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A summary is presented of the results of two experiments concerned with the advisability of reusing school plant plans both in highly divergent situations and in very similar situations. A review is included of an attempt to reuse an elementary school plan, as well as some pertinent literature on stock plans and modifiable stock plans. (FS)

REPORT ON EXPERIENCES AND LITERATURE IN THE USE OF MODIFIABLE STOCK PLANS FOR SCHOOL BUILDING CONSTRUCTION

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PREFACE

It is the purpose of this report to summarize the findings of two experiments authorized by the State Board of Education on the advisability of reusing school plant plans both in highly divergent situations and in very similar situations.

A review is also included of another attempt in Auburn to reuse an elementary plan, as well as some pertinent literature on stock plans and modifiable stock plans. Supporting data for all of the above material is on file in the Office of the State Superintendent of Public Instruction.

For the material covering the elementary buildings in Edmonds we are indebted to Mr. William Fortune, who chose this topic for a thesis to be submitted as part of the requirement for a master of arts degree.

The summary of the 1963 report from California is included in this report because it is one of the best compilations so far done, and is as applicable today as in 1963.

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DEFINITIONS

Stock Plans

In the context here used, stock plans are those that can be reused without modification.

Modifiable Stock Plans

By modifiable stock plans reference is made to basic design that can be effected to serve a segment of the educational program (elementary, junior high or senior high) and that this design can be reused by adapting it to varying conditions of site, climate, seismological factors, codes, or a variety of other variables that might be encountered.

Sites

Sites include the total acreage involved in a school plant, including building location, parking, playground and athletic facilities. The State of Washington has adopted a recommended minimum of 5 acres for an elementary school, with one additional acre for each 100 students ultimately to be housed in this plant, and 10 acres for each junior or senior high school with an additional acre for each 100 students.

Building Orientation

The term building orientation involves two concepts, viz., (1) the arrangement or rearrangement of the units of a plant in reference to each other on a particular site, and (2) the directional facing of the plant or plants in reference to sun control and access.

SUMMARY OF FINDINGS ON THE USE OF STOCK PLANS OR MODIFIABLE STOCK PLANS

For many years hope has been expressed that stock plans or modifiable stock plans might expedite school construction and also save money. Research and experience since 1951 indicate that this approach to school construction will do neither, for the following reasons:

1. Any stock plan, however good, still requires architectural services to redesign the site plan, storm drainage, lavatory drainage, electrical service, variations in local educational requirements, heating system for locale and orientation, seismological variations, foundation plan, and specifications to fit all of the foregoing.
2. Architectural services are important in supervising bidding procedures, securing approvals of Health Department and fire marshals, and awarding of contracts.
3. Architectural services are important in supervising construction. This alone amounts to 1.5% to 2%.
4. Stock plans create unfair bidding practices by granting advantages to original bidders on subsequent project.
5. Architects serve as liaison between contractors and clients. Who would serve in this capacity for stock-planned buildings?
6. The cost of stock plans would have to be borne by the State or assumed by the school district through the purchase of plans. New York spent $700,000 on 9 sets of plans and only one set has been purchased in sufficient quantities for bidding. The architect charged 5½% for his services in connection with redrawing 40 pages of this standard plan.
7. Stock planning freezes design and makes no provision for adapting plan to its surroundings.

8. Stock plans dictate educational programs by interfering with the freedom of a district to accept or to develop new educational procedures.
9. Stock planning precludes the incorporation of new construction materials unless those plans are under a constant state of revision--hence no stock plan.
10. Local building codes vary to the extent it would be difficult to conform in many locations without significant revisions.
11. Stimulation of design and use of materials would be lost by use of stock plans and stock specifications.
12. Stock plans would tend to over-design starter buildings by incorporating larger core facilities than needed.
13. Stock plans could increase the use of change orders and thereby increase costs over an individually planned building.
14. Stock planning cannot eliminate the preliminary planning by which a district determines its needs, philosophy and future enrollment.
15. Bureau sponsored designing is counter to the philosophy of private enterprise. It is undemocratic and in direct competition with private enterprise.
16. Bureau costs are continuous, whereas private architects costs are based on a particular job. Bureau designs may be more expensive.
17. Elimination of competition for design and use of materials eliminates impetus for better quality and more economy.
18. State departments are not staffed or otherwise prepared to develop and administer stock plans. California found that a much larger staff was required.

19. Where available, stock plans are not being used.

20. In a survey of states, of the 45 reporting, not one state recommended stock plans to other states.

21. In a bureau-designed plan that is revised by an architect, who assumes final responsibility, the state or the project architect?

EDMONDS AND EPHRATA EXPERIMENT
Junior High Schools

In 1959 Senate Bill No. 392 (a Modifiable Plan Bill) was defeated on the Senate floor by a close vote. In compliance with the spirit of this bill the State Board of Education in a regular meeting authorized:

> "The Director of School Plant Facilities to establish a controlled stock plans experimental program with a school district or districts for one junior high school project and one elementary school project; in addition to state funds allotted to the school district or districts under the statutory formula, an amount not to exceed 8 per cent of construction costs be allotted for additional costs involved; and an architectural board of review be appointed by the Director to validate the planning and procedures of the stock plans experiment."

The first project involved two junior high schools, one in Ephrata and another in Edmonds, that were to be constructed from the same basic plan with the necessary modifications to meet.

(a) Differences in climatic condition

(b) Differences in seismological condition

(c) Differences in school enrollment

(d) Differences in curricula

(e) Differences in directional orientation of buildings

(f) Differences in school building sites

(g) Differences in codes

A report of the results of this experiment was published by the State Board of Education in January 1963 under the title, "A Summary of an Experi-

ment Using a Modifiable School Plan." The following summary from that report breifly states the problems and results.

Conclusions of the Story

The purpose of this research experiment in the use of modifiable school plans was to test how the use of a modifiable school plan, as set forth in the provisions of Senate Bill No. 392, would work in one actual practical application. The findings presented here relate only to the data as evidenced in this experiment.

A. The influence of the use of the modifiable school plan relative to economies:

Basic Design "A" duplicated the Ephrata design except for changes to provide for differences in code and ordinance requirements, and for changes to provide for the larger enrollment at Edmonds. However, the Board of Review, hearing a report on a detailed cost analysis study of Basic Design "A" by Architect Dietz, agreed that Basic Design "A" could not be built in Edmonds within the State ceiling costs and consequently directed Mr. Dietz to modify the design in order to effect economies.

Basic Design "B" was a modification of Basic Design "A" consisting of redesign of certain structural and mechanical and electrical systems to effect the necessary economies.

Both Basic Designs were bid. "A" would have cost $116,050.00 more than "B".

The architectural services for the redesign work on "A"

and "B" amounted to $15,213.85 more than the amount of architectural services computed at 6%.

B. The influence of the factors specified in Senate Bill No. 392:

1. Climatic Conditions

a. Temperature Factor

Milder weather in Edmonds than in Ephrata necessitated extensive redesign of the mechanical system in order to provide only what was needed and to reduce costs of construction.

b. Rainfall Factor

The increase in the average volume of rainfall from .75 inches per month in Ephrata to 4.5 inches per month in Edmonds caused conditions which could not be handled by limited modifications to the Ephrata plans. The necessary plan changes to provide an adequate drainage system for the Edmonds school increased design and construction costs.

c. Sun, Glare, Wind and Dust Factors

Differences in conditions resulting from sun, glare, wind and dust were not considered to be great enough to cause changes to be made to the original plans.

2. Enrollment Factor

The Edmonds school was required to accommodate a larger enrollment than the Ephrata school. To provide facilities to house additional students meant increasing the number of classrooms and enlarging the central service units; the

gymnasium, cafeteria, library, etc. The additional facilities and redesign to provide enlarged spaces resulted in increased costs in design and in construction.

3. Curriculum Factor

   The changes resulting from differences in curriculums were not major factors causing redesign of the original plans in this study.

4. Directional Orientation of School Building Factor

   The directional orientation of the buildings in Edmonds did not constitute cause for redesign of the original plans in this study.

5. Differences in Terrain of School Building Sites Factor

   Differences in the site conditions, including terrain, between the sites at Ephrata and the one at Edmonds constituted major problems in the use of the original plans for Edmonds. The necessary changes to adjust the Ephrata plans to the site increased the costs of design and construction.

C. The influence of major factors which emerged during the progress of the study and not specified in Senate Bill No. 392:

   1. Earthquake Resistance Factor

      Transferring the Ephrata plans from Earthquake Zone 2 to Earthquake Zone 3 at Edmonds resulted in major redesign to produce the increased structural strength necessary to meet the seismic forces requirement at Edmonds. Earthquake resistance was a major factor in the redesign of the Ephrata plans.

2. Codes and Ordinances Factors

   The upgrading of state regulations relating to fire, health, and sanitation minimal requirements resulted in considerable changes to the original Ephrata documents. Those changes increased the design and construction costs of the second school.

3. School District Requirement Factors

   Extensive modification of the original plans to implement the requirements of the Edmonds district was an important factor in this study.

EDMONDS MODIFIABLE STOCK PLAN EXPERIMENT

The second portion of the study involved an elementary school that was constructed in the Edmonds District and repeated on two additional sites. It is the purpose of this portion of the report to summarize that experiment. Since these buildings were constructed in one school district, most of the variable factors reported in the first experiment were eliminated. The construction was masonry with thin-shell, inverted Paraboloid roofs.

Adaptation to the last two sites required a complete inversion of one plan and a relocation of units on the other with additional architectural services.

Problems encountered were:

1. Shape of site: required change in location
2. Ingress and egress: inversion of plan
3. Countours of site: extra land grading
4. Subsoil conditions: extra footings over an old creek bed
5. Bid advantage: the successful original bidder had metal forms made up for roof structure
6. Changes: the plan did not permit free exercise of administrative wishes (acoustics)
7. Costs: higher on second and third buildings

GENERAL DESCRIPTION OF MODIFIABLE PLAN

The plan used in this particular study was single story with concrete roof and floor. The walls were comprised of stucco and steel studs, pumice block and concrete. Building capacity was 600 pupils (K-6). The plan was made up of 3 units housing twenty rooms; one administrative unit containing a library, faculty room, office, and storage; and a fifth unit containing a double multi-purpose room with divider curtain and raised platform.

The roofing specification for the plan called for concrete thin-shell hyperbolic and inverted paraboloids. All windows were aluminum sash. Sky lights provided secondary neutral lighting. Drapes and shades were specified for the windows.

The interior finish included the following:

1. Classrooms. The walls were plaster board and cedar with flat paint. Ceilings were finished with acoustical tile. All millwork was finished with enamel paint.
2. Entries. The walls were finished with V.G. fir and stain. The ceilings were finished with acoustical plaster. All millwork was finished with enamel paint.
3. Toilet rooms. Ceramic tile was used for the walls. The ceilings were furred plaster board with enamel paint.
4. Library. The walls were plaster board with flat paint. Acoustical plaster with enamel paint was the finish used for the ceiling.
5. Multi-purpose rooms. The pumice block walls were finished with enamel. Acoustical plaster and applied acoustical panels were used to finish the ceiling.

The floor covering used in the general classrooms, corridors, library, and multipurpose room was vinyl asbestos tile. Ceramic tile was specified as the floor covering for the general toilet rooms.

The acoustical treatment for all classrooms and library ceilings was acoustical plaster. Acoustical plaster was used for the multi-purpose area and platform ceilings. Applied acoustical panels were used for the multi-purpose walls.

The scope of heating and ventilating mechanical systems was central hot water-oil fired boiler supplying hot water to heat and vent units in each building. Heating and ventilating units supplied rooms with mixed fresh and returned air. Rooms were individually controlled by face and poss dampers. Heating piping was distributed in pipe tunnels under floors and over-head in covered walkways. The heating system used was automatic firing, and the fuel used was PS-300 oil. The heating system contained no provision for expansion. The ventilating system provided an exhaust in the kitchen and toilet rooms. A supply and exhause were provided in the multi-purpose room.

Sewage disposal was handled through city sewers although when the plan was first completed at the Cedar Valley Elementary School it was necessary to install a septic tank and drain fields as sewer service was not available at the time. Culverts and drywells were used for the disposal of rain water. The local Alderwood Water District served as the source of water supply. Hydrants and extinguishers were provided for fire protection. The Western Uniform Code was followed in the plumbing system. No provision for expansion was provided.

The electrical systems included under ground service. The type of race-way was rigid conduit and electrical metallic tubing. A circuit breaker was located in the boiler room as the main point of distribution. A pro-

vision for expansion was provided in the electrical systems. The lighting system used in the classrooms, offices, and library was flourescent with indirect fixtures. The type used were incandescent with direct fixtures.

The modifiable plan used in this study was a "Class A" type building. An outside door from each classroom, a fire alarm system, and fire extinguishers in strategic locations provided for fire patrol for pupil safety.

DISTRICT REQUIREMENTS AND CODES

The modifiable plan used in this study complied with the Uniform Building Code and the local code requirements for the cities of Lynnwood and Edmonds, Washington.

The three plans included many requirements which were typical of all elementary schools in the Edmonds, Washington, school district. Some of those requirements are included below.

The typical elementary school in the Edmonds School District houses twenty classrooms with ten designed as primary classrooms, and ten as intermediate. Each classroom contains approximately 961 square feet. Classrooms are clustered around a foyer area which is used for food service and other activities. The specifications for cabinet work within the classroom include:

1. A teacher cabinet with two legal file drawers and adjustable shelves
2. A student wardrobe
3. Sink, supply, and paper storage cabinets

One of the newer district standards is for a double-sized multi-purpose room. The extra station is in lieu of outdoor play sheds. The multi-purpose room includes two basketball courts divided by a folding partition. A raised platform with built-in risers and chair storage room are other standard features.

The library in each elementary school serves as the center of instruction for the building.

some of the basic features found in the typical elementary school library are:

1. The main reading room which includes a display cabinet with book drop, a library check-out desk, both a portable and a stationary magazine cabinet, and approximately 88 lineal feet of adjustable library shelving approximately 5' in height.
2. Two conference rooms just off the main reading room. The conference rooms are separated by the folding partition which may be opened to form one large conference room, providing greater flexibility.
3. An audio-visual storage room located near the library operation to promote better usage of audio-visual equipment and materials.
4. A room for administering the district testing program, etc.
5. Easy access to the textbook storage room.

Other standard features within the administrative area include:

1. The principal's office
2. Office reception area
3. The office workroom and storage
4. The health room
5. The teachers' room.

CLIMATE FACTORS OF THE EDMONDS SCHOOL DISTRICT

Local climate and earthquake factor influence building design and specifications. The report by the State Board of Education, in January of 1963, involving an experiment in the use of a modifiable school plan for junior high school in the Edmonds, Washington, School District, included climate and earthquake statistics for the general Everett area. The statistics in the report were derived from a climatological summary prepared by the U. S. Department of Commerce weather bureau in cooperation with the Everett Chamber of Commerce for the period from 1926 to 1958. Climate data included in the report which was pertinent to this study were:

1. Temperature data. The daily minimum temperature for January in the Everett area was reported as 32.0, and the daily maximum in the area was 42.2. The daily minimum for September was reported as 48.4, and the daily maximum as 67.5. The experienced low was recorded in 1950 at 01.0.

2. Rainfall data. The rainfall data as reported, showed a mean rainfall over a thirty-year period of 34.5 inches for the Everett area. The greatest monthly rainfall as reported occurred in the months of November, December, and January with an avarage amount of 4.50 inches. The mean for snowfall and sleet in the Everett area was 10.6 inches.

3. Sun, glare, wind, and dust factors. This was reported as being a significant factor in the Everett area due to the amount of rainfall.

4. Earthquake resistance data. The report indicated that the Edmonds School District is located in earthquake zone 3. It was indicated in the report, that to meet earthquake factors, twelve-inch sheer walls were required.[1/]

1/ State Board of Education, "A Summary of an Experiment Using a Modifiable School Plan." (Experimental Research, State Board of Education, Olympia, Washington, 1963), pp. 13-22.

SITE DEVELOPMENT

The site descriptions for the schools used in this study are recorded in Snohomish County, Washington. Cedar Valley is recorded as tract 2, volume 8, page 26. Meadowdale Elementary is recorded as tract 109, Meadowdale Beach, Vol. 5, page 38. Chase Lake Elementary School is recorded in volumes 10, 14, and 18, pages 6, 90, and 39. The sites for the modifiable plan were comparable in size. Overall site dimensions for Cedar Valley were 619.88 feet on the north, 618.59 feet on the south, 602.65 feet on the east, and 602.87 feet on the west. The Meadowdale site dimensions were 667.38 feet on the north, 678.55 feet on the south, 645.36 feet on the east, and 592.60 feet west. Both the Cedar Valley and Meadowdale sites were rectangular in shape. The Chase Lake site was irregular and roughly "L" shaped. The overall dimensions of this site were approximately 580 feet by 600 feet.

While the general relief within the sites was comparable, access for ingress and egress up to the buildings, effected the directional orientation and location of the units of the plan. Relief within the Cedar Valley site was approximately 35 feet generally sloping toward the northeast corner of the property. The southern area of the site was wooded. The Meadowdale site generally sloped from the north and west toward the south and east. Relief within the site was approximately 20 feet. The north and west boundaries of the Meadowdale property were wooded. Relief within the Chase Lake site was approximately 10 feet and generally more level than Cedar Valley and Meadowdale. Growth and obstructions on or near the Chase Lake site included several small homes and a small grove of evergreens.

Utilities and access roads to the sites were quite comparable. Electrical service was available to all three sites through Snohomish County Public

Utility District No. 1. Water service was available through the Alderwood Water District. Washington Natural Gas Service was available to both the Cedar Valley and Chase Lake sites. Sewer service was not available to Cedar Valley at the time of construction, making it necessary to install septic tanks and drain fields. Sewer service did become available to the Cedar Valley School at a later date, however, and the conversion was then made. Meadowdale Elementary School was able to obtain sewer service through the Lynnwood sewer district, as was Cedar Valley. The city of Edmonds sewer district was available to the Chase Lake site. Telephone service was available to all three locations through the West Coast Telephone Company. Roads surfaced with asphalt were available to all three sites. The access road to Cedar Valley Elementary School was 52nd Avenue West. The south and west boundaries of the Meadowdale site were bordered by 68th Street S.W. and 66th Avenue West. Access to the Chase Lake Elementary School was gained from 84th Avenue West on the west boundary of the school site.

Extensive soil studies were not made on the Cedar Valley and Meadowdale sites. The consulting firm of Neil H. Twelker and Associates was contracted to make a study of the soil conditions on the Chase Lake site. The soil report revealed that a small stream had formerly traversed the site from north to south near the east margin of the property. Drainage from the site had been blocked by the construction of roads and homes. Various soil units were found on the site. These units consisted of (1) a thin layer of one to three feet of heavy silt overlay. (2) A dense compact glacial till extending to unknown depths. (3) Artificial fills along the east margin of the property. These fills were not within the actual construction area, however. The report indicated that glacial till was considered to be non-water bearing. Twelker and Associates recommended that (1) all structures could be founded at a shallow

depth within the glacial till unit; (2) that footings should not have widths of less than 14 inches. It was also recommended that site preparation begin with the restoration of the surface drainage to the entire site. Grading of the site was to take place in the pebbly silt and in the upper layers of the glacial till, since these materials may be readily compacted under favorable weather. The report stated that there were no foreseen difficulties in placing the building foundations on undisturbed glacial till.2/

2/ Twelker, Neil H. and Associates, Consulting Soils Engineers, Soil Report, March 13, 1964.

DIRECTIONAL ORIENTATION OF BUILDINGS ON THE SITE

It was impossible to orient the three buildings on the sites in the same manner, because access and the area within the site best suited for construction varied considerably.

The illustrations shown on the accompanying prints will help to better visualize the directional orientation of the three buildings on the site. The five units of the plan used in this study, are labeled A, B, C, D, and E for identification purposes. Unit "A" contained eight classrooms. Unit "B" contained four classrooms; two primary and two intermediate. Unit "C" contained eight classrooms. The administrative unit containing the office, library, health center, and storage, is identified as unit "D". Unit "E" contained the multi-purpose room and kitchen.

Access to the Cedar Valley School was gained from 52nd Avenue West, which borders the west side of the school site. Print 1 shows the relationship of the five units to one another on the Cedar Valley site. Entrance is gained from west toward the southeast. Unit "E" is toward the northwest as one enters the site. Unit "D" is to the immediate east of unit "E". The intermediate unit, which is unit "A" is located on the north. Unit "C", primary unit, is located directly south of unit "A". Unit "B" is located between units "A" and "C" toward the east.

Entrance to the Meadowdale Elementary School is gained from the southwest corner of the site on access road 68th Street Southwest, and 66th Avenue West. (See figure 2) As one enters the Meadowdale site from the south, unit "E" is located immediately east with the entrance facing west. Unit "D" is directly north of unit "E". Unit "A" is located on the west of the site with the length of the unit being north and south. Unit "C", the intermediate

unit, is located toward the north forming an "L" with unit "A". Unit "B" is located to the east of unit "A", and between units "C" and "D".

Figure 3 shows access to the Chase Lake from the west on 84th Avenue West. The multi-purpose room, unit "E", is located directly east with the entrance to the building facing west. Unit "D" is located to the immediate south of unit "E". The intermediate unit, unit "A", is located east of unit "D" with the length of the building being north and south. Unit "C" is parallel and west of unit "A". Unit "B" lies between units "A" and "C" to the south.

DIFFERENCES IN REDESIGN OF THE PLAN

The site was the key in relocation of units of the plan used in this study. Two factors related to site which were most influential in the relocation were (1) ingress and egress, and (2) elevation of contours.

Figure 1 shows the original relationship of units A, B, C, D, and E to one another as established on the original plan for Cedar Valley Elementary School. Unit E, the multi-purpose room, was reverse on the Meadowdale plan and on the opposite side of the driveway with respect to the Cedar Valley plan. Unit D on the Meadowdale plan is in a similar relationship to unit E on the same plan, as are units D and E on the Cedar Valley plan. The primary unit, C, and the intermediate unit, A, are parallel and opposite one another on the basic Cedar Valley plan, whereas units A and C are at right angles to each other on the Meadowdale plan. Unit B on the Cedar Valley plan lies between units A and C, and toward the east. Unit B on the Meadowdale plan is parallel to unit A, and to the south of unit C. The basic difference in arrangement of units between the Cedar Valley plan and the Chase Lake plan is the distance

of the units from one another. The general arrangement of the units on the Cedar Valley and Chase Lake plans was similar.

The elevation of contours on the three sites created the need for ramps to gain access from one unit to another. Figure 4 shows the finish ground elevation for each unit of the three plans, and illustrates how the differences in elevation changed the requirements for ramps at each school.

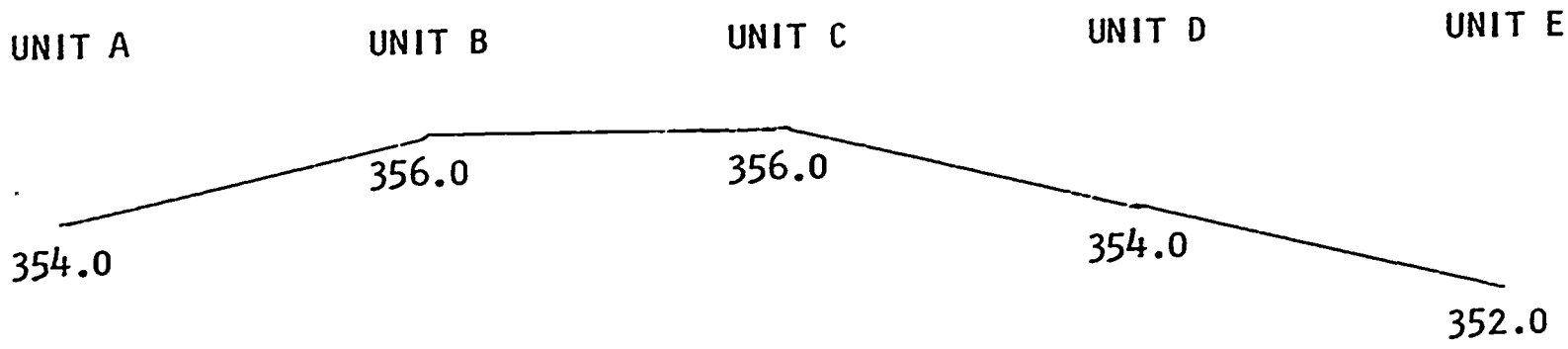
The total square footage at each school was (1) Cedar Valley - 38,337 square feet, (2) Meadowdale - 38,083 square feet, (3) Chase Lake - 38,385 square feet. A comparison of the square footage for each of the three schools would imply that change in the plan had taken place. The differences in square footage are accounted for by state regulations which recognize walk ways as being part of the basic building. The relocation of the plan units on the site was particularly important in maintaining specified square footage because as the distance between units increased, the area of covered walkway increased. Site contours complicated the placement of units to meet square footage requirements, since greater elevation differences between units necessitated longer walkways to lessen the incline.

Where site topography decreased the distance between units, square footage was reduced. Although the closeness of units to one another helped to reduce the square footage, it created the need to relocate windows for lighting purposes.

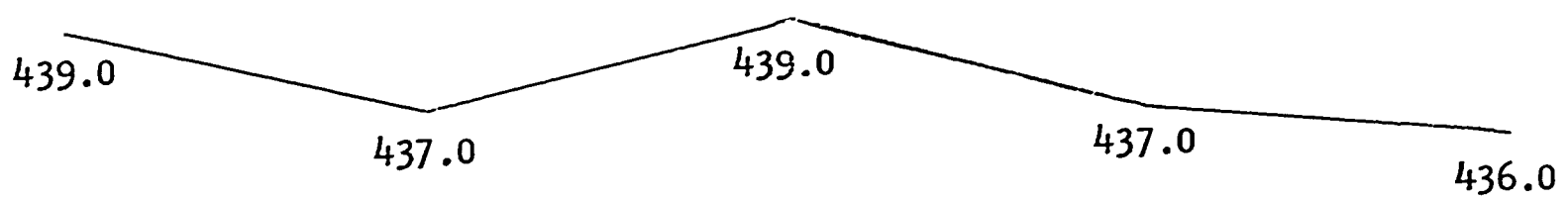
Figure 4

COMPARATIVE FIGURES REPRESENTING THE
ELEVATIONS OF THE FIVE UNITS IN
EACH OF THE THREE PLANS IN
THIS STUDY

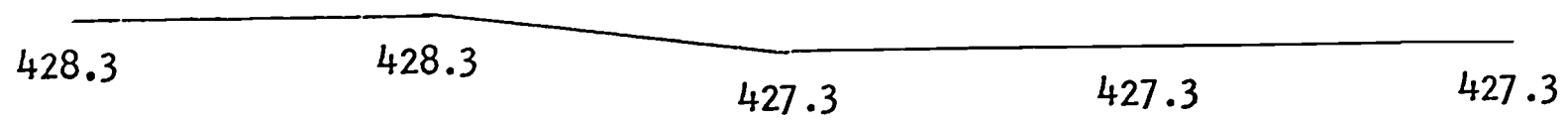
CEDAR VALLEY ELEMENTARY



MEADOWDALE ELEMENTARY



CHASE LAKE ELEMENTARY



ACOUSTICAL CHANGES IN THE BASIC PLAN

An acoustical problem became apparent upon completion of the Cedar Valley Elementary School. To help correct this problem, the firm of Robin M. Towne and Associates, Consultants in Acoustics, was employed to investigate the problem.

The basic problem in the typical classroom was the shape of the room and the placement of acoustical materials. The center portion of the acoustical plaster on the concrete ceiling was not providing sufficient sound absorption for adequate noise control. The paint of acoustical plaster in several rooms helped to further reduce its effectiveness. To correct the problem, it was recommended that slightly less than 200 square feet of 9/16th cellulose fiber acoustical tile with a fissured surface be placed above 7 feet on three wall surfaces. It was also recommended that perforated hard board panel 4 feet high and 12 feet wide be placed on the available wall space opposite the inside door 2 feet 6 inches above the floor. In order to quiet the area and cut down cross-interference between rooms, it was recommended that both acoustical tile and perforated hard board panels be installed in the entrance halls to the classrooms.

The acoustical problem in the library was found again to be the shape of the room, and the placement of acoustical materials. As in the classroom, the acoustical plaster of the concrete ceiling was not providing sufficient sound absorption for adequate noise control. Paint on the acoustical plaster helped reduce its effectiveness. To correct the problem, Towne and Associates recommended that acoustical tile be installed in the same manner as recommended for the classrooms. It was pointed out the quantity of materials used was not critical, but that installation should be on two walls which did not have

glass above 7 feet. To correct the problem of cross-talk between the library and the two smaller conference rooms, it was recommended that (1) a solid-core door be used with acoustical seals at the top, side, and bottom, (2) that a special double glazed relight be used, and (3) to use heavier construction below the relight.

The acoustical problem in the multi-purpose room was that (1) the acoustical plaster ceiling had considerably less sound absorption than was required, and (2) that no sound absorption on the hard opposite and parallel side walls was possible. It was suggested that the problem could be corrected by installing perforated hard-board panels 4 feet wide by 12 feet high with the bottom of the panels 2 feet 6 inches off the floor in 8 bays of the south wall. It was also suggested that half-sized panels 4 feet wide by 6 feet high with the bottom of the panels above the doors in each of two bays on the south wall. Full size perforated hard-board panels were recommended in 6 bays of the north wall. Half sized panels were also recommended in each of two bays on the north wall. A further recommendation was to extend the horizontal wood slot treatment on the rear wall to within 6 inches of the floor. The glass fiber board was to be covered with wire screening below about 5 feet.

In order to correct the acoustical problem on the raised platform it was recommended that (1) six type "c" panels be installed two feet above the floor with a one-foot separation between panels on the south wall, (2) that ten type "c" panels be placed on the east wall in a similar manner to the south wall, (3) that a better seal be put on the stage folding door. It was also suggested that no louvers be installed on one door.3/

3/ Robin M. Towne and Associates, Consultants in Acoustics, 120 West Harrison Seattle, Acoustical Recommendations for Cedar Valley El. School, Study and Report, May 1, 1963

ANALYSIS OF BID DATA

The bid data used in this chapter were obtained from state forms B-8, Robert A. Bezzo and Associates, Architects, and the files of the Edmonds School District No. 15. Material is presented in this chapter in two general parts. The first part gives a comparison of costs for the Cedar Valley, Meadowdale, and Chase Lake projects. The second part gives a bid summary for each individual project.

Cost Analysis of Contracts

Table I shows a comparison of the General, Mechanical, and Electrical contracts for the three projects used in this study. The General Contract was $352,639.00 at Cedar Valley School, $376,590.00 at Meadowdale Elementary School, and $379,725.00 at Chase Lake Elementary School. The Mechanical Contracts including sanitary sewage contracts for each of the three schools in the same order were: (1) $116,093.00, (2) $121,845.10, and (3) $131,212.00. Electrical Contracts were (1) $44,895.00 at Cedar Valley, (2) $46,513.00 at Meadowdale, and (3) $49,560.00 at Chase Lake. Sanitary Sewerage Facilities Contracts at the time of construction were $6,820.10 at Meadowdale, and $2,944.00 at Chase Lake. A Sanitary Sewerage Facility was not installed at the Cedar Valley Elementary School at the time of construction, since service was not available at the time. The costs figures presented for Cedar Valley include a septic tank and drain field. A conversion to the Lynnwood City Sewers was later made. The costs of the conversion were not included above, since this phase of the project would not be significant to this study.

Cost Analysis of Projects

This paragraph relates the total costs of the three projects as presented in Table II. The total of all contracts for Cedar Valley Elementary School,

Meadowdale Elementary School and Chase Lake Elementary School were (1) $513,627.00, (2) $544,948.10, and (3) $560,497.00 respectively. A six per cent architect's fee totaling $30,817.62 was assessed on the Cedar Valley project. Since the same plan was modified and re-used for the Meadowdale and Chase Lake Elementary Schools, the architect's fee was reduced from six per cent to four and a half per cent for both schools. The architect's fee was $24,522.66 at Meadowdale, and $25,222.37 at Chase Lake. Project costs also included state sales tax which was four per cent. State sales tax for each of the three schools in order was (1) $20,545.08, (2) $21,797.92, and (3) $22,419.88. The grand total for the Cedar Valley project was $564,989.70, not including equipment. The project costs for Meadowdale Elementary School, not including equipment, $591,268.68. The Chase Lake project cost $608,139.25, not including equipment.

TABLE I.

Cost Analysis of Contracts

	Item	Cedar Valley	Meadowdale	Chase Lake
I.	General Contract	$352,639.00	$376,590.00	$379,725.00
II.	Mechanical Contract	116,093.00	121,845.10	131,212.00
III.	Electrical Contract	44,895.00	46,513.00	49,560.00
	Table of Contracts	513,627.00	544,948.10	560,497.00

TABLE II.

Cost Analysis of Projects

Item		Cedar Valley		Meadowdale		Chase Lake
Total Cost Contracts		$513,627.00		$544,948.10		$560,497.00
Architects Fee	6%-	30,817.62	4½%-	24,522.66	4½%-	25,222.37
State Sales Tax	4%-	20,545.08	4%-	21,797.92	4%-	22,419.88
GRAND TOTAL		564,989.70		591,268.68		608,139.25

COST ANALYSIS OF GENERAL CONTRACT

The basic bids awarded on the general contract for Cedar Valley, Meadowdale, and Chase Lake, not including alternates were $351,750.00, $358,000.00, and $364,000.00. A comparison of the alternates on the general contract for each of the three schools are shown on Table III. The first alternate shown on Table III is for a built-up roof and synthetic flash. This alternate was a deductive on the Cedar Valley project and represented $9,105.00. The same item was included in the basic for Meadowdale and Chase Lake.

Alternate #2 which called for light weight concrete and insulation was included at Cedar Valley without charge. This alternate was included in the basic at both Meadowdale and Chase Lake. Alternate #6 which called for vinyl asbestos tile was an additive of $4,042.00 at Cedar Valley, and was included in the basic at both Meadowdale and Chase Lake. Acoustical treatment as provided at Cedar Valley was included in the basic at Meadowdale and Chase Lake. This was additive alternate #15 at Cedar Valley at $1,020.00, and provided only partial acoustical treatment. Complete acoustical treatment as recommended in the study was included in the basic of Meadowdale and Chase Lake. The alternate for draperies and blinds was an additive for each of the three schools. This additive was $2,032.00 at Cedar Valley, $2,800.00 at Meadowdale, and $2,990.00 at Chase Lake. Additive alternate #22 for $2,900.00 for painting of the soffits and columns was accepted at Cedar Valley Elementary School. This item was included in the basic at Meadowdale and Chase Lake Elementary Schools. An additive alternate #8 which called for marblecrete finish on the multi-purpose room was $3,720.00 at Meadowdale, and $3,700.00 at Chase Lake. The basic at Cedar Valley included concrete tilt-up walls without marblecrete. Additive

alternate #10 for accordian-type folding door for library conference room was accepted at Meadowdale and Chase Lake for $280.00 and $310.00 respectively. The same door was provided in the basic at Cedar Valley. The school sign at Cedar Valley Elementary was not provided. The sign for Meadowdale and Chase Lake was provided in additive alternate #12 for $650.00 and $605.00. Chalk and tack board was included in the basic at Cedar Valley and Chase Lake. Son-Nel chalk and tackboard were provided at Meadowdale Elementary for $700.00 on deductive #13. Additive #16 at Meadowdale Elementary for kitchen equipment was accepted at $1,990.00. Earth work beyond 30 feet of the building was included in the basic at Cedar Valley since the change in state matching had not taken place at the time. It was included at Meadowdale on additive #1-7 for $3,550.00.

Additive alternate #1 for Chase Lake Elementary School was $5,450.00. Parking area surfacing was included in the basic at Cedar Valley. It was picked up at Meadowdale on additive #2 for $2,500.00, and for Chase Lake at $3,350.00. Alternate #3 for the asphalt paving for play courts was included at Meadowdale for $2,850.00. It was not included in the general contract at Cedar Valley, was later provided on a separate contract for $2,175.00. Asphalt paving of play courts was not provided at Chase Lake Elementary School. Basketball back stops were not provided at Cedar Valley and Chase Lake Elementary Schools, but were purchased later on separate contracts. Additive alternate #14 for basketball back stops was accepted at Meadowdale Elementary School for $950.00. The alternate calling for concrete benches and gravel were included in the basic at Cedar Valley and Meadowdale Elementary Schools. This item was deductive alternate #17 at Chase Lake and represented $680.00. The total cost of the general contract for each school including additive and

deductive alternates was (1) $352,639.00 at Cedar Valley, (2) $376,590.00 at Meadowdale and (3) $379,725.00 at Chase Lake.

TABLE III.

Cost Analysis

General Contract

Item	Cedar Valley	Meadowdale	Chase Lake
I. Basic bid	$351,750.00	$358,000.00	$364,000.00
II. Alternates			
Built-up roof & synthetic flash	deductive #1 9,105.00	Included Basic	Included basic
Light-weight conc. & insul.	Additive #2 no charge	Included Basic	Included basic
V.A. tile	Additive #6 4,042.00	Included Basic	Included basic
Acoustical treatment	*Additive #15 1,020.00	Complete as recommended in acoustical study	Complete as recommended in acoustical study
M.P. room	(center portion only)	Included in basic (represented 5,820.00)	Included in basic (represented 3,620.00)
Draperies & Blinds	Additive #17 2,032.00	Additive #11 2,800.00	Additive #11 2,990.00
Paint soffits & columns	Additive #22 2,900.00	Included Basic	Included Basic
Marblecrete finish on multi purpose room	*Not provided	Additive #8 3,720.00	Additive #8 3,700.00
Accordian-type folding door library conference rooms	Included Basic	Additive #10 280.00	Additive #10 310.00
School sign	Not provided	Additive #12 650.00	Additive #12 605.00

Item	Cedar Valley	Meadowdale	Chase Lake
Son-Nel chalk & tackboard	Included Basic	Deductive #13 700.00	Included Basic
Kitchen equip.	*Not provided	Additive #16 1,990.00	*Not provided
Earth work beyond 30 ft.	Included Basic	Additives #1&7 3,550.00	Additive #1 5,450.00
Parking Area surfacing (crushed rock)	Included Basic	Additive #2 2,500.00	Additive #2 3,350.00
Asphalt paving-play courts	*Not provided	Additive #3 2,850.00	*Not provided
Basketball backstops	*Not provided	Additive #14 950.00	*Not provided
Concrete benches & gravel	*Not provided	Included Basic	Deductive #17 680.00
III. Total cost - general contract only	352,639.00	376,590,00	379,725.00

* Not included under state ceiling

COST ANALYSIS OF MECHANICAL CONTRACT

Table IV shows the basic bids and alternates for the Mechanical Contracts at Cedar Valley, Meadowdale, and Chase Lake Elementary Schools. The basic bid not including alternates was $96,735.00 at Cedar Valley, $94,825.00 at Meadowdale, and $106,338.00 at Chase Lake. Additive alternate #1 for water service and fire protection was accepted at $7,255.00 for Cedar Valley, $6,700.00 at Meadowdale, and $5,990.00 at Chase Lake, Additive #2 for a water main extension was accepted at Cedar Valley, Additive alternate #2 for septic tank and drain fields was accepted at the Cedar Valley Elementary School for $4,052.00 since sewerage facilities were not available. This alternate was not needed for the other two schools, since hook-up to the Edmonds and Lynnwood City sewers was possible at the time of construction. Sanitary sewage facilities contracts were $6,820.10 at Meadowdale and $2,944.00 at Chase Lake. Additive alternate #3 for storm drainage was accepted at Cedar Valley for $7,930.00. This alternate cost $11,500.00, and $16.690.00 at Meadowdale and Chase Lake Elementary Schools. A garbage disposal was provided at Cedar Valley Elementary School for $517.00 on additive #4. Garbage disposals were included in the basic at Meadowdale and Chase Lake. Water closets were provided in the basic at Meadowdale and Chase Lake Elementary Schools, and were included on deductive alternate #5 for $456.00 at Cedar Valley Elementary School. Temperature control was provided in the basic at Cedar Valley and Meadowdale Elementary Schools, and in deductive alternate #4 for $750.00 at Chase Lake Elementary School. The total cost on the mechanical contracts including sanitary sewage facilities were: (1) $116,093.00 at Cedar Valley, (2) $121,845.10 at Meadowdale Elementary School, and (3) $131,212.00 at Chase Lake Elementary School.

TABLE IV.

Mechanical Contract

Cost Analysis

	Item	Cedar Valley	Meadowdale	Chase Lake
I.	Basic Bid	$ 96,735.00	$ 94,825.00	$106,338.00
II.	Alternates			
	Water service & Fire Protection	Additive #1 7,255.00	Additive #1 6,700.00	Additive #1 5,990.00
	Water Main Extension.	Included #1	2,000.00	Included #1
	Septic Tank & drain field (or) Sanitary Sewage Facilities	Additive Septic tank 4,052.00	#2 Sewer 6,820.10	Sewer 2,944.00
	Storm drainage	Additive #3 7,930.00	Additive #3 11,500.00	Additive #2 16,690.00
	Garbage disposal	Additive #4 517.00	Included Basic	Included Basic
	Water closets	Deduct #5 456.00	Included Basic	Included Basic
	Temperature control	Included Basic	Included Basic	Deduct #4 750.00
III.	Total cost mechanical contract	$116,093.00	$121,845.10	$131,212.00

COST ANALYSIS OF ELECTRICAL CONTRACT

The basic electrical bids for Cedar Valley, Meadowdale and Chase Lake Elementary Schools were (1) $44,895.00, (2) $44,788.00, and (3) $47,975.00. Items concerning the electrical contract for the elementary schools in this study and the alternates are shown on Table V. The alternate for signal distribution augmented for the intercom was not accepted as an alternate on the electrical contract for Cedar Valley Elementary School, but was later provided at a cost of $388.00. The same alternate for Meadowdale Elementary School cost $510.00. The cost at Chase Lake Elementary School for this additive was $432.00. The additive alternate for T.V. conduit and outlets cost $750.00 at Meadowdale, and $757.00 at Chase Lake. This item was not provided at Cedar Valley Elementary School. Substitute alternate for an electronic clock system was accepted for $88.00 at Meadowdale School on additive alternate #5. This item was included in the basic contract at Cedar Valley and Chase Lake, but was not of the same specification. The alternate for multi-purpose electric sound system was not provided at Cedar Valley. It was provided at Meadowdale and Chase Lake on additives #1 for $377.00 and $306.00. The total cost including alternates for the electrical contract at Cedar Valley, Meadowdale, and Chase Lake Elementary Schools were (1) $44,895.00, (2) $46,513.00, and (3) $49,560.00.

TABLE V.

Cost Analysis

Electrical Contract

Item	Cedar Valley	Meadowdale	Chase Lake
I. Basic bid	$ 44,895.00	$ 44,788.00	$ 47,975.00
II. Alternates			
Signal distribution augmented for intercom	*Not provided	Additive #3 510.00	Additive #2 432.00
TV conduit & outlets	*Not provided	Additive #4 750.00	Additive #3 757.00
Substitute electronic clock system	Included basic	Additive #5 88.00	Included Basic (Not same specification)
Multi-purpose electric sound system	*Not provided	Additive #1 377.00	Additive #1 396.00
III. Total cost electrical contract only	$ 44,895.00	$ 46,513.00	$ 49,560.00

* Not included under state ceiling

INDIVIDUAL PROJECT BID DIFFERENCES

This section of chapter IV gives a comparison of the bid differences for each project for the General, Mechanical, and Electrical contracts. Of the three contracts, only one construction company was successful bidder on more than one project. The following paragraph identifies the bids for the first and second low bidders for the General, Mechanical, and Electrical contracts for each of the three schools used in this study. The bidders in each case are identified as contractor "A", "B", etc.

General Contracts

Construction company "A" was the successful bidder for the General contract at Cedar Valley Elementary School with a bid of $352,639.00 including alternates. The difference between the successful bidder "A" and the next low bid was $33,641.00. Seven other contractors submitted bids for the General Contract at Cedar Valley. The basic bids of the seven, not including alternates ranged from $390,000.00 to $400,000,00. The basic bids submitted by the "A" and "B" construction companies were $351,750.00 and $384,347.00 respectively.

Construction Company "A" was again successful bidder for the General Contract at Meadowdale Elementary School, with a basic bid of $358,000.00 and a total bid including alternates of $376,590.00. Construction Company "C" was the second low bidder with a basic bid of $367,000.00, and a total bid with alternates of $380,100.00. The difference between low and second low bids was $3,510.00. Nine other companies participated in the bidding and the basic bids not including alternates ranged from $367,500.00 to $422,900.00

The General Contract at Chase Lake Elementary School was also awarded to Construction Company "A" with a basic low bid of $364,000.00 and a total

including alternates of $379,725.00. Construction Company "D" was second low bid at a basic bid of $365,348.00, and a total bid including alternates of $381,503.00. The difference between the low and second low bids was $1,778.00. Only three other bidders participated in the bidding. The basic bids only for the three bidders ranged from $374,900.00 to $377,600.00. Construction Company "A" had somewhat of an advantage in bidding the Meadowdale and Chase Lake projects, since the metal forms originally fabricated by this company for the Cedar Valley project were re-usable.

MECHANICAL CONTRACTS

Mechanical Contractor "E" was awarded the Mechanical Contract for the Cedar Valley Elementary School with a basic bid of $96,735.00, and a total bid including alternates of $116,093.00. The next low bid was submitted by Contractor "H" with a basic bid of $97,379.00, and a total bid including alternates of $119,165.00. A difference of $3,072.00 occurred between the two bids. A range of basic bids by four other contractors was $99,813.00 to $109,971.00.

Construction Company "F" was awarded the Mechanical Contract for Meadowdale Elementary School with a basic bid of $94,825.00 and a total bid of $115,025.00 including alternates. The second low bidder was Contractor "E" with a basic bid of $101,000.000, and a total bid including alternates of $115,050.00. The difference between the accepted low bid, and the next low bid was $1,025.00. These figures do not include a $6,820.10 Special Sewage Facilities Contract which was awarded to another contractor. Seven other bidders participated in the bidding with basic bids ranging from $101,200.00 to $110,294.00.

The Mechanical Contract for Chase Lake Elementary School was awarded to Contractor "G" with a basic bid of $106,338.00, and a total bid including alternates of $128,268.00. The second low bidder, Company "F", submitted a basic bid of $111,790.00, and a total bid with alternates of $134,565.00. A difference of $6,297.00 separated the two bidders. These figures do not include a $2,944.00 Special Sewage Facilities Contract which was awarded to another contractor. Five other bidders participated, with basic bids ranging from $111,400.00 to $120,460.00.

ELECTRICAL CONTRACTS

Contractor "I" was successful bidder for the Cedar Valley contract, with a bid of $44,897.00. Contractor "L" submitted the second low bid of $49,700.00. No alternates were accepted on the electrical contract at Cedar Valley. The difference between the two low bidders was $4,803.00. One other company participated in the bidding with a basic bid of $50,987.00.

Contractor "J" was awarded the electrical contract at Meadowdale with a basic bid of $44,788.00, and a total bid including alternates of $46,513.00. Company "M" was next low bid with a basic bid of $48,144.00. The total bid including alternates was $49,433.00. A difference of $2,920.00.separated the two bidders. Three other bids submitted ranged from basic bids of $50,022.00 to $55,830.00.

The successful bidder for the Electrical Contract for Chase Lake Elementary School was Contractor "K" with a basic bid of $47,975.00, and a total bid including alternates of $49,560. Contractor "J" was second low bid with a basic bid of $48,990.00 and a total including alternates of $50,477.00. A difference of $917.00 separated the two bidders. Three other bids were submitted, and ranged from basic bids of $49,955.00 to $51,333.00.

The bids for Cedar Valley were awarded November 6, 1961. The Meadowdale bids were awarded October 21, 1964, and the Chase Lake bids were awarded May 4, 1964. The square footage for each of the schools was 38,337 square feet at Cedar Valley, 38,083 at Meadowdale, and 38,385 at Chase Lake, The differnce in square footage among the three schools is a result of a change in the method of evaluating square footage by the State Board of Education. The placement of the units largely accounted for the differences in square footage as walkways were included as part of the building area. The buildings

in this study were constructed under State Ceiling. The State Ceiling was $14.75 at the time Cedar Valley Elementary was constructed. The actual square foot cost for the Cedar Valley project was $14.74 per square foot. The State Ceiling for Meadowdale Elementary was $15.60, and the square foot cost for the project was $15.53. State Ceiling at the time of the Chase Lake project was $15.85 per square foot. The actual square foot cost for Chase Lake was $15.84. The difference in State Ceiling for each of the projects accounted for inflation factors.

The overall financial savings on the Meadowdale Project based on State Ceiling was an $8,869.03 savings in architectural fees, and $3,616.97 in construction costs. The total savings at Meadowdale based on Cedar Valley was $12,486.00. The Meadowdale Project also included $4,800.00 more in acoustical treatment, but this figure was included in the basic bid.

Alternates provided at Meadowdale and not at Cedar Valley included marblecrete walls for the multi-purpose room, the school sign, kitchen equipment, asphalt play courts, basketball back stops, concrete benches, signal distribution, T.V. conduit, and an electric sound system in the multi-purpose room. Alternates totaling $6,570.00 not provided at Cedar Valley were included under State Ceiling for Chase Lake. The alternates included in the figure included marblecrete for the multipurpose room, the school sign, concrete benches, a signal distribution, T. V. conduit, and electrical sound system for the multi-purpose room.

Change orders of various types amounting to approximately one thousand plus dollars per project were made during the course of construction. The change-order costs are not given in this study, nor are they included in the cost figures.

CONCLUSIONS

The following conclusions were drawn concerning the modifiable plans used for the construction of three elementary schools in the Edmonds, Washington School District.

1. There was some evidence that a cost savings did occur by a repeated use of the Cedar Valley plan for the Meadowdale and Chase Lake schools. It appeared, however, that the savings was in the area of architectural services only, which allowed $8,800.63 more in alternates to be taken under State ceiling at Meadowdale, and $4,017.91 at Chase Lake. It is difficult to determine whether this savings is legitimate since data were not available to show whether a new design for each site would have represented a more substantial savings, or whether the savings in architectural services might have caused stereotype buildings, poor orientation, inflexibility, repeated errors, and change orders for missing items such as the location of switches.
2. It would appear that excluding architectural fees, actual construction costs were not reduced through the repeated use of one plan, since the amount of $3,616.97 saved in construction costs for Meadowdale was probably offset by the playground development which had taken place before construction had started, and the evidence available showing that construction costs were $2,552.09 more for Chase Lake than Cedar Valley.
3. The modifiable plan approach appears to be necessary over a true stock plan approach where site conditions vary, causing problems in orientation of the building to the site. Good school sites in a growing community are becoming more and more difficult to obtain, and it

follows that the orientation problem of adapting a stock plan to the site would also become a greater problem because of less adequate sites. Since the cost of site development varies greatly from building to building, it appears doubtful that architectural savings would offset the cost of adapting standard plans to site of the over-all picture. The value and need of standard plans is questionable when modifications are necessary to make them function.

4. There is question as to whether a stock plan insures better bid prices. The low bids for the second project would tend to indicate that contractors were looking toward the third project. The high bids for the third and final project would tend to indicate that the contractors found it either necessary to increase prices because of their experience, or that there was no incentive for another similar project in the future. The best bids on the modifiable plan used occurred for the Cedar Valley and Meadowdale schools in the months of October and November, which was probably the time of year when contractors were competing to obtain business.

   The Chase Lake project was bid in May, and produced higher bids than the two earlier schools. It would appear that business was not as competitive as during the spring season. The winning contractor had a bid advantage for the second and third projects, as he was able to use the hyperbolic paraboloid steel forms which had been constructed for the first school.

5. The possibility of salvaging desirable natural landscaping, and the problem of orientating the school building harmoniously with the surrounding area is somewhat limited when using standard plan. Standard

plans appear to restrict optimum use of the school site for landscaping.

6. A refinement of workmanship was apparent on the second school because of the contractor's familiarity with the plan of the project.

7. Perhaps two to three months planning time might be gained by using standard plans according to the experience in this study. The Edmonds School District did not realize any actual gain, however, because of the financial uncertainty which delayed the bidding and start of the second and third project. The number of modifications necessary to adapt a standard plan to a site would also have an effect on the saving of time.

8. Based on this study, it would appear that a stock plan or modifiable plan should be one which is highly flexible in terms of future educational demand, be simple in design, and be able to utilize materials which are common to construction and are readily available. Unless a standard plan were highly flexible in terms of design and materials, some contractors and manufacturers might not be interested in bidding. The particular plan used in this study lacked some of the qualities of flexibility which pose a problem in planning, and could also present a problem for future changes in education. No evidence of high costs or poor bid coverage through the standardization of materials was found in this study.

9. A plan made up of multiple building appears to be better for repeated construction than a single unit plan, as it would probably require less cost in adapting it to fit the site through the elimination of excess earth work.

10. It would appear that the use of a modifiable or stock plan would be

increasingly more difficult to use on the junior and senior high levels because of the size and complexibility of the buildings. It would also follow that if stock plans or modifiable plans were used at the state level, many sets of plans would have to be designed to suit geographic areas or locations, building size, ard building type.

11. It would appear that stock or modifiable plans encouraged from the state level could force a community to construct facilities which are not needed. It would also appear that state plans might not include facilities required in a given community, and tend to dictate curriculum. It would seem likely that standard plans developed within a school district would be more practical than those developed at the state level in terms of curriculum needs, etc.

12. It would appear that if standard (stock) plans were adopted at the state level, periodic review and revisions would be necessary to keep pace with educational and construction progress.

13. It is assumed that the buildings constructed from the stock plan in this study were satisfactory as they were accepted by the Edmonds School Board and were functioning in a satisfactory manner.

14. After examining related literature, and the data available in this study, it is difficult to provide a simple answer as to whether stock plans or modifiable plans are good or bad, because of the many variables. It appears doubtful, based on the stock plans experiences in other states, and looking toward probable educational changes in the future, that the stock plan approach is practical in terms of cost or utility, except for small schools of simple design.

A STUDY OF THE USE OF A MODIFIABLE SCHOOL DESIGN

AUBURN, WASHINGTON

An attempt to determine the advisability of reusing an elementary school design was made by the Auburn School District by adapting the plans for the Pioneer Elementary School to the Lea Hill School.

The Pioneer School was constructed in 1958 and involved 38,871 square feet of floor space. It contained 20 classrooms, multipurpose room, two covered play areas, library, office, kitchen, health unit, teachers' room, four workrooms, heating plant, storage areas, seven toilet rooms and classroom toilet facilities. The square foot ceiling applicable at that time was $13.85 and the final cost was $12.67 on eligible square footage.

The Lea Hill School was constructed in 1964 and involved 38,457 square feet of floor space. It contained 20 classrooms, multipurpose unit, two covered play courts, library, office unit, kitchen, health unit, teachers' room, workroom, heating plant, storage areas and seven toilet rooms. The square foot ceiling cost applicable for the project was $16.20 and the final cost, as estimated by the architect, was $16.04 per square foot.

The following analysis by the architects, Don Allison and Associates, summarizes the changes made in the development of the Lea Hill School and the conclusions reached as a result of this study.

SUMMARY OF CHANGES - Pioneer to Lea Hill Elementary School

1. DESIGN

The floor plans were redesigned to improve the arrangement of rooms.

(a) The kitchen was relocated so that food carts could be taken to the classrooms without going through the multipurpose room.

(b) Toilet rooms serving the multipurpose room were relocated so that they could be entered from the play field. (The toilet rooms on the original scheme were so remote that they were seldom used.)

(c) The Health room was redesigned so that students could line up and enter on one side of the room and leave through an outside door. (This should prevent a lot of the "scare" which is conveyed to those who are still waiting in line.)

(d) The Library was redesigned to eliminate cross traffic and to reduce the amount of window area. (Book shelves are more necessary than the "attention distracting" windows.)

(e) Covered play areas for the smaller children were increased in size.

(f) The plans were separated into two "Phases" in order to receive bids for only 14 classrooms OR all 20 classrooms, This involved a complicated change in all of the drawings and specifications.

2. SITE AND ORIENTATION

(a) The topography of the site had a large part in determining the location of the building. If we could have used a different "scheme", the buildings could have been separated and stepped-down to conform to the sloping site. This may have saved several thousands of dollars in site grading and filling. The design was not compatable with the site.

(b) Larger parking areas were required because this school was to be built in a rural area where there are no developed streets with curbside parking.

(c) Bicycle racks were deleted to discourage children from riding their bikes on the undeveloped country roads.

(d) Storm drainage, domestic water supply, sewage disposal and power facilities required individual attention due to the site. A standard design cannot suit more than one site.

(e) The original plan had to be "turned over" in order to get the building to fit the site. Also, the orientation of the building was better this way and the parking and service areas were placed where they did not interfere with the play grounds. This necessitated a complete redrawing of all the plans.

3. LATEST MATERIALS AND METHODS

To take practical advantage of the most recent developments in materials and methods of construction, many items were changed.

(a) Aluminum windows were used instead of steel, the cost now being about the same. (The original school had steel windows at a savings of about $1200 over aluminum.)

(b) Vinyl-Asbestos floor tiles were used instead of asphalt tile, which will reduce maintenance costs.

(c) Cabinets were completely redesigned to conform to the latest available standard items.

4. MISCELLANEOUS ITEMS

(a) Kitchen was completely redesigned to improve the workability. Equipment was brought up to date with the newest ideas.

(b) An electrolysis prevention system was specified to eliminate some of the heating problems that were encountered on the original design.

(c) The lighting system was changed from incandescent to fluorescent, to save maintenance and operating costs.

5. BUILDING CODES

(a) Incinerator was changed to a Retort type to comply with newest "Anti-smog" codes.

(b) Automatic dampers were placed on door louvers, and wire glass placed under some of the skylights, to comply with new state and county codes.

6. SPECIFICATIONS

(a) Format was completely rewritten to bring it up to date with the new standards of the construction industry.

(b) Revised the legal sections of the specifications to incorporate newest State and Federal Laws: i.e.: Indiscrimination clause; latest wage rates.

(c) Revised specifications and bidding documents to allow for Alternates and Deduct Bids to suit the project scope.

(d) Each section of the Technical Specifications was completely rewritten. Some items were deleted, others added, and nearly everything was changed in some manner.

7. COST ANALYSIS

	Sq. Ft. Cost	Allowed	Difference
(1958) Original building cost	$12.88	$13.88	$1.00
(1964) Repeated building cost	16.04	16.24	.20

The savings were not so great on the second use of the scheme.

8. ARCHITECTURAL AND ENGINEERING COSTS

The Architect has attempted to produce this plant at the lowest possible cost to the school district. The services of the Architect were divided into 3 main phases:

1. Preliminary Phase
2. Working Drawing Phase
3. Supervision Phase

The Architect agreed to perform his services on Phase 2 (working drawings and specifications) on an hourly basis, passing whatever savings there might be to the school district. The Preliminary and Supervision Phases were performed on the customary fee basis as the amount of services required for these parts of the work were not necessarily changed.

Because a complete redrafting of all the drawings and specifications was required, the actual savings to the school district amounted to approximately $150.00 on the total services value of $33,000.

9. CONCLUSIONS

The Architect believes that it is impractical to reuse a design. Although at first it appears that a savings can be had on the Architect's fees, the actual savings is so small that it is not justifiable.

The school district did not receive the very best in arrangement, design and aesthetics because of the limitations set in the original scheme.

NEW YORK EXPERIMENT WITH STOCK PLANS

In 1960 the New York Legislature appropriated $1,000,000 to develop a series of standard plans and make them available to the school districts of New York. To date, nearly $700,000 has been spent on 9 plans. In only one case have enough plans been purchased by a district and put out to bid. In all other cases only one set of the plan was purchased by a district. This indicates that they were purchased for review purposes, and, as one district stated, to put the pressure on the architects. It was the opinion of the respondent from New York that some of the plans that were purchased have been turned over to the architects.

The district that purchased enough plans to go to bid required 40 sheets to take care of the alterations and additions that the district wished to make to the standard plans. The bids were about $25,000 over the architect's estimate.

The architect charged this district 5½% for his services in connection with the standard plans. It is evident that the district might have paid the architect his usual 6% and had a plan developed as they wished and that was adapted to their particular site.

In another instance a district was interested in using one of the plans. The site the district purchased was so irregular that two different architects found it impossible to adapt the building to their site. Then they insisted that the auditorium and gymnasium be enlarged. Due to the design of the building, enlarging these two units meant lengthening the four sides of the unit containing them. This created numberous problems. As a result, the district was forced to give up the idea.

The state architect and his staff strongly emphasized that if a district could not use the standard plans as they were, that it would be much better if no attempt were made to use the standard. plans.

WHY STOCK PLANS HAVE FAILED IN PRACTICE

By Charles D. Gibson, Chief
Bureau of School Planning
California State Department of Education
December, 1963

In terms of the simple mechanics of providing building area in different locations, composite local, State and national experience indicates that stock plans are impractical and overly-costly for the following reasons:

1. Physical site conditions vary at every school site. Every building plan must take into consideration existing soil conditions for foundation bearing values, drainage of ground around buildings and over playground area, and orientation of building for proper daylight conditions to eliminate glare.
2. Separate foundation plans would have to be prepared, with special footings and foundation walls to fit soil bearing values of the particular site and the contours both existing and final grades. This work requires the services of a qualified structural engineer because the foundations of a building are an integral part of its earthquake resistance.
3. Separate electrical engineering and plans are required to provide for the electrical loads within the buildings. The number of rooms and their uses affect the total electrical load, metering and distribution of electrical circuits within a building.
4. Separate heating plans must be furnished for each school to provide for the climatic conditions of the area in which the building is located. The orientation of the building on the site also affects the design of the heating system. Temperatures vary throughout the State from very hot to mild and extreme cold.

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5. Separate plumbing plans are required for each site condition. The relation between the floor level of a building and that of the sanitary sewer connection varies with each site in order to provide required slope from plumbing fixtures to sewer connections. In many areas, sanitary sewer systems are not available.

6. Separate drainage plans are necessary for each school plant because of the physical conditions of the site on which the building is to be constructed. Access roads, traffic controls, walks and paved areas are therefore affected, which require separate drawings.

7. Separate contract documents would have to be prepared for each school building project. These documents are necessary to provide a complete description of the construction contract so that contractors may submit a firm lump sum competitive bid for each school project. These documents cover all conditions of the particular building which, in addition to the specific plans, consist of:

   Specifications - describing materials and workmanship.

   Instruction to Bidders - describing all bidding conditions.

   Bid Forms - so that all contractors' bids cover the same items of work.

   Construction Contract and Surety Bonds between School District and Owner.

8. Stock plans for school buildings do not eliminate private architectural and engineering services. All building plans must be signed by an architect or structural engineer employed by the school district. All buildin plans must be adapted to each specific site condition. Architectural and engineering inspections must be maintained throughout the

construction of each building project. The architect is responsible for the over-all administration of the total construction project. He verifies that the building has been constructed according to the officially approved plans and specifications. The architect signs a certificate of project completion.

9. All the above-listed architectural services, of course, must be paid for directly by the school district. In addition to the district's architectural fee, the State would charge a fee for the developing and processing of stock plans. The total planning cost when using stock plans, then, would be the sum of the cost incurred by the governmental agency plus the fee charged by the project architect. This sum could easily come within a per cent or two of the same fee charged for custom design.

10. Most constructive building design improvements result from experimentation with new building materials or construction techniques. The changes resulting from such experimentation develop gradually and usually on a small scale. Such currently commonly accepted school building design features as wide structural spans; multi-use of space; quality systems of daylighting and electric lighting; adequate thermal, sonic and aesthetic environments evolved gradually from the efforts of many people and interests to improve educational space. This space improvement has resulted in better value for the school building dollar.

11. The development of new materials and new processes is going on constantly in all phases of the construction industry. A limited survey of such developments in the school building field was made to determine where significant changes in materials and processes had occurred during the

past ten years. The following pages represent only a partial summary of these changes. There are enough, however, to indicate conclusively that unless a set of stock plans was kept in a near constant state of revision, the user could build a 1954 model school and pay 1964 prices for it. If the continuing revisions were made, there could be no such thing as a stock plan. If the revisions were not made, the stock plan would represent the poorest value on the building market.

Development of Construction Materials and Processes Over a Ten-Year Period

New materials and new processes have been developed within the past ten years which have improved school construction through economy, appearance and total environment.

Listed below in outline form are some of the more prominent developments divided into the four major divisions: architectural, structural, mechanical and electrical.

ITEM	1950	1960
ARCHITECTURAL		
Aluminum sash	Available but expensive	Increased competitive production has brought price down in line with steel sash
Acoustic tile	Available in limited pattern	Wider choice of patterns
Low-transmission glass	Not in production	In competitive production
Plastic wall covering	Not available	In competitive production

ITEM	1950	1960
Packaged metal doors and frames	Not in competitive production as complete unit	In competitive production: aluminum and steel
Curtain wall panels	Available but not fully developed	In competitive production
Vinyl floor coverings	Not in production	In competitive production
Prefabricated cabinets	Limited production	Generally competitive
Plastic Skydomes	Not available	Competes favorably with glass skylights
Epoxyresins*	Not developed	Used but still expensive
Aluminum coating for roofs	Not developed	Widely accepted
Glass blocks	Widely used	Largely abandoned in favor of other materials
Fireproof Sheetrock	Available, but not tested in fireproofing	Now tested & extensively used for 1-hour conditions
Acrylic paints	Not developed	Widely accepted
STRUCTURAL		
Engineered fill for foundations*	Not developed	In general use
Tilt-up concrete walls	Not fully developed	Economical in large repetitive areas
Pre-stressed concrete*	Not fully developed	Plants in operation for mass production
Concrete Block	Limited in shapes	Wide variety of shapes, color and texture
Plywood roof and wall sheathing	Limited usage because of cost, and not fully tested and reported	In wide use, and more economical than S.D.S.
High-strength steel bolts*	Development stage	Bolted field connections used in lieu of rivets
Steel deck	Used for vertical loads only	Used as horizontal diaphragms to resist seismic load

ITEM	1950	1960
STRUCTURAL (continued)		
Laminated wood beams and bents	Limited usage	In competitive production
Laminated fiber roof decks	Not developed	Developed with seismic values
MECHANICAL		
Heat pump	Not developed	Available & competitive
Airfloor heating	Too new for wide acceptance	Wide usage
Glass lined water heaters	Not developed	Now the preferred type
Asbestos-cement pipe	Limited usage	Widely accepted and economical
Plastic pipe	Not fully developed	Economical lawn sprinkler installations
Wall-type water coolers*	Not developed	Practical and attractive models now available
High velocity duct System	Not developed	Widely accepted
Electronic temperature & humidity controls	Not developed	Now the preferred type
Steam absorption chillers	Development stage	Highly efficient where steam is available
Gas-fired unit ventilator*	Not approved by A.G.A.	Now has A.G.A. approval
Package heating-cooling units*	Not developed	In general use
ELECTRICAL		
Service voltage choices*	120/208 volt service not available 480/277 volt service not available	Available and widely used

ITEM	1950	1960
ELECTRICAL (continued)		
"Quiet" toggle switches	Not available	Available and widely used
Grounded receptacles*	Not available	Now required by Code
Fluorescent fixtures	Available but poor design	Quality of illumination vastly improved. Greater choice of current and voltage lamps.
Clock, intercom and P. A. systems*	Separate installations	Now combined into a single system of wiring
Provision for future air conditioning	Seldom considered	Many schools now planned for future air conditioning
Television	Development stage	Closed circuit and direct broadcast systems used in greater numbers
Electronic clock system	Not developed	In competitive production
Motor operated folding bleachers*	Not developed	In competitive production

NOTE: Items marked with an asterisk (*) have been developed and put into use.

NEW MATERIALS AND PROCESSES - 1960-1962
SUPPLEMENT TO 1950-60 ANALYSIS

Although only a two-year period has elapsed since the 1960 report, a number of new products have been developed which will undoubtedly have an influence on future school design in California. The following items should prove of unusual interest. A number are in the area of fire rated materials.

(a) Several companies are now marketing acoustical tile which has a four-hour fire rating when used properly as a component part of furred

ceiling assemblies. This product eliminates the requirement for a backing material such as plaster or gypsum board to obtain fire protection. Although not on the market in 1960, it is already being used extensively.

(b) Paint is now available to protect steel to give it a one-hour fire protection. The principle of these paints is unique in that under high temperatures they expand to about 3/4" thickness and protect by creating their own air foam insulation. Although not in wide use now, they will undoubtedly see extensive service because they offer the lowest cost, lightest weight protection now available for steel structural members.

(c) Fire retardant solutions for impregnating lumbers and plywood are now receiving wide acceptance for buildings which require noncombustible materials.

(d) Very recently pre-stressed concrete structural members of standard shapes have received Underwriter's fire rating approval. Although not yet produced in California, these structural sections are in use on a few major projects in the East and reports indicate important economies over pre-stressed sections that are not fire rated but which must be fire protected. Their use may be applicable for multi-story construction.

(e) The continued search for the means to obtain space flexibility in schools has resulted in the wide use of foiding interior walls at very competitive costs. Walls are now available which permit complete flexibility of space division. These are the panel wall systems held in place only by friction.

(f) Stresses skin structural members are now available which permit long span beams for much less weight than the present commonly used glu-lam beams. This is made possible by the recently accepted values of 75% of normal value in design for scarfed plywood joints. Plywood is generally used for the skins.

This engineering principle of stressed skin components will undoubtedly achieve very wide acceptance in the next few years because of its high efficiency. Fireproofing remains a problem.

(g) Glazed concrete blocks which combine the advantages of a structural masonry unit with a glazed surfacing to eliminate the need for a ceramic tile surface in such areas as showers and kitchens has been available for about twelve years. Now tough 1/8" thick polyester resin glazing surfaces have been tested thoroughly and these units are widely available at competitive costs.

(h) Progress is being made in the area of chemical resistant non-porous floors. In the past the epoxy floor toppings over concrete has been generally unsatisfactory because of appearance. Few applicators can do quality work. Recently, however, it has been demonstrated on a few major State buildings that the addition of marble or granite aggregates to the epoxy resin surface gives good results. This is known as epoxy terrazzo and produces a thin (about $\frac{1}{4}$") attractive floor finish with the highly desirable properties of the silica epoxy toppings. At present the high cost is restricting the use of this highly promising floor surface.

(i) Several major companies are producing nylon tile for schools, which is relatively low in cost (although higher than conventional vinyl tile) and very durable. It is generally recognized that nylon fibre tile offers high resiliency and is more attractive than other floor materials. More important in a school, however, is the fact that they aid materially in the reduction of unwanted sound which is created by furniture and children's feet. This type of flooring also is a good sound absorber, and permits the reduction or elimination of acoustical tile on the ceilings. Even more important is the money

saved in maintenance. Nylon tile is usually only vacuumed periodically, while tile floors must be continuously washed and waxed. Manufacturers claim that reduced maintenance costs more than offset the increased initial expense within a relatively short period.

(j) The most remarkable development to date in product design with major implications for school construction is the School Constructions Systems Development Project (S.C.S.D.) being carried out as a joint activity of the School Planning Laboratory of the Stanford University School of Education and the Department of Architecture of the University of California at Berkeley under a grant from the Educational Facilities Laboratories, Inc., of the Ford Foundation.

The basic premise upon which S.C.S.D. project is based, is that a higher degree of coordination is necessary in the design of building components, and that industry should be encouraged to design products which are compatible with one another, and preferably be multi-functional. Twenty-one schools will utilize S.C.S.D. components and will generate a floor area not less than 1,400,000 square feet. The schools will be designed individually by architects and consulting engineers selected by each of twelve school districts ranging geographically from Sacramento to Los Angeles.

Criteria for the component categories which have been developed from educational needs include: (1) long-span structures, (2) varied movability of partitions, (3) full environmental control with adaptability to changing plan configurations, and (4) an efficient,,attractive, low-brightness lighting system which adapts to changing plan configurations. S.C.S.D. prepared detailed performance specifications. Manufacturers have responded enthusiastically to the project. A number of companies have developed

completely new products and in many cases have formed joint ventures in order to submit bids on compatible components.

On December 3, 1963, lump-sum bids from manufacturers were opened at Stanford University. Within thirty days, the Commission will select the lowest bods which meet specification standards. The bids for the structural systems, heating and ventilating systems, lighting systems and interior wall systems are now public and the best bids are from two to five per cent under the cost estimates projected by the Commission. Evidence indicates that the venture is highly successful since the first intent is not to reduce the cost of schools but to achieve higher performance standards within our present State-aid cost allowances.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education
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REPORT ON DEVISING STANDARD PLANS FOR ELEMENTARY AND SECONDARY SCHOOL BUILDINGS

by
William W. Chase

The possibility of using stock or standard plans drawn for elementary and secondary school buildings has been discussed at various times and in a majority of the States. Reports from many of these States are unanimous in expressing the opinion that, after considered study, the use of such plans by individual districts is neither practical nor economical.

Experience has shown that, even though a set of standard plans were available, there are many local conditions which must be met. The terrain varies widely in the several regions of each of the States; consequently, it would entail increased costs to construct a standard building on anything but an absolutely level site. Site alteration and changes in standard plan foundations can be made to accommodate differing sites but only at costs which would offset the economy of stock building use.

Local building codes, trade practices, and use of school buildings vary widely. Climate is also a factor. Although this means little to the layman, to the school builder it means wide variation in heating contract work which, in turn, means added costs if plans are not drafted to accommodate local conditions. Parts of a building which face north require more heat than do other parts. In some areas, it is more economical to burn coal; in others, gas, and in others, oil. Standard plans cannot accommodate these differences.

Some building sites have easy access to water, sewers, rain, water disposal, and electricity or gas. Others must depend on septic disposal, bring electricity from a distance, install transformers or drill wells. In one area it may be more economical to use steel frame structures; in others, reinforced concrete. Approach drives, parking, sidewalks and grading, all vary with every project. For all of these reasons, cost of revisions that have to be made to adapt standardized plans to local conditions offset any savings they create. Changes in construction methods, materials and educational practice come so rapidly in this modern age that such plans soon become obsolete and have to be revised before they can be of any real use.

To achieve maximum economy in the planning and designing of a school construction project, it must take place as a result of firm decision by the local board of education as a part of a previously formulated, long-range, district-wide school plant program. The decision regarding a specific project, moreover, must be made with due regard for the time needed to carry out the essential steps of educational program planning and building design in accordance with the planning and actual construction of the building. Thus, the concept of uniformity in building plans, as implied by standard designs, would deny new and experimental work in educational program planning, methods of teaching and learning and the use of electronic and other teaching aids.

In reference to architects' fees and services; the charges will vary according to the locality, the size, and the type of project. For normal services such as those involved in a school construction project, the fees agreed upon are usually based on a percentage of the cost of the project. The services of an architect usually extend from the point at which educational specifications are given to him to the acceptance of the finished building by

·:e owners. This includes interpreting the educational specifications, ·:,igning the building, preparation of preliminary, final, and shop drawings ·-d specifications (which include interpretation of various State and local building codes), supervision of construction, and certification to the board :.at the plans and specifications have been executed correctly and completely.

Before the architect can start development of even the most preliminary sketches, he must understand thoroughly the purposes and requirements of the proposed structure. He must know the client's needs, budget and other factors which will affect the final design. Consideration should be given, not only to present needs, but also to future expansion in terms of site utilization, orientation and topography. These factors are related although subordinate to the main consideration which is the designing of a proper environment for learning--spatially adequate, architecturally significant, and economically feasible.

The architect must necessarily call upon the resources of others: the engineers--structural, mechanical, electrical, acoustical and civil--the landscape architect, and many special consultants. Except in a few unusual cases, the architect pays for these services out of his own fee. He coordinates all of these activities and generally protects the interests of the board of education.

It is axiomatic that those who plan a school building will influence extensively the type and the cost of the educational program to be accommodated in that building. Although public education has long been accepted as a function of the individual States, local school districts have been given much of the responsibility for providing and managing its educational program. Among the responsibilities are the planning of physical facilities as well as the

financing program needed for them. If the local board of education utilizes standard plans devised by an outside agency for a particular building project, it must be aware of potential prob'ems or shortcoming arising from local needs and desires.