Public School Building Costs

General Assembly of the Commonwealth of Pennsylvania

JOINT STATE GOVERNMENT COMMISSION

Harrisburg, Pennsylvania

1970

The Joint State Government Commission was created by Act of 1937, July 1, P. L. 2460, as amended, as a continuing agency for the development of facts and recommendations on all phases of government for the use of the General Assembly.

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1969-1971

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LETTER OF TRANSMITTAL

To the Members of the General Assembly of the Commonwealth of Pennsylvania:

In accordance with the directive contained in House Resolution No. 106, Session of 1967, there is submitted herewith a report on public school building costs in Pennsylvania.

The Joint State Government Commission acknowledges the assistance and cooperation of numerous architects, building specialists, public and parochial school administrators, and staff members of the Department of Education, all of whom contributed materially to the study. On behalf of the Commission, the contribution of the members of the Task Force on School Taxes and Construction Costs is recognized with appreciation.

FRED J. SHUPNIK, *Chairman*

Joint State Government Commission
Capitol Building
Harrisburg, Pennsylvania
April 1970

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1. The annual dollar volume of public school building projects in Pennsylvania has averaged about $270 million over the past several years. Typically, the Commonwealth pays between 40 and 50 percent of a project's annual financing charges through reimbursement to the school district.

2. In any year, on a per pupil basis, the most costly school building of a given type is likely to be at least twice as expensive as the least costly building. In 1968, out of 21 new elementary buildings, four cost less than $1,500 per pupil and one cost more than $3,000 per pupil; and out of 21 secondary buildings, two cost less than $2,700 per pupil and two cost more than $5,500 per pupil. The least expensive as well as the most expensive of these buildings conformed to the minimum standards established by the State Board of Education and had plans and specifications approved by the Department of Education.

3. As a method of reducing school building costs, standardized architectural plans have been recommended in many states, tried in a few, and succeeded in none. In contrast, standardization through the *systems approach* to the design and construction of school buildings has succeeded in producing quality schools at cost savings ranging from 10 to 25 percent over conventional methods. This technique involves the development, on the basis of educational and performance standards, of integrated component systems (structure, ceiling—lighting, electric—electronic, etc.) designed and manufactured especially for schools. Component systems permit interior flexibility without restricting exterior design. For the systems approach to achieve measurable economies of design and production a sufficient volume of school construction —perhaps $30 million or more over a period of several years—is required.

   Recommendations:

   (a) *It is recommended that the Commonwealth embark upon a program encouraging utilization of component systems in the design and construction of a substantial portion of annual public school construction.*

   (b) *As an initial step in the direction of encouraging the component systems approach in Pennsylvania, it is recommended that $200,000 or such sum as is found to be necessary be appropriated to the State*

Public School Building Authority to finance the preliminary work (writing of specifications and testing of components) and the coordination of a component systems school construction program consisting of about 15 buildings over a two or three year period. Participation in the program should be open to any school district whether or not its project is to be financed through the authority.

4. The provisions of existing law which require that school building construction be done under separate contracts for lighting systems, plumbing, and heating and ventilating may constitute an impediment to utilization of certain types of component systems.

   Recommendation:
   It is recommended that Section 751 of the Public School Code of 1949 be amended to permit school building construction under a single contract with the proviso that the contract bid contain the names of the principal subcontractors to be employed on the project.

5. In more than 40 other states, the approval of the electors or property owners must be obtained (sometimes by more than a majority vote) before bond issues for new school buildings may be floated. Despite an occasional voter rejection of the financing of needed school space, educational authorities in states requiring voter approval feel that it is an effective way to keep the public informed of building projects and that the public scrutiny results in more economical school buildings.

   Recommendation:
   It is recommended that the Public School Code of 1949 be amended to require the approval of the electorate before any school district of the second, third or fourth class enters into a contract to construct or lease a new school building or a substantial addition to an existing building. The question as submitted to the electorate should specify the maximum project cost as well as annual financing charges.

6. The general belief that parochial school buildings are constructed at a lower cost than public school buildings appears to be correct. Both the types of educational programs offered and architectural and mechanical design features appear to contribute toward the lower cost of these buildings. Also, there may well be pressures for economy because of the limited resources available for parochial school building financing.

7. The minimum standards for school buildings established by the State Board of Education are too inflexible, have no provisions for variances in unusual situations, are reviewed and revised too infrequently, and in a few instances (e.g., classroom sizes) contain unnecessarily costly requirements. The Advisory Committee on Standards deals with many matters potentially affecting the health of school children yet this committee has no statutory members drawn from the medical profession.

Recommendations:

(a) *It is recommended that the Public School Code of 1949 be amended to provide:*

(i) *That the school building standards of the State Board of Education be reviewed and revised as necessary but at least once every three years rather than every five years as is now required.*

(ii) *That the provisions relating to revision of standards be amended to include a reference to design economies as well as educational adequacy as a guide for the State Board of Education in setting building standards.*

(iii) *That the State Board of Education be required to hold a hearing when requested by a school district on the question of variances from school building standards and be authorized to grant exceptions for individual projects whenever adherence to the standards would work unnecessary hardships.*

(iv) *That the Advisory Committee on Standards contain at least three members of the medical profession and that the Advisory Committee provide a justification for recommended changes in standards in terms of the specific educational or health benefits expected to be gained and the expected increase or decrease in the associated building or maintenance costs.*

(b) *It is recommended that the State Board of Education reduce the minimum recommended classroom size for standard elementary classrooms to a size or selection of sizes (or provide an alternative in terms of space per pupil) that more appropriately reflects the actual utilization of classroom space throughout the commonwealth.*

8. Under existing law, Commonwealth reimbursement for school building construction is based upon the lesser of: the actual cost of the school building, or the product of the rated capacity of the building and the per pupil cost standard ($2,300 for elementary schools and $3,000 for secondary schools). While the term "rated pupil capacity" has remained unchanged in the statute since the

original enactment in 1956, practices of the Department of Education in determining rated capacity have been changed several times with the effect of substantially increasing the rated capacity for schools of a given size. As a result, Commonwealth obligations for subsidies for new school buildings are increased without legislative action.

Recommendation:
It is recommended that the school building reimbursement statutes be amended to preclude administrative changes in reimbursement factors which increase Commonwealth school building subsidy obligations.

9. From a statistical analysis of the per pupil costs of public school buildings constructed during the period 1963–1968 it was found that:
A. The increase in average per pupil building costs over the period far exceeded the rise in construction prices.
B. There are economies of scale in school buildings. Larger buildings tend to cost slightly less on a per pupil basis than smaller buildings.
C. There are small but significant variations in school building costs among several areas of the Commonwealth.
D. Increases in per pupil reimbursement cost standards are strongly associated with higher per pupil expenditures on school buildings.

Recommendation:
It is recommended that no future increases in school building subsidies be enacted without a careful appraisal and realistic projection of the probable effect of increasing building subsidies upon school building construction expenditures and the Commonwealth subsidy obligations generated thereby.

10. "Middle school" buildings which combine certain traditional elementary and secondary grades appear to be more closely related cost-wise to junior high schools than to combination elementary-secondary schools. Programs offered in middle schools and the organizational pattern which includes middle schools are viewed as experimental by the Department of Education.

Recommendation:
Until such time as the department accepts middle schools as part of a permanently recognized grade organization, it is recommended that no consideration be given to changing reimbursement on account of middle school buildings.

11. The administrative procedures of the Department of Education with respect to the approval of school building projects are mainly concerned with assuring conformity with the requirements of the school laws and regulations. The department's responsibilities, in its view, do not extend to advising districts on methods of effecting economies in school construction nor does the department reject designs or propose revisions in building plans that may entail unnecessarily costly features.

Recommendation:

It is recommended that the Department of Education be authorized to employ sufficient staff to effectively perform the following functions:

(a) *Have departmental personnel hold frequent and extensive discussions with local authorities during the stage of project design when final costs become apparent. In all cases, representatives of the school board should be present when final plans are approved and should be made fully aware of any unnecessarily costly designs, materials or specifications.*

(b) *Disseminate among school districts contemplating building projects information concerning products, materials and designs which have proved unreliable, unnecessarily costly or failed to meet manufacturer's specifications.*

(c) *Through a cooperative arrangement with architects or otherwise, encourage the utilization of designs, plans or innovations which have proven unusually successful in reducing space requirements or otherwise effecting economies in construction costs or maintenance expenses.*

(d) *Have the department continue its efforts toward fuller utilization of existing buildings and in cases where future increases in enrollment are not expected, encourage school districts to investigate all possible alternatives to the construction of new facilities. Whenever there appears to be considerable local resistance to the construction of new buildings, the department should encourage the districts to hold public hearings on the matter and assist the local authorities in explaining to the public both the advantages and disadvantages of alternative housing plans.*

12. The law which mandates a time limit within which school construction must start following departmental approval is archaic, serves no useful purpose and may work a hardship in some cases.

Recommendation:

It is recommended that subsection (c) of Section 2577 of the Public School Code of 1949 which mandates a time limit within which construction must be started after project approval is received be repealed.

SECTION I

STATUTORY PROVISIONS RELATING TO SCHOOL BUILDING CONSTRUCTION

Under the school laws of the Commonwealth, each school district must provide ". . . the necessary grounds and suitable school buildings to accommodate all the children between the ages of six and twenty-one . . . who attend school."[1] In large part, the decision as to where to build and what to build rests with the local board of school directors. Commonwealth requirements, whether statutory or regulatory, are designed to insure that school building projects meet minimum standards of health, safety and educational adequacy. While parts of projects deemed unnecessary by the Department of Education (i.e., extra classrooms not justified by realistic enrollment forecasts) will not be approved for reimbursement purposes, the Commonwealth invokes no maximum conditions. School districts are generally free to build schools of any size or cost so long as they have the financial capacity to meet projected capital and operating expenses.

When a local school board has determined the need for a new school building, or an addition or alteration to an existing building, an application is submitted to the Department of Education requesting an inspection of the present building and of the proposed site for the addition or new building. Pursuant to the provisions of the Public School Code of 1949:

> "(c) The Department of Public Instruction shall not approve any project for which Commonwealth reimbursement is sought unless an inspection has been made by the department of the location and adequacy of existing school facilities and the determination made that existing facilities are inadequate in terms of prevailing educational standards."[2]

When the need for a new building or addition has been established, the school board is notified and the department designates a member of its staff to advise and assist the local school officials in the development and preparation of a schedule of space allocations.

All public school buildings constructed in school districts of the second, third or fourth class must meet the following statutory requirements:

[1] Public School Code of 1949, March 10, P. L. 30, § 701, as amended.

[2] Public School Code of 1949, § 2576(c) added 1956, March 22, P. L. (1955) 1315.

1. Approval of the plans and specifications therefor by the Department of Education.[3]
2. Conformity with standards established by the State Board of Education as to light area, floor space and cubical contents. "Such standards shall permit an opportunity for individuality in design and equipment to meet the requirements and possibilities of each public school building to be built or rebuilt."[4]
3. Inclusion in every public school building with 10 classrooms or more of a health room ". . . not less than twenty-one (21) feet in length, and which shall be furnished and equipped for use as quarters in which regular school medical inspections may be given, . . ."[5]
4. Conformity with heating and ventilating standards established by the State Board of Education; the type of heating system used is the choice of the board of school directors.[6]

In addition to the Department of Education, three other State agencies have statutory powers with respect to school buildings. The Secretary of Health is empowered to establish and enforce sanitation standards:

> "The Secretary of Health shall employ sanitarians or request local health authorities to assign a sanitarian to make a careful examination of all privies, water-closets, urinals, cellars, the water-supply and drinking-vessels and utensils and sewage and refuse disposal systems, lighting, heating and ventilating systems, and such additional examinations of the sanitary conditions of the school buildings and grounds as the regulations of the Secretary of Health may require."[7]

The State Art Commission, under the Administrative Code of 1929, has certain duties as to the location and design of school buildings:

> "Subject to any inconsistent provisions in this act contained, the State Art Commission shall have the power, and its duty shall be, to examine and approve or disapprove the design and proposed location of all public monuments, memorials, build-

[3] Ibid. § 731, as amended.
[4] Ibid. § 733.
[5] Ibid.
[6] Ibid. § 734.
[7] Public School Code of 1949, § 1420 added 1957, July 15, P. L. 937, § 2.

ings, or other structures, except in cities of the first or second class, in accordance with the act approved the first day of May, one thousand nine hundred and nineteen (Pamphlet Laws, one hundred three), . . ."[8]

"No construction or erection of any public monument, memorial, building, or other structure, which is to be paid for, either wholly or in part, by appropriation from the State Treasury or from any subdivision of the State, or for which the State or any subdivision is to furnish a site, shall be begun unless the design and proposed location thereof shall have been approved by such commission."[9]

Under the provisions of the Fire and Panic Law,[10] the Department of Labor and Industry has authority to regulate the safety features of all school buildings except buildings in cities of the first and second class. The statute requires that buildings covered by the act shall be:

". . . so constructed, equipped, operated, and maintained, with respect to type of construction and materials used, fireproofing, number and type of ways of egress, aisles and passageways, stairs and fire escapes, wall openings, exits and exit signs, doors and doorways, shaftways and other vertical openings, emergency lighting, automatic sprinkler systems, fire alarm systems, fire drills, electrical equipment, inflammable and explosive materials, heating apparatus and fuel storage, number of occupants, ventilation, arrangement of seating and standing space, construction and equipment of stages, projection rooms, and dressing rooms, and all other fire and panic protection as to provide for the safety and health of all persons employed, accommodated, housed, or assembled therein."[11]

Section 8 of the act provides that:

"It shall be the duty of the owner, architect, or contractor of every building or structure, as described in this act, hereafter erected, adapted, remodeled, or altered, to submit to the Department of Labor and Industry for approval, architectural drawings, specifications, or other data showing compliance

[8] The Administrative Code of 1929, § 2414, as amended 1937, June 21, P. L. 1865, § 1.
[9] 1919, May 1, P. L. 103, § 5.
[10] 1927, April 27, P. L. 465.
[11] Ibid. § 1, as amended.

with the provisions of this act and the rules and regulations of the said department which may be promulgated for the enforcement of the provisions of this act. No such building or structure shall be erected, adapted, remodeled, or altered, until such plans have been examined and approval given by the Department of Labor and Industry, and a building permit obtained in municipalities where such permit is required by ordinance."[12]

One specific provision of the act applies only to school buildings:

"The auditoriums or gymnasiums of schoolhouses, normal schools, academies, and colleges hereafter erected and when used for public assembly shall not be placed above the first floor level nor below the grade level."[13]

To effectuate its regulatory powers under the Fire and Panic Law, the Department of Labor and Industry has issued building regulations which comprise approximately 124 pages. Among the Department of Labor and Industry standards and regulations applicable to school buildings are requirements in the following areas:

1. Height limitations and minimum fire resistance requirements for various types of construction.
2. Minimum exitway requirements and exitway capacities.
3. Maximum number of occupants for various types of occupancy.
4. Fire escapes and fire alarm systems.
5. Design loads and wall thickness for various construction materials.
6. Emergency lighting systems.
7. Special requirements for grandstands and stadiums.

In addition to the above provisions for public school buildings all school building projects for which Commonwealth reimbursement is sought must:

1. Be in conformance with the applicable ". . . county-wide plans prepared by the county board of school directors and approved by the standards of the State Board of Education for the orderly

[12] Ibid. § 8, as amended.
[13] Ibid. § 5, as amended.

development of improved attendance areas and administrative units . . .",[14] and

2. ". . . conform with standards and regulations prescribed by the Department [of Education] with respect to educational and architectural design, building materials, fixtures and equipment, location, usefulness for community activities, safety, comfort and convenience, and that the school district or school districts which incur the indebtedness or to which the project is to be leased will have the ability to meet from current revenues the rental or sinking fund charge or their respective shares of rental or sinking fund charge and to defray the cost of their respective shares of the cost of operation and maintenance of the project."[15]

[14] Public School Code of 1949, § 2576(a) added 1956, March 22, P.L. (1955) 1315, as amended.

[15] Ibid.

SECTION II

METHODS OF FINANCING SCHOOL CONSTRUCTION

Practically all school building projects involve long-term financing although many school districts contribute some current funds towards project costs. There are three instrumentalities for borrowing funds to finance school building projects:

1. School districts, through sale of general obligation bonds;
2. Municipality authorities, which construct or acquire a school building for lease to a school district, through sale of school revenue bonds; and
3. The State Public School Building Authority, which constructs or acquires a building for lease to a school district, through sale of school revenue bonds.

Table 1 shows the total dollar volume of reimbursable public school building construction by year for the period 1963–1969 and the percentage of the total financed by municipality authorities, the State Public School Building Authority and by general obligation bonds. Because the school districts of Philadelphia and Pittsburgh use general obligation bond financing exclusively, the percentages of the totals for these two districts are shown separately. The data in the table indicate that methods of financing have not changed greatly over the seven-year period. Municipality authorities have accounted for 73 percent, on the average, of the total while the share of construction financed by the State Public School Building Authority has ranged from 11.8 percent in 1963 to 22.9 percent in 1965. Over the period only about 9 percent of school construction was financed directly by school districts through the issue of general obligation bonds and Philadelphia and Pittsburgh accounted for about 41 percent of all such bonds.

TABLE 1

DOLLAR VOLUME OF REIMBURSABLE PUBLIC SCHOOL BUILDING PROJECTS BY METHOD OF FINANCING AND BY YEAR, 1963 to 1969

		Percentage of Total Amount Financed by:			
				General Obligation Bonds	
Year Bid Approved	*Total Amount*	*Municipality Authorities*	*State Public School Building Authority*	*Philadelphia and Pittsburgh*	*Other School Districts*
(1)	(2)	(3)	(4)	(5)	(6)
1963	$136,301,723	78.6%	11.8%	3.3%	6.3%
1964	172,412,450	64.4	18.8	13.7	3.1
1965	186,490,963	66.4	22.9	1.4	9.3
1966	209,659,844	74.9	18.1	3.0	4.0
1967	270,301,819	79.4	14.7	.1	5.8
1968	278,545,369	74.1	20.4	3.0	2.5
1969	256,207,970	73.2	18.1	3.0	5.7

SECTION III

COMMONWEALTH REIMBURSEMENT FOR PUBLIC SCHOOL BUILDINGS

Since 1956,[1] when school building reimbursement was extended to sinking fund charges, virtually all public school building projects—additions and alterations to existing buildings as well as new buildings—have been approved for Commonwealth building subsidies. Under existing law, with a few exceptions,[2] each school district constructing an approved building receives an annual building subsidy determined by multiplying the approved amortization charge (either reimbursable rental or a sinking fund charge) by the district's "aid ratio."[3]

The approved amortization charge is the portion of the total amortization charge for the building project attributable to:

1. The costs of land acquisition, rough grading, and of sewage treatment plants as required by the Department of Health, to the extent that such costs are deemed reasonable by the Department of Education, and the interest on these costs, and
2. The approved building construction cost and the interest on such cost.

For new elementary and secondary school buildings,[4] the approved building construction cost is the lesser of:

1. The cost of constructing the building including the cost of essential fixtures and equipment and architect's fees not in excess of 6 percent of the contract price; or

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[1] For the history of school building subsidies prior to 1956 see *Public School Building Subsidies*, Report of the Joint State Government Commission (1955).

[2] For a very few districts a different reimbursement fraction is used and for districts eligible for "density" payments, the portion of the approved amortization charge reimbursed is not less than .5.

[3] The aid ratio is the need—capacity measure used for practically all school reimbursement accounts. For a district of statewide average wealth (as measured by market value of taxable real property per pupil) the aid ratio is .5. The median aid ratio is .61. For the wealthiest districts, the aid ratio is .10 and for the poorest districts, about .85. For the precise calculation, see the Public School Code of 1949, § 2501, cl. (14).

[4] Special statutory provisions apply to area technical schools and additions and alterations to existing buildings.

2. The product of the rated pupil capacity of the building as determined by the Department of Education at the time the project is approved and the per pupil cost standard ($2,300 in the case of elementary schools and $3,000 in the case of secondary schools).

For most building projects the actual building construction cost has exceeded the product of rated capacity and the per pupil cost standard; hence, the latter becomes the basis for reimbursement. This amount may be reduced if there are facilities in the project which are not deemed eligible for reimbursement or if the district's projected enrollment is greater than the department believes is realistic. As a general rule, for a district of typical wealth, the Commonwealth pays between 40 and 50 percent of the annual financing charges.

For the fiscal year 1970–1971, the estimated budgetary requirement for Commonwealth school building subsidy payments is about $88.5 million—slightly more than double the $42.8 million in building subsidy payments made for the school year 1966–1967. The rapid rise in Commonwealth subsidy obligations is attributable only in part to an increase in the volume of building construction. Other factors responsible for the large increase in Commonwealth obligations are the following:

1. The substitution of "aid ratio" for "capital account reimbursement fraction" in computing the annual reimbursement for all school buildings constructed since 1950 upon which amortization payments are still being made (as provided by the Act of April 28, 1969, Act No. 11);
2. An increase in per pupil cost standards (as provided by the Act of April 28, 1969, Act No. 11); and
3. Administrative changes in the calculation of "rated capacity."

Use of the aid ratio in place of the capital account reimbursement fraction accounts for about $16 million of the $29 million increase in building subsidies between 1968–1969 and 1969–1970. This change increased building subsidy payments by an average of about 30 percent.

The per pupil cost standards have been increased twice by legislative action. The initial standards enacted in 1956 were $1,100 for elementary schools and $1,700 for secondary buildings. Effective July 1, 1966, the standards were increased to $1,600 and $2,300 per pupil for elementary and secondary schools, respectively. Again, in 1969, effective retroactively to 1966, the cost standards were increased to the existing levels of $2,300 and $3,000 per pupil.

While the term "rated pupil capacity" has remained unchanged in the statute[5] since the original enactment in 1956, practices of the Department of Education in determining rated capacity for reimbursement purposes have changed several times with the effect of substantially increasing the rated capacity of buildings of a given size. For example, a regular elementary classroom was rated at 30 pupils for a new building in 1957, and assigned a "capacity" of 35 in 1967. The actual enrollment per elementary classroom averages less than 29 pupils.[6]

Again, starting in 1967, large specialty rooms (art, music and large group instruction rooms) in new elementary buildings with 12 or more regular classrooms were assigned capacities of 35 pupils each, even though in few, if any cases, are these rooms utilized in a fashion which provides for an increase in the total building enrollment.[7]

The effect of granting capacities to instruction rooms which do not increase pupil enrollment is clearly seen in Table 2, which shows the ratio of rated capacity to average projected enrollment for buildings with different numbers of large specialty rooms for new elementary buildings constructed during 1966–1968.

The data in the table indicate that rated capacity (used only for reimbursement calculations) increasingly departs from average projected enrollment as the number of large specialty rooms increases. For elementary buildings with no specialty rooms, average rated capacity

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[5] Public School Code of 1949, § 2574(b)(2) added 1956, March 22, P. L. (1955) 1315, as amended.

[6] See Section IX, *infra*.

[7] In New York, which has a public school building reimbursement system similar in many respects to that in Pennsylvania, this practice is specifically ruled out:

"The capacity of elementary schools shall be determined by ascertaining the total number of kindergartens, rooms for grades one through six and rooms for handicapped children and multiplying by 27.

"Note: Since the use of libraries, art, music, physical education, remedial and large group instruction spaces does not increase the number of pupils an elementary school can house, such spaces are not included in the computation of the capacity of the building. Each pupil's share of these spaces, together with the necessary ancillary spaces, is deemed to be included in the basic cost allowance per pupil specified in the law."

See *Educational Facilities Planning Bulletin*, "Implementation of Section 3602, Education Law for School Building Projects," The University of the State of New York, The State Education Department, Division of Educational Facilities Planning, (May 1, 1967).

exceeds projected enrollment by 18.8 percent. For buildings with three large specialty rooms, average rated capacity exceeds average projected enrollment by 35.4 percent.

TABLE 2

COMPARISON OF AVERAGE PROJECTED ENROLLMENT AND AVERAGE RATED CAPACITY FOR NEW ELEMENTARY SCHOOL BUILDINGS
1966–1968

Number of Art, Music and Large Group Instruction Rooms	*Number of Buildings*	*Average Projected Enrollment*	*Average Rated Capacity*	*Rated Capacity in Excess of Projected Enrollment as a Percentage of Projected Enrollment*
(1)	(2)	(3)	(4)	(5)
0	40	542	644	18.8%
1	9	554	708	27.7
2	9	563	751	33.4
3	12	691	936	35.4

NOTE: Projected enrollment includes one-half the actual number of kindergarten pupils. The table excludes five projects with special education enrollment greater than 10 per cent of regular enrollment and projects with incomplete data.

The practice of granting an addition to rated capacity of 35 for each large specialty room has introduced a measure of inequity into the subsidy system since in many cases the additional reimbursement exceeds the actual cost of constructing the room. At $24 per square foot,[8] the actual cost of adding an art or music room of 1,000 square feet is $24,000, but the reimbursement level is increased by 35 times $1,600 or $56,000. At the median aid ratio of .61, reimbursement is increased about $34,200 and the eligible district garners a "profit" of $10,200 per room. At the current elementary cost standard of $2,300 the "profit" is about $25,000.

[8] $24 is the average per square foot cost for elementary schools bid in 1967 or 1968, Table 6, column (5). Since marginal costs rather than average costs would be more appropriate, this calculation undoubtedly overstates the probable cost of adding 1,000 square feet of room space to a building plan.

It appears that changes in the determination of rated capacity were generally instituted simultaneously with mandatory changes in school plant requirements or with recognition of the advantages which additional instructional space would impart to the educational program. In a sense, therefore, the increases in rated capacity have been used to compensate school districts for providing mandatory additional facilities (e.g., libraries in elementary schools) or as an incentive to districts to construct recommended additional facilities (e.g., art rooms, etc.). Nevertheless, since higher rated capacities are translated directly into higher reimbursement levels for new projects, Commonwealth obligations for school building subsidies are substantially increased without legislative action. Within the structure of the subsidy system, the proper instruments for changing reimbursement levels are the per pupil cost standards. Administrative changes in reimbursement factors—however meritorious the objectives of such change—should be prohibited.

Recommendation

It is recommended that the school building reimbursement statutes be amended to preclude administrative changes in reimbursement factors which increase Commonwealth school building subsidy obligations.

SECTION IV

PROJECT COSTS

A. AGGREGATE PROJECT COSTS

Since 1949 when public school building subsidies were first made available by the Commonwealth, about 3,300 public school building projects with an aggregate cost of about $3.3 billion have been constructed in Pennsylvania. The total number of projects and aggregate costs by type of project for each year during the period 1963 to 1969 are shown in Table 3.

It may be observed from column (5) that the program of building vocational-technical high schools throughout the Commonwealth added considerably to the volume of building projects during 1966 and 1967. Exclusive of vocational-technical buildings, aggregate project costs have risen from $136 million in 1963 to $244 million in 1969. The number of new elementary buildings constructed annually has tended to decline since 1963, but the average project size has increased about 200 percent. The average new elementary building in 1963 involved a total project cost of about $733,000, while the comparable cost for the average new elementary building constructed in 1969 was almost $2,200,000. This increase is split almost equally between higher per pupil costs and larger pupil capacity.

Aside from vocational-technical schools, the number of new secondary buildings constructed annually has changed very little over the past seven years. The average project cost of new secondary buildings increased from $3.0 to $5.3 million or about 75 percent over the period—by far the greater part of which was attributable to an increase in per pupil costs. Average pupil capacity increased 13 percent.

Included in column (6) of Table 3 are new elementary-secondary buildings, most of which in recent years have been "middle schools." In both 1968 and 1969, five middle schools were constructed at an average total cost in each year of about $4 million.

TABLE 3

REIMBURSABLE PUBLIC SCHOOL BUILDING PROJECTS
BY TYPE AND BY YEAR
1963 TO 1969

Year Bid Approved	*Total Projects*	*New Elementary Buildings*	*New Secondary Buildings*	*New Vocational Technical Buildings*	*Other Types,*[1] *Additions and Renovations*
(1)	(2)	(3)	(4)	(5)	(6)
1963					
Number of Projects	154	47	17	. . .	90
Total Amount	$136,301,723	$34,458,059	$ 51,769,047	. . .	$50,074,617
1964					
Number of Projects	176	45	21	1	109
Total Amount	$172,412,450	$41,707,560	$ 58,462,495	$ 1,710,000	$70,532,395
1965					
Number of Projects	178	45	19	3	111
Total Amount	$186,490,963	$44,510,926	$ 59,745,564	$ 4,313,092	$77,921,381
1966					
Number of Projects	175	33	16	8	118
Total Amount	$209,659,844	$40,447,962	$ 63,119,689	$17,993,891	$88,098,302
1967					
Number of Projects	150	35	20	20	75
Total Amount	$270,301,819	$52,281,214	$ 97,770,072	$57,287,138	$62,963,395
1968					
Number of Projects	131	24	28	3	76
Total Amount	$278,545,369	$45,896,368	$123,735,268	$12,742,958	$96,170,775
1969					
Number of Projects	125	28	20	3	74
Total Amount	$256,207,970	$61,137,914	$106,889,596	$12,071,085	$76,109,375

[1] Includes middle schools, administration buildings, etc.

B. PER PUPIL COSTS

To permit comparisons with the statutory per pupil cost standards discussed in the preceding section, the per pupil building costs presented below are calculated on the same basis as the statute specifies for approved building construction cost per pupil: structure and equipment costs plus architect's fees not in excess of 6 percent divided by the rated per pupil capacity of the building.

New Elementary Buildings

A distribution of the cost per pupil of new public elementary schools constructed each year during the period 1963 to 1968 is presented in Table 4. Reference to column (3) indicates that the average per pupil cost of new elementary buildings increased from $1,325 in 1963 to $1,927 in 1968. These averages, however, are effected by changes in the computation of rated capacity as noted in Section III. If rated capacity had been computed at a constant 35 pupils per regular, kindergarten or special education classroom throughout the period, the average per pupil cost would have been $1,298 in 1963 and $2,068 in 1968—an increase of 59 percent. Over the same period, construction prices increased about 23 percent.[1]

The average cost, however, conceals wide variations in the per pupil costs of individual projects. In most years, the per pupil cost of the most expensive building exceeded that of the least expensive building by 100 percent. In 1963, out of 44 new elementary buildings, eight were constructed at a cost per pupil of less than $1,100, while two cost more than $2,000 per pupil. In 1968, out of 21 new elementary buildings, four cost less than $1,500 per pupil and one cost more than $3,000 per pupil.

[1] See Appendix Table 9.

TABLE 4

NEW PUBLIC ELEMENTARY SCHOOL BUILDINGS
COST PER PUPIL OF RATED CAPACITY BY YEAR
1963 to 1968

Year Bids Approved	*Number of Buildings*[1]	*Average*	*Cost Per Pupil of Rated Capacity*[2]								
			Less Than $1,100	*$1,100 to $1,299*	*$1,300 to $1,499*	*$1,500 to $1,699*	*$1,700 to $1,899*	*$1,900 to $2,099*	*$2,100 to $2,299*	*$2,300 to $2,499*	*$2,500 and Over*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1963	44	$1,325	8	12	17	3	2	1	1	..	..
1964	36	1,397	2	10	14	5	4	1	..	..	..
1965	43	1,536	4	6	10	9	8	5	..	1	..
1966	30	1,637	..	4	9	8	3	3	..	1	2
1967	31	1,874	..	..	5	3	8	8	5	1	1
1968	21	1,927	..	..	4	1	6	4	4	1	1

[1] The number of buildings is smaller than the number contained in Table 3 due to incomplete data for some projects.
[2] Averages for open-end classes are as follows: 1963, $1,019; 1964, $909; 1965, $1,037; 1966, $2,858; 1967, $2,605; and 1968, $3,214.

New Secondary Buildings

A distribution of the per pupil cost of new public secondary buildings constructed in Pennsylvania during each year between 1963 and 1968 is shown in Table 5. The average per pupil cost of new secondary buildings increased from $2,504 in 1963 to $4,036 in 1968—an increase of 61 percent. As with elementary structures, in most years the average per pupil cost of secondary buildings conceals an annual cost range of about 100 percent. In 1963, out of 17 new secondary buildings, two cost less than $1,900 per pupil and two cost more than $3,100 per pupil. In 1968, out of 21 new secondary buildings, two cost less than $2,700 per pupil and two cost more than $5,500 per pupil.

A comprehensive statistical analysis of the factors governing variations in per pupil costs of public elementary and secondary school buildings constructed during the period 1963 to 1968 is presented in Section VII. Also, Appendix A contains a summary of per pupil cost data for public elementary and secondary buildings constructed during 1956–1959.

TABLE 5

NEW PUBLIC SECONDARY SCHOOL BUILDINGS
COST PER PUPIL OF RATED CAPACITY BY YEAR
1963 to 1968

Year Bids Approved	*Number of Buildings*[1]	*Cost Per Pupil of Rated Capacity*[2]										
		Average	*Less Than $2,100*	*$2,100 to $2,299*	*$2,300 to $2,499*	*$2,500 to $2,699*	*$2,700 to $2,899*	*$2,900 to $3,099*	*$3,100 to $3,499*	*$3,500 to $3,899*	*$3,900 to $4,299*	*$4,300 and Over*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1963	17	$2,504	3	..	6	4	1	1	2	..	..	..
1964	21	2,415	4	3	3	6	3	2	..	..	..	..
1965	19	2,676	2	..	6	4	1	2	3	1	..	..
1966	16	3,067	..	..	1	4	2	4	1	1	3	..
1967	20	3,608	..	2	..	2	..	1	4	3	5	3
1968	21	4,036	..	1	..	1	1	1	3	4	2	8

[1] The number of buildings is smaller for 1968 than the number contained in Table 3 due to imcomplete data for some projects.
[2] Average values for open-end classes are as follows; 1963, $1,936; 1964, $1,856; 1965, $2,036; 1967, $5,157; and 1968, $5,064.

SECTION V

VOTER APPROVAL OF SCHOOL BUILDING PROJECTS

From 1874 to 1967, constitutional provisions required school districts to obtain the approval of the electorate for indebtedness beyond 2 percent of the assessed valuation of taxable property and prohibited them from incurring indebtedness in excess of 7 percent. Following the creation of the State Public School Building Authority in 1949 and the inclusion of school districts under the provisions of the Municipality Authorities Act in 1951, wide-scale utilization of authority financing was an inevitable development. The combination of a 7 percent debt limitation, a small property tax base and low assessed-market valuation ratios formed a barrier to general obligation financing for all but a relatively few districts with a substantial volume of industrial property. Although authority financing extracted a penalty in the form of higher interest costs because of the inherently greater risk in floating issues that had no taxing power as security, the higher interest rates were accepted as the cost of bypassing constitutional restrictions. A 1955 study[1] (when interest rates on most local bond issues ranged from 2 to 3 percent) estimated that net interest rates on general obligation bonds averaged about three-fourths of a percent lower than net interest rates on municipal authority issues of otherwise comparable quality.

A 1966 constitutional amendment increasing municipal debt limits, was heralded by its proponents as a change that would save millions in interest costs to local taxpayers. The new debt limits for all school districts effective upon the enactment of implementing legislation[2] in March, 1967 prescribed a maximum debt of 15 percent of the assessed valuation of taxable property with debt in excess of 5 percent of assessed valuation subject to approval of the electorate.

With the increase in the constitutional debt limit and the enlargement of school district tax bases following school district reorganization (which reduced the number of school districts from 2,530 in 1949–1950 to 669 in 1969–1970) opportunities for general obligation financing changed markedly. What was a practical impossibility on any large

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[1] *Public School Building Subsidies*, Report of the Joint State Government Commission (1955), p. 17.

[2] 1967, March 16, P. L. 9, Act No. 3.

scale during the 1950's and early 1960's, became widely feasible during the latter part of the 1960's. But the record shows no change whatsoever in the utilization of general obligation financing. Table 1 in Section II, indicates that for school districts other than Philadelphia and Pittsburgh there was no significant change in the proportion of school construction which was financed by general obligation bonds for the three years prior to and subsequent to 1966.

The potential for general obligation financing of school construction within the constitutional debt limitation is substantial. Excluding Philadelphia and Pittsburgh, 15 percent of the total assessed valuation of taxable real property amounts to almost $2 billion. The aggregate net outstanding debt of school districts—again excluding Philadelphia and Pittsburgh—is estimated at less than $240 million.[3] Even granting considerable inequality in the distribution of taxable property among school districts, it is apparent that general obligation bond issues could be increased manyfold before reaching constitutional limitations. Under the 1968 amendments to the Constitution, the General Assembly is directed to specify local government debt limits in relation to total revenues over some past period of years. This provision is scheduled to take effect in 1972.[4]

The evidence clearly suggests that a great deal of the current use of authority financing of school construction—especially municipality authority[5]—is not a response to unrealistic constitutional debt limits, but a device to bypass the electorate.[6]

In 43 states, the approval of the electorate is required for all or most local school jurisdictions before bonds to finance new school construction may be issued. In a dozen or more states more than a simple

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[3] "Finances of School Districts," *The 1967 Census of Governments*, Vol. 4, No. 1 (U.S. Department of Commerce, Bureau of the Census, 1969), indicates that the net outstanding debt of Pennsylvania school districts excluding Philadelphia and Pittsburgh was about $207 million as of June, 1967. Increases since then, as indicated by Table 1, Section II would put the current total at no more than $240 million and possibly as low as $220 million, depending upon repayment schedules.

[4] Pa. Const., Art. IX, § 10.

[5] It is possible that many small districts would prefer to finance their projects through the State Public School Building Authority, even if the question of bypassing the electorate were not involved because of its long experience and considerable expertise in school financing and school construction problems.

[6] According to news reports, taxpayers in Mt. Lebanon Township, Allegheny County, have filed suit against the township school board charging that the board's action to establish a municipality authority to finance a $14 million high school modernization program is "a wilful and deliberate attempt to avoid giving the citizens and taxpayers an opportunity to vote." The school district's constitutional debt limit apparently would permit financing of the building project by general obligation bonds. See *Pittsburgh Post Gazette*, February 24 and 28, 1970.

majority, frequently 60 percent or two-thirds is required by law before the question is approved. While recognizing that an occasional rejection by the electorate may delay construction of needed school space and produce temporary overcrowded conditions in some districts, educational authorities in states requiring voter approval regard it as an effective way to keep the people informed of building projects. Ordinarily, project costs are publicly available and a model of the proposed building is on view prior to the election at which the bond issue vote is scheduled. Public scrutiny often results in more economical buildings and post-construction taxpayer disputes over building costs are likely to be reduced.

A comparison between elementary school building costs in Pennsylvania and in New York State provides some evidence that the requirement of a vote of the electorate may produce lower school building costs. Except for a few cities, a majority vote of the electorate is required before school bond issues may be floated in New York. Table 6 contains a summary of the results of the comparison between New York and Pennsylvania buildings by year for the period 1965 through 1968. It should be noted that the data in Table 6 for Pennsylvania buildings were adjusted to be comparable to the cost categories and pupil capacity definitions utilized in the available New York data and differ from the per pupil costs presented elsewhere in this report. The costs in the table are the structure costs of the building only, exclusive of architect's fees, furniture, equipment and all other project costs. Per pupil costs are presented both on the basis of 27 pupils per classroom to conform with the New York reports and on the basis of 35 per classroom to conform with the cost analysis in this report. Because the New York procedure is more realistic in terms of actual classroom utilization,[7] the measure of space per pupil is presented only on the basis of 27 pupils per classroom.

The comparative analysis of Pennsylvania and New York elementary buildings shows that:

1. In each of the four years average structure costs per pupil capacity for elementary schools in Pennsylvania exceeded the comparable costs for elementary schools in New York, with a

[7] See Section IX, *infra*.

TABLE 6

AVERAGE STRUCTURE COSTS OF NEW ELEMENTARY SCHOOL BUILDINGS CONSTRUCTED IN PENNSYLVANIA AND NEW YORK 1965-1968

Year	State	Number of Buildings	Structure Costs[1] Per Pupil Capacity		Structure[1] Costs Per Gross Square Foot	Square Feet Per Pupil Capacity[2]	
			27 Per Classroom[2]	35 Per Classroom[3]		Scheduled	Nonscheduled
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1965	Pennsylvania	43	$1,792	$1,382	$18.86	52	43
	New York	39	1,483	1,144	18.50	53	28
Pennsylvania minus New York			309	238	.36	−1	15
1966	Pennsylvania	30	1,923	1,483	21.37	50	39
	New York	51	1,602	1,236	19.35	53	29
Pennsylvania minus New York			321	247	2.02	−3	10
1967	Pennsylvania	31	2,298	1,773	23.87	53	44
	New York	35	1,906	1,470	22.02	56	31
Pennsylvania minus New York			392	303	1.85	−3	13
1968	Pennsylvania	21	2,408	1,858	24.39	55	44
	New York	32	1,792	1,382	21.49	57	27
Pennsylvania minus New York			616	476	2.90	−2	17

[1] Structure costs of the building only, exclusive of architect's fees, furniture, equipment and all other project costs.

[2] Pupil capacity in both states is calculated at 27 pupils per regular, special education, or kindergarten classroom to conform with the New York cost reports.

[3] Pupil capacity in both states is calculated at 35 pupils per regular, special education, or kindergarten classroom to conform with Pennsylvania practice.

SOURCE: New York data from "Semi-Annual Schools Cost Report And Statistical Data," various issues, 1965 through 1969, Division of Educational Facilities Planning, State Education Department, Albany, New York.

maximum difference in 1968 on the 27 pupil basis of $616 and on the 35 pupil basis of $476.

2. Average structure costs per square foot for Pennsylvania buildings exceeded the structure costs per square foot for New York buildings in each of the four years with the difference reaching a maximum of $2.90 per square foot in 1968.

3. The average net area of scheduled space per pupil is very similar in the two states for all years with a maximum difference of three square feet per pupil in 1966 and 1967. (Scheduled area is the total net space of the building in classrooms and in all other areas used for educational, health, administrative, and social purposes, such as offices, cafeterias, gymnasiums, locker rooms, etc.)

4. The average nonscheduled square feet per pupil in Pennsylvania buildings exceeded the comparable measure in New York buildings in each of the four years with the difference reaching 17 square feet or 63 percent greater nonscheduled space per pupil in 1968. Larger nonscheduled area per pupil appears to be one of the principal sources of the higher cost of Pennsylvania elementary schools compared to those in New York State. (Nonscheduled space includes corridors, lobbies, storage space, stair enclosures, washrooms, and the areas occupied by the walls of the buildings.)

5. New York elementary buildings tend to be somewhat larger in average pupil capacity than Pennsylvania buildings (see Appendix Table 6) but the cost per pupil and the cost per square foot differences persist throughout different size categories (see Appendix Table 7), hence, economies of scale cannot be a significant source of lower per pupil costs in New York.

The well-established positive relationship between the wealth of a school district and the per pupil cost of its buildings[8] would be expected to produce more costly buildings in New York State than in Pennsylvania, other factors being equal.[9] Among the factors that are not equal is the requirement for voter approval of school building bond issues.

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[8] See Appendix A and Section VII.

[9] In 1966, per capita personal income in Pennsylvania was $2,968, while in New York State it was $3,497. In New York State, exclusive of New York City, per capita personal income was $3,337. It is not likely that the relative differences between these measures has changed since 1966.

The cost data in Table 6 lend strong support to the view that a requirement for approval by the electorate may result in more economical school buildings. In Pennsylvania, a statutory requirement for voter approval of school projects could generate cost savings on interest as well, since the incentive to avoid general obligation issues would be removed.

Recommendation

It is recommended that the Public School Code of 1949 be amended to require the approval of the electorate before any school district of the second, third or fourth class enters into a contract to construct or lease a new school building or a substantial addition to an existing building. The question as submitted to the electorate should specify the maximum project cost as well as annual financing charges.

SECTION VI

STANDARDIZATION

A. STANDARDIZED ARCHITECTURAL PLANS

Attempts to achieve economies in both the design and construction of schools through the use of standard building plans have been made in many states over a long period of time with little or no success. A comprehensive review of the use of standard plans in the several states was published in a 1958 report of the Commonwealth of Massachusetts which summarized the status at that time as follows:

> "At the present time the six following States are utilizing uniform architectural plans for public schools: Arkansas, California, Maine, Mississippi, Oklahoma and West Virginia.
>
> "Twenty States, as follows, made use of such plans in the past, but have abandoned them: Alabama, Connecticut, Florida, Georgia, Kentucky, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New York, North Carolina, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia and Wisconsin.
>
> "In all but one of the above instances, the uniform or 'stock' plan was instituted for small rural school buildings of from one to four classrooms. The exception—Virginia—concerned seven-room elementary school buildings expandable to ten rooms."[1]
>
> ". . . The experience of States which have tried the stock plan concept for school construction has been disappointing and unproductive. The practice of uniform plans has fallen into disuse except in remote rural areas where a small one or two room school building meets the local needs. Not one State

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[1] An inquiry to the State of Virginia in 1968 resulted in the following information:

"The Virginia General Assembly authorized the development of standard plans for elementary and high schools about 1948. The State Department of Education developed plans for two or three sizes of elementary schools of rather good quality and certainly adequate for their purpose at that time. The authorization to develop plans for high schools was never acted upon under the pressure of other work and the recognition of the impossibility of such a task.

"From the several standard elementary school plans developed, one building was built, and a second was built with enough modification to obliterate it."

Letter of May 20, 1968, from the Supervisor of School Buildings, State Board of Education, Commonwealth of Virginia.

which has tried to evolve uniform plans for school buildings believes that the concept has any promise except in the cases of the small rural schools cited."[2]

Under an ambitious New York State program started in 1962 with the "strong support" of Governor Rockefeller, nine standardized plans were developed for typical sizes of elementary and secondary buildings at a total cost of $900,000. Local architects were required to prepare foundation and site development drawings and prepare plans for such modifications as were desired by the school districts. These standard plans could be obtained by any school district in New York State at the cost of reproduction and delivery and their availability and advantages were widely publicized. In the six years since the New York State plans were made available, only two projects were constructed using the standard plans, one of which involved major modifications and neither of which produced any apparent cost savings. Because of the infrequent utilization of these plans, the original program to develop a second series of nine stock plans has apparently been abandoned.

Recent developments in building construction methods have led to a new approach in the search for economies of school building construction —component systems. The so-called systems approach to school design and construction[3] has all of the alleged advantages of stock plans and none of the disadvantages. Stock plans offer, at best, possible savings in design and construction time and a relatively trivial savings in architectural fees at the cost of inflexibility, increasingly outmoded building materials and techniques, and lessened competition.

B. SYSTEMS BUILDING

The objectives of systems building programs are higher quality schools at lower costs, savings in design and construction time, and near total spatial flexibility. These objectives seem to have been achieved in projects in such diverse localities as England, Canada, California, and Florida. Unlike standard plans, school buildings constructed with standardized building component systems are not restricted in architectural design nor in external appearance. In fact, the modular scale

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[2] The Commonwealth of Massachusetts, *Report Submitted by the Legislative Research Council Relative to School Construction Methods and Costs and Uniform Architectural Plans*, (Boston: Wright & Potter Printing Co., February, 1958) pp. 15-16, 122.

[3] In its broadest usage the systems approach also includes planning, scheduling, financing and management within the concept. See the definitions in the report on systems building in *Engineering News-Record*, (October 30, 1969).

of building systems enhances flexibility and freedom of design. The major obstacle to utilization of the systems approach by small or moderate-sized school districts is the necessity for joint action to obtain a sufficient volume of construction—$30 million or more over a period of several years—to achieve economies of design and bulk purchasing.

The systems approach in school construction involves all or most of the following steps:

1. The development of performance specifications (based on educational requirements) for a number of building subsystems, such as structure; lighting and ceiling; heating, ventilating, and air conditioning; etc.
2. Distribution of specifications to interested component manufacturers requesting competitive bids based upon compatibility with other components, and guaranteeing a sufficient volume of school construction to insure design and production economies.
3. Erection of a sample building or other method of testing that the subsystem products submitted by successful bidders meet the specifications and are compatible.
4. Construction of school buildings, designed in accordance with the requirements of each district by its architect, using the preselected components at predetermined unit prices.

The initial and model systems building program in the United States was the School Construction Systems Development (SCSD) program started in 1961 in thirteen California school districts. The program contained five subsystems which accounted for about 50 percent of the total construction cost of $30 million. Under this program, completed in 1967, the cost of component products was about 20 percent less than could have been attained using standard items. As a result of the success of the SCSD program in California, numerous other jurisdictions became interested in the systems approach to school construction.

A Florida project, which used the performance specifications of the SCSD program, was designed to achieve some of the cost savings and quality benefits of systems building without going through all of the steps outlined above. Twenty-four schools were built or are under construction using four component systems and on successive component bids overall unit price declines were achieved even in the face of general rising construction prices.[4]

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[4] *Building Systems Information Clearinghouse Newsletter*, Vol. No. 1 (Stanford, Calif., California School Planning Laboratory, School of Education).

The Metropolitan Toronto School Board has embarked upon a school building systems project (SEF Building System) comprising 31 elementary and intermediate schools and one office building—a total of about two million square feet—to be built in the period 1969–1971.[5] The economic advantages to be gained under the SEF program as presented by the technical director of the project are:

> "The gross budget for SEF was $41.7 million. The value of subsystem proposals offered if tendered by traditional means would have been $52 million. The designated subsystem cost will be $38.2 million. In general terms, the Metropolitan Toronto School Board obtained about 30 percent more value for 8.39 percent less cost than by traditional means.
>
> "I would expect the second SEF system to generate a similar improvement in value with about a 10 percent reduction in cost below the current cost of the First SEF Building System, and reach a price level about 25 percent below the current cost of traditional school construction in 1972–73."[6]

The feasibility of developing a component systems building program in the Commonwealth has been investigated at length by the Educational Facilities Laboratories, Inc., at the request of the State Board of Education. The EFL report concludes that:

> "1. A project in Pennsylvania which incorporates an integrated system of standard school building components is educationally, architecturally, and legally feasible.
>
> "2. Development of component systems based upon educational and performance specifications and competitive bidding among manufacturers will produce superior school buildings in terms of quality, flexibility, and function."[7]

Existing law relating to separate contracts for school construction may constitute an impediment to certain applications of standardized

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[5] The subsystems utilized in the SEF program, which in total account for about 80 percent of the finished cost of a school building, are as follows: structure; heating, cooling and ventilating systems; lighting-ceiling; interior partitions and other space dividers; outside walls, windows and doors; plumbing; electric-electronic; case work; seating; standard furniture; roofing; carpeting; gymnasium flooring; and hardware.

[6] Roderick G. Robbie, "The Flexible Future of Architecture," *American Institute of Architects Journal* (November, 1969), pp. 63–68.

[7] *Report of the Pennsylvania Feasibility Study of the Educational Facilities Laboratories, Inc.* (November 9, 1965), p. 32.

component systems. Section 751 of the Public School Code of 1949[8] requires that, except for prefabricated buildings, all school building construction must be done under separate contract for lighting systems, plumbing, and heating and ventilating. This means that with the general construction contract there must be at least four contracts involved in the construction of a public school building. To facilitate maximum utilization of the systems approach, authority to employ a single contract for school construction may be needed.

Permissive authority to utilize a single contract for school construction has been proposed as an aid to increasing construction efficiency and thereby reducing costs. It has been stated that the requirement of separate contracts prevents centralized authority, complicates coordination and results in a failure to fix responsibility among contractors for delay and unsatisfactory performance.[9]

Recommendations

1. (a) It is recommended that the Commonwealth embark upon a program encouraging utilization of component systems in the design and construction of a substantial portion of annual public school construction.

(b) As an initial step in the direction of encouraging the component systems approach in Pennsylvania, it is recommended that $200,000 or such sum as is found to be necessary be appropriated to the State Public School Building Authority to finance the preliminary work (writing of specifications and testing of components) and the coordination of a component systems school construction program consisting of about 15 buildings over a two or three year period. Participation in the program should be open to any school district whether or not its project is to be financed through the authority.

2. It is recommended that Section 751 of the Public School Code of 1949 be amended to permit school building construction under a single contract with the proviso that the contract bid contain the names of the principal subcontractors to be employed on the project.

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[8] Public School Code of 1949, March 10, P. L. 30, § 751, as amended.

[9] See, for example, *Protecting the Public Interest in Philadelphia Public School Construction Program*, Report No. 348, Pennsylvania Economy League (Eastern Division) in association with The Bureau of Municipal Research (Philadelphia), 1968, p. 30.

SECTION VII

FACTORS GOVERNING VARIATIONS IN PUBLIC SCHOOL BUILDING COSTS

Previous studies have established the existence of stable relationships between the per pupil costs of public school buildings and such factors as school district wealth and building capacity.[1] Aside from a study which predated the existing reimbursement system, little evidence is available as regards the impact of Commonwealth building subsidies upon per pupil building costs.[2] The increase in per pupil reimbursement cost standards in July, 1966 offered an unusual opportunity to measure the effect of substantial changes in subsidy levels (an increase of $500 per pupil for elementary schools and $600 per pupil for secondary schools) upon building costs.

Accordingly, an extensive statistical analysis was undertaken of factors governing variations in the per pupil cost of public school buildings constructed between January, 1963 and December, 1968. The analysis is restricted to regular elementary and secondary buildings and excludes additions, renovations and remodeling, as well as special facilities such as area vocational-technical schools, administration and special education buildings. In total, 205 new elementary buildings and 114 new secondary buildings constructed in all areas of the Commonwealth are included in the analysis. Middle schools, the innovation in educational housing which combines certain elementary and secondary grades in one building, were too few in number to include in the comprehensive analysis. A separate study of the costs of these buildings is provided in part B of this section.

A. ELEMENTARY AND SECONDARY SCHOOL BUILDINGS

Building costs in terms of structure cost per pupil of rated capacity have been analyzed by separate linear regressions for elementary and secondary schools. Structure cost includes the costs of essential fixtures

[1] See *Public School Building Subsidies*, Report of the Joint State Government Commission (1955), and Appendix A.

[2] A 1953 report concluded that school buildings financed in part by Commonwealth subsidies were more expensive than buildings financed entirely from local funds. On the average, and after correction for the influence of other relevant factors, elementary buildings constructed with Commonwealth participation cost almost $200 per pupil more than buildings constructed without State aid. See *State and Local Support of Public Education*, Report of the Joint State Government Commission (1953).

and equipment and an architect's fee not in excess of 6 percent. In general, rated capacity is the capacity assigned by the Department of Education for reimbursement purposes.[3] However, to maintain consistency, capacity for all years was computed from the approved room schedule on the basis of the method which prevailed for the major part of the period. The principal effect of this modification was to reduce the assigned capacities for 1967 and 1968 elementary schools with one or more specialty instruction rooms by 35 pupils for each such room. To absorb the cost of constructing these facilities and any additional costs generated by the additional reimbursement attributable to specialty rooms a variable was added to the elementary regression.

The changes in construction prices for the period 1963–1968 were taken into account by adjusting the actual cost per pupil to a 1967 price basis, utilizing a simple average of the Pittsburgh and Philadelphia Engineering News Record Building Cost Indexes for each year 1963 to 1968 (individual city indexes and the two-city averages are reproduced in Appendix Table 9).

Variations in per pupil school building costs were found to be associated with changes in the following factors, measured as indicated:

X_1 *Wealth or taxable capacity* of the school district as measured by the district's market value of taxable real property per weighted average daily membership (MV/WADM) for the 1966–1967 school year in thousands of dollars.

X_2 *Size* of the school building as measured by the total pupil rated capacity, in hundreds of pupils.

X_3 *Efficiency of design* as measured by the percentage that the number of scheduled square feet in the building is of the total number of square feet.

X_4 *Geographical variation in labor costs* as measured by the weighted average hourly wage of occupations employed in school construction in 1966 for the county in which the building is located. A value of 1 is assigned if the average wage is less than $4.12, and 0 otherwise.

X_5—X_6 *Change in per pupil reimbursement cost standards* as measured by whether or not (1 or 0) the building project was bid or leased subsequent to July 1, 1966, the effective date when the per pupil reimbursement cost standards were increased from $1,100 to

[3] See Appendix Table 8.

$1,600 for elementary and from $1,700 to $2,300 for secondary buildings. The plans for some buildings built or leased in 1966 may have been complete prior to the time when the increase in reimbursement standards became known and the change in standards would not have influenced the expenditures on such projects. To provide for the likelihood of a gradual adjustment of expenditures to the higher reimbursement levels, separate variables are provided, X_5 for 1966 and X_6 for 1967 or 1968.

X_7 Whether or not (1 or 0) the building is a *senior high school* (utilized only in the analysis of secondary buildings).

X_8 Whether or not (1 or 0) the building contained *specialty instruction rooms* (art, music or large group instruction) and was assigned additional capacity for reimbursement purposes (utilized only in the analysis of elementary buildings).

The effects of these factors on the per pupil costs of elementary and secondary school buildings are summarized in the following two equations and discussed below. Technical data will be found in Appendix Table 10.

Elementary Schools

Cost per pupil (1967 dollars) =

$$2{,}059 + 17X_1 - 42X_2 - 9X_3 - 177X_4 + 257X_5 + 400X_6 + 133X_8$$

Secondary Schools

Cost per pupil (1967 dollars) =

$$3{,}220 + 56X_1 - 56X_2 - 15X_3 - 196X_4 + 387X_5 + 805X_6 + 569X_7$$

Discussion of Findings

X_1. The equations indicate that for both elementary and secondary buildings the wealth of the school district has a significant positive association with per pupil building costs. An increase of $1,000 in MV/WADM is associated with an increase of $17 per pupil in elementary building costs and $56 per pupil in secondary building costs. In other words, a secondary building constructed by a wealthy school district with, say, $20,000 of MV/WADM would be expected to cost about $728 more per pupil than a secondary building constructed by a poor district with $7,000 of MV/WADM, with the difference attributable solely to the difference in wealth levels.[4] For elementary schools the

[4] The MV/WADM of about 8 percent of Pennsylvania school districts is less than $7,000 and of about 18 percent is greater than $20,000.

comparable difference in building cost for these two districts would amount to $221 per pupil. In a prior study of school building costs, covering buildings constructed between 1949 and 1954, it was found that an increase in market value comparable to an increase of $1,000 per WADM was associated with an increase in cost per pupil for elementary buildings identical to the $17 found in the present study. For secondary buildings the prior study reported a coefficient comparable to $30 in contrast to the $56 in the current study.[5]

X_2. The analysis shows that for both elementary and secondary buildings an increase in the size of buildings as measured by pupil rated capacity is associated with a modest decrease in cost per pupil, an indication that economies of scale are apparently present in school building construction. An increase of 100 pupils in rated capacity can be expected to reduce per pupil cost of elementary buildings by about $42 and of secondary buildings by about $56.

X_3. This factor is utilized to represent the efficiency of educational space utilization in the building design. The percentage that scheduled space (classrooms, laboratories, gymnasiums, conference rooms, offices, etc.) is of the total space (scheduled space plus lobbies, corridors, lavatories, etc.) is a measure of the extent to which the building was designed efficiently. On the average, the percentage of scheduled to total square feet was 57 for elementary buildings and 56 for secondary buildings. The equations indicate that an increase of 5% (from, say, 55% to 60%) is associated with a decrease in cost per pupil of $45 for elementary buildings and $75 for secondary buildings.

X_4. This factor is used to obtain some evidence as to the intrastate variation in school construction costs attributable to differences in labor costs. Ordinarily there is little variation in materials costs over wide regions of the country except for transportation costs. In counties where the average hourly wage[6] is below $4.12 the equations show that, provided the 1966 wage differences persist, an elementary school building can be expected to cost $177 less per pupil and a secondary building $196 less per pupil than similar schools in comparable districts elsewhere in the State. Inspection of Appendix Table 5 shows that the counties where the average wage is less than $4.12 occupy a narrow band in the center of the State, from Adams and York Counties in the south to

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[5] See *Public School Building Subsidies*, Report of the Joint State Government Commission (1955), p. 31 (calculation was based on 29 WADM per teaching unit).

[6] For explanation of calculation of average wage, see Appendix B.

Tioga and Bradford Counties in the north. The lower labor costs are apparently reflected in lower school construction costs even though greater absolute differences in average wage rates elsewhere are not. This may mean that where wage rates for occupations employed in school construction are highest there is greater utilization of off-site labor (e.g., prefabrication), that machinery or other capital goods are utilized more extensively so that less labor is required or that the higher paid labor is more productive.

X_5—X_6. The increases in per pupil reimbursement cost standards which were effective July 1, 1966 are strongly associated with higher per pupil costs. The analysis indicates that the increase added $257, on the average, to the per pupil cost of an elementary building and $387 to the per pupil cost of a secondary building in 1966, and $400 per pupil to the cost of an elementary school, and $805 per pupil to the cost of a secondary school constructed in 1967 or 1968. The lower coefficients for 1966 are consistent with the hypothesis of a gradual adjustment to higher reimbursement levels. The X_6 coefficient for elementary schools indicates that 80 percent of the per pupil cost standard increase of $500 was reflected in higher per pupil costs. For secondary schools the X_6 coefficient is $205 greater than the cost standard increase of $600 per pupil. Since an increase in costs exceeding the increase in the reimbursement standard does not seem reasonable this result may indicate either that all of the price rise in 1967–1968 was not accounted for by the building cost index used or that some other factor was operating on secondary school costs during these years and not during earlier years. In any event, the X_5 and X_6 coefficients are of such magnitude for both elementary and secondary schools as to provide considerable evidence that increases in Commonwealth dollar reimbursements consequent upon increased pupil cost standards tend to generate more costly buildings rather than savings to the taxpayers or additional expenditures on instruction or other current expenses.

X_7. This factor is utilized in the secondary school analysis to differentiate between senior high schools and other types of secondary schools—junior and junior-senior high schools. The coefficient in the equation shows that the per pupil cost of senior high schools, other factors held constant, averages $569 higher than the per pupil cost of other secondary schools. Roughly two-thirds of the additional cost of senior high schools over other secondary schools is attributable to greater space per pupil and the remainder to more expensive products or materials or more costly construction. There is no appreciable difference in the average per pupil cost of a junior high school and a junior-senior

high school when variations in the other factors are removed. The finding of higher costs per pupil for senior high schools raises a policy question as to whether the equity of the school building reimbursement system could be improved by differentiating among types of secondary schools.

X_8. The coefficient of X_8 (in the elementary equation) may be interpreted as showing that the assignment of extra capacity for reimbursement purposes for specialty instruction rooms added $133 per pupil, on the average, to the cost of buildings with such facilities. For schools with these rooms the average reimbursable capacity (as used in the regression) was 739 pupils. The average number of specialty rooms was 2.1. Therefore, the total structure cost increase per specialty room averaged $46,800,[7] whereas the gross increase in reimbursement was 35 ($1,600) or $56,000. This result, therefore, that about 84 percent of the increase in reimbursement level is reflected in higher structure costs is extraordinarily consistent with the finding noted above in the discussion of X_6, that 80 percent of the increase in reimbursement stemming from an increase in the elementary cost standard is reflected in higher structure costs. For buildings constructed subsequent to full adjustment to the 1969 increases in per pupil cost standards, the expected impact upon structure costs of additional reimbursement attributable to specialty instruction rooms, will be about 84 percent of 35 ($2,300) or an increase of $67,600 per specialty room.

B. MIDDLE SCHOOLS

The construction of "middle schools," a building combining certain traditional elementary and secondary grades—usually grades 6, 7, and 8, or 5, 6, 7, and 8—appears to be gaining increased acceptance among school districts across the Commonwealth. Of all new school buildings constructed between 1963 and December, 1968, 4.5 percent were middle schools. An inspection of the school building projects on file in the Department of Education to be constructed after 1968, indicates that about 17 percent of new projects will be "middle schools" and they will represent about 25 percent of total expenditures. An analysis of the per pupil costs of the nine middle schools constructed between 1966 and 1968, suggests that these buildings are more closely related to junior high schools than to combination elementary-secondary schools. The average per pupil cost for the nine middle schools was $3,082 (in 1967 prices). Reference to Tables 4 and 5 in Section IV shows that average

[7] 739 x 133 ÷ 2.1

per pupil cost for all new schools constructed in 1967 was $1,874 for elementary buildings and $3,608 for secondary buildings. A method of appraising the costs of middle schools is to utilize the information contained in the regression equations presented in the preceding part of this section. The average of the *expected* costs per pupil for middle schools derived by substituting the relevant values for each of the cost factors into the secondary equation is $3,269 and the average of similar calculations using the elementary equation is $1,766. The average of the *expected* costs of these buildings as prorated combinations of elementary and secondary buildings is $2,622 per pupil. These results, although based upon a small number of cases, suggest that middle schools appear in cost terms more like typical junior high schools than combinations of elementary and junior high schools. Several school districts which have constructed new middle schools have recommended that these structures be treated for reimbursement purposes as if they were secondary schools rather than combined elementary and secondary schools as is required under existing law. While the apparent cost differences may justify such a policy, the Department of Education views the organizational pattern which includes middle schools as experimental.

Recommendations

1. It is recommended that no future increases in school building subsidies be enacted without a careful appraisal and realistic projection of the probable effect of increasing building subsidies upon school building construction expenditures and the Commonwealth subsidy obligations generated thereby.

2. Until such time as the department accepts middle schools as part of a permanently recognized grade organization, it is recommended that no consideration be given to changing reimbursement on account of middle school buildings.

SECTION VIII

NONPUBLIC SCHOOL BUILDING COSTS

It has long been the opinion of casual observers that building costs of nonpublic schools, particularly parochial schools, are significantly below those of public schools, but factual support for such views has been lacking. A variety of reasons for the alleged cost differences have been suggested but again little in the way of firm evidence has been presented.

Costs and other data for eight parochial high schools constructed during the past seven years were obtained through the cooperation of parochial school officials and architects. Although these data were not collected on a uniform basis, are subject to estimating errors and therefore must be interpreted with caution, the existence of significantly lower costs than for public senior high schools is indicated.

Because of the small number of buildings, it is not possible to systematically relate the parochial school building costs to the public school building costs taking into account such variables as capacity and geographic location. For public senior high schools constructed during the period 1963 to 1968, the average building cost per gross square foot was $24 (in 1967 prices) while the estimated average cost per gross square foot for the eight parochial schools was $19 per square foot (in 1967 prices). For four of the parochial high schools, it was possible to analyze the composition of space and divide it into scheduled and nonscheduled areas as such areas are utilized in public secondary schools.[1] For the parochial buildings, an average of 70 percent of the total area was dedicated to scheduled education programs and 30 percent to nonscheduled uses.[2] In the public senior high schools, an average of 52 percent of the total area was assigned to scheduled activities and 48 percent to nonscheduled uses. These data indicate that the source of some of the cost differences between public and parochial buildings (as was the case between New York and Pennsylvania elementary schools) probably lies in the greater amount of nonscheduled space provided in the public buildings. Other factors being equal, the regression equations presented in Section VII indicate that the difference in the percentages of scheduled to total space (70 versus 52) could be expected to lower the cost per pupil by $270 in the parochial schools.

[1] For types of facilities in scheduled and nonscheduled areas, see Sections V and VII.

[2] Chapels, sacristies, and faculty housing, which are contained in several of the buildings, have been eliminated for purposes of these comparisons.

The above data, although fragmentary at best, are consistent with the opinions of a number of education officials and architects who have had experience with parochial school building costs. Both the types of educational programs offered and architectural design factors appear to contribute to the lower costs of parochial buildings. Parochial schools tend to operate with much larger class sizes than do public schools, contain fewer specialized facilities, place less emphasis upon certain costly educational programs, such as vocational education, and are not subject to the space, lighting, heating and ventilating standards of the State Board of Education. Aside from these sources of lower cost, there may well be pressures for economy because of the limited resources available for parochial school building financing.

SECTION IX

STANDARDS OF THE STATE BOARD OF EDUCATION

The Department of Education requirements for approving building plans and specifications are derived from the minimum standards for school building projects contained in the regulations of the State Board of Education. Sections 733 through 735 of the Public School Code[1] of 1949 provide that:

> "All public school buildings . . . shall conform to standards established by the State Board of Education as to light area, floor space, and cubical contents."
>
> "The State Board of Education shall establish proper standards for heating and ventilating every school building . . . "
>
> "The State Board of Education shall, at least once during each period of five years, completely review and revise such standards in the light of improved facilities, equipment and methods, and in the light of changing philosophies of classroom efficiency . . ."
>
> "For the purpose of advising the State Board of Education in making revisions of standards . . . , the Governor shall immediately before the time for making any revision, appoint an advisory committee consisting of fifteen members, five of whom shall be registered architects experienced in designing school buildings, three of whom shall be school administrators and three of whom shall be educators."

These provisions which contain the authority for promulgation of school building standards by the Board appear to be both outmoded and incomplete. The statutes contain few guides except "improved facilities" as legislative directives to be followed in revising standards. The Advisory Committee on Standards deals with many matters potentially affecting the health of school children, yet this committee has no statutory members drawn from the medical profession. In past Advisory Committee reports and in State Board revisions, specification of the

[1] Public School Code of 1949, March 10, P. L. 30, §§ 733–735, as amended, 1965, Oct. 21, P. L. 601, § 14.

precise educational or health benefits to be achieved from changes in standards is notably lacking. In general, the minimum standards for school buildings are too inflexible, contain no provisions for variances in unusual situations and are reviewed and revised too infrequently.

The regulations of the State Board of Education for school buildings contain standards and approved practices with respect to minimum areas for school facilities, reimbursable equipment, space, lighting, heating, ventilating and electrical work, and standards relating to the size and adequacy of building sites.

The regulations for elementary buildings contain only one size for regular classrooms—850 square feet—which is considered adequate to house from 30 to 35 pupils.[2] Prior to May 1, 1957 the recommended minimum square footage for regular elementary classrooms was 660 square feet. It is well known that the ratio of pupils to teachers in both elementary and secondary schools has not increased and it is generally considered a desirable educational practice to maintain smaller class sizes.[3] In the light of the preferred practice, a question arises as to the necessity of having design standards which mandate that *all* classrooms be of sufficient size to house at least 30 pupils.

To ascertain the extent to which elementary schools operate with class sizes smaller than 30, the average number of pupils per classroom for each elementary building constructed since 1950 was computed. The results are shown in Table 7. The data are divided between those buildings constructed between 1950 and 1957, and buildings constructed since 1957. This separation was made to determine whether any difference exists in the average utilization of classrooms between the buildings constructed prior to the change in standards (from 660 square feet to 850 square feet per classroom) and the newer buildings. A separate distribution is shown for buildings with kindergartens, since the inclusion of kindergarten pupils (who attend half-days) overstates the actual number of pupils using a classroom. Inspection of the table indicates that the distributions of elementary buildings by average number of pupils per classroom are virtually identical for the buildings constructed prior to and since 1957. For example, for buildings without kindergarten enrollment, 28.8 percent of those constructed between 1950 and 1957 and 29.1 percent of those constructed between 1958 and 1967 had

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[2] Standards setting forth the minimum areas for elementary school building facilities, extracted from the regulations of the State Board of Education, are presented in Appendix C.

[3] It may be noted, however, that the effect of smaller classes upon learning performance has not been demonstrated.

an average enrollment per classroom of from 29 to 31.9 pupils. The bottom row of Table 7 indicates that 52.5 percent of the buildings constructed since 1957 average less than 29 pupils per classroom. As expected, buildings with kindergarten enrollment have a somewhat higher average number of pupils per classroom. Were it possible to remove the kindergarten enrollment from the data, it appears that the differences between the distributions would vanish.

TABLE 7

PUBLIC ELEMENTARY SCHOOL BUILDINGS BY NUMBER OF PUPILS PER CLASSROOM IN 1967–1968 AND BY PERIOD OF CONSTRUCTION

Average Number of Pupils Per Classroom	*Elementary Buildings Without Kindergarten Enrollment*		*Elementary Buildings With Kindergarten Enrollment*	
	Period of Construction		*Period of Construction*	
	1950–1957	*1958–1967*	*1950–1957*	*1958–1967*
(1)	(2)	(3)	(4)	(5)
Number of buildings	243	141	278	371
Percentage total	100.0%	100.0%	100.0%	100.0%
Less than 23	8.3	6.4	5.1	4.9
23 to 25.9	18.5	17.0	16.9	14.3
26 to 28.9	25.9	29.1	26.3	25.9
29 to 31.9	28.8	29.1	26.9	28.0
32 to 34.9	9.5	10.0	15.1	12.9
35 to 37.9	6.2	4.2	3.6	5.9
38 and over	2.8	4.2	6.1	8.1
Percentage with less than 29 pupils	52.7	52.5	48.3	45.1

The data in Table 7 strongly suggest that somewhat more than one-half of the classrooms in the elementary schools throughout the Commonwealth could have been designed to accommodate fewer than 29 pupils without in any way impairing educational practices.[4]

[4] In a survey of school districts conducted by the House Committee on Basic Education in 1968, the average reported elementary class size was 27.9 pupils. See Table I, *Report on Salary and Subsidy Hearings*, Pennsylvania House of Representatives, Committee on Basic Education (March, 1968).

Merely reducing the minimum size of classrooms in recognition of actual utilization patterns, while an obvious improvement over current standards which mandate unnecessary space, may not be the most appropriate revision in light of contemporary developments. Trends in the design and utilization of educational space are gradually moving away from the traditional concept of a classroom of given area and ceiling height and containing a specified number of windows and uniform equipment. Introduction of the component systems approach to school design and construction with its emphasis upon internal spatial flexibility will require an even greater departure from the type of rigid space requirements which have been customary in Pennsylvania. Investigation of the advantages of specifying only the minimum number of square feet per pupil for various functions, rather than various rooms of various sizes, seems warranted. Inflexible standards changed infrequently not only perpetuate wasteful building designs but hinder the adoption of the best educational practices.

The standards of the State Board of Education with respect to the size of building sites are apparently based on the rule-of-thumb recommendations of the National Council on Schoolhouse Construction some of which were originally formulated during the 1950's.[5] For elementary schools, for example, the standards prescribe an optimum size of ten usable acres plus one usable acre for each 100 pupil enrollment. Sprawling, single-story, finger-plan structures, the design trademark of the typical suburban school during the mid-fifties and sixties, may be economically outmoded in view of the rapidly rising land values in areas contiguous to the population growth centers. Compactness in school building design as well as the specification of site requirements in terms of type of school organization and range of activities and services to be provided could reduce site costs substantially. Detailed studies of functional utilization of outdoor space have resulted in site guides that contain, in many cases, less than half the acreage recommended in the current standards of the State Board.[6]

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[5] National Council on Schoolhouse Construction. *Guide for Planning School Plants.* George Peabody College for Teachers (Nashville, Tenn., 1958), p. 23.

[6] See William W. Chase, "School Site Selection and Utilization," *American Institute of Architects Journal* (March, 1965); *School Site Analysis and Development* (Sacramento, California, State Department of Education, Bureau of School Planning, 1966).

Recommendations

1. It is recommended that the Public School Code of 1949 be amended to provide:

(a) That the school building standards of the State Board of Education be reviewed and revised as necessary but at least once every three years rather than every five years as is now required.

(b) That the provisions relating to revision of standards be amended to include a reference to design economies as well as educational adequacy as a guide for the State Board in setting building standards.

(c) That the State Board of Education be required to hold a hearing when requested by a school district on the question of variances from school building standards and be authorized to grant exceptions for individual projects whenever adherence to the standards would work unnecessary hardships.

(d) That the Advisory Committee on Standards contain at least three members of the medical profession and that the Advisory Committee provide a justification for recommended changes in standards in terms of the specific educational or health benefits expected to be gained and the expected increase or decrease in the associated building or maintenance costs.

2. It is recommended that the State Board of Education reduce the minimum recommended classroom size for standard elementary classrooms to a size or selection of sizes (or provide an alternative in terms of space per pupil) that more appropriately reflects the actual utilization of elementary classroom space throughout the Commonwealth.

SECTION X

ADMINISTRATIVE PRACTICES OF THE DEPARTMENT OF EDUCATION

The administrative procedures of the Department of Education with respect to the approval of school building projects are mainly concerned with reviewing plans and specifications to assure conformity with the minimum standards of the State Board of Education and with other requirements of the school laws and regulations. The department's responsibilities, in its view, do not extend to advising districts on methods of effecting economies in school construction, nor does the department reject designs or propose revisions in building plans that may entail unnecessarily costly features. In a number of cases, the final per pupil costs of school projects have exceeded by almost 50 percent the original estimates on the basis of which the projects were initially approved. Selected cost data for four such projects are presented in Table 8. The per pupil structure cost increases between the preliminary and final cost estimates range from 39 to 47 percent for these projects. Since the basis for reimbursement by the Commonwealth is limited to the per pupil cost standards, all costs above the standard amounts are borne completely by the local taxpayers. Two of the projects in Table 8 were initiated in 1965, but construction contracts were let subsequent to the passage of legislation in 1966 increasing the reimbursement cost standards.[1] In all four cases as shown by column (7), the local tax burden attributable to the financing of the new school increased more between the preliminary and final cost stages than the per pupil costs. For Middle School B, the tax rate increase was from 6.62 to 11.07 mills or about 67 percent.

The building projects shown in Table 8 are not representative cases. For most projects, changes between initial and final costs are far less extreme. The data in the table, however, suggest either that some projects are initiated on the basis of unrealistic cost estimates or that there is little control over rapid cost escalations as project revisions are made. In either event, such situations may produce extended local conflicts over school projects and local taxpayers may not be able to obtain realistic cost data until it is too late to affect the decisions of the school authorities.

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[1] All of the projects will benefit from the retroactive increase in cost standards enacted in 1969.

TABLE 8

SELECTED COST ESTIMATES FOR FOUR NEW SCHOOL BUILDINGS AT THREE DESIGN STAGES (PRELIMINARY, REVISED AND FINAL COST ESTIMATES)

Date	*Rated Capacity*	*Structure Cost Per Rated Capacity*	*Total Project Cost*	*Annual Authority Rental*		*District's Amount as Mills on Assessed Valuation*
				Amount Reimbursed by Commonwealth	*Amount Borne by District*	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
			MIDDLE SCHOOL A			
June 1965	1,482	$2,193	$3,500,000	$54,742	$170,950	5.71 mills
January 1966	1,761	2,295	4,490,000	66,891	222,639	7.43
April 1967	1,761	3,060	5,925,000	94,348	273,207	9.12
			MIDDLE SCHOOL B			
June 1966	1,193	2,768	3,698,909	63,154	179,307	6.62
June 1967	1,193	3,459	4,542,469	63,154	235,038	8.67
April 1968	1,274	4,066	5,775,000	71,665	299,955	11.07
			SECONDARY SCHOOL A			
August 1965	1,365	3,857	5,817,730	39,033	276,678	4.23
December 1966	1,365	4,534	6,846,694	52,540	319,010	4.87
April 1967	1,365	5,588	8,570,500	54,224	402,976	6.16
			SECONDARY SCHOOL B			
July 1966	848	3,870	3,486,000	36,369	177,528	7.16
November 1967	842	4,828	4,365,000	36,139	240,911	9.71
March 1968	842	5,683	5,170,000	37,859	277,591	11.19

Subsection (c) of Section 2577 of the Public School Code provides that, with exceptions for several extensions of 90 days each, the general construction contract for any project must be awarded within ten months of project approval or approval shall be withdrawn. This provision was inserted in the statute in 1957 at a time when the Commonwealth imposed a dollar limit upon the total volume of reimbursable school construction. Since the statute no longer contains such limitations the provisions of subsection (c) are archaic, impose an unnecessary restriction on approval procedures and may work a hardship on some districts.

Recommendations

1. It is recommended that the Department of Education be authorized to employ sufficient staff to effectively perform the following functions:

(a) Have departmental personnel hold frequent and extensive discussions with local authorities during the stage of project design when final costs become apparent. In all cases, representatives of the school board should be present when final plans are approved and should be made fully aware of any unnecessarily costly designs, materials or specifications.

(b) Disseminate among school districts contemplating building projects information concerning products, materials and designs which have proved unreliable, unnecessarily costly or failed to meet manufacturer's specifications.

(c) Through a cooperative arrangement with architects or otherwise, encourage the utilization of designs, plans or innovations which have proven unusually successful in reducing space requirements or otherwise effecting economies in construction costs or maintenance expenses.

(d) Have the department continue its efforts toward fuller utilization of existing buildings and in cases where future increases in enrollment are not expected, encourage school districts to investigate all possible alternatives to the construction of new facilities. Whenever there appears to be considerable local resistance to the construction of new buildings, the department should encourage the districts to hold public hearings on the matter and assist the local authorities in explaining to the public both the advantages and disadvantages of alternative housing plans.

2. It is recommended that subsection (c) of Section 2577 of the Public School Code of 1949 which mandates a time limit within which construction must be started after project approval is received be repealed.

APPENDIX A[1]

PER PUPIL COST OF PUBLIC SCHOOL BUILDINGS 1956-1959

Appendix Table 1 summarizes public school building activity in Pennsylvania for the period 1956 to 1959 in terms of number of buildings and average per pupil cost by type of structure. Per pupil cost is defined as structure and equipment costs plus architect's fee (limited to 6 percent of the contract price) divided by the rated pupil capacity of the building. This definition is directly comparable with the building construction cost standards of $1,700 per pupil for secondary schools and $1,100 per pupil for elementary schools contained in the reimbursement provisions during the period under review. Variations in per pupil costs are most meaningfully evaluated by reference to such factors affecting costs as wealth of district and size of building. An analysis of the 1956-1959 data justifies the following conclusions.

In general:

1. Variations in costs are much smaller among elementary schools than among secondary schools.

2. Junior-senior high schools are the most economical secondary structures and senior high schools the most costly.

3. Cost per pupil tends to decline as rated capacity increases, but the effect of size in reducing per pupil cost is less pronounced among secondary structures than for elementary buildings.

   Larger high schools often contain special facilities (extensive vocational facilities, language laboratories, etc.) not provided in smaller buildings and usually contain separate auditoriums, gymnasiums and cafeterias, which facilities are often partly combined in smaller structures.

4. Cost per pupil increases as wealth of district, measured by market value per teaching unit,[2] increases.

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[1] An excerpt, with minor editorial changes, from an unpublished study by the Joint State Government Commission completed in January, 1961.

[2] Until 1966, the reimbursement system operated with teaching units consisting of 30 elementary or 22 secondary pupils. On the average, a teaching unit equals about 29 weighted average daily membership (WADM). Using this relationship, conversion can be made between market value per unit and market value per WADM.

Appendix Table 1

NUMBER OF NEW PUBLIC SCHOOL BUILDINGS AND AVERAGE PER PUPIL COST BY TYPE OF BUILDING, BY YEAR, 1956–1959

	1956		*1957*		*1958*		*1959*	
Type	*Number*	*Average Per Pupil Cost*	*Number*	*Average Per Pupil Cost*	*Number*	*Average Per Pupil Cost*	*Number*	*Average Per Pupil Cost*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Elementary Schools	45	$1,288	83	$1,302	52	$1,256	55	$1,316
Junior High Schools	5	2,138	18	2,398	6	2,150	7	2,224
Junior-Senior High Schools	18	1,953	25	2,072	17	2,000	16	2,058
Senior High Schools	8	2,451	16	2,739	12	2,729	13	2,765

Wealth is the single most important factor in accounting for cost variations among structures of a given type. While it is not at all surprising that wealthier districts build more expensive schools, this fact is frequently overlooked in aggregating per pupil cost data and erroneous conclusions are drawn with respect to the source of cost variations.

5. The per pupil cost data, when the effects of wealth of district, capacity and type of building are taken into account, do not indicate any building cost increase over the period under review.

   In other words, there is no evidence that an average district of given wealth could not have constructed a building of similar type and capacity at approximately the same per pupil cost in 1959 as in 1956. While wage rates and materials prices have undoubtedly increased over the period,[3] a rise in prices alone is insufficient evidence to justify a conclusion that building costs have changed. Technological innovation in construction methods, substitution of new or different materials and some changes in standards (e.g., the recommended ceiling height of classrooms was reduced from 10.6 to 9.6 feet in 1957) frequently produced cost reductions.

To illustrate the effects upon costs of the factors discussed above, the per pupil costs for two types of buildings—elementary schools and junior-senior high schools—have been arranged in cost factor categories.

Appendix Table 2 shows the number of elementary schools and average per pupil cost by size and wealth categories, grouped into two time periods.[4] Inspection of the table shows that, with few exceptions, cost per pupil for buildings of comparable size increases consistently as market value per unit increases.[5] For example, average cost per pupil for the 1958-1959 schools in the smallest size category increased from $1,297 for eight buildings in districts with market value per unit of less than $200,000 to $1,948 for two buildings in districts whose value per unit

[3] Building cost indices, based on wage rates of skilled labor and prices of common building materials, are compiled and published by the *Engineering News-Record*. The index for Pittsburgh rose about 22 percent between June, 1955 and June, 1959, and the index for Philadelphia about 12 percent. In both cities, the price rise was practically continuous throughout the period.

[4] To increase the number of observations in each wealth-size group, the data were combined into two-year periods.

[5] Of the 24 possible comparisons in the table between adjacent wealth categories for constant capacities, average per pupil cost increases with increases in market value per unit 17 times, decreases 4 times and is unchanged (or no observations) 3 times.

Appendix Table 2

NUMBER AND AVERAGE PER PUPIL COST FOR ELEMENTARY SCHOOLS BY MARKET VALUE PER UNIT AND SIZE 1956 AND 1957, AND 1958 AND 1959

School District's Market Value Per Teaching Unit	*Rated Pupil Capacity*	*1956 and 1957*		*1958 and 1959*	
		Number of Buildings	*Average Per Pupil Cost*	*Number of Buildings*	*Average Per Pupil Cost*
(1)	(2)	(3)	(4)	(5)	(6)
Less than $200,000	Less than 200	8	$1,491	8	$1,297
	200—399	12	1,224	9	1,235
	400—599	5	1,028	1	1,251
	600 and over	1	1,064	1	1,037
$200,000—$399,999	Less than 200	6	1,295	4	1,377
	200—399	29	1,200	19	1,268
	400—599	7	1,283	14	1,178
	600 and over	6	1,168	5	1,037
$400,000—$599,999	Less than 200	5	1,479	0	. . .
	200—399	14	1,394	8	1,428
	400—599	11	1,330	6	1,210
	600 and over	5	1,253	7	1,139
$600,000 and over	Less than 200	1	1,445	2	1,948
	200—399	8	1,479	8	1,640
	400—599	10	1,355	10	1,288
	600 and over	0	. . .	5	1,212

exceeded $600,000. Similarly, for the schools in the largest size category, average per pupil cost increased from $1,037 to $1,210. Again, with but occasional exceptions, cost per pupil declines as size of building, measured by rated pupil capacity, increases. Comparisons between the two time periods for the same wealth-size categories show that there was no consistent change in per pupil costs. Average per pupil costs were higher in 1958 and 1959 than in 1956 and 1957 in seven instances and lower in seven instances.

Appendix Table 3 shows the number of buildings, average per pupil cost and average rated capacity by wealth categories for junior-senior high schools bid in 1956 or 1957 and in 1958 or 1959. For these buildings, increases in pupil capacity are closely associated with increases in market value per unit. Due to the limited number of observations, it is not meaningful to calculate average per pupil costs for different size categories for the buildings within each wealth group. Inspection of the table shows that, except for the group of eight buildings in 1958 and 1959 constructed by districts with a market value per unit of less than $200,000, average per pupil cost increased consistently with increases in market value per unit in both time periods. The increases shown probably understate the relationship between wealth increases and per pupil cost increases for buildings of similar capacity. The table also shows that there was no consistent change in per pupil costs between the two time periods. For two wealth categories—less than $200,000 and $200,000–$299,999—average per pupils costs decreased between 1956-1957 and 1958-1959, and for the other two categories, per pupil costs increased.

Appendix Table 3

NUMBER, AVERAGE PER PUPIL COST AND AVERAGE PUPIL CAPACITY FOR JUNIOR-SENIOR HIGH SCHOOLS BY MARKET VALUE PER UNIT FOR 1956 AND 1957, AND 1958 AND 1959

	1956 and 1957			*1958 and 1959*		
School District's Market Value Per Teaching Unit	*Number of Buildings*	*Average Pupil Capacity*	*Average Per Pupil Cost*	*Number of Buildings*	*Average Pupil Capacity*	*Average Per Pupil Cost*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Less than $200,000	9	758	$1,939	8	651	$1,914
$200,000—$299,999	15	1,034	1,956	11	897	1,848
$300,000—$399,999	8	1,089	2,078	9	1,011	2,210
$400,000 and over	11	1,014	2,142	5	1,087	2,279

APPENDIX B

GEOGRAPHIC VARIATION IN SCHOOL CONSTRUCTION LABOR COSTS

Under the Pennsylvania Prevailing Wage Act,[1] all labor employed on public construction contracts must be compensated at not less than the prevailing minimum wage rates, as determined by the Secretary of Labor and Industry, for the county in which the work is performed. Prevailing minimum wage rates for all construction occupations for each county of the Commonwealth for the year 1966 were obtained from the Department of Labor and Industry. In the absence of any reliable data as to the proportions of different types of skilled and unskilled labor employed on school construction projects in Pennsylvania, estimates compiled by the Federal Government for the northeast region of the United States for 1965 were used. These estimates of on-site manhours worked per $1,000 of school construction are shown in Appendix Table 4. The prevailing minimum hourly wages in each county for each of

APPENDIX TABLE 4

ON-SITE MAN-HOUR REQUIREMENTS PER $1,000 OF SCHOOL CONSTRUCTION CONTRACT FOR SELECTED OCCUPATIONS NORTHEAST UNITED STATES, 1965

Occupation	*Man-hours Worked*
(1)	(2)
Asbestos Workers	.6
Bricklayers	6.5
Carpenters	10.1
Cement Masons	1.1
Electricians	5.4
Operating Engineers	1.7
Ironworkers	2.4
Brush Painters	2.2
Plasterers	.7
Plumbers	6.9
Sheet-metal Workers	2.0
Laborers	12.2

SOURCE: *Labor & Material Requirements for School Construction*, Bulletin No. 1586 (Washington, D. C., United States Department of Labor, June, 1968).

[1] 1961, August 15, P. L. 987, as amended, 1963, August 9, P. L. 653.

11 occupations weighted by the manhours worked from Appendix Table 4, produced an estimated average hourly wage for occupations utilized in school construction for each county in the Commonwealth. These averages are presented in Appendix Table 5. Column (3) contains an index of the average hourly wage for each county with the lowest wage, that of Lancaster County, as 100. It may be observed from the table that the highest average hourly wage—Allegheny County—is 31 percent above the Lancaster County average. These data were tested in various ways to determine the effect on school building costs per pupil. The only relationship that was found significant is incorporated in the regression equations where variable X_4 represents whether or not (1 or 0) the average hourly wage, calculated as explained above, for the county in which the school building is located, is below $4.12.

APPENDIX TABLE 5

AVERAGE PREVAILING MINIMUM HOURLY WAGES FOR ELEVEN OCCUPATIONS EMPLOYED IN SCHOOL CONSTRUCTION BY COUNTY 1966

County	*Average Hourly Wage*[1]	*Index Lancaster County ($3.86) = 100*
(1)	(2)	(3)
Adams	$4.03	104
Allegheny	5.07	131
Armstrong	4.75	123
Beaver	4.83	125
Bedford	4.22	109
Berks	4.21	109
Blair	4.37	113
Bradford	4.04	105
Bucks	4.77	124
Butler	4.73	123
Cambria	4.65	121
Cameron	4.11	107
Carbon	4.31	112
Centre	4.29	111
Chester	4.78	124
Clarion	4.40	114

County	*Average Hourly Wage*[1]	*Index Lancaster County ($3.86) = 100*
(1)	(2)	(3)
Clearfield	$4.32	112
Clinton	4.08	106
Columbia	3.90	101
Crawford	4.20	109
Cumberland	4.04	105
Dauphin	4.04	105
Delaware	4.87	126
Elk	4.07	105
Erie	4.33	112
Fayette	4.68	121
Forest	4.16	108
Franklin	4.10	106
Fulton	4.24	110
Greene	4.72	122
Huntingdon	4.22	109
Indiana	4.57	118
Jefferson	4.26	110
Juniata	4.00	104
Lackawanna	4.25	110
Lancaster	3.86	100
Lawrence	4.53	117
Lebanon	3.97	103
Lehigh	4.43	115
Luzerne	4.03	104
Lycoming	4.05	105
McKean	4.11	107
Mercer	4.35	113
Mifflin	4.08	106
Monroe	4.31	112
Montgomery	4.86	126
Montour	4.05	105
Northampton	4.42	114
Northumberland	4.08	106
Perry	4.04	105
Philadelphia	4.92	127
Pike	4.26	110

County	*Average Hourly Wage*[1]	*Index Lancaster County ($3.86) = 100*
(1)	(2)	(3)
Potter	$4.11	107
Schuylkill	3.94	102
Snyder	4.05	105
Somerset	4.54	118
Sullivan	4.09	106
Susquehanna	4.22	109
Tioga	4.06	105
Union	4.05	105
Venango	4.09	106
Warren	4.09	106
Washington	4.90	127
Wayne	4.22	109
Westmoreland	4.88	127
Wyoming	4.26	110
York	4.00	104

SOURCE: Calculated from information obtained from the Department of Labor and Industry.

[1] Prevailing wage rates for each county for each of eleven occupations weighted by man-hours.

APPENDIX C

EXCERPT FROM REGULATIONS OF THE STATE BOARD OF EDUCATION

3–210 *Minimum Areas for Elementary School Facilities*

3–211 *Instructional Use*

Classrooms		850 sq. ft.
Special Education Room		850 sq. ft.
Approximately 5% of elementary pupils will need special education services. Facilities should provide for the different types of handicaps to be served: physically handicapped, blind, deaf or hard of hearing, day care, mentally retarded, etc.		
Kindergarten Room		900 sq. ft.
Arts and Crafts*		1000 sq. ft.
Music*		1000 sq. ft.
Music Instrument Practice and Storage Room*		425 sq. ft.
Large Group Instruction Area		1200–1500 sq. ft.
Seminar Room*		425 sq. ft.

3–212 *General Use*

Library**	Up to 12 classrooms	850–1000 sq. ft.
	13 to 18 classrooms	1000–1500 sq. ft.
	Over 18 classrooms	1500–2000 sq. ft.
Multipurpose Room**	Ceiling Height—16′	
	Stage or Platform	
6 classrooms (optional)	12′–15′ Depth	1500 sq. ft.
7 to 12 classrooms	15′–18′ Depth	1500–1800 sq. ft.
13 to 18 classrooms	15′–18′ Depth	1800–2400 sq. ft.
Over 18 classrooms[1]	———	2400–3000 sq. ft.

The chair and equipment storage area should not exceed 1/5 of the "free" floor area.

Kitchen and Storage**	3 sq. ft. per pupil served
The area recommended is exclusive of toilet and dressing room for help, which should not exceed 1/5 of the "free" space allocated to the main working area.	
Buildings served from a central kitchen may provide a serving kitchen of 425 sq. ft.; if dishwashing facilities are desired, necessary additional space may be provided.	

Locker and Shower Room*	As Required
Cafeteria**	10 sq. ft. per pupil based on 3 serving
As a separate area in buildings of over 18 regular classrooms, exclusive of kindergarten and special education	
Faculty Room	
Up to 12 classrooms	425 sq. ft.
Over 12 classrooms	850 sq. ft.
(Includes toilet rooms)	
Health Room	
Up to 12 classrooms	425 sq. ft.
13 to 18 classrooms	660 sq. ft.
Over 18 classrooms	850 sq. ft.
Principal's Office, Clerk, Itinerant Staff, Waiting Area, Conference Room	
Maximum for buildings of 12 classrooms or less	850 sq. ft.
Maximum for buildings over 12 classrooms	1275 sq. ft.
Swimming Pool*	6000 sq. ft.
May be scheduled if no pool exists in administrative unit or if pool will serve only elementary pupils within the administrative unit.	

3–213 *Service Use*

Classroom storage, wardrobes, work alcoves	As Required
General storage, book storage	As Required
Toilet rooms, janitor room, boiler room, incinerator room, electrical rooms, fuel storage area, slop sinks	As Required
Storage for maintenance equpiment and supplies, and storage for equipment and supplies for care of property and grounds	As Required

Five percent deviation from scheduled areas shall be permitted. This is not to be interpreted as an across-the-board reduction or increase of space allocations, but is intended to provide for adjustments in plan development.

Size of instructional areas represents free floor space.

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* Optional if building contains minimum of 12 regular classrooms, exclusive of kindergarten and special education.

** These specialized facilities shall be sized for the projected enrollment of the building in accordance with the projection under the Long Range Developmental Plan.

[1] May have folding partition to provide two teacher stations for gym classes. Stage or platform should be placed adjacent to cafeteria for maximum utilization of multipurpose or gymnasium area.

Appendix Table 6

CAPACITY AND TOTAL COST PER PUPIL OF ELEMENTARY SCHOOL BUILDINGS CONSTRUCTED IN PENNSYLVANIA AND NEW YORK, 1965–1968

Year	*State*	*Number of Buildings*	*Average Pupil Capacity*[1]	*Structure Cost Per Pupil Capacity*[1]	*Incidental*[2] *Cost Per Pupil Capacity*[1]	*Total Cost Per Pupil Capacity*[1]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1965	Pennsylvania	43	439	$1,792	$492	$2,284
	New York	39	664	1,483	382	1,865
Pennsylvania minus New York			−225	309	110	419
1966	Pennsylvania	30	494	1,923	495	2,418
	New York	51	717	1,602	454	2,056
Pennsylvania minus New York			−223	321	41	362
1967	Pennsylvania	31	509	2,298	664	2,962
	New York	35	687	1,906	548	2,454
Pennsylvania minus New York			−178	392	116	508
1968	Pennsylvania	21	647	2,408	631	3,039
	New York	32	681	1,792	537	2,329
Pennsylvania minus New York			− 34	616	94	710

[1] Calculated at 27 pupils per regular, special education or kindergarten classroom.

[2] Architects and legal fees, insurance, site costs and development, general administrative costs, furniture and equipment.

SOURCE: New York data from "Semi-Annual Schools Cost Report And Statistical Data," various issues, 1965 through 1969, Division of Educational Facilities Planning, State Education Department, Albany, New York.

Appendix Table 7

DIFFERENCE IN COSTS OF ELEMENTARY SCHOOL BUILDINGS IN PENNSYLVANIA AND NEW YORK BY NUMBER OF CLASSROOMS 1965–1968

	Structure Costs[1] *Per Pupil Capacity*[2]				*Structure Costs*[1] *Per Gross Square Foot*			
	Pennsylvania minus New York				*Pennsylvania minus New York*			
Number of Classrooms	*1965*	*1966*	*1967*	*1968*	*1965*	*1966*	*1967*	*1968*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Less than 8	$−98	$....	$...	$2,009	$−2.65	$...	$...	$5.86
9—17	104	−309	214	222	−1.92	1.12	.57	3.56
18—23	360	268	273	616	2.32	1.53	1.09	3.20
24—29	253	−38	226	635	.03	−.97	.10	2.52
30 or more	385	979	...	368	.61	4.09	...	2.44

[1] Structure costs of the building only, exclusive of architect's fees, furniture, equipment and all other project costs.

[2] Pupil capacity is calculated at 27 pupils per regular, special education or kindergarten classroom to conform with the New York reports.

SOURCE: New York data from "Semi-Annual Schools Cost Report And Statistical Data", various issues, 1965 through 1969, Division of Educational Facilities Planning. State Education Department, Albany, New York.

APPENDIX TABLE 8

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF PUBLIC INSTRUCTION
BUREAU OF SCHOOL CONSTRUCTION
HARRISBURG

REIMBURSABLE CAPACITY OF SCHOOL BUILDINGS

Elementary Buildings (Complete—See below)

Size of Classroom	*Reimbursable Capacity*
660 to 669 sq. ft.	32
770 to 849 sq. ft.	34
850 sq. ft. and over	35

The total reimbursable capacity equals the sum of the reimbursable capacity of all classrooms.

Secondary Buildings (Complete—See below)

Teaching Stations	*Reimbursable Capacity*
Classroom 660 sq. ft. and over	35
Language Laboratory	35
Science Laboratory	24
Student Project Room (220 sq. ft.)	9
Business Classroom	35
Typing	24
Office Practice	24
Art Room	24
Gymnasium (Each teaching station)	40
Homemaking (Each teaching station)	24
Shop (Each teaching station)	24
Band Room	24
Music Classroom	35
Large Group Instruction Area	40
Planetarium	30
Observatory	15
Instrumentation-Library Classroom	35

Utilization factor—85% All secondary areas are considered as having 85% of full time use.

The total reimbursable capacity equals 85% of the sum of the reimbursable capacity of all teaching stations.

Reimbursable capacity is based on the assumption that a complete school facility is essential for a modern educational program. (See forms, BBCT-435 and 436, for a listing of complete facilities. Areas indicated as optional are not required for a complete facility.) If a district constructs less than a complete facility, the reimbursable capacity is reduced.

August 10, 1967

Appendix Table 9

ENGINEERING NEWS-RECORD BUILDING COST INDEXES FOR PITTSBURGH AND PHILADELPHIA

1963–1968

(1963 = 100)

Year	*Pittsburgh*	*Philadelphia*	*2-City Average*
(1)	(2)	(3)	(4)
1963	100.0	100.0	100.0
1964	103.2	102.8	103.0
1965	105.4	105.1	105.3
1966	109.3	109.2	109.2
1967	112.3	112.2	112.2
1968	122.8	122.4	122.6

SOURCE: Calculated from quarterly indexes published in *Engineering News-Record*, March, 1967 and various other issues.

Appendix Table 10

CORRELATIONS AND STANDARD ERRORS OF REGRESSION EQUATIONS

Elementary school building equation:

Cost per pupil (1967 dollars) =

$$2059 + 17X_1 - 42X_2 - 9X_3 - 177X_4 + 257X_5 + 400X_6 + 133X_8$$

Multiple correlation coefficient = .627

Standard error of estimate = 308

Number of observations = 205

Secondary school building equation:

Cost per pupil (1967 dollars) =

$$3220 + 56X_1 - 56X_2 - 15X_3 - 196X_4 + 387X_5 + 805X_6 + 569X_7$$

Multiple correlation coefficient = .766

Standard error of estimate = 523

Number of observations = 114

	Standard error of the regression coefficient		*Partial correlation coefficient of the highest order*	
	Elementary	*Secondary*	*Elementary*	*Secondary*
(1)	(2)	(3)	(4)	(5)
X_1	4	10	.306	.473
X_2	10	13	.298	.389
X_3	1	8	.202	.187
X_4	51	121	.241	.156
X_5	65	150	.273	.243
X_6	77	108	.349	.587
X_7	..	117	..	.429
X_8	90	..	.105	..