THE ADAPTATION OF THE SMALL ELEMENTARY SCHOOL BUILDING TO A MODERN EDUCATIONAL PROGRAM

By

PETER L. JENSEN

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I

INTRODUCTION

* The school building is an integral part of any school situation. It exercises a positive influence and may become the dominant factor in shaping and controlling our educational policies and programs. Many of our much criticized curricula may be traced to the compromising of educational necessities to meet arbitrary building and construction standards. Too often the layman's and even the architects conception of the school building is merely "A device to protect the children from the elements while learning." Too often the building is patterned from those already in existence without due regard to the demands of modern education. To serve these demands of modern education adequately, buildings must be planned to meet the needs of teaching, learning, and living. The extraordinary high cost of building construction together with the most unusual economic conditions that exist today have complicated the problem many-fold. There is no doubt that the procedure in planning would be simplified, costs reduced, and greater returns for the money secured, if the

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* Almack, J. C., "The Adaptation of the School Building to a Modern Educational Program," Doctor's Thesis, Stanford University, Preface.

relations between the architectural factors and the educational factors were more clearly understood. The problem, then, is to bring about a state of cooperation between the guiding specialists of these two fields. Until this has been effected, no satisfactory school building can be evolved. It is the purpose of this thesis to analyze the essential phases of a school building program in terms of educational, architectural, and economical practices, with the view of aiding in their cooperation in evolving a better school building.

Scope of Study

Our public schools of today may be classified as (1) Elementary schools, (2) Junior High schools, (3) Senior High schools, and (4) Colleges. The educational problems and practices of these groups vary greatly. Each has a program (dictated by modern Psychology) adapted to fit the child at some period of his development. Consequently, the housing facilities must necessarily be adapted to the needs of these respective programs. Each requires specialization.

Schools may also be classified as to size, viz: (1) the large school, and (2) the small school. Again, they may be classified as to locality, viz: (1) the rural school, (2) the town school, and (3) the city school. Each embodies characteristics peculiar to itself and requiring specialization in planning housing facilities for it.

The small elementary schools (grades 1-6), due to the fact that they are usually located in the less wealthy and

less enlightened districts, have not kept pace with the progress made in modern school-building.

With the attempt to aid in the progress of small elementary school building, this type of school has been selected as the subject of this study.

Obviously, in such a study a complete discussion of each phase of school building would be impossible. In some cases the material was fully covered elsewhere, in others available data was insufficient or changing so rapidly that no discussion seemed advisable.

Sources of Material

The material used in this study has been collected by the writer through several sources. He worked several years in the offices of an architectural firm specializing in school buildings. Later he designed and superintended the construction of several elementary school buildings. The experience gained in these activities has been utilized in this study. Many existing elementary schools of different types in various localities were visited and their curricula and building facilities noted. Practicing architects of this section were interviewed, with the objective of gaining their opinions on school house planning and construction. All available building material and equipment catalogues, advertising bulletins, and other printed materials issued by city, county, and state and national educational organizations were examined and contents noted. Other information was gathered

from educational and building magazines as noted in the bibliography.

In making final selection for each item for recommendation, personal investigation or recommendation by those who have had actual experience was used as check-up.

II

NEW MOTIVES IN ELEMENTARY EDUCATION

Dewey, Thorndike, Kirkpatrick, and other educational leaders of today have pretty clearly established the laws of growth and the needs of the modern elementary school child. Briefly, every child needs a healthy body, good habits of both mind and body; a well organized mind; many widened interests; a sense of fair play and honesty; the ability to live and work with others; the ability to read, to write, to use numbers easily and efficiently; and, most important, a constant increasing capacity for appreciating beauty and fineness.

Psychologists say that none of these qualities or skills will spring up overnight, but that they are of slow growth; that, in order to grow, a child must be active; that he must have freedom to move, and the privilege, in both work and play, of investigating and trying his own ideas, feelings, and interests, rather than those of grown-ups. He must have many real experiences, and he must think things out for himself.

The grade handling of the elementary school has also grown out of the development of child psychology. We have been forced to recognize the fact that children are always growing in experience, and are always changing in their interests and needs. We have learned that children are not little men and women, but that they are growing, developing beings with their own distinctive characteristics and unique demands, and we are seeking to

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* Horn, J. L., Principles of Elementary Education.

grade, accordingly, everything in our schools: the lessons, the methods, and the equipment.

Our better understanding of the nature of the functioning of the mind has developed a pedagogy which repudiates the "Five Formal Steps," which once held sway. Teaching is regarded as a vital act rather than a formal process; character and conduct are put above mere knowledge content. Worthwhile, purposive activity on the part of those who are taught is stressed; larger use is made of the project principle and of the students' initiative.

"Both our new psychology and our new pedagogy take the emphasis away from the ungraded 'exercises' of the large single group and place it upon the grade handling of smaller groups in department and classes."

These are the essential ideas which underlie the development of recent elementary school architecture. The building is taking a new shape in order that it may conform to the demands of the new psychology.

III

THE PROBLEM OF ADAPTING THE SMALL BUILDING TO MODERN ELEMENTARY TRENDS

School Architecture has been defined as the science and art of creating a plan suited to the needs of youth in the process of obtaining an education, and in clothing the plan with a structure that interprets to the occupants and to the community the meaning and dignity of modern education.*

In the larger, wealthier communities, school buildings have been and are being built according to these standards. School Architecture specialists cooperating with educational engineers are producing edifices which are magnificent expressions of true school architecture.

It is in the smaller, less wealthy communities that there is an urgent need for improvement in school building procedure. Here we find many small district boards of education made up of hopelessly incompetent personnel, elected rather upon popularity than knowledge in educational matters. It never occurs to a board of this kind that they need advice in building programs. They will meet and pass on a plan for a building in a few minutes, and not know until the building is ready for use that conditions are not as they should be and that they have wasted thousands of dollars uselessly.

In the name of economy they will select a "Jack of All Trades" designer, usually the one with the most talk and the

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* Finney, John, "School Architecture from the Aesthetic Point of View," ASBJ, January, 1927, page 65.

most striking colored picture. The writer has sat in three such meetings where the designs for school buildings were chosen entirely from colored perspectives of the elevation, the plans never being considered.

These designers have not the spirit of modern education. They still pattern the traditional buildings, defects and all. Waste spaces, poor illumination and orientation, and uninteresting styles that "ape" styles prevalent when religion and education were synonymous, are adopted even to the extent of ecclesiastical ornament, useless belfries, and stained glass. Space does not permit reference to the many important principles violated and the innumerable essential details frequently omitted by architects who have not given long and serious study to the needs of modern schools.

A Suggested Solution

What is the solution to this problem for the small, less wealthy community? Certainly they need advice--what is the best means to extend this advice? There are three possible means.

Through state and county departments of education is the first. Departments of schoolhouse planning may be established to give advice to communities about how to build. However, handicaps due to political situations may hinder the efficient service of such departments.

Schools of architecture could help by inducing a more general recognition of the idea of specialization in their

profession. This would create more specialists and eventually lead to an adequate supply to fulfill needs of all communities. However, since the boards do not know that they need advice, this plan also may not suffice.

A third solution would be to educate the school board to seek the aid of competent school men, who have been trained in all the problems of school building and school hygiene, and put the architects under their control. The architect, of course, would be responsible for such items as strength of material, architectural treatment, and other parts of the work demanding skilled artistry. But the school man should command when problems of light, heat, ventilation, and sanitation in its many forms are involved. He should see that convenience and all the educational needs are met, without waste or undue outlay. A plan which is aiding in constructing better buildings in several sections is to have the plans scored according to the Strayer-Englehardt system before building.

This last plan seems the most plausible solution. School men are being prepared in many of our leading educational institutions in these lines. Their pedagogical work obviously brings them in close contact with the board, where they may be able to influence them to at least seek the advice they need in building matters.

The remaining parts of this study will be devoted to such details of school building architecture in which a school man would be able to give advice to his board both before and after selecting an architect.

IV

DIVISION OF STUDY

1. Preliminary Steps in School Building

A. School Building Programs

* The average annual expenditure for school buildings in the United States approximates $400,000,000 a year. It is not unusual for a city school system in which the annual budget for current expenses is $150,000 to authorize bond issues for capital outlay which varies from this sum to as much as $600,000 or $700,000. It is reasonable to expect that such large sums should be expended for sites and school buildings which may long serve the interests of public education. In the small community, likewise, the capital outlay for the new building represents a sum of no small importance to the taxpayer. A school building program developed to meet the needs immediately ahead, therefore, should be available for the guidance of the board of education in every school system.

In the small community this is probably the most neglected phase of school building construction. Of twenty-five communities of less than 2000 population visited by the writer, not one had given thought to the future. They had just built. The conduction of a school building survey and the formation of a school building program is considered the work of an expert. However, in the small community, with no great future growth in view, the school man with a knowledge

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* Englehardt, W. H., A Building Program for American Cities, Preface.

of the technique of a survey may well advise the schoolboard in developing a sound building program. The subject of school building programs has been thoroughly treated in the works of Englehardt, Sears, and others, and is now being taught in our leading schools of education. The technique of conducting a survey and formulating a building program comes under the work of educational engineering.

B. Educational Engineering

* The technical educational knowledge that is needed in the planning of school buildings has been termed educational engineering. This profession is comparatively new, but is fast gaining recognition in the school building field. Most of the larger school building projects of today have an educational engineer working with the architect. On the small building projects, however, the work of the educational engineer is practically unknown.

Access to the newer school-planning engineering service is usually out of the question due to financial reasons. Their problems are as important, or even more so, as those of communities much larger, where finances rarely intrude themselves as a vital matter.

The duties of the educational engineer have been outlined in recent writings of Kingsley, educational engineer of Chicago, Womrath of Minneapolis, and others. Their duties as outlined, although pertaining to the planning of large

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* Kingsley, Chas. D., "Dependence of School Architecture upon Educational Engineering," A. S. B. J., Jan.'25, page 43.

projects, may well be adapted to the smaller ones. In their adapted form they will appear much simpler and well within the scope of the trained school man, although he may have had no special work in this line.

Following is an outline of the technical educational information needed by an architect in planning an efficient small elementary school. Since the departmental plan is being adopted by many of our smaller elementary schools, information pertaining to this type of school has been included.

a. Duties of Educational Engineers:

(Adapted for small elementary schools)

(1) Formulate School Building Program

(a) Consider growth of community.

(b) Evaluate applicability of recent developments in educational theory and practice.

(c) Indicate number of pupils to be accommodated.

1- at present.

2- in the future.

(d) Consider to what extent present facilities fulfill needs.

(e) Consider ability of community to meet expenses.

(2) Work out Schedule of Rooms

(a) State necessary number of rooms of each type.

(b) State pupil capacity of each room.

(c) Should list all auxiliary rooms, indicating areas needed and function of each.

(d) List chief equipment to be installed.

(e) Must be based upon:

1- time allotments for various subjects.

2- probable number of students who will take each subject.

(f) Should provide for:

1- changes that should be made in program of studies in next few years.

2- contingencies due to unexpected developments.

(3) Make Usable Room Layouts

(a) This includes:

1- orientation of rooms.

2- placing rooms in proper relation to each other.

3- methods of caring for clothing, books, etc.

4- shape and size of rooms.

5- selection of proper equipment.

(b) Involves such factors as:

1- maximum number of pupils to be accommodated in each room.

2- width of aisles and spaces.

3- arrangement of pupils' equipment to give proper safety of circulation, and ease of supervision by teachers.

4- size and location of demonstration table.

5- proper amount and location of blackboards and tack-boards.

6- provisions for reference books and general supplies.

7- locations of lavatories, sinks, telephone, thermostats, thermometers, and outlets for electric current, gas, and electricity.

(4) Educational Considerations Affecting Planning

(a) Is building to be used for community functions?

1- involves independent entrances.

2- involves separate heating lines.

3- involves segregation of rooms for this purpose.

(b) What is practice of supervising corridors?

1- involves shapes of corridors.

2- glass in doors.

(c) What is desired method of bring pupils in and out of school?

1- involves size, shape, and number of entrances.

(d) Orientation.

1- involves receiving of natural light according to accepted modern theory.

a- affects design of building.

(e) Ventilation.

1- School man should know of recent development in ventilation field.

a- elimination of costly force system.

The foregoing outline of educational information affecting the planning of a school building is general and incomplete

but may serve to show such phases as the school man may give advice upon in the building process.

C. School House Design

* a. History of American School Architecture:

Architecture generally as we see it today is not original with the Americans, but has been borrowed from Europe. In Europe the early schools were closely associated with the church. In America a similar association obtained. Due to this association, church and school came finally to have much in common in their building structures. Spires and towers crowned both alike. The steeple suggested the school belfry. This practice continued until the time immediately following the civil war. Following the civil war, interest in education and a general state of prosperity in the north encouraged the erection of new and more ornate school houses. Towers, cupolas, and spires vied with gothic windows and wooden scroll-work; balconies, pillars, winding stairs, and mural decoration were lavishly furnished. It was very near the present day that this craze for ornamentation became tradition.

b. Present Styles in School Architecture:

About the beginning of the twentieth century, a reaction set in, emphasizing a more rational planning of structures with reference to their specific use or uses. The ecclesiastical style still persisted somewhat.

A consideration of style past and present in American school house construction shows the following types:

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* Finney, J., "School Architecture from an Aesthetic Point of View," A.S.B.J., ja., 1927, p. 65.

(1) The octagonal form
(2) The box type
(3) The Colonial type
(4) The Mission type
(5) The factory type
(6) The Gothic type
(7) The Flemish type
(8) The Italian Renaissance
(9) The Classic type
(10) The bungalow type

These styles, except the octagonal form, which no longer exists, may be found in almost any state. The bungalow type has only recently made its appearance. These styles may form the basis for making a choice when school officials are confronted with the problem of constructing a new building, or these officials may use their own imaginative and creative powers. If the latter method is chosen, it will be well to remember that principles of architectural design are not affected by specific difference of style; that domestic character should be taken as a key to the design; that due consideration should be given to the style used in existing buildings, and the new school made to harmonize with them; that the architect should always create within the limitations of acceptance and understanding; that the less known part of the community is a source of suggestions for style; that the local community most likely has talent for this work equal to any that may be imported; that public indifference to taste is painfully manifest on all sides; and that architecture is not an easy art. A knowledge of these facts should spur the school official who is fully conscious of his responsibility to the very best he is capable of achieving.

c. Determinants of Architectural Style:

Into all building style, certain factors enter as determinants. These limit the range of possibilities and thereby demand careful and constant consideration while planning and designing. The interior spaces necessarily condition the subdivision of the exterior mass and, therefore, affect architectural composition. It is only by artistic disposal of these subdivisions that beauty of structure can be achieved. It should therefore be perceived by school officials that beauty in building erection bears a very close relationship to the activities carved within the completed structure.

d. Ornamentation:

All effort to compensate for the lack of true architecture by gaudy and useless ornamentation should be condemned. While ornament loses dignity as it becomes superficial, aesthetic feeling may demand the addition of features for which there are no material needs. Although this is true, school-house designers should keep constantly before them in their labors, as a guiding principle, the truth that style and that general pleasing effect ought to be accomplished through a proper treatment of large mass, rather than through elaborate, costly, and useless ornamentation. It should also be borne in mind that mouldings, base courses, cornices, door frames, although they do not fall within the classification of ornamentation, may, through skillful handling, be caused to enhance the beauty of the building.

e. Utility as a Factor:

Utility must enter as a factor into the designing for beauty in a building. The beauty of the building should be in close vital relation to the use of the structure desired, this in spite of the fact that the whole spirit of art is opposed to the idea of complete subordination to utility. The following guiding principle may be held in view: "Give the use and structure first consideration, but let aesthetics bind them inseparately to art."

f. Material as a factor:

There is a close relationship between the smaller features of a structure, the material to be used, and the style to be employed. Material therefore also enters as an important factor in the aesthetic treatment of a building.

g. The Building Functions as a Factor:

The appearance of a school building should reveal to all the secrets of its purpose. School-houses should look like houses for school. Elementary buildings should look like houses wherein children acquire the tools of learning.

h. Psychological and Social Significances:

Architectural beauty has both a psychological and a social significance. Beauty of design in school-houses as it affects the minds of both pupil and parents enhances a respect for and a belief in education and a desire to further it. A beautiful building excites pleasure in those who view and thereby attracts them to it. Beauty of structure influences the development of natural moral qualities. The

style of art in which the school-house is finished determines to some extent the taste of those who build later in the vicinity. Community housing conditions are materially influenced by school-housing practices. Beautiful school buildings promote the development of wise and healthful, progressive, sentiment in the community.

i. Criteria for Judging Architectural Design: A definite appropriate set of principles for judging the aesthetic efficiency of a structure should be adopted by the school officials who wish to profit by the above facts. Following are outlined a few such principles.

(1) Imposing mass conveys the aesthetic impression of the sublime.

(2) Architectural beauty is due to composition--the breaking up of the whole into subsidiary portions related to each other and to the mass on some pleasing scheme of proportion.

(3) Balance can be secured only by arranging many subordinate factors harmoniously about some principal factor.

(4) The conception of many different things as one gives unity.

(5) Unity can be achieved only through a process of comparison.

(6) When things have no order there is a confusion of variety.

(7) Order is obtained by the connection of kinds of forms on the basis of resemblance in series.

Most that has been said regarding designing for beauty

in the school building applies alike to large and small projects.

j. Conclusion:

Patterning the new building from those already in existence will not produce the essentials of good design mentioned. But good architectural design is important, and the construction of school buildings that will have the maximum of simplicity, utility, and withal beauty is a great and important duty of school men, school-boards, and school architects.

2. The One Story Elementary School Building

* There is a growing feeling that the ideal elementary school building for the suburban or rural community is the one story type, which is not only attractive in itself, but attractive likewise in its relation to the residential character of its environment. For this reason it can be definitely said that it adds to the character of a residential neighborhood rather than in any way detracting from it, and its low lines give something of a domestic quality that correlates the school with the home.

Other factors favoring the one story building for small elementary schools are: economy in construction costs; increased safety, due to elimination of stairways. The factor of necessity of erecting multi-story buildings to utilize expensive sites seldom enters into the suburban or

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* Matlock, Price, "The One Story School," Architectural Forum, March, 1928, page 409.

rural school building situation, hence the one story school should be seriously considered.

3. Choosing Site and Orienting Building

As in the other phases of school-house building, most available information refers to the larger projects. The problems of locating the small school in the small community are no less important, although considerably less difficult. Sites are more plentiful in the small community, real estate costs are not so high, and as a rule there are no troublesome factories or tall buildings to take into consideration. However, the essentiality and importance of a good site are more often unknown to the school officials of the small community than they are to the city officials. This, combined with other conditions peculiar to the small community, has given the small community a greater proportion of misplaced school-buildings. The following factors play an important part in locating the town and rural school building.

A. Factors Influencing Choice of Sites.

a. Civic pride--placing the building on highways where transients may see it.

b. The donation of sites by influential citizens. Sites may be very poor, but boards are loath to reject them.

c. The tendency to use land unsuited for other purposes.

d. The over-emphasizing of the factor of access-

ibility. It is a matter of small moment if children be compelled to walk a little farther than the others, if thereby a better and larger site can be secured.

e. Community interest--more interest is usually taken by citizens in the selection of the site than in any other phase of a building program, barring, of course, the expense. Every citizen has his idea of where the new school should be located.

It is quite common to select the site, in smaller communities, by popular vote. As the average citizen is not informed of the essentials of a good site, it can be readily seen that such procedure is not conducive to the acquiring of a good site.

The essential qualities of a site have been well summarized by the N. E. A. committee of school-house planning in their 1925 Report. See Chart No. I of appendix. The subject of sites has also been well covered in the works of Donovan,* Englehardt,** Dressler,** and others.** Strayer and Englehardt have devised a score card which enumerates well the factors attending the selection of a good site. This is available

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* Donovan, J. J., School Architecture, Chapter I.
** Englehardt, W. H., A Building Program for American Cities, 1928.
** Dressler, American School Buildings, 1924.
** Strayer and Englehardt, Standards for Elementary School Buildings, Columbia University, 1921.

to all school officials.

Many of the points mentioned in these works, of course, will not apply to the small community. For example, the factor of maximum walking distance need not be taken into consideration. However, it is well to use the methods described in this regard in checking the location of the school with respect to the center of the population of the district.

There is quite a variety of opinion as to the size of the site. Many states have regulations limiting the minimum size to 50 square feet per child, exclusive of space occupied by the building. However,* most writers mentioned claim this is too small. The N. E. A. commission recommends 272 square feet per child for elementary schools.** Donovan recommends from 2½ to 3 acres for each school. There should be no excuse for the small community not to adopt the maximum recommendation.

B. Essential Qualities of the Site.**

a. Adequate Size:

(1) For the building and its future extensions.

(2) For the proper setting of the building and its removal from the noise and dust of the street.

(3) For outdoor games and physical education.

(4) For school gardens, if desired.

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* Report of Committee on School-house Planning, 1925
** Donovan, J. J., School Architecture, Chapter I.
** Report of Comm. on School-house Planning, N. E. A.,
* 1925.

b. Orientation of Building:

Most classrooms should have sunlight part of the day. This result is obtained most readily if the site permits the long axis of the building to extend approximately north and south.

c. Freedom From Noise and Odors:

Avoid proximity to railroads, gas plants, factories, and other sources of injurious noise and odors.

d. Suitability for Construction:

Avoid low, filled, and wet land. Avoid abrupt changes in grade unless the building can be readily adapted to them. Ledge rocks may increase cost of foundation.

e. Safety:

Elementary schools especially should not be located on dangerous thoroughfares.

f. Healthfulness:

Abundance of fresh air and sunlight and freedom from noise, dust, and odors are conducive to health.

g. Reasonable Centrality to Contributing Area:

Exact centrality is not as important as other factors.

h. Reasonable Accessibility:

When many children must come by railroad or trolley, the school should not be too far distant from them.

With these essentials in mind, the school officials should act for the best interests of their community in acquiring a suitable site. This will in many cases be the

4. Materials

The choice of materials for the new school building has, to date, usually been a duty allotted solely to the architect. With the school man in his new role, it should be his duty to discuss and select with the architect building materials, with respect to their practicability and lasting qualities on the basis of low original cost, commensurate with cost of maintenance. A few points to consider in choosing materials are listed as follows:

A. Types of Construction.

The classification code of the American Institute of Architects classifys all building construction as follows:

Type a.

A building constructed entirely of fire resistive materials.

Type b.

A building of fire-resistive materials in its walls, floors, stairways and ceilings, but with wood finish, wood or composition floor finish, and wood roof construction over fireproof ceiling.

Type c.

A building with masonry walls, fire resistive corridors and stairways, but with ordinary construction otherwise. (i.e., combustible floors, partitions, roof and finish)

Type d.

A building with masonry walls, but otherwise ordinary joist construction and wood finish.

Type e.

A frame building constructed with wood above foundation, with or without slate or other semi-fire-proof material on roof.

The first two types, types a. and b., need not be considered in this study. In a country community where the fire hazard is largely internal there is no reasonable excuse for constructing a fire-proof school building, beyond the protection of the vital spaces such as boiler room, exit corridors, and so forth.

Type c. construction, also known as "Slow burning mill construction," is considered very satisfactory for small rural and village buildings, but the small district under financial stress often must resort to the type d. or type e. construction. However, as a school-house must be made safe for the youth housed therein, these types are not as desirable as type c. Furthermore, as it has been repeatedly proved that the difference between the cost of a type d. and type c. construction is often as low as 5 per cent and seldom higher than 10 per cent, it is extremely unwise to attempt a saving in this direction, if for no other reason than to safeguard child life. If by necessity the type d. or the type e. construction must be adopted, added precaution against fire hazards should be exercised in planning the building.

B. Wall Materials.

Brick, concrete, tile and wood are the materials

usually used in school-building walls. In the small schools, wood is by far the most popular, owing to its lower cost. It must, however, be borne in mind that with the completion of the building, its cost to the public does not cease. There immediately begins the cost of operation and maintenance. Over a period of years it has been proven that the masonry wall is the most economical, not to take into consideration the added safety of the pupils and insurance rate reductions. A majority of building experts recommend brick as the most suitable material for school-house walls. They are, as a rule, always obtainable, of good appearance, economical in cost, are durable, and have good weather resisting qualities. Special considerations should be given to the size of bricks, as the selection of a small brick will involve use of many additional bricks and a much greater labor cost in laying them. Laminated brick and glazed brick with surfaces that chip should not be used if subsequent maintenance expense is to be avoided. In addition to natural wear, the defacement of these bricks by school children should be considered.

C. Roofs and Roofing Material.

A flat roof is less expensive in original cost than any other type of roof construction, is cheaper to maintain, and is more easily accessible. It is a factor in the reduction of heating cost of the building and adapts itself well to the modern architectural styles of small school

buildings. Materials successfully used for this type of roof are pitch slag and felt, and asphalt and felt. Both types give excellent service if properly applied.

D. Flooring Materials.

No other feature of school-house construction has been given more consideration than the materials which should be used for school-house floors. Wood, cement, tile, asphalt, rubber, stone, linoleum, mastic, terazza, cork, and many other materials have been used more or less successfully. In this problem of selection, the matter of appearance is often the deciding factor, whereas durability, ease of cleaning, and maintenance cost should also be taken into consideration. Will the floors be soft and sticky? Will the floors be cold, hard, and noisy? Will the floors hurt the feet of the children? Will the hardness of the floors cause tools to break which may be dropped upon them? Will the softness of the floors cause them to be damaged if pianos and heavy furniture are moved across them, or will heavy equipment sink into the floors, leaving them full of bumps and holes? These are some of the questions to be answered in selecting school-house floors.

To these problems, another must be added for the small less wealthy district. Is the initial cost within the limit allowed for a small building? Obviously, every such district wishes the cost as low as possible, and despite the arguments that the more expensive floors are the most economical in the end, the tendency is to choose a cheaper flooring.

Many experiments have been made by various floor manufacturers to determine the most economical flooring material, but most of these are biased and lean, naturally, toward their own product. With the objective in view of determining the most serviceable and most economical floor material for the small building, the following analysis has been made.

An Analysis of Floor Materials:

The four most common materials used in modern school house floors are wood, linoleum, asphalt tiles, and rubber. Following is an attempt to analyze the various qualities that go to make up the ideal flooring with the view to determine how nearly each of the common flooring products meets these requirements.

Lowness of First Cost:

Wood	Linoleum	Asphalt Tile	Rubber
1	2	3	4

Linoleum is rated in most national estimator's guides as the lowest in first cost, but it is apparent that wood might be the cheapest of all under some conditions as well as the most expensive, as it is available in such a wide range of thickness and of quality, and the cost of installation varies greatly. In this locality (the northwest) wood is the lowest and most available; hence it has been rated first, although the consensus of opinion of the estimator's guides places linoleum first.

Asphalt tile is usually higher in price than an equal thickness of linoleum, and rubber proves to be the highest

of the manufactured products listed.

Lowest in Maintenance Cost:

Linoleum	Rubber	Wood	Asphalt
1	2	3	4

All that a good grade of linoleum needs to maintain its qualities is an occasional waxing and dry mopping. Smooth grade rubber tiling can only be maintained by protecting the surface, and this requires an expensive refinishing process every few months. If rubber is not given this refinishing process, an uneven surface results due to variation of wear, ordinary maintenance is similar to linoleum, with mopping in areas where dirt is severe.

Varnishing, painting, waxing, oiling, and so forth, are always necessary to keep up wood floor. General experience seems to prove wood to be more expensive than the other types listed. Asphalt tiling is difficult to maintain. Dirt grinds in, due to the fact that the floor softens under heat. Wax cannot be used successfully upon asphalt to protect its surface. Asphalt flooring possesses some distinctive merits, but it should not be used in a school building where appearance is such a factor and dirt conditions are unusually severe.

Indentation:

Wood	Rubber	Linoleum	Asphalt
1	2	3	4

Hardwood floors are little affected by indentations. Even the softer grades of wood so extensively used in this locality are less subject to indentations than are the

other three materials listed.

Rubber is a relatively hard vulcanized product which resists indentations very well. Linoleum rates third and asphalt tile last.

Color and pattern range:

Linoleum	Rubber	Wood	Asphalt
1	2	3	4

This quality of floor material has lately become very important in school rooms, as mentioned previously in this study.

Linoleum unquestionably comes first under this heading. It is made in a wide range of plain colors and in innumerable patterns. The proper color base for every conceivable color scheme is available in this material. Rubber also comes in many colors, both plain and marbleized. Rubber, however, is not applicable to color schemes as easily as linoleum as it usually comes in tile patterns and is laid out square by square by the workmen on the job. The only rubber sheets available are those giving a marbleized effect with no decided pattern.

Wood floors are obviously capable of treatment in many different ways, but since wood is a very old flooring material and was used differently in different periods of history and in different parts of the world, it is more affected by precedent, and by exterior design of the building, as well as the decorative treatment of the interior.

Asphalt is very limited in colors and design. The binder medium of asphalt tiles, which is black asphaltum, has

the effect of making any color used in this material dull and lifeless.

Water Resistance:

Asphalt Tile	Linoleum	Rubber	Wood
1	2	3	4

Asphalt tile are superior in any flooring situation where resistance to moisture is a problem. Asphalt tile seem unaffected by moisture. Rubber and linoleum are both immune from effects of water on their surface, but neither product will stay down when moisture is continually present at the base. Linoleum has fewer joints than rubber and is therefore given a better rating.

Wood is obviously unfit for use as a flooring under moist conditions, because of its tendency to swell.

Resilience:

Linoleum	Rubber	Asphalt	Wood
1	2	3	4

This also is an important factor in the selection of a school-house floor--a resilient floor gives off far less noise under traffic than a rigid, resounding type of floor finish. Linoleum must obviously be placed first, especially if it is laid over a felt liner. Rubber rates next, with asphalt and wood next in order.

Hygienic Properties:

Linoleum	Rubber	Asphalt	Wood
1	2	3	4

A school house floor must not only look clean, but

must be free from hiding places for germ life which spreads disease.

Linoleum is virtually seamless, therefore eliminating joints for dirt to catch in. Since its binding medium is oxidized linseed oil which possesses the unique property of killing germs, linoleum is claimed to be harmful to germ life. It is the standard material for hospital floors for this reason.

Rubber is easier to keep clean than asphalt, so holds the next position, though both are open to objections because of their numerous joints. Wood, also, is liable to cracking and splintering, which also creates hiding places for germ life.

Ease of Repairs:

Rubber	Asphalt	Linoleum	Wood
1	2	3	4

Rubber and asphalt have been given the same rating, as obviously it is easier to replace a damaged tile than to patch a sheet material such as linoleum or a nailed-down wooden floor. Linoleum rates next and wood last. In either of the last two a very skillful workman is necessary not to detract from the appearance of the floor.

Useful Life:

Wood	Linoleum	Rubber	Asphalt
1	2	3	4

This is a difficult matter to determine, since a useful life of any flooring product is so dependent upon the proper

installation and maintenance. End grain wood might well last for centuries under ordinary conditions.

There is very little authentic information as to how long linoleum will wear. However, there are several schools on record which have jobs of linoleum of 20 years duration. The manufacturers claim that a good grade of battleship linoleum installed and maintained might easily last fifty years or more. Rubber has only been used as a flooring material to any large degree in the past few years, and jobs exceeding ten years are rare. Asphalt tile is the newest product of all, and its right to a long life remains to be proved.

SUMMARY

	Wood	Linoleum	Rubber	Asphalt Tile
Low First Cost	1	2	4	3
Low Maintenance	3	1	2	4
Indentation	1	3	2	4
Color Range	3	1	2	4
Water Resistance	4	2	3	1
Resilience	4	1	2	3
Hygienic Properties	4	1	2	3
Ease of Repairs	4	3	1	1
Useful Life	1	2	3	4
Totals	25	16	21	31

In a summarized table of properties which make an ideal flooring, on the basis of low scores linoleum theoretically would rate first with 16 points, rubber second with

21 points, wood third with 24 points, and asphalt last with 31 points.

However, in the small, less wealthy projects, such items as low cost, low maintenance cost, and a long, useful life will undoubtedly be given greater weight than they have on the summary chart. With this, and with the relative standings as shown on the summary chart in view, linoleum and wood would probably be rated fairly close, with the school officials, who select in terms of educational factors, favoring the linoleum.

Newer Flooring Products.

There are several newer flooring products on the market, advertised for school use, which have yet to prove their merits. Those that are gaining the most favor are the mastic floors. A very low cost is claimed for them, as well as low maintenance cost, resilience, hygienic properties, water resistance and useful life, but they lack color range and indentation qualities. Black and red, so far, are their sole colors, and the quality of indentation is claimed as an asset, as to it is due the much-advertised healing properties of these floors. This flooring material comes in strips and is pasted to the sub-floor with a mastic composition. As stated before, its initial cost is comparatively low, and with improvements in color qualities, this flooring may become the solution for the small school with limited finances.

E. Window Material.

There is a great variety of opinion as to the matter

of school-house windows. The use of wood or steel sash, double-hung or swivel sash, casement or banked windows, is a matter of continual debate.* It is claimed that use of steel sash increases the operating expense of building, because steel conducts heat out of the structure so rapidly that the burning of a considerably larger amount of fuel is required to heat the building. The steel sash is the most expensive and involves additional expense in installing window shades. Most authorities agree that for the small building the wood sash is preferable. The window sills and stools, however, should be made of stone or brick, as the drying, rotting, and wetting effects of the sun and rain have demonstrated that a more durable material should be used than wood.

Single strength, selected glass of modern manufacture is satisfactory for school building use. The lower cost is noteworthy, as glass breakage is a considerable item of maintenance expense in the elementary school building.

F. Entrance Door Materials.

Double-hung, light-weight, glass-paneled doors are being looked upon with more and more favor in school house construction from standpoints of ease of operation, economy in first cost, low cost of maintenance, and light for the space just inside the entrance. The general practice is to have two single doors with a small mullion between them. By this, construction weight is reduced, shrinking and swelling

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* Womrath, G. F., "School-house Materials," Architectural Forum, March, 1928, page 447.

minimized, application of panic bolts simplified, and the use of light-weight, standardized door units made possible.

Door sills made of wood or other soft material soon become cupped and prove a hazard to the pupils. In this condition they also allow cold air to enter under the doors, thereby adding to heating cost. Iron sills become slippery, thereby also becoming hazardous. There are several durable, non-slip sills manufactured which are satisfactory and economical.

5. The Structure

A. The Class Room

The school building has accumulated many new accessories during the past few years, but the class-room still remains the predominant feature, and its main attributes have not undergone many changes. The primary unit of a school building is the class-room, and no definite plans for a building can be thought out until a decision has been reached as to size, form, and number of class-rooms desired.

The variety in size and form of classrooms was once considered as resulting from accommodating the size of the room to the exterior features of the building as designed by the architect.

a. Area:

The size of the class-room should be governed by the number of pupils it is to accommodate. Opinions of school authorities differ as to the maximum number of pupils that may be efficiently taught in one room. Almack has probably made

the most extensive study regarding class-size. A few statements from his study are as follows:*

"The median practice in the United States, including 67.5 per cent of the total elementary school pupulation, is 36."

"England has a 40 class-room limit." (Goes into effect in 1930)

"The German Volksckule sets limit at 55."

"France sets maximum at 48."

"The best results can be secured in a class having the average daily attendance of 15. Efficiency decreases at a gradual rate until the class of 55 is reached, where it is a median."

"Class size is one of the most important factors contributing to costs."

He concludes his study by stating that in general the class-room should be built to accommodate 38 pupils.

Dressler recommends 35 to 40 pupils per class-room.** The N. E. A. committee on school-house planning recommends that an elementary school class-room should be planned large enough to accommodate the normal number of pupils that one teacher can instruct effectively, and no more.

Since this study deals with the small elementary school, where the class enrollment very seldom reaches this

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* Almack, John C., Doctor's Thesis, Stanford University.
** N. E. A. committee on School-House Planning report, 1925.

figure, 38 may well be set as the maximum to be accommodated. However, if previous study in number of pupils to be accommodated now and in the future show a lower figure, the class-room should be made smaller. In the small school there can be no standardized class-room dimensions. Sixteen to eighteen square feet per child has been recommended by the majority of authorities.* From this the size of the class-room may be determined. A compilation of the practices of leading school architects of the United States shows that the most popular class-room size for the elementary school is 22' by 30'. However, the real factors to be taken into consideration are: the teacher's voice should be heard at the rear of room; the light, which should come from one side, should reach to the other side of the room; pupils in rear must be able to see the front blackboard--all measures of the adaptability of the room for efficient teaching. See figure 7

In order to ascertain the proper dimensions for a room, the following procedure may be followed: Make a scale drawing showing layout with location of all desks, furniture and equipment, aisle widths, radiators, and all other equipment. A study of this drawing will enable the determination of suitable working space for teachers and pupils.

Another procedure that has been carried out successfully is to actually equip a room with school furniture with conditions approximating as nearly as possible the new

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* N. E. A. committee on School-house Planning report, 1925.

building. The proper size of the room may then be easily visualized. The ideal dimensions for an elementary class-room seems to be 21' by 30'.

b. Height:

The height of the ceiling is a very important item in the cost of a building and should for that reason be kept as low as possible. However, the most important factors to be taken into consideration in determining the height of ceilings are:

(1) Illumination -- Ceiling must be high enough to allow windows to be placed sufficiently high to light room adequately. See Sketch #5.

(2) Ventilation -- Sufficient air cubage must be provided for each child.

A compilation of practice of leading school architects* of the United States shows the median height for ceilings to be 12' 0". The decision as to the exact height of a class-room ought to depend somewhat on local conditions with reference to the source and quantity of light.

B. The Kindergarten.

The kindergarten is being accepted today as an integral part of an educational program.** Over half a million children are now enrolled in Public School Kindergartens in this country. If a school system desires a modern, up-to-date educational system, the kindergarten must be included as a part of the educational program.

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* Donovan, J. J., "Class-room Standards of leading School Architects," A. S. B. J., August, 1929, page 51.

** U. S. Bureau of Education, "The Housing and Equipment of Kindergartens," 1921.

It will probably be some time before the kindergarten will become universal in the rural communities, but it is already becoming quite popular in the suburban communities and small towns. School officials who build with the future in mind should consider seriously the including of a suite of kindergarten rooms.

The consensus of opinion requires that the kindergarten room be placed upon the sunniest side of the building. It should have its own separate entrance, and, if possible, a level,sunny playground, on a level with the door-sill so that the children need not have to be helped up and down as they go out for air. The toilet should be adjacent to the main room, with plenty of light and special low-height fixtures.

Considerable time will be spent by the pupils upon the floor, so that detail will require special consideration. The ideal material would be something warm,or at least not too much of a heat conductor, which is, at the same time, easily cleaned. The new rubber fabric floor or linoleum seems to fit the requirements. Cork floor, although not so easily cleaned, is warmer and has been used successfully in many kindergartens.*

It is quite common to build a large and a small room with rolling accordion doors between them in the larger kindergartens. Custom also seems to decree that there must be a fireplace and a bay window. For the small school of very limited finances, these last items may well be left out without handicapping the success of kindergarten operations.

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* Donovan, J. J., "School Architecture," page 279.

C. Wardrobes.

The "Chicago" type of wardrobe, integral with the class-room, has found great favor with school officials of elementary schools because of its convenience and its saving of cubage and floor space. Objections to this system have been raised, namely: that they cause loss of black-board space and that they are unsanitary, due to crowding of wet clothing near children. The first objections may be overcome by utilizing doors as blackboard space. This has been done successfully in many of the later-constructed schools of this vicinity. The second objection, regarding sanitation, may be partly overcome by installation of an adequate ventilation system. Such a system should always be placed in rear of room where it may be under the surveillance of the teacher. The greatest problem with the "Chicago" type of wardrobe is that of the doors. Shall they be hung by weights and slide up and down, or shall they fold back into the wardrobe, or shall they pull down in roller slat fashion? If they pull down, difficulties in regard to overhead space are encountered in the one story school. If the doors are mounted on any of the clever folding hardware devices advertised, each is likely to require a little of the length of the wardrobe for folding back, space which may be badly needed for hook space. This is especially so if the wardrobe shares the narrow end of the room with a bookcase, a communicating door, and the heat and vent ducts, a very common arrangement in the smaller, compact schools. The pull-down

method is the most satisfactory, and may by careful planning and a little sacrificing of head-room space be adapted to the one story school. This has been done in the detail shown in Sketch #6. A cement floor with a bevel and sloped back to prevent water from umbrellas or wet clothing running out on class-room floor will add to its sanitation. It should have a 6 or 8 inch vent connection in the top,and open space at the floor so that the draft will always be into the wardrobe from the room. A shelf with the hat and coat hooks attached to bottom enables the wardrobe to be utilized as a storing place for books as well. The "Chicago" type wardrobe has generally been left out of small schools, owing to its expense. Mamufacturing concerns have designed and patented many variations of this wardrobe, placing the cost at quite a high figure. The wardrobe shown in Sketch #6 may be built quite economically, and is working successfully in several small schools.

D. The Corridors, Entrances and Exits.

a. Corridors:

Often school officials and architects, recognizing the class-room as the unit of the school building, will neglect the corridors to carry out specific classroom schemes. This is a mistake. The excellence of any school building plan is largely dependent upon the orderly arrangement of the corridors, entrances and exits. Correct plans of buildings are distinguished by their superiority of treatment of the channels of circulation. The desire for economy is a factor that has tended to

produce inferior corridors, but the safety of the children must not be jeopardized by reducing the size of the corridors to an extent that would unwisely limit the possibilities for quick and orderly egress from the building. It is always well to keep in mind dangers from a blockade in case of panic or fire.

It is not possible to specify definitely what the width of any hall should be without first calculating the number of students likely to use it at one time. The size of the pupils to use the corridor is also a factor to be taken into consideration--a corridor of 12' would be more spacious for lower elementary grade pupils than one of 14' for upper elementary grade pupils. Additional width may also be wished for in the halls to make possible the display of pictures and mural paintings, a factor which many school authorities deem very important. The powerful though silent and unconscious influence exerted by pictures upon young people is becoming more and more recognized as an integral part of the educational process, and there is no better opportunity for this than the hallways.

*Donovan gives the following rule for determining widths of corridors for one story school buildings. "Corridors with class-rooms on one side only, accommodating four rooms or less, should be 9'-0" in width; for each additional room 6" should be added. Corridors with rooms on each side accommodating four rooms or less should be 9'-0"; for

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* Donovan, J. J., School Architecture, page 306.

each additional pair of rooms, 1'-0" should be added.

It is unlikely that secondary corridors would ever have to be planned to accommodate more than 4 rooms in the type of school that is being considered in this study. The main entrance hallway should be like the wide end of a funnel, 12' to 14' is a common width for elementary school main entrance hallways. This may vary, however, according to the peculiarities of the plan.

In the corridors, walls are subjected to very hard usage up to a point about 5'-0" above the floor. To counteract this, the lower part of the corridor wall may be covered with burlap glued to the plaster, and painted to suit. This has proven very satisfactory in many cases and is quite durable. The walls and ceilings should be treated with light colors so as to reflect the greatest possible amount of light. If the corridor is used for the art gallery of the school, any special decoration of the walls should be in keeping with the character and the grade of the school, and the corridors should have a picture molding for hanging pictures, sculpture, and other mural decorations.

School corridors receive the heaviest traffic of the school and should have materials to withstand the resulting wear. Noise is also a disturbing element in the corridors, and every effort should be made to minimize it. The materials most used for floors to accomplish this are linoleum, cork tile, rubber tile, and mastic floors. As has already

been stated in the study allotted to floors, battleship linoleum is probably the best material for school corridors.

Radiators, hose reels, drinking fountains, trophy cases, or any other corridor equipment should be recessed into the walls of the corridors. No obstructions should be permitted to interfere with full width of corridor.

The corridor near the principal office is the proper place for the bulletin board. Cork mat or linoleum framed in wood are practical materials for this purpose. All doors swinging into corridors should be hung flush with corridor wall surface to permit doors to swing against wall. Catches to hold them in that position should also be provided.

Doors leading to the boiler room and storage room from the corridor should be of hollow metal construction and should close automatically. This is for fire protection purpose.

Since it is difficult to secure adequate natural light for corridors in Oregon, artificial lighting should be provided.

b. Entrances:

There should be one main entrance from ten to twelve feet wide in the middle of the main axis of the building. In case the building includes only the first six grades, ten feet would be sufficient for this entrance. Wherever there is an intersection between a main and a secondary corridor, a secondary

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* U. of O. Bureau of Educational Research, Bulletin on Standard Elementary School.

entrance should be provided which should be from eight to ten feet wide. One entrance should lead directly from the playgrounds to the gymnasium, if such is provided, or to the wash-rooms if there is no gymnasium. All school buildings of more than one room should be provided with a minimum of two entrances. If the building has more than four rooms, a minimum of three entrances should be provided. All these entrances should be free from outside obstructions. Entrances should use as few steps as possible and, whenever the elevations permit, these steps should be within the building rather than outside. Entrance steps should have a six inch rise and a ten inch non-slipping tread. The steps of the entrance should be constructed of stone or concrete. The vestibule should be of the same width as the corridor and should be equipped with wire glass doors and water-proof floors. These doors should swing in both directions. Each entrance should be provided with two pairs of double doors ($3\frac{1}{2}$'x 8' in size) swinging outward. These doors should be substantial, but not too heavy. They should be provided with fire-bolts, checks, and footstops.

E. The Assembly Hall.

The assembly has assumed a very important place in modern elementary education. Its activities are recognized by the educators as stimulating the pupils as much as the class-room activities to lives of useful endeavor. It is a kind of clearing-house of ideas; a place of action where theories of learning are turned into realities. An artistic

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* Dressler, F. B., American School Buildings, 1925, page 86.

assembly room will greatly contribute to the spirit of loyalty to school, to scholarly ideals, and to the community. Nor is its use confined to the school alone. In the country and village districts it is common to find the school-house the recognized community center. This is as it should be, and an assembly hall should be included in the type of school we are considering. Due to financial stress, the including of an assembly hall in the small school sometimes becomes a real problem, and too often it is eliminated from the plans. By careful planning, however, many ingenious arrangements and combining of rooms are possible in the small school building to make a satisfactory assembly-room possible. In some cases, two class-rooms may be constructed over-size and separated by sliding doors to form the assembly hall. In other cases the hall may be utilized, and the stage and office combined. In still other cases, the gymnasium and auditorium are combined. Sketch #7 shows the former arrangement.

The best location for the assembly room is the central axis of the building and opposite the main entrance. This will permit its use for community purposes without disturbing the remainder of the building.

An assembly hall should be provided with a stage conduction of plays, choruses, and recitals. There should be dressing rooms at both ends of the stage and on the same level with it. In the small school the stage need not be elaborate. A small stage as shown in sketch #8 may be very economically built and will well serve the purpose.

Movable desks may be used in the combination class-assembly room, and folding chairs may be used to supplement these during gatherings. These extra chairs may be stored under the stage by framing it into stalls facing the assembly floor, and small trucks provided, the width of a folding chair and the length of the depth of the stage, constructed with counter-sunk casters, upon which to place the chairs and run them under the stage when not needed. These little trucks are not expensive to make; they require only a groove on either side under the stage upon which to run the casters, and posts at each end to prevent the chairs from sliding off. One of these will hold sometimes as many as a hundred chairs, and thus practically all the extra chairs can be cared for by using very few trucks. Double doors are set in front of the stalls to close them when the chairs are removed or returned. This arrangement may also be used in the gymnasium-assembly, and the hall-gymnasium-assembly combinations. * A new Assembly chair has recently appeared on the market which should prove very satisfactory to the small school. It is an Assembly seat with a hinged desk attached to back, so that Assembly may be converted almost immediately into a study hall. Thus the assembly room may be made to serve assembly, class-room, gymnasium, and social purposes, and the values of the room and the income from the investment multiplied many fold.

Many authorities figure the seating capacity of an elementary school assembly to accommodate 50 per cent or 60

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* The Nation's Schools, January, 1930, page 20. Advertisement by Desk or Chair Corporation.

per cent of the total enrollment. In the school building being considered, it will be well to figure considerably more, due to its intended use for community purposes. A seating capacity of 200 is quite common in the assembly rooms of the existing buildings of this type.

F. Administrative Rooms and Library.

a. Office-Library:

In elementary school buildings of the size that is being considered, economy of space may well be practiced by combining the office and library, and yet provide satisfactory equipment. Elementary school practice usually requires that books be read under the supervision of the teacher in the classroom, so that the library becomes primarily a store-room for books.

The office-library should be easily accessible to the main entrance, while conveniently placed for the administration of the school. The common practice is to locate the office directly to the right of the main entrance.

The following built-in features are listed by authorities as essential to a good office suite:* (1) A waiting room or public space. (2) A general office providing a place for clerical work and housing office equipment and machinery. (3) A private office equipped with a flat top desk, a chair or two, providing a place for the storage of school and office supplies, text books and other equipment not in constant use. (5) A fire proof vault to protect reports, grade records, and other valuable papers against

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* Hubbard, J. J., "Elementary School Offices," A. S. B. J., October, 1929, page 57.

fire. In a building to be built according to the economic standards set forth in this study, it will be impossible to build these essentials as described, nor is it necessary in a small school. An adaptation of the points mentioned should be effected to fit the economic means of the district. The first two essentials, the waiting room and general office may well be combined, as no clerk is as a rule necessary in the small school. This room may also be constructed to house the library books. Built-in shelves along the walls will satisfactorily fulfill this requirement. This room should also contain a reading table and several chairs. Adjacent should be located the conference room and the storage room. Sketch #1 shows possible arrangements of an office library as described. The fifth essential, a fireproof safe is a good investment for any school. They are not expensive and in case of fire will save valuable records which every school possesses, which, once lost, cannot be duplicated.

Necessity often requires the principal to work in the office after school hours and on days when school is not in session, hence there should be some means of heating the office independently of the general plant.

As the principal of a small elementary school is also part-time teacher, it is well to have a door opening from the principal's office into a classroom. This will enable the principal to keep in touch with the office while teaching.

The conference room should have a door leading into a corridor.

With the toilet arrangement for faculty described in the section allotted to toilet facilities, no toilet room should be provided in the administrative suite.

The principal's room should be made as attractive as possible, not merely for the satisfaction of the principal, but for the wholesome effect it will have on pupils, teachers, and patrons.

b. Teachers' Room:

A room should be provided for the teachers while not on duty. In the small school this room may also be adapted to be used as a first aid room and clinic. This room should be located very near the administrative rooms. It is a common practice to locate it across the corridor from the principal's room. Sketch #1 shows such an arrangement.

c. Janitor's Quarters:

*In the small elementary schools, the janitor is often the sole male employee, and is considered a member of the administrative force. His influence among the boys often accounts more than the teacher. For this reason, he should be provided with comfortable, dignified quarters. Since the boiler room is placed on the main floor, usually in the rear of the building, a small office may economically be provided adjacent to this room and overlooking the playground. Such an arrangement will prove an aid in supervision. A storage room and work shop should also be provided for the janitor.

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* Whiteneck, H. A., "The Administrative Unit in an Elementary School," A. S. B. J., January, 1929, page 92.

G. Toilet Rooms.

More thought has been given in recent years to the proper housing of toilet facilities, but it is still quite common in the smaller schools to regard this phase of school building as a minor consideration. Toilet rooms are often located in poorly lighted basements or in inconvenient spaces deemed unsuitable for other purposes, and in some cases even the traditional outbuildings are still resorted to. With the newer ideas of education regarding moral values, new significance has been given to the importance of providing well lighted, sanitary toilet rooms. In the modern well planned school buildings these rooms have been given the same consideration in planning as have the classrooms.

a. Location:

The toilet rooms should be placed on the main floor of the one story school building and should be located with thought to accessibility to both class-rooms and playgrounds. The drainage conditions of site will also often enter as a factor in locating the toilet room, but the first two factors mentioned should be given first consideration.

b. Toilet Bowls:

A toilet bowl, according to physicians, should always be lower than a school seat.* Bennett, in his studies of school posture and seating, arrived at certain heights for school seats. These figures are generally accepted as standards.

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* Bennett, H. E., "Grade Distribution of School Desk Sizes," Pamphlet issued by American Seating co., 1927.

Using these figures as a basis and making allowance for the lower height requirements demanded by physicians, the following heights have been determined upon as the proper heights for school toilet bowls.

Kindergarten	Maximum of	9	inches
Lower Elementary	"	" 10	"
Upper Elementary	"	" 12	"

Juvenile-sized fixtures are on the market today and cost less than the adult sizes. They should be utilized for the physiological reasons set forth by the physicians and for obvious sanitary reasons. The toilet bowls should be of the type automatically operated, as children are exceedingly careless in the matter of flushing. Attached seats should be provided,as integral seats have been tried and found to have a general unhealthful effect, due to the cold flushing water passing through the flushing rim and chilling the body resting upon it. One of the largest single items in plumbing repair bills is for taking up and removing obstructions from toilet bowls. This can be minimized by using a full siphon jet bowl with a 2½ inch or 2¾ inch waterway throughout, so that pencils, knives, and dropped articles will pass through the trapway without hindrance. The seat should be of the comfortable saddle type, open in front. Ordinary wooden seats with either varnish or celluloid finish have not proved successful

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* McGonegal, A. R., "Sanitation for School Buildings," Architectural Forum, March, 1928, page 463.

for school work, but there are several good composition seats with a minimum of unprotected metal work to corrode. The flushing should be full and powerful. Pressure flush is the only suitable system for school work.

c. Urinals:

There are two types most suitable for school-house use. The vitreous china stall urinal and the slate stall type, In either case, they should be set down into the floor construction so that the immediate adjacent floor surface grades into the waste trough part. If vitreous china stalls are used, a medium of 24-inch centers should be used. This gives sufficient, but no excess, shoulder room, economy of space, and of cost. The 18-inch stalls must be set 3 inches apart to provice for shoulder room, which leaves a space that must be plastered or tiled, thus adding to the expense, as well as being unsanitary. The slate stall fixture is continuous and of practically non-absorbant material. The enamel iron trough urinal flushed by a perforated pipe is now obsolete and should never be used.

d. Number of Fixtures:

It is important that there should be a sufficient number of fixtures for proper and reasonable use, but it is just as important that there be no more fixtures than are necessary. Every unnecessary fixture adds to the cost of the building, to the amount of space unavailable for other needed uses, to water consumption, and to repair expenses in years to come.

*The economical number of fixtures to provide for any given condition has been worked out through months of investigation and timing under actual conditions of use. The final rule is very close to the 15 to 1 rule in force in many states and cities for factories, schools, and similar buildings. The following rules may be used for determining the number of toilet fixtures for elementary schools:

For each 20 girls provide one toilet bowl.

For each 25 boys provide one toilet bowl.

For each 25 boys provide one urinal.

Teachers' toilets should be provided for, as teachers should never be required to use the same fixtures as the pupils, but, on the other hand, good administration requires the teacher's presence in the pupil's room occasionally, and a way to insure this indirect supervision effect is to locate fixtures for the teachers use in private rooms opening from the main toilet rooms, so that they must pass through one to get to the other. Rows of toilet closets and urinals should be set along the walls and not out in batteries at the center of the room,so that racing and playing tag around them will be out of the question. Batteries of fixtures set out in the room also add to the difficulties of supervision by providing shields for those hiding from teachers passing or looking in the door. In general, it is a good practice to lay out a school toilet room so that every portion of the room is visible from the entrance.

e. Walls and Floors:

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* Schmidt, H. W., Sanitary Conveniences in Schools, A. S. B. J., Jan., 1930, page 53.

Walls and floors of toilet rooms should be of non-absorbant materials with a finish not easily damaged. White tile, glazed buck, or hard cement, finished with a hard, water-proof, light-colored paint have proven satisfactory. Ordinary cement surfaced concrete floors are likely to be spongy and absorb moisture, giving rise to odors. There are a number of good composition floor materials and concrete floor hardeners on the market which can be laid with the ease of ordinary cement and troweled to a hard glassy finish which is practically water-proof. A mastic bituminous compound is one of the most successfully used. It is laid hot and ironed smooth in a manner similar to the laying of asphalt pavement. This material can be surface heated and ironed smooth again after it has been marred by use.

f. Stalls:

A maximum width of 32 inches and depth of 4 feet are practical dimensions for the stalls. The top of the sides of the stalls should not be over 5 feet high, and the bottom should be 14 inches from the floor. A door 3 feet high should be provided. This gives all the privacy needed, good ventilation and adequate light. Wood is not a good material for stalls. Even with the best of finish, wood will absorb and will give off odors in time. The most practical material seems to be standard steel partitions as used in the better class of factory buildings. These partitions will stand abuse and may be finished in desired colors. The stalls should be located facing the windows.

Toilet rooms should be narrow, allowing no more space than is necessary for legitimate purposes. No opportunity should be offered for congregating of pupils. The toilet rooms should be provided with as much light as possible and, obviously, should be well ventilated. In a building of the size being considered, if plenty of outside window space is provided, no other ventilation with the exception of the ceiling vent is usually necessary in the small school. The windows should be placed at a height of 7 feet from the floor and made of metal. If it is necessary to provide a ventilating fan, it should be separate from the rest of the building.

g. Sewage Disposal:

Few small towns and rural communities have a public sewer system. A sewage disposal plant, therefore, is necessary. A leaching cess-pool is an abomination and should never be considered, even if the law is loose enough to permit it. What is usually called a septic tank will answer for the preliminary treatment of reducing the sewage to a liquid form, but even in the design of this there is the difficulty that the quantity of sewage to be treated varies greatly. The plant must normally work five days and be idle two, and there are several short and one long vacation. Stale sewage will not respond readily to secondary or purifying treatment. This intermittent use also tends to sludge up the tanks excessively.

A two or three part concrete tank of rectangular shape is generally used, although a much smaller unit built on the Imhof principle will occupy less space and cost less to build.

The Imhof pattern also has the advantage of the quickly clearing of stale sewage, the mat area is small, and the removal of sludge is easier.

H. Basement.

In the type of school building being considered, a basement should not be included if the site is anywhere near level. The excavating entails undue expense and basement space is unsuitable for most school purposes. However, topographical conditions of site are sometimes such that a well lighted, roomy basement may be included in building at little expense. In such cases, such space may well be utilized as boiler-room and fuel-room, and play-room space, including showers. The boiler-room and fuel-room should be inclosed in masonry walls, separate from each other, but accessible. If play-room is also placed in basement, a 12-foot ceiling height should be provided with a maximum of 3 feet extended below the grade line. Water proofed cement, or membrane system should be used on basement walls to keep the basement damp-proof.

I. Interior Decoration and Trim.

*a. The factors that determine a proper school-room interior have been divided into two classes:

(1) The Permanent:

Consisting of treatment of walls, ceiling, floors, and wood-work, the furniture and equipment, the windows and the wall decorations.

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* Baker, Chas. M., "Interior Finish and Decoration of Schools," Architectural Forum, August, 1922, page 73.

(2) The Temporary:

Pictures, exhibits, and other collections.

The permanent obviously only interests the builder, but the educator must consider both in planning the building. The environment of the child is a potent factor in moulding character and producing impressions of life-long effectiveness. Hence the decoration should receive the amount of attention commensurate with its importance. Walls are fundamental elements in interior decoration. Thought should be given to the division of wall surface to give pleasing composition and suitable spaces for pictures. This will not involve additional expense, but will require careful planning. A few points to observe are:

The wall finish should be smooth--the sand-finish plastered wall so often used is objectional, as it is a dust-collector.

Blackboards, registers, clocks, bells, etc., may be made part of a good composition.

Blackboard is not a decorative element and only as much as needed should be provided.

Mouldings may be placed at cove, but if not at cove, one-fourth the distance from ceiling to blackboard (ration of space above moulding to that below being about 1 to 3).

Blackboard tops should be kept low and not decorated, so as not to interfere with picture spaces.

Clocks, registers, etc., should not be placed just above or below picture moulding, thereby breaking line of

moulding and attracting undue attention.

General Trim:

This should be of simple design without elaborate, deep-cut mouldings which are dust-gatherers and readily injured.

Doors:

Plain veneered doors without transoms are better than the ordinary paneled doors.

Windows:

Windows can be made sanitary by omitting trim and plastering corners against frames.

Wainscoting:

Especially in corridors must dado be made of exceedingly wear-resisting qualities. Cement and brick attractively finished are used quite frequently. For a more economical treatment, burlap pasted upon plaster or wood will suffice for the small building.

Blackboards:

The blackboards should be placed on sides opposite windows, and behind teacher's desk. If necessary, they may be supplemented by placing in rear of room. No more blackboard should be placed in the room than is actually needed, as it absorbs light, interferes with effective decoration, and adds to expense. Fifty feet is enough for a normal room (30" x 42" wide).

The height to the chalkrail should vary according to the grade of pupils using blackboards. * The compilation of

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* Donovan, J. J., "Class-room Standards of Leading School Architects," A. S. B. J., August, 1929, page 51.

practices of United States school architects shows the medium dimensions used as follows:

Kindergarten . . . . . 2' 2"

1st and 2nd grade . . . 2' 2"

3rd and 4th grade . . . 2' 4"

5th and 6th grade . . . 2' 6"

7th and 8th grade . . . 2' 8"

Glass blackboards have proven the best but are very expensive. Slate is next best, and, although expensive, will last indefinitely. Hylo-Plate and beaver board are used quite extensively, but, although quite inexpensive, in the end are not as economical as the first two materials mentioned, due to poor lasting qualities. It is not as satisfactory for school use and requires continuous, periodic repainting.

A comparatively recent improvement in the chalk and eraser tray is an open wire cover of ¼" mesh in the form of a tray or swing on hinges. This keeps accumulated chalk dust from blackboard implements.

Tack-boards above the blackboard is another development of the elementary class-room which is becoming popular. Many teachers ask for as much as 50 per cent tack-board space going the full width of the blackboard, while others, generally those of the lower grades want a cork carpet border about a foot wide going all around the top of the blackboard, which is reduced in height for this purpose.

An instrument board near the door, on which switches, thermostats, telephones, etc., may be placed, will, if the

electrician can be induced to place it there, save good wall space for picture use.

*b. Color Scheme:

The controlling factor in the development of a welcoming, attractive class-room interior is the color scheme, which must merge all the finishing and furnishings into a harmonious and beautiful unity. The bases for most desirable color schemes are what are known as "sunlight colors" which are of the yellow variety and range from light cream to gold. In rooms that are very well lighted, greens, blues, and grays may be used safely. Intense colors such as strong reds and yellows should be avoided as they have been proven to be the cause of restlessness of pupils through undue stimulation of nerves. White walls are injurious to eyes. They are also considered cheerless and inartistic.

Each room should be an attractive unit, also a harmonious whole. Rooms with one color for ceilings, walls, and woodwork are monotonous, however unusual, striking combinations also are to be avoided. The dado should be of a darker value of the color used on the main wall and the ceiling a light tint of the same color. A washable paint of flat color should be used. Woodwork should not have a glossy finish.

One educator has suggested that the same color be used on doors and door-trim throughout public portions of the

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* Trolle, Henry, and Merril, G. E., "Building for Religious Education," The Anthony Co., 1925, Chapter on Interior Decoration.

building, but to have different color schemes for the various rooms so that the pupils as they pass from one department to the next higher may be assisted in appreciating the fact of advancement, as typified by their new surroundings.

J. Ventilation and Heating.

*Until comparatively recent years it was assumed that the amount of oxygen consumed or the amount of carbon dioxide exhaled by the occupants of the room were the most important factors in school ventilation. Another theory was based upon the assumption that some toxic organic substance is present in respired air. Later experiments, however, have indicated that neither the oxygen nor the carbon dioxide content of the air, nor the presence of toxic organic substance satisfactorily accounts for the ill effects of ventilation. Modern investigations have led to the conclusion that under ordinary circumstances the physical condition of the air is of much more importance than is its chemical composition. The factors which are now considered the most important in ventilation are the temperature, the humidity, and the rate of movement of the air. These new factors in ventilation have also disproved the old theory that 30 cubic feet of fresh air are necessary for each child per minute. The theory was that the additional air was to replete the used oxygen and dilute the poisonous carbon dioxide and toxic substances. It has been stated by experts that 30 cubic feet of air per minute is positively

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* Butch, R. L. C., "A Comparative Study of the Effects of Different Types of School Ventilation," Elementary School Journal, September, 1929, October, November, 1929.

harmful, due to the chilling effects which are very difficult to prevent in forcing that much air into a room. Systems designed on the old theory were very expensive both in initial cost and operation, and it is small wonder that school officials are welcoming the modified system. The Frank Irving Cooper Corporation, one of the leading school architectural firms of the country, is designing window gravity systems in many of the schools of the East. William E. Watt of Chicago has put the entire school system of Evanston, Illinois, on a window gravity system. The window gravity system has been endorsed by the joint committee on Health Problems in Education of the N. E. A. and the American Medical Association.

This change in ventilation practice has been a fortunate one for the small school of limited finances, for the modified systems are very much more economical in initial cost and operating expense.

a. Systems:

Heating and ventilation systems are usually operated in conjunction with each other, and for that reason are usually treated as one subject. The same contractor usually installs both systems.

Steam and vapor heating systems are the two most generally used in school buildings of over four rooms. The vapor-heating system is nothing more or less than heat by steam at a low pressure. Both systems are simple, no machinery, pumps and the like being required for their successful operation. The systems for heating and ventilation most

common in use today are:*

(1) The gravity indirect system of heating with gravity ventilation.

(2) The control fan system.

(3) The "Split system."

(4) The unit ventilation system.

(5) The window gravity system.

The first four mentioned systems are the more expensive and with the exception of the first and the fourth are designed primarily for larger schools. Since one objective of this study is the attaining of adequate ventilation at the least expense, the window gravity system alone will be considered.

The window gravity system has been criticized much by the building profession journals, and the ventilation engineers, however it seems to an observer that their arguments are considerably biased, owing undoubtedly to the inevitable passing of their handiwork. The arguments advanced are that this sort of ventilation requires constant supervision; that it is a step backward; that any set of conditions can be provided more satisfactorily by mechanical ventilation than by window ventilation, and that such a system cannot be controlled. Other investigations have later been instituted. Notably, among them, those conducted by the Milbank Memorial

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* Kellogg, Alfred, "Heating and Ventilating the School," Architectural Forum, March, 1928, Part 2, page 453.

fund grant. These have all verified the findings of the New York State commission on ventilations committee and the window gravity system still remains as a recommended ventilation system.

b. The Window Gravity System: (See Sketch #4 of Appendix)

The essentials of this system as recommended by the joint committee of the N. E. A. and Medical Association are:

(1) Radiators long enough to extend width of window.
   (a) Equipped with either hand or automatic control--committee recommends both.
(2) Metal shields to be used to protect children near radiator.
(3) Window shades to be attached firmly to window frame to prevent movement due to air flow.
(4) Deflecting boards to be placed at bottom of windows.
   (a) Windows to be opened from bottom.
(5) Exhaust ducts having a total area of not less than 8 square feet to be placed in wall opposite window.
   (a) Should be provided with dampers, which can be adjusted to suit weather conditions.
   (b) The exhaust ducts should be carried up through the building so as to avoid chilling and the tendency to back draft should be further reduced by placing an aspirating cowl at the opening at the roof and perhaps by placing heating coils in the exhaust duct.
(6) School room should not be over-crowded.

(a) 250 cubic feet for each 1st, 2nd, and 3rd grade pupil.

(b) 310 cubic feet for each 4th, 5th, and 6th grade pupil.

(7) A large thermometer with a danger signal at 68 degrees F. should occupy a prominent place for observance.

(8) Must be supervised.

The observance of the above essentials will produce satisfactory results and an enormous saving in initial expense as well as expense of operation will be effected in adopting this system in preference to the mechanical systems.

c. Criteria for Choosing Successful Ventilation System: However, in choosing any ventilating system, the following criteria should prove useful in selecting a successful ventilation system:

(1) Is temperature always at 68 degrees? If so the system has merits.

(2) Is air in the school moving, fresh, alive, stimulating, or is it the reverse?

(3) What does system cost to install and what does it cost to operate? (of two systems apparently giving satisfaction, the school officials, in the interest of the taxpayer, must decide upon the less expensive)

K. Lighting (Natural)

Modern educational methods impose upon the eyes of school children requirements that create a need for the best possible working conditions. It is only through the application of certain basic scientific lighting rules that such conditions may be obtained.

*Tests have revealed that fully 25 per cent of the school children of the United States have defects of vision and symptoms of eye strain, which naturally hampers them in their school work. The prevention of eye strain is important first and foremost to conserve the children's eyes for their own sake. A second consideration and an important one from the standpoint of the community is the economy in the conservation of vision. Under usual conditions a child should finish the eighth grade at 14 years of age. If, on account of defective vision a child reaches the fifth grade only, the cost to the taxpayer is the same, but with 5/8 of the result. Children of normal sight also suffer in conditions such as mentioned, as "backward" pupils tend to disorganize the school organization. Especially is this true in the small school, due to lack of numbers to make segregation practical.

Eye strain is, of course, attributable to both artificial and natural lighting improperly presented. The latter phase only will be considered here.

**The three important factors in proper lighting are:

a. Amount of illumination.

b. Distribution of light.

c. Diffusion of light.

The first factor simply means that an object in order to be seen properly requires a certain minimum and maximum

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* Shade Service Bureau, Chicago, "Modern Shading," 1930.
** Clark, T., and Beal, A. F., "Studies in Natural Illumination of School Rooms," Public Health Bulletin #159.

of light. The foregoing seems self-evident, but too often the consideration of the amount of illumination is neglected. It is common to find rooms where the amount of illumination in the forepart of the room will not parallel that near the windows, with the result that there is either inadequate light in one section or glare in the other. Distribution of light depends upon the proper arrangement of the light units. Two systems of lighting are most common, Unilateral and Bilateral. Unilateral, secured by locating windows entirely on one side is preferred. One of the fundamental rules is that the dominant light should come from the left side. For effective vision, light should strike the work at such an angle as to illuminate it without reflecting glare into the eyes. Maximum lighting is secured when the direction of light is perpendicular to the surface. When the direction is parallel to the surface, the illumination is zero. Diffusion of light means breaking up the direct light rays from the light sources and reflecting light sources. Diffusion is necessary to eliminate the glare and soften the shadows. It also aids in the distribution of illumination. Diffusion, which is probably the most difficult problem in lighting, is secured by the use of proper window shades.

The first two factors mentioned depend considerably upon the orientation of the building and the selection of the site. Poor judgment in either will prevent suitable lighting or may necessitate misplacing of rooms to overcome obstacles incurred from the choice of an unsuitable site. Hard and fast

rules cannot be laid down in regard to orientation of the building,as range of seasonal temperature and geographic conditions are varying factors that must be taken into consideration. In this section where high temperatures are not of long duration, east and west lighting are most favorable for class-rooms. Overhead lighting has been adopted in some school buildings, but it is not generally recommended, although it gives a uniform distribution. The confining impression created by the four walls extending to the ceiling with no outlook is said to fit children mentally to occupy cells. The right amount of glass area for a class-room likewise is dependent upon the locality and orientation of room. The common practice is to allow 25 per cent of the floor area for masonry opening, which will give a little more than 20 per cent equivalent in glass area. In Oregon the equivalent in glass area should be 25 per cent. Many architects violate this rule for the sake of the design of the building, as the repetition of groups of windows of similar form has a tendency to give the impression of monotony. Nevertheless, proper lighting should take precedence over everything but structural safety. The vertical and horizontal divisions of the window should be as small as good construction will permit.

*The most suitable height of the window stool above the floor seems to be from 2' 6" to 3' 6". Educators differ on

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* Kilham, W. H., School-house Details, page 441, Arch. Forum, March, 1928.

this point, however. Some contend that distractions result from low window stools, while others say that the momentary restful changes in looking out are beneficial. But one determining factor regarding this point is the requirement of glass area. It will be found that to meet the 25 per cent equivalent, both the head and stool are almost automatically fixed. The soffit of the window head is usually not more than six inches below the ceiling line. If the stool is placed lower than 2' 6", glaring reflected light from the ground will shine directly into the eyes of the pupils near the windows, which is extremely harmful. It is also desirable to have the reveal extend so far to the rear of the classroom as the rear seat, and on the right to the front line of desks.

The height of the ceiling is also a factor that enters into the lighting problem. Assuming that the site is large enough to locate the building as desired, the height of the ceiling from the floor should be determined by the amount of light falling upon the row of desks most removed from the windows. A rule recommended by authorities is that the classroom should be no wider than twice the height of the window head from the floor and the rays of light should be direct by sky-light. Figure #7 (from Donovan) demonstrates this rule on a larger scale, also the direction of rays within the classroom. The drawing is self-explanatory, and from it the deduction may be made that for a room of five rows in width (21' 0"), a ceiling height of 12' 0" is sufficient. Also the general rule that no desk should be further removed from the

source of light than 1½ times the height of the window head from the floor is demonstrated by the figure. The window lentils are assumed to be 6" below the ceiling. The relationship between height and width of class-room, and the reason for 21' and 22' widths is also apparent.

The sky as seen through a window is a source of glare. For this reason the seating arrangements should always be such that the pupils of the room do not face the windows.

The amount of illumination derived from a window at any given location in the room depends upon the brightness of the sky, the amount of sky visible through the window at the given location, upon the reflection of light from surrounding objects and the dimensions of the room. Observations in well-lighted school-rooms having a comparatively unobstructed horizon show that under normal conditions of daylight, satisfactory illumination is usually obtained when the visible sky subtends a minimum vertical angle of 5° at any work-point of the room. In cases where the horizon is obstructed by adjacent high trees, provisions should be made for larger window area, or, if need be, for redirecting the light into the room by means of prismatic glass in the upper sashes of the windows.

*As previously mentioned, diffusion of light is obtained by the use of shades. Shades are also sometimes necessary to exclude light in controlling illumination, and in eliminating

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* Shade Service Bureau, Chicago, "Modern Shading," 1930.

glare from the black-boards. These requirements make it desirable to equip counterbalanced or double hung windows, with two shades operated by double rollers placed near the level of the meeting rail. The shades may thus be raised or lowered from the middle, which providesthe maximum elasticity for shading and diffusing. The light yellow-colored material is preferable for shades, and it should be sufficiently translucent to transmit a considerable percentage of light while at the same time diffusing it.

Ceilings and walls should be so finished as to have a high reflection factor.

L. Artifical Lighting

Artificial lighting should be provided in all schools for certain quite fundamental and obvious reasons. The most important of these is that provisions must be made for those inevitable cloudy or stormy days which in this locality comprise a startlingly large percentage of the school year. The fact that the school building is often used for various community meetings, in addition to school activities, are direct evidence of the need for artificial light.

a. Artificial light requisites:

The same requisites given for natural lighting system apply to artificial lighting.

b. Standards of intensity:

The unit of illumination in artificial lighting is also the same as in natural lighting. (The foot candle, defined as the illumination on a surface normal to a one candle power

source at a distance of one foot) The values given in the following table have been found from experience and observation to be desirable standards of illumination of school rooms.

*Desirable Standards of Illumination of School Rooms

Classrooms	8 to 12 foot.	Candles on desks
Study Rooms	10 to 12 foot.	" " "
Offices	10 to 12 foot.	" " "
Corridors	2 to 5 foot	" " "
Auditoriums	3 to 6 foot	" " "
Auditoriums used for study	8 to 12 foot	" " "

**c. Diffusion and Glare:

Sufficient diffusion and elimination of glare is very important in the school room. The construction of the building places definite limits upon the heights at which the lights may be hung, therefore diffusion and elimination of glare must be obtained by diffusing globes, shades, or reflectors, which either effectively enlarge light sources or actually hide them from view. The walls, ceilings and woodwork have a very large effect on this phase of lighting. In order to eliminate annoying reflections, desk tops and other woodwork should have a dull rather than a glossy finish.

d. Distribution of Light:

General lighting (or systems where large lamps are hung as

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* Frandsen, D. J., "Artificial lighting of schools," Architectural Forum, May 28, part II, page 459.

** Clark, T., and Beal, A. T., "Studies in Natural Illumination of School Rooms," Pub. Health Bulletin #159.

high as possible to provide good distribution) is the system best suited for school-room lighting. Proper location of outlets will insure almost uniform distribution of light throughout the room; in fact, there is possible a much more uniform distribution than with daylight. The following table, with the lighting value of a 100 watt light as unit, gives the relative amounts of light that may be expected from higher wattage lamps.

100 watt inside frosted lamps:	1.
150 watt clean lamps:	1.75
200 " " " :	2.45
300 " " " :	4.00
500 " " " :	7.2

It is essential that light should be directed on the object to be seen and not into the eye. Therefore reflectors and other devices are necessary to direct the light to the desk or the the ceiling to to be redirected downward.

Types of Fixtures: Direct, semi-direct and totally indirect systems are all employed for school lighting. Each has certain inherent advantages, although they are all satisfactory if properly installed. There is, however, growing preference for the semi-indirect and totally indirect systems. A few points to consider in selecting each system are included in the following summary.

e. Indirect Lighting:

Totally indirect lighting produces an extremely good quality of lighting, but is somewhat less efficient than direct light-

ing with inclosing globes. A very light-colored ceiling is absolutely essential if the indirect system is to be used, as dark walls and ceilings would absorb light and the efficiency of the system considerably lowered. With indirect lighting there is little possibility of glare, and the resultant light is soft and free from shadows. The principal objection to indirect lighting, other than from the standpoint of initial efficiency, is that the bowls tend to accumulate dust.

Semi-indirect lighting: The luminary employed in this type directs the greater part of the light toward the ceiling, yet a small portion of the light is permitted to pass downward through the frosted glass. This downward light serves the purpose of illuminating the luminary so that it does not stand out as a dark spot against the lighted ceiling area. The direction quality of this downward light has in some cases an added advantage in that it serves to emphasize, to a slight extent, shadows which might be wholly lost under the totally indirect lighting. Semi-indirect lighting is slightly more efficient than totally indirect lighting. The resultant illumination is well diffused, and such shadows as are produced cause no annoyance. This type of lighting is particularly well adapted to school-rooms, especially if the totally inclosing type of semi-indirect luminary, of which the upper portion is of clear glass, is used. The open type of semi-indirect units are also open to the objection as regards the accumulation of dust.

f. Direct Lighting:

Open-bottom direct lighting units are still used in some schools. These are obviously efficient from the standpoint of light output, but their other characteristics are not such as to make them suitable for use in school-rooms. The inclosing, diffusing, direct-lighting luminary or inclosing globe seems to quite satisfactorily fulfill all of the major requirements of class-room lighting. With this type of equipment, the major portion of the light is directed downward, although a considerable portion is directed upward, thus giving a character of illumination somewhat similar to that produced by the semi-indirect units. The equipment is easily cleaned, and, in general, does not depreciate as rapidly from dust accumulation as do other fixtures giving comparable qualities of illumination.

*g. Spacing of Luminaries:

The location of the luminary in the class-room depends upon the dimensions of the room and the type of lighting to be used. Indirect and semi-indirect systems permit a slightly wider spacing than would be satisfactory if inclosing diffusion globes were to be used. With direct lighting from enclosing globes or reflectors, the spacing should never greatly exceed the hanging height of the luminary. Ordinarily this spacing may be increased to 1½ times the hanging height if semi-indirect or totally indirect lighting is employed. For instance, in a room 21 by 21 feet, with a 13-foot ceiling, four outlets

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* Frandsen, D. J., "Artificial Lighting of Schools," Architectural Forum, part 2, May, 1928, page 459.

should be essential for good lighting. They should be spaced on approximately 11-foot centers, about 5 ft. from the walls.

Calculation of Sizes of Lamps: The calculation of the sizes of lamps which should be used involves consideration of the type of equipment, the color of the walls, ceiling and other woodwork, and the dimensions of the room. Direct estimates based upon an assumption of a certain number of watts per square foot of floor area are liable to lead to erroneous results. The lumen method, as set forth in bulletins issued by the larger lamp companies, will ordinarily give more accurate results, since it is based on the light output rather than the power consumption of the lamps.

M. Electric Service System.

a. Clock and Program System:

In any building where two or more clocks,are used,a Master Electric clock is a good investment. Much confusion is caused in the school program when clocks in the various rooms show a difference in time. A master electric clock keeps all the clocks in the building accurately regulated. Clocks of this type are now manufactured with electric program attachment, so that it is not necessary to ring signals by hand. The possibilities of a program clock will be readily appreciated when by means of such a system signals may be operated at any stated hour, day or night, on one or more different schedules which may be automatically changed each day of the week if necessary. The master and program clock is usually placed in the principal's office. This system may be also used for special assembly calls, drills, etc., but the state fire regulations in Oregon require that the fire alarm system bell should be

separate from the regular class-bells. An extra large gong installed on the outside of the building and attached to the master system is sometimes necessary where the playgrounds are large to call the pupils to their rooms at the opening of sessions. Buzzers are usually preferable to bells in the class-rooms.

b. Telephones:

A telephone in the principal's office is a necessity for any standard elementary school. House telephones are used in large schools, but are not necessary in the type of school being considered.

N. Cleaning System.

A good investment, if it can be afforded, is a vacuum cleaning system. There are several very good such systems on the market today, which are quite inexpensive. The system should have discharge

O. Fire Protection System.

A standard stand-pipe system should be provided so that no part of the building is more than 75 feet from the nearest hose outlet. These outlets should be equipped with 2½-inch hose, hose racks, and valves all opening into the corridors. One fire extinguisher should be provided for every 5000 feet of floor area or fraction thereof. A fire alarm system such as the "break glass" system should be placed in the corridors and boiler room with wires leading to an annunciator, placed in the principal's office. If glass is broken, the annunciator will indicate from what point the alarm was turned in. The stations should be designed to be operated with a key for

testing purposes, and fire drills. The heating plant should be cut off from the rest of the building by fire walls.

P. Water Supply System:

One of the first steps taken in determining upon a school building site should be a laboratory test of the water supply. Test should also be taken to determine if water pressure is adequate for operating of the school's water facilities. Many small cities having a water system adequate for general purposes are unable to furnish the supply of water necessary for a modern school building, especially during hours when the city inhabitants are watering lawns. A small air pressure water system has been found a very good investment by many small school systems. A 200-gallon tank system is adequate for the needs of a system such as we are considering.

Several school systems having such water systems were visited by writer. In a few cases they had available figures showing that they were obtaining their water supply more economically than they would be able to through the municipal water system. In one case the water system had paid for itself in five years.

Drinking Fountains: *There should be provided one automatic bubbling drinking fountain for every 75 children or marginal fraction thereof. These should be recessed in the corridor walls, and located so that they will be easily

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* U. of O. Bureau of Educational Research. Bulletin on Standard Elementary Schools of Oregon

accessible to the class-rooms, play-rooms, and playgrounds. The apparatus should be of the type that prevents children from touching their faces to the bubbler.

Lavatories: Lavatories or wash basins should be placed in toilet rooms, teacher's rooms, and janitor's room. They should be of substantial pattern with as small a slab size as can be used with an adequate bowl. A small slab has little space for dust collecting and offers little inducement to tired boys as a resting place. More than ordinary strong fastenings to the wall should be used, such as 4-inch expansion bolts or lag-screws and lead sleeves. Extra-heavy, self-closing basin faucets should be used so that the water cannot be left running by careless pupils. Mechanical wastes have not been found as practical in school work as rubber corks and chain, as they are a constant challenge to the boy with mechanical ideas.

Janitor's sink: There should be provided a mop-sink in the boiler room and the janitor's closet.

Showers: All modern schools are now provided with showers. There should be one individual shower stall and adjoining dressing room for both boys and girls for each class-room. The stalls for the girls' room should be provided with canvas curtains. The side type of shower is recommended with separate valves for hot and cold water.--all washbowls, sinks, and showers should be provided with hot and cold water.

Q. Equipment

The type of equipment to be used in the school building

should be chosen by the educator. This subject, therefore, has been discussed under the heading "Educational Engineering." However, a few supplementary remarks should be made in reference to the buying of equipment for the small school. Tables and chairs for the three lower grades and the kindergarten are becoming very popular in many parts of the country. They cost less than the traditional school-seat, and the primary teachers are, as a whole, very pleased with them. They tend to supply that much desired "home atmosphere" to the room, which successful elementary teachers consider essential. The location of the tables may be changed to conform with lighting and heating requirements. Tables are usually built to accommodate four pupils, and cabinets are provided for the storing of books and supplies. Dimensions of the tables and chairs are made to conform with the accepted standard sizes of school desks, as given in chart #5 of the appendix; a long reading table to accommodate at least a third of the pupils in the room should be supplied in addition to the regular desks.

The most serious objection is that the chairs are "hard on" the floors, and that disturbing noises result from the sliding of the chairs by pupils in moving. In some districts, tables and chairs are also being provided for the upper elementary grades, but opinions of educators seem to indicate that the movable desk, such as has recently appeared on the market, is most satisfactory for these grades. The stationary desks which are screwed to the floor should not be considered in the new school. All firms dealing in school furniture publish literature

giving information regarding the furnishing of the school. This literature, although usually biased, may be used to advantage in selecting equipment. Bennett's book on School Equipment, probably the best book on the subject, may also be used to advantage.

6. Recreation Facilities

"The instinct of play is one of the fundamental demands of child life. The play spirit is preeminently the spirit of learning, and the delight resulting from play is nature's remuneration and incentive. The child multiplies his experience a thousand-fold in his early years by reason of the contacts that play induces."

The above quotation, taken from* Dressler, indicates the importance of play in the early training of the child. Health has been placed first in all accepted objectives of education, and for the elementary school child there is no better way to provide for the attaining of this objective than by providing adequate facilities for play.

Hence all elementary schools should provide a playground of proper size, properly arranged, well-drained, and adequately equipped. The national education association recommends** 272 square feet for each child for play, recreation, and gardening. Donovan*** recommends one-fourth acre per classroom.

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* Dressler, F. B., "School Hygiene," The Macmillan Co., 1922.
** N. E. A. Report on School House Planning, 1925.
*** Donovan, J. J., School Architecture, Chapter I, The Macmillan Co., 1921.

Consequently the type of school being studied should have a four-acre playground to be in accord with these recommendations. However, since gardening is very seldom part of the curriculum of schools in this section, 2½ to 3 acres will suffice as a playground. The building should be placed on the far north side of the site leaving the driest and sunniest part of the grounds available for play. A fair division of the grounds should be made between the boys and girls.

Donovan's recommendations for equipment and areas for elementary playgrounds appear in the chart #4 of the appendix. This recommendation, no doubt, is ideal for California, but in this state, due to climatic conditions and differences in prevailing games, several changes would be necessary. Playground baseball has become a popular elementary sport in this state both for boys and girls and a space should be allotted for it; if a play-room has not been provided for in the school building, it is well to provide a play-pavilion on the grounds. This will enable the play program to go on during the long rainy periods. Such a pavilion may be built quite economically and may be limited to a frame structure 50' x 100' with a roof and walls on one side and the ends. It should be located near the school building, but should not obstruct main playground space.

Swings, slides, giant strides, see-saws, horizontal bars, merry-go-rounds, and slanting ladders are all good forms of apparatus for the playground. Giant strides and merry-go-rounds have been shown by the National Safety council to be

the safest.* The swing rates highest as the cause of accidents.

With the exception of cases where gymnasium and auditorium are combined, it is not advisable for a district of limited means to attempt to include a gymnasium in an elementary school building. A play-room or pavilion serves the purposes of recreation much better and is more economical.

7. School Financing.

The financing of a school building project for the small district is usually one of the most difficult tasks of the school officials. A district is called upon to build a school house about once every fifty years. Consequently the officials are not experienced in the technical procedure incident to financing a building project. For some unexplained reason, small district school boards do not seem to realize this, with the result that many become badly involved.

Two of the phases of school financing which most often lead to trouble are the estimating of costs and appropriations and the issuance of bonds. A few general remarks and precautions will be given, which, if taken by school officials, will avoid serious mistakes.

A. Costs and Appropriations.

**In 350 cities which erected schools within the past five years, 22 per cent of them overspent the bond issues or

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* From report given at Inland Empire Teachers' Convention, Spokane, Washington, 1930.

** Taylor, C. S., "School Financing and the Architect," Architectural Forum, May, 1928, page 469.

appropriations. The results of incurring building and equipment costs which exceed appropriations are always unfortunate. In the first place, if there is an excess cost, the community is forced to issue warrants bearing high rates of interest. In many communities this practice is not legal, and the only thing that can be done where the construction cost is excessive is to curtail definitely the finishing and equipping of the building. Old equipment may be substituted for new, and in every way the final structure will be inferior. This situation may also lead to the eliminating of important extra-curricular activities such as music, art, gymnasium, and playground. It becomes quite evident that it is very important that a reliable estimate of the building cost be made. If a reliable architect is employed, this, of course, becomes his task, but it is quite common not to hire an architect, and an architect is not a legal necessity in this state. Also there are many architects who are good draftsmen but very poor engineers and estimators. These require supervision.

Another phase of school financing which usually falls to the lot of the school official is allotting the available money for building purposes, so as to satisfactorily equip the building after construction. General experience with school equipment budgets indicates that they should be established as an entirely separate fund upon which the building cost itself should not encroach. Reports received by the Better Schools league from 350 cities which have erected school buildings since the year 1923 showed a very consistent

ratio of the percentage of the bond issue which should go for equipment. The experience of this group provides a basic standard of average practice. In the summary for the different types of school buildings the average equipment cost of the schools housing grades 1 to 6 was 8.2 per cent of the appropriated funds.* In schools housing grades 1 to 8 the percentage was 10 per cent. These figures may be used to formulate a budget for school building and equipment.

B. The Issuance of Bonds.

The employment of a local attorney is not always sufficient in ascertaining the correct technical procedure of issuing bonds.** He usually handles very few bond issues in the course of his legal practice, and the fee involved does not justify the exhaustive investigation necessary to a really competent conduct of proceedings.

The authorization, issuance, and sale of bonds is only a process of borrowing money. The dealer or broker who handles the money acts as a banker to the district. It is only natural to expect the dealer to make every effort to protect himself and his clients. The security behind the bonds consists of the taxes levied on the taxable property and the dealer must be sure that the bonds are legally and regularly issued and that they are payable from sufficient collectable taxes levied on the property involved. When all legal pro-

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* Taylor, C. S.,"School Financing and the Architect," Architectural Forum, May, 1928, page 469.

** Bucher, H. M., "The Issuance of School Bonds in a Small Town," A. S. B. J., Jan., 1930, page 50.

ceedings have been completed, a record is compiled into a transcript which corresponds to the abstract of title in a mortgage transaction. It must show that the authorities have legal right to their office and lawful authority to borrow money for their electors. The transcript is submitted to the dealer's attorney for his opinion as to the regularity of the proceedings. There are firms of attorneys that make a specialty of this work. Reference to bond circulars, and newspaper advertisements of municipal bond issues will give the name of these attorneys in each section of the country. The laws of various states differ as to the necessary proceedings, but with few exceptions they are of the same general character, differing only in minor details.

A bond election is usually called upon petition, presented to the school board. The number of voters that must sign this petition is generally a stated percentage of the number voting at the last preceding general election. (In this state required) The Board then passes a resolution calling an election and this resolution sets the date of voting, prescribes the form of ballot, designates the polling places, and indicates how notice of the election shall be brought to the attention of the voters. Very particular care should be used to make sure that the requirements of all pertinent laws are fully met as to notice of election, as it is vital that proper notice be given the voters before their property is pledged for debt. This state requires publications in the local newspaper and poting of notices in public places.

The form of the ballot is also very important, and failure to state properly the proposition has probably invalidated more proposed bond issues than any other error. The supreme courts of several states have held that a voter must have the opportunity to reject each and every proposal submitted to him, so care should be taken not include several proposals in one. Give the taxpayer opportunity to vote for or against each proposition separately.

After the bond election, the board should meet and certify the election results. If the election has carried, a resolution is passed authorizing the issuance of bonds and prescribing the manner of their sale. It is generally best to postpone the adoption of the bond form, as well as the printing of the bonds, until after they have been sold, because purchasers have different preferences as to place of payment, size and form of coupons, color bonds, and other details. It is also a good plan to advertise the bonds at a rate of interest not exceeding ___ percent, thus allowing the bidders to take the lowest coupon rate for which they can pay par and accrued interest. The money market fluctuates just as any other commodity market changes, and in the event bonds are offered for sale at a rate of interest too low for a par bid, the bonds must be reoffered and a delay results.

The safest and most practical plan is to first ascertain the name of an attorney acceptable to the potential purchasers. It is desirable to have this attorney approve the petition and prepare the subsequent resolutions. His guidance in the matter

will entail little extra expense, as the bond-purchaser will bid subject to the "favorable opinion of a qualified municipal bond attorney," and he will, of course, bid more for the bonds if the opinion of such an attorney is furnished and paid for by the school district. If the attorney prepares the forms to be used, this work of examination is thereby lessened and his fee is consequently about the same as for examination only. The district might as well have the full benefit of a recognized bond attorney, for even when employed by the banker his fee is indirectly paid by the district in the price quoted on the bonds. There is an added advantage in selling an approved issue of bonds. Few bond dealers like to gamble on future conditions and will generally deal on a very narrow margin when the issue is almost immediately ready for delivery and resale to clients; when an unapproved issue of bonds is bought there is usually a delay in the delivery while legality is being checked. The conservative banker makes provisions for contingencies in this case.

At best the issuance of bonds is intricate and technical, and a surprising number of issues have to be resubmitted to the voters with consequent expense to the district and embarrassment to the officials. It therefore behooves school officials to see to it that each step taken as a preliminary to flotation of bonds is checked.

8. School Construction Costs

A study of this nature would not be complete without a discussion on construction costs. There are few subjects in

which the school board member is more vitally interested today than school construction costs. *A glance at chart #7, showing the trend of building costs since 1890, coupled with the facts that during the period of time since 1920 the expenditures for education per capita wealth have increased 40 per cent and that the school enrollment has increased 17 per cent, reveal that it is hardly to be wondered at that the taxpayer is beginning to become more than usually interested and wonders where it will all end. Already, in many sections of the country, particularly in the village and rural sections which are being considered in this study, tax-burdened citizens are contemplating radical action to stop the relative increase in school expenditures. Luckily, however, this condition is not general. Most citizens realize that as long as the public as a whole demands increasingly better educational facilities for its children, and so long as the mechanical improvements of our age demand of the citizen better fitness to cope with economic problems, we cannot hope to stop the increase in the unit cost of education. It is conceivable that the voters of a community could by negative action forestall for a time any increase in the cost of education, but the moment they did so they would set in motion inescapable forces which would bring about a retrogression in the local standards of living and would in a larger period materially injure the progress of civilization. It is, then, of utmost importance to every community to consider

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*Dorman, George E., "School Construction Costs," A. S. B. J., June, 1930, page 68.

the way its education finances are handled, so that the citizen receives the utmost value for his dollar. One of the major elements of educational costs today has to do with construction and maintenance of school buildings. School construction costs are dependent upon six conditions.

a. The economic standards of the day and generation. This has already been discussed in a preceding paragraph.

b. The social ideals, the reputation and the financial standing of the community. A town which has the reputation of being "high brow" will pay more for its buildings than adjacent towns not so afflicted. The town which pays contractors promptly can always get better prices than towns which play the "hold up" game.

c. The program of the building. This has already been discussed in the chapter on Educational Engineering.

d. The design. No one factor has more to do with the cost of the building than the design. This also has been discussed previously under the heading "Architectural Design." Two buildings designed for exactly the same number of pupils may vary greatly in construction cost, in administration cost, and in maintenance cost, although the construction materials remain identically the same.

For example, in a country community where the fire hazard is largely internal there is no reasonable excuse for constructing a fire-proof school building, beyond the protection of vital spaces such as the boiler room, exit corridors, and

supply rooms. Also, as has been shown in the discussion on "Floors," there is a great difference in the costs of floor materials of equal value.

e. The materials of construction. This factor affects the cost of the building only less than the design factor. Often specifications call for high priced materials when less expensive ones would serve quite as well.

f. The relative amount of constructive work in progress at the time the contract is let. When work is slack, a reputable contractor will frequently take a job at a small profit for the sake of keeping his organization together. Also under our present "lowest bidder" system of letting contracts, a contractor often will, in his effort to obtain as low a figure as possible, find himself with a contract to build the building at a loss. The latter situation, however, should be avoided as it is certainly not favorable for good building. Many architects and builders today believe that the "lowest bidder" system is instrumental in greatly lowering the quality of American buildings. No builder can put his best into a building that he has contracted to build at the lowest possible figures. It is natural that he should use the cheaper materials when he sees the opportunity, though they may be inferior. This, obviously, does not lead to good construction.

In discussions of school building costs one often hears the phrase "when costs get back to normal." "Normal"usually is used in this sense as pertaining to pre-war costs. There is no reason for supposing that construction costs will ever return

to the pre-war levels. Basic economic changes since the war make this impossible. Luxuries and conveniences are being enjoyed today that only the rich enjoyed 15 years ago. The cost of living has increased, and it is only natural that building costs should experience a similar increase.

It is common in discussing construction costs, to refer to the cubic foot as the unit of construction. However in discussing school construction costs a much better comparitive idea of the subject may be obtained by considering the unit of construction and cost as the class-room. It will be found in figuring on the class-room basis, and allowing for the variations in cost accounted for in the six factors mentioned above, that costs do not vary widely in similar jobs. Not taking these factors into consideration, accounts for the intangibility of figures derived from comparative instruction unit cost from groups of buildings. The writer attempted to formulate such a comparative list of Oregon one-story schools, with the result that instruction unit cost was shown to vary from as low as $2,000 to as high as $15,000. Such figures are incomprehensible and useless without taking the conditions mentioned, which govern construction costs, into consideration. The lower cost schools included, however, were of the kind which no district ought to erect, and to the high cost schools, from the taxpayer's standpoint, the same statement applies.

NOTE: Studies have shown that the cost of the class unit of the one-story school is about 5 per cent cheaper to construct than the multi-story school. Dorman, Geo. C., "School Construction Costs," A. S. B. J., May, 1930, page 68.

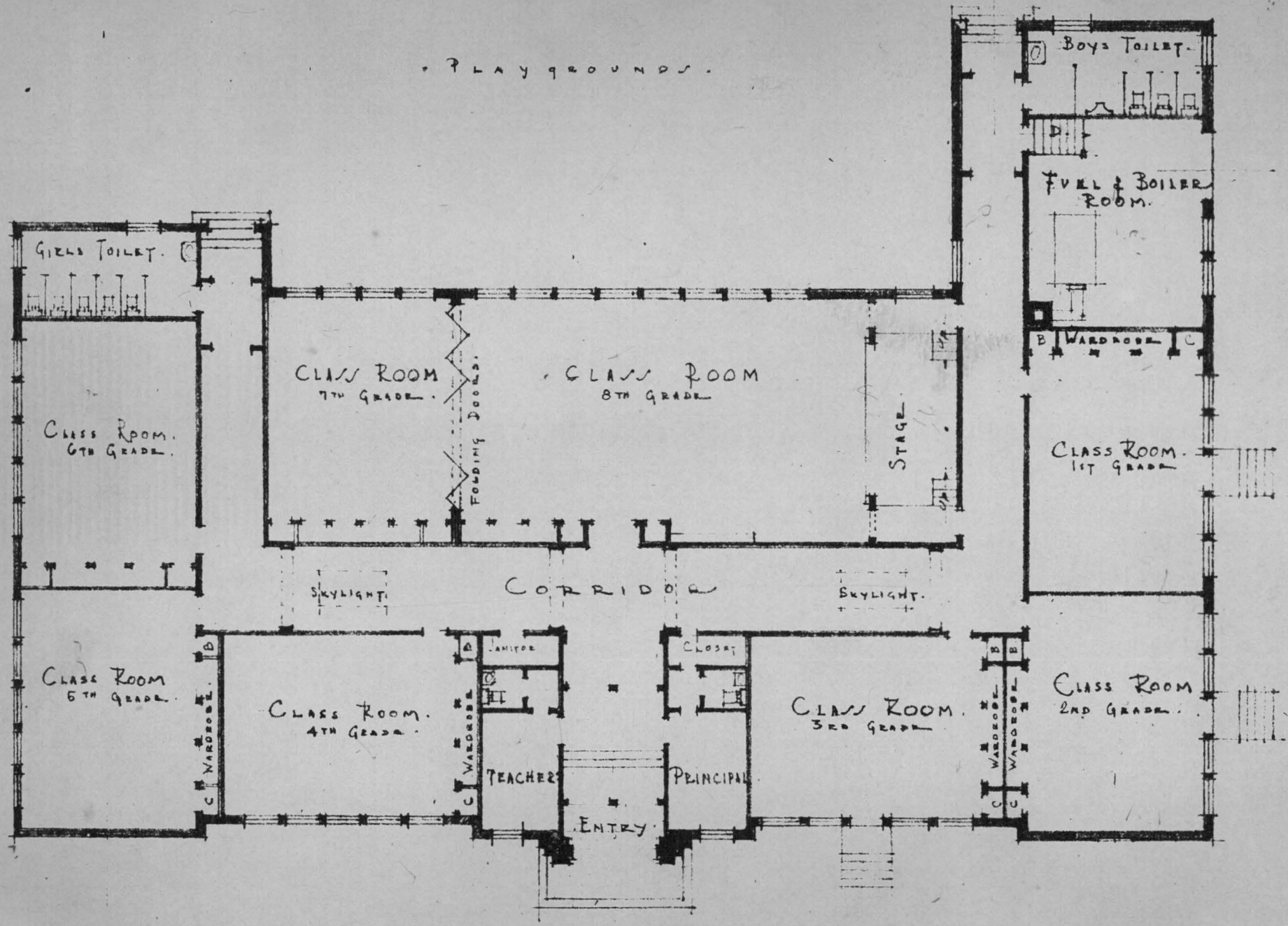
It is the writer's opinion that the class unit cost for small, one-story schools in Oregon should be about $4,500. Average costs of existing class-room units cannot be used in preliminary estimates covering an appropriation for the erection of a school building, for as has been shown, "costs can be averaged, but the conditions which determine costs cannot." These conditions all unite to make each problem a special problem which must be solved for its own sake.

9. Conclusion

This study has dealt with such information of elementary school-house building as may be of value in producing better buildings in the small districts. The study is by no means complete, being only those phases of small school-house building most obvious to the writer. It is hoped that other studies specializing in the building problems of the small district will follow. However, the writer feels confident that, if this study be observed, a better small elementary school building, better and more economically constructed and better adapted to the modern educational program, will result.

- 0 -

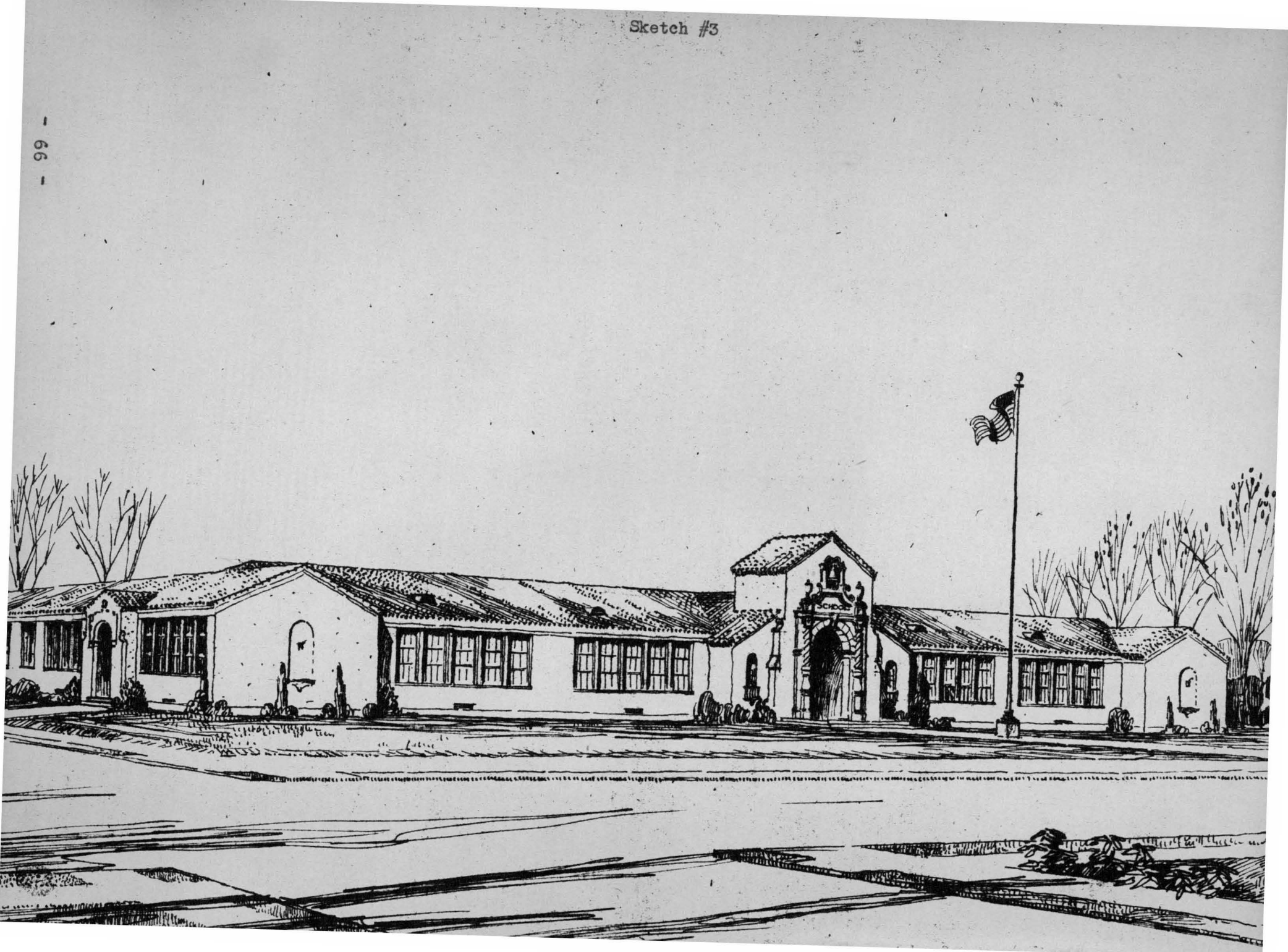
Sketch #1



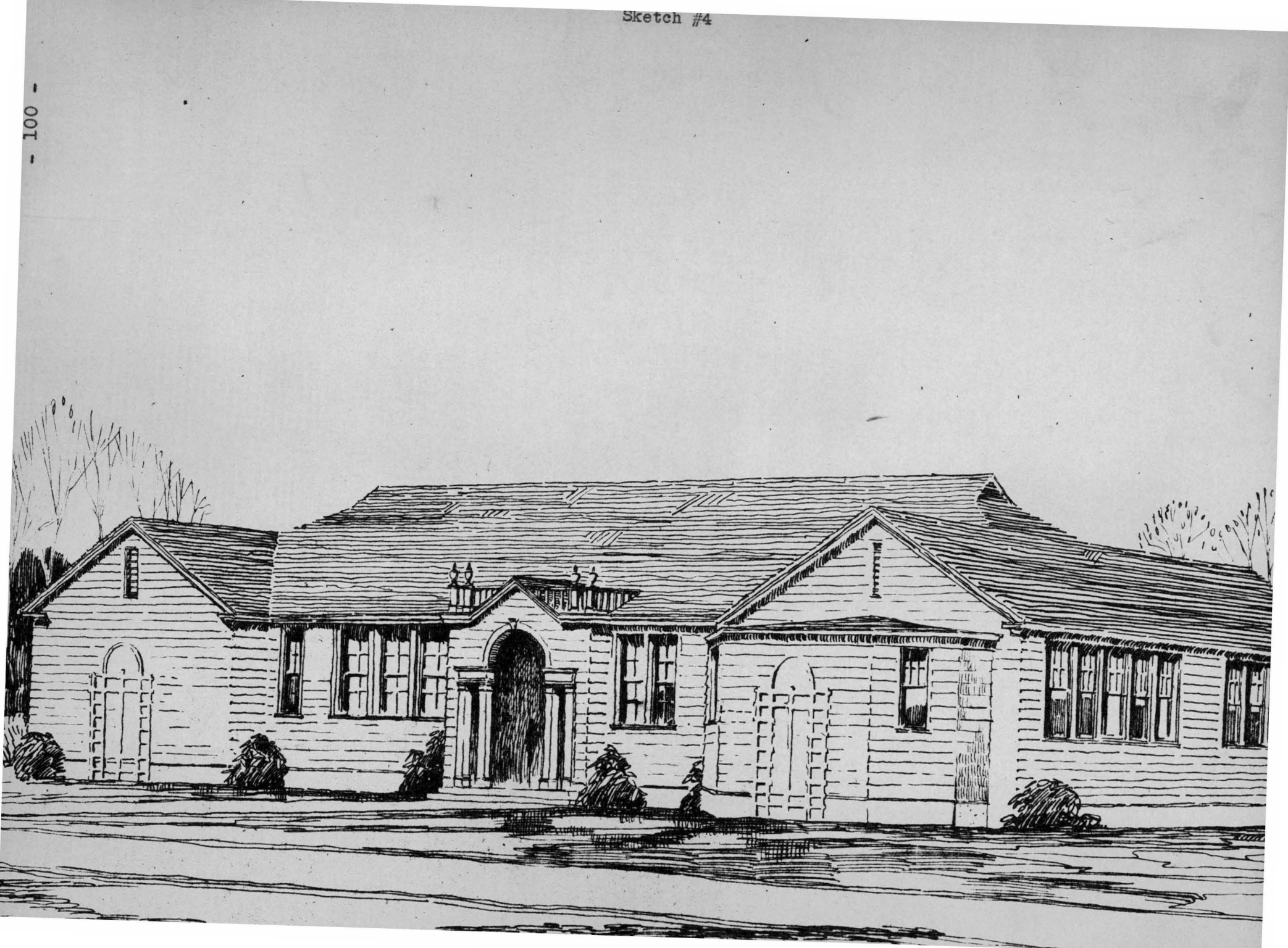
ELEMENTARY GRADE SCHOOL PLAN

Sketch #2

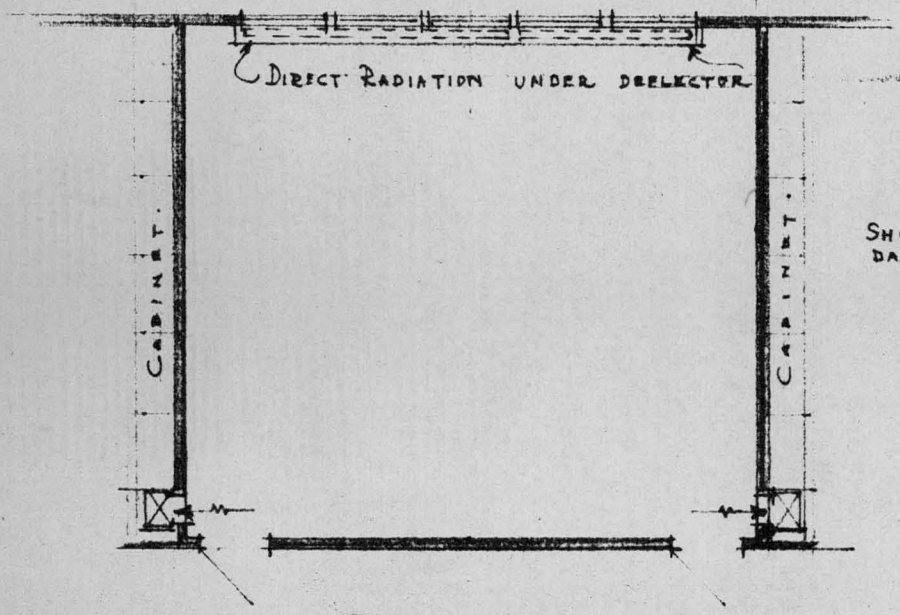
Sketch #3



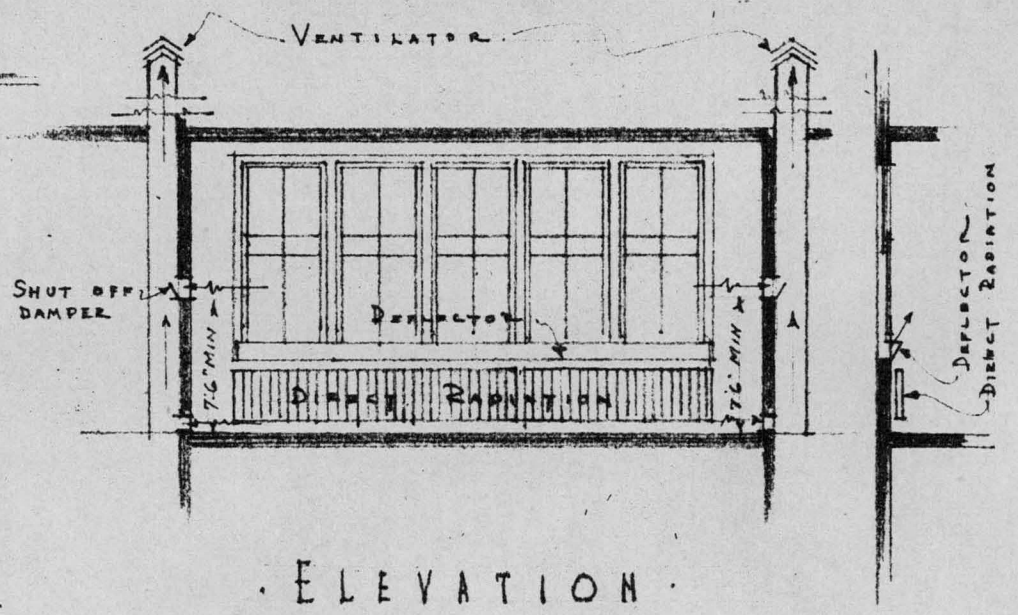
Sketch #4



Sketch #5



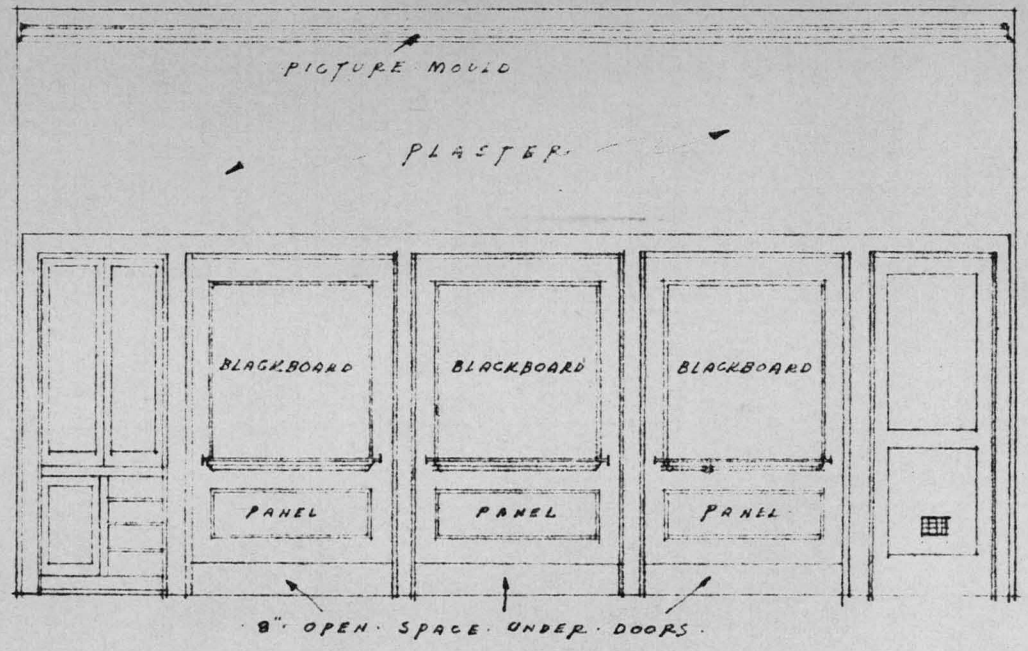
PLAN

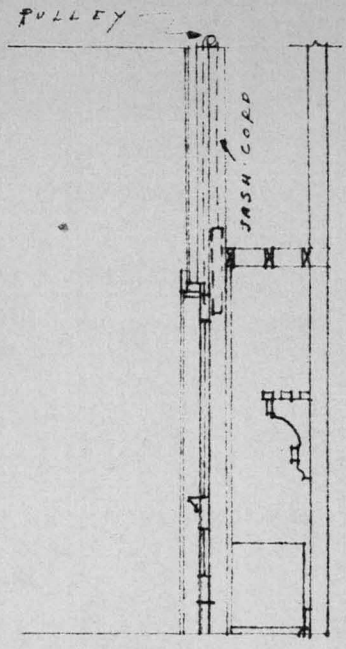


ELEVATION

SECTION

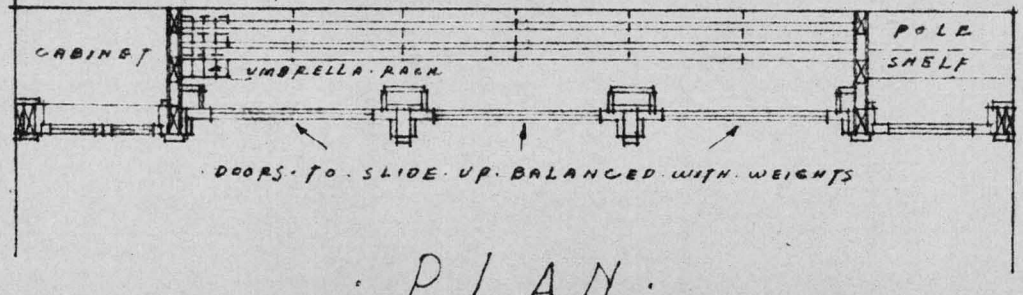
THE OPEN WINDOW SYSTEM.





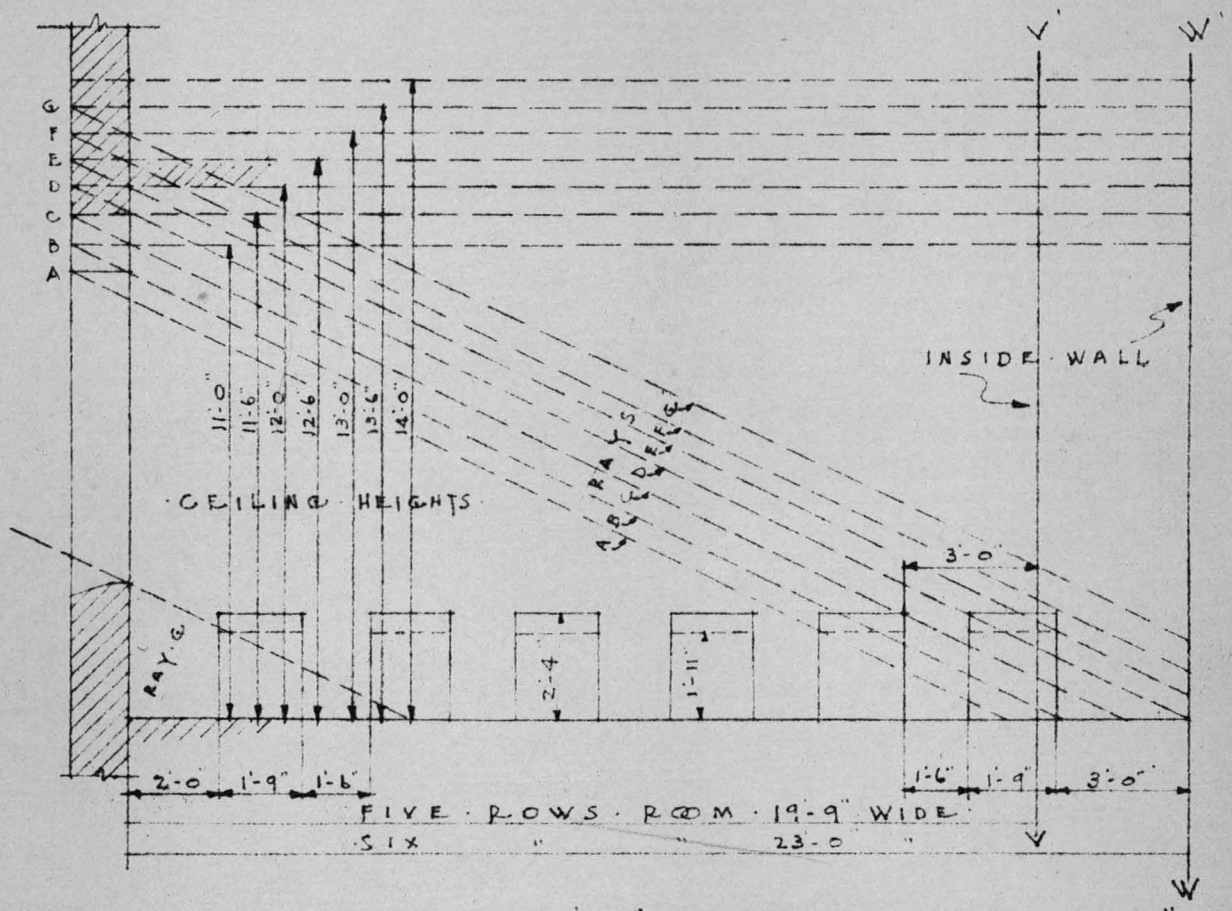
ELEVATION OF ROOM WARDROBE SECT

SCALE 1/4" = 1'-0"



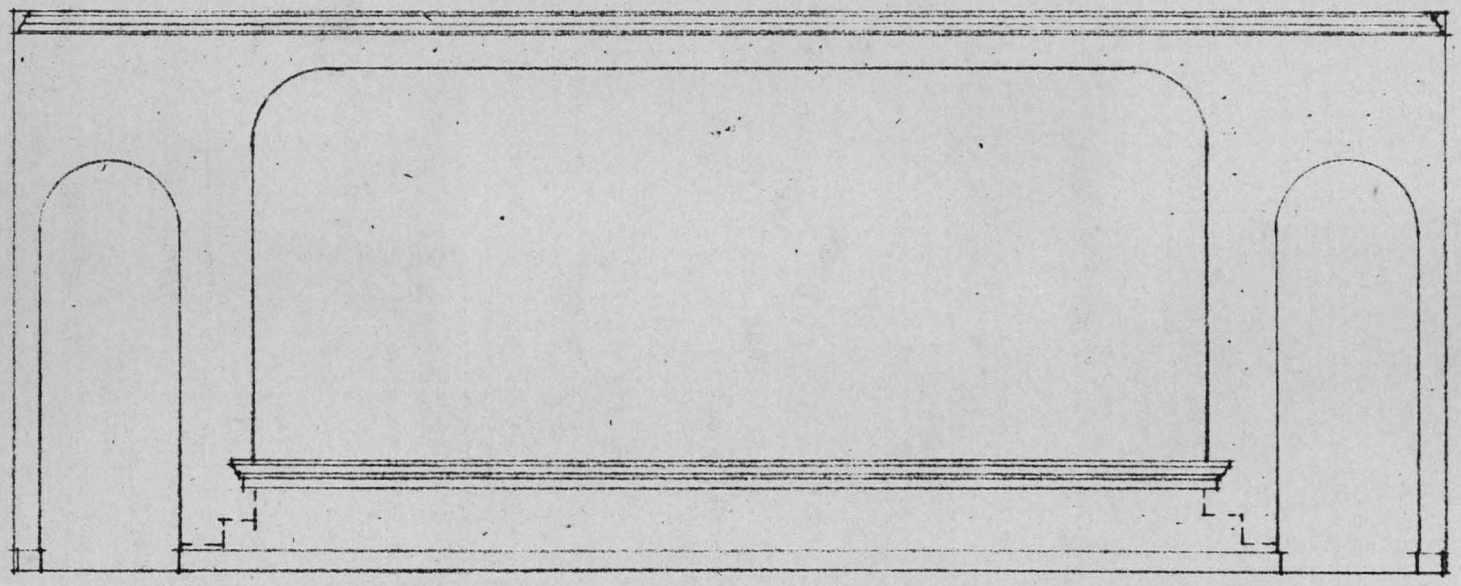
PLAN

TYPICAL WARDROBE



FROM DONOVANS "SCHOOL ARCHITECTURE"

DIAGRAM ILLUSTRATING THE DIRECTION OF RAYS OF LIGHT AND RULE THAT ALL CLASSROOMS SHOULD NOT BE WIDER THAN TWICE THE HEIGHT OF THE WINDOW HEAD FROM FLOOR



ELEVATION OF STAGE: Scale 1/4"=1'0"

Stage Approx. 11'0" Deep.

CHART #1

ESSENTIAL QUALITIES OF THE BUILDING

or

OBJECTIVES IN PLANNING THE SCHOOL BUILDING

(a) Adaptation to Educational Needs.

(b) Safety.

(c) Healthfulness.

(d) Expansiveness.

(e) Flexibility.

(f) Convenience.

(g) Durability.

(h) Aesthetic Fitness.

(i) Economy.

CHART #2

*REQUIREMENTS FOR A HIGH ELEMENTARY SCHOOL

GRADES 1 TO 8 INCLUSIVE

(a) Principal's Suite

1. Public office, waiting room.
2. Private office.
3. Toilet.
4. Storage.
5. Telephones, program system, fire alarm.

(b) Library

For text books and about 1000 reference and fiction books.

(c) Teachers' Suite

1. Rest room.
2. Lunch room, kitchenette.
3. Toilets.
4. Wardrobes.

(d) Medical Department.

1. Emergency room.
2. Examination room.
3. Toilet rooms.
4. Girls' rest room.

(e) Mechanical Department

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* From Bulletin of Oakland, California, Schools.

(Chart #2 cont.)

1. Boiler room (isolated).
2. Fan rooms.
3. Work and repair room.
4. Storage room.
5. Incinerator.
6. Janitor's room on each floor.

(f) Pupils' Service

1. Bicycle rooms.
2. Toilet rooms (on each floor)
3. Play-rooms (boys' and girls')
4. Swimming (possible).
5. Dressing rooms.
6. Athletic-field rooms.

(g) Gymnasium.

1. Dressing rooms (if there is a swimming pool, one set will do for both pool and gym.)
2. Showers.
3. Instructor's room.
4. Examination rooms.
5. Apparatus room.

(h) Department of Instruction

1. Class-rooms, wardrobes.
2. Kindergarten, wardrobes.

(i) Home Economics

1. Cooking room.
2. Dining room.
3. Pantry.

(Chart #2 cont.)

4. Sewing room.

5. Fitting room.

6. Locker room.

(j) Manual Training

1. Bench room.

2. Lumber room.

3. Finishing room.

4. Painting room (fire-proof).

5. Small fire-proof room for storage of painting materials.

(k) Drawing

1. Freehand.

2. Mechanical.

(l) Music

1. Choral room.

2. Small practice rooms (dressing rooms off stage serve well).

3. Office for storage of instruments, music sheets, books, and so forth.

(m) Assembly Hall

1. Main room to seat about 60 per cent of the school capacity.

2. Stage (with dressing rooms).

3. Moving picture booth.

(n) Science Department.

1. Laboratory for general science.

2. Store-room.

3. Germination room.

(o) Commercial.

1. Book-keeping.

2. Commercial geography.

CHART #3

SCHEDULE OF ELEMENTARY REQUIREMENTS

.....School Date.....

STANDARD REQUIREMENTS	ROOMS REQUIRED	REMARKS
20 Standard Class Rooms 22 x 35..	.....	.....
2 Occupational Rooms 22 x 35.....	.....	.....
Kindergarten Suite.....	.....	.....
Principal's Office.....	.....	.....
Private Office.....	.....	.....
Outer Office.....	.....	.....
Book and Supply Room.....	.....	.....
Teachers' Rest Room.....	.....	.....
P. T. A. Room.....	.....	.....
Teachers' Lunch Room.....	.....	.....
Kitchenette.....	.....	.....
Nurse's Room.....	.....	.....
Assembly and Play Hall (Capacity)	.....	.....
Custodian's Storeroom.....	.....	.....
Playground Supervisor's Office...	.....	.....
Music Rooms.....	.....	.....
ROOMS NOT STANDARD		
Junior Kindergarten.....	.....	.....
Playground Office.....	.....	.....
Library.....	.....	.....
Bicycle Room.....	.....	.....
Basement Play Space.....	.....	.....

Signed..... Date.....

CHART #4

ELEMENTARY SCHOOL PLAY AREAS RECOMMENDED BY JOHN DONOVAN

1. Boys' Yard

One basketball court 50' x 70'.....	3,500 sq. ft.
One tennis court 50' x 100' (court proper is 36' x 78').....over all	5,000 sq. ft.
Two volley ball courts, each 25' x 50'..	2,500 sq. ft.
Two handball courts, each 20' x 36'.....	1,440 sq. ft.
Allowance around courts, about.....	4,000 sq. ft.
Space for gymnasium apparatus.....	5,000 sq. ft.
General play space, at least.....	20,000 sq. ft.
	41,440 sq. ft.

2. Girls' Yard

One basket ball court 50' x 70'.....	3,500 sq. ft.
One tennis court 50' x 100'.....	5,000 sq. ft.
Two volley ball courts, each 25' x 50'..	2,500 sq. ft.
One handball court 20' x 36'.....	720 sq. ft.
Allowance for space around courts.....	4,000 sq. ft.
Gymnasium apparatus.....	5,000 sq. ft.
Dancing pavilion 30' x 60'.....	1,800 sq. ft.
General play space.....	10,000 sq. ft.
	32,520 sq. ft.

3. Small Children's Space

Sand Box)
Swings)
See-Saws)
Slides)

about 5,000 sq. ft.

The above requires a total area of about 78, 960 square feet, or 1.7 acres.

CHART #5

Percentage Distribution of Seat Heights According to Grade

School Grade	9	10	11	12	13	14	14	16	17	18	19	20	Totals
Kindergarten	23%	47%	28%	2%									100%
I	3%	29%	50%	17%	1%								100%
II		7%	30%	51%	10%	2%							100%
III		2%	14%	44%	30%	8%	2%						100%
IV			2%	28%	43%	19%	7%	1%					100%
V				13%	42%	25%	17%	3%					100%
VI				3%	12%	44%	30%	10%	1%				100%
VII					6%	26%	40%	24%	4%				100%
VIII					3%	11%	39%	34%	11%	2%			100%

Percentage Distribution of Seat Sizes According to Grade

Grade	6	5	4	3	2	1	Totals
I	90%	10%					100%
II	50%	50%					100%
III	25%	50%	25%				100%
IV		50%	40%	10%			100%
V		35%	40%	25%			100%
VI		10%	40%	50%			100%
VII			25%	50%	25%		100%
VIII			10%	40%	50%		100%

BIBLIOGRAPHY

Key

A. S. B. J.	American School Board Journal
ch.	Chapter
bk.	Book
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