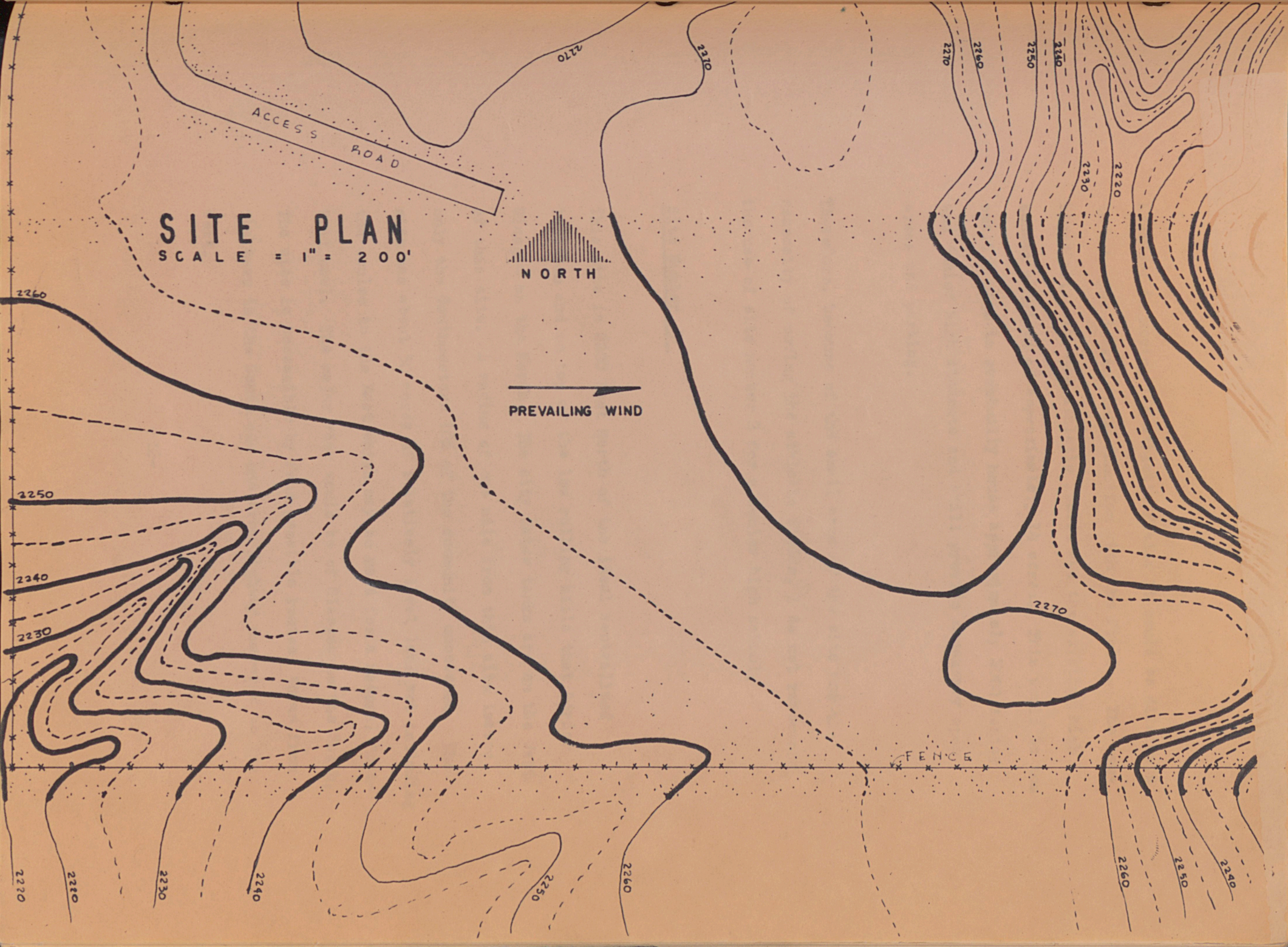
LOCATION EQUIDISTANT FROM PERIMETER

NORTH

GLASGOW MONTANA
SCALE - 1" - 800'


DISTANCE FROM MOST CENTRAL LOCATION TO PROPOSED SITES
NO.1
NO.3
4000 FEET
2200 FEET
2000 FEET
NO.2
4400 FEET
NO.4
NORTH
GLASGOW MONTANA
SCALE - 1" = 800'


1 MILE RADII FROM PROPOSED HIGH SCHOOL SITES
NO. 1
NO. 2
NO. 3
NO. 4
NORTH
GLASCOW MONTANA
SCALE


ACCESS ROAD
SITE PLAN
SCALE = 1" = 200'
NORTH
PREVAILING WIND
FENCE
2210
2220
2230
2240
2250
2260
2270
2310

however, in moving the athletic fields it would be difficult to make the locker rooms function with the fields. The combined site with the athletic fields and the existing high school consists of approximately 14 acres. This would be too small a site to eventually house approximately 2000 senior and junior high students and still provide necessary open areas and parking.

Therefore, because of the small area of the site and the necessity of moving the athletic fields, I do not recommend the use of site number 2 for a senior high school.

Site Number 3

This site is 2200 feet North of the ideal centralized location and on top of the low rolling hills that border Glasgow on the North. The city water tanks are on the West of this site. A radius of one mile from this site leaves only the Southwestern 10% of the community uncovered. The site has about 30 acres of relatively level land not including the coulee to the East which may be used for a natural football bowl. The major view would be of Glasgow to the South, The site is accessible by four possible routes, three from the town to the South and one from Highway number 2 to the West.

To the North lies the city airports (the runways of which are more than sufficient distance to cause any noise problems, especially considering its use for light planes). Adjacent to the airport to the South is the United States Weather Bureau Station which could be of definate aid in science study. There is land close to the airport which might be used for outdoor science labs and possible rocket experimentation.

The site is treeless and has little vegetation. The soil is gravel and gumbo clay as are most of the hills in this area. The soil would be of no problem for construction and the site has excellent drainage.

Utilities

The site is bordered directly on the South by a subdivision from which sewer and gas would be available. The site is at approximately the same elevation as the city water tanks, and water from this source would have to be pumped.

Cost

The site is owned by the city-county and therefore would be a saving than if the site were located on private property.

# ECONOMIC CONDITIONS

## ECONOMIC CONSIDERATIONS

"Nothing in the world is too good for our kids."
-Anonymous

"What are we building anyway, a palace?"
-Anonymous

Since the earliest days of public education, these two cries have been an enevitable sound in the school building process. But in school building today money is an especially anguished subject creating pressures which squeeze much of the juice out of schoolhouses, leaving them stripped, temporary, and uneconomical-that is, unable to meet complicated long-range challenges.[14]

### Economic Fundamentals

The three economical fundamentals, cost, size, and quality, react upon one another. Two of the factors can be predetermined, but there must be some freedom to adjust the remaining one to the others. However, this applies primarily to initial cost, that is, the cost of construction. Often overlooked, the continuing costs of operation, maintenance, and repairs are of an importance and deserve careful attention in the design stages.

Anything that can be designed into a plant which saves work on the part of the paid staff, reduces the consumption of fuel and power, or minimizes the needs for refinishing and repairs, will pay dividends to the community for the useful life of the plant.

Materials and finishes should not be chosen on the basis of low initial cost alone, but rather for lowest overall cost. In some of the larger systems, particularly in cities, rather careful accounts are kept of the costs of operation, maintenance, and repairs. It is no accident that such systems are also those which insist most strongly on the use of durable, high-quality materials and finishes.

## Cost Comparisons

The three most common cost comparisons are:

1. Cost per square foot
2. Cost per pupil
3. Area per pupil

Practically every new school plant project is subjected to comparisons with others already built or in the planning stage. Many persons, in making such comparisons, overlook the facts that such schools have been built at different times and places, of various materials, and by different methods, under various regulations, and often for differing

purposes. The basic cost factors must all be computed and no comparisons of different schools can be valid unless these factors are computed the same way in each case, and adjustments made for variations in certain qualitative factors.[8]

## Space Utilization

Productive spaces may be defined as those in which the required functions of the building take place. In the case of a school this function is primarily education. Non-productive spaces, such as administration, food service, corridors, toilets, storage, and service spaces are all essential to carrying out this primary purpose. They should be kept at a practical minimum, consistent with achieving the primary objective of a good educational program.

Circulation spaces such as corridors, passages, stairs, lobbies, and entrances are obvious necessities, but ordinarily do very little to further the education program. Corridors should be utilized for educational purposes, possibly for a gallery.

Combination facilities often prove economical. Idle spaces, resulting from inability to fully schedule their use, should be carefully considered in this connection. Some of these combination facilities that have been used are; Auditorium-Cafeteria, Cafeteria-Special Purpose, Stage-Music Room, Gymnasium-Auditorium, and Gymnasium-Cafeteria.

Caution is required to avoid false economics resulting from impractical combination-facility uses. One of the most successful combinations has been the Cafeteria-Special Purpose Room in which special purposes such as a cooking-sewing laboratory for an adjacent home-ec. department and a reading room for an adjacent library have been used to supplement the limited use of a cafeteria. The cafeteria may also be subdivided with folding partitions into separate rooms for small enrollment classes or various activities.

## Uniformity

Repetition of the use of various components, such as structural members and windows, simplifies construction in many ways, resulting in lowered costs. In the design stage, the adoption of a "planning module" paves the way to economical basic uniformity. The "planning module" is an imaginary building block of which the entire building is composed. The dimensions of the module are consistent in general throughout the building permitting repetition of a great many conditions.

## Single Story vs. Two Stories

Controversy and misunderstanding continue to exist, expecially among the uninitiated, on this subject. In some cases one will be less costly, in some cases the other. There are too many factors bearing on costs to allow a clear-cut conclusion one way or the other.

Evidence from a number of souces seems to indicate that in general one-story construction is slightly less expensive, particularly in the smaller schools. While single-story building obviously has a majority of advantages, there are situations where consideration of more stories is justified.

In larger schools (1000 pupils or more) wings tend to become extensive in length, causing long runs for mechanical installations and increased class-passing time. In such cases a second story may justify the additional cost of stairs and the space they occupy, some duplication of equipment, and other disadvantages of multi-story construction.

Economics of Aesthetics

The aesthetic environment to which we are all subjected are relatively intangible; yet, genuine works of art, such as sculpture, murals, and painting, are not a waste of public money in a school building, nor are aesthetically satisfying plantings. A school building endowed with aesthetic excellence is worth something extra to the community it graces, even though it costs no more than a mediocre design. It is also well known that where pupils enjoy and are proud of their school plant, custodial problems diminish and vandalism is reduced. Good architecture, then, is good business. It seems a poor policy to resist efforts toward such excellence on the mistaken assumption that it is not economical.

Local Economics

Because of the high mill levy for Glasgow it would be difficult to pass a bond issue at the present time; therefore, plans are being made to construct a junior high at the airforce base. This would relieve some pressures at the junior-senior high school and allow the seventh grade (now in the new East side Elementary School) to move back to the junior-senior high where it belongs. This change will at least keep the situation status quo for a few years until plans can be made for financing a new senior high. At this point it is difficult to say how much money will be available for such a project. The most effective way to approach the problem would be to show the approximate cost of a school of this type for approximately 100,000 square feet. The method used to estimate the cost was the Marshall Valuation Service calculator method.

The cost figures on page 31 have been computed to comply with current cost figures and local cost figures and variation in heating requirements due to extreme climate situations in Glasgow.

In figuring the entire high school using $14.30 per square foot, the cost would be $1,430,000. In figuring the gym,

| CLASS | QUALITY | SQ. FT COST |
|---|---|---|
| GOOD SCHOOL | Exterior Steel columns, bar joists, face brick, ornamentation<br>Interior Plaster, asphalt tile, ceramic wainscot, terrazzo, & pool<br>Lighting and Plumbing Good flourescent lights, tile restroom<br>Heating Hot water | $16.90 |
| AVERAGE SCHOOL | Exterior Brick, block, concrete, steel frame, or bearing wall<br>Interior Plaster, acoustic tile, hardwood, asphalt tile<br>Lighting and Plumbing Adequate lighting and plumbing<br>Heating Hot water | $14.30 |
| LOW COST SCHOOL | Exterior Brick or block,bearing wall, woood joists, plain<br>Interior Painted, acoustic tile, asphalt tile, soft wood<br>Lighting and Plumbing Minimum<br>Heating Wall furance | $10.25 |
| GOOD CLASSROOM | Exterior Steel columns, bar joists, face brick, ornament<br>Interior Plaster, hardwood, asphalt tile, acoustic tile,<br>Lighting and Plumbing Good fluorescent lighting, tile restrooms<br>Heating Hot water | $16.65 |
| AVERAGE CLASSROOM | Exterior Brick or block concrete, steel frame, bearing wall, wood joists<br>Interior Plaster, acoustic tile, hardwood, asphalt<br>Lighting and Plumbing Adequate<br>Heating Forced air | $13.95 |
| LOW COST CLASSROOM | Exterior Brick or block, bearing wall, wood joists, plain<br>Interior Painted, asphalt tile acoustic tile, softwood<br>Lighting and Plumbing Adequate lighting, no plumbing included<br>Heating Wall furnace | $10.20 |

| CLASS | QUALITY | SQ. FT COST |
|---|---|---|
| GOOD GYM | Exterior Steel columns and girders, face brick, ornamental stucco<br>Interior Plaster, wainscot basketball court, terrazzo, asphalt tile<br>Lighting and Plumbing Good lighting, tiled shower and restrooms<br>Heating forced air | $20.40 |
| AVERAGE GYM | Exterior Steel or glulam bents, brick or block some trim<br>Interior Plaster, basketball court linoleum, exposed beams<br>Lighting and Plumbing Adequate lighting, showers and restrooms<br>Heating Unit heaters | $16.50 |
| MULTIPURPOSE | Exterior Steel frame, brick, block concrete panels, ornamental stucco<br>Interior Plaster, acoustic tile asphalt tile, hardwood<br>Lighting and Plumbing Adequate<br>Heating Forced air | $15.95 |
| AVERAGE MANUAL ARTS | Exterior Steel or glulam bents brick or block, some trim<br>Interior Painted wall and ceilings storeroom<br>Lighting and Plumbing Good lighting, adequate outlets small restroom<br>Heating Hot water | $12.80 |
| AUDITORIUM | Exterior Steel frame, brick or block, some trim, concrete panels<br>Interior Plaster, acoustic tile asphalt tile, hardwood, upholstered fixer seats<br>Lighting and Plumbing Good lighting adequate plumbing<br>Heating Forced air | $23.00 |

manual arts, multipurpose room, auditorium, and classrooms separately a figure of $1,510,000 was determined. These figures average a cost per pupil of about $1,470 which compares favorably with the following costs per pupil figures:

| | |
|---|---|
| Good High School | $2,078 |
| Average High School | $1,484 |
| Low High School | $1,100 |

The average life of such a building has been estimated at 45 years.

Nationwide Economic Proposal

Solutions to reduce school construction costs such as stock plans for schools, prefabrication of whole school rooms, prefabrication of parts, and modular coordination has been suggested.

Such proposals such as stock plans for schools don't have as great a saving as may appear to have due to the problems of adapatation of the stock plans to the individual sites,,and to the needs of the individual schools. Stock plans would only save at the most 4% of the total building cost in the form of smaller architectural fees. In the future there will be a closer coordination between modular construction and prefabrication of building parts through out the building industry.[1]

# AESTHETIC CONSIDERATIONS

## AESTHETIC CONSIDERATIONS

There are three general areas of aesthetic consideration which are involved;

1. Relation of the student to the building.
2. Creation of an atmosphere conducive to learning.
3. Expression of materials and character.

### Relation of the Student to the Building

The building should be designed so that the individual student feels that he belongs and is a part of the school. Even though there are large group activities, the student must experience a human scale. One of the greatest problems in working with the student is a sensation of loneliness in relation to the other students. There should be a strong basic concept or form to give the student a sense of relation and order. This sense of relation and order can help overcome the student's lonely feeling and enable him to become more efficient in his school work.

### Creation of an Atmosphere Conducive to Learning

Although it may be advantageous to have large areas of

glass to let in the light and to let the students take advantage of a well planned view, there are times of the day when the glare and heat of the sun becomes unbearable. Then the disadvantages far out-weigh the advantages. If the view warrants such a use of glass, then some system of sun control must be devised.

Acoustics can also affect the learning process, see appendix II.

The building should express the honest use of materials in such a way that students learn to appreciate the growing trends of contemporary American Architecture, as a part of their education. The fact is, that to extablish a strong character and aesthetically fine design does not necessarily increase the cost but is dependent on the sensitivity of the designer. The materials and colors should be warm and cheerful, yet; they should be permanent and durable in color and surface. The student should be exposed to the fine art forms of painting, sculpture, and architecture. Although it may not have an immediate effect on the student, the amount of appreciation that one derives from the arts in later life can be possibly attributed to the degree of education to the arts in the younger years.

Creativity, imagination, invention-these are essential to

the design of a good school building. The building must provide an environment which excites the imagination and challenges the abilities of those who use it. Ideals and goals of education-aesthetics, order, proportion, strength, sensitivity, courage-should be embodied in the school building. If this is accomplished, the structure itself becomes an important tool for teaching, an essential and intergral part of the process of education.

Character and Materials

Glasgow has no strong defined character in its' buildings and the choice of materials is restricted to the use of transportation facilities. There are no local materials except concrete and the cement for that must be imported to the area. The closest manufacturers and suppliers of material would be in Billings and Great Falls areas, both of which are about 300 miles away. The choice then is not one of conformity to local character or restriction of available materials, but one of relation to the site, sensitive honest expression of materials, and expression of the educational processes.

Such functions as the gym, auditorium, cafeteria, and classrooms should express an individual character because of their varying functions, yet there should be an overall unity.

This unity can be accomplished through unity of materials and similar expression of structure, details and ornament.

# FUNCTION OF THE BUILDING

## THE FUNCTIONS OF THE BUILDING

### Types of Students

According to projected enrollment figures, the senior high school, consisting of grades 10, 11, and 12, should be planned for an enrollment of about 1000 students.[4]

These 1000 students represent widely varied areas of interest which must be provided for in the school curriculum.

One group of students has no desire for college education and will probably remain in Glasgow after graduation. It is the duty of the high school to train these students in the type of work that they desire and need, but still give them an education so that they will be a credit to the community. They will remain in Glasgow as farmers, secretaries, clerks, mechanics, bookkeepers, and housewives. They will need a certain type of education to train them for their jobs.

In another group (40%) is the student who expects college prepartion from his high school education. This student needs modern facilities and up-to-date information.

There is a third group of students who have not made up their minds as to what they want out of life. In some ways this may be a difficult group to handle; however, if the requirements for the other two groups are satisfactory, the requirements of this middle group would also be satisfactory in the process.

The program is organized partially in accordance with recommendations for secondary schools of the Trump Report, see appendix I .

Types and Functions of Spaces

The core of the school is the library, an area with which all the students should have contact with and be familiar. The Trump system gives the student more time for individual study; therefore, adjacent to the library there should be areas for private study and counseling. This is not a study hall space, which in the past has proved to be an inefficient method of study, but a place the student can call his own although he will have to share it with two or three other students. In addition to this type of space there are spaces for large groups of 100 students or more for lecture-type of instruction. After a lecture period the students would divide into discussion groups of 15-20 to discuss the material presented in the lecture.

There are still some subjects which can be taught best to groups of 25-30 students. This is the laboratory-type of instruction. Science, mathematics, home economics, industrial arts, art, business machines, typing, and journalism, fall into this laboratory type of space. Such subjects as history, English, and social studies, which the majority of the students must take, are more suited to the large lecture type instruction. Since a large number of students take these subjects it also justifies the use of special auditorium spaces. Science, home economics, and business also have classes which would benefit from large lecture classes. Only a few of the previously mentioned laboratory spaces must have special facilities (science, home economics, and art); therefore, the rest can be typical classrooms. These classrooms can be subdivided into two smaller areas for discussion groups.

This type of school organization is quite different from what we now have and it would be difficult to make an abrupt change. Many students would not be mature enough to handle the individual study. Since we live in a democracy, can we let just the bright students have an education and let the less bright student fall beside the way? No; therefore, there would have to be a complex system of class organization in which the brighter more mature student would spend about 40% of his time searching out information and solving co-

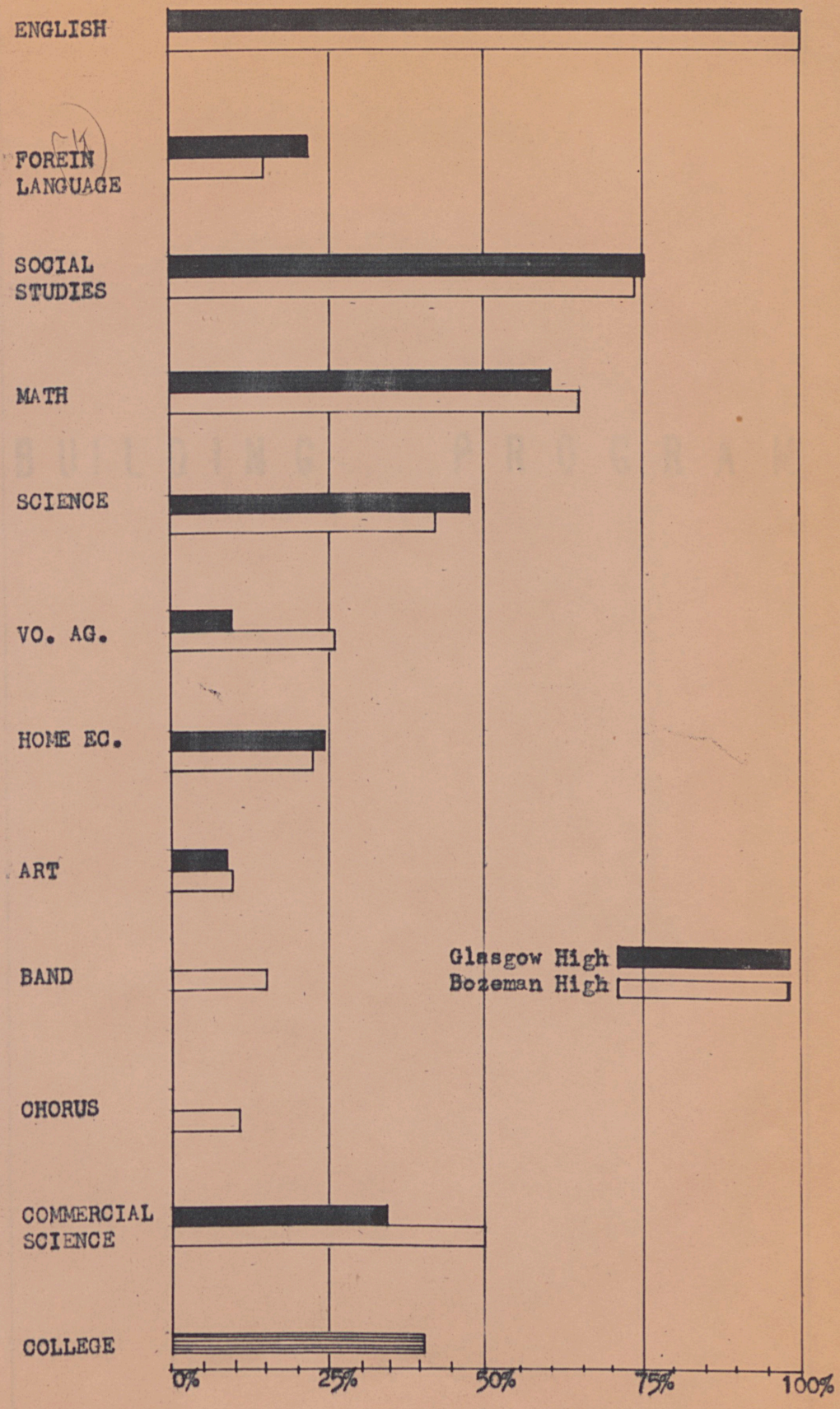
problems through individual study. The scheduale of the less mature student may be fitted to allow the student to spend only 10% of his time in individualized study.

With the increasing use of television actual auditorium space may be reduced and large lecture groups could be handled separately and concurrently in the individual study spaces or the space for group discussion. There would still be a need for auditorium and lecture space but to a lesser extent than if television teaching were not possible.

From these varied types of instruction the student may expect to be exposed to the type of instruction-learning process from which he may gain the most benefit.

The building should be planned for approximately a 2/3-3/4 usage in the classroom areas; however, in the specialized areas such as the band room, auditorium, cafeteria, a much lower percentage of occupancy can be expected.

For a high school of 1000 students a student-teacher ratio of approximately 25-1 should be planned for, which would mean 40 teacher areas. The majority of these teacher areas are incorporated within or adjacent to the classrooms, while the remainder of the teachers' area will be part of the area for testing and counceling of students.




PERCENTAGE OF STUDENTS ENROLLED IN VARIOUS SUBJECTS
FIGURE 8

# BUILDING PROGRAM

| | | |
|---|---|---|
| I. PHYSICAL EDUCATIONAL AREA | | 22,000 Sq. ft. |
| A. Gymnasium | 17,500 Sq. ft. | |
| 1. Function<br>For spectator sports, such as basketball, tumbling, wrestling<br>For Science Fairs and large civic groups. | | |
| 2. Equipment<br>Basketball floor-50'x 84'<br>Moveable Bleachers<br>Some permanent seating<br>Basketball backboard<br>Radio announcing equipment<br>Acrobatic equipment fixtures | | |
| 3. Finish<br>Good quality floor<br>Simple and durable | | |
| 4. Capacity<br>Maximum capacity of 4000 spectators for tournament use | | |
| B. Locker Rooms | 4000 Sq. ft. | |
| 1. "A" & "B" varsity girl's lockers<br>Storage for gym equipment and gym clothes<br>Offices for coaches and gym instructors<br>Showers<br>Lavatories<br>Access to gym and outside | | |
| 2. Equipment<br>Showers<br>Lavatories<br>Lockers<br>Laundry | | |
| 3. Finish<br>Rough | | |
| 4. Capacity<br>Full football team per area | | |

| | | |
|---|---|---|
| C. Public Rest Rooms | 600 Sq. ft. | |
| 1. Function<br>To serve spectators in gym and auditorium | | |
| 2. Equipment<br>Equivilent of 6 water closets per restroom | | |
| 3. Finish<br>Simple and durable | | |
| 4. Capacity<br>For crowd of 4000 but not too generous (300 feet each) | | |
| II. LOBBY | 1200 Sq. ft. | 1200 Sq. ft. |
| 1. Function<br>Ticket sales<br>Adjacent to restrooms | | |
| 2. Equipment<br>Ticket booths<br>Concession stands | | |
| 3. Finish<br>Simple and durable | | |
| 4. Capacity<br>To handle 4000 people | | |
| III. AUDITORIUM | | 13000 Sq. ft. |
| A. Audience Area | 8000 Sq. ft. | |
| 1. Function<br>To be capable of being divided into smaller auditoriums for small lecture classes<br>To be used for community concerts<br>Student plays<br>All school assembly | | |
| 2. Equipment<br>Permanent upholstered seats<br>Folding partitions<br>Projection booth | | |
| 3. Finish<br>Good quality | | |

| | | | |
|---|---|---|---|
| | 4. Capacity<br>1000 people | | |
| B. | Stage and Side Stage | 2500<br>Sq. ft. | |
| | 1. Function<br>Plays, concerts (including band and chorus)<br>Assembly | | |
| | 2. Equipment<br>Lighting, sound, backdrop machinery | | |
| | 3. Finish<br>Simple and durable | | |
| | 4. Capacity<br>Large enough for symphonic band of 100 | | |
| C. | Backstage | 2500<br>Sq. ft. | |
| | 1. Workshop<br>@1200 Sq. ft.<br>Storage<br>@700 Sq. ft.<br>Dressing room<br>600 Sq. ft. | | |
| | 2. Equipment<br>Shop equipment<br>Lavatory<br>Dressing room equipment | | |
| | 3. Finish<br>Rough | | |
| | 4. Capacity<br>Dressing room capacity for 12 people | | |
| IV. | MUSIC AREA | | 5000<br>Sq. ft. |
| A. | Band Room | 1800<br>Sq. ft. | |
| | 1. Function<br>Symphony and bands<br>Access to outdoors and gym | | |
| | 2. Equipment<br>Stepped seating<br>Acoustic treatment | | |
| | 3. Finish | | |

Simple and durable

4. Capacity
80-100 band members

B. Chorus Room — 1500 Sq. ft.
1. Function
To be used for 100 students
Lecture hall, when chorus
is not in session

2. Equipment
Stepped seating

3. Finish
Simple and durable

4. Capacity
100-135 people

C. Practice Rooms — 1000 Sq. ft.
1. Function
Sound proof areas for
music practice and
listening

2. Equipment
Sound proofing, listening
Hi-fi jacks

3. Finish
Simple and durable

4. Capacity
1-2 per room
15-20 rooms

D. Music Offices — 500 Sq. ft.
1. Function
Office plus area for private
lessons

2. Equipment
Office equipment-desks, chairs
music stands, storage spaces.

3. Finish
Simple and durable

4. Capacity
Rooms to hold 3-4 people

| | | |
|---|---|---|
| V. CAFETERIA | | 5600 Sq. ft. |
| A. Dining Area | 4400 Sq. ft. | |
| 1. Function | | |
| School lunches | | |
| Special dinner meetings | | |
| Club meetings | | |
| Soda bar | | |
| Dances | | |
| Divisible space for multi-use in unused hours | | |
| 2. Equipment | | |
| Tables | | |
| Folding partitions | | |
| Food pickup area | | |
| 3. Finish | | |
| Simple and durable | | |
| 4. Capacity | | |
| 500 students at a time | | |
| B. Kitchen | 1000 Sq. ft. | |
| 1. Function | | |
| Food preparation | | |
| Freezer, cooler, dishwashing | | |
| Food Storage | | |
| 2. Equipment | | |
| Food preparation equipment | | |
| Stoves, sinks, dishwashers | | |
| Freezer and coolers | | |
| Storage equipment | | |
| 3. Finish | | |
| Food preparation area | | |
| Simple and durable | | |
| Freezer area | | |
| Rough | | |
| 4. Capacity | | |
| 500 meals/hour | | |
| C. Service | 250 Sq. ft/ | |
| 1. Function | | |
| Food receiving | | |
| Garbage | | |
| Storage | | |

| | | |
|---|---|---|
| 2. Equipment<br>Incinerator<br>Garbage disposal | | |
| 3. Finish<br>Rough | | |
| 4. Capacity<br>2-3 people | | |
| VI. LIBRARY AND STUDY | | 12,500 Sq. ft. |
| A. Stack Room | 2500 Sq. ft. | |
| 1. Function<br>Book stack<br>Few study tables<br>Reception desk<br>Center of educational process | | |
| 2. Equipment<br>Stacks<br>Tables<br>Desk | | |
| 3. Finish<br>Good quality | | |
| 4. Capacity<br>10-15 people | | |
| B. Library Office and Work Area | 250 Sq. ft. | |
| 1. Function<br>Library business<br>Book repair | | |
| 2. Equipment<br>Office equipment<br>Sink | | |
| 3. Finish<br>Simple and durable | | |
| 4. Capacity<br>14 people | | |
| C. Study Area | 6000 Sq. ft. | |
| 1. Function<br>Space for individual work | | |

| | | | |
|---|---|---|---|
| | Space student can call his own | | |
| | 2. Equipment<br>T. V.<br>Teaching machines<br>Recording and listening devices<br>Storage | | |
| | 3. Finish<br>Simple and durable | | |
| | 4. Capacity<br>200 students | | |
| D. | Testing and Counseling | 3000 Sq. ft. | |
| | 1. Function<br>Areas for more private study<br>Offices for lesser staffmembers<br>For individual counseling from instructors | | |
| | 2. Equipment<br>Similar to study area<br>Desks<br>Office equipment | | |
| | 3. Finish<br>Simple and durable | | |
| | 4. Capacity<br>50 students | | |
| E. | Language Lab | 1000 Sq. ft. | |
| | 1. Function<br>Separate area for language listening, but similar to study area and to be used as such when not a language lab | | |
| | 2. Equipment<br>Same as study area | | |
| | 3. Finish<br>Simple and durable | | |
| | 4. Capacity<br>50 students | | |

| | | | |
|---|---|---|---|
| VII. | SHOP AREA | | 8000 Sq. ft. |
| A. | General Shop | 2000 Sq. ft. | |
| | 1. Function<br>Wood, metal, paint and electricity area | | |
| | 2. Equipment<br>Saws, laths, sanders, paint room, work table<br>Equipment storage | | |
| | 3. Finish<br>Rough | | |
| | 4. Capacity<br>20-25 students | | |
| B. | Drafting Room | 1000 Sq. ft. | |
| | 1. Function<br>Instruction of mechanical drawing and working drawings to be used by college bound students | | |
| | 2. Equipment<br>Drafting desks | | |
| | 3. Finish<br>Rough | | |
| | 4. Capacity<br>24 students | | |
| C. | Paint and Lumber Storage | 500 Sq. ft. | |
| | 1. Function<br>Storage | | |
| | 2. Equipment<br>Storage racks<br>Separate paint room | | |
| | 3. Finish<br>Rough | | |
| D. | Vo-Ag. and Mechanic Shop | 3600 Sq. ft. | |
| | 1. Function<br>Agriculture and mechanical shop | | |
| | 2. Equipment<br>Welding, body work, hoists, | | |
| | 3. Finish<br>Rough | | |

| | | | |
|---|---|---|---|
| | 4. Capacity<br>30 students | | |
| E. | Vo-Ag and Mechanical Classroom | 900 | |
| | 1. Function<br>Instruction separate from noise and shop | Sq. ft. | |
| | 2. Equipment<br>Same as a typical classroom | | |
| | 3. Finish<br>Rough | | |
| | 4. Capacity<br>25-30 students | | |
| VIII. | CLASSROOMS | | 10,700<br>Sq. ft. |
| A. | Specialized Classrooms | 4400 | |
| | 1. Function<br>Typing room<br>Business room<br>Machines room<br>Home Economic rooms<br>Cooking<br>Sewing<br>Art rooms | Sq. ft. | |
| | 2. Equipment<br>Floor to ceiling tackboard or chalkboard<br>Storage<br>Panel for T. V. , sound, clock, and switches | | |
| | 3. Finish<br>Simple and durable | | |
| | 4. Capacity<br>25-30 students | | |
| B. | Typical Classroom | 6300 | |
| | 1. Function<br>Math<br>Foreign languages<br>Journalism | Sq. ft. | |

| | | | |
|---|---|---|---|
| | Able to be divided for smaller discussion groups | | |
| | 2. Equipment<br>Floor to ceiling chalkboard<br>pegboard, tackboard,<br>Special panel for T. V.,<br>sound, clock, and switches<br>Folding partitions | | |
| | 3. Finish<br>Simple and durable | | |
| | 4. Capacity<br>25-30/room<br>12-15/discussion room<br>7 rooms/@ 900 Sq. ft. | | |
| | C. Instructor space adjacent to classroom to be included in classroom Sq. ft. | | |
| IX. | SCIENCE AREA | | 7000 Sq. ft. |
| | A. Labs | 3600 Sq. ft. | |
| | 1. Function<br>Biology<br>Chemistry<br>Physics | | |
| | 2. Equipment<br>Lab tables with standard science equipment<br>Demonstration equipment | | |
| | 3. Finish<br>Simple and durable | | |
| | 4. Capacity<br>15-30 students<br>1200 Sq. ft. room | | |
| | B. Lecture Room | 1500 Sq. ft. | |
| | 1. Function<br>Science and other lecture demonstrations. | | |
| | 2. Equipment<br>Stepped seating<br>Lecture demonstration equipment | | |

| | | |
|---|---|---|
| | 3. Finish<br>Simple and durable | |
| | 4. Capacity<br>100 students | |
| C. Project Room | | 600<br>Sq. ft. |
| | 1. Function<br>To serve biology and chemistry without disturbing labs | |
| | 2. Equipment<br>Lab facilities<br>Work spaces<br>Project storage | |
| | 3. Finish<br>Simple and durable | |
| | 4. Capacity<br>10 students | |
| D. Project Room | | 600<br>Sq. ft. |
| | 1. Function<br>To serve chemistry and physics without disturbing labs | |
| | 2. Equipment<br>Same as lab facilities | |
| | 3. Finish<br>Simple and durable | |
| | 4. Capacity<br>10 students | |
| E. Dark Room | | 100<br>Sq. ft. |
| | 1. Function<br>Photography | |
| | 2. Equipment<br>Safe lights<br>Enlarger<br>Tanks<br>Sinks | |
| | 3. Finish<br>Rough | |
| | 4. Capacity<br>2-3 people | |

| | | | |
|---|---|---|---|
| F. | Plant and Animal Room<br>1. Function<br>Separate storage off biology lab<br><br>2. Equipment<br>Storage racks and cages<br><br>3. Finish<br>Rough | 500<br>Sq. ft. | |
| G. | Storage<br>1. Function<br>Separate storage for biology, chemistry, and physics<br><br>2. Equipment<br>Storage equipment<br><br>3. Finish<br>Rough | 400<br>Sq. ft. | |
| X. | GENERAL OFFICE AREA<br>1. Function<br>To serve administrators and staff in their offical capacities and duties<br><br>2. Equipment<br>Office equipment<br>Storage spaces<br>Office machinery<br><br>3. Finish<br>Simple and durable<br><br>4. Capacity<br>3-5 persons per office | | 2500<br>Sq. ft. |
| A. | Reception and Waiting Area | 400<br>Sq. ft. | |
| B. | Principal Office | 200<br>Sq. ft. | |
| C. | Main Office | 700<br>Sq. ft. | |
| D. | Machine Room | 100<br>Sq. ft. | |

| | | | |
|---|---|---|---|
| | E. Business Office | 300 Sq. ft. | |
| | F. Vice Principal Office | 100 Sq. ft. | |
| | G. Health Office | 200 Sq. ft. | |
| | H. Vault | 200 Sq. ft. | |
| | I. Staff Room | 300 Sq. ft. | |
| XI. | MISCELLANEOUS | | 15,000 Sq. ft. |
| | A. Corridors and Stairs | | |
| | B. Lockers | | |
| | C. Restrooms 3 areas of men and women @600 square feet each | 1800 Sq. ft. | |
| | D. Entry Areas | | |
| | E. Mechanical and Boiler Rooms | | |
| TOTAL | 1000 student 100 sq. ft./student | Approx. | 100,000 Sq. ft. |

**Note**
Areas may fluctuate 15% more or less in the final analysis.

## XII. OUTSIDE AREAS

A. Parking
   1. Staff and visitors
      50 cars

   2. Public and Student
      750-1000 cars
      (for tournaments)

B. Outdoor Science Labs

C. Football Field and Track
   1. 1000 spectators in stands

   2. 100 cars for auto spectators

D. Outdoor Auditorium
   1. 100 students
      Hillside orientation

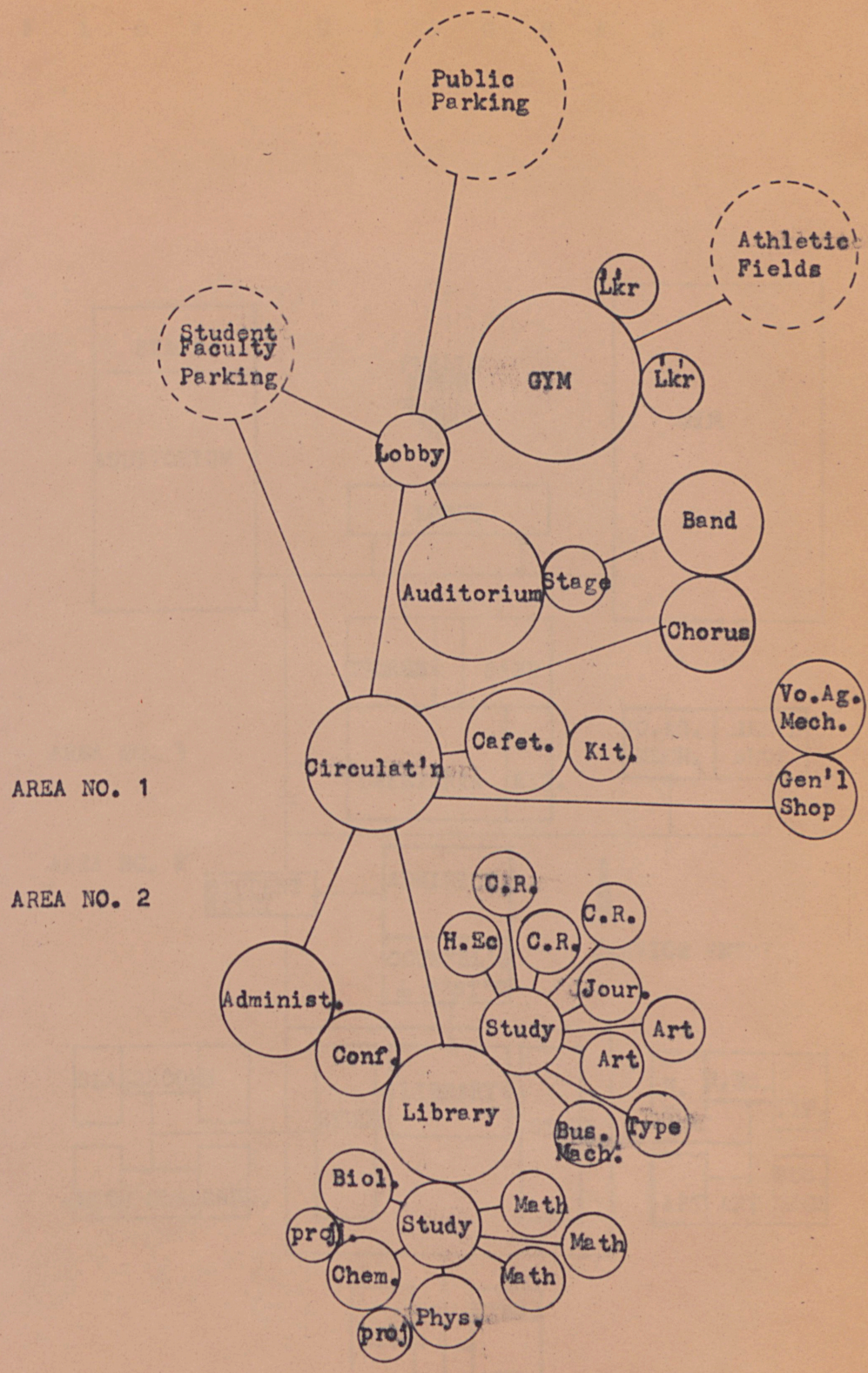
E. Outdoor Courts
   1. Tennis courts

# FLOW DIAGRAMS

EXPLANATION OF FLOW DIAGRAM

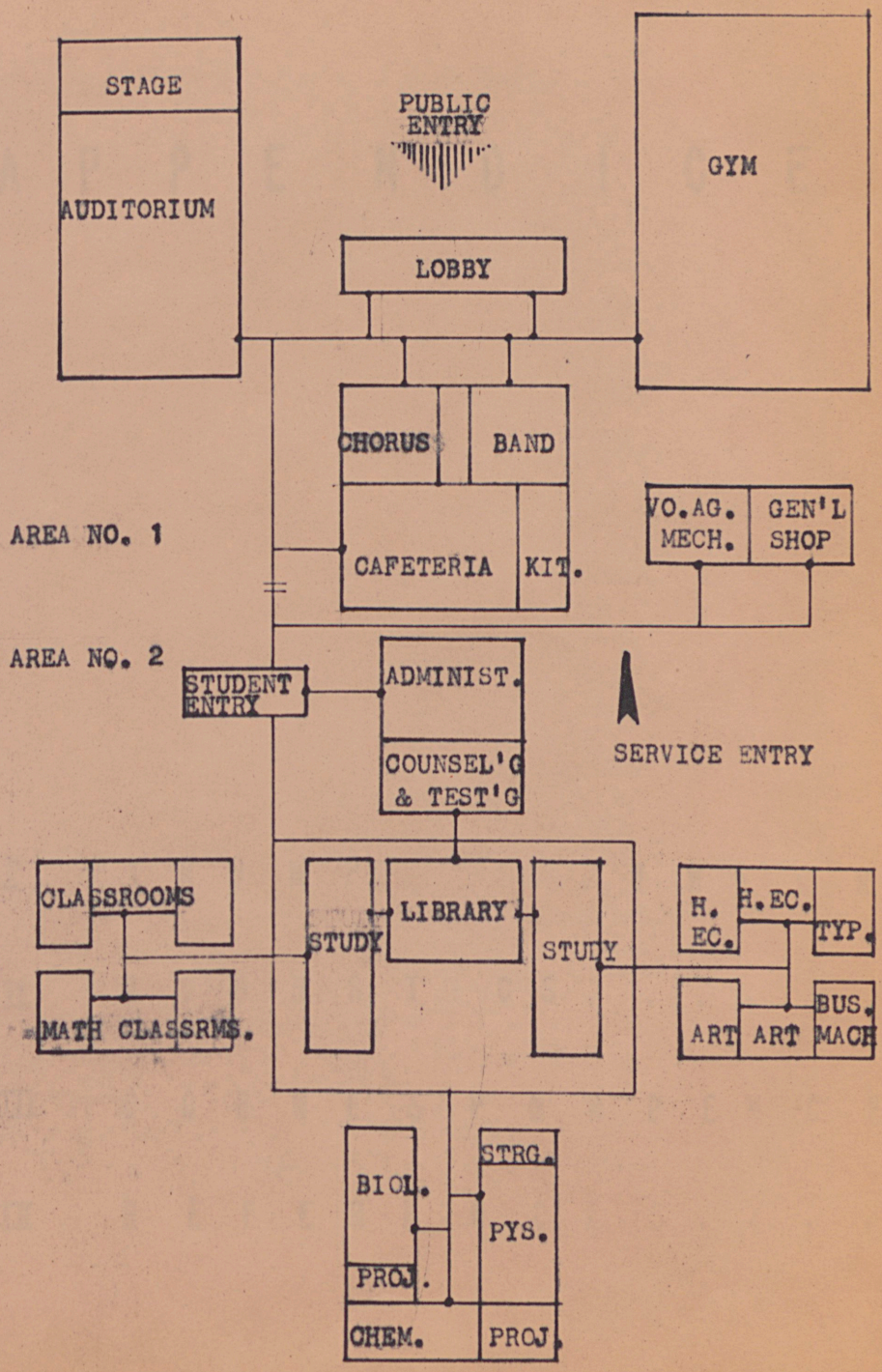
The flow diagram, which shows the relation of general areas to each other, is divided into two general areas. Area #1 is concerned with noisy and large group functions. Area #2 is concerned with individual study and small groups. Area #1 could be closed off from the rest of the school during evening use of the school for dinners, plays, and basketball games. The second area is centered around the library. Adjacent to the library are areas for individual study and private conference. In connection with the study areas are the labs, classrooms and administration area.

# PRELIMINARY FLOW DIAGRAM




GLASGOW SENIOR HIGH SCHOOL

# F L O W  D I A G R A M




GLASGOW SENIOR HIGH SCHOOL

# APPENDICES

I TRUMP . . . THEORY

II ACOUSTICS . . . . . .

III CORRESPONDENCE .

IV REFERENCES . . . . .

## A THEORY FOR MORE EFFICIENT SECONDARY EDUCATION

A theory for more efficient secondary education has been developed by Professor J. Lloyd Trump of the University of Illinois, Director of the Commission on the Experimental Study of the Utilization of the Staff in the Secondary School of the National Association of Secondary-School Principals (NASSP).[10]

Supported by the Ford Foundation and the Fund for the Advancement of Education, a distinguished group of educators has worked for more than two years with Dr. Trump to evolve theories for the qualitative improvement of the nations' secondary schools. Their most important suggestions may be summarized as follows:

1. REORGANIZATION of INSTRUCTION: Most instruction should be arranged as to provide more opportunity for individual study, more participation in small discussion groups, and increased attendance at large classes given by gifted teachers.

2. REARRANGEMENT of CURRICULUM AND CLASS SCHEDULES: In the high school of the future these elements should be much more flexible. There should be less reliance on the standard 40-45 minute period, [illegible] as needed.

3. CHANGES IN STAFFING PATTERNS: Much greater utilization of instructional assistants, clerks, general aides,

and other types of relatively unskilled educational labor is forseen. There should be greated reliance on team teaching and the highly skilled specialist.

4. MORE EXTENSIVE USE OF TECHNOLOGICAL AIDS: We are at the beginning of a period in which television, tape recordings, teaching machines, and electronic devices of all kinds will be very significant.

This above educational plan has certain architectural implications and applications which are as follows:

A. Spaces where individuals can keep their materials, study, use teaching machines, read, draw, listen to music, write, and engage in many other activities. At present the only place which a student can call his own is a steel locker. Students must places with privacy and accessibility- probably about 300-350 such individual study areas would be needed for every 1000 students where they would spend about 40 percent of their time.

B. Spaces where 12-15 people can gather for small group discussions. For this purpose the typical 30 feet by 30 feet classroom is costly and wasteful. In a school with 1000 students about 15-20 such classroom spaces would be required in which the student would spend about 20 percent of his time.

C. Spaces where large groups-100, 200, 500, or more,

depending on the size of the school-can meet. For 1000 students, 5 spaces for large groups might be needed. One might be a cafeteria and one an instructional center (formerly called an auditorium). Shops, libraries, art areas, and laboratories will, of course, also have to be provided, but will be changed to serve students in the new patterns of instruction. About 40 percent of the students' time will be spent in large group instruction.

The adequacy of this theory depends upon whether or not the high school student is mature enough to be given the study freedom as outlined by the Trump report.

HOW AN AVERAGE 16-YEAR-OLD STUDENT MIGHT SPEND HIS SCHOOL TIME

Average minutes per week

| SUBJECT | required basic education | | | as selected by personal and professional decision | |
|---|---|---|---|---|---|
| English | 100 | 50 | 40 | | |
| Social Studies | 100 | 50 | 40 | | |
| Foreign Language | 60 | 40 | 40 | | |
| Mathematics | 80 | 40 | 60 | choice among the subject areas | |
| Science | 80 | 40 | 70 | | |
| Fine and Practical Arts | 80 | 40 | 30 | | |
| Health-Physical Education Recreation | 40 | 40 | 80 | | |
| TOTAL | 540 | 300 | 360 | 240 | 360 |
| | large group | small group | independent study | group activities | indep. study |

Extra hours available for independent study in educational facilities open and supervised additional hours, days and weeks.

| GROUP ORGANIZATION | Large Group Instruction | Small Group Instruction | Individual Study |
|---|---|---|---|
| TEACHING-LEARNING EXPERIENCES | Introduction<br>Motivation<br>Explanation<br>Planning<br>Group Study<br>Enrichment<br>Generalization<br>Evaluation | Group examination of terms and concepts and solutions of problems<br><br>Reach areas of agreement and disagreement<br><br>Improve inter-personal relations | Read<br>Self-appraise<br>Listen to records and tapes<br>View, Question, Analyze, think, Experiment, Examine, Investigate, Consider Evidence, Write, Create, Memorize Record, Make, Visit |
| SPACE ALLOCATION | Auditorium, little theater cafeteria study hall classrooms joined via televison or remodeling other large room | Conference room<br>Classroom | Library, Laboratories, Workshops, Project and materials centers, Museums-inside or outside the school plant |
| TIME DIVISION | 40% | 20% | 40% |

ORGANIZATION OF INSTRUCTION from Images of the Future
by
J. Lloyd Trump, Director

# A C O U S T I C S

ABSTRACT

This report consists of an analysis of noise problems in schools. It deals with problems of choosing a site which is not plagued with traffic problems, and the arrangement of the buildings and landscape on the site to reduce noise problems.

This report also deals with the application of acoustical principles in controlling noise between rooms and noise control with such spaces as classrooms, halls, and auditoriums. The conflict between the trends of contemporary educational flexibility and the application of acoustic technology is brought out. A solution to this conflict has been considered.

## HOW CAN THE NOISE LEVEL IN SCHOOLS BE CONTROLLED?

Providing a good acoustical environment in today's school buildings has become a difficult problem over the past few years. Because of the demand for lighter construction, the need for mechanical equipement, and the daily use of many modern devices in the classroom (television sets, typewriters, record players) the problem of noise control has become more complex and expensive. Older buildings -with their heavy masonry walls and partitions, and their plastered ceilings- solved one of the problems of acoustics, that of controlling the transmission of sound from one room to the other. On the other hand, these same materials did a poor job on another aspect of sound control, that of absorbing sound within the room itself. The first attempts of noise control within classrooms were directed toward this problem. Tiles of absorptive material were placed on the ceiling to obtain a degree of sound control in the room. Even today many persons are of the opinion that these measures are all that is needed to create satisfactory control.

Actually, complete acoustical control involves the consideration of many aspects such as the control of noise

originating outside the building, the control of noise originating outside the classroom and the control of noise originating within the classroom itself. The fact must be realized that all acoustical control is not preventive or negative. Some background noise may be present in order to give a sense of privacy. A condition of dead quiet tends to be quite oppressive. In some cases materials are used to increase the audibility of sound by reflecting it instead of dampening it by absorption. First, consider the negative control of noise.

## Control of Noise Originating Outside the Building

Noise control may be partially solved through the selection of the site, the location of the building on the site, the location of the playground, and the location of the trees and shrubs.

### Selection of the Site

Many existing schools are so disturbed by the traffic noise that the classroom efficiency is greatly reduced. Noise not only distracts thinking but makes the hearing of speach difficult and at times impossible. The convenience, economy, and availability of a site does not justify its use for a school if a major noise problem exists. A quiet site, even if more costly than a noisy one, may prove to be the more economical one in the long run. The choice of a location

adjacent to quiet streets, or even of one removed only a few hundred feet from noisy streets, can help to insure freedom from disturbing traffic noise.

It is not enough just to select a quiet site. In addition zoning ordinances should be established to require trucking routes, main traffic arteries, and airplane routes to be located sufficiently far from the school. The noise level at the site should be below 70 decibels. In order to insure this condition it is necessary to keep honking auto horns 400 feet from the site, motorcycles 300 feet away, trucks 200 feet away and private autos 100 feet away. These distances are based on the assumption that noise travels through the air along unobstructed paths. These figures can be approximately halved if buildings, embankments, trees, or other obstacles are located between the source of noise and the school site. For all the above-named sources, such obstacles frequently exist, but this is not the case of air traffic. Planes are so noisy that they must not be allowed to pass within 4,000 feet of the school site. This distance is based on the average noise of four-motor propeller-type aircraft.[14]

Layout of Building and Landscape of the Site

Well planned grading and landscape and the separation of the noisy functions (machine and wood shops, band rooms,

and the gymnasium) from the classroom area may reduce the noise level by more than 10 decibels. Much of the disturbing noise is transmitted through open windows; therefore, it is advisable not to face window areas toward the noise.

Trees and plantings provide some acoustical protection if they are properly employed. A single row of trees is of little value. In order to obtain maximum protection, several rows of trees and shrubs should be placed as close as possible to the noise source.[16]

Noise Originating in the Adjacent Rooms

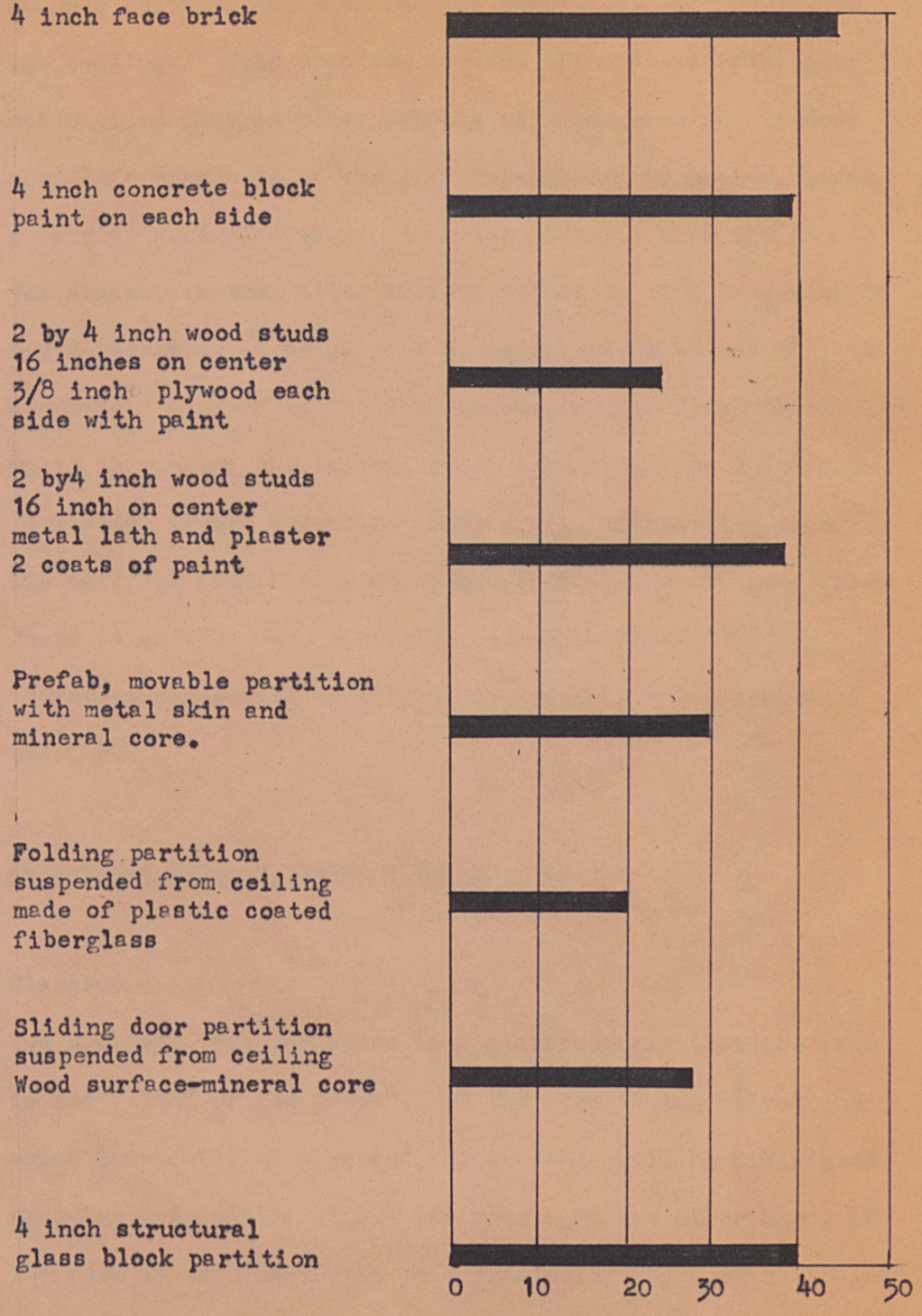
There are many people who think they can cure the noise from adjacent areas by wrapping a room on the inside with sound absorbing materials. Isolation from sound is a much more complex matter than people realize. The transmission of sound from one room to the other can follow many paths- machinery noises, thin partition, continuous ventilating ducts, light fixtures, open windows, spaces around doors and over ceilings- all which contribute to a disturbing high noise level. What does stop noise from penetrating walls? The answer is old fashioned; a good substancial air tight wall. The sound vibrations in the air are not capable of passing through anything dense. When sound waves

hit a wall on one side they make it vibrate just like our eardrums. If the wall is flimsy, it vibrates easily and the sound waves are produced on the other side; however, if the wall is substantial, it does not vibrate, and the sound waves are not produced on the other side. It is the difference between hitting a drum and a block of granite. Figure 11 shows the relative noise reduction value of various types of partition construction.

A noise reduction of 40 decibels is needed for adequate sound control.[15] A lead wall five inches thick would have a noise reduction factor of 60 decibels but there would be little point to build such a wall if you were going to put a single panel door in it (noise reduction, 15 decibels). No partition is acoustically stronger than five square feet of its' surface. If you include a door in a partition that shows light under the bottom edge you may as well leave it open.

Another increasing practice is to top a partition wall between classrooms with a strip of glass next to the ceiling to give the room a feeling of spaciousness. Visually this is pleasant, but single glass is not a good sound barrier. If you want to use glass between classrooms the conservative method is to use two thicknesses of ¼ inch glass with a four-inch air space between them.

Figure 11 COMPARITIVE DECIBEL TRANSMISSION LOSS OF WALL MATERIALS



In the Southwest, particularly, there are some "open plan" schools which do not even run the partitions all the way to the ceilings. This practice evolved after their architects had noticed that in other schools all the doors and windows were left open much of the year because of the heat-a bigger potential area of discomfort in that climate than the sound. The students seemed to be able to adjust to this lessening of sound barriers. A trick used to help classes adjust to this acoustical openess is the introduction of low level background music throughout the school, which seemed to absorb (psychologically, if not actually) some of the distracting noises. The call for flexibility and convertibility for future classrooms is another very difficult demand on the bulky ( and therefore permanent) partitions demanded by pure acoustical utility.

## Acoustical Control Within a Space

### Classrooms

Two problems that may arise in a classroom are that the room is too "live" or too "dead". If the room is too "live" the noise level will be high and the students will be distracted by noise originating within the room. On the other hand, if the room is too "dead" the teacher's voice may appear lifeless and the students will also lose interest. A successful solu-

tion has been to cover the center of the ceiling with a hard surface to reflect the teacher's voice and to cover the perimeter of the ceiling and part of the walls with an absorptive material to "soak-up" the noise originated by the students.

Halls

Usually neglected in the acoustical design of a school, a corridor becomes a huge speaking tube, down which every footstep or cough echoes and resounds. The sound of a group of pupils leaving a classroom for recess interrupts everything. The slam of a door can startle people all over the building.

It is especially important to install as much absorbing material as possible on the ceilings and walls of the halls. Durable materials should be specified for this rough wear. Resilient hall floors are also important, to soften the sounds made by footsteps.

In some parts of the country outdoor corridors have come into use to save money; however, they are also excellent acoustically because they don't contain the sound.

Halls can also be quite useful acoustically. In a noisy neighborhood, they can sometimes be placed between the classrooms and the outdoor noise to function as a kind of gigantic hollow partition.

Auditoriums

Auditoriums must be well insulated from foreign noise but still have good positive acoustical treatment. An auditorium must have a hard reflective ceiling (acoustical tile on an auditorium ceiling is like black paint to indirect lighting). A good ceiling acts like a sound "mirror" reflecting the sound to the audience. Auditoriums are often cut short on acoustical treatment but here is a case where it is cheaper to provide for acoustics originally than to correct afterwards.

## CONCLUSION

It may appear confusing that there are many opposing approaches to the solution of acoustical control of schools. One approach is to use heavy permanent types of construction while the other extreme leans toward lighter construction for flexible open plans. It seems hard to realize that both of these extremely opposite solutions have the same goal in mind, that of efficient education. It stands to reason that something may be sacrifice in each case in order to achieve their relative goals. But we can, "have our cake and eat it" ! Since economy and construction technology trends lean toward the lighter types of construction why not follow this direction? If this type of construction and planning is restricted to areas in the educational program where noise has proved to be the least problem, then the money saved can be ulitized to treat areas with greater acoustical problems. For example, in an elementary school the ordinary level of classwork doesn't necessarily need special acoustical consideration but activities such as music, art, and games would create disturbance to other classes. These activities need special acoustically controlled spaces. A similar situation can be seen in the high school where money may be saved on the typical classroom and utilized to a better advantage in auditoriums, lecture rooms, and music rooms which have special acoustical problems.

# CORRESPONDENCE

820 South Seventh Street
Bozeman, Montana
February 1, 1962

Mr. William Greer
Superintendent of Glasgow Public Schools
Glasgow, Montana

Dear Mr. Greer:

I am a 1957 graduate of Glasgow High School and for the past four and a half years I have been studying Architecture at Montana State College. I am also working part time for Oswald Berg Jr. and Associates, Architects.

During the fifth year in Architecture, two quarters are spent on a design thesis. For my thesis I have chosen the application of contemporary secondary educational theories to architectural design. I have chosen the design of a new senior high school for Glasgow as a hypothetical case to which I can apply my efforts.

The first quarter of my thesis consists of preliminary research and concepts of the problem. I have become acquainted with the requirements of Glasgow's high school through information and recommendations from the Next Steps in Glasgow's School Plant by the Bureau of Field Studies and Surveys of the University of Minnesota.

I have also been studying the Dr. Trump theory for more efficient education and its architectural implications.

I hope to be in Glasgow w ithin the next few weeks and would appreciate an interview toreceive answers to some of the problems that have confronted me.

One of the problems that I am concerned with at the present is the choosing of one of the proposed sites.

I will appreciate hearing from you and of your opinions on this subject.

Sincerely yours,

Roger Ruppel

Mr. Roger Ruppel

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